SIEMENS

Telecommunication Products

PowerLink 100 and PowerLink 50

V3.10 and higher

Equipment Manual

C53000-G6040-C614-5

NOTE

For your own safety, observe the warnings and safety instructions contained in this document, if available.

Disclaimer of Liability

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

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Version of the product described: V3.10 and higher

Copyright

Preface

Purpose of the Manual

This manual describes the control and monitoring functions for Smart Communications.

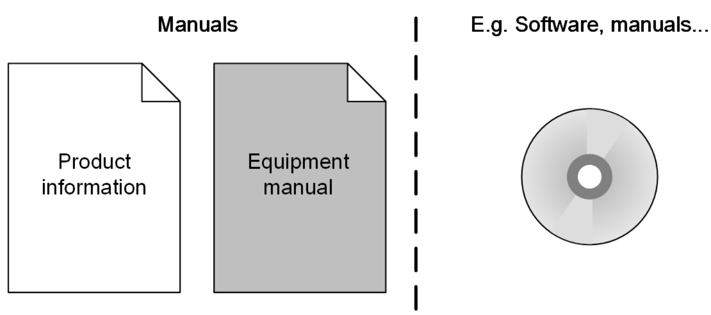
Target Audience

Smart Communications engineers, protection system engineers, commissioning engineers, persons entrusted with the setting, testing and maintenance of automation, selective protection and control equipment, and operating personnel in electrical installation and power plants.

Scope

This manual is valid for the PowerLink device family.

Further Documentation



[dw_Product-overview_SWT3000_Equipment-manual, 2, en_US]

- Product Information
  The **Product Information** includes general information about device installation, technical data, limit values for input and output modules, and conditions when preparing for operation. This document is delivered with each device.
- Equipment Manual
  The **Equipment Manual** describes the functions and applications of a specific PowerLink device.

Additional Support

For questions about the system, contact your Siemens sales partner.

Customer Support Center

Our Customer Support Center provides a 24-hour service.

Siemens AG
Smart Infrastructure – Protection Automation
Customer Support Center

Tel.: +49 911 2155 4466
E-Mail: energy.automation@siemens.com

Notes on Safety

This document is not a complete index of all safety measures required for operation of the equipment (module or device). However, it comprises important information that must be followed for personal safety, as well as to avoid material damage. Information is highlighted and illustrated as follows according to the degree of danger:

DANGER

DANGER means that death or severe injury **will** result if the measures specified are not taken.

✧ Comply with all instructions, in order to avoid death or severe injuries.

WARNING

WARNING means that death or severe injury **may** result if the measures specified are not taken.

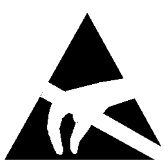
✧ Comply with all instructions, in order to avoid death or severe injuries.

CAUTION

CAUTION means that medium-severe or slight injuries **can** occur if the specified measures are not taken.

✧ Comply with all instructions, in order to avoid moderate or minor injuries.

CAUTION



ESD (Electrostatic sensitive devices) means that a device or component **can** be damaged by common static charges built up on people, tools, and other non-conductors or semiconductors.

✧ Comply with all instructions, in order to avoid moderate or minor injuries.

NOTICE

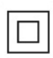
NOTICE means that property damage **can** result if the measures specified are not taken.

✧ Comply with all instructions, in order to avoid property damage.

NOTE

Important information about the product, product handling or a certain section of the documentation which must be given attention.

Selection of Used Symbols on the Device

No.	Symbol	Description
1		Direct current, IEC 60417, 5031
2		Alternating current, IEC 60417, 5032
3		Direct and alternating current, IEC 60417, 5033
4		Earth (ground) terminal, IEC 60417, 5017
5		Protective conductor terminal, IEC 60417, 5019
6		Caution, risk of electric shock
7		Caution, risk of danger, ISO 7000, 0434
8		Protective insulation, IEC 60417, 5172, safety class II devices
9		Guideline 2002/96/EC for electrical and electronic devices
10	EAC	Guideline for the Eurasian market
11		Mandatory conformity mark for electronics and electrotechnical products in Morocco
12		Extra low voltage (ELV), IEC 60417, 5180, Safety Class III devices

OpenSSL

This product includes software developed by the OpenSSL Project for use in OpenSSL Toolkit (*http://www.openssl.org/*).

This product includes software written by Tim Hudson (*tjh@cryptsoft.com*).

This product includes cryptographic software written by Eric Young (*eay@cryptsoft.com*).

Table of Contents

1 Safety Instructions

1.1 Scope of Delivery

The equipment is delivered with:

- The **Product Information** with a system description and instructions for installation, commissioning and operation, decommissioning and disposal.
- The corresponding software package (formerly delivered on DVD) is available for download on *SIOS* (Siemens Industry Online Support) platform free of charge, a registration is required.
- Test protocols are available for download under *Energy Automation Testreports*
  Enter BF code of device to view the requested test protocol in pdf format. The installed firmware package version loaded into the device can be seen in the protocol.

For further details, see the information that can be found in the manual.

1.2 Transport, Package and Storage

1.2.1 Unpacking the Device

NOTE

Devices are tested prior to delivery. The verification certificate is part of the device and can be called up with the product.
Devices are packed on site in a way that meets the requirements.

- ✧ Check the packing for external transport damage. Damaged packing may indicate that the devices inside have also a damage.
- ✧ Unpack devices carefully; do not use force.
- ✧ Visually check the devices to ensure that they are in perfect mechanical condition.
- ✧ Check the enclosed accessories against the delivery note to make sure that everything is complete.
- ✧ Keep the packing in case the devices must be stored or transported elsewhere.
- ✧ Return damaged devices to the manufacturer, stating the defect. Use the original packaging or transport packaging that meets the requirements.

1.2.2 Repacking the Device

- ✧ If you store devices after incoming inspection, pack them in suitable storage packaging.
- ✧ If devices are to be transported, pack them in transport packing.
- ✧ Put the accessories supplied and the test certificate in the packing with the device.

1.2.3 Storing the Device

- ✧ Only store devices on which you have carried out an incoming inspection, thus ensuring that the warranty remains valid. For incoming inspection refer to chapter Incoming inspection.
- ✧ The device must be stored in rooms, which are clean, dry, and dust-free. Devices or associated spare parts must be stored at a temperature between –40° C and +70° C.
- ✧ Siemens recommends that you observe a restricted storage temperature range of +10° C to +35° C in order to prevent the electrolytic capacitors used in the power supply from aging prematurely.
- ✧ If the device shall be stored for a long time, connect it every 2 years to an auxiliary voltage for 1 to 2 days. This will cause the electrolytic capacitors to form on the printed circuit board assemblies again.
- ✧ If devices must be shipped elsewhere, you can reuse their transport packaging. If using other packaging, ensure that the transport requirements are met.

1.3 Incoming Inspection

1.3.1 Safety Notes

DANGER

Danger during incoming inspection.

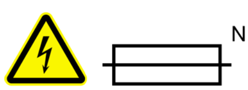
If you do not comply with the safety notes, this will result in death, severe injury, or considerable material damage.

✧ Comply with all given safety notes when carrying out the incoming inspection.

✧ If you identify a defect during incoming inspection, do not correct it yourself. Repack the device and return it to the manufacturer, stating the defect. Use the original packaging or transport packaging that meets the requirements.

Siemens recommends that you check the device and the connectors which are not assembled.

Double Pole/Neutral Fusing



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CAUTION

The fuse is used in the neutral of single-phase equipment either permanently connected or provided with a non-reversible plug.
After operation of the fuse, parts of the equipment that remain energized might represent a hazard during servicing.

If you do not comply with the safety notes, this will result in medium severe or slight injuries.

✧ Comply with all instruction in order to avoid moderate or minor injuries.

1.3.2 Performing a Follow-Up Inspection on a Device

✧ Visually check for external damage as soon as you have unpacked the devices; they must not show any signs of dents or cracks.

1.3.3 Checking Rated Data and Functions

✧ Check the rated data and functions using the complete order designation/the product code. The **Equipment Manual** contains all technical data and a description of the functions.

✧ Check the information provided on the name plate too. The device features a product label sticker, which contains the technical data.

✧ Make sure that the rated data of the device properly matches the system data. You can find the necessary information in the **Equipment Manual**.

1.4 Electrical Inspection

1.4.1 Device Protection

DANGER

Danger when connecting the device.

If you do not comply with the safety notes, this will result in death, severe injury, or considerable material damage.

✧ The device must be situated in the operating area for at least 2 hours before you connect it to the power supply for the first time. This avoids condensation to occur in the device.

✧ Perform the electrical inspection (refer to *1.4.5 Performing the Electrical Inspection*).

1.4.2 Grounding a Device

The device has to be connected to the protective earthing conductor of the cabinet prior to commissioning.

CAUTION

The cross-section of the ground wire must be equal to or greater than the cross-section of any other control conductor connected to the device. The cross-section of the ground wire must be at least 2.5 mm^2 (AWG14).

The following consequences can occur if the cross-section of the ground wire is not properly installed:

- The device can be damaged.

- Touching the device can cause a flashover and health damage if the device is not sufficiently grounded.

- A faulty activation can occur by undefined states.

✧ The cross section of the ground wire and the laying of the wire must comply with the regulations applicable for the place of installation.

Ground the device with solid low-resistance system grounding (cross-section ≥ 4.0 mm^2, grounding area ≥ M4).

1.4.3 Connecting the Device

✧ Connect all cables and lines. Use the connection diagrams stated in the **Equipment Manual**.

✧ Tighten the terminal screws.

1.4.4 Safety Notes

DANGER

Danger during electrical inspection.

If you do not comply with the safety notes, this will result in death, severe injury, or considerable material damage.

- ✧ Comply with all given safety notes when carrying out the electrical inspection.
- ✧ Note that hazardous voltages are present when you perform the electrical inspection.

- ✧ During the electrical inspection, check that the device becomes ready for operation once it has been connected to the power supply.

DANGER

Danger of over voltage.

To prevent the risk of possible over voltage

- ✧ The cable shield of the communication cable between Line Matching Unit (LMU, AKE) and the power line carrier communication devices (PowerLink, PowerLink with iSWT or detached SWT 3000) must be grounded on both ends.
- ✧ The grounding of the cable shield must be carried out on the LMU side itself and once again before entering the station building or a ground connection within the building in which the PowerLink devices or any other powerline carrier communication device are installed.

- ✧ The grounding must be carried out using a connection that cannot be detached without tools. The grounding of the cable shields must not be removed until it is ensured that by closing the short circuit switch on the LMU and attaching an additional grounding rod to the HV input, the LMU is voltage-free and safely grounded.

1.4.5 Performing the Electrical Inspection

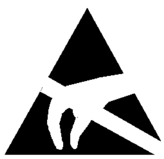
- ✧ Connect the power supply.
- ✧ Activate the power supply.
- ✧ The device must have the normal operating state (process mode) if the configuration, connection, and transmission have been set up successfully. The device must communicate with the PC. If not, disconnect and check the installation of the device and the installation and configuration of the service program PowerSys (refer to *Chapter 4*).
- ✧ If a defect of the device is suspected, please contact the Customer Support prior to a return to manufacturer. If the suspect for a defect is confirmed by Customer Support, pack the device and return it to the manufacturer, stating the defect. Use transport packaging that meets the requirements.

1.5 Electrostatic Sensitive Devices

NOTE

This Manual is written for **service and operation personnel** in the high voltage power line environment. All existing safety instructions in the **environment of the user** must be observed and **only trained and instructed** personnel shall be allowed to work with the equipment.

CAUTION



Electrostatic sensitive devices are protected against destruction by electrostatic charge with protective structures at the inputs and outputs. In unfavorable cases, however, plastic floor coverings, non-conductive work surfaces, or clothing containing artificial fibers can result in such high charges.

These charges can damage or even destroy the electrostatic sensitive devices despite the protective networks mentioned. If a device is damaged, its reliability decreases drastically although the effects of the damage are noticeable a long time before.

✧ In order to ensure that electrostatic charges are completely eliminated when working on the system, comply with the following instructions in order to avoid moderate or minor damage:

✧ Before carrying out any work on the system, ground yourself with a wrist strap.

✧ When working on modules, always place them on a grounded conductive surface.

✧ Transport modules only in suitable protective bags.

The following points must also be observed during **installation**:

- Before installing the device, lay and connect the grounding wire to ground potential.
- Connect the grounding wire immediately after installing the device or setting up the cabinet.
- Use shoe grounding strips.

DANGER

The device can be damaged if not installed in a locked room.

Death or severe injuries can occur if a foreign person has access to the equipment.

✧ Install the device in a locked room with admission for commissioning personnel and trained operating personnel only.

NOTICE

The temperature in the room shall not exceed the temperatures specified in the operating rules.

The device can be damaged if it is not operated in accordance with regulations of the operation.

✧ Provide sufficient cooling or heating (for outside operation in cold areas or during cold times).

WARNING

There is a risk of electrostatic discharge until the grounding wire has been connected, even if you are wearing a wrist strap.

The grounding wire must not be disconnected until all work has been completed if you are disassembling the system.

✧ If possible, do not touch the modules and wiring before the work has been completed.

1.6 Installation

1.6.1 Preparing Installation

DANGER

Danger due to live voltage when installing the plug-in modules.

If you do not comply with the safety advice, this will result in death or severe injuries.

✧ Install plug-in modules on the electrically deactivated device only.

CAUTION

This equipment is suitable for mounting on concrete or other non-combustable surface only.

✧ In case the Powerlink System is mounted on a combustable surface, the use of the mounting kit (7VR9656, Fire prevention kit) is obligatory.

CAUTION

Exercise caution with laser beams of the optical plug-in modules.

The laser beams can damage your eyes. If you do not comply with the safety notes, this will result in medium severe or slight injuries.

✧ Do not look directly into the optical fiber terminals of the active optical plug-in modules, not even with optical devices.

✧ De-energize the device.

NOTE

Laser class 1 is adhered to in compliance with EN 60825-1 and EN 60825-2, in the case of ≤ 62.5 μm/125 μm optical fibers.

✧ Undo the fastening screw and remove the cover plate from the plug-in module position.

1.6.2 Power Supply

✧ Dangerous voltages are present within this power supply. Perform the installation/removal following the safety notes.

DANGER

Do not connect the redundant power supply while the equipment is powered.

If you do not comply with the safety notes, this will result in death, severe injury, or considerable material damage.

✧ Make sure that the power is turned OFF before installing or removing the power supply.

- ✧ If delivered separately, plug the power supply into the device without any modification.

1.6.3 Completing Installation

- ✧ Set the jumpers of the module for operation mode.
- ✧ The device shall recognize the new plug-in module.
- ✧ In case you installed a new module, configure the settings of the new module in PowerSys.

NOTE

Only qualified electrical engineering personnel is authorized to reset the hardware parameters.

1.7 Replacement

1.7.1 Preparing for Replacement

General Information

The device can be supplied as stand-alone device or installed in a cabinet with other system components.

If the device is **delivered in a cabinet**, the cabling of the individually installed devices is installed at the factory up to the connection terminals on the assembly board. In this case, the **connection points for the cabling can be found in the supplied documentation**.

NOTE

The modules available for reordering are not preconfigured.

✧ Before any maintenance work, disconnect the equipment from all energy sources to ensure that no dangerous voltage is present.

Laser Guide

CAUTION

Exercise caution with laser beams of the optical plug-in modules.

If you do not comply with the safety notes, this will result in medium severe or slight injuries.

✧ Do not look directly into the optical fiber terminals of the active optical plug-in modules, not even with optical devices. The laser beams can damage your eyes.

✧ De-energize the device.

NOTE

Laser class 1 is adhered to in compliance with EN 60825-1 and EN 60825-2, in the case of $\leq$ 62.5 µm/125 µm optical fibers.

NOTE

If you have not cabled the optical fiber plug-in modules, then seal the terminals with protective covers. This prevents soiling of the terminals.

Replacement Description

DANGER

Danger due to live voltage when replacing the plug-in modules.

If you do not comply with the safety notes, this will result in death or severe injuries.

✧ Install plug-in modules on the electrically deactivated device only.

✧ Remove the front plate from the device.

✧ Carefully pull out the plug-in module.

- Configure the jumper settings prior to installation.
- Push in the new plug-in module on the inner guide as far as it is possible.
- Connect the leads to the terminals.
- Then check for secure attachment of the connectors.
- Mount and fasten the front plate on the device.

1.7.2 Completing Replacement

- Set the jumpers of the module for operation mode.
- The device shall recognize the new plug-in module.
- In case you installed a new module, configure the settings of the new module in PowerSys.

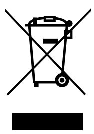
NOTE

Only qualified electrical engineering personnel is authorized to reset the hardware parameters.

1.8 Environmental Protection Hints

Disposal of Old Equipment and Batteries (Applicable only for European Union and Countries with a Recycling System)

The disposal of our products and possible recycling of their components after decommissioning has to be carried out by an accredited recycling company, or the products/components must be taken to applicable collection points. Such disposal activities must comply with all local laws, guidelines and environmental specifications of the country in which the disposal is done. For the European Union the sustainable disposal of electronic scrap is defined in the respective regulation for "waste electrical and electronic equipment" (WEEE).



The crossed-out wheelie bin on the products, packaging and/or accompanying documents means that used electrical and electronic products and batteries must not be mixed with normal household waste.

According to national legislation, penalties may be charged for incorrect disposal of such waste.

By disposing of these products correctly you will help to save valuable resources and prevent any potential negative effects on human health and the environment.

NOTE

Our products and batteries must not be disposed of as household waste. For disposing batteries it is necessary to observe the local national/international directives.

Disposal of Mobile Storage Devices (e.g. USB Sticks and Memory Cards)

When disposing of/transferring mobile storage devices, using the **format** or **delete** functions only changes the file management information and does not completely delete the data from your mobile storage device. When disposing of or transferring a mobile storage device, Siemens strongly recommends physically destroying it or completely deleting data from the mobile storage device by using a commercially available computer data erasing software.

REACH/RoHS Declaration

You can find our current **REACH/RoHS** declarations at:

https://www.siemens.com/global/en/home/products/energy/ecotransparency/ecotransparency-downloads.html

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NOTE

You can find more information about activities and programs to protect the climate at the EcoTransparency website:

https://www.siemens.com/global/en/home/products/energy/ecotransparency.html

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2 Functional Description

2.1 System Description

2.1.1 PowerLink – The Versatile Solution

PowerLink uses the high-voltage line between transformer substations as a communication path for data, protection signals, and voice. This technology, which has been tried and tested over decades and adapted to the latest standards, has two main application areas:

- as a communications link between substations where a fiber-optic connection does not exist or would not be economically viable, and
- as a backup system for transmitting protection signals parallel to an installed fiber-optic link.

A basic distinction is made between analog (aPLC) and digital (dPLC) systems. Newer digital systems allow more efficient use of the frequency band, while traditional analog PLC systems offer advantages in cases where transmission conditions are less favorable (low signal/noise ratio, for example). With PowerLink, both operating modes are open to you. You can even combine aPLC and dPLC services in a single communications network.
PowerLink is available in 2 frame types:

- PowerLink 100
  The double frame system offers full flexibility concerning transmission power (20 W – 100 W) and modular expandability.
- PowerLink 50
  Tis system is a smart and compact power line carrier single frame system with up to 50 W transmission power.

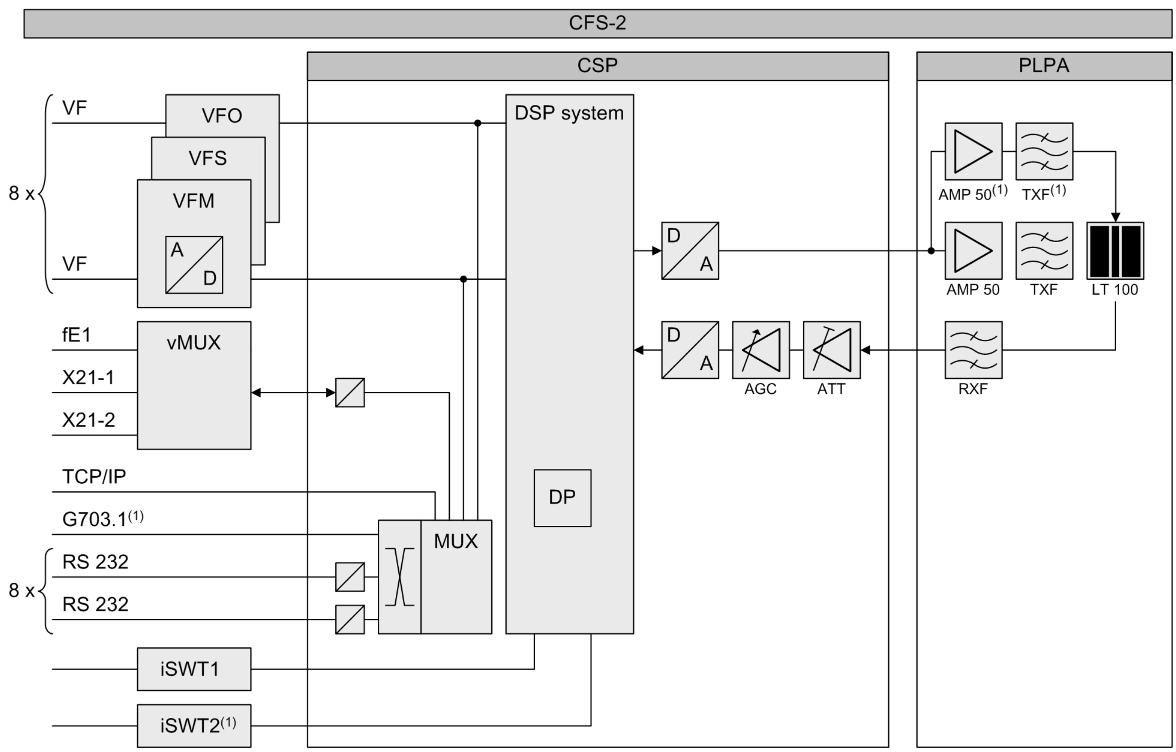
[ph_PowerLink_50_100, 1, --_--]

Figure 2-1 The PowerLink 100 and PowerLink 50

Advantages at a glance

- Cost-effective for small to medium data volumes over long distances
- Processes analog and digital signals
- Dynamic transmission rate

- Adjustable transmission power
- Variable bandwidth
- Transmission capacity up to 320 kbps
- Integrated TCP/IP interface
- Voice compression
- Versatile multiplexer
- Integrated teleprotection systems
- Cross-functional management system for all integrated services
- Can be used effectively in combination with broadband technologies for optimal availability



[dw_plcfs2_011214, 1, en_US]

Figure 2-2 PowerLink - The versatile Solution

1) for PowerLink 100

DSP	Digital signal processing
VF	Voice frequency
VFO	Voice frequency interface FXO
VFS	Voice frequency interface FXS
VFM	Voice frequency interface E & M
X.21-x	Synchronous digital interface
RS232	Asynchronous digital interface
iSWT	Integrated SWT 3000
vMUX	Versatile multiplexer
DP	Data pump
AGC	Automatic gain control
ATT	Attenuator

fE1	Fractional E1 2 Mbps
CFS-2	Carrier frequency section
PLPA	PowerLink power amplifier
CSP	Central signal processor unit
AMP50	50-W power amplifier
RXF	Receive filter
TXF	Transmit filter
TCP/IP	LAN interface
LT 100	Line transformer

High performance

PowerLink offers a transmission capacity of 320 kbps and an integrated TCP/IP interface. Many different types of IP terminals can use the power line communications network effectively.

Easy to manage

PowerLink not only simplifies communications, it also makes communications cost-effective. The PowerSys software administers all of PowerLink's integrated applications under a standard user interface. This ensures higher operating security while keeping training time and costs to a minimum.

2.1.2 Overview of the Features

Features	Digital PLC system	Analog PLC system
Universally applicable in analog, digital, or mixed operation	X	X
Carrier frequency range 24 kHz to 1000 kHz	X	X
Bandwidth selectable 2 kHz to 32 kHz	X	X
Data rate up to 320 Kbps @ 32 kHz	X	
Transmission power 20 W / 50 W / 100 W, Fine adjustment through software	X	X
Operation with or without frequency band spacing with automatic cross talk canceller	X	X
Digital interface		
Synchronous X.21 (max. 2 channels) Asynchronous RS 232 (max. 8 channels) TCP/IP (2 x electrical, 1 x optical) E1 (2 Mbps) for voice compression G703.1 (64 kbps) [1)	X X X X X	
Analog interface		
VF (VFM, VFO, VFS), max. 8 channels for voice, data, and protection signal [2)] Asynchronous RS232 (max. 4) via FSK	X	X X
Miscellaneous		
Adaptive dynamic data rate adjustment	X	
TCP/IP Layer 2 Bridge	X	

Features	Digital PLC system	Analog PLC system
Integrated versatile multiplexer for voice and data	X	
Max. 5 compressed voice channels via VF interface [3]	X	
Max. 8 voice channels via E1 interface	X	
StationLink bus for the cross-connection of max. 4 PLC transmission routes (compressed voice and data without voice compression on repeater)	X	
Reverse FSK analog RTU/modem data via dPLC (2 x)	X	
Protection signal transmission system SWT 3000		
Integration of 2 devices in PowerLink 100 and 1 in PowerLink 50	X	X
Remote operation via cable or fiber-optic cable[1] identical to the integrated version	X	X
Single purpose or multi purpose/alternate multi purpose mode	X	X
Element manager, based on a graphical user interface for the control and monitoring of PLC and teleprotection systems	X	X
Command interface binary and in accordance with IEC 61850	X	X
Remote access to PowerLink		
Via TCP/IP connection	X	X
Via in-band service channel	X	X
SNMP compatibility for integrating NMS	X	X
Event memory with time stamp	X	X
Simple feature upgrade through software	X	X
[1] Not applicable in PowerLink 50 [2] Max. 7 VF channels for PowerLink 50 [3] 4 compressed voice channels via VF for PowerLink 50		

2.1.3 PowerLink – Developed for the Challenges of the Future

PowerLink has numerous outstanding features and functionality, many of which are patented. The real hallmark of the system, however, is its openness and flexibility, which offers you a host of technical options for the best operation of your communication networks. You can use PowerLink for the transmission of:

- Protection signals
- Telecontrol signals
- Voice
- Data
- TCP/IP communication

For this purpose, PowerLink has analog and all current digital interfaces. Because these can be combined flexibly, you can protect investments you have already made, and continue to use the older analog terminals while you gradually switch over to the new communication technologies. At the same time, with PowerLink, you already have at your disposal all the possibilities of TCP/IP communication – which is increasingly emerging as the standard in the power supply area as well.

Best transmission performance under all operating conditions

Variable transmission power

The transmission power can be configured via software in two ranges (20 – 50 W or 40 – 100 W), based on the requirements of the transmission path. This makes it easy to comply with national regulations and to enable optimized frequency planning.

Optimal data throughput under changing environmental conditions

PowerLink adapts the data rate to changes in ambient conditions, thus guaranteeing maximum data throughput. Thanks to PowerLink's integral prioritization function, which can be configured for each channel, routing of the most important channels is assured even in poor weather conditions.

Integrated versatile multiplexer (vMUX)

The vMUX is a statistical multiplexer with priority control. Asynchronous data channels can be transmitted in "guaranteed" or "best effort" modes, to guarantee optimal utilization of available transmission capacity. The priority control ensures reliable transmission of the most important asynchronous and synchronous data channels and voice channels even under poor transmission conditions. Naturally, the vMUX is integrated into PowerLink's management system, and – with its extended options for transmitting digital voice and data signals – perfectly equipped for the power line communication requirements of the future.

For highest bandwidth efficiency, PowerLink offers integrated voice compression with different compression rates between 5.3 and 8 kbps. To prevent any impairment of voice quality, the compressed voice bands are routed transparently through transit stations without requiring additional decompression and compression.

Bridge to IP

This functionality is best suited for the migration from TDM to packet-switched networks. PowerLink offers electrical and optical Ethernet interfaces, including an integrated L2 switch, extending the IP network to remote substations with a bit rate up to 320 kbps.

Integrated teleprotection system SWT 3000

For PowerLink 100, two independent SWT 3000 systems can be integrated. Each iSWT 3000 system can be used to transmit up to 4 commands in different operation modes. For maximum availability, an alternate transmission path via a digital communication link can be connected.

For PowerLink 50, one SWT 3000 system can be integrated. The iSWT 3000 system can be used to transmit up to 4 commands in different operation modes.

2.1.4 Transmission Mode

The signals are transmitted using the single side band method (amplitude modulation) with suppressed carrier:

SSB advantages:

- Large ranges due to maximum utilization of the transmitter energy for signal transmission.
- The smallest possible bandwidth and therefore optimum utilization of the spectrum space of the frequency range permitted for the transmission.

2.1.5 Frequency Range

The transmission is carried out in the frequency range from 24 kHz to 1000 kHz. The frequency positions of the HF send and receive band can be freely selected. The following frequency orders are possible:

- Regular:
  The VF band is only shifted linear in the frequency (lowest frequency remains the lowest frequency).
- Inversed:
  The VF band is shifted linear and turned around the center of the band (lowest frequency becomes the highest frequency).

The adjacent band operation is possible in both frequency orders.

Frequency Grid

The frequency grid is adjustable to 2.5 kHz resp. 4 kHz. The frequency adjustment is possible in steps of the half grid (1.25 kHz resp. 2 kHz).

HF-Bandwidth

The HF bandwidth for each directional transmission is adjustable to 2, 2.5, 3.75, 4, 5, 7.5, 8, 12, 16, 24 kHz or 32 kHz. It is divided via Software Configuration into the sub channels for the services to be transmitted.

2.1.6 Automatic Gain Control (AGC)

When used as a transmission path, the attenuation of a high-voltage line is depending on the switching status and the weather conditions. The resultant variations in attenuation have to be off-set by the receiver with the AGC.

The deviation of the amplitude of the system pilot tone is used as the control variable.

2.1.7 Automatic Frequency Control (AFC)

Frequency deviations between the send and receive signal are compensated by the automatic frequency control in the receive path.

2.1.8 Automatic Channel Equalization (ACE)

Attenuation distortion can arise within a transmission channel due to the frequency response of the transmission line. To compensate for this distortion within a transmission channel, line equalizers are fitted. Line equalization is carried out automatically in the receive path.

With automatic channel equalization (ACE), the frequency characteristics of the transmission path are measured and compensated. For voice and data channels, equalization is carried out separately. The voice channel is equalized completely automatically during the speech-free time so that, even when the transmission characteristics of the high-voltage line change, there is always an optimum transmission channel available. Data-channel equalization is always initiated via the service PC.

Every restart (reset) of the device causes an automatic channel equalization of the voice and also of the data channel.

2.1.9 Automatic Crosstalk Canceller (AXC)

In the PLC line equipment, a part of the transmit signal is reflected to the input of the system. This is disturbing particularly in the adjacent band operation. To reduce this effect and to avoid overload in the receive path, the function AXC (Automatic Crosstalk Canceller) is integrated on the CSPi module.

The service program PowerSys offers the following possibilities for executing the function AXC:

- Off
- Single (AXC executed at each startup of PowerLink)
- Alarm triggered/AXC Automatically Activated (AAA)
- Adaptive

For most common conditions with adjacent transmission bands the setting **adaptive AXC** is the best choice for crosstalk cancellation. It allows a continuously adaption of the AXC to the changing of the line conditions.

However, the setting **alarm triggered AXC activation** allows an activation of AXC depending on the behavior of selected alarm sources. In quantifying different levels for an **automatic AXC activation**, digital resp. analog alarm sources of the PowerLink system can be defined.

Refer to Chapter *3.7.3 AXC Automatically Activated* for details.

2.1.10 Parameterization

The service program PowerSys enables all settings in the PowerLink system to be made such as:

- Defining operating frequencies and bandwidth
- Services to be transmitted
- Channel equalization
- Tx and Rx level adjustment
- Alarm thresholds

2.1.11 VF Interfaces

2.1.11.1 VF Interfaces for Speech Channels

Depending on the communication equipment the following modules are available for the speech transmission:

- VFM **V**oice **F**requency E&**M**
- VFS **V**oice **F**requency **S**ubscriber
- VFO **V**oice **F**requency **O**ffice

The modules are different in the realization of port 1 (for the service F2). Additionally port 2 from each module provides an E&M speech interface. Also the ports 3 and 4 on the modules are identical. (see also *2.2.4.1 Interface Module VFx*

2.1.11.2 Compander

Voice channels (F2) can be equipped with companders for improving the signal-to-noise ratio. The compander, consisting of a compressor on the transmission side and expander on the receive side, increases the separation between the noise level and the received speech level. In no-speech periods, it almost completely suppresses the noise level.

If transmission sections are connected in series, companders may only be inserted at the beginning and end of the total route. Companders in nodal switching centers are switched on and off by the automatic exchange. In the PowerLink, the compander function is also implemented in the form of an SW module of the signal processors and, depending on the application, can be switched on or off continuously or can be controlled from the exchange via control wires.

2.1.11.3 VF Interfaces for Data Channels

The ports 2 up to 4 of the VFM, VFS resp. VFO modules can be used for connecting a modem. In the VFx slot position 1, max. 3 data interfaces are available and in the slot position 2, 2 data channels can be connected.

2.1.11.4 VF Interface for External Protection

The ports 3 and 4 of the VFM, VFS resp. VFO modules are designed for connecting an external protection signaling equipment. In the VFx slot position 1, max. 2 protection signaling interfaces are available and in the slot position 2, 1 protection signaling device can be connected. The possible operating modes with the PowerLink system are single purpose, multi purpose resp. alternate multi purpose.

2.1.12 dPLC with the Data Pump Function

2.1.12.1 X.21 Interface

Additional to the analog interfaces digital interfaces according ITU-T X.21 are available in the PowerLink system, which allow the transparent transmission of information up to 320 Kbps (in a 32-kHz channel) via the Data Pump. This results in an extension of the operating possibilities such as:

- Increase of the transmission capacity
- Optimal use of the available frequency band
- Transmission of fast data channels
- Access to digital broadband networks
- Integral part of digital communication networks
- Back up system to digital networks
- Cross linking of digital voice communications systems with ISDN connection S0 (in combination with external multiplexer)

2.1.12.2 G703.1 Interface

In addition, an ITU-T G703.1 interface is part of the PowerLink 100. G703.1 is an alternative to the X.21-DP interface.

For PowerLink 100, the interface also allows the transparent serial synchronous data transmission with 64 Kbps (in an 8-kHz channel).

2.1.12.3 10/100BASE-T Ethernet Interface

PowerLink also offers 10/100BASE-T Ethernet interfaces, 2 electrically and 1 optical interface. 1 electrical interface is dedicated for the communication with the service PC that runs the program PowerSys.

They can be used for transmission of serial IP data up to 320 Kbps (in a 32-kHz channel) via the high voltage line (“remote bridging”). The IEC 60870-5-104 protocol is supported as well as the IEC 61850 protocol (except real-time applications).

The embedded IP controller enables a layer 2 switching functionality according IEEE 802.3 between the LAN ports including the PLC transmission line.

Multiplexed Ethernet and vMUX data (voice, X.21, RS232) can be transmitted via PowerLink.

2.1.13 RS232 Interface

2.1.13.1 Overview

In the PowerLink system, 8 RS232 interfaces are existing. They can be transmitted via an internal multiplexer and the service Data Pump or via integrated iFSK channels (max. 4) and the service data (F3).

The following bitrates are possible:

- 50 bps up to 2400 bps when transmitting via the iFSK channels
- 1.2 Kbps up to 19.2 Kbps when transmitting via the internal multiplexer iMUX resp.
  1.2 Kbps up to 115.2 Kbps via vMUX and the service Data Pump

2.1.13.2 Integrated FSK-Channels (iFSK)

Transparent data transmission is possible via the integrated FSK (iFSK) channels. For the iFSK channels, a frequency band in the range from 300 Hz up to max. 3840 Hz has to be defined.

The frequency deviation as well as the channel level results from the adjusted bit rate and is calculated by the system. The system makes sure, that the channels do not overlap and the grid distance is observed.

The transmit levels for the different systems are determined automatically from the PowerLink equipment and adjusted accordingly.

2.1.13.3 Connection of Local RTU in Polling Mode with Integrated Splitter

The RS232-1A up to -4A resp. RS232-1B up to -4B interfaces of the PowerLink system provide an **RS232 splitter**.

The RS232 splitter is used in the polling mode of RTU (Remote Terminal Unit) via integrated FSK channels resp. iMUX and integrated Data Pump of the PowerLink equipment to connect a requested RTU **in the direction to the telecontrol center**.

All RTUs assigned to the same group will receive the polling request from the control center. If the local RTU is addressed, the RTS (Request To Send) signal will switch the transmit data line (TxD) to the local RTU.

2.1.13.4 iMUX

The iMUX is an integrated statistical multiplexer with a priority management function. It allows asynchronous data transmission from up to 8 data channels with 1.2 Kbps up to 19.2 Kbps.

The statistical multiplexer functionality allows to assign an overall higher bit rate to the ports than the aggregate bit stream can handle. The priority management function assigns ”guaranteed bit rates” to ports 1 through 4 (for example 4 x 19.2 Kbps) and ”best effort” to ports 5 through 8 (for example, 4 x 19.2 Kbps). Channels with guaranteed bit rates will always be transmitted. ”Best effort” channels will be transmitted if transmission capacity is available (1 or more ports from 1 to 4 is/are in an idle state).

2.1.13.5 vMUX

The vMUX is an integrated versatile multiplexer in the PowerLink. It makes it possible for PowerLink to compress speech, process data services with 1.2 Kbps to 115.2 Kbps, multiplex speech and different data services and transmit them via PLC. The integration of theses capabilities in PowerLink renders external multiplexers obsolete.

2.1.14 Transmit Power

For the PowerLink equipment, transmit amplifiers with 50 W and 100 W peak power ratings are available.

All transmit amplifiers have a built-in transmitter supervisory. An automatic gain control adapts the transmit power to the changing impedance of the high voltage line. This makes an optimal utilization of the transmit power with less distortion possible.

2.1.15 Alarms

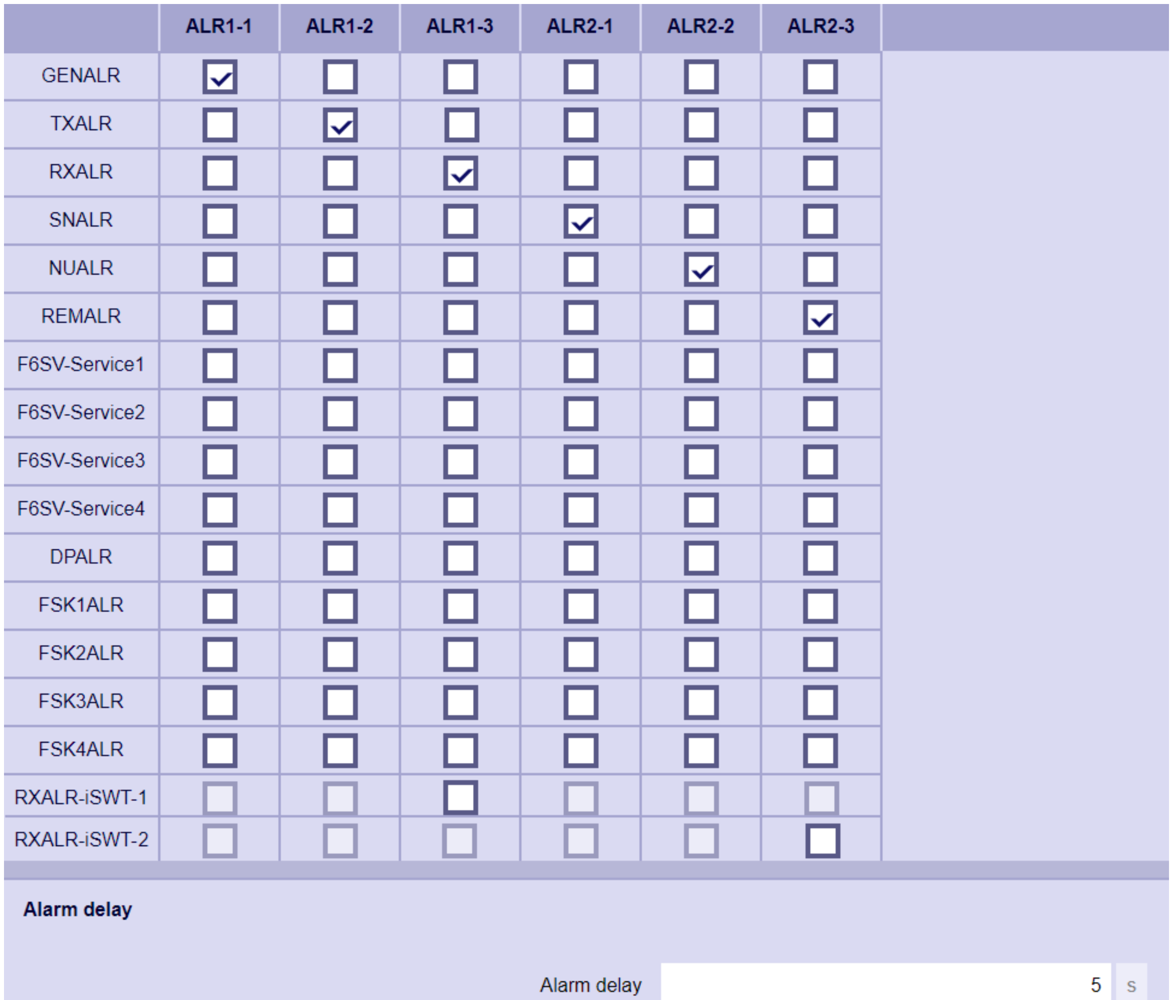
2.1.15.1 Alarm Outputs of the ALR Module

In PowerLink 100, the alarms are distributed via up to 2 alarm modules (ALR) with 3 relay outputs respectively. Therefore, up to 6 alarm outputs are available.

In PowerLink 50, the alarms are distributed via one alarm module (ALR) with 3 relay outputs.

Alarms can be arbitrary allocated to the outputs of the ALR modules with the service program PowerSys. The following alarms are available in the PowerLink System:

- GENALR (General alarm)
- TXALR (Transmitter alarm)
- RXALR (Receiver alarm)
- SNALR (Signal to Noise alarm)
- NUALR (Non-urgent alarm)
- REMALR (Alarm in the remote terminal)
- F6SV-Service1 up to -Service4 (F6 supervision alarm for service 1 up to 4 depending which service is used for protection signaling in mode AMP).
- DPALR Data Pump alarm. Activated when the secondary transmission rate is used. (Only in case of dynamic Data Pump).
- FSK1ALR up to FSK4ALR Alarm from the integrated FSK channels 1 up to 4
- RXALR-iSWT-1 / -2 (output of the iSWT Rx alarm, unblocking impulse, or impulse limitation alarm; depending on the alarm configuration of the iSWT)



[sc_example_config_2alr_modules, 1, --_--]

Figure 2-3 Example of an alarm configuration with 2 ALR modules

ALR1-1 up to ALR1-3 = ALR module 1 alarm output 1 up to 3

ALR2-1 up to ALR2-3 = ALR module 2 alarm output 1 up to 3

The output ALR1-3 can be allocated to the output of the RXALR from the iSWT1. The output ALR2-3 can be allocated to the output of the RXALR from the iSWT2. In this case **no additional alarm allocation** to these outputs is possible. Additional a common relay activation time delay (effective for all relays) can be adjusted in the range from 1 up to 15 seconds.

2.1.15.2 Binary Inputs of the ALR Module

It provides 3 alarm relays, 2 binary inputs as well as indication LEDs.

The DC input voltage for each binary input is adjustable to 24 V, 48 V/60 V, 110 V resp. 250 V. The binary input 1 can be used for the time synchronization of the PowerLink system clock and the iSWT. Either an external sync pulse is connected or the input is alternatively configurable as an input for IRIG-B signals.

The ALR module provides an LED for visual indication of the state of each binary input and of each alarm output. The LEDs are visible after removal of the front cover. For more details refer to Chapter *Commissioning*.

The input 2 is provided for future use.

2.1.16 Service Telephone (STEL)

For commissioning and maintenance purposes each PowerLink system which is parameterized for voice transmission can be equipped with a service telephone. The transmission is carried out via the service F2 or alternatively to the service Data Pump. When operating the STEL the corresponding service is interrupted.

For voice input and output, a headset is used. The operation of the service telephone is controlled with the „STEL-button“. The STEL operation mode is displayed additionally with a LED.

2.1.17 Remote Access

2.1.17.1 Overview

The TCP/IP connection via Intranet as well as a optional remote access server (RAS) connection serves the complete system functionality administration for remte PowerLink devices identical to local on-site operation. Standard TCP/IP network protocols are used for easy access to each PowerLink from anywhere within a company Intranet. The system can interface with your own network security systems and firewalls, providing you with just the right security level your company requires.

2.1.17.2 Remote Monitoring (RM)

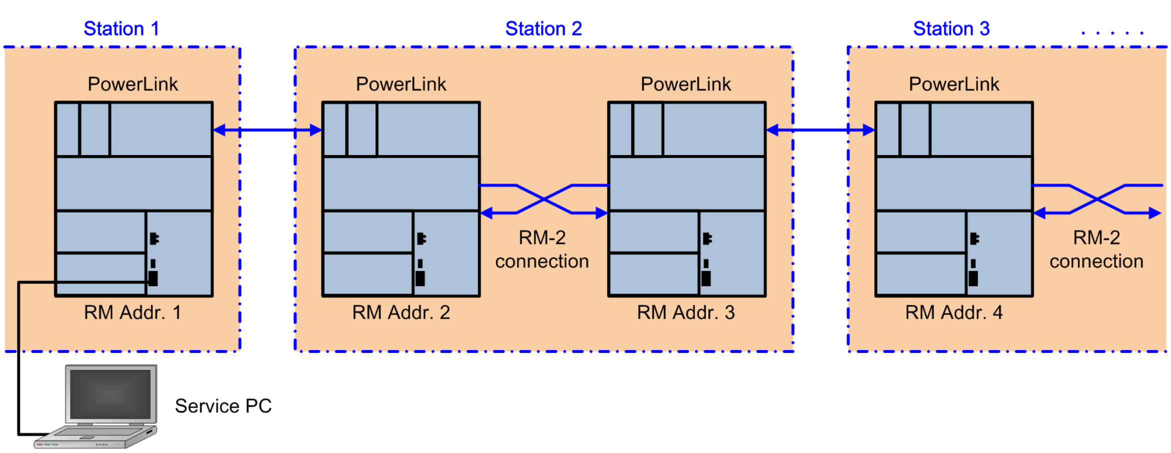
In the event that no Intranet or modems are available, remote terminals can be monitored or configured using the in-band RM channel. With the optional service “Remote Monitoring” (RM), data can be transmitted between the devices of one or more PowerLink routes. The RM function enables the user to have access via a serial interface with the PowerSys service program to the following function:

- Query of the device data (configuration, parameter, status) of the remote device
- Temporary adjustments (for example test loops)
- Producing a reset

In PowerLink 100, via an additional interface (RM-2) up to 5 transmission routes can be coupled. It is possible to mix PowerLink transmission links with SWT 3000 links in arbitrary sequence.

In PowerLink 50, the RM-2 interface is not available.

When using transmission links with SWT 3000 devices the correct baud rate (9600) must be adjusted.



[dw_exroco_011214, 1, en_US]

Figure 2-4 Example of a route coupling with the RM function - PowerLink 100

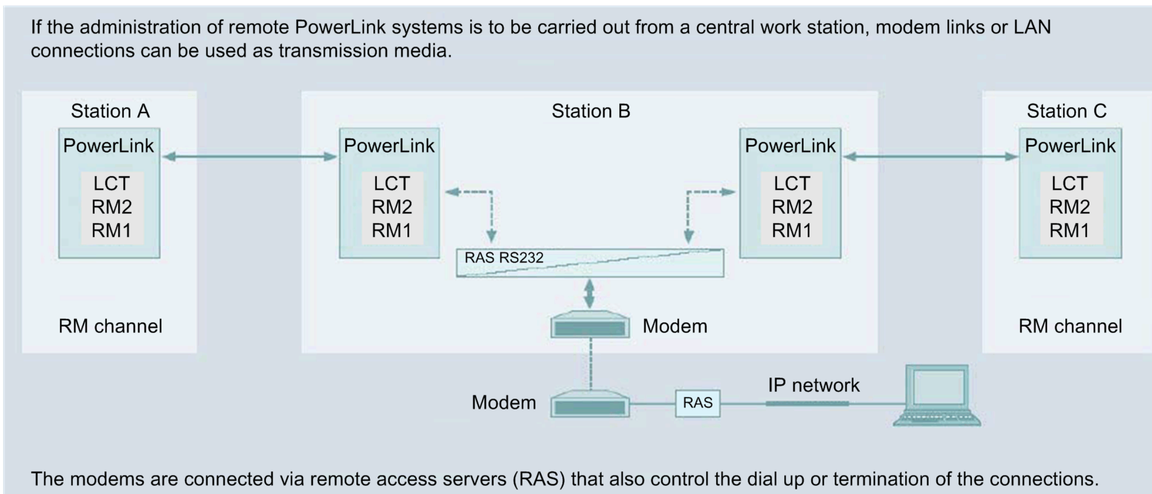
OHL	Overhead line
RM-2	Service interface backplane

2.1.17.3 Remote Maintenance

Changing of the configuration and parameter (Remote Maintenance), except HF and System Configuration, in the remote device is possible with this service but the **configuration** via the in band RM-channel has to be **enabled** in the corresponding device

2.1.17.4 Remote Access Interface RM-2 for PowerLink 100

Via the service interface remote access (RM-2) it is possible to connect the PowerLink to a remote access server (RAS). This allows users to gain access to the system from a remote location.



[dw_erawpl_011214, 1, en_US]

Figure 2-5 Example for the remote access to the PowerLink

The user has access to the PowerLink systems in the stations A and B via the intranet and the RAS. In this case, a corresponding TCP/IP address has to be entered into the service program PowerSys. Access is also possible to the PowerLink in station C when an RM connection between stations B and C is parameterized.

The bit rate between RAS and PowerLink RM-2 is 19.2 Kbps. In this case, RM-2 has to be configured as “Slave”.

2.1.17.5 SNMP

The module CSPi includes an SNMP (v2/3) functionality. This feature enables the user for instance:

- Working with a central NMS (Network Management System) via TCP/IP
- Spontaneous alarm indication (traps)
- Remote access to PowerLink (without additional hardware)

2.1.18 Event Recorder

A non volatile CSPi event recorder is part of PowerLink. The events are marked with a date and time information. By using the service program PowerSys the content of the event recorder can be displayed, saved as file and printed.

2.1.19 Real-Time Clock (RTC)

The integrated real-time clock (RTC) in PowerLink delivers the time information for the CSPi event recorder. The RTC can be synchronized by external clocks. If PowerLink is equipped with iSWT which also includes an event recorder and an RTC, all RTC are synchronized by the same external signal.

Alternative, if PowerLink should work without external time synchronization the RTC from the CSPi can generate a synchronization impulse for the iSWT RTC to avoid different times inside PowerLink.

2.1.20 Cyber Security

2.1.20.1 Overview

Cyber security is designed to protect PowerLink devices against common IT security threats and to minimize the impact of these threats on system operations. If PowerLink devices are under network attack, no device reset and telecommunication interruption should occur. For PowerLink, the reset of CSPi controller and IP controller is decoupled. Therefore, a possible manipulation of the network configuration via the CSPi web page by a cyber attack will only cause an IP controller reset and the PowerLink device will not restart.

Table 2-1 shows the communication protocols of PowerLink.

Table 2-1 List of Communication Protocols of PowerLink Service Interface

Service	Layer 4 Protocol	Layer 7 Protocol	Client	Client Port	Server	Server Port
Web Server	TCP	HTTP	Web browser	>1024	PowerLink	80
Web Server with SSL Encryption	TCP/TLS	HTTPS	Web browser	>1024	PowerLink	443
Time Synchronization	UDP	NTP	PowerLink	>1024	NTP Server	123
DHCP Client	UDP	DHCP	PowerLink	68	DHCP Server	67
DHCP Server	UDP	DHCP	DHCP client	68	PowerLink	67
SNMP	UDP	SNMP	NMS	>1024	PowerLink	161
SNMP Inform Acknowledge	UDP	SNMP	SNMP Trap Receiver	162	PowerLink	>1024
SNMP Trap/Inform	UDP	SNMP	PowerLink	>1024	SNMP Trap Receiver	162
PowerLink Configuration	TCP	PowerSys Protocol (Proprietary)	PowerSys	>1024	PowerLink	10001
PowerLink Configuration with SSL Encryption	TCP/TLS	PowerSys Protocol (Proprietary)	PowerSys	>1024	PowerLink	10001
PowerLink Measurement	TCP	PowerSys Protocol (Proprietary)	PowerSys	>1024	PowerLink	10002

Supported secure network communication protocols for PowerLink devices:

- SNMPv3 protocol:
  Simple Network Management Protocol Version 3 (SNMPv3) addresses the cryptographic security by adding authentication service (MD5 or SHA-1) and privacy service (DES). The entire SNMP messages are encrypted.
  For details on SNMPv3 features, refer to the related chapters in the Equipment Manuals or in the Application Notes.
- HTTPS protocol:
  Hypertext Transfer Protocol Secure (HTTPS) is a communication protocol for a secure communication between Web browser and Web server. The HTTP protocol is running on top of standard Transport Layer Security (TLS) protocol or predecessor Secure Sockets Layer (SSL). The entire HTTP messages are encrypted.
- PowerSys connection over SSL protocol:
  PowerSys TCP/IP connection is running on top of TLS/SSL protocol. The entire device configuration parameters are encrypted including sensitive data (for example, Password).

The supported SSL cipher suite is listed in *Table 2-2*:

Table 2-2 SSL Version and Cipher Suite

SSL Feature	PowerLink
Version	SSLv3/TLSv1
Public Key Cryptography	RSA
Symmetric Cipher	3DES
Message Digest Algorithm	SHA

2.1.20.2 Certification

Each device creates a self-signed certificate which has to be trusted on all clients used to access this device. The IP addresses of both service port and user port are part of this certificate. Therefore, create the certificate once again after the IP address is changed. Otherwise, a certificate warning message is shown with an IP address mismatch in the Web browser.

[sccreatc-080513-01.tif, 1, en_US]

Figure 2-6 Parameter: Create Certificate

The certificate creation is done via the device web page: **PowerLink > Service Interface Settings**.

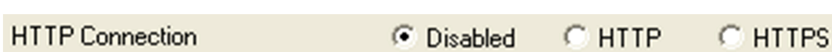
After having activated the settings, the certificate is created and stored into flash. The system is restarted automatically.

NOTE

If HTTPS is enabled and no valid certificate is created before, a default certificate will be created for PowerLink after the system startup.

2.1.20.3 HTTPS Connection

HTTPS connection is configured in **PowerSys of PowerLink > Configuration > Ethernet > IP (service port)**.

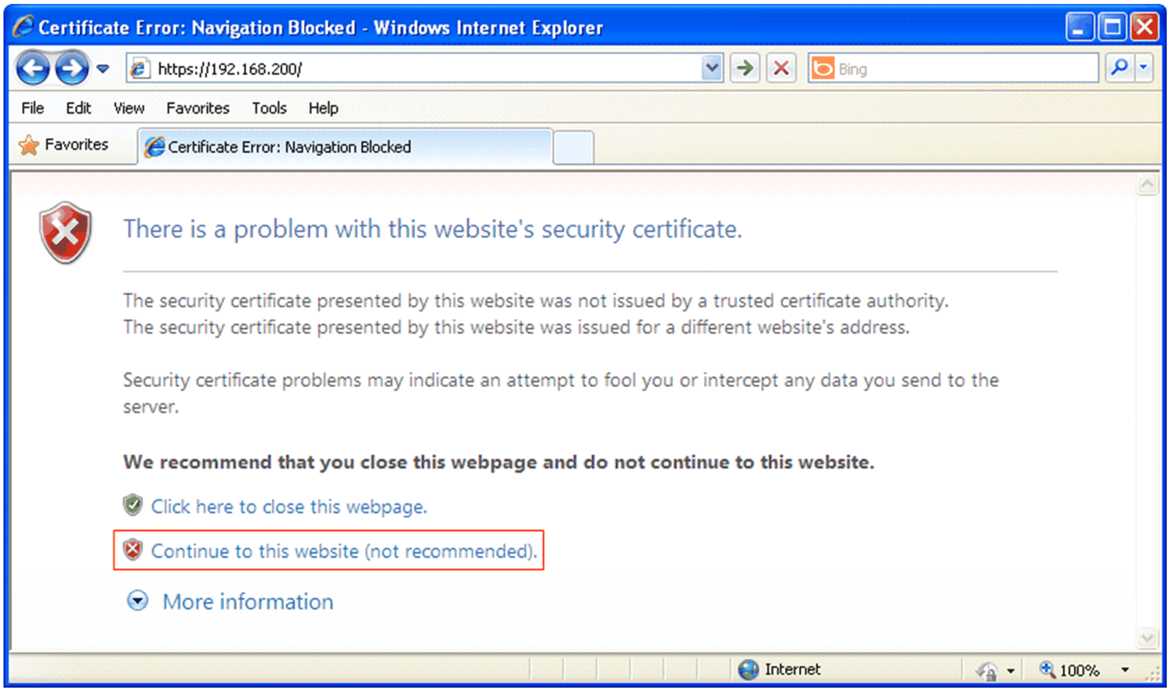


[schttpsc-080513-01.tif, 1, en_US]

Figure 2-7 Parameter: HTTP Connection

Disabled	HTTP and HTTPS are disabled
HTTP	HTTP is enabled (default option). You can access the web page via HTTP protocol (e.g. http://192.168.20.200)
HTTPS	HTTPS is enabled. You can access the web page via HTTPS protocol (e.g. https://192.168.20.200)

When accessing the device web page using an HTTPS protocol for the first time, an error message occurs mentioning that the certificate is not trusted. In order to enable the trust, you have to install the certificate in **Trusted Root Certification Authorities Store**. Continue to this website as shown in *Figure 2-8*.

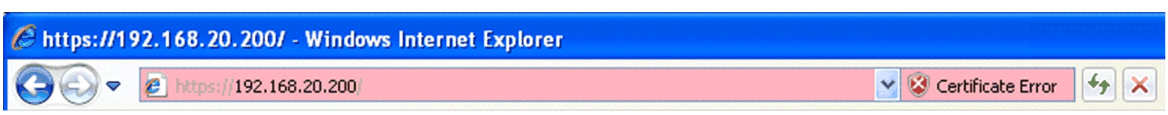


[scerrorm-080513-01.tif, 1, en_US]

Figure 2-8 Certficate Error Message

The device homepage can now be opened.

Open the certificate window by clicking on the certificate error message in the address bar of the Web browser (see *Figure 2-9*).



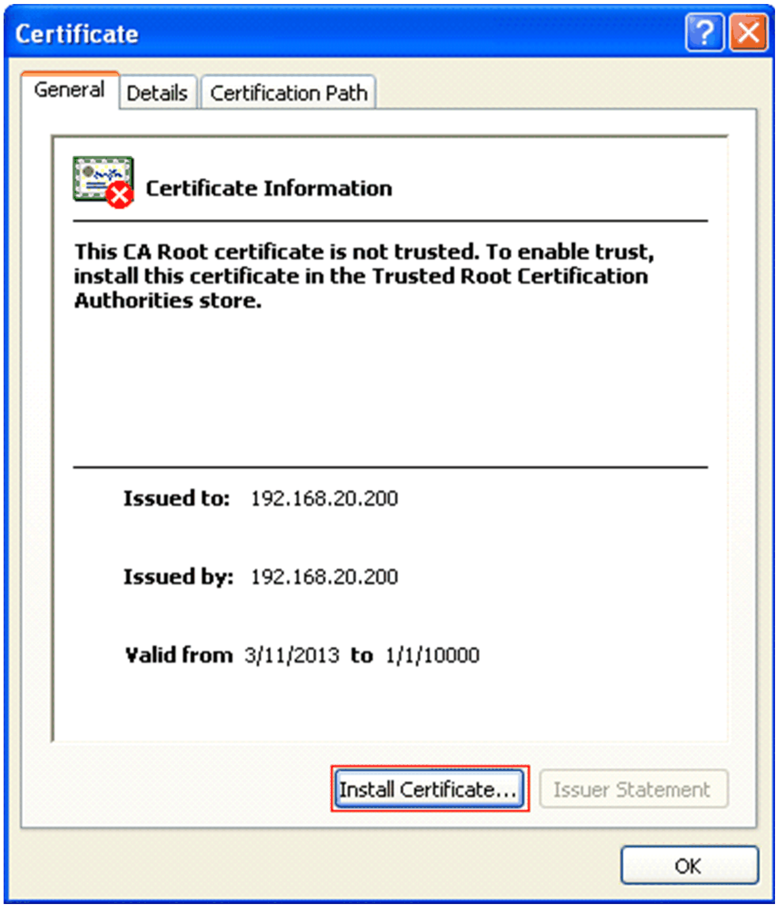
[scuntrus-080513-01.tif, 1, en_US]

Figure 2-9 Untrusted Certificate

You can view the detailed certificate information in the opened certificate window (see *Figure 2-10*).

By clicking on the **Install Certificate** button and afterwards on the **OK** button in the certificate import wizard, the certificate will be installed in the **Trusted Root Certification Authorities Store** automatically.

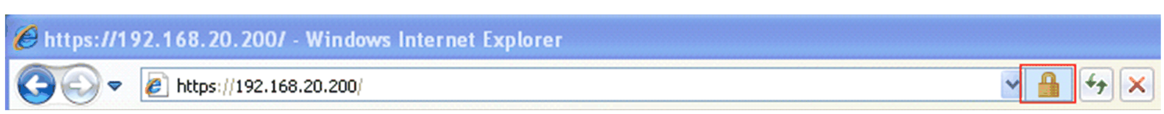
You can find the installed certificate under **IE browser > Internet Options > Content > Certificates > Trusted Root Certification Authorities**.



[sccertwi-080513-01.tif, 1, en_US]

Figure 2-10 Certificate Window

After the certification has been successfully installed, no error message occurs again when reopening the device homepage again (see *Figure 2-11*).

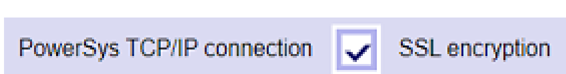


[sctrucer-080513-01.tif, 1, en_US]

Figure 2-11 Trusted Certificate

2.1.20.4 PowerSys connection over SSL

The PowerSys SSL connection is configured in **Configuration > Ethernet > IP (service port)**.



[sc_tcp_ip_ssl_encryption, 1, --_--]

Figure 2-12 Parameter: PowerSys TCP/IP Connection

Checked	SSL Encryption is enabled for PowerSys TCP/IP connection
Unchecked	SSL Encryption is not enabled for PowerSys TCP/IP connection

If the certificate has not been installed before, PowerSys will open a certificate window automatically.

After you finish the installation of the certificate on your PC, connect again PowerSys to the device. The exchanged data message between PowerSys and device is encrypted with SSL.

2.2 Functional Description

2.2.1 PowerLink 100 - Carrier Frequency Section CFS-2

2.2.1.1 Mechanical Construction

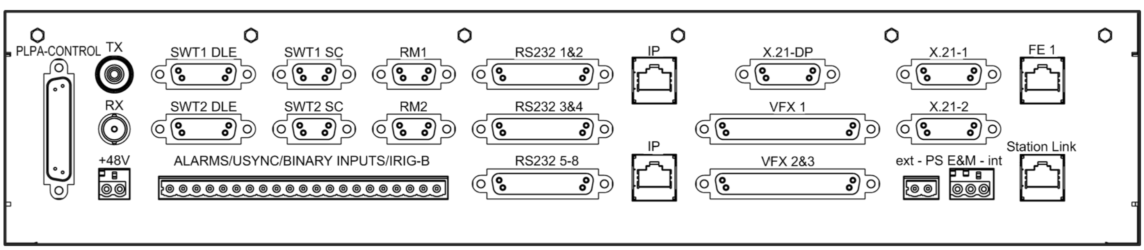
PowerLink 100 system consist of 2 module frames, the carrier-frequency section (CFS-2) and the line equipment section (PLPA).

For the PLPA section, a distinction is made between 50 W and 100 W transmit power.

The terminals are built to the proven ES 902-C design pattern. The dimensions of these module frames correspond to the 19" mounting system in accordance with DIN 41494 and can be installed directly into 19" swing frame cubicles or mounting frames without any additional fixing brackets.

The modules of a module frame are electrically connected to each other via a backplane with the appropriate sockets and plug connectors. The module frames are connected to each other by plug-in connectors and cables with integral connectors.

The ports for the external interfaces are mainly centralized on a connector panel. It is connected via the backplane with the CFS-2 part and located between the PLPA and the CFS-2. For VF and telephone channels Sub-D 37 pin sockets, for RS232 channels Sub-D 25 pin sockets, for fractional E1, for 10/100 Base TCP/IP and for G703.1 RJ45 sockets are existing, which are accessible from the front.



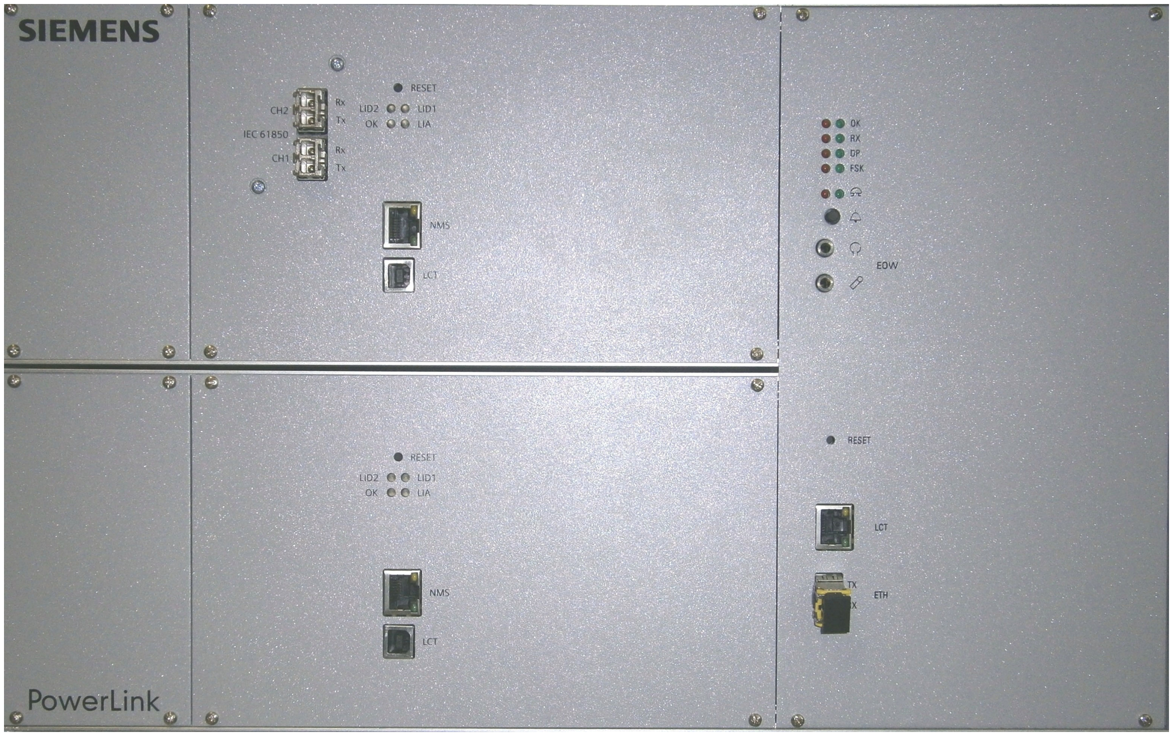
[dwconpls-220813-01.tif, 1, en_US]

Figure 2-13 PowerLink connector panel

2.2.1.2 CFS-2 Part

The module frame for the carrier frequency section (CFS-2) consists of a 19" module rack with a height of 6-tier. It contains, depending on the configuration:

- the power supply (PSCF2)
- the central signal processing module (CSPi)
- max. 2 alarm modules (ALR)
- up to 2 integrated SWT 3000 (PU, IFC)
- max. 3 VF interface modules (VFx)
- 1 vMUX module



[dwplcfs2-270813-01.tif, 1, --_--]

Figure 2-14 The CFS-2 module frame

At the right-hand part of the frame module slots are located for the mounting of the modules CSPi, VFx and vMUX in double-height euro card format. The modules have a common front cover with a cut-out for the service interface, the optical TCP/IP interface and the displays resp. operating elements of the CSPi module.

Alongside to the left the slot positions, the power supply PSCFS and the 2 alarm modules are located.

The mounting positions for the integrated SWT 3000 can be equipped with the processing unit PU4 and 2 interface modules IFC.

2.2.1.3 Functions of the CSPi

The CSPi module is the central component of the PowerLink and contains all functions except the analog VF inputs and outputs, the integrated protection signaling, and the PLC line equipment PLE. The module can be subdivided into the following functions:

- Digital signal processing

  For the function modulation, Data Pump and transmitting of FSK and rFSK data channels.
- Control unit

  With the micro controller, the memory, the RTC (real-time clock) and the nonvolatile event memory.
- Data interface

  Which can be programmed either as synchronous multiplexer (SMUX) for transmission via the X.21 interface, or iMUX for transmission of up to 8 RS232 asynchronous data interfaces, the G703.1, or the 10/100Base TCP/IP interface.
- High frequency analog

  Containing the HF output resp. input part.
- Input part

  Including attenuator and automatic gain control (AGC)
- Ethernet interface

  IP controller for service PC connection, Ethernet bridging and SNMP

2.2.2 PowerLink 50 - Carrier Frequency Section

2.2.2.1 Mechanical Construction

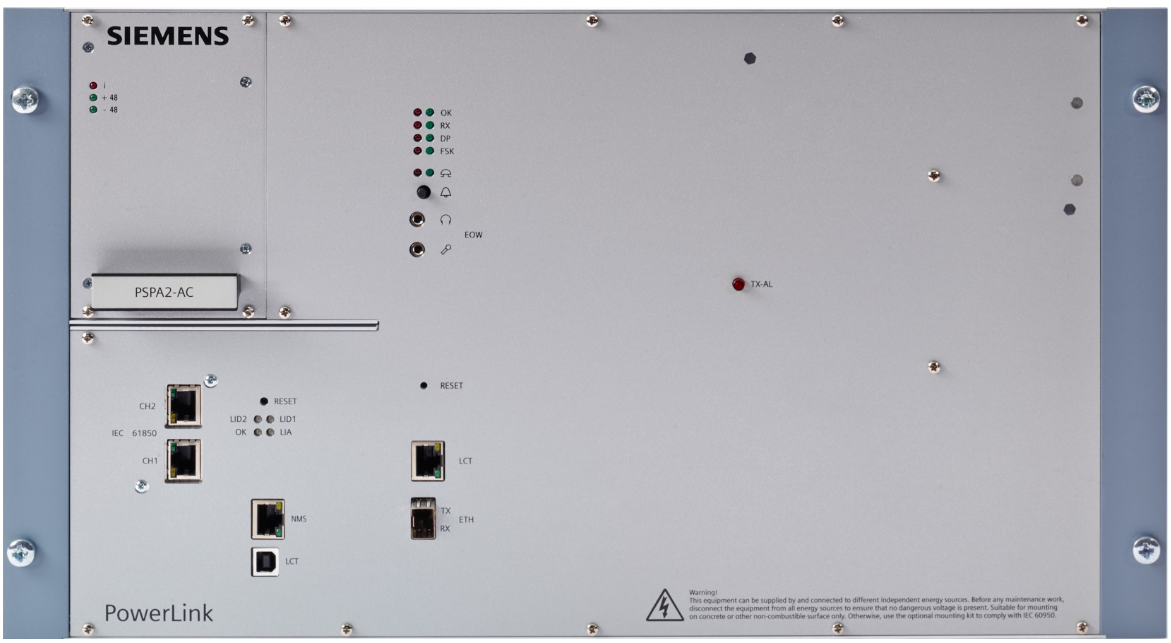
The PowerLink 50 system consist of the carrier-frequency section (CFS-2) and the line equipment section (PLPA). The terminals are built to the proven ES 902-C design pattern. The dimensions of these module frames correspond to the 19" mounting system in accordance with DIN 41494 and can be installed directly into 19" swing frame cubicles or mounting frames without any additional fixing brackets.

The Ports for the external interfaces are available on the front of the device and on the backplane.

The following sockets are accessible from the front

- 2 Sockets for IEC 61850 interface
- Service interface
- TCP/IP interface

The operating elements of the CSPi module are located on the front of the device.

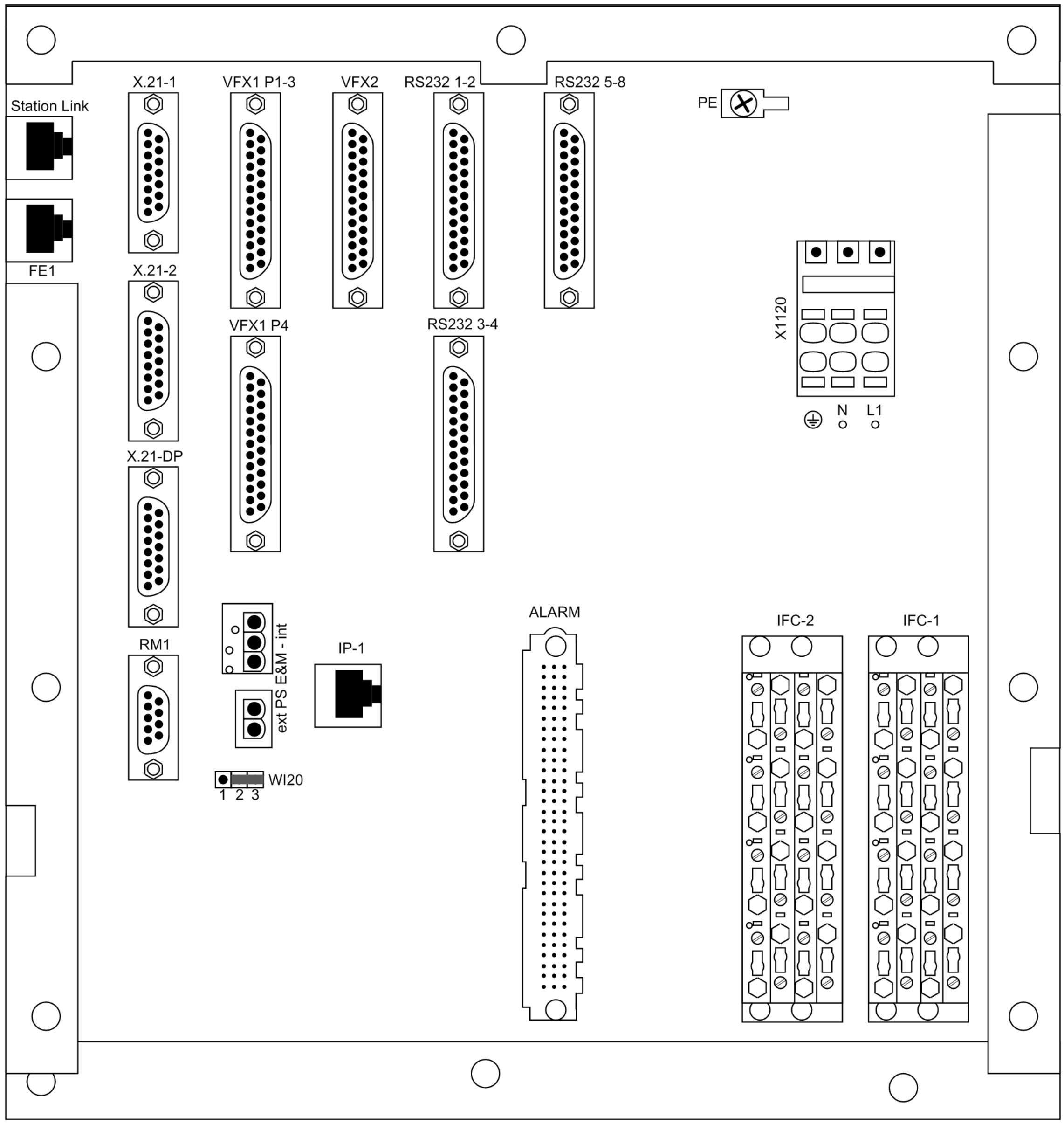


[PowerLink_50S_front_geschl-ausschnitt, 1, --_--]

Figure 2-15 PowerLink 50 - Front

The following sockets are accessible from the rear side of the device:

- Sub-D 25 pin sockets for VF and telephone channels
- Sub-D 25 pin sockets for RS232 channels
- Sockets for fractional E1
- Sockets for 10/100 Base TCP/IP
- RF interface
- TX RX interface
- HF test jack



[Dw_PowerLink-50S_klemmenbelegung, 1, --_--]

Figure 2-16 PowerLink 50 - Connectors

2.2.2.2 Functions of the CSPi

The CSPi module is the central component of the PowerLink and contains all functions except the analog VF inputs and outputs, the integrated protection signaling, and the PLC line equipment PLE. The module can be subdivided into the following functions:

- Digital signal processing
  For the function modulation, Data Pump and transmitting of FSK and rFSK data channels.
- Control unit
  With the micro controller, the memory, the RTC (real-time clock) and the nonvolatile event memory.
- Data interface
  Which can be programmed either as synchronous multiplexer (SMUX) for transmission via the X.21 interface, or iMUX for transmission of up to 8 RS232 asynchronous data interfaces or the 10/100Base TCP/IP interface.

- High frequency analog
  Containing the HF output resp. input part.
- Input part
  Including attenuator and automatic gain control (AGC)
- Ethernet interface
  IP controller for service PC connection, Ethernet bridging and SNMP

2.2.3 Definition of the Transmission Capacity

2.2.3.1 General Information

With PowerLink, you can plan beyond the limitations imposed by single- or double-channel terminals. PowerLink gives you all the flexibility you need to configure your various services within the available bandwidth. The transmission capacity for the different services like voice, data, and protection signal transmission is shown in the following table.

Table 2-3 Transmission capacity of the PowerLink system

Service	Max. Number
Analog voice channel with / without protection signaling in alternate multi purpose operation	3
Data transmission bands	2
Data Pump with / without protection signaling in alternate multi purpose operation	1
Protection signaling in single purpose operation	2
Simultaneous transmission of different services	4

2.2.3.2 Examples

No.		DP and F6 in AMP	Data F3	Data F3	Voice F2 (+Protection AMP)	Voice F2 (+Protection AMP)	Voice F2 (+Protection AMP)	Protection (Single purpose)	Protection (Single purpose)		
1								X			
2								X	X		2 x Protection signal transm.
3					X						
4					X			X	X		
5			X		X			X	X		
6			X	X	X			X			
7					X	X		X	X		
8			X		X	X		X			
9			X	X	X	X					
10					X	X	X				
11			X		X	X	X				3 x analog voice channel and 1 x data FSK
12			X					X	X		
13			X	X				X	X		
14		X						X			
15		X	X					X			
16		X			X			X			
17		X	X		X			X			1 x Datapump 1 x analog voice channel 1 x VF-data channel 1 x Protection signal transm.
18		X			X	X		X			
19		X	X	X				X			
20		X	X		X	X					
20		X	X	X	X						
21		X			X	X	X				
...											

[dw_tcefts-021214, 1, en_US]

Figure 2-17 Combination examples for the transmission of services in the PowerLink system

NOTE

The services must fit into the available HF bandwidth observing a defined gap between the single services and the transmission band limits. An accurate power calculation is required.

2.2.4 Analog Interfaces

2.2.4.1 Interface Module VFx

The analog interface modules VFx are used for the connection of analog signals in the frequency range from 300 Hz up to max. 3840 Hz to the PowerLink.
The following communication equipment can be connected via the VFx to the PowerLink:

- 2-/4-wire PABX systems with E&M signaling via separate links (service F2)
- 2-wire PABX systems with signaling via the voice link FXO (foreign-exchange office) (service F2)
- 2-wire subscriber terminal FXS (service F2)

- 4-wire data modem (service F3)
- 4-wire protection signal transmission equipment (service F6)

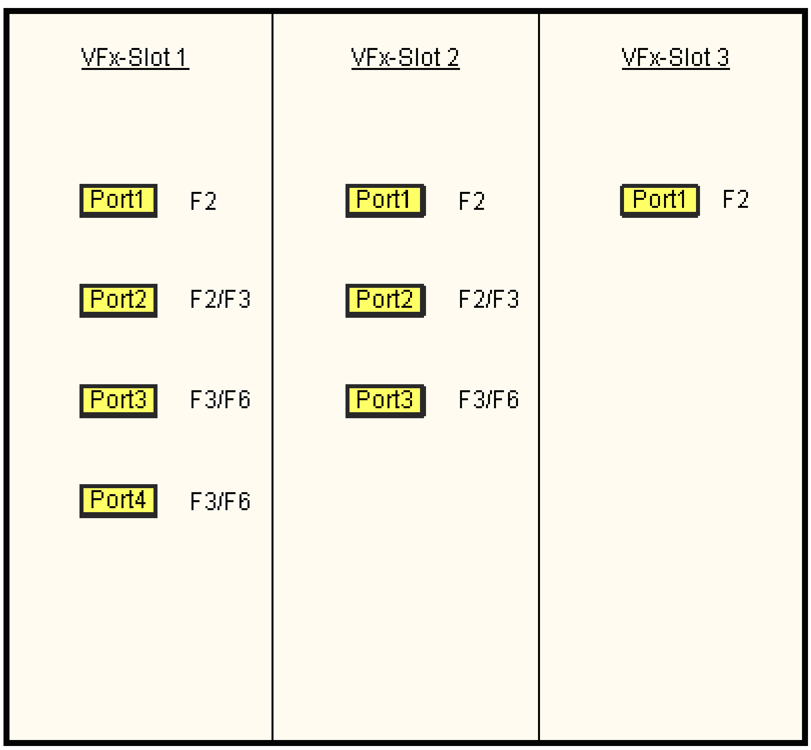
Each VFx module has 4 analog ports. Depending on the type of module and port, one of the above mentioned equipment can be connected.

For PowerLink 100, up to 3 VFx modules for max. 8 analog ports can be equipped.

For PowerLink 50, up to 2 VFx modules for max. 7 analog ports can be equipped.

The modules are different in the realization of the port 1. The ports 2 to 4 are identical on each module.

The figure below shows the segmentation of the max. 8 ports to the VFx modules in the mounting places 1 to 3 of PowerLink 100. From the module in place 2, only the ports 1 to 3 and in mounting place 3 only port 1 can be used.



[scpoivfx-040111-02.tif, 1, en_US]

Figure 2-18 Possible occupation of the inputs on the VFx modules - Example for PowerLink 100

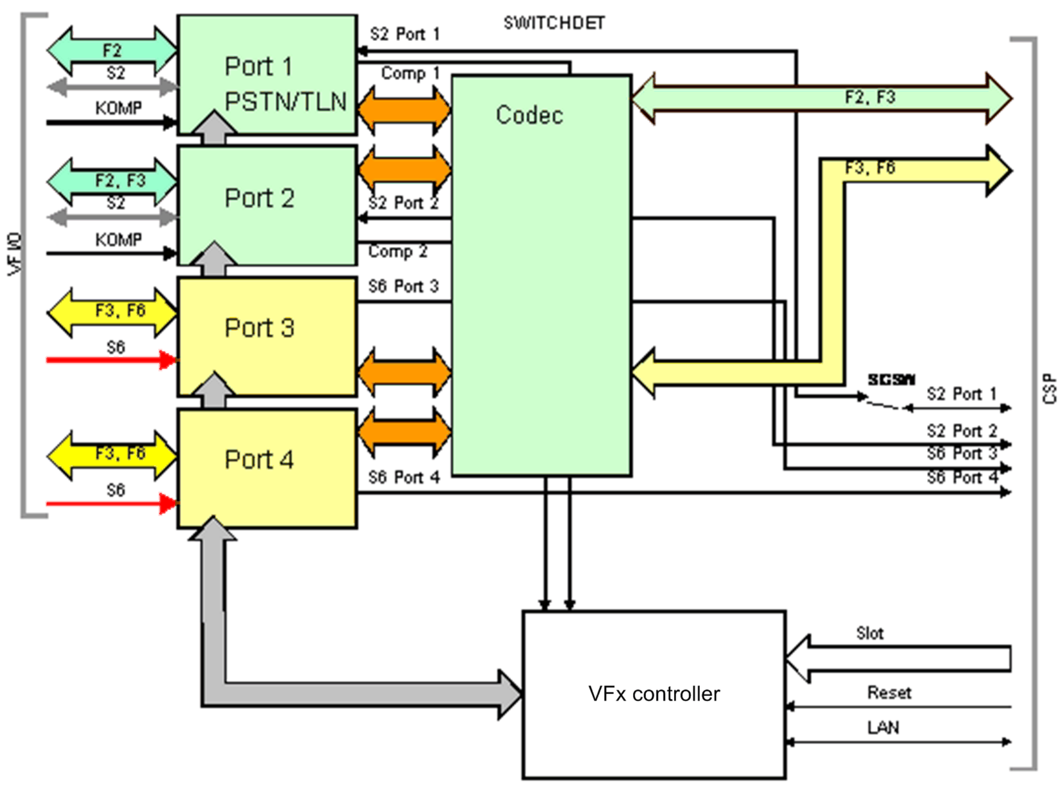
Slot 1-3	Mounting place 1-3
F2	Voice
F3	Data
F6	Protection signals
VFx	VFM resp. VFS resp. VFO module

Table 2-4 VFx module types

Module type	Port	Communication equipment
VFM	1	E&M 2-wire (F2); E&M 4-wire (F2); (4- wire data F3)
	2	E&M 2-wire (F2); E&M 4- wire (F2); 4- wire data F3
	3	4- wire data (F3); 4- wire protection (F6)
	4	4- wire data (F3); 4- wire protection (F6)

Module type	Port	Communication equipment
VFS	1	2-wire foreign-exchange station FXS (F2)
	2	E&M 2-wire (F2); E&M 4- wire (F2); 4- wire data F3
	3	4- wire data (F3); 4- wire protection (F6)
	4	4- wire data (F3); 4- wire protection (F6)
VFO	1	2-wire foreign-exchange office FXO (F2)
	2	E&M 2-wire (F2); E&M 4- wire (F2); 4- wire data F3
	3	4- wire data (F3); 4- wire protection (F6)
	4	4- wire data (F3); 4- wire protection (F6)

2.2.4.2 Block Diagram VFx



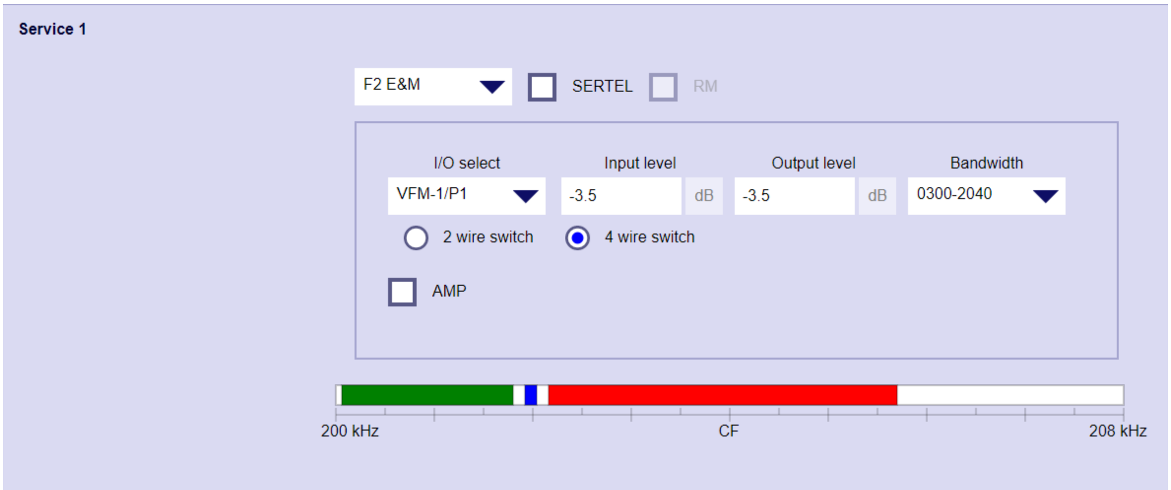
[dw_bdovfx-021214, 1, en_US]

Figure 2-19 Block diagram of the VFx modules

F2	Voice
F3	Data
F6	Protection signals
S2	Signaling voice
S6	Control wire F6
Comp	Compander
Codec	Coding / Decoding
Commuté	Evaluation S2 signal VFS resp. VFO
SIGSW	S2 Signal switch over

2.2.4.3 Input/Output

The assignment of the VFx modules input is carried out via the service program. After that the input- resp. output- level as well as the bandwidth of the VF band in the range from 300 Hz to 3600 Hz/3840 Hz in case of data transmission for each service can be defined.



[sc_service_F2_em, 1, --_--]

Figure 2-20 Assignment of a VFM input for the voice transmission F2

2.2.5 Voice Transmission F2

2.2.5.1 Interface Modules

Depending on the communication equipment the following modules are available for the voice transmission:

VFM	**V**oice **F**requency E&**M**
VFS	**V**oice **F**requency **S**ubscriber
VFO	**V**oice **F**requency **O**ffice

The modules are different in the realization of port 1 (for the service F2). The ports 2 to 4 on the modules are identical.

The max. number of analog voice channels per equipment is 3. The minimum required bandwidth for a voice channel is defined from 0.3 kHz up to 2.04 kHz. The upper limit is 3.6 kHz. It can be adjusted in steps of 120 Hz.

Each service F2 needs a pilot signal for transmitting the dialing information (S2). Each pilot requires a bandwidth of 120 Hz. The gap to the voice channel is also 120 Hz. Thus the bandwidth of a voice channel results in: Frequency range + gap + pilot bandwidth.

2.2.5.2 Voice Transmission Via vMUX

The vMUX offers 2 possibilities for transmitting voice channels via dPLC:

- Up to 5 compressed voice channels connected via VFx modules. In this case 3 VFx modules (VFx = VFM, VFS resp. VFO) are required.
- It is possible to transmit up to 8 voice channels from a 2 Mbps E1 frame of a digital telephone exchange. The exchange is connected via the FE1 interface on the PowerLink 50/100 connector panel.

2.2.6 Data Transmission F3

2.2.6.1 Data Transmission via Analog VFx Interfaces

The number of usable ports on the VFx modules for data transmission depends on the number of modules and the slot position. In slot position 1 three ports and in slot position 2, two ports are available. The ports 2 to 4 can be used on each VFx module for connecting analog data signals.

Table 2-5 Usable VFx ports for analog data signals

Port	VFM Module	VFS Module	VFO Module
1	analog voice with E&M	Subscriber	2 wire exchange
2	analog voice or data	analog voice or data	analog voice or data
3	analog data or protection	analog data or protection	analog data or protection
4	analog data or protection	analog data or protection	analog data or protection

A VF bandwidth must be assigned to each port. The **lower start frequency** is 300 Hz and can be increased in steps of 60 Hz up to max. 3840 Hz. The following bandwidths are selectable:

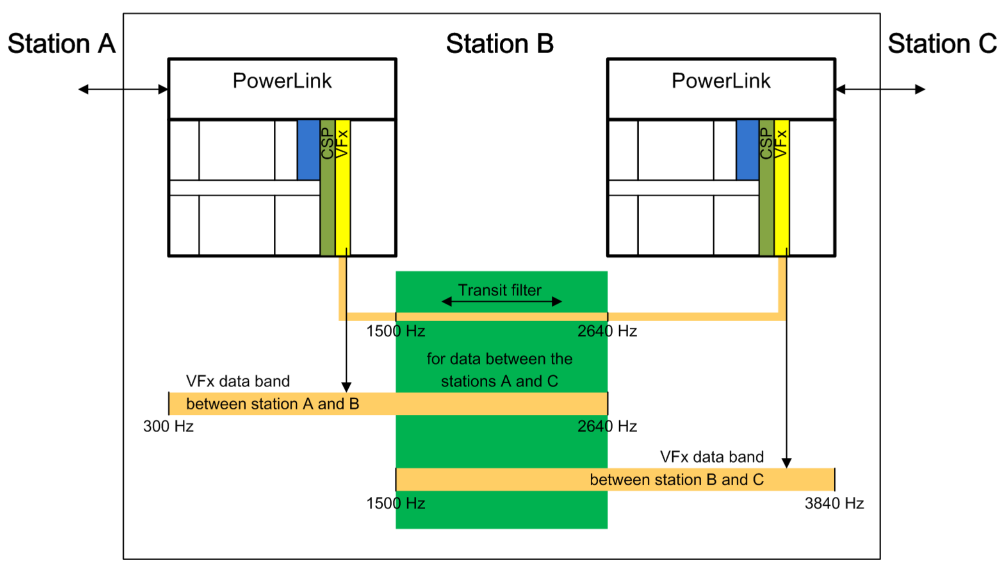
Table 2-6 Selectable F3 bandwidth

F3 Bandwidth in Hz						
120		600		1080		1560
240		720		1200		2340
360		840		1320		3300
480		960		1440		3540

The input and output level for each port have to be defined with the service program.

Transit Filter

With through connection of data between 2 PowerLink devices in a substation, a transit filter can be created by the adjustment of different VF bandwidth for the F3 service like shown in the figure below.



[dw_tfdt2l-021214, 1, en_US]

Figure 2-21 Transit filter for data transmission between 2 PLC links

The VF band for the data transmission between the station A and B is adjusted from 300 Hz up to 2640 Hz, and between the station B and C from 1500 Hz up to 3840 Hz. When connecting the VFx data ports between the PowerLink devices in the station B a transit filter for data from 1500 Hz up to 2640 Hz between the stations A and C is established.

2.2.7 Data Transmission via Digital Interfaces

2.2.7.1 RS232 Interfaces

In the PowerLink system 8 RS232 interfaces are available. They can be transmitted via an internal multiplexer (iMUX) and the service Data Pump or via iFSK channels (max. 4) and the service data (F3).

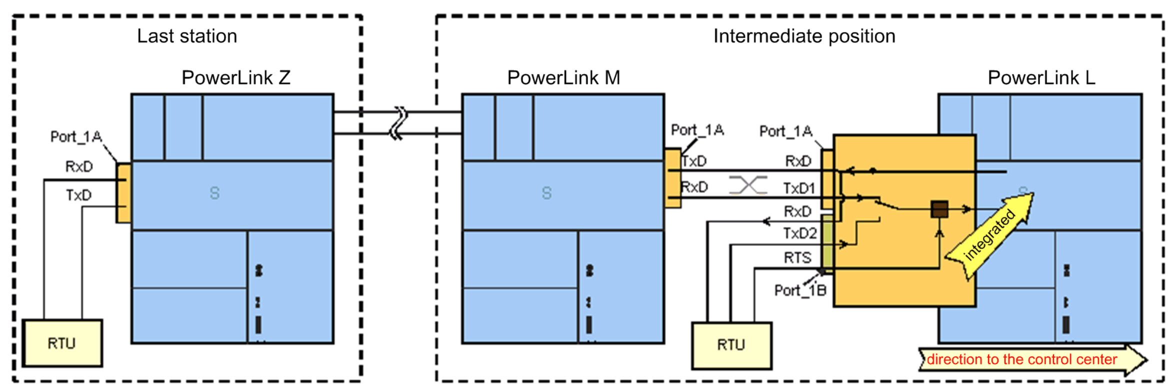
The following bitrates are possible:

- 50 bps up to 2400 bps when transmitting via the FSK channels
- 1.2 Kbps up to 19.2 Kbps when transmitting via the internal multiplexer iMUX and the Data Pump
- 1.2 Kbps up to 115.2 Kbps when transmitting in configuration with vMUX and the Data Pump

2.2.7.2 RS232 Splitter

The RS232-1A up to -4A resp. RS232-1B up to -4B interfaces of the PowerLink system provide an **RS232 splitter**.

The splitter is used in the polling mode of RTU (remote terminal unit) via integrated FSK channels resp. iMUX and integrated Data Pump of the PowerLink equipment in order to connect a requested RTU **in the direction to the telecontrol center**. The principle is shown in the following figure:



[dw_prturs-021214, 1, en_US]

Figure 2-22 Polling mode of RTU with PowerLink systems. e.g. via RS232_1

Intermediate station:

The polling messages coming from the telecontrol center (TCC) are connected from receiver output of the Port_1A from PowerLink L, to the transmitter input of the Port_1A from the PowerLink M, and parallel to the stations **RTU which is connected to the Port_1B**.

Response messages to the (TCC) from other RTUs are connected from the receiver output of the Port_1A from PowerLink M to the transmitter input of the Port_1A from PowerLink L.

A message addressed to the stations RTU is recognized with the corresponding station address. At first the **RTS** (request to sent) signal has to be activated in order to transmit the response messages to the TCC. This causes a switchover from **TxD1of the Port_1A** to the **TxD2 of the Port_1B**.

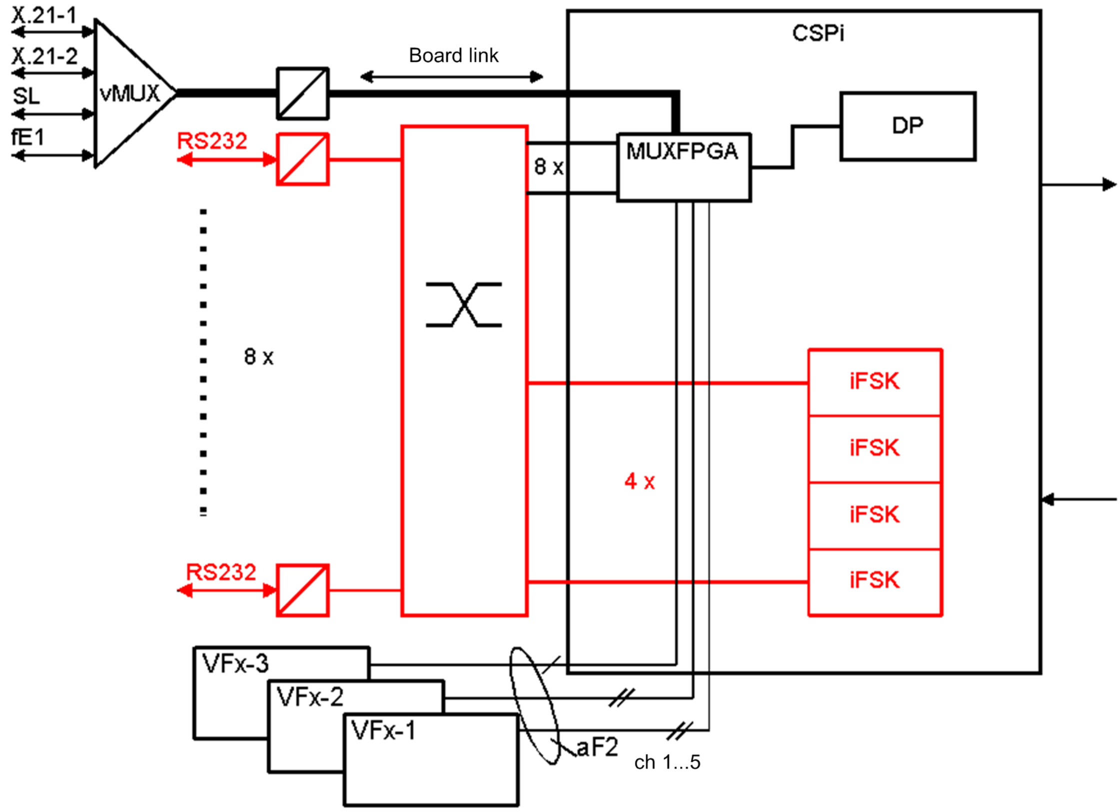
The RTU deactivates the own RTS signal after it has completed the response messages. This establishes the „normal“ connection between the Port_1A interfaces again and allows the through connection of the response messages from the other stations to the TCC.

Last station:

In the last station (PowerLink Z) the RTU is direct connected to the Port_1A interface because a switchover for transmission of response messages is not necessary.

2.2.7.3 Transparent Data Transmission via iFSK

In the PowerLink system up to 4 integrated FSK channels (iFSK) are available. They have to be located in 1 or 2 frequency bands. The bands are adjustable in the range from 300 Hz up to 3840 Hz. The connection to the iFSK channels is carried out via the interfaces RS232-1A up to RS232-4A resp. B on the PowerLink connector panel.



[dw_tddifsk-021214, 1, en_US]

Figure 2-23 Transparent data transmission via up to 4 iFSK channels

The required bandwidth for the iFSK channels results from the baud rate.

Table 2-7 Definition of the iFSK baud rates

No.	System	Nominal Baud rate	max. Baud rate	Grid distance Hz	Bandwidth Hz	FM deviation Hz	Nominalchannel level dBr
1	FM 120 *)	50	85	120	100	± 30	-22.5
2	FM 240 *)	100	170	240	200	± 60	-19.5
3	FM 480 *)	200	340	480	400	± 120	-16.5
4	50 Bd NB	50	60	90	75	± 22.5	-24.5
5	100 Bd NB	100	120	180	150	± 45	-21.5
6	200 Bd NB	200	240	360	300	± 90	-18.5
7	600 Bd	600	880	1140	1000	± 200	-13.5
8	1200 Bd	1200	1300	1710	1440	± 400	-10.5
9	2400 Bd	2400	2500	3400	2720	± 800	-7.5

*) The systems FM 120, FM 240 and FM 480 comply with the ITU-T requirements R35, R37, R38A and R38B concerning the transmission rate, bandwidth, transmit level, frequency deviation etc.

The center frequency of each iFSK channel is determined from the system. The frequency deviation as well as the channel level depends on the adjusted bit rate and is also calculated from the system. This makes sure, that the channels do not overlap and the grid distance is observed.

The send levels for the different systems are determined automatically from the PowerLink equipment and adjusted accordingly.

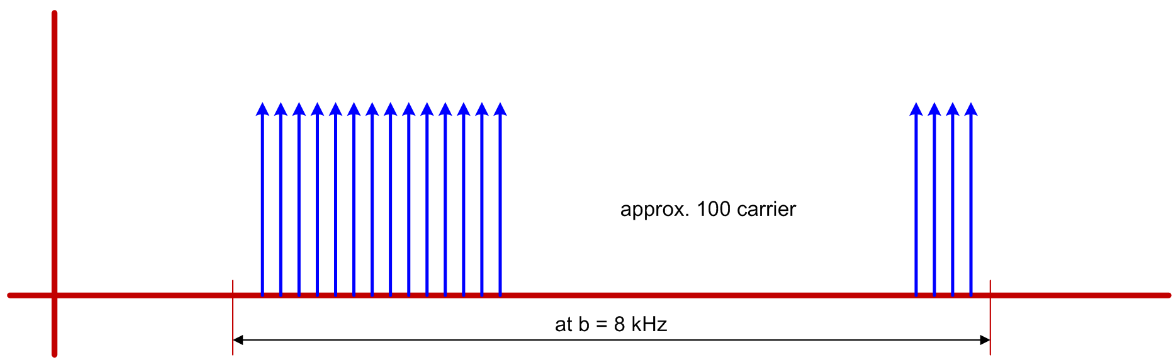
2.2.8 The Function Data Pump

2.2.8.1 Overview

The Data Pump function allows a fast and transparent data transmission up to max. 320 Kbps via power lines.

2.2.8.2 Modulation Method

For the modulation the multicarrier method is used. The information which has to be transmitted is divided in blocks (with approx. 700 bit). Then the information of 1 block is distributed to many single carriers. Each carrier is QAM modulated.



[dw_lompofdp-021214, 1, en_US]

Figure 2-24 The modulation principle of the Data Pump

The following sync modes are available:

Adapted

This is a connection between the 2 Data Pumps with the best adaptation to the transmission path. The latency (data throughput delay) of the Data Pump is for example 80 ms in case of 7.5-kHz bandwidth (see also chapter *technical data*) and the sync time in this case is approximately 10 s.

Dynamic

In this sync mode a primary and a secondary bit rate can be adjusted. In normal case the Data Pump is working always with the "primary" bit rate. The secondary bit rate is used as fallback-bit rate for adverse weather conditions. The latency (data throughput delay) of the Data Pump is for example 80 ms in case of 7.5-kHz bandwidth (see also chapter *technical data*) and the sync time in this case is approximately 10 s.

The dynamic mode offers a higher availability than the adapted mode!

2.2.8.3 Data Pump Latency

The data transmission time of the Data Pump (latency) depends on the selected Data Pump bandwidth.

Table 2-8 Data Pump latency

Data Pump bandwidth	Data Pump latency
31 500 Hz, 23 500 Hz, 15 500 Hz, 11 500 Hz	40 ms
7500 Hz, 7200 Hz, 7000 Hz, 6500 Hz	80 ms
5500 Hz, 5000 Hz, 4700 Hz, 4500 Hz	120 ms
4000 Hz, 3700 Hz, 3500 Hz	160 ms

2.2.8.4 The Information Density

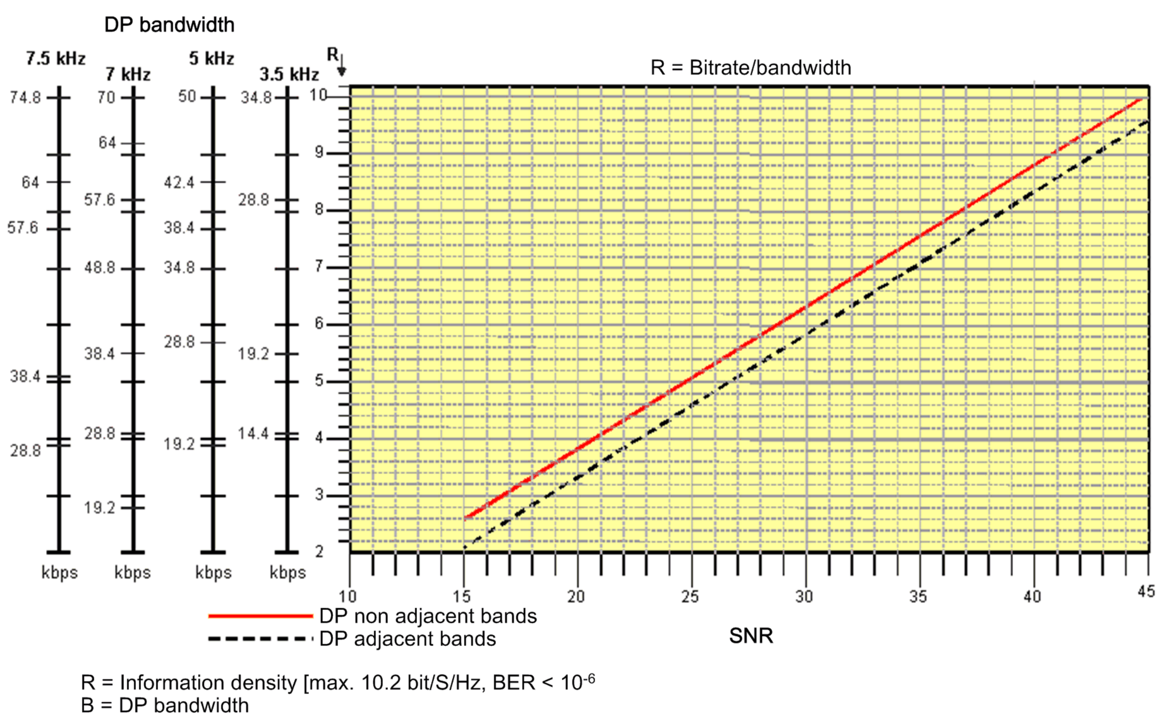
Unit of Measurement:

The performance of a data transmission via analog lines is measured with the information density, showing the bit rate via the bandwidth. The unit of measurement is bit/s/Hz. For PowerLink the highest possible information density is 10.2 bit/sec./Hz.

2.2.8.5 Coherence Bit Rate – SNR

Between the max. attainable transmission rate and the signal-to-noise ratio for instance, an approximately linear connection exists. From the information density R (bit/s/Hz), multiplied by the used PLC bandwidth, the rate of the Data Pump in Bit/s results. The SNR depends on many factors of uncertainty such as line, weather etc..

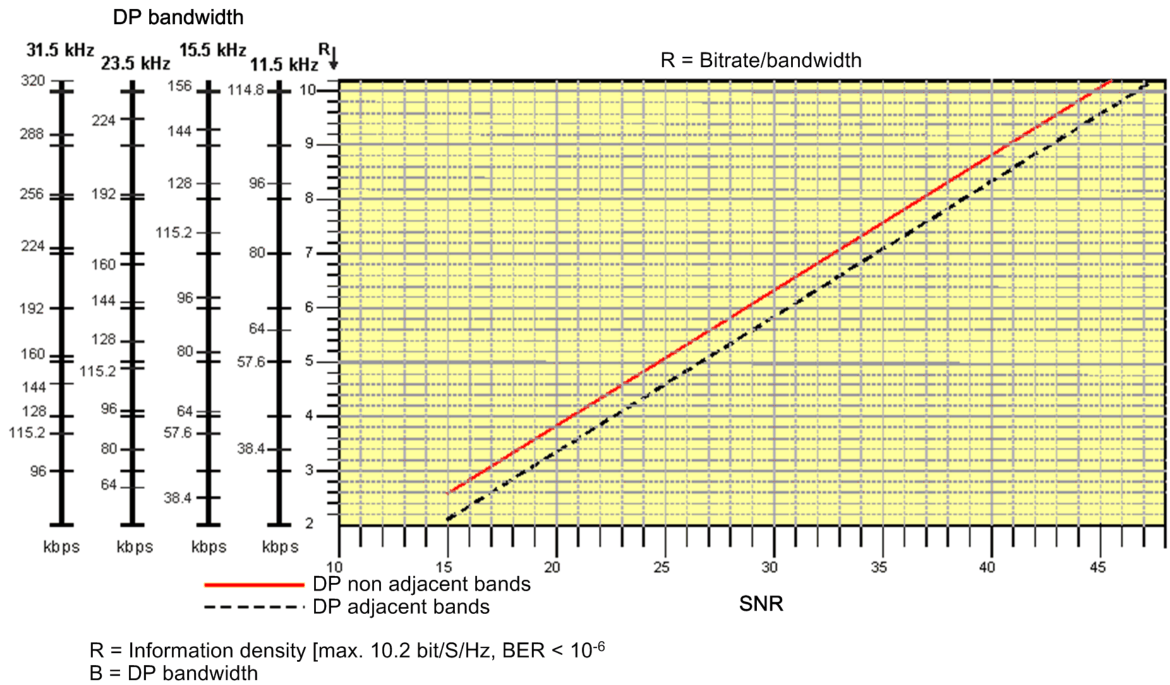
For the DP bandwidths 5 kHz resp. 3.5 kHz and 7 kHz resp. 7.5 kHz the bit rate can be read off directly in the following diagram.



[dw_dpfldp-021214, 1, en_US]

Figure 2-25 Derivation of the DP bit rate from the lower DP bandwidth and the information density

For the DP bandwidths 11.5 kHz, 15.5 kHz, 23.5 kHz, and 31.5 kHz the bit rate can be read off directly in the following diagram.



[dw_dpfhdp-021214, 1, en_US]

Figure 2-26 Derivation of the DP bit rate from the higher DP bandwidth and the information density

2.2.8.6 Supervision of the Transmission Line

Each transmission error is recognized in the Data Pump as a block error. The block error rate is supervised continuously serving the criteria for restart with regard to:

- A number of continuous following errored blocks. This is recognized as loss of the transmission channel and a restart is executed. The adjustment is made in the menu <**DP**>/<**Alarm**> **Block error sequence**
- The increase of block error rate without attention of impulse noise. A restart is executed. The adjustment is made in the menu <**DP**>/<**Alarm**> **Block window size** and **Threshold**. The number of blocks which have to be supervised is adjusted with "Block window size" and the number of errored blocks per window with "Threshold". If the threshold is exceeded **in 3 successive windows** a restart is executed.

Example:

Block error sequence = 100

More than **100 blocks defective in sequence** (short disturbers) will cause a Restart. The duration of a block depends on the bandwidth of the DP (15 ms for 7.5 + 8 kHz; 22.5 ms for 5 kHz). A new synchronization is carried out after 100* 15 ms (in case of 8-kHz bandwidth), that means after a disturbance from 1.5-s duration.

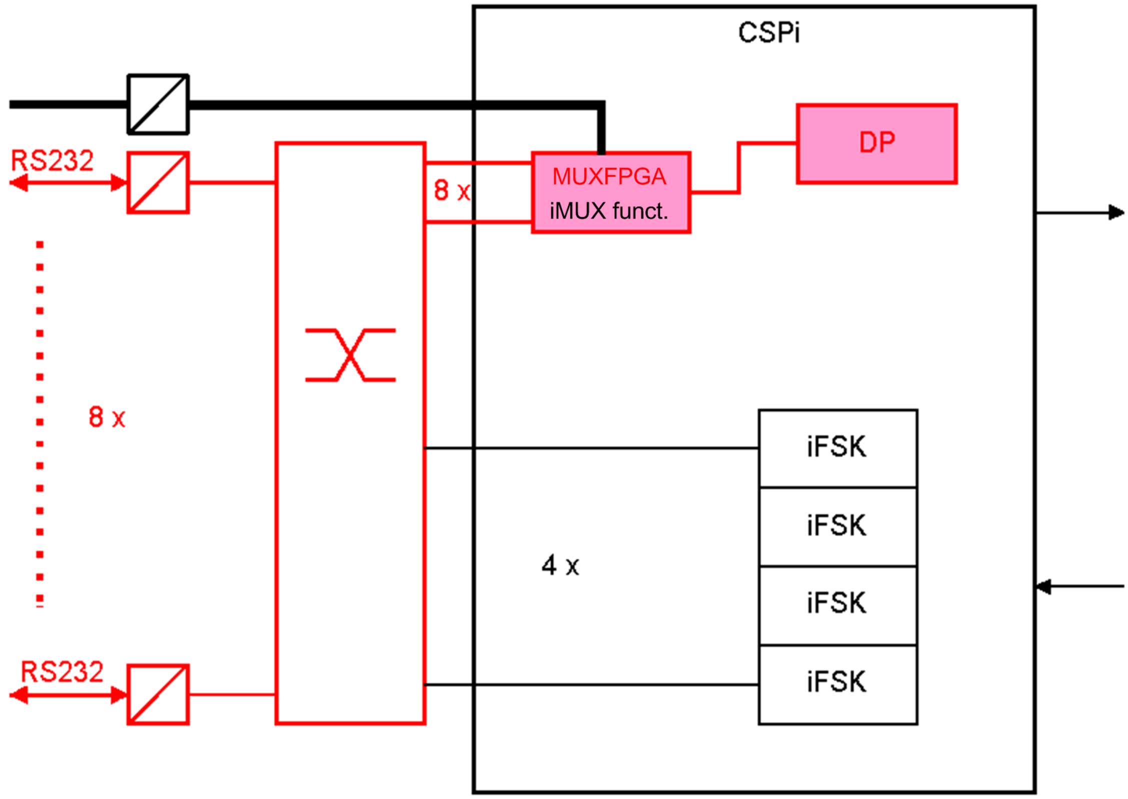
1.5 s is the maximum bypass time for a disturbance. Higher values for the block error sequence are not sensible. Normally the restart is already carried out due to the second criterion:

Block window size = 50 Threshold = 30

With this adjustment 50 blocks are permanent supervised. If more than 30 of the 50 blocks mentioned before are faulty in 3 successive windows in any sequence (ratio 90 : 150 = 0.6) a new start is carried out. The ratio between block error rate and bit error rate is about 100 : 1. The threshold for the new start corresponds to a bit error rate of 0.6 / 100 = 6 * 10^{-3}.

2.2.8.7 Asynchronous Data Transmission via iMUX

With the function Data Pump it is possible to transmit up to 8 asynchronous data channels (RS232-1 up to RS232-8) via the multiplexer iMUX which is integrated in the PowerLink.



[dw_adcmul_imux-021214, 1, en_US]

Figure 2-27 Transmission of asynchronous data channels via iMUX

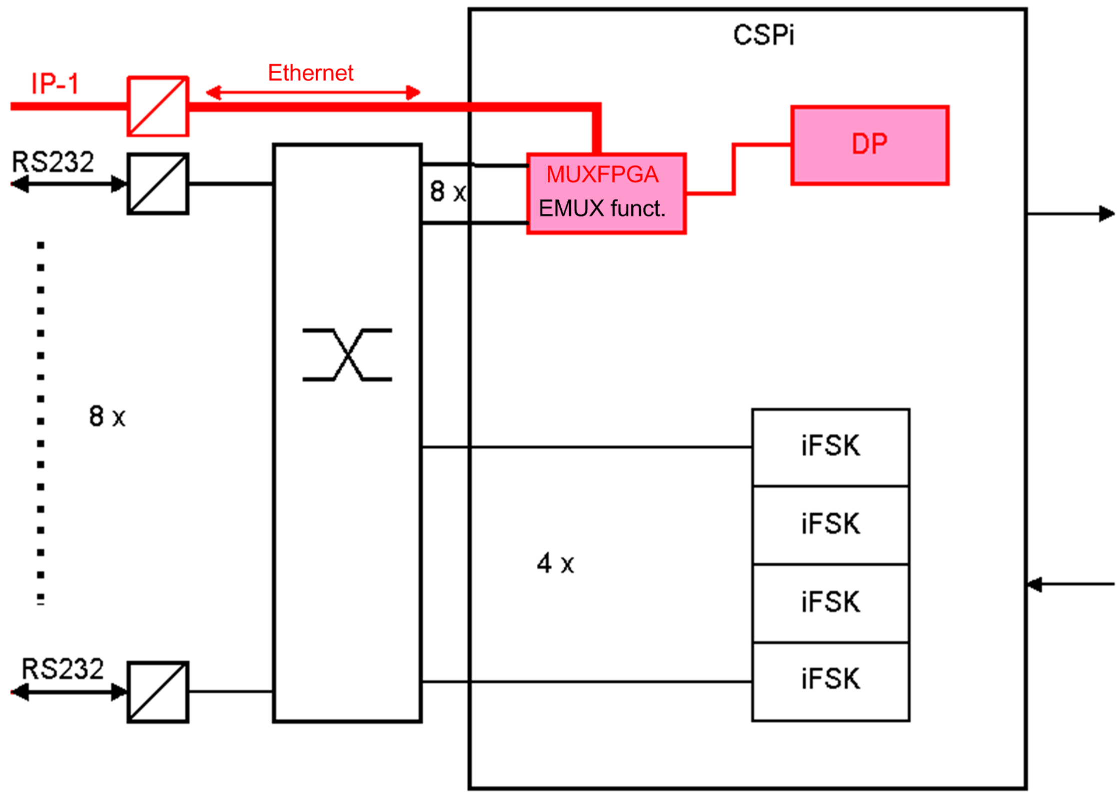
The iMUX is a statistical multiplexer with 4 resp. 8 inputs and priority management. The ports RS232-1 up to 4 are always transmitted (the aggregated bit rate of the DP may not be exceeded). The bitrates assigned to the ports 5 to 8 will be transmitted, if the transmission capacity is available. Therefore these interfaces operate with handshake signals RTS/CTS.

Each channel can be adjusted to 1200, 2400, 4800, 9600 resp. 19 200 bps. The transmission capacity is up to 76.8 Kbps. The supported UART modes are:

7N1, 7N2, 7E1, 7E2, 7O1, 7O2, 8N1, 8N2, 8E1, 8E2, 8O1, 8O2 (data bits, parity, stop bits).

2.2.8.8 Asynchronous TCP/IP-DP Interface

The EMUX interface (IP-1) is used for connection to 10/100Base TCP/IP data. The value of the primary and the secondary transmission rate of the Ethernet only channel (EMUX) can be adjusted up to 320 Kbps. The transmission is carried out with the service Data Pump.



[dw_adtcml_emux-021214, 1, en_US]

Figure 2-28 Transmission of asynchronous TCP/IP data channels via EMUX

Header Compression

Enhancement with PowerSys ≥P3.5.131

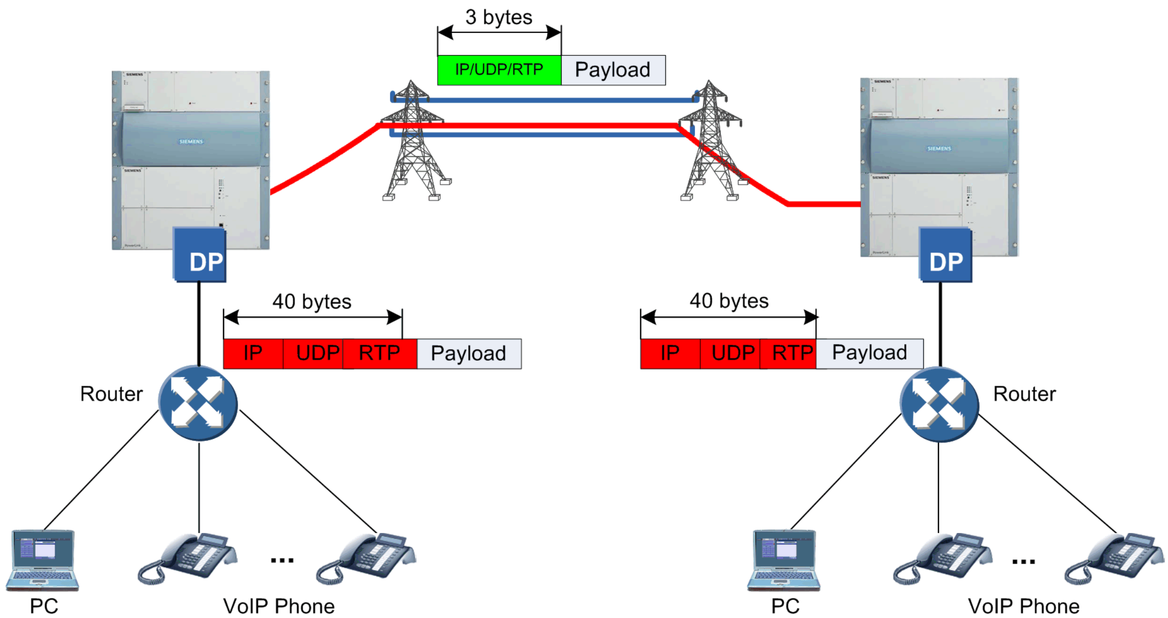
The PowerLink device provides an Ethernet channel, which can enable a whole range of IP applications such as VoIP, remote maintenance, and centralized monitoring. But with limited resources, the number of VoIP channels is restricted.

Header Compression is the process of compressing excess protocol headers before transmitting them on a link and decompressing them to their original state on reception.

PowerLink supports RFC1144 and RFC 3095 header compression standards:

- RFC3095: **Robust Header Compression** (ROHC) is a highly robust and an efficient header compression scheme for RTP/UDP/IP, UDP/IP, and ESP/IP headers.
- RFC1144: Header compression for low-speed serial links

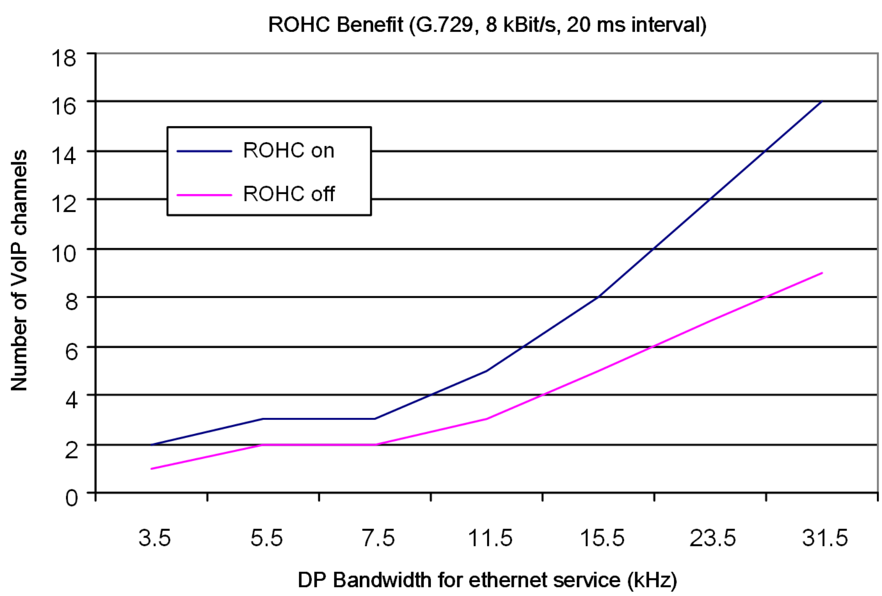
Generally, the VoIP (Voice over IP) payload of the IP packets has almost of the same size or even a smaller size than the header. Over the point-to-point connection, comprised of multiple hops, these protocol headers are important but over just one link. Under optimal conditions, on one side, a RTP/UDP/IP-header can be compressed from 40-bytes to approximatively 3-bytes, saving 37-bytes (see *Figure 2-29*) and providing more than 90 % savings in many cases in many cases **more than 90 % savings**. This compression makes also the saving of the bandwidth and the better use of the resource possible. On the other side, ROHC also provides other important benefits such as the reduction of packet losses and the improvement of the interactive response time.



[dw_rohcpo_051214, 1, en_US]

Figure 2-29 ROHC Compression and Decompression

Figure 2-30 shows the number of supported VoIP channels for the datapump in PowerLink when ROHC is enabled and disabled. It was tested with 8 Kbit/s VoIP codec (G.729) with 20-ms interval. Maximal 16 bidirectional VoIP channels can be supported when ROHC is enabled.



[dw_ROHC_benefit, 1, --_--]

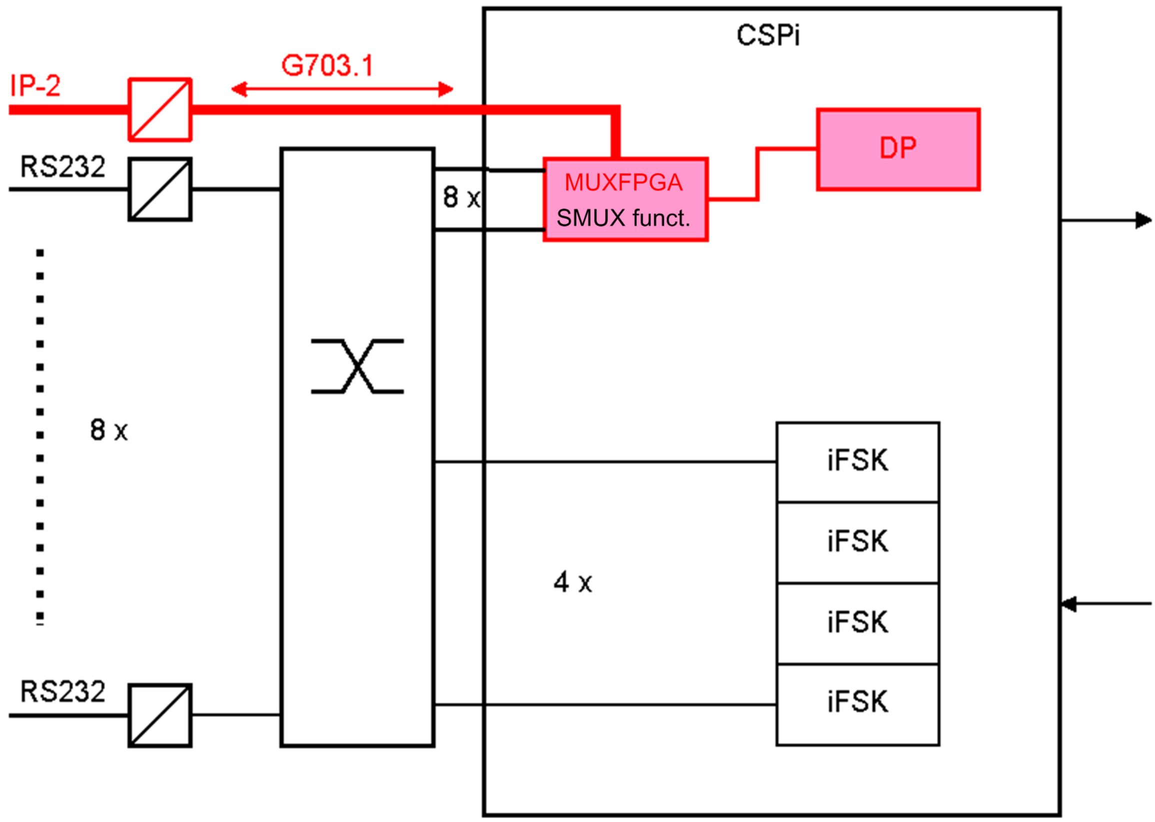
Figure 2-30 ROHC Benefit

NOTE

ROHC can be configured for the 10/100Base TCP/IP User Interface of EMUX and vMUX Data Pump Service.

2.2.8.9 Synchronous ITU-T G703.1-DP Interface

The interface IP-2 is used for connecting a synchronous ITU-T G703.1 interface which is normally working in the "co- directional clock timing" mode. The interface can be parameterized as clock master (DCE) or clock slave (DTE). When this interface is selected the bit rate is automatically fixed by the service program PowerSys to 64 Kbps The transmission is carried out with the service Data Pump.



[dw_fdemdp_smux-021214, 1, en_US]

Figure 2-31 Functional diagram for the connection of an external multiplexer to the G703.1-DP interface

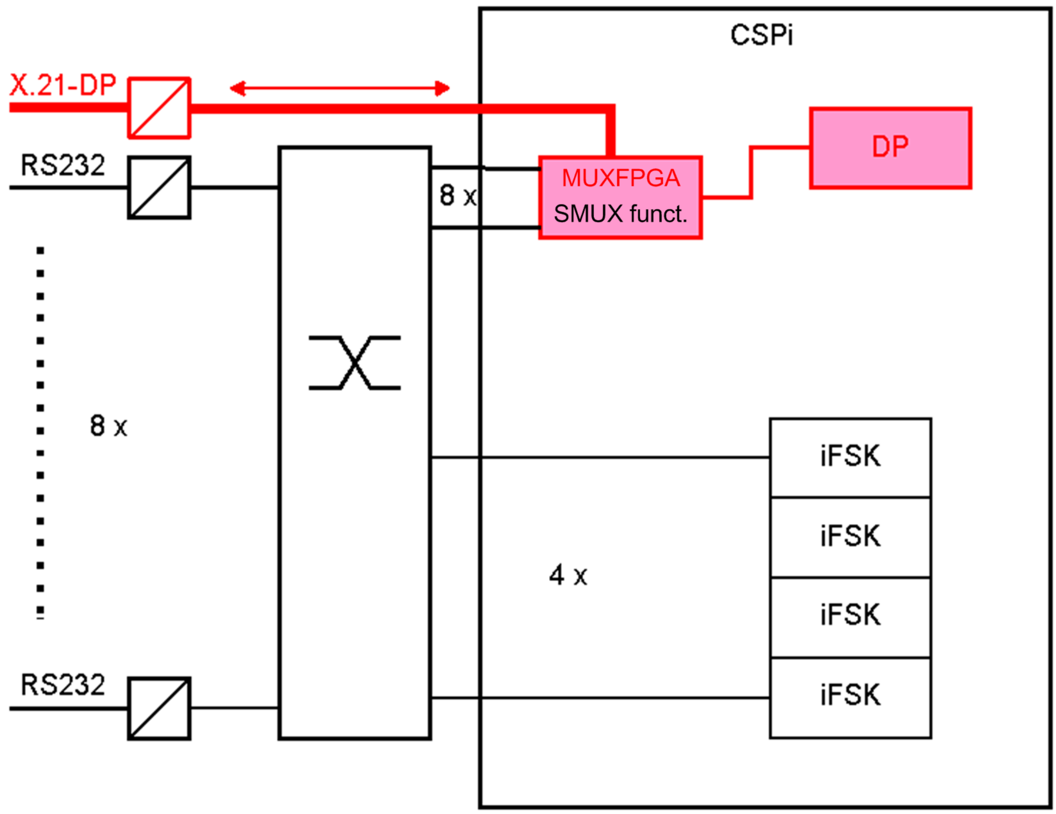
In this operation mode the iMUX resp. vMUX cannot be used.

NOTE

Using this interface is only possible in combination with adapted sync modes.

2.2.8.10 Synchronous X.21-DP Interface

The interface is used for connecting a synchronous X.21 interface. The interface can be parameterized as clock master (DCE) or clock slave (DTE). The bit rate is adjustable from 9.6 up to 64 Kbps in steps of 400 bps or in fixed settings to 80 Kbps, 96 Kbps, 128 Kbps, 144 Kbps, 160 Kbps, 192 Kbps, 224 Kbps, 256 Kbps, 288 Kbps, and 320 Kbps. The transmission is carried out with the service Data Pump.



[dw_fdemxd_smux-021214, 1, en_US]

Figure 2-32 Functional diagram for the connection of an external multiplexer to the X.21-DP interface

In this operation mode the iMUX resp. vMUX cannot be used.

NOTE

When the **DP** is adjusted to the **dynamic** sync mode, the connected **multiplexer** must be adapted to the primary resp. secondary transmission rate. Therefore the X.21-DP interface of the PowerLink has to be set to **DCE** mode.

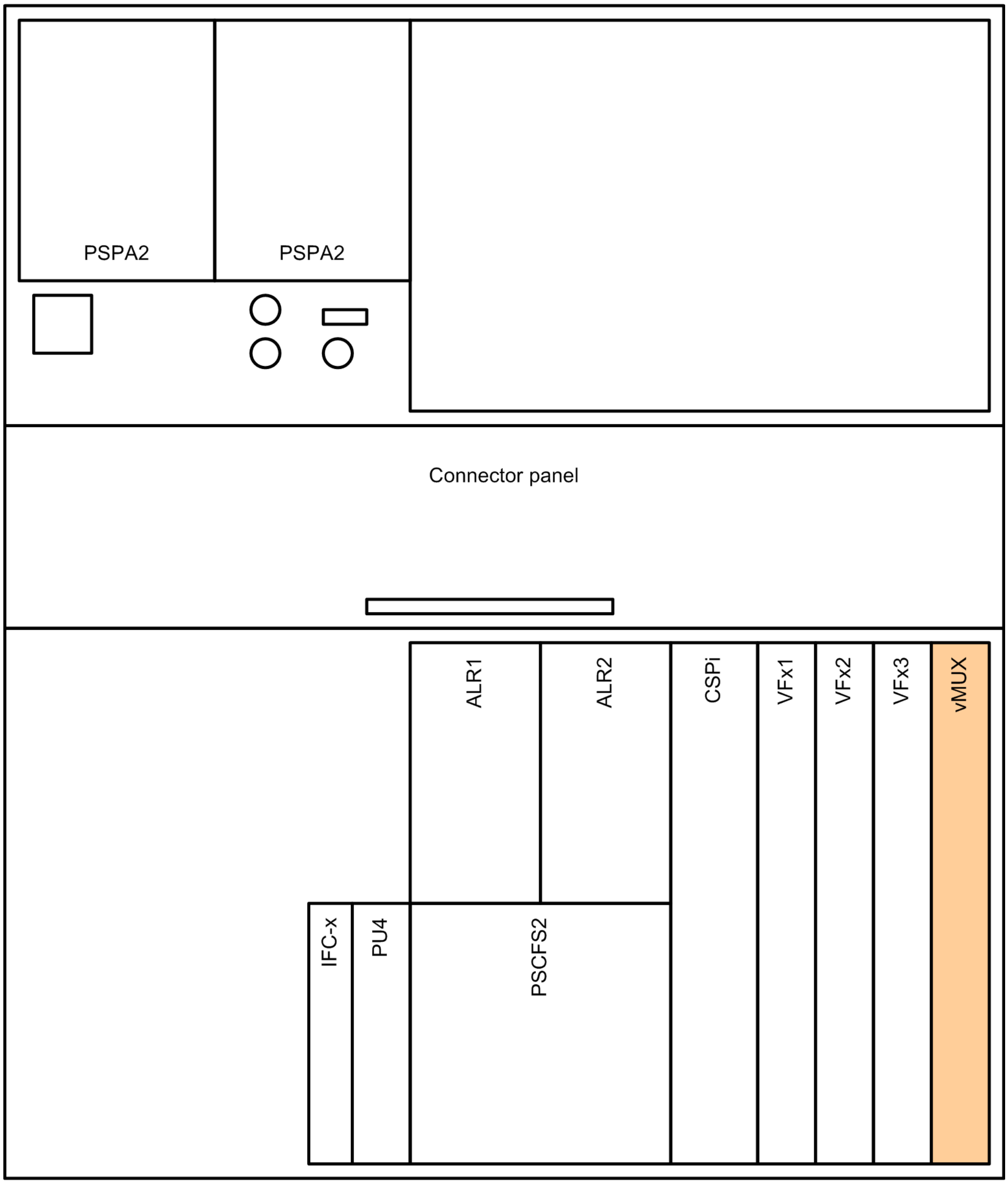
2.2.9 The Versatile Multiplexer vMUX

2.2.9.1 In General

The vMUX is an integrated statistical multiplexer in the PowerLink. It makes it possible for PowerLink to compress speech, process data services, multiplex speech and different data services and transmit them via PLC. The integration of these capabilities in PowerLink renders external multiplexers obsolete.

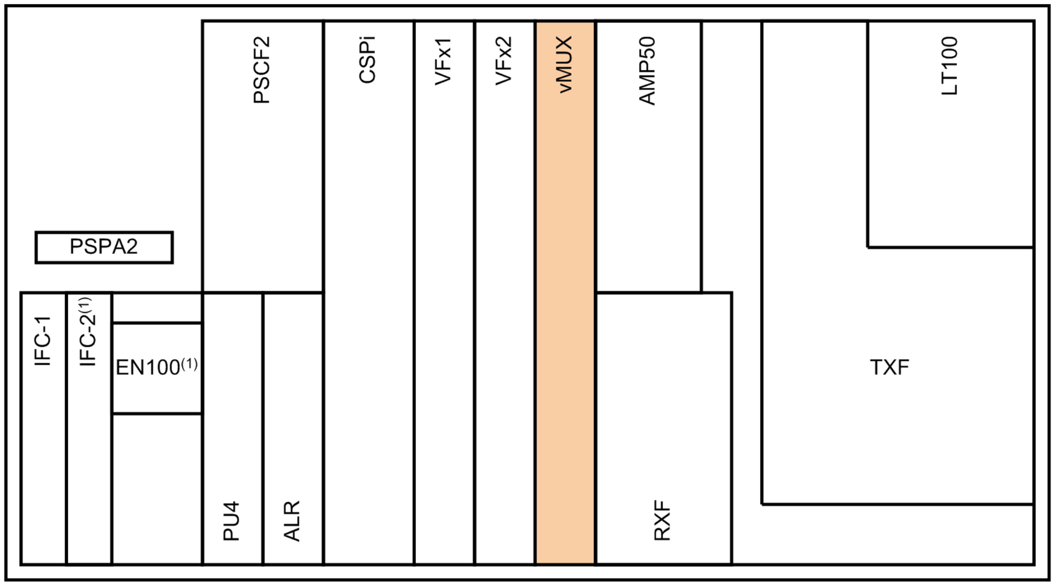
For the transmission via the high voltage line, the function Data Pump is used. In this case the X.21-DP and the G703.1 interfaces of the PowerLink are not available. Instead of that the synch. interfaces X.21-1 and X.21-2 are available for synchronous data transmission via the vMUX. Without the vMUX module, the PowerLink functionality and the user interfaces remain unchanged.

The vMUX is a separate module and located in the PowerLink carrier frequency section CFS-2. The CFS-2 backplane provides the necessary electrical and mechanical extensions.



[dw_lovmux_051214, 1, en_US]

Figure 2-33 Location of the vMUX in the PowerLink 100



[dw_powerlink50s_vMUX-231014, 1, --_--]

Figure 2-34 Location of the vMUX in the PowerLink 50

(1) IFC-2 or EN100

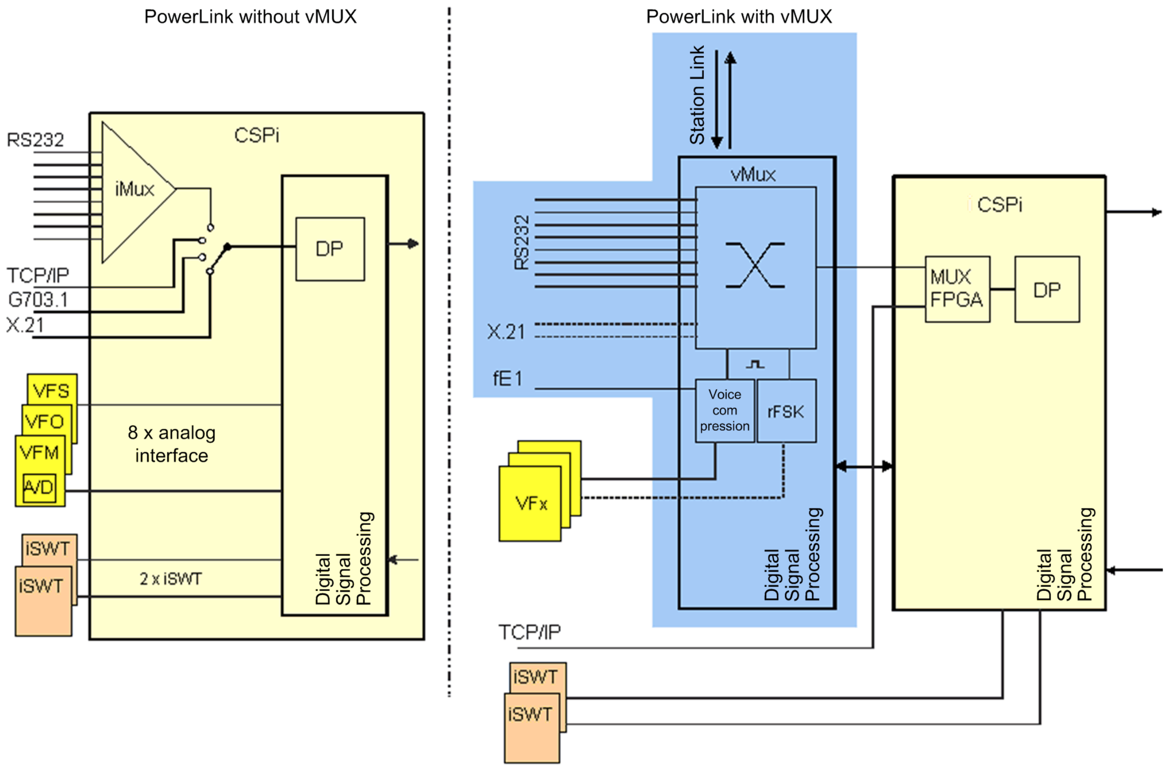
Features

The vMUX provides the following features:

- Transmission of up to 8 compressed voice channels
- Transmission of up to 8 asynchronous data channels (RS232)
- Transmission of up to 2 synchronous data channels (X.21)
- Mixed transmission of asynchronous and synchronous data channels
- Embedded switching matrix for data channels and compressed voice (StationLink)
- Transmission of up to 2 analog FSK channels in digital mode (reverse FSK, rFSK)
- Transmission of Ethernet channel

All other analog services like voice (F2), data (F3), protection signal transmission (F6) as well as iFSK remain unchanged but the following restrictions have to be observed:

- In case a VF-x port is used for the transmission via vMUX, it cannot be used for an analog service and vice versa.
- **When the vMUX is used, the X.21-DP interface is not available but the interfaces X.21-1 and X.21-2 can be operated**. (vMUX may not be mounted if X.21-DP is used.)
- **When the vMUX is mounted, the G703.1 interface is not available**. (vMUX may not be mounted if G703.1 is used.)

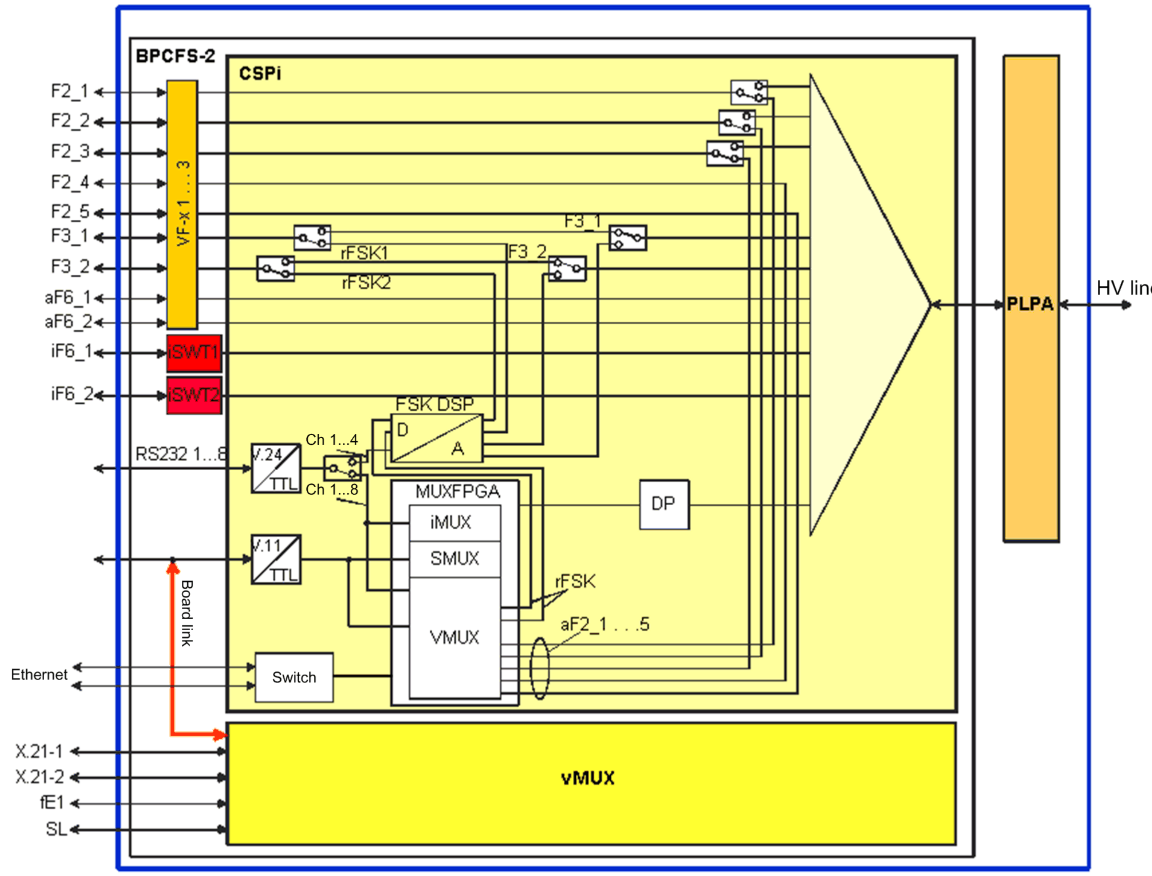


[dw_plvmul-021214, 1, en_US]

Figure 2-35 The PowerLink 100 without and with vMUX, Example

2.2.9.2 Structure of the PowerLink with vMUX

The structure of the PowerLink system with vMUX is shown in the figure below:



[dw_plwvmu-081214, 1, en_US]

Figure 2-36 PowerLink 100 system with vMUX, Example

CSPi	central signal processing	BPCFS-2	backplane carrier frequency section
F2_x	analog voice channel x	X.21-x	synchronous data interfaces
F3_x	analog data channel x	aF6_x	external protection signaling device x
iF6_x	integrated protection signaling device x	PLPA	PowerLink power amplifier
FSKDSP	FSK signal processor	aF2_1..5	analog voice channels 1 -5
rFSK	reverse FSK	SL	station link interface
fE1	fractional E1 interface		

2.2.9.3 User Interfaces

RS232 Interfaces

The connection of the data is carried out via SUB-D plug sockets on the PowerLink connector panel. The RS232 interfaces are located on the CSPi module. The data channels are routed to the vMUX via the board link. Max. 8 channels can be transmitted simultaneously.

Each channel can be adjusted to 1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6 resp. 115.2 Kbps.

The supported UART modes are: 7N1, 7N2, 7E1, 7E2, 7O1, 7O2, 8N1, 8N2, 8E1, 8E2, 8O1 resp. 8O2 (data bits, parity, stop bits).

Synchronous User Interfaces X.21-x

The synchronous data interfaces X.21-1 and X.21-2 are located on the vMUX module. The connection of the data channels is carried out via 15-pin SUB-D plug sockets on the PowerLink connector panel. Data rates from 9600 bps up to 192 000 bps can be transmitted.

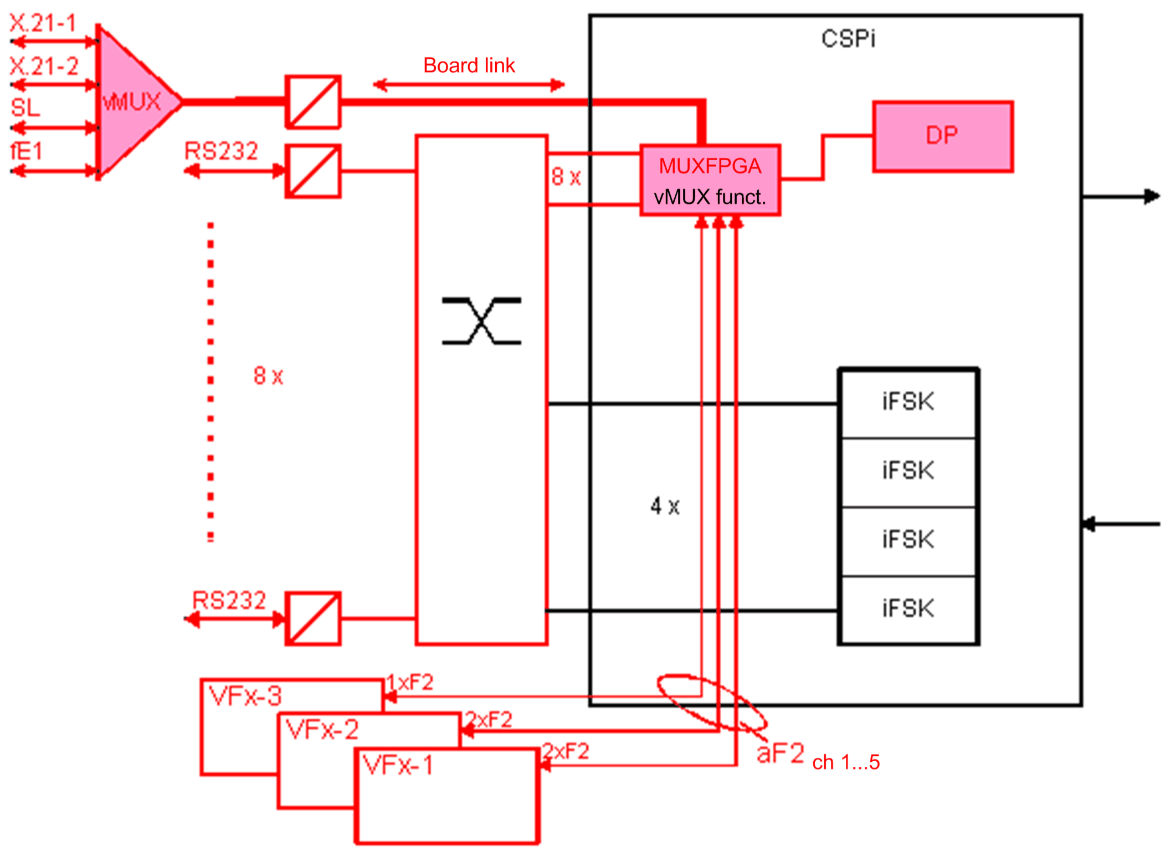
10/100Base TCP/IP User Interfaces

The 10/100 Base TCP/IP data interfaces are located on the CSPi module. The connection of the data channels is carried out via RJ45 plug socket (IP-1) on the PowerLink connector panel and via an optical module (SFP) located on the module CSPi.

Analog Voice Channels

A total number of 5 analog voice channels can be transmitted with the vMUX.

The interfaces for the analog voice channels are located on the VFx modules in the slot positions VFx-1 up to VFx-3. The voice channels are routed to the vMUX via the board link. The connection of the voice channels is carried out via SUB-D plug sockets on the PowerLink connector panel. Via the modules in slot position 1 and 2 respectively 2 voice channels and via the module in slot position 3, one voice channel can be connected.



[dw_fd-vmux-funct-021214, 1, en_US]

Figure 2-37 Functional diagram for the vMUX with voice and data transmission

X.21-x	synchronous data
RS232	asynchronous data
SL	StationLink
aF2ch1 . . 5	analog voice channels via VFx modules
VFx-1-3	VFx modules in slot pos. 1 – 3 (VFx = VFM; VFS or VFO)
fE1	fractional E1

Digital Voice Channels fE1

With the function fractional E1 it is possible, to transmit up to 8 digital voice channels from a 2 Mbps E1 signal. The channels are connected to the FE1 interface on the PowerLink 50/100 connector panel. The interface can be configured in NT (Network terminal) and in TE (Terminal equipment) mode. The default configuration is the NT mode, and in such a case a direct cable can be used to connect the PBX to the FE1 interface. If the interface is configured as TE, an NT system will be connected to the PowerLink with a **crossed** cable.

Dynamic Voice Groups

This is a group of configured channels (connected terminals/telephones), that are being transmitted through some common PowerLink channel. If no channel is active, nothing is being sent. If there is only 1 configured PowerLink voice channel and is being used, a second telephone of the same voice group would get the busy tone if it tries to make a call.

Voice Activity Detection

To reduce the required bit rate during the idle state of the voice channel, the voice channel can be monitored by the voice activity detection. A reduction of approximately 75 % can be reached during voice inactivity (idle state). vMUX can use this bit rate for transmitting RS232 best effort channels or the TCP/IP channel.

2.2.9.4 rFSK Channels

The rFSK channels are converting analog FSK data channels into digital signals. The connection of the data channels is carried out via the ports 2, 3 or 4 of the VFx modules using the SUB-D plug sockets on the PowerLink connector panel. The data channels are routed to the vMUX via the FSKDSP on the CSPi module and the board link. 1 rFSK channel occupies up to 2 iFSK channels. The corresponding RS232 inputs for the iFSK channels are disabled in this case.

The data rate of the rFSK channels is adjustable to 50, 100, 200, 300, 600, 1200 and 2400 bps. The data rate 300 bps is only adjustable with UART mode.

NOTE

For more details of the PowerLink connector panel and the pin assignment of the connectors refer to Chapter *Installation*.

Supported rFSK Systems with UART Mode

Table 2-9 Supported rFSK systems with UART mode

rFSK Systems with UART Mode		
Frequency range	**Frequency shift**	**System/Baudrate**
0.3 kHz to 3.8 kHz	±22.5 Hz	50 Bd NB
	±30 Hz	50 Bd FM120
	±45 Hz	100 Bd NB
	±60 Hz	100 Bd FM240
	±90 Hz	200 Bd NB
	±120 Hz	200 Bd FM480
	±200 Hz	300 Bd
	±200 Hz	600 Bd
	±400 Hz	1200 Bd
	±800 Hz	2400 Bd

The following UART modes are supported: 7N1, 7N2, 7E1, 7E2, 7O1, 7O2, 8N1, 8N2, 8E1, 8E2, 8O1, 8O2 (data bits, Parity, Stop bits).

Transmission of rFSK Channels in Transparent Mode

Table 2-10 rFSK channels with unknown (transparent) mode

rFSK Systems with unknown (transparent) Mode			
Frequency range	Frequency shift	Nom. Baud rate	Max.
0.3 kHz to 3.8 kHz	±22.5 Hz	50 Bd	60 Bd
	±30 Hz	50 Bd	85 Bd
	±45 Hz	100 Bd	120 Bd
	±60 Hz	100 Bd	180 Bd
	±90 Hz	200 Bd	240 Bd
	±120 Hz	200 Bd	340 Bd
	±200 Hz	600 Bd	600 Bd
	±400 Hz	1200 Bd	1200 Bd
	±800 Hz	2400 Bd	2400 Bd

When the transmission mode of the rFSK channels is not known, the channels are transmitted in the transparent mode with oversampling. The oversampling bit rate depends on the required distortion.

Table 2-11 Configuration of oversampling bit rate

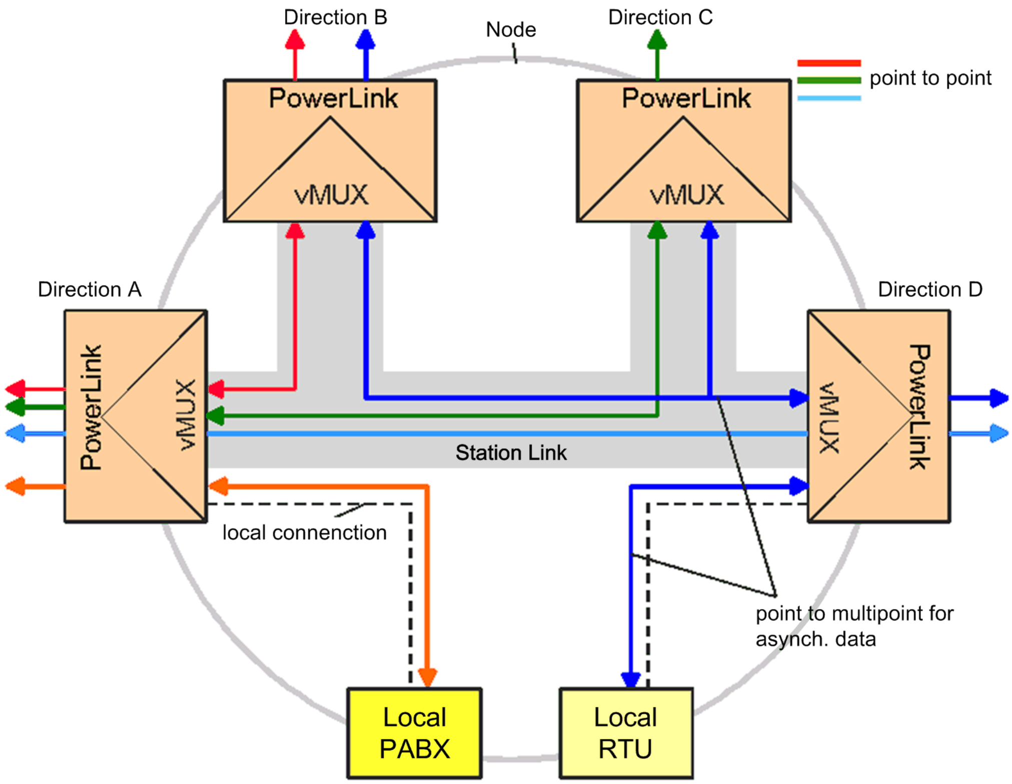
Maximum distortion	Oversampling bit rate
Up to 25.0 %	4 x rFSK channel baud rate
Up to 12.5 %	8 x rFSK channel baud rate
Up to 6.25 %	16 x rFSK channel baud rate

2.2.9.5 The StationLink (SL)

The station link SL is a 2 wire bus system. It provides the routing of vMUX voice and data channels between max. 4 PowerLink 50/100 in 1 substation each with up to 16 user channels.

Features:

- Bus interface for catenation of up to 4 PowerLink 50/100 systems on a multi-repeater station.
- Interconnection of compressed voice channels without decompression over several PLC hops.
- Forwarding of data channels point-to-point
- Point-to-multipoint connection for asynchronous data (multicast mode)



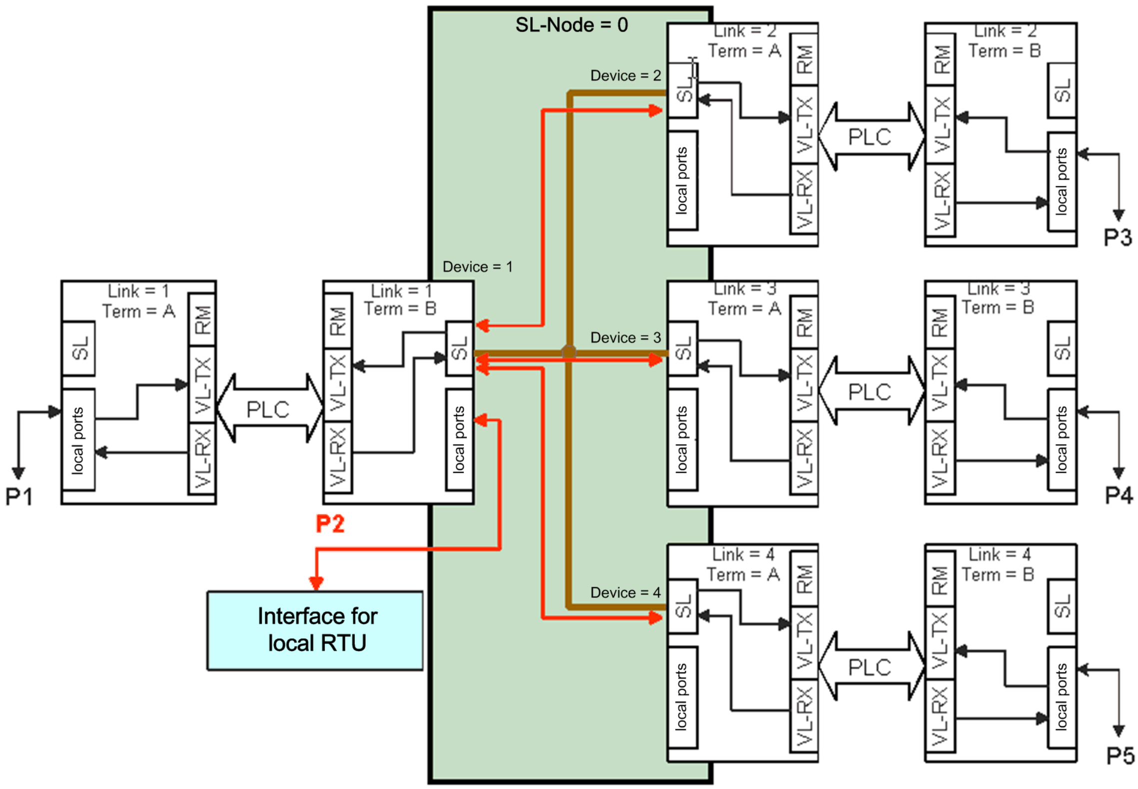
[dw_exslpl-081214, 1, en_US]

Figure 2-38 Example of a station link with 4 PowerLink systems

Multicast Function via StationLink

Multicast for vMUX over SL means, that an RTU message is not only sent to 1 SL target but to all which are selected. Normally in RTU mode there is a multiplexing between a local port and 1 SL port. If multicast is enabled, all SL targets are possible.

With multicast function via StationLink, asynchronous data from 1 source can be transmitted to up to 3 destination directions and to local port.



[dw_dexofmf-081214, 1, en_US]

Figure 2-39 Example of a multicast function

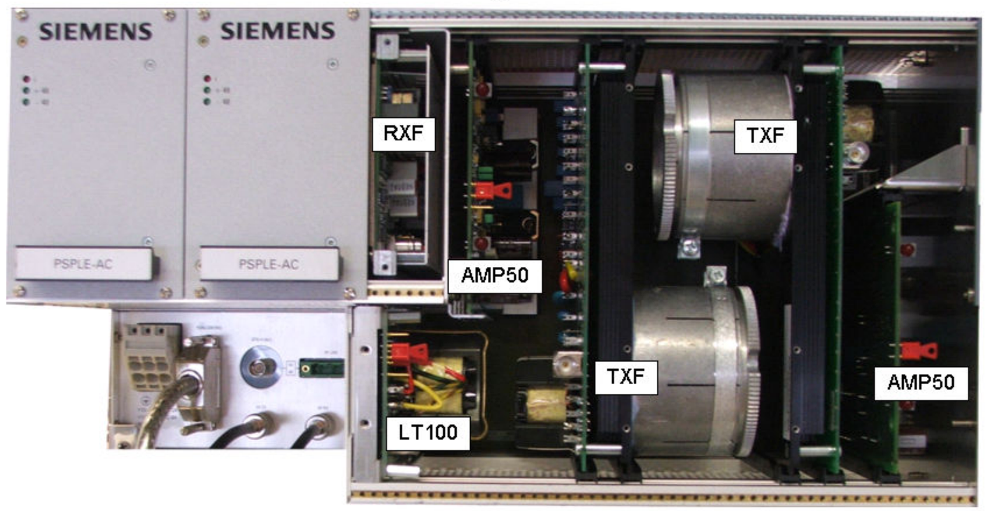
In the figure above, StationLink device 1 is set to multicast to all other StationLink members. That means all data sent to local port P2 are also sent to all SL members (device 2, device 3, device 4). In the opposite direction, the StationLink receives all incoming data from all StationLink members and multiplex it with local port P2 (initiator). The definition of RTU (polling mode) prevents collisions.

2.2.10 PowerLink 100 - The PLPA Section

2.2.10.1 Structural Design

The PowerLink 100 can be equiped with the following PLPA sections:

- PLPA 50
  The PLPA 50 section consists of a single-tier (5 units) module frame, and contains the power supply PSPA2 (PSPA2 is the successor of PSPLE shown in the picture), the power amplifier AMP50, line filter TXF, line transformer unit LT100 and the RXF receiver module.
- PLPA 100
  The PLPA 100 section contains 2 power supplies supply PSPA2 (PSPA2 is the successor of PSPLE shown in the picture), 2 power amplifier AMP50, 2 line filter TXF, 1 line transformer unit LT100 and the RXF receiver module.



[scsdplpa-231110-01.tif, 1, en_US]

Figure 2-40 Structural design of the 100 W PLPA module frame

The AMP50 printed-circuit board with the amplifier circuit, the TXF printed-circuit boards with filter capacitors CB and the tuning coil, the LT100 printed-circuit board with the line adapter and the coil of the line filter are fitted in this frame. The modules can be removed for jumper settings.

The measuring socket and connecting sockets are located on the bottom left corner of the PLPA module frame. The PLPA module frame is mounted above the section CFS-2.

NOTE

For carrier frequencies in the range from 24 kHz to 500 kHz and 500 kHz to 1000 kHz different modules have to be used like shown in the table below:

Table 2-12 Module versions for the PLPA section

Carrier Frequency range [kHz]	Amplifier type	TX Filter	Line transformer	Receiver
24 to 500	AMP50–**LB** C53207-A367-B210 4	TXF1-**LB** C53207-A367-B230 2	LT100-**LB** C53207-A367-B240 2	RXF-**LB** C53207-A367-B220 2
500 to 1000	AMP50-**HB** C53207-A367-B211 4	TXF1-**HB** C53207-A367-B231 2	LT100-**HB** C53207-A367-B241 2	RXF-**HB** C53207-A367-B221 2

For more details refer to Chapter *Commissioning*. The following description applies to the low band and high band versions of the modules. Therefore the module names are extended with XB.

2.2.10.2 The Power Supply PSPA2

The power supply PSPA2 is available in DC and AC versions.

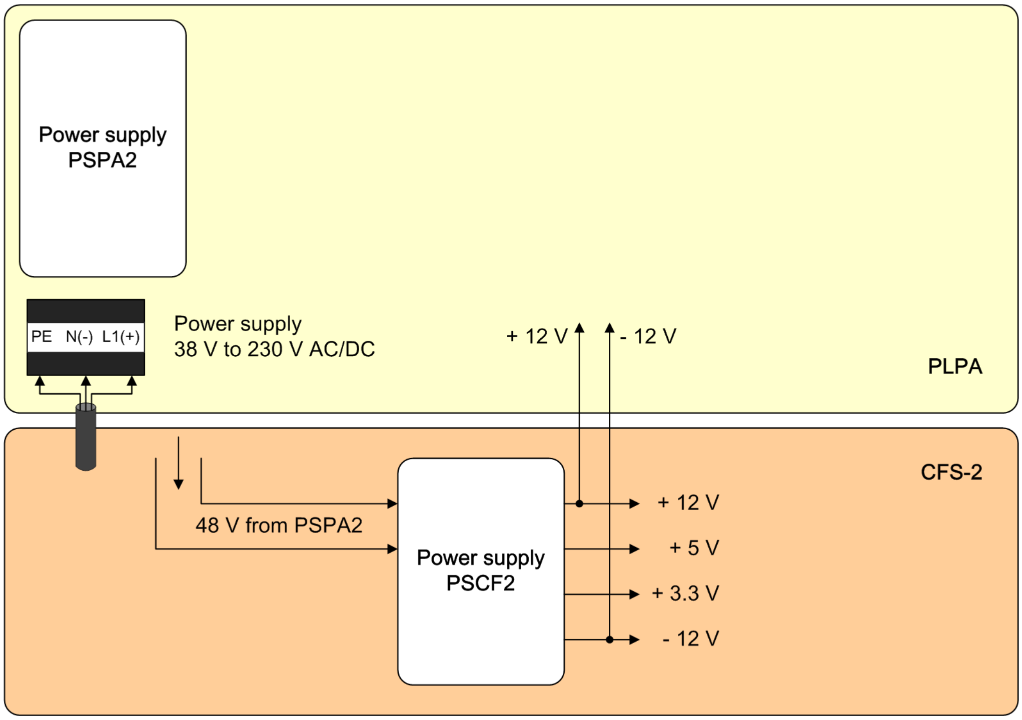
Table 2-13 PSPA2 versions

PSPA2 version	Input voltage
PSPA2-DC	DC 38 V to 72 V
PSPA2-AC	AC 93 V to 264 V (47 Hz to 63 Hz) DC 88 V to 264 V

Each power amplifier has its own power supply. The first power supply feeds the power supply in the carrier frequency section (PSCFS) as well. The connection is carried out via the **PLPA control cable**.

Interconnection of the Power Supplies PowerLink 100

The principle of the voltage distribution in the PowerLink 100 system is shown in the figure below.



[dw_dicpspl-150914, 1, en_US]

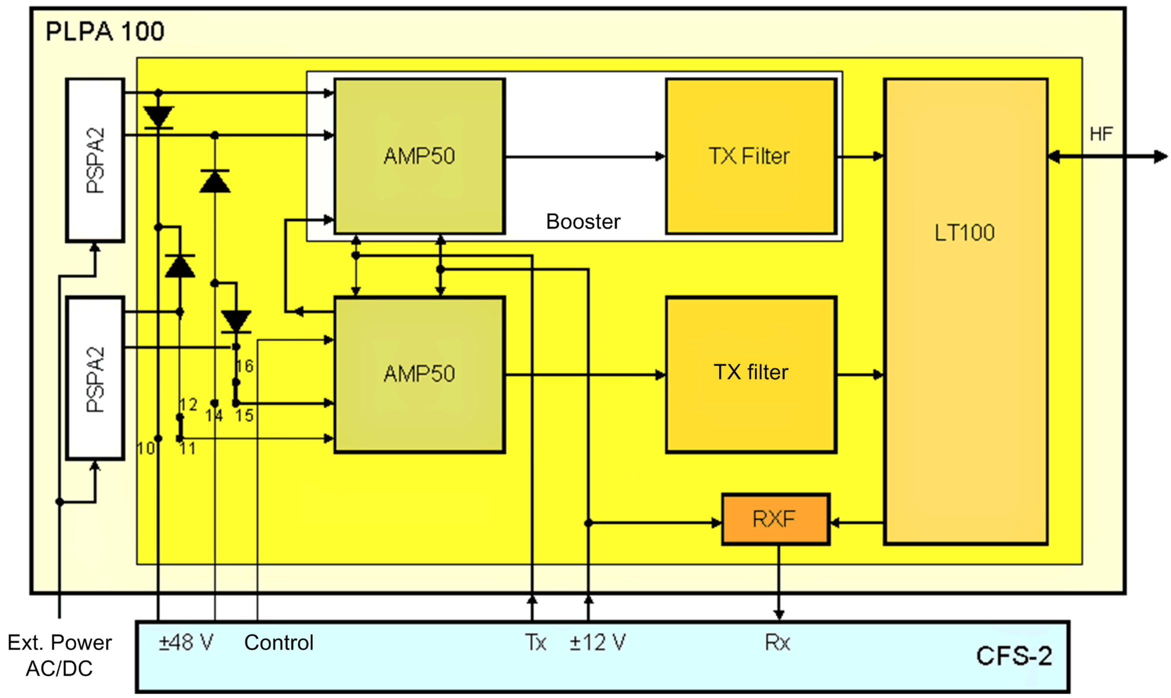
Figure 2-41 Interconnection of the power supplies in the PowerLink system

Enable/disable of the power supply is carried out with the switch S1 on the CSPi module. The switch is behind the front cover and controls the PSPA2 via an inhibit conductor (in the PLPA control connection cable).

NOTE

When the PSPA2 is disabled and the external supply voltage is connected the red LED “i” (inhibited) lights up.

2.2.10.3 PLPA Block Diagram



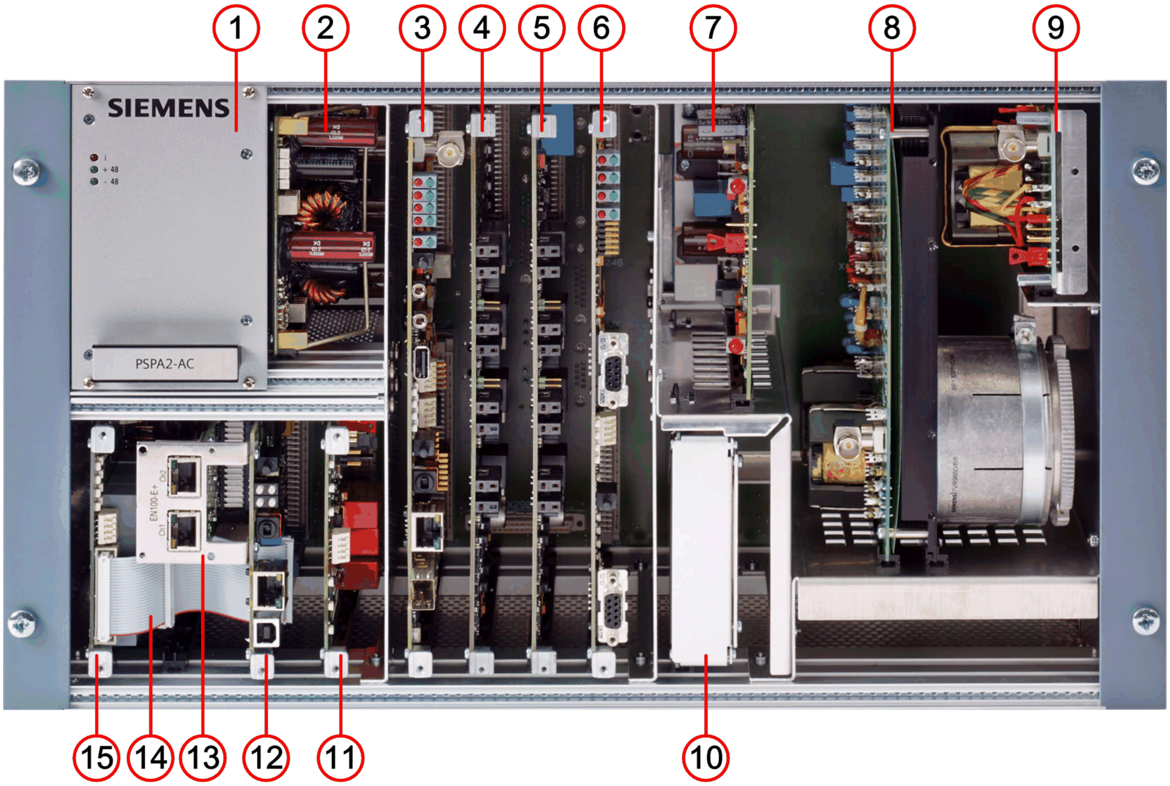
[dw_desplpa-120814, 1, en_US]

Figure 2-42 Electrical structure of a PLPA 100

2.2.11 PowerLink 50 - The PLPA Section

2.2.11.1 Structural Design

The PLPA 50 section contains one power supply PSPA2, one power amplifier AMP50, one line filter TXF, one line transformer unit LT100 and the RXF receiver module.



[dw_powerlink50s_Front-off-legende, 1, --_--]

Figure 2-43 Structural design of ther PowerLink 50 module frame

(1) PSPA2
(2) PSCF2
(3) CSPi
(4) VFX1
(5) VFX2
(6) VMUX
(7) AMP50
(8) TXF
(9) LT100
(10) RXF
(11) ALR
(12) PU4 (iSWT3000)
(13) EN100
(14) IFC2
(15) IFC1

The AMP50 printed-circuit board with the amplifier circuit, the TXF printed-circuit boards with filter capacitors CB and the tuning coil, the LT100 printed-circuit board with the line adapter and the coil of the line filter are fitted in this frame. The module can be removed for jumper settings.

The measuring socket and connecting sockets are located on the rear side of the device.

NOTE

For carrier frequencies in the range from 24 kHz to 500 kHz and 500 kHz to 1000 kHz different modules have to be used as shown in the table below:

Table 2-14 Module versions for the PLPA section

Carrier Frequency range [kHz]	Amplifier type	TX Filter	Line transformer	Receiver
24 to 500	AMP50–**LB** C53207-A367-B210 4	TXF1-**LB** C53207-A367-B230 2	LT100-**LB** C53207-A367-B240 2	RXF-**LB** C53207-A367-B220 2
500 to 1000	AMP50-**HB** C53207-A367-B211 4	TXF1-**HB** C53207-A367-B231 2	LT100-**HB** C53207-A367-B241 2	RXF-**HB** C53207-A367-B221 2

For more details refer to Chapter *Commissioning*. The following description applies to the low band and high band versions of the modules. Therefore the module names are extended with XB.

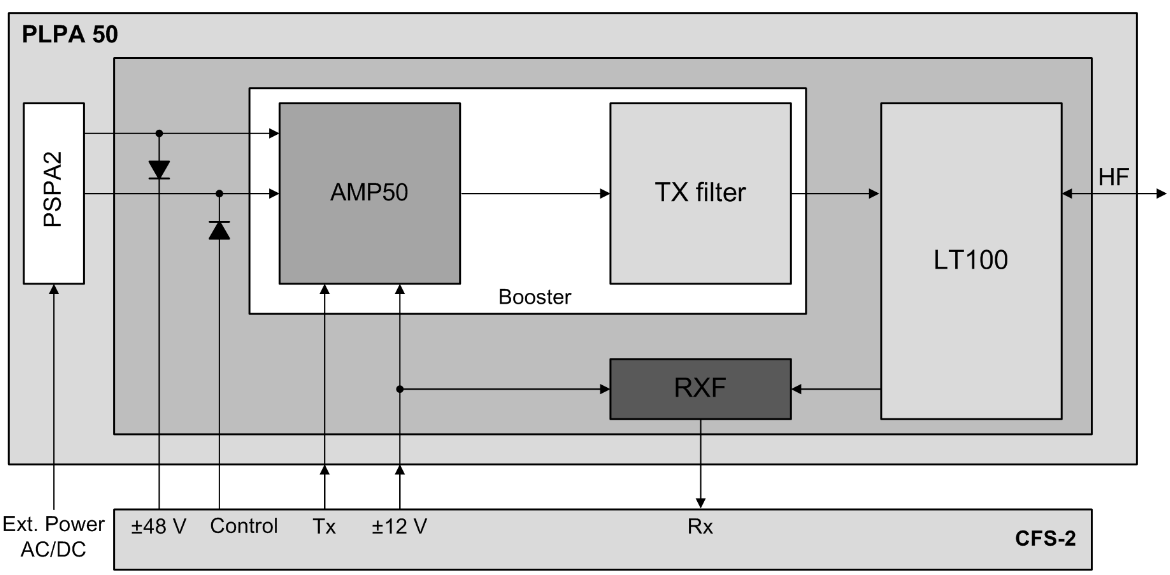
The power supply PSPA2 is available in DC and AC versions.

Table 2-15 PSPA2 versions

PSPA2 version	Input voltage
PSPA2-DC	DC 38 V to 72 V
PSPA2-AC	AC 93 V to 264 V (47 Hz to 63 Hz) DC 88 V to 264 V

2.2.11.2 PLPA Block Diagram

PLPA Block Diagram



[dw_pl50-struc-plpa_091214, 1, en_US]

Figure 2-44 PowerLink 50 - Electrical structure of a PLPA

2.2.12 Amplifier, Transmission Line Filter, Line Matching Module, Receive Module

2.2.12.1 Functional Description of the Amplifier

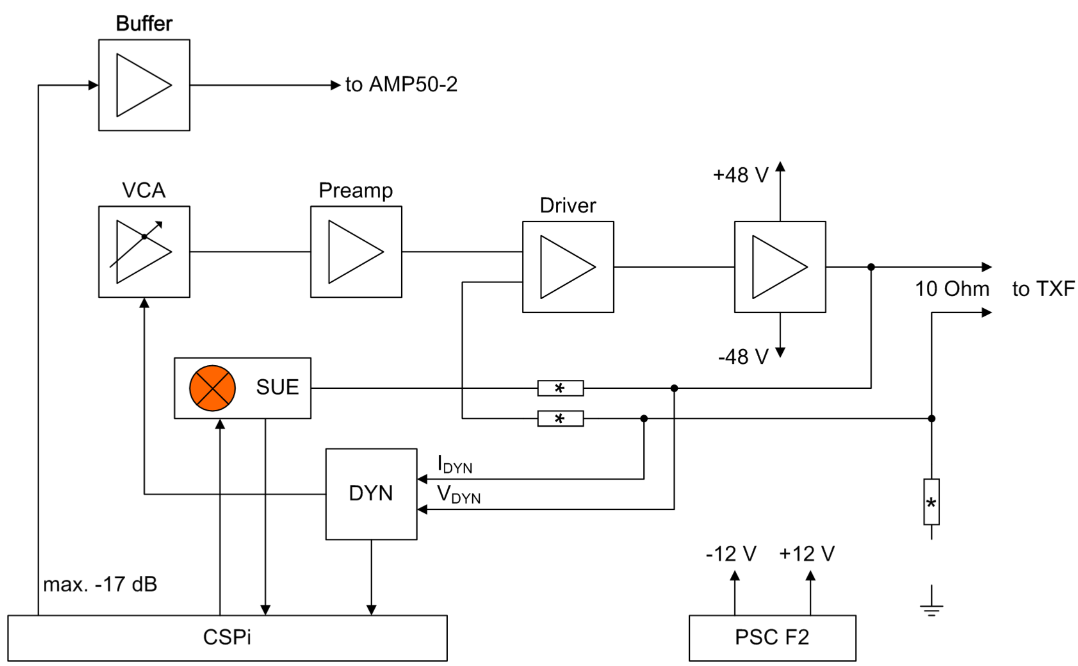
HF_Tx signals: The HF signal from the CSPi module enters the power amplifier via the HF-TX connector. The input signal is first sent to 2 amplifier components. 1 component returns the signal to the X1 connector where it is available for operation with a second amplifier (for 100 Watt operation). The other component is a voltage-controlled amplifier (VCA) whose power is controlled by the dynamic control unit.

25 W / 50 W: At the subsequent pre-amplifier component, the rated power of 50 Watt can be changed to 25 Watt by means of a jumper.

Output stage: The amplified signal is connected to the transmission-line filter via the output transformer. The output transformer can be set to the specific in-put impedance of the band-pass filter with 5 kHz, 8 kHz, 12 kHz, 16 kHz, 24 kHz, 32 kHz bandwidth.

Switching operations in the high-voltage network, in addition to climatic conditions, can lead to an alteration of the impedance in the high-voltage line. This affects the output current and the output voltage of the amplifier adapted to the line.

Function: In order to prevent overdriving when the amplifier is driven to full output, the module contains a controller. At the amplifier output, the values of the voltage and current are fed to a section of the circuit where exceeding of the stipulated limit values is detected. In this case, a control loop is activated with the voltage controlled amplifier acting as the actuator in order to fix the output signal of the AMP50 amplifier at a permitted maximum value.



[dw_bdamp5-121214, 1, en_US]

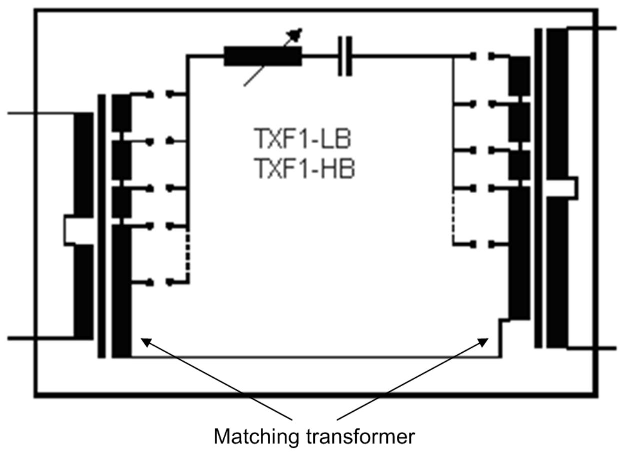
Figure 2-45 Block diagram of the AMP50 amplifier module

VCA	Voltage controlled amplifier
CSPi	Central Signal Processing unit

Transmitter monitoring: The transmitter monitor is used to monitor functioning of the amplifier. At the rated level of the amplifier, a voltage is produced at the monitoring output. This voltage is then fed to the CSPi module. There, the signal is monitored. If the voltage fails to reach the set threshold value, a transmitter alarm and general alarm on the ALR module are triggered by the CSPi. The CSPi also activates an alarm LED (red) on the PLPA via the transmit alarm line.

Voltage monitoring: In order to prevent destruction of the output stage if voltage supply is cut off, the latter is monitored. If the voltage drops a signal block ensures at the input of the amplifier by means of the VCA.

2.2.12.2 The TXF1-XB Transmission Line Filter (single circuit)



[dw_bdfior-161214, 1, en_US]

Figure 2-46 Block diagram of the first order transmission line filter TXF1-XB

AL-1-XB	adjustable coil
CB-1	capacitor bank

Function: The first order transmission line filter TXF1-XB is located between the amplifier output and the LT100-XB line transformer module. Its function is to protect the transmission amplifier against reverse activation by other transmitters on the same line and against dangerous line impulses.

Modules: The TXF1-XB consists of the CB tuning capacitors and 1 tunable coil. By setting the capacitor values with soldering straps (coarse tuning) and by adjusting the coil (fine-tuning), the filter can be tuned to all frequency slots of the PLC transmission range from 24 to 1000 kHz. For the fre-quency range 500 to 1000 kHz the high band version TXF1- HB has to be used.

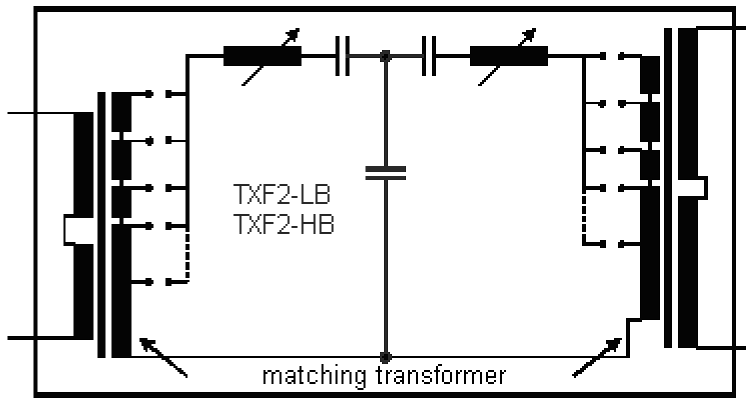
The transmission line filter TXF1-XB can be tuned to bandwidths 5 kHz, 8 kHz, 12 kHz and 16 kHz.

Outside the pass band, the impedance of the filter becomes high so that other terminals operating on the same line are practically load-free.

NOTE

For information on setting the capacitor values and the measuring setup for fine-tuning of the filter, see Chapter *Commissioning*.

2.2.12.3 The TXF2-XB Transmission Line Filter (dual circuit)



[lobdseor-040111-01.tif, 1, en_US]

Figure 2-47 Block diagram of the second order transmission line filter TXF2-XB

AL-1-XB	adjustable coil
CB-1	capacitor bank

Function: The second order transmission line filter TXF2-XB is located between the amplifier output and the LT100-XB line transformer module. Its function is to protect the transmission amplifier against reverse activation by other transmitters on the same line and against dangerous line impulses.

Modules: The TXF2-XB consists of 2 CB tuning capacitors and 2 tunable coils. By setting the capacitor values with soldering straps (coarse tuning) and by adjusting the coils (fine-tuning), the filter can be tuned to all frequency slots of the PLC transmission range from 24 to 1000 kHz. For the fre-quency range 500 kHz to 1000 kHz the high band version TXF2-HB has to be used.

The transmission line filter TXF2-XB can be tuned to bandwidths 24 kHz and 32 kHz.

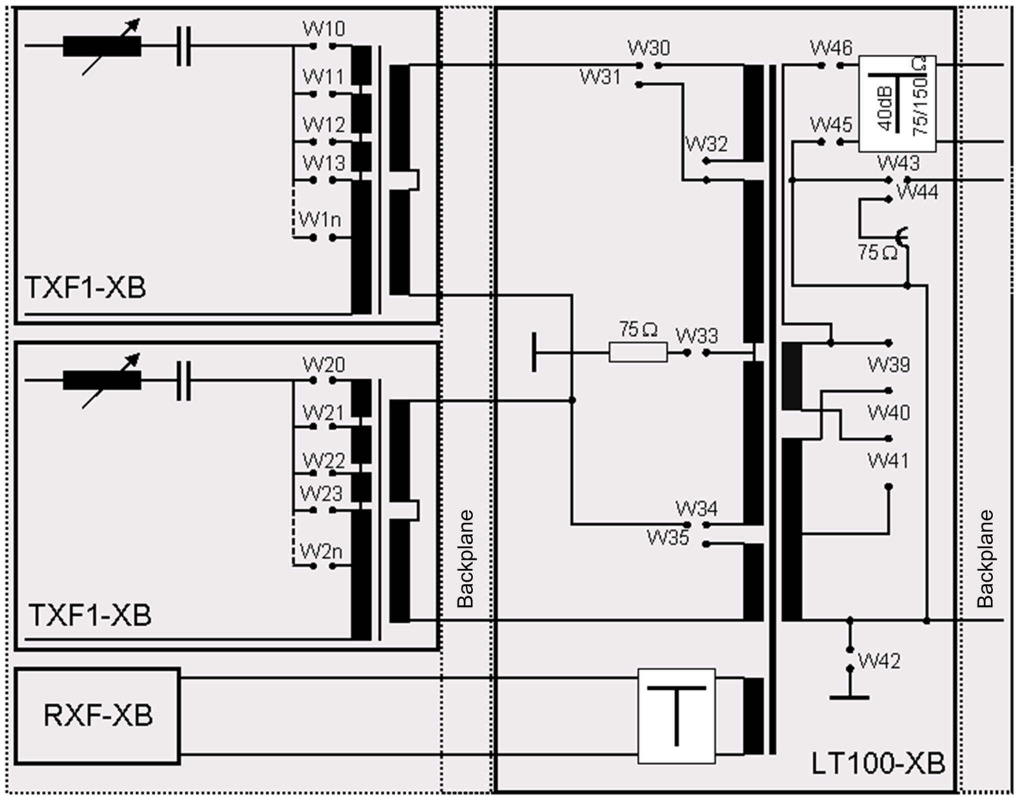
Outside the pass band, the impedance of the filter becomes high so that other terminals operating on the same line are practically load-free.

NOTE

For information on setting the capacitor values and the measuring setup for fine-tuning of the filter, see Chapter *Commissioning*.

2.2.12.4 The LT100-XB Line Matching Module

The following functional circuit diagram shows the paths of the send and receive signal through the LT100-XB:



[dw_fclt10-161214, 1, en_US]

Figure 2-48 Functional circuit diagram of the LT100-XB module

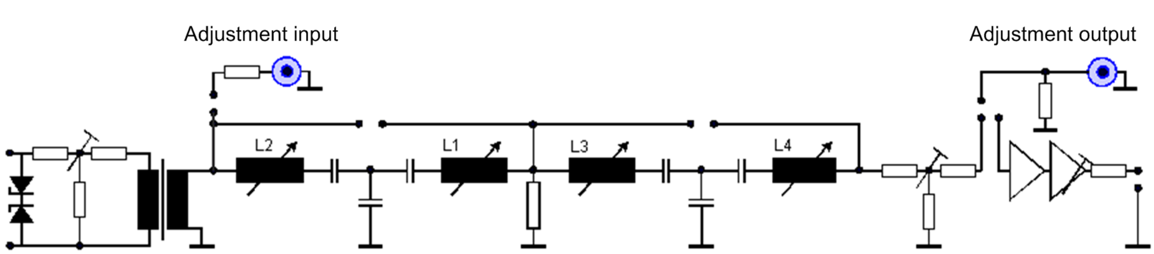
Structure of the LT100: The LT100-XB module basically consists of the line transformer, a filter transformer, a voltage divider for adapting the receiver (RXF-XB) and voltage dividers for safe measurement of the transmit signal.

Line transformer: The line transformer which adapts the unit to the 75 Ω or 150 Ω impedance of the transmission line can be used for connecting 2 line amplifiers (for doubling the transmission power).

For changing over to the many possible operating modes and different impedances, there are soldering straps and plug-in jumpers on the module. The positions of these jumpers are described in the section commissioning.

Structure: The RXF-XB receiver module contains an HF receive filter and an HF amplifier. A transformer at the input of the circuit ensures that the filter's impedance is adapted and that the filter circuits which are connected to ground by 1 pole are electrically isolated from the different ground voltages of the LT100-XB receiver output. Limiter diodes at the input of the circuit protect the receiver module against high-power pulse voltages from the transmission lines.

2.2.12.5 The RXF-XB Receiver Module



[dw_bdgrxf-161214, 1, en_US]

Figure 2-49 Block diagram of the receiver RXF

Structure:	The RXF-XB receiver module contains an HF receive filter and an HF amplifier. A transformer at the input of the circuit ensures that the filter's impedance is adapted and that the filter circuits which are connected to ground by 1 pole are electrically isolated from the different ground voltages of the LT100-XB receiver output. Limiter diodes at the input of the circuit protect the receiver module against high-power pulse voltages from the transmission lines.
Function:	Due to the connection method with a "high-resistance receiver input", the input is adapted in the receive frequency band to the impedance of the line. The HF receive filter selects the receive band.
Amplification:	The receive signal is not amplified until it has passed through the receive filter. The level of the receive signal is increased again in an amplifier.
Measuring sockets:	2 BNC measuring sockets are used for tuning the filter. For details refer to Chapter *Commissioning*.

2.3 Applications

2.3.1 Overview

PowerLink's high degree of flexibility becomes readily apparent when we take a closer look at each of its potential applications. No matter what tasks are assigned to the system: PowerLink's high quality and protective function are first-class in every case.

The PowerLink system permits carrier frequency transmission of speech, data, telecontrol, and teleprotection signals via high voltage overhead power lines and cables.

Carrier frequency equipment must match the particular characteristics of the high-voltage line. High interference levels over the transmission link and the high attenuation over longer transmission routes require particularly powerful transmission. The requirements for reliability and availability are especially high in relation to the transmission of protection signals. For the most efficient utilization of the available frequency range, a high degree of selectivity is necessary.

In opposition to other PLC systems, there is no hardware provided transmission channel allocation. For the different applications like voice, data or protection signal transmission the equipment can be extended by integrating modules for connecting a modem or external teleprotection as well as for various telephony duties.

With the Remote Monitoring function "RM", device data can be requested with the service PC between 1 or several PLC-links.

2.3.2 PowerLink for Telecontrol Transmission

RTU – remote terminal unit polling is, together with protection signal transmission, still a core requirement and use case for PowerLink. This is why RTU polling is available in many different ways. Typically, a number of RTUs are spread over several substations and connected in a daisy chain to a centralized power system control center (SCADA). PowerLink can be applied in analog mode via FSK channels or in digital mode via the implemented data pump to transmit RTU information. Even "old" RTUs with a VF modem can be connected directly to PowerLink. Our integrated multiplexer and the StationLink function offer pointto- point and point-to-multipoint operation for remote terminal units.

The following figures show examples for the different connection.

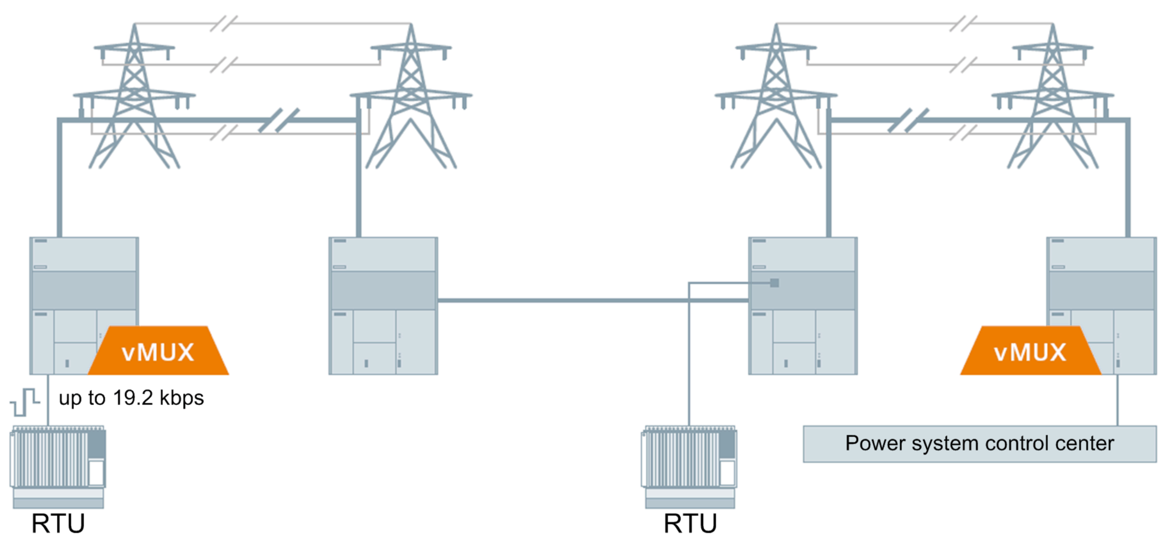


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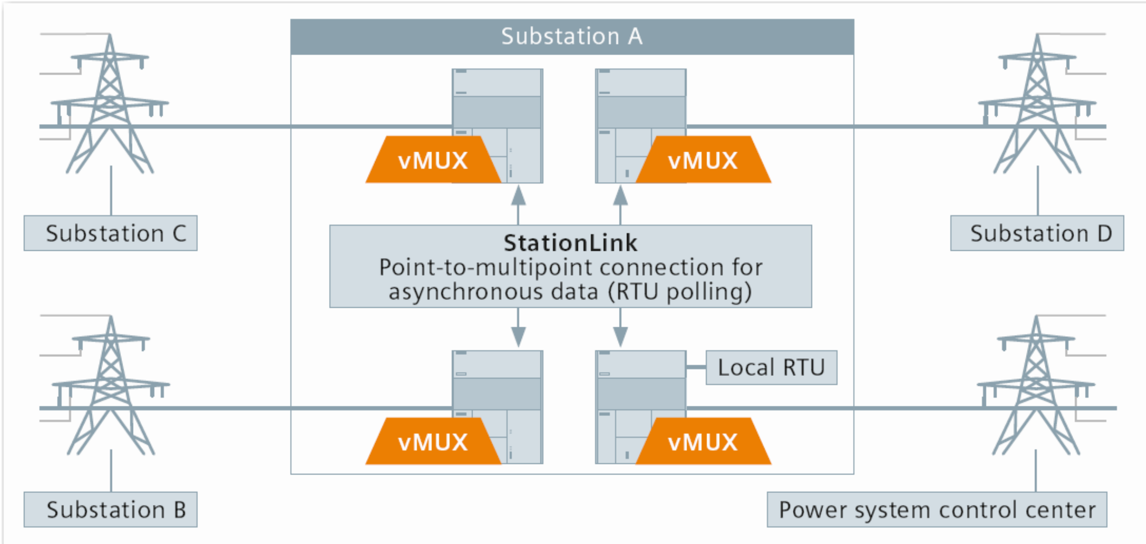
Figure 2-50 Telecontrol via the integrated multiplexer

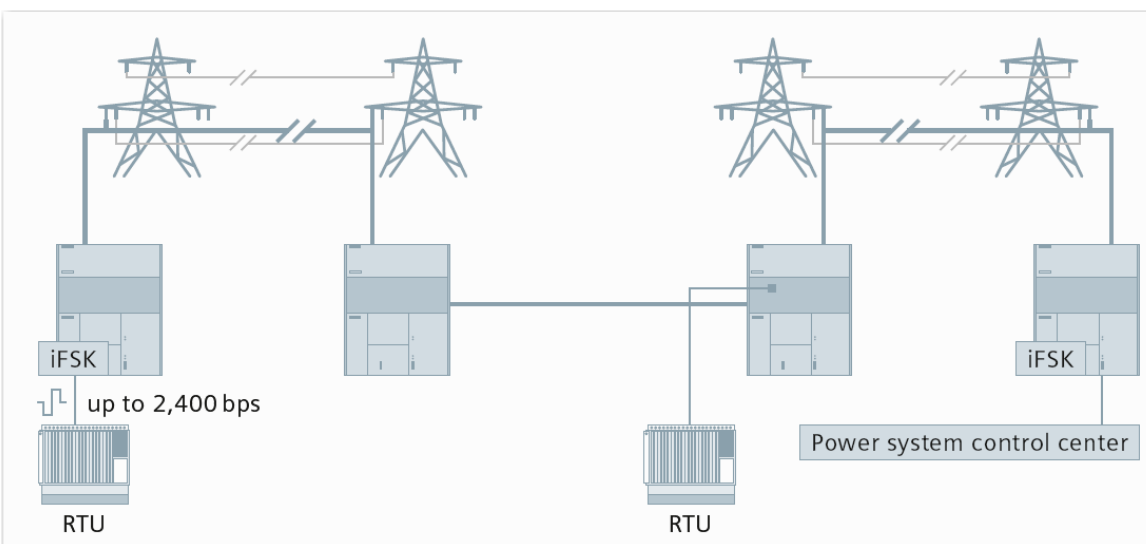
Digital modulation (dPLC) Polling telecontrol data via the integrated multiplexer vMUX with data rates up to 19.2 kbps



[scpltc02-270813-01.tif, 1, en_US]

Figure 2-51 Telecontrol via point-to-multipoint connections

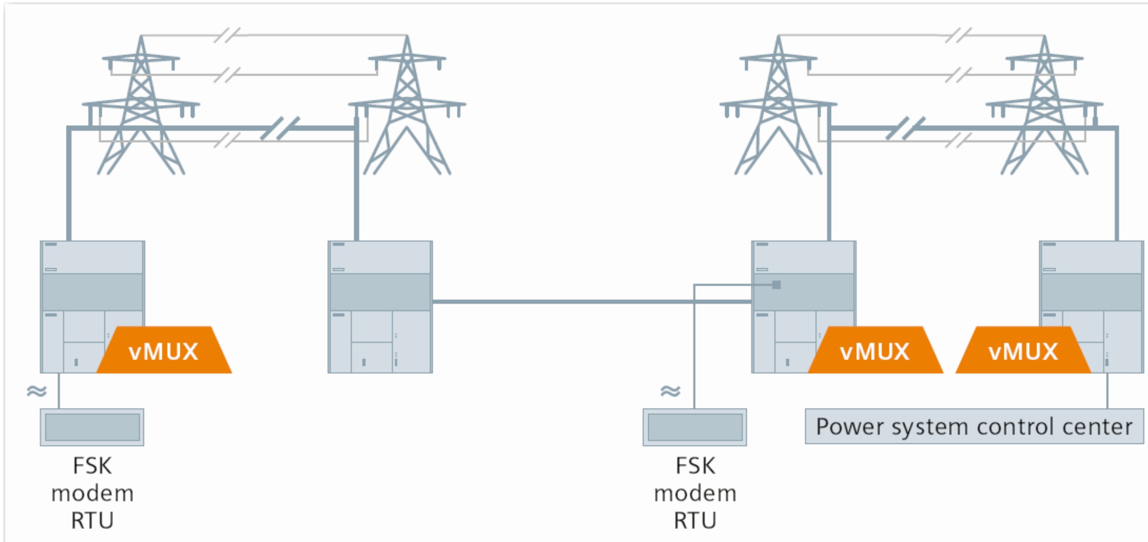
The functions of a power system control center include the regular interrogation of event data from the telecontrol units. Point-to-multipoint polling can be implemented in a substation between the PowerLink systems by means of the StationLink function.



[scpltc03-270813-01.tif, 1, en_US]

Figure 2-52 Telecontrol via the integrated FSK channel

Analog modulation (aPLC) Connection of a telecontrol unit to an integrated modem



[scpltc04-270813-01.tif, 1, en_US]

Figure 2-53 Telecontrol with modem via the rFSK channel

Digital modulation (dPLC) Polling telecontrol data from RTUs with integrated FSK modem via the vMUX at up to 2,400 bps

2.3.3 PowerLink for Data Transmission

The versatile multiplexer integrated in PowerLink provides the following functions:

Asynchronous data transmission

Up to eight data terminal devices can be connected to PowerLink via the RS232 interface. These asynchronous data channels can be transmitted in the "guaranteed" or "best effort" modes, and thus guarantee optimal utilization of the available transmission capacity.

Synchronous data transmission

PowerLink provides 2 X.21 or 1 G703.1 interfaces for the data link between plesiochronous (PDH) or synchronous (SDH) transmission networks.

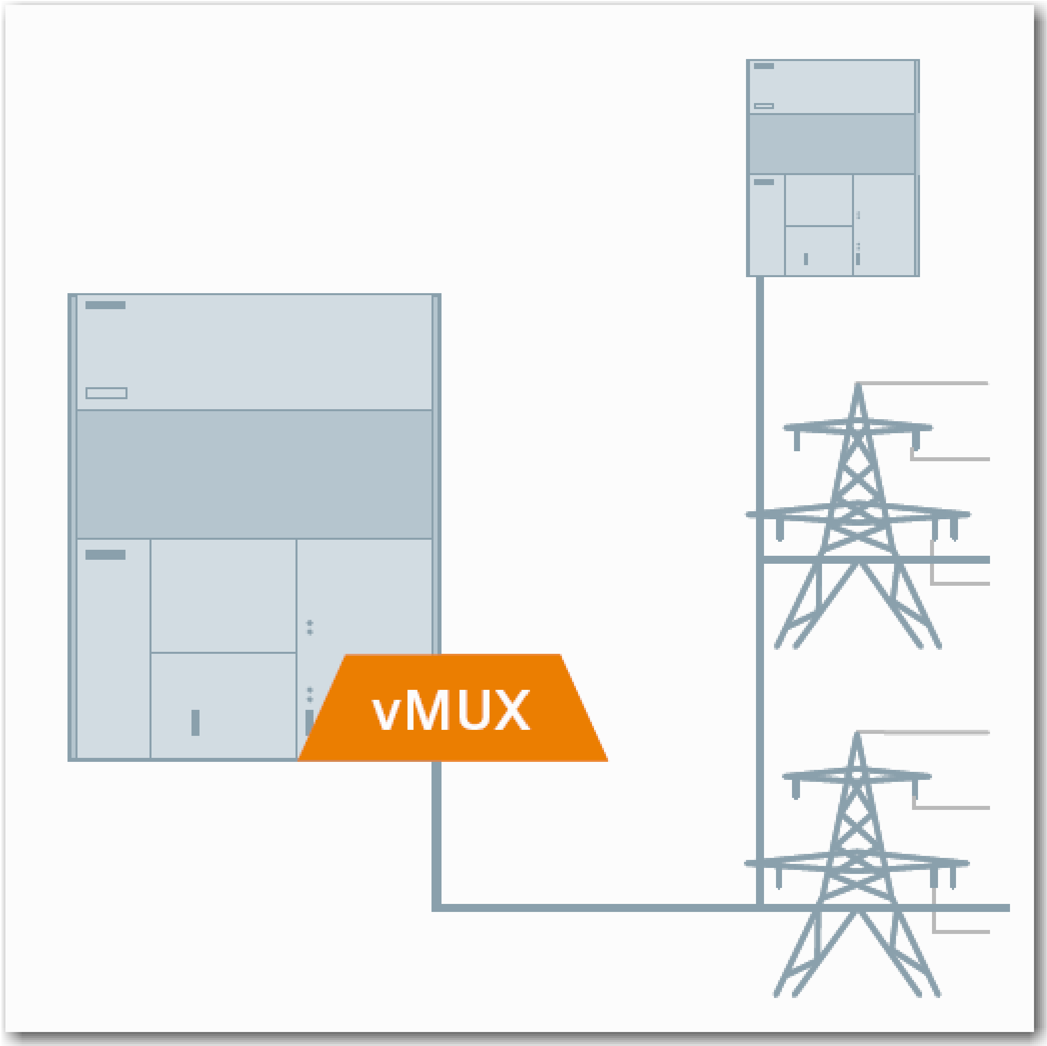
LAN connection

PowerLink permits the establishment of a LAN connection between substations in the high-voltage network. Electrical and optical Ethernet interfaces as well as an integrated L2 switch allow IP-enabled data terminal equipment to be connected directly at low cost.

Transparent analog data transfer

When PowerLink is used in analog mode, a maximum of four conventional asynchronous data channels (up to 2,400 bps) can be transmitted transparently by means of FSK modulation.

The following figures shows a connection example.



[scpldt01-270813-01.tif, 1, en_US]

Figure 2-54 PowerLink for data transmission

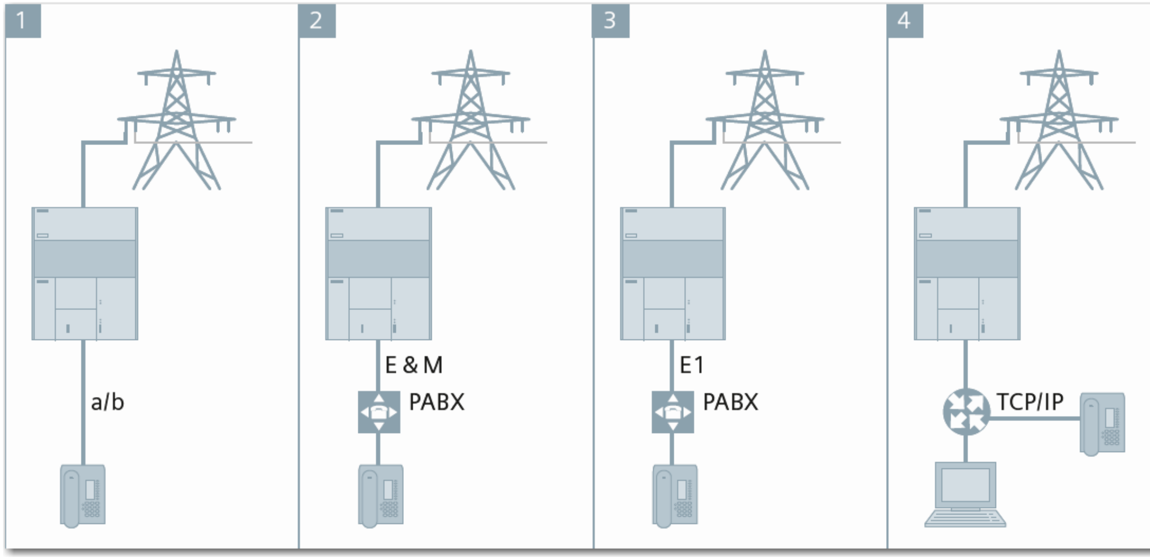
Flexible combination of interfaces until full transmission capacity is attained.

- Max. 2 x X.21 or 1 x G703.1
  For example, data terminal
- Max. 8 x RS232
  RTU connection Point-to-Point, Point-to-Multipoint
  Optional 4 x RS232 with FSK modulation in analog operation
- Ethernet TCP/IP
  For example, router

2.3.4 PowerLink for Telephone Networks

PowerLink is designed to connect different types of telephone systems and individual telephones – from analog to IP. In transit stations, the compressed voice band is routed transparently, with no additional decompression and compression, so that the end-to-end voice quality is not degraded. This StationLink functionality for voice channels is shown in the graphic below.

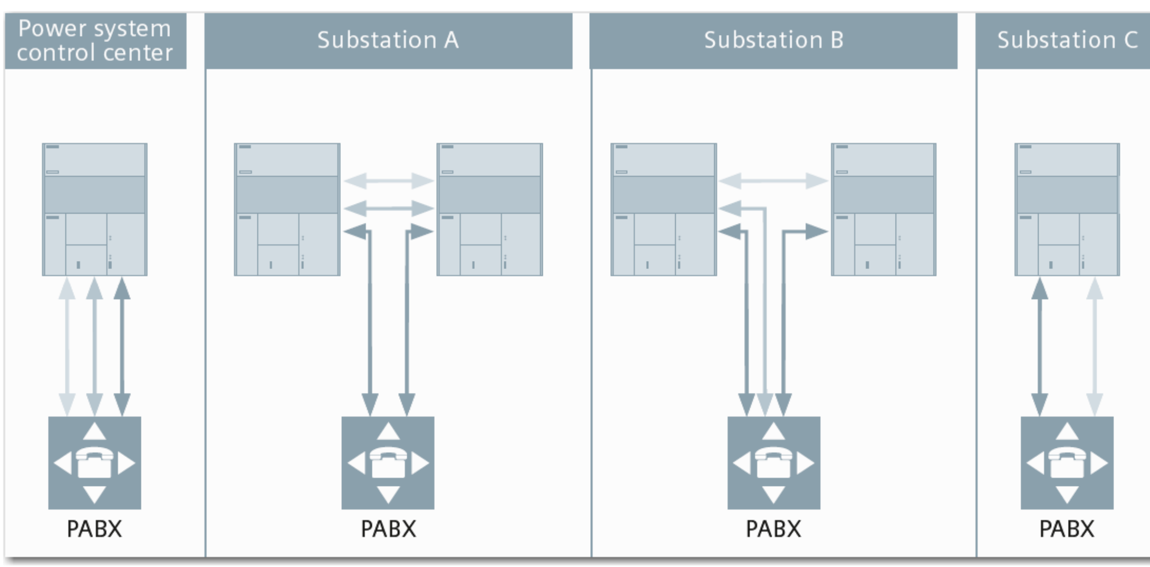
The following figures show examples for the different connection.



[scpltn01-270813-01.tif, 1, en_US]

Figure 2-55 PowerLink for telephone networks

(1)	Analog interface Analog connection of individual telephones
(2)	Analog interface Analog connection of telephone systems
(3)	Digital interface Digital connection of telephone systems
(4)	TCP/IP interface Connection of telephone or telephone systems via TCP/IP



[scpltn02-270813-01.tif, 1, en_US]

Figure 2-56 StationLink functionality for voice channels

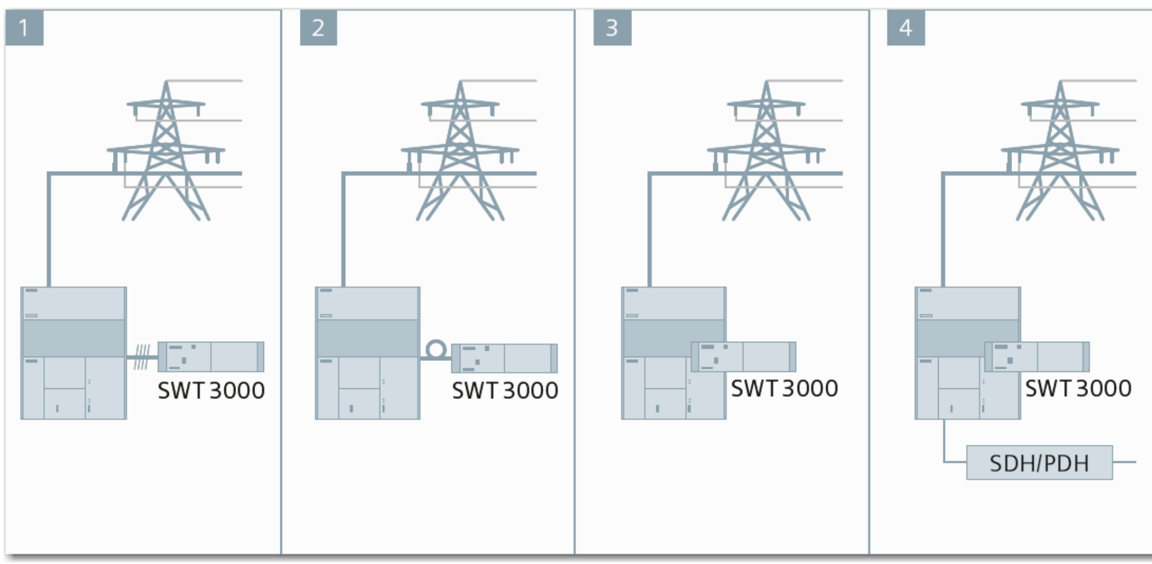
2.3.5 PowerLink for Protection Signal Transmission

The teleprotection system SWT 3000 can be operated as an integrated system (with a maximum of two systems) or adapted with PowerLink. Every SWT 3000 system can transmit up to four protection commands. The command interface type for distance protection devices can be either standard binary or compliant with IEC 61850. Even a combination of both command interface types is supported. For highest availability, an alternate transmission path via a digital communication link (for example, SDH) can be connected.

The SWT 3000 system offers you a unique and varied range of operating options:

- **Single purpose mode**
  In this operating mode, the PowerLink transmission channel is used exclusively for transmitting protection signals. Maximum transmission range, with the highest reliability in the case of pulse noise and the minimum signal propagation delay, are achieved in this mode.
- **Multi purpose mode**
  In this mode, voice and data are transmitted parallel to protection signals.
- **Alternate Multi purpose mode**
  In this mode, the entire transmission capacity is used for voice and data as long as it is not needed for protection purposes. The PowerLink pilot tone is used as the guard tone in this mode. If a protection command needs to be transmitted, voice transmission is interrupted for the duration of transmission of the protection command. Data transmission may also be interrupted if the relevant parameter is set.

The following figure shows an connection example.



[scplst01-270813-01.tif, 1, en_US]

Figure 2-57 Protection signal transmission

(1)	External SWT 3000 4-wire link
(2)	External SWT 3000 Fiber-optic link
(3)	Internal SWT 3000, integrated in PowerLink
(4)	Internal SWT 3000, integrated SWT 3000 with path switching via digital networks (1+1)

2.3.6 Easy to Operate – the PowerLink Management System

All applications in PowerLink, like the versatile multiplexer and the integrated and external SWT 3000 devices, use one common HMI.

PowerSys Administration Interface

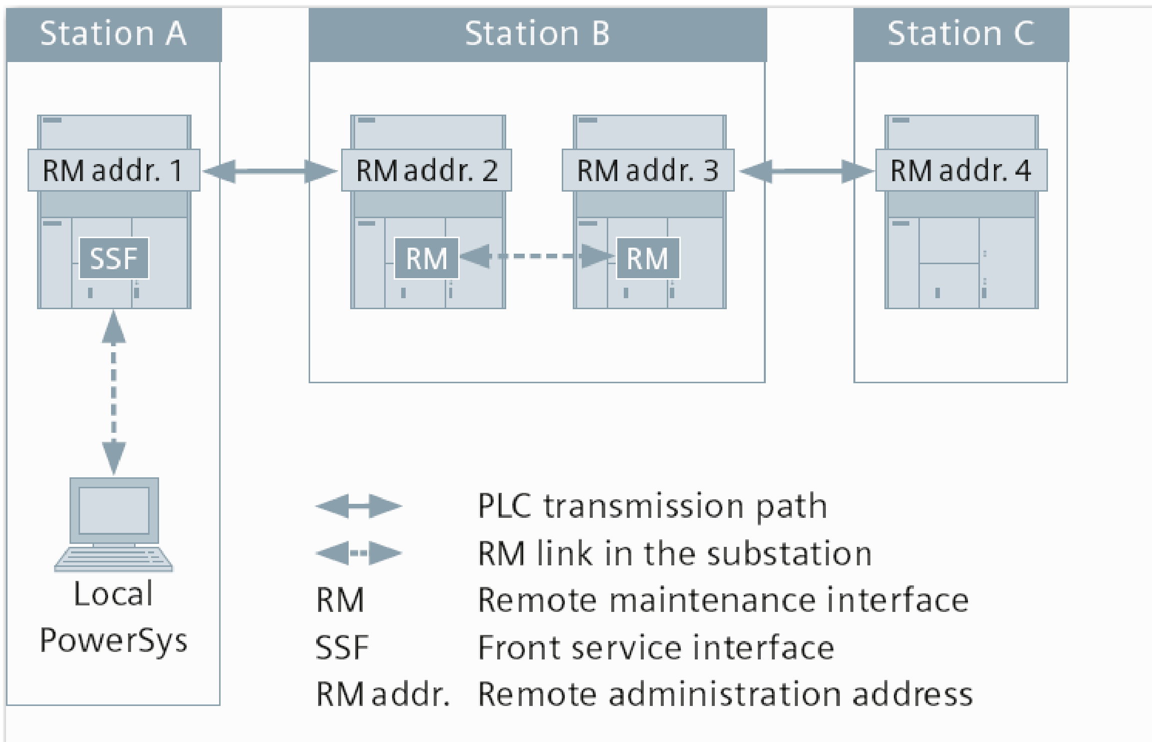
Intuitive and easy-to-operate, the Windows-based PowerSys software runs on all standard PCs. In addition to local operation, PowerLink also offers two options for remote administration. This makes it possible to meet a wide range of different customer infrastructure requirements. Regardless of the chosen solution, the user has complete system access – just as with a direct local connection. For easy maintenance, the integrated event recorder with real-time clock synchronization options provides the required information.

- Remote access via in-band channel RM
- Remote access via IP

The administration of remote PowerLink systems can be easily performed from the local operator console via a customized service channel or the IP network. Administration can also be performed via the corporate LAN network, using the common TCP/IP network protocol. The system can be connected with its own network protection equipment and a firewall to ensure the security level necessary for the company.

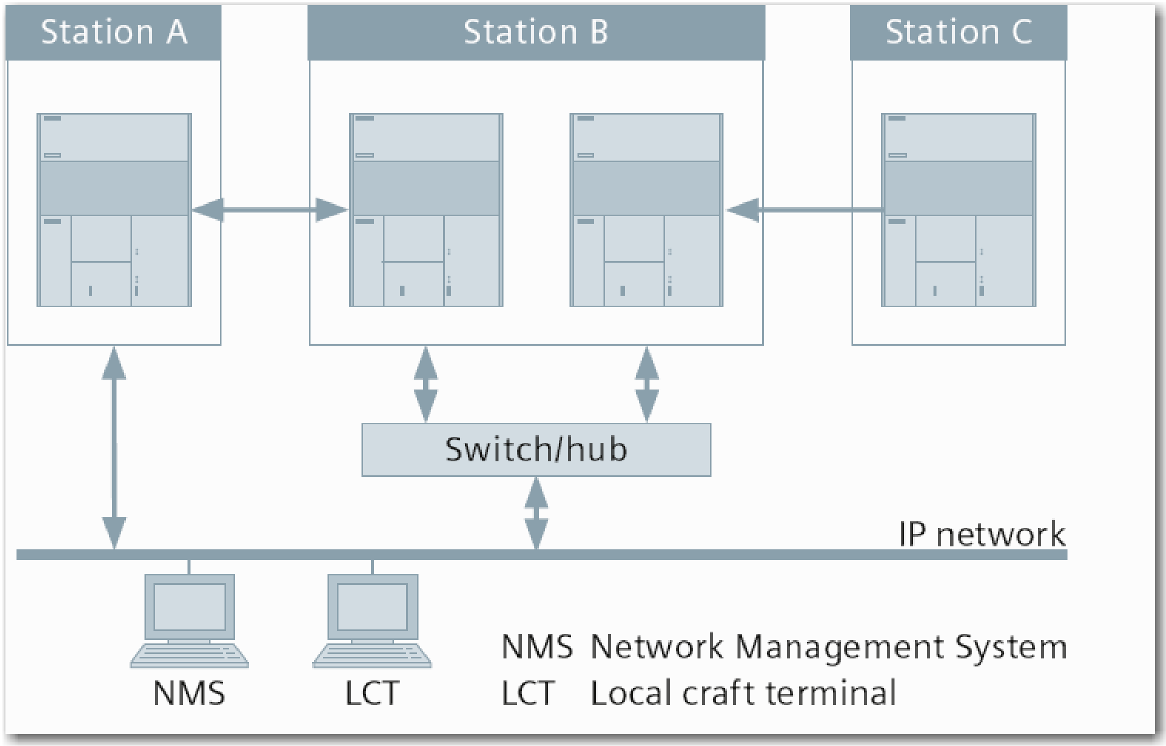
PowerLink systems can be integrated in higher-level management systems via the IP access, using the SNMP protocol (simple network management protocol). System and network status data can be transferred, for example, to an alarm, inventory, or performance management system. In case the PowerLink devices in stations B and C are enabled with Ethernet service, station C is also part of the NMS supervision.

The following figures show examples for the different connection.



[scpleto1-270813-01.tif, 1, en_US]

Figure 2-58 Remote access via in-band channel



[scpleto2-270813-01.tif, 1, en_US]

Figure 2-59 Remote access via IP

2.4 Integrated Protection Signal Transmission with iSWT 3000

2.4.1 Overview

2.4.1.1 General Information

This chapter provides the user a comprehensive description of the integrated teleprotection signaling equipment iSWT 3000.

It describes the possible operating modes with PowerLink like single purpose (SP), multi purpose (MP) or alternate multi purpose (AMP) operation.

You can find information about the applications for analog and /or digital transmission and the corresponding transmission concepts (e.g. F6 Modulation, Coded Tripping, digital transmission concept). The differencies between the Broadband- and Narrow-Band equipment version are explained and security aspects from the influence of burst interferrences are discussed.

The description of **Protection Operating Modes** shows the number of trip commands which can be transmitted coded or uncoded with the corresponding input / output allocation.

The user finds the functional description of the processing unit **PU4** and the Digital Line Equipment **DLE**, the signification of the PU4 LEDs as well as a functional description of the **IFC-x** modules and the Ethernet **EN100** Module.

Fibre Optic Modules (FOM) can be used for connection of the PowerLink 100 with stand-alone SWT 3000 units. The section Fiber-Optic Modem within this chapter provides the required information for the connection to the PowerLink PLC system and further information about the **FOM** modules.

For jumper settings of the PU4, DLE and interface modules IFC-x refer to Chapter *Installation*. Here you find all information about the system configuration and adjustments of PowerLink and iSWT 3000 with corresponding examples as well.

The pin assignment of the IFC-x modules and pinout tables of the SWT-x/DLE resp. SWT-x/SC connector are included in Chapter *Installation*.

NOTE

The following modules and interfaces are not available in PowerLink 50:

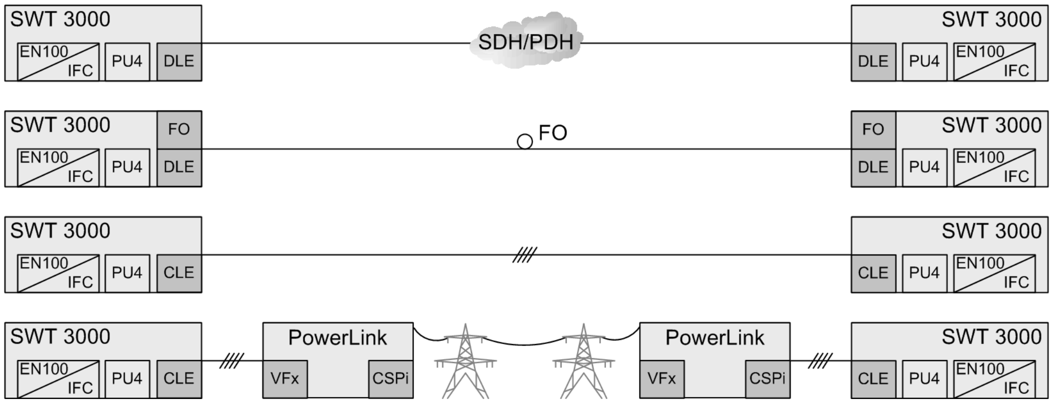
- Digital line equipment DLE
- Fibre Optic Modules (FOM) for connection with stand-alone SWT 3000 units
- SWT-x/DLE resp. SWT-x/SC connector
- VFx-3 module
- RM2 connector
- G703.1 connector

2.4.1.2 Integrated (iSWT) or Stand Alone Units SWT 3000

In the event of faults occurring in high-voltage systems the object of the high voltage network protection is to disconnect the faulty part of the system selectively as quickly as possible. As a consequence of higher power plant outputs and the increasingly close interconnection of high-voltage power systems, high demands are placed on network protection systems in terms of reliability and availability. Therefore, network protection systems with absolute selectivity need a reliable and fast transmission system for the transfer of information between the stations.

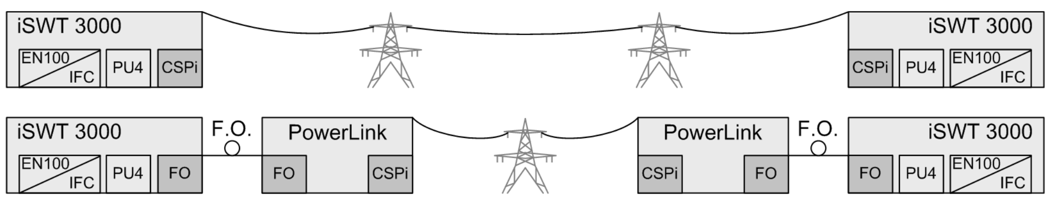
The SWT 3000 for teleprotection signaling in analog and digital communication networks offers the required maximum security and reliability together with the shortest command transmission time.

The SWT 3000 device can be used as a **stand-alone** unit or it can be **integrated** in the PowerLink Power Line Carrier (PLC) system. In this case only the processing unit PU4 and at least one IFC-D/P or EN100 are necessary. An integrated SWT 3000 system in PowerLink (iSWT 3000) can be equipped with up to two interface modules IFC.



[scswtalo-010813-01.tif, 1, en_US]

Figure 2-60 SWT 3000 "Stand-alone" versions



[scswtint-010813-01.tif, 1, en_US]

Figure 2-61 SWT 3000 integrated in the PowerLink (iSWT versions)

The PowerLink Equipment Manual covers only the **SWT 3000 integrated in the PowerLink** (following described as **iSWT**). A connection from an **external SWT 3000 via FO** is also considered as **integrated**.

For the "**Stand-Alone**" **version** refer to the **SWT 3000 Equipment Manual**.

For PowerLink 100, combinations of analog and digital interfaces are possible in both cases. The analog interface of an iSWT 3000 system in PowerLink 100 is operated via the high voltage connection of the PowerLink PLC. The digital interface LID-1 can be configured as alternative path for X.21, G703.1 (64 Kbps) or G703.6 (2 Mbps). The Digital Line Equipment DLE with LID-1 is only used for PowerLink 100.

2.4.1.3 Quick Overview of the Features

Table 2-16 Quick Overview of the Features

Feature	Digital	Analog
Number of commands	Up to 8	Up to 4
Digital line interface[1]		
64 Kbps (X.21 or G703.1)	x	-
2 Mbps (G703.6 sym. 120 Ω, G703.6 asym. 75 Ω)	x	-
Analog line interface		
4-wire	-	x
2-wire	-	x
Fiber-optic interface[1]		
Long-range (single-mode, 1550 nm)	x	-
Short-range (single-mode, 1310 nm)	x	x
Short-range (multi-mode, 850 nm)	x	x

Feature	Digital	Analog
Transmission paths		
Digital network	x	-
Direct connection to SDH multiplexer	x	-
Direct connection to PDH multiplexer	x	-
Fiber-optic cable[1)]	x	x
Power line carrier	-	x
Pilot cable	-	x
Integrated path protection (1 + 1)	x	x
Integration into PowerLink PLC system	x	x
Redundant power supply (hot standby)	x	x
Addressing for increased security	x	-
Impulse Noise Compression (INC)	-	x
Configuration of SWT 3000 with a service PC (intuitive Windows-based user interface)	x	x
Software-upgrade via service PC (download)	x	x
Free programmable output allocation	x	x
Remote access to SWT 3000 devices via TCP/IP link	x	x
Remote access to SWT 3000 devices via inband RM-Channel	x	x
Real-time clock integrated and synchronizable from external sources (for example, GPS, IRIG-B, and NTP) and via the transmission link	x	x
Event recorder (date stamped and time stamped) with guaranteed data storage when the power supply is switched off	x	x
Remote readout of the event recorder	x	x
Easy upgrade from analog to digital and digital to analog	x	x
Simple Network Management Protocol (SNMP) agent for Network Management System (NMS) integration	x	x
Coded tripping (CT) for up to 4 independent commands	-	x
IEC 61850	x	x
Service channel	x	-
[1)] for PowerLink 100		

2.4.2 Applications for Transmission

2.4.2.1 Applications for Analog and/or Digital Transmission

The iSWT is used for fast, reliable transmission of several commands for protection and/or special switching functions in supply networks.

Protection functions (Mode 1, Mode 2)	Commands can be transmitted for the protection of two 3-phase systems (double system protection) or one 3-phase system (single phase protection). High-voltage circuit breakers can be operated with selective protection relays. This operation is designated as a **permissive protection system**. Direct switch operation is also possible. This operation is known as **intertripping**, **transfer tripping**, or **direct tripping**.
4 commands with priority (Mode 3)	It is possible to transmit 4 individual commands. Several commands can be activated simultaneously. They are arranged according to priority (input 1, 2, 3, and 4) and output one after the other.

Only one command active (Mode 4)	Only one of the signal inputs 1 to 3 can be active in this operating mode. Input 4 has priority and is treated independently of the states of input 1 to 3. Therefore, if input 4 is active, the state of the other inputs is insignificant. If more than one of the signal inputs 1 to 3 is active and input 4 is inactive, an input error occurs. The guard tone continues to be transmitted.
3 independent commands, 3iC (Mode 5A)	3 signal inputs are available in this operating mode. On the transmit side, every possible combination of signal input is assigned to one specific protection frequency. On the receive side, each protection frequency can be assigned to one or more signal outputs (1 to 4).
4 independent commands, 4iC (Mode 3a)	4 signal inputs are available in this operating mode. On the transmit side, every possible combination of signal input is assigned to a pair of protection frequencies. On the receive side, each pair of protection frequencies is assigned to one or more signal outputs. This function is only available with the coded tripping feature.
2 plus 2 (Mode 3b)	This mode offers the transmission of 2 double systems. One is transmitted in the fast permissive underreach transfer trip (PUTT), the other in the external trip initiation using the CT feature.

2.4.2.2 Applications for Digital Transmission for PowerLink 100

1 digital line interfaces (LID-1) is available through expansion of the PU4 module with the interface module to digital transmission paths DLE (digital line equipment).

A **separate digital cable connection** to the SWT-x/DLE interface connector is required.

The hardware interfaces X.21 (64 Kbps), G703.1 (64 Kbps) and G703.6 (2 Mbps HDB3-coded balanced or coaxial) can be selected on the LID, although only 1 can be used per LID.

2.4.2.3 Combination of Analog and Digital Interfaces for PowerLink 100

Multipath transmission can be implemented in the iSWT by using the analog interface (LIA) and the digital interface (LID-1). This combination, like only analog or only digital transmission is possible for units integrated iSWT in the PowerLink system.

2.4.2.4 Transmission Paths

The following transmission paths can be used depending on the nature of the supply networks:

- High-voltage overhead lines
- High-voltage cables
- Aerial and (buried) underground cables
- Radio relay routes
- Digital networks (SDH/PDH)
- Fiber-Optic Module (FOM) for PowerLink 100

It results in the following possible applications:

Table 2-17 Possible Applications of the SWT 3000

Configuration	Option
SWT 3000 stand-alone for analog path	Digital alternate path
SWT 3000 stand-alone for digital path for PowerLink 100	Analog or digital alternate path
SWT 3000 integrated in PowerLink PLC unit analog	Digital alternate path

Configuration	Option
SWT 3000 integrated in PowerLink PLC unit digital for PowerLink 100	Analog alternate path
SWT 3000 stand-alone with connection via FOM for PowerLink 100	Analog or digital alternate path
SWT 3000 stand-alone with connection via FOM to the PowerLink 100	Digital alternate path
SWT 3000 stand-alone with connection of the digital interface via FOM to a PDH or SDH multiplexer for PowerLink 100	Analog or digital alternate path

2.4.2.5 Modes of Operation

Analog Mode of Operation

F6 Modulation	The principle of F6 modulation (frequency-shift keying FSK) is applied with the iSWT. Therefore only 1 of the possible frequencies is ever transmitted. This enables the available transmit power to be used to the full.
Security	The influence of burst interferences with amplitudes that can be significantly greater than the wanted signal is suppressed. This is achieved by limiting the amplitude of the input signal with the largest possible band-width and then analyzing the frequency with a small bandwidth. Burst interferences are generated, for example, by lightning strike or by switching operations in high-voltage systems. An optimum setting of the evaluation thresholds and the integration times guarantees maximum security against unwanted tripping and a high degree of reliability at the same time. Protection commands are still transmitted in time despite serious interfer-ence.
Coded tripping (CT)	The CT function is available for the analog line interface (LIA). The command codes consist of 2 simultaneously transmitted trip frequencies (parallel coding).

Digital Mode of Operation

General	The digital line interfaces LID-1 is needed for transmitting the protection commands over a digital network. The data for the interfaces RM (Remote Monitoring) and SC (Service Channel) and system-internal control information are transmitted additionally. Also an address given to the device is transmitted.
Transmission concept	Information is transmitted via the digital interface with the periodic transmission of 4 message types with constant length. The messages have the following priority among each other: • Tripping command information = priority 1 • Service channel = priority 2 • Remote maintenance = priority 3 • System-internal control information = priority 4
Command transmis-sion	Each command message is transmitted 4 times with a hamming distance of 4. The receiving end checks whether 3 identical command messages have been received. The command is not valid until this check has been successfully carried out.

2.4.2.6 Features

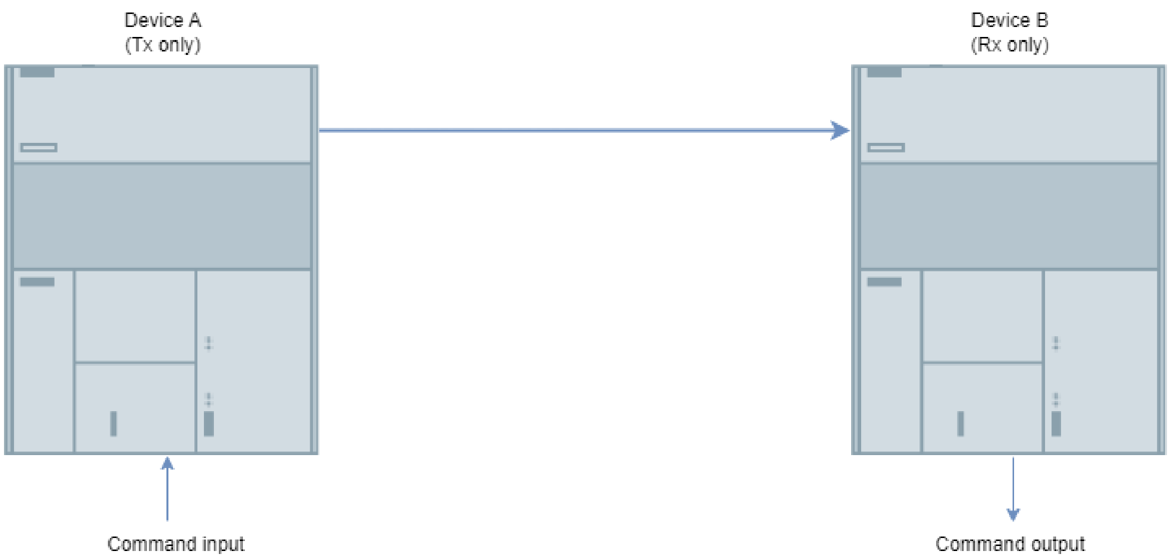
The transmission features are as follows:

- Frequency generation and evaluation by digital signal processor (DSP)
- Full utilization of the available transmit power since only one of the possible frequencies is ever trans-mitted
- Burst interferences with greater amplitudes than the desired signal are largely suppressed

- Noise analysis in the unused desired signaling circuits
- Analog and digital line interfaces
- Alternative paths possible by combination of analog and digital interfaces
- Non-volantile event memory for 8192 entries (Data retention over several days, at least 5 hours). Also possible to read out the event memory remotely via RM or service channel (only with digital transmission path).
- Possible remote readout of the event memory via RM or SC
- Configuration of the device with PC

2.4.2.7 Simplex TPS Transmission

Simplex teleprotection command transmission is one side Tx, another Rx only. The required HF frequency is reduced to half because of one transmission direction only. Simplex command transmission can be used in F6 single purpose or alternative multipe purpose (F2 + AMP) mode. For F2 AMP service, the telephone services are not possible.



[sc_simplex_tps_transmission, 1, --_--]

Figure 2-62 Simplex command transmission

The simplex transmission can be commissioned on site via software configuration PowerSys > Configuration > HF.

	Device A (Tx only)	Device B (Rx only)
Transmit start / end frequency	24 up to 1000 kHz	0 kHz
Receive start / end frequency	0 kHz	24 up to 1000 kHz

Device A (Tx only) disables the receiver for F2 / F6 service. Rx alarm and LED are switched off on CSPi / PU4 boards. Correspondingly all command outputs are deactivated.

Device B (Rx only) disables the transmitter by setting PLPA output power to zero. No command signals are transmitted ot the HV line.

2.4.3 Operating Modes with PowerLink Systems

2.4.3.1 Overview

Power system protection signals can be transmitted over the high-voltage overhead line to be protected in conjunction with PLC equipment. In case of using an PowerLink system it is also possible to integrate SWT

3000 in the system. When using PLC equipment several variants of teleprotection signaling are possible as described in the following:

2.4.3.2 Single Purpose Operation (SP)

In this operating mode the transmission band of the PowerLink is used exclusively for protection signaling.

[dwsgpuop-231110-01.tif, 1, en_US]

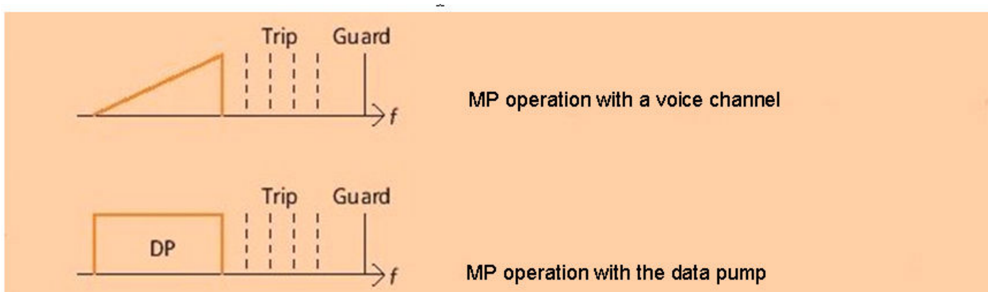
Figure 2-63 Single Purpose operation

The greatest transmission distances are reachable in this mode with maximum security against impulse noise and minimum signal transmission time.
The following equipment combinations are possible:

- SWT 3000 remote with VF or optical connection to PowerLink
- SWT 3000 integrated in PowerLink

2.4.3.3 Multi Purpose Operation (MP)

In this operating mode the protection signals are transmitted simultaneously with voice and/or data signals.



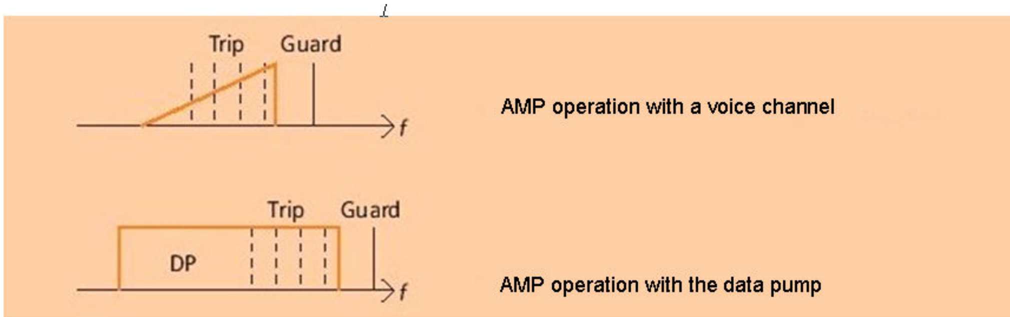
[dwmlpuop-231110-01.tif, 1, en_US]

Figure 2-64 Multi Purpose operation

The distribution of the available transmission power between the services to be transmitted results in shorter transmission ranges. The command transmission times are the same as in single purpose operation.
The following equipment combinations are possible:

- SWT 3000 remote with VF or optical connection to PowerLink
- SWT 3000 integrated in PowerLink

2.4.3.4 Alternate Multi Purpose Operation (AMP)



[dwaltmpo-231110-01.tif, 1, en_US]

Figure 2-65 Alternate Multi Purpose operation

Normal operation:	In this operating mode the transmission band is used for the transmission of voice and/or data as long as there is no protection case. In the idle state, i.e. the high-voltage system is operating properly the signals of all services including the guard tone are transmitted simultaneously. The pilot of the PLC system is used as the guard tone in this operating mode.
Protection mode:	If a protection command has to be transmitted voice transmission or Data Pump is interrupted briefly while the protection command is being transmitted. The protection command can thus be transmitted with the full transmission power available (this only applies to devices with no other services). This operating mode saves frequency space but results in shorter transmission ranges and higher signal transmission times than with single purpose or multi-purpose operation.

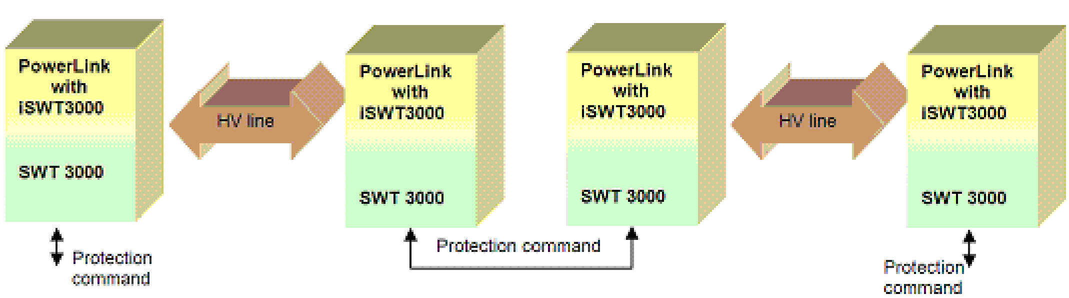
The following equipment combinations are possible:

- SWT 3000 remote at short distance with VF coupling to PowerLink. Keep the connecting cable between SWT 3000 and PowerLink as short as possible.
- SWT 3000 remote with fiber-optic connection to the PowerLink
- SWT 3000 integrated in PowerLink

2.4.4 Teleprotection Repeater Service

The protection-signaling system SWT 3000 via the PLC system PowerLink is realized as a point-to-point connection with the available binary input and output ports. A PLC repeater is required if the distance between PLC terminals is too far. On such a PLC repeater, all signals are forwarded unchanged.

If SWT 3000 is used as protection signal repeater (*Figure 2-66*), the transmission time is multiplied by the number of PLC hops.



[losol2is-120813-01.tif, 1, --_--]

Figure 2-66 Solution with 2 x iSWT 3000 in repeater stations

The TP-Repeater provides the protection-signal forwarding on voice-frequency level (*Figure 3-75*) with the advantages of:

- No SWT 3000 hardware needed on repeater station.
- Reduction of transmission time because of no coding/decoding time carried out by the SWT 3000 in the repeater station. The additional transmission delay caused by the TP-Repeater is less than 14 ms.

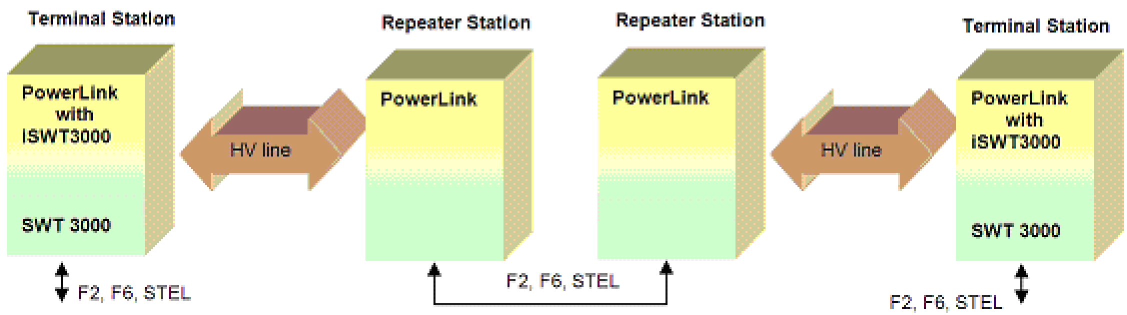


Figure 2-67 Solution with TP-Repeater

For both terminal stations, the PowerLink must be configured with service type F2 AMP, and all signals within the bandwidth of this service are forwarded between terminals by TP-Repeater stations. These signals include:

- Telephone (F2)
- Service telephone (STEL)
- Protection command (F6)

NOTE

The noise is increased for each PLC hop because the signal is not regenerated by the TP-Repeater. Therefore, the maximum number of PLC hops is limited to 3 (2 repeater stations).

2.4.5 iSWT Equipment Versions

2.4.5.1 Broadband Version

Application:	In this equipment version, the desired frequencies are distributed over the complete available frequency space. It offers a high level of security against impulse interference and disturbance voltages and is the preferably application for protection signaling over PLC links. With PLC, transmission frequency space in the 2.5-kHz or 4-kHz channel arrangement is required for each operating direction.
PLC connections	Variants VF1, VF1_M5A, VF3_M5A, VF1_CT, and VF3_CT are used with PowerLink PLC systems depending on the assignment of the transmission band.

2.4.5.2 Narrow Band Version

Application:	Use in conjunction with PowerLink transmission is possible in multi purpose operation (NB1 only). However, a smaller range (transmit level distribution for all services) and less security against interference must be expected compared with the broadband version.
Alternate Multi-Purpose:	Use in conjunction with PLC transmission is not possible in alternate multi purpose operation.

2.4.6 Monitoring

The monitoring functions of the device are as follows:

- Operating voltage
  All outgoing information (TX and command outputs) are blocked as long as the operating voltages of the equipment are not within the specified ranges.
- Switching command duration
  If a switching command with a duration of > 500 ms is received, the command outputs are disabled and an alarm is triggered. The switching command duration can be configured.
- Guard tone failure alarm
  If there is no valid command frequency present, a guard tone failure alarm is triggered after about 10 ms.
- Signal to Noise (S/N) ratio
  If the configured threshold of the S/N ratio is exceeded, a signal to noise alarm can be triggered. During alternate multi-purpose operation the S/N supervision is not performed.
- Transmit level monitoring
  The level of the transmit amplifier is monitored.
- Operating state
  The operating state of the device is displayed on the front panel with differently colored LED.
- Control contacts for external equipment
  A floating make contact or break contact (alarm contact) is available at the device terminals for signaling the following alarms:
  - Non-urgent alarm (NU-alarm, NUALR, or NDALR)
  - Receiver alarm (RXALR or EALR)
  - General alarm (GALR or GENALR)
- A Signaling module IFC-S can be provided additionally as an option. With the aid of this module, any operation of the local circuit can be signaled externally via an auxiliary contact.

NOTE

In an iSWT 3000 maximum 1 IFC-S module is possible.

- Input pulse suppression
  In order to be accepted as an input signal, commands must be applied at the input for at least 1 ms. You can increase this minimum time to 100 ms in steps of 1 ms. The input pulse suppression can be configured.
- Minimum transmission duration
  Each command is transmitted for at least 15 ms. The minimum transmission time can be configured.

2.4.7 Protection Modes

2.4.7.1 Overview

The PowerLink system has the following different protection operating modes:

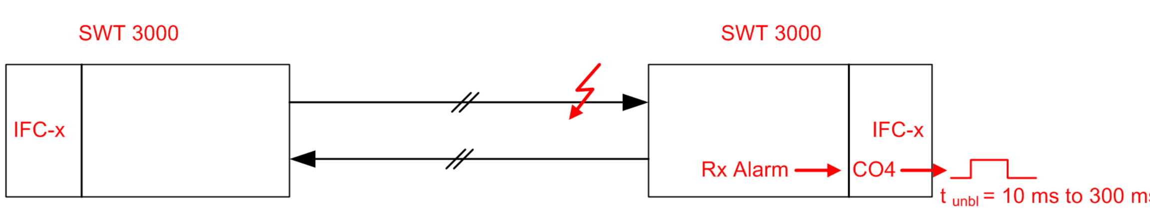
- Protection operating mode 1 (double system protection) for the analog and digital interface.
  The commands can be transmitted coded or uncoded with the application permissive or direct tripping (selectable per device).

- Protection operating mode 2 (single phase protection) for the analog and digital interface.
  The commands can be transmitted coded or uncoded with the application permissive or direct tripping (selectable per device).
- Protection operating mode 3 (4 commands with priority) for the analog and digital interface.
  The commands are transmitted uncoded with the application permissive or direct tripping (selectable per device).
- Protection operating mode 3a (4 independent commands, 4iC) for the transmission of 4 independent commands.
  The commands are always transmitted coded with the application permissive or direct tripping (selectable per device).
- Protection operating mode 3b (2 plus 2).
  This mode offers the transmission of mode 1 twice. 2 commands are transmitted in the fast permissive underreach transfer trip, the other 2 are transmitted in the direct trip application and using the CT feature.
- Protection operating mode 4 (only one command active) for analog and digital interfaces.
  The commands can be transmitted coded or uncoded with the application permissive or direct tripping (selectable per device).
- Protection operating mode 5A (3 independent commands) for analog and digital interfaces.
  The commands are transmitted uncoded with the application permissive or direct tripping (selectable per device).
- Protection operating mode 6 (24 analog commands with priority) for analog multi command modules.[1]
- Protection operating mode 7a (8 Independent Commands, 8iC) This operating mode is only available for integrated SWT.
  Available for the transmission of eight independent commands. Commands are always transmitted coded with the application permissive or direct tripping (selectable per iSWT device).

2.4.7.2 Unblocking Mode

The unblocking mode is a release procedure. Short circuits on overhead lines can cause a disturbance of PLC links. In this case, in order to warrant the release of the permissive protection device, the unblocking impulse ($t_{unbl.}$) is used.

If the signal to be transmitted does not reach the other line end, the receiver recognizes a fault and emits the unblocking impulse. The reason for the unreached signal is because a short circuit on the line causes excessive attenuation or reflection of the signal. For other modes, it is carried out via the interface module IFC-P/D command output 4 and connected to the unblocking logic of the protection relay. If there is a fault, the unblocking logic of the protection device ensures the release (for $t_{unbl.}$ = 10 ms to 300 ms).



[dwprunbm-010711-01.tif, 1, en_US]

Figure 2-68 Principle of the Unblocking Mode

The unblocking function is activated when the time for the unblocking impulse is more than 0 ms ($t_{unbl.}$ > 0 ms).

1 not released in P3.5.x

2.4.7.3 iSWT Trip Frequencies

All trip frequencies of an iSWT can be measured only in the HF range. They are displayed with the corresponding service in the PowerSys information menu.

2.4.7.4 Mode 1 (Double System Protection)

Table 2-18 Logic Scheme for the Mode 1

Activated Input	Transmission Uncoded	Transmission Coded	Command Output in the Remote Station without Unblocking	Command Output in the Remote Station with Unblocking $T_{unbl.} > 0$[1)]
All off	f_g	f_g	–	CO3
BI1	f_1	$f_s + f_4$	CO1 + CO3	CO1
BI2	f_2	$f_s + f_5$	CO2 + CO4	CO2
BI1 + BI2	f_4	$f_s + f_6$	CO1 + CO2 + CO3 + CO4	CO1 + CO2
BI3	x[2)]	x[2)]	–	–
–	–	–	Alarm signaling[3)]	Alarm signaling + unblocking impulse at CO4
BI4[4)]	f_g	f_g	–	CO3
USYNC[5)]	f_s	$f_s + f_7$	–	–

[1)]If an invalid frequency or code is received, or in case of guard tone alarm: If $t_{unbl.} > 0$, output of the unblocking impulse ($t_{unbl.}$ = Duration of the unblocking impulse)

[2)]x = No reaction (does not trigger alarm)

[3)]If an invalid frequency or code is received or in case of guard tone alarm

[4)]With AMP operation (PLC connection), signal S6 is also activated through **BI4** = **on** and voice transmission is interrupted.

[5)]Clock synchronization (USYNC)

2.4.7.5 Mode 2 (Single Phase Protection)

Table 2-19 Logic Scheme for the Mode 2

Activated Input	Transmission Uncoded	Transmission Coded	Command Output in the Remote Station without unblocking	Command Output in the Remote Station with Unblocking $T_{unbl.} > 0$[1)]
All off	f_g	f_g	CO4	-
BI1	f_1	$f_s + f_4$	CO1	CO1
BI2	f_2	$f_s + f_5$	CO2	CO2
BI3	f_3	$f_s + f_6$	CO3	CO3
BI1 + BI2 or BI1 + BI3 or BI2 + BI3 or BI1 + BI2 + BI3	f_4	$f_s + f_7$	CO1 + CO2 + CO3	CO1 + CO2 + CO3
-	-	-	Alarm signaling[2)]	Alarm signaling[1)] + unblocking impulse at CO4
BI4[3)]	f_g	f_g	CO4	-

Activated Input	Transmission Uncoded	Transmission Coded	Command Output in the Remote Station without unblocking	Command Output in the Remote Station with Unblocking $T_{unbl.} > 0$[1)]
USYNC	f_s	$f_1 + f_4$	-	-

[1)]If an invalid frequency or code is received, or in case of guard tone alarm: If $t_{unbl.} > 0$, output of the unblocking impulse ($t_{unbl.}$ = Duration of the unblocking impulse).

[2)]If an invalid frequency or code is received or in case of guard tone alarm.

[3)]In AMP operation (PLC connection), signal S6 is also activated (**energized**) through BI4 = on and voice transmission is interrupted.

2.4.7.6 Mode 3 (4 Commands with Priority)

NOTE

For this mode, coded tripping is not available.

In Mode 3, if more than one of the command inputs BI1 to BI4 is active, the command information is transmitted alternately. The signal inputs also have different priorities (BI1 = Prio1, BI2 = Prio2, BI3 = Prio3, and BI4 = Prio4). That is, if several signal inputs are active at the same time, the priority control determines the sequence in which the commands are transmitted.

Table 2-20 Logic Scheme for the Mode 3

Activated Input	Transmission Uncoded	Transmission Coded	Command Output in the Remote Station without unblocking	Command Output in the Remote Station with Unblocking $T_{unbl.} > 0$[1)]
All off	f_g	-	-	-
BI1	f_1	-	CO1	CO1
BI2	f_2	-	CO2	CO2
BI3	f_3	-	CO3	CO3
BI4	f_4	-	CO4	CO4
BI1 and/or BI2 and/or BI3 and/or BI4	f_1 and/or f_2 and/or f_3 and/or f_4 alternating	-	CO1 and/or CO2 and/or CO3 and/or CO4 alternating[2)]	CO1 and/or CO2 and/or CO3 and/or CO4 alternating[2)]
-	-	-	Alarm signaling[3)]	Alarm signaling[1)] + unblocking impulse at RXALR
USYNC	fs	-	-	-

[1)]If an invalid frequency or code is received, or in case of guard tone alarm: If $t_{unbl.} > 0$, output of the unblocking impulse ($t_{unbl.}$ = Duration of the unblocking impulse). The unblocking impulse is distributed via the RXALR output of the ALR board.

[2)]If more than one input is active, command transmission is alternating. The priority control dictates the sequence in which the command frequencies are transmitted. Setting the output extension to ≥ 100 ms on the receive side prevents the output relays releasing during alternating command transmission.

[3)]If an invalid frequency or code is received or in case of guard tone alarm.

2.4.7.7 Mode 3a (4 Independent Commands, 4iC)

NOTE

This mode is always transmitted in the coded tripping function.

Table 2-21 Logic Scheme for the Mode 3a

Activated Input	Transmission Uncoded	Transmission Coded	Command Output in the Remote Station[1)] without Unblocking	Command Output in the Remote Station[1)] with Unblocking[2)] $T_{unbl.} > 0$
All off	-	fg	-	-
BI1	-	$f_s + f_4$	CO1	CO1
BI2	-	$f_1 + f_4$	CO2	CO2
BI3	-	$f_2 + f_4$	CO3	CO3
BI4	-	$f_3 + f_4$	CO4	CO4
BI1 + BI2	-	$f_s + f_5$	CO1 + CO2	CO1 + CO2
BI1 + BI3	-	$f_2 + f_5$	CO1 + CO3	CO1 + CO3
BI1 + BI4	-	$f_s + f_6$	CO1 + CO4	CO1 + CO4
BI2 + BI3	-	$f_1 + f_5$	CO2 + CO3	CO2 + CO3
BI2 + BI4	-	$f_3 + f_5$	CO2 + CO4	CO2 + CO4
BI3 + BI4	-	$f_2 + f_6$	CO3 + CO4	CO3 + CO4
BI1 + BI2 + BI3	-	$f_1 + f_6$	CO1 + CO2 + CO3	CO1 + CO2 + CO3
BI1 + BI2 + BI4	-	$f_3 + f_6$	CO1 + CO2 + CO4	CO1 + CO2 + CO4
BI1 + BI3 + BI4	-	$f_s + f_7$	CO1 + CO3 + CO4	CO1 + CO3 + CO4
BI2 + BI3 + BI4	-	$f_1 + f_7$	CO2 + CO3 + CO4	CO2 + CO3 + CO4
BI1 + BI2 + BI3 + BI4	-	$f_2 + f_7$	CO1 + CO2 + CO3 + CO4	CO1 + CO2 + CO3 + CO 4
USYNC	-	$f_3 + f_7$	-	-
-	-	-	Alarm signaling[3)]	Alarm signaling + unblocking impulse at RXALR[2]

[1)]If output allocation 1:1 is adjusted.

[2)]If an invalid frequency or code is received, or in case of guard tone alarm: If $t_{unbl.} > 0$, output of the unblocking impulse ($t_{unbl.}$ = Duration of the unblocking impulse). The unblocking impulse is distributed via the RXALR output of the ALR board.

[3)]If an invalid frequency or code is received or in case of guard tone alarm.

NOTE

In device configurations with EN100 and IFC (Mixed mode) the first input ports are always allocated to the pre-configured EN100 channels.

The remaining input ports (depending on the number of assigned EN100 channels) are allocated to the input ports of IFC module in ascending order, IFC-1/IN1, IFC-1/IN2, etc.

2.4.7.8 Mode 3b (2 plus 2)

The commands 1, 2 and 1+2 are permissive tripping commands, which are always transmitted uncoded. The commands 3, 4 and any combination with commands 3, 4 (e.g. 1+2+3+4) are direct tripping commands, which are always transmitted coded.

The transmission time of direct tripping command is approx. 5 ms longer than permissive tripping command in order to increase transmission security.

The mode 3b has been enhanced with the setting for fast transmission of permissive commands.

Table 2-22 Logic Scheme for the Mode 3b

Activated Input	Transmission Uncoded	Transmission Coded	Command Output in the Remote Station without Unblocking	Command Output in the Remote Station with Unblocking $T_{unbl.} > 0$[1)]
All off	f_g	-	-	-
BI1	f_1	-	CO1	CO1
BI2	f_2	-	CO2	CO2
BI1 + BI2	f_3	-	CO1 + CO2	CO1 + CO2
BI3	-	$f_s + f_4$	CO3	CO3
BI4	-	$f_s + f_5$	CO4	CO4
BI3 + BI4	-	$f_s + f_6$	CO3 + CO4	CO3 + CO4
BI1 + BI3	-	$f_1 + f_4$	CO1 + CO3	CO1 + CO3
BI1 + BI4	-	$f_1 + f_5$	CO1 + CO4	CO1 + CO4
BI1 + BI3 + BI4	-	$f_1 + f_6$	CO1 + CO3 + CO4	CO1 + CO3 + CO4
BI1 + BI2 + BI3	-	$f_1 + f_7$	CO1 + CO2 + CO3	CO1 + CO2 + CO3
BI2 + BI3	-	$f_2 + f_4$	CO2 + CO3	CO2 + CO3
BI2 + BI4	-	$f_2 + f_5$	CO2 + CO4	CO2 + CO4
BI2 + BI3 + BI4	-	$f_2 + f_6$	CO2 + CO3 + CO4	CO2 + CO3 + CO4
BI1 + BI2 + BI4	-	$f_3 + f_4$	CO1 + CO2 + CO4	CO1 + CO2 + CO4
BI1 + BI2 + BI3 + BI4	-	$f_3 + f_5$	CO1 + CO2 + CO3 + CO4	CO1 + CO2 + CO3 + CO4
USYNC	-	$f_s + f_7$	-	-
-	-	-	Alarm signaling[2)]	Alarm signaling + unblocking impulse at RXALR[1]

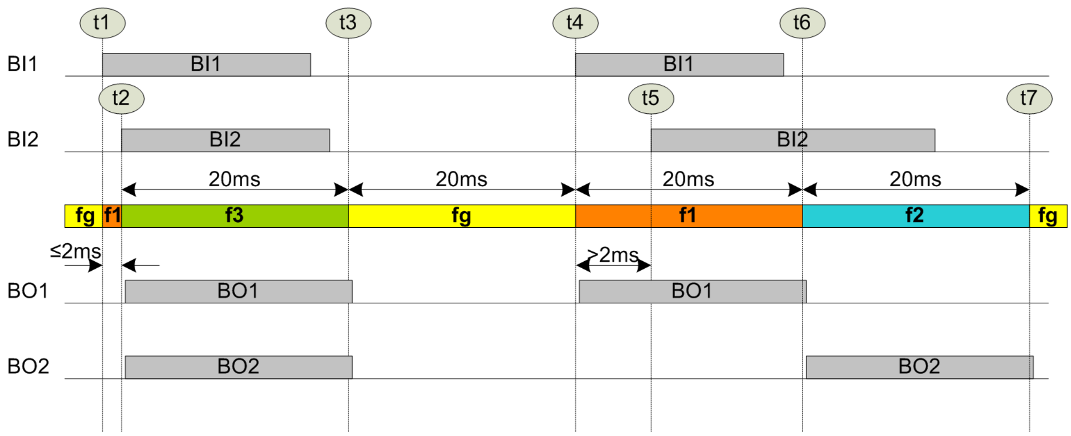
[1)]If an invalid frequency or code is received, or in case of guard tone alarm: If $t_{unbl.} > 0$, output of the unblocking impulse ($t_{unbl.}$ = Duration of the unblocking impulse). The unblocking impulse is distributed via the RXALR output of the ALR board.

[2)]If an invalid frequency or code is received or in case of guard tone alarm.

Command Duration of Mode 3b

The single command applied at the device input is transmitted for at least 15 ms or 20 ms. The next command is then transmitted, or the same command is continuously transmitted if no other command input active.

If next command input is active at same time or within the time interval of 2 ms, the transmit signal is shifted to the frequency corresponding to this input combination. Otherwise, the next command will be transmitted after minimal transmission duration.



[DwpermComm-020215, 1, en_US]

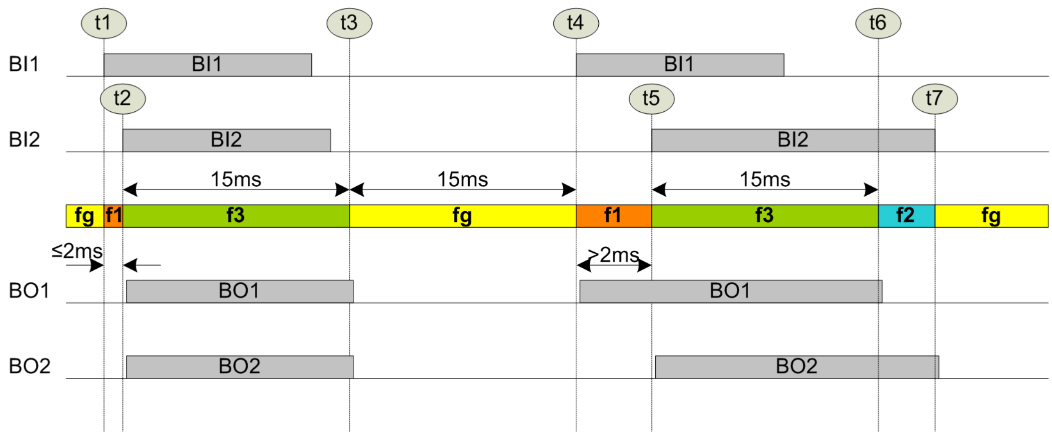
Figure 2-69 Permissive Command 1+2 Transmission

Table 2-23 Command Transmission Timeline Description

Timeline	Description
t1	BI1 active, start transmission of command 1.
t2	BI2 active within time interval 2 ms, switch to transmit command combination of 1+2, BO1+2 active after command transmission time.
t3	Transmission duration time-out, BO1+2 inactive after command transmission time.
t4	BI1 active, start transmission of command 1.
t5	BI2 active after time interval 2 ms, continue transmission of command 1.
t6	Transmission duration time-out, switch to transmit command 2, BO1 inactive after command transmission time.
t7	Transmission duration time-out, BO2 inactive after command transmission time, switch to transmit guard command.

It is possible to enable fast transmission of permissive command with additional setting in PowerSys as below:

- "BI1+2 interrupt single command BI1 or BI2 without delay" is enabled. Permissive command 1 or 2 transmission can switch to input combination 1+2 without waiting for minimal transmission duration time-out.
- Transmission duration for permissive command is set to 20 ms. Permissive command is transmitted for at least 20 ms.
- Pulse suppression for permissive command is set to 0 ms. Permissive command input is accepted without additional delay by suppression timer.



[DwFastComm020215, 1, en_US]

Figure 2-70 Fast Transmission of Permissive Command 1+2

Table 2-24 Fast Command Transmission Timeline Description

Timeline	Description
t1	BI1 active, start transmission of command 1.
t2	BI2 active within time interval 2 ms, switch to transmit command combination of 1+2, BO1+2 active after command transmission time.
t3	Transmission duration time-out, BO1+2 inactive after command transmission time.
t4	BI1 active, start transmission of command 1, BO1 active after command transmission time.
t5	BI2 active after time interval 2 ms, switch to transmit command combination of 1+2, BO2 active after command transmission time.
t6	Transmission duration time-out, switch to transmit command 2, BO1 inactive after command transmission time.
t7	BI2 inactive, switch to transmit guard command, BO2 inactive after command transmission time.

2.4.7.9 Mode 4 (Only One Command Active)

Table 2-25 Logic Scheme for the Mode 4

Activated Input	Transmission Uncoded	Transmission Coded	Command Output in the Remote Station without Unblocking	Command Output in the Remote Station with Unblocking $T_{unbl.} > 0^{1)}$
All off	f_g	f_g	-	-
BI1	f_1	$f_s + f_4$	CO1	CO1
BI2	f_2	$f_1 + f_4$	CO2	CO2
BI3	f_3	$f_2 + f_4$	CO3	CO3
BI4	f_4	$f_3 + f_4$	CO4	CO4
BI1 + BI2 or BI1 + BI3 or BI2 + BI3 or BI1 + BI2 + BI3	$f_g^{2)}$	f_g^{2}	-	-
BI4 + BIx	f_4	$f_3 + f_4$	CO4	CO4

Activated Input	Transmission Uncoded	Transmission Coded	Command Output in the Remote Station without Unblocking	Command Output in the Remote Station with Unblocking $T_{unbl.} > 0^{1)}$
-	-	-	Alarm signaling[3)]	Alarm signaling[1)] + unblocking impulse at RXALR
USYNC	f_s	$f_s + f_7$	-	-
[1)]If an invalid frequency or code is received, or in case of guard tone alarm: If $t_{unbl.} > 0$, output of the unblocking impulse ($t_{unbl.}$ = Duration of the unblocking impulse) The unblocking pulse is distributed via the RXALR output (ALR1-3 resp. ALR2-3 contact if activated in the ALR configuration). [2)]Input error. If more than one input is activated f_g is transmitted. [3)]If an invalid frequency or code is received, or in case of guard tone alarm.				

Explanation

The PU4 checks the state of input signals BI1 to BI4 from the protection device for **plausibility**. Only 1 of the signal inputs BI1 to BI3 can be active. If more than 1 of the signal inputs BI1 to BI3 is active and BI4 is inactive, an **input error** occurs (prohibited input combination).

BI4 has priority and is treated independently of the states of BI1 to BI3. That is, if BI4 is active, the state of BI1 to BI3 is not significant. If BI4 is active, the frequency f4 is transmitted regardless of the state of BI1 to BI3.

The guard tone (f_g) is transmitted in the case of an **input error** and an entry is generated in the event memory with specification of the **prohibited input combination**. The unblocking function can be activated for Mode 4 in the same way as with the other operating modes.

2.4.7.10 Mode 5A (3 Independent Commands)

NOTE

For this mode, coded tripping is not available.

3 signal inputs are available for the operating mode **3 independent commands**. 9 frequencies are needed for transmitting **3 independent commands** via the analog line interface.

At the transmit end, every possible combination of signal inputs BI1 to BI3 is permanently assigned to a protection frequency.

At the receive end, every protection frequency can be assigned to one or more signal outputs (CO1 to CO4).

Table 2-26 Logic Scheme for the Mode 5A

Activated Input	Transmission Uncoded	Transmission Coded	Command Output in the Remote Station[1)] without Unblocking	Command Output in the Remote Station[1)] with Unblocking $T_{unbl.} > 0^{2)}$
All off	f_g	-	-	-
BI1	f_1	-	CO1	CO1
BI2	f_2	-	CO2	CO2
BI3	f_3	-	CO3	CO3
BI1 + BI2	f_4	-	CO1 + CO2	CO1 + CO2
BI1 + BI3	f_5	-	CO1 + CO3	CO1 + CO3
BI2 + BI3	f_6	-	CO2 + CO3	CO2 + CO3

Activated Input	Transmission Uncoded	Transmission Coded	Command Output in the Remote Station[1)] without Unblocking	Command Output in the Remote Station[1)] with Unblocking $T_{unbl.} > 0$[2)]
BI1 + BI2 + BI3	f_7	-	CO1 + CO2 + CO3	CO1 + CO2 + CO3
USYNC	f_s	-	-	-
-	-	-	Alarm signaling[3)]	Alarm signaling[2)] + unblocking impulse at RXALR

[1)]If output allocation 1:1 is adjusted.

[2)]If an invalid frequency or code is received, or in case of guard tone alarm: If $t_{unbl.} > 0$, output of the unblocking impulse ($t_{unbl.}$ = Duration of the unblocking impulse). The unblocking impulse is distributed via the RXALR output of the ALR board.

[3)]If an invalid frequency or code is received, or in case of guard tone alarm.

2.4.7.11 Mode 6 (Multi Command Modules)

The MCM (multi command modules) [2]extend the command transmission of the (i)SWT 3000 via the analog interface up to 24.

MCM modules use the proctection command mode 6. The commands are transmitted serial and according to the programmed priority.

NOTE

The MCM functionaltiy is only available for PowerLink 100.

For further details see chapter *6 MCM Function*.

2.4.7.12 Mode 7a (8 Independent Commands, 8iC)

This operation mode is only available for integrated SWT.

It allows the transmission of eight independent commands. Commands are always transmitted coded with the application permissive or direct tripping (selectable per device). There are 255 command combinations. Every possible combination of signal input is assigned to a protection frequency and are defined as code number (Cxxx) in below table:

Table 2-27 Code number definition for all signal inputs

code no.	BI8	BI7	BI6	BI5	BI4	BI3	BI2	BI1
C1	-	-	-	-	-	-	-	X
C2	-	-	-	-	-	-	X	-
C3	-	-	-	-	-	-	X	X
C4	-	-	-	-	-	X	-	-
...	...	...	...	...	...	...	...	...
C254	X	X	X	X	X	X	X	-
C255	X	X	X	X	X	X	X	X
C256	USYNC							

2 not released in P3.5.x

2.4.7.13 Command Duration for Single Purpose Operation

Mode 1, Mode 2, Mode 3a, Mode 3b, Mode 4 , Mode 5A

In these modes, a signal applied to the device input is transmitted as long as the input circuit is activated. If another input signal is received while one is still applying, the transmit signal is shifted to the frequency corresponding to this input combination. The signal output at the receive side can optionally be interrupted at the receiver output after 500 ms.

If the output relay must be activated for a minimum time on reception of a command, an increase in the command output time can be set. The increase in the command output time can be set in steps of 5 ms up to maximum 2000 ms.

Mode 3 - Four Commands with Priority

In this mode, any command applied at the device input is transmitted for 20 ms or for the time set in time slot. The next command is then transmitted or the same command is transmitted again (only if there is no other command active at the inputs) depending on the priority. The command output can optionally be extended at the receiver output in steps of 5 ms to maximum 2000 ms. To avoid that the output relays drops a prolongation time ≥ 100 ms must be set. This extension makes it possible to transmit commands from all input combinations depending on priority.

2.4.7.14 Command Duration for Alternate Multi-Purpose Operation

The command duration for SWT 3000 is automatically adjusted to a default value of 1000 ms. Inputs can be activated for a longer time but the transmission of the signal is limited to 1000 ms. The transmission of the commands is switched off due to the limited command duration even though the command is active at the input of the device.

2.4.8 The PU4 Module

2.4.8.1 Overview

The Processing Unit PU4 is the central control module of the SWT 3000 unit.

The protection commands are received via an interface module IFC-D or IFC-P and/or an EN100 module.

At the transmit side, PU4 converts protection commands or commands at digital transmission lines into one of the following cases:

- Tones of a defined frequency
- A digital code in case of digital transmission

If the PU4 is housed in a stand-alone SWT 3000 unit, the commands are transmitted to the remote station by:

- analog transmission via CLE and/or
- digital transmission via the Digital Line Interfaces (LID) and/or
- digital transmission via fiber-optic module (FOM)

It is also possible to transmit commands of a stand-alone SWT 3000 unit via a PowerLink PLC system by:

- connecting the CLE with a VFx- Interface of the PowerLink or
- a fiber-optic connection with FOM modules in SWT 3000 and PowerLink

The PU4 of an integrated (i)SWT 3000 unit in a PowerLink PLC system is processing the commands via the CSPi for transmission via the high voltage line of the PLC link. Optionally a digital transmission via the LID- Interface is possible with additional digital transmission lines, e.g. for a secondary transmission path.

NOTE

The Digital Line Equipment DLE and the fiber-optic connection with FOM modules are applicable in Power-Link 100 only.

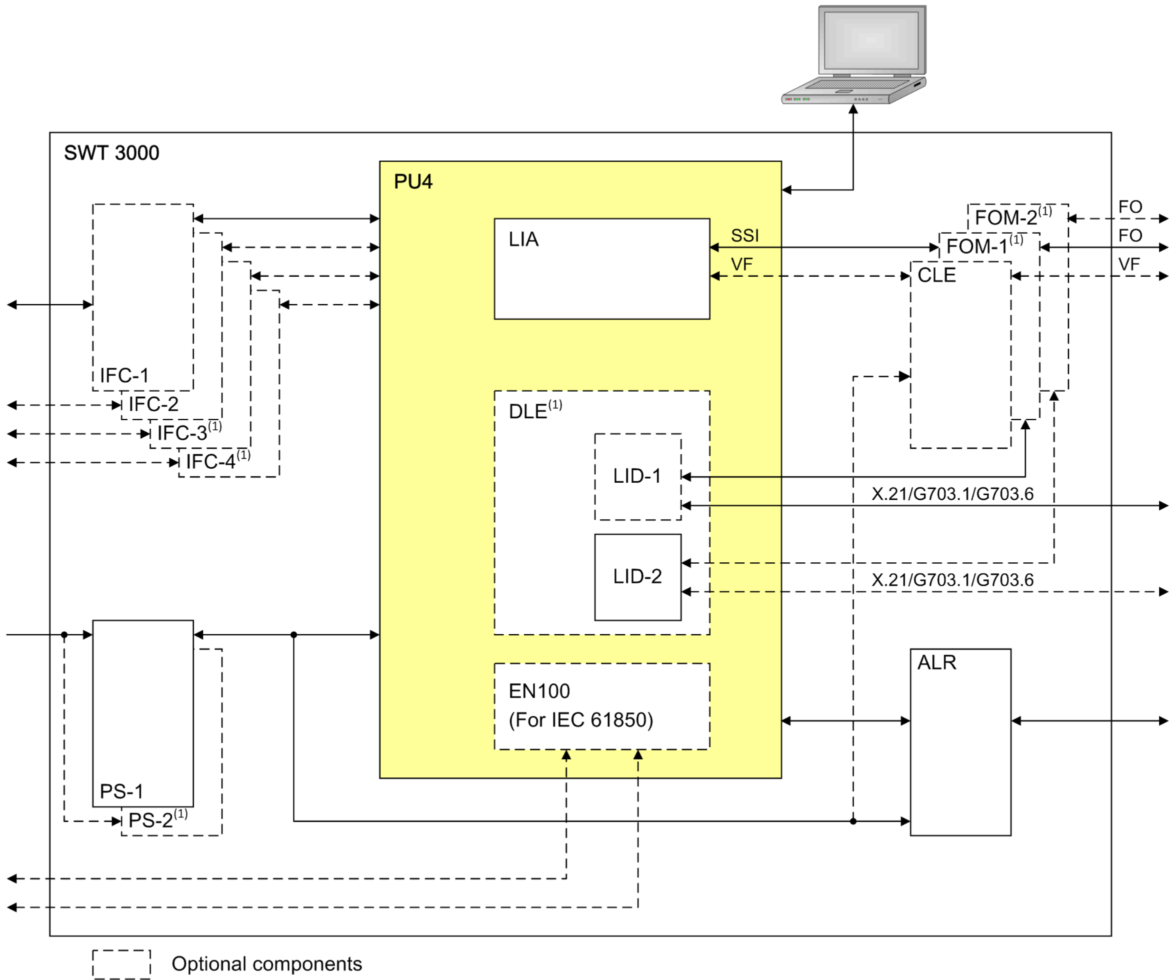


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Figure 2-71 Block Diagram of the SWT 3000 Unit

1)	for PowerLink 100
IFC	Interface command module
PS	Power supply
PU4	Processing unit module
LIA	Analog line interface
DLE	Digital line equipment
LID	Digital line interface
EN100	Ethernet EN100 module for IEC 61850
FOM	Fiber-optic module
CLE	Copper line equipment
ALR	Alarm module
SSI	Serial synchronous interface
VF	Voice frequency
FO	Fiber-optic connection

A DLE submodule can optionally expand the PU4 module for digital transmission paths accommodating the 2 digital line interfaces LID-1 and LID-2. These interfaces are used for transmitting the protection commands via a digital network (SDH/PDH). They can also be directly connected without network. You can also connect the LID to a multiplexer system via a FOM module.

If the PU4 and the IFC modules are integrated in the PowerLink unit, the frequencies are forwarded directly to the CSPi module via the SSI interface without D/A - A/D conversion.

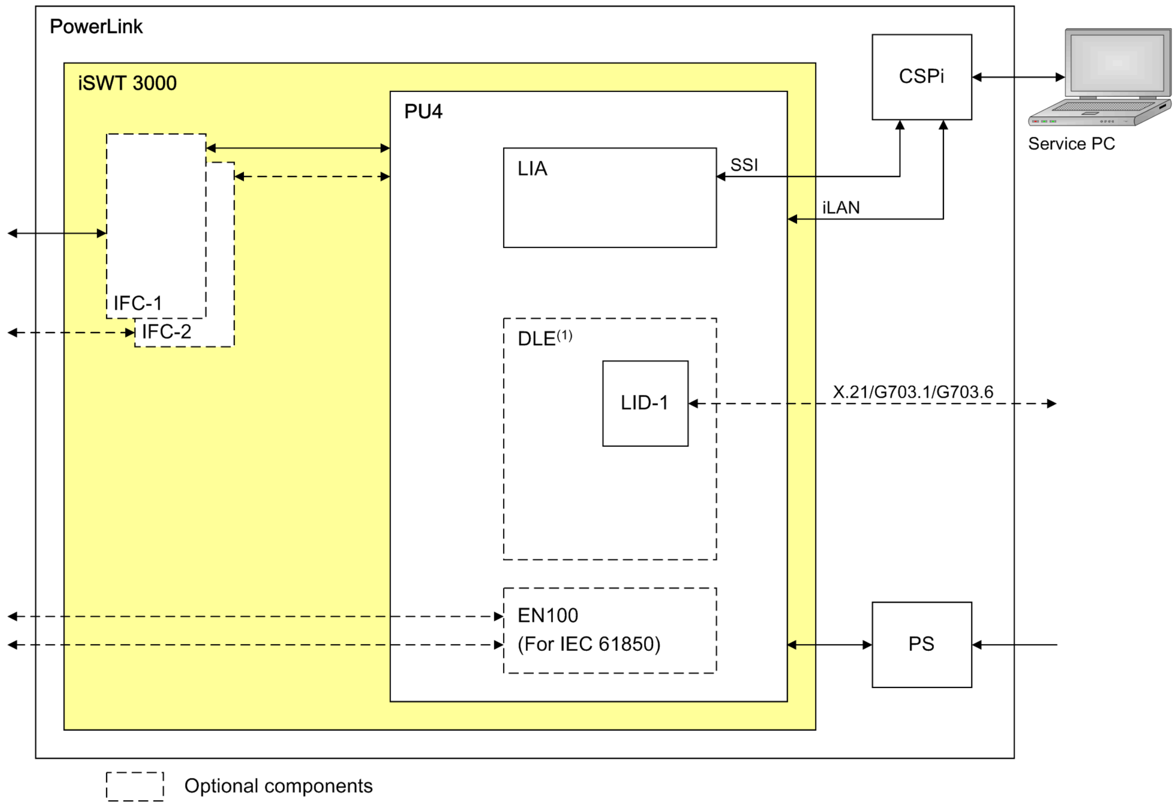

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Figure 2-72 Block Diagram of the SWT 3000 Unit Integrated in the PowerLink

1)	for PowerLink 100
IFC	Interface command module
PU4	Processing unit module
LIA	Analog line interface
DLE	Digital line equipment
LID	Digital line interface
EN100	Ethernet EN100 module for IEC 61850
SSI	Serial synchronous interface
iLAN	Internal LAN
CSPi	Central signal processing unit
PS	Power supply

At the receive side, the incoming commands are received in the VF range or digital depending on the operating mode.

These commands are converted into one of the following cases:

- Binary protection commands, and forwarded to the IFC-D/P module for command output.
- GOOSE command and forwarded to EN100 module for command output

Apart from coding and decoding of protection commands, the PU4 also performs various **monitoring functions**.

For example, the receive and transmit levels are fed via measuring points to the PU4 where they are compared with the permissible values. If these levels are not reached, the PU4 activates an alarm. In the normal situation, that is, if there is no protection command transmitted, the guard signal is sent to the remote station.

Loss of a wanted signal (command or guard tone) triggers a receive alarm at the receive side and causes the relay outputs of the device to block. This alarm state can only be canceled by receiving the guard signal again.

When the unit is started, a self-test is carried out. A watchdog also monitors the functionality of the internal Digital Signal Processor (DSP). If there are failures, the transmitter output and the relay outputs of the unit are blocked. An overview of the functional units of the PU4 is shown in the following diagram:

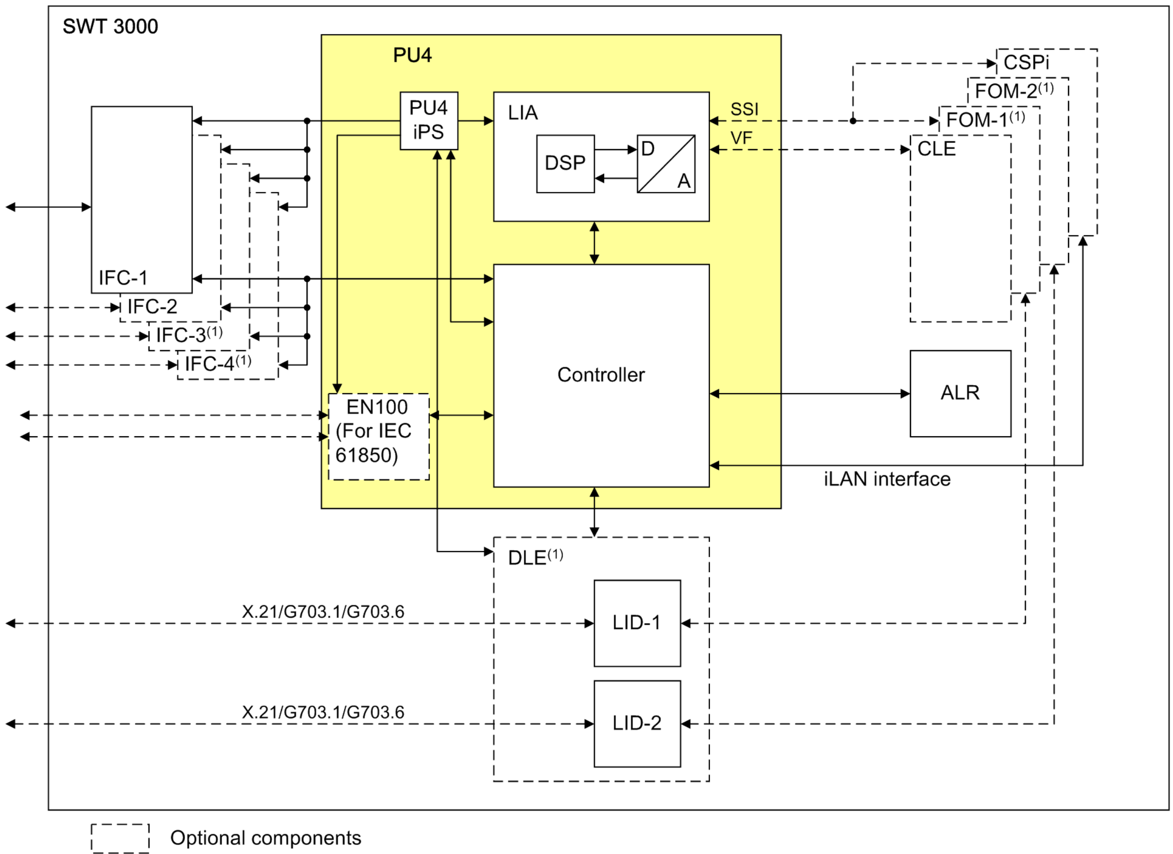

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Figure 2-73 Functional Units of the PU4 Module

1)	for PowerLink 100
IFC	Interface command module
PU4 iPS	Internal power supply of the processing unit module
PU4	Processing unit module
LIA	Analog line interface
DSP	Digital signal processor
DLE	Digital line equipment
LID	Digital line interface
EN100	Ethernet EN100 module for IEC 61850
FOM	Fiber-optic module
CLE	Copper line equipment
ALR	Alarm module
CSPi	Central signal processing unit
SSI	Serial synchronous interface
VF	Voice frequency

2.4.8.2 Functional Units

The PU4 module consists of the following functional units:

- Internal power supply
- Controller
- Analog line interfaces with digital signal processor
- Digital line equipment, which intercommunicates via an interface (for PowerLink 100)
- Ethernet EN100 module (optional)

2.4.8.3 Internal Power Supply

The internal power supply generates the voltages needed on the module that are not fed externally:

- Supply voltages for the analog line interface
- Switched 12 V supply voltage for the relays on the IFC modules

The 12 V operating voltage for the IFC modules can be switched from the controller and allows selective disabling of the output relays. The operating voltages on the module are monitored. Loss of a voltage generates a reset and an alarm on the module.

2.4.8.4 Controller

The controller is the central element of the PU4. It controls communication with the analog line interface, the digital line unit, the local (service) interface for the service PC, the LAN, and the alarm interface. You can load equipment variants and user data via the local interface or via the iLAN interface. The service program PowerSys is responsible for the administration of the possible equipment variants for the DSP.

The controller carries out the entire administration of memory space. Available RAM/PROM:

- NV-RAM for event recorder
- SRAM for working memory
- FPROM for program memory

The controller also implements the data exchange in the transmit and receive direction with the interface module IFC-D/P and IFC-S. The controller reads the data from the IFC module, which is fed via an input buffer into a register. The controller writes the data relating to the IFC module also into this register per interrupt. The data reaches the IFC module via an output buffer.

If an error is detected in the SWT 3000 unit, a message to this effect is output via an interface to the alarm module ALR. If the PU4 is used in PowerLink, the alarms are forwarded to the CSPi and the alarm is output on the ALR module of PowerLink.

2.4.8.5 Analog Line Interface

The LIA sets up the connection of the module to the analog protection command transmission and consists of a DSP, operational amplifiers, and analog switches.

DSP generates the necessary command frequencies and communicates with the transmission interfaces. Depending on the equipment variant, these transmission interfaces are the interfaces to the Intermediate Frequency (IF) modules or to the CLE.

All necessary information is loaded with the equipment variant via the service program. The controller writes the information into the DSP via an interface. During operation, this interface is used to transmit protection commands and parameters. The controller can read and write DSP memory cells, and can also transfer commands and trigger various interrupts.

The controller triggers an interrupt in the DSP for the transmission of outgoing protection commands. For the receiving of incoming protection commands, the DSP triggers an interrupt in the controller. The controller continuously monitors the functionality of the DSP with a watchdog function.

2.4.8.6 Control and Display Elements of the PU4 Module

Control and display elements are mounted on the module. The front panel covers some of them.

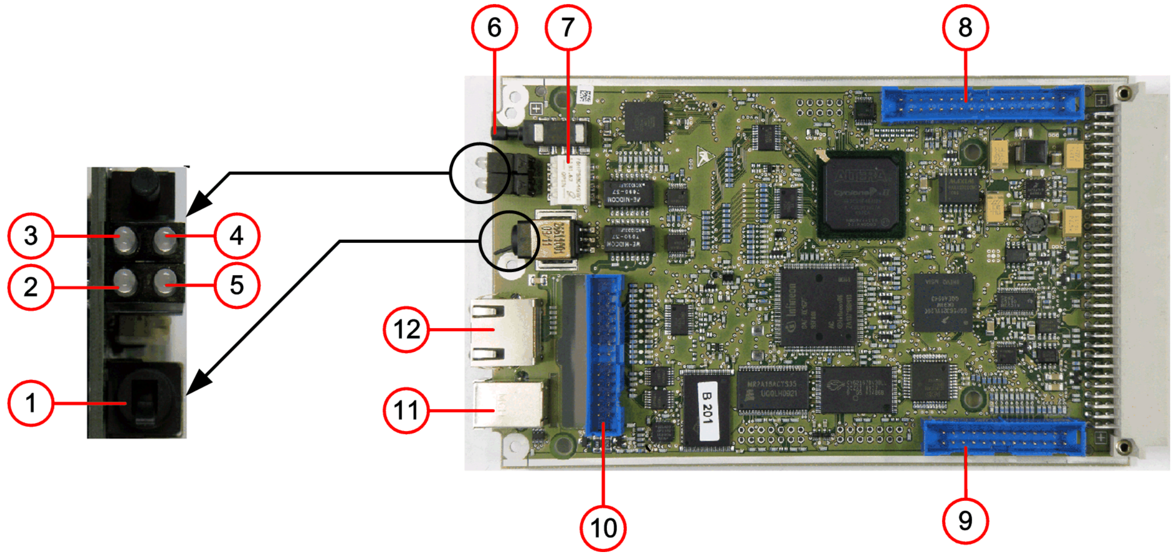

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Figure 2-74 Position of Jumpers, Input and Signaling Elements on the PU4 Module

1	S2: Power ON/OFF
2	LED OK/GBAL
3	LED Status Interface LID-2 (for PowerLink 100)
4	LED Status Interface LID-1 (for PowerLink 100)
5	LED Status Interface LIA
6	S1: Reset button
7	S3 (3.1 to 3.4)
8	Connection on DLE (for PowerLink 100)
9	Connection on DLE (for PowerLink 100)
10	Connection of the IFC Modules
11	LCT: Service Interface (USB)
12	NMS: Ethernet Interface

- The 2-color LIA LED is needed for displaying the status of the LIA. The following states can be displayed:

Table 2-28 Significance of the LIA LED Displays

State	Significance
Off	LIA is not configured
Red static	LIA is not ready for operation (for example, primary path receiver alarm)
Red flashing	LIA is only operational to a limited extent (for example, secondary path receiver alarm)
Green static	LIA is working correctly and used as main path.
Green flashing	Secondary path

NOTE

Red flashing always means that the secondary path is not working correctly.

- The 2-color LID-1 LED is used for displaying the status of the LID-1. The following states can be displayed:

Table 2-29 Significance of the LED LID-1 Displays

State	Significance
Off	LID-1 is not configured
Red static	LID-1 is not ready for operation
Red flashing	LID-1 is only operational to a limited extent (for example, receiver alarm)
Green static	LID-1 is functioning correctly
Green flashing	Secondary path

- The 2-color OK/BGAL LED is needed for displaying the PU4 module status. The following states can be displayed:

Table 2-30 Significance of the OK/BGAL LED Displays

State	Significance
Off	Power supply is disconnected or faulty
Red static	Module is not ready for operation
Red flashing	General alarm module is only operational to a limited extent
Green static	Normal operation
Green slow flashing	Test operation
Green fast flashing	Ethernet port of PU4 is not ready for operation

2.4.8.7 Access to the Integrated SWT 3000 (iSWT)

In this operating mode, the local (service) interface is connected to the controller of the CSPi module of the PowerLink unit via iLAN. The user-service interface is located on the CSPi from which the parameters of the PU4 module are also set. The USB plug on the front panel of the PU4 is not used.

2.4.8.8 Event Memory and Real-Time Clock

Protection commands and alarms are provided with time and date and a registration number before they are entered in the event memory. Up to 8192 entries with a time resolution of 1ms are possible. They are read out by the service PC and this is also possible from the distant station by means of Remote Monitoring. The following events are entered:

- Incoming protection commands from IFC-D/P and EN100
- Outgoing protection commands to the IFC-D/P and EN100
- Detected alarms
- Program restart
- Changing date and/or time
- Changing the configuration

In case of an overflow the oldest entry in the event memory is overwritten.

The **real-time clock** supplies the time marker for the particular entries. It is possible to synchronize the local time with an external signal (SYNC). The synchronizing pulse is fed into the SWT 3000 unit via a surge-proof, floating signal input on the alarm module ALR/ALRS. Synchronization can be configured in minute or hourly intervals with the positive or negative edge of the pulse.

The external SYNC pulse is recognized by the PU4 controller of the SWT and processed. The evaluation of the rising or falling pulse edge can be parameterized.

The local sync pulse must be received in a **1 minute** interval via signal input USYNC. Clock synchronization can be done when:

- second > 35 (time is set to xx:xx:59.99) or
- second < 25 (time is set to xx:xx:00.00)

With the ALR module the clock synchronization is also possible with IRIG-B message. For more information refer to Chapter *Commissioning*.

Event memory and clock module are buffered so that no data is lost in the event of a power failure (data retained for about 2 hours without supply voltage).

2.4.8.9 Master - Slave Clock Synchronization

It is also possible to carry out a clock synchronization (USYNC) between the 2 iSWT of a transmission route with a control command. For this purpose the PU4 modules of a transmission route must be configured as USYNC master and USYNC slave.

The USYNC master transmits a synchronizing tone (fs) to the USYNC slave instead of the guard tone. If the time in the slave when receiving the fs is

- more than XXh59m01s the time is adjusted to XXh59m59s99
- less than XXh:01m it is synchronized, to XXh00m00s00.

The line synch. hour is adjustable and has to be the same for Master and Slave device.

2.4.8.10 The Digital Line Equipment (DLE) for PowerLink 100

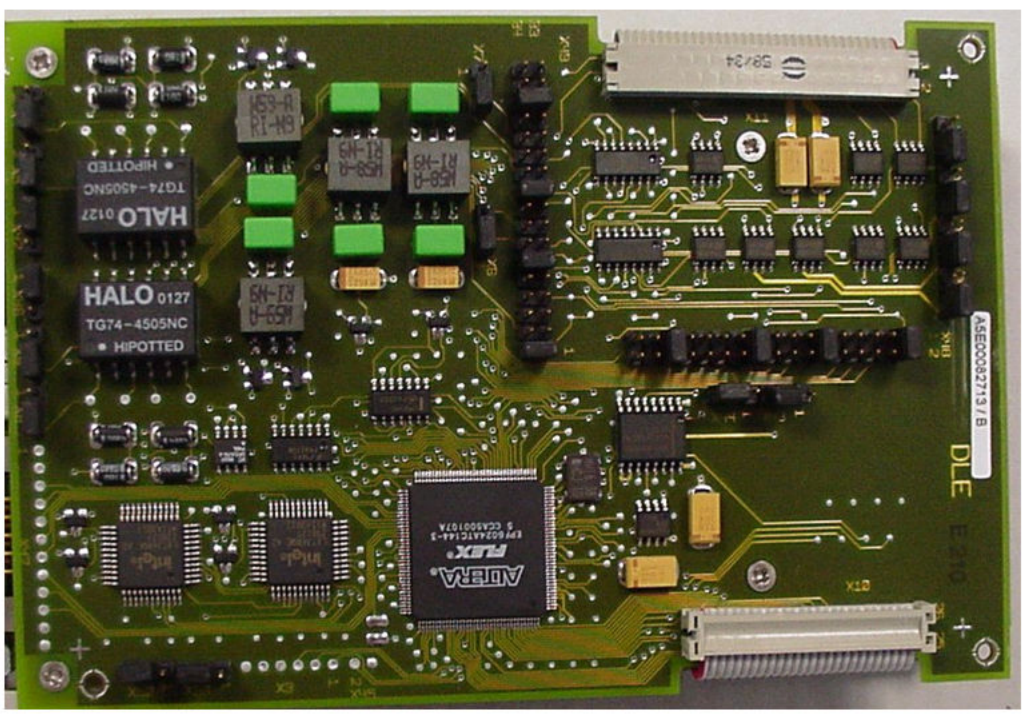

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Figure 2-75 The digital line equipment DLE

The digital line interface LID-1 of the iSWT is implemented on module DLE. This interface enables the transmission of the protection commands via a digital network (SDH/PDH). The data for the remote maintenance and the service channel interfaces and the system-internal control information are transmitted additionally.

The DLE module is designed as a self-contained PC board connected electrically to the PU4 via a ribbon cable and mechanically via spacer sleeves. All external interfaces are routed via the PU4 module. The following hardware interfaces are available:

The following hardware interfaces are available:

- X.21 (64 Kbps)
- G703.1 (64 Kbps)
- G703.6 (2 Mbps)

NOTE

Multipath transmission can be implemented by using the analog interface LIA on the PU4, and LID-1.

2.4.9 The Interface Modules IFC

2.4.9.1 General Information

Overview

The interface module IFC is used for communication between protection equipment and the iSWT. The following versions are available:

- Interface Command module **IFC-D** (high contact load, e.g. for direct tripping)
- Interface Command module **IFC-P** (normal contact load, e.g. for permissive tripping)
- Interface Command module **IFC-S** (for signaling)

IFC Module Equipment in integrated SWT 3000 systems

For an integrated SWT 3000 unit in PowerLink you can insert up to 2 IFC-D or IFC-P modules into the module slots IFC-1 and IFC-2 of the PowerLink subrack. Slot IFC-2 alternatively can be equipped with an IFC-S module.

If 2 IFC-D/P modules are equipped they can be used for contact doubling. The inputs are not used because the maximum number of commands is 4. In this case, activate the function Contact doubling in the Special allocation list box.

2.4.9.2 Description of Operation

Overview

IFC-D — The IFC-D module has 4 binary inputs for receiving contact information from the protection devices. Up to 4 circuit breaker coils can also be operated with this module. It is thus possible to implement the trigger commands **directly** from a distant station, for example, without a protection device. This module is preferably used for direct tripping mode but the use in protection systems with permissive tripping is also possible.

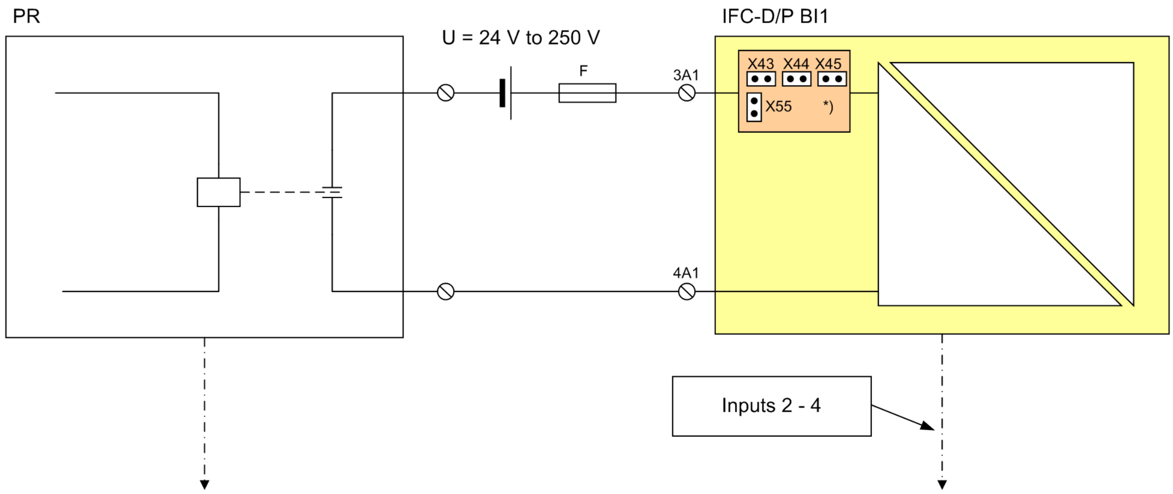
IFC-P — The IFC-P module is preferably used in protection systems with permissive tripping. When observing the maximum switching current of the relays, direct tripping of circuit breaker coils is also possible (refer to *Technical Data*). There are similarly 4 binary inputs and 4 command contact outputs available. The contact rating of the output relays is lower compared to the IFC-D module but operating times are shorter. IFC-D and IFC-P modules are pin-compatible.

IFC-S — The IFC-S is used for signaling. Each command input as well as each command output in the corresponding IFC-D/P is activating a relay on the IFC-S.

The IFC-S module is used for:

- Signaling commands that are entered (binary inputs)
- Signaling commands that are output (binary output)

Connection Principle



[dw_SWT_baseim, 1, en_US]

Figure 2-76 Basic Connection of IFC-D or IFC-P Modules

*)	Setting the rated voltage 24 V, 48 V/60 V, 110 V, 250 V
IFC-D/P BI 1	IFC Binary Input 1
PR	Protection Relay
3A1 - 4A1	Terminals Binary Input 1
F	Fuse

NOTE

Each interface needs its own shielded, twisted wire cable.
The binary Input cabeling shall not run in parallel with other power supply or heavy load cables.

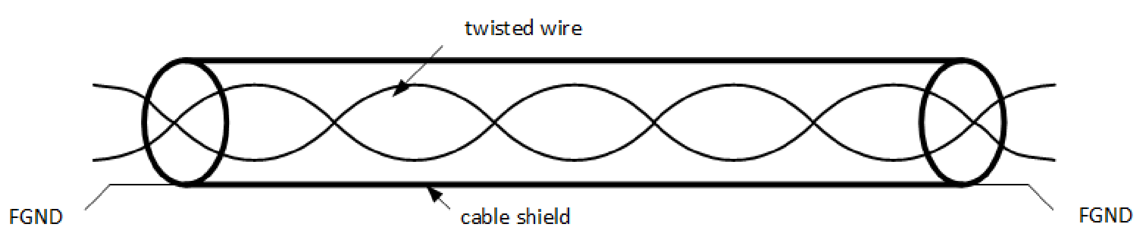


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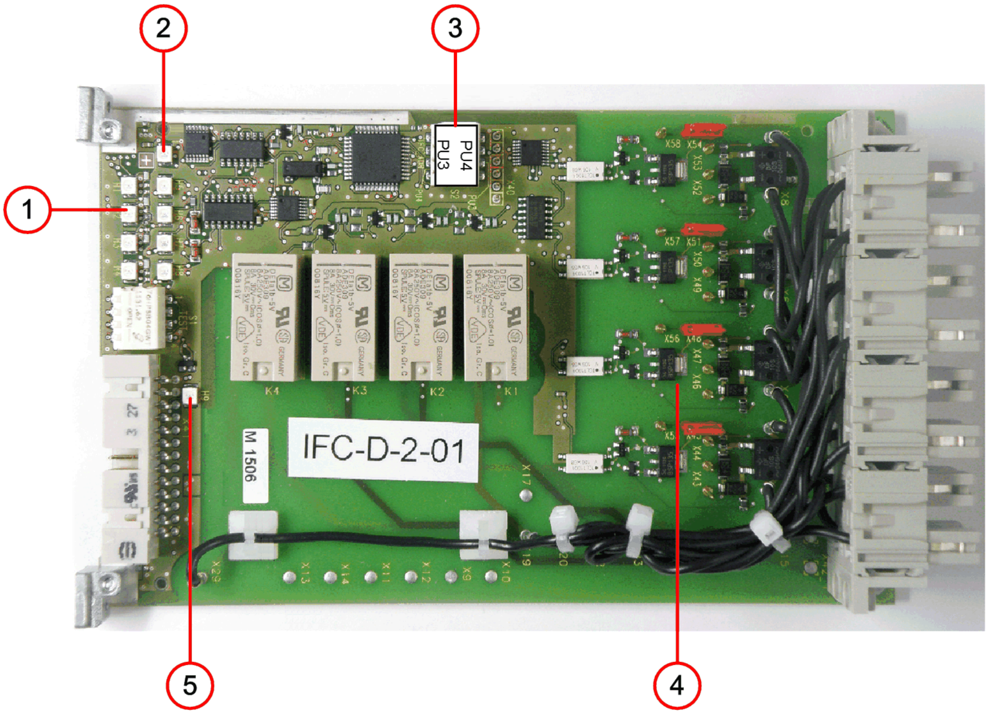
Figure 2-77 Shielded twisted wire cable



[scjumper-220513-01.tif, 2, en_US]

Figure 2-78 Signaling elements and DIL-switches of the IFC module, e.g. IFC-D

(1) LED H1 to H4 (red): activated outputs
LED H5 to H8 (green): activated inputs

(2) Test Operation Display (H10)

(3) S2: IFC Slot Address Selection (S2.1, S2.2) and PU3 / PU4 switch:
S2.3: closed/down - PU3
S2.3: open/up - PU4

(4) Jumpers X43 to X58

(5) Operating LED (H9)

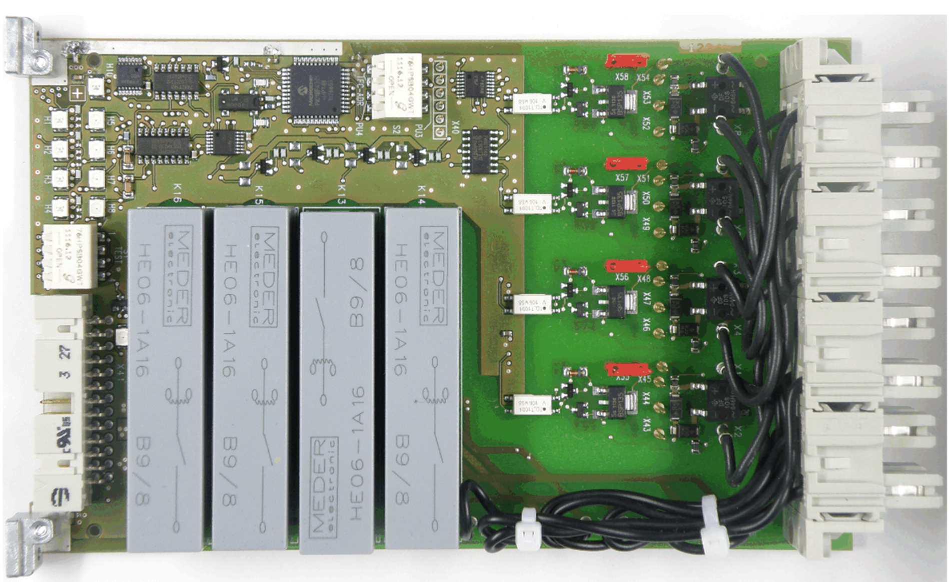


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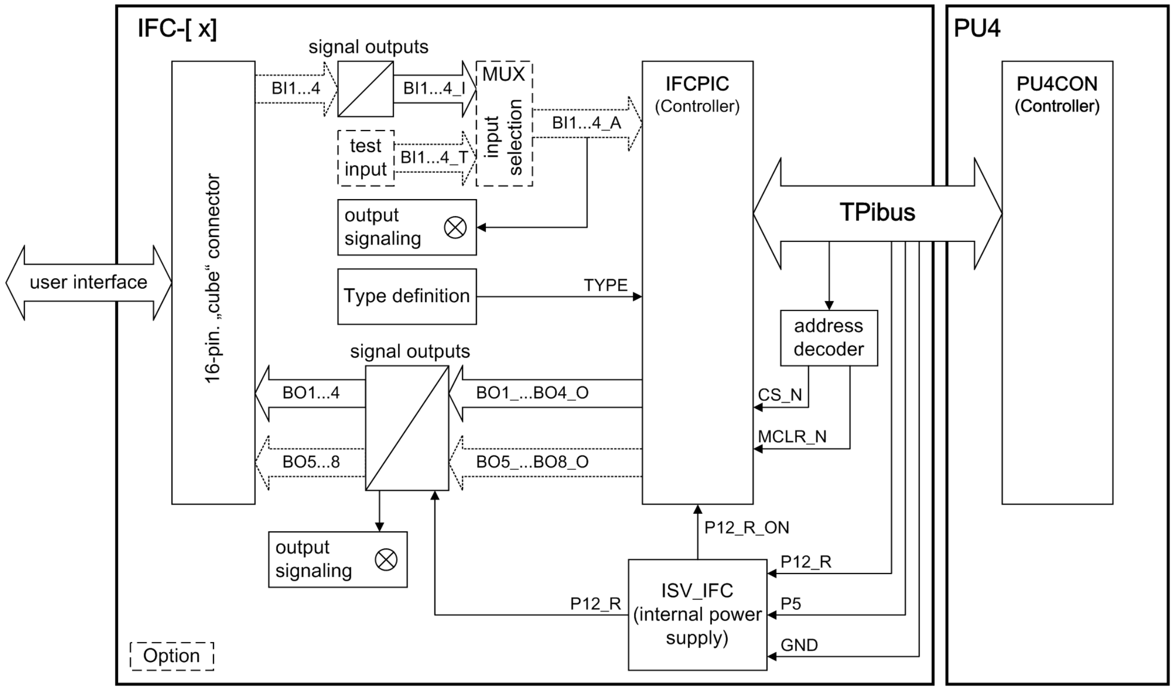
Figure 2-79 IFC-P Module



[dwifcblc-051011-01.tif, 1, en_US]

Figure 2-80 Block Diagram of IFC Modules

TPi-Bus	Internal bus
MUX	Multiplexer
ISV_IFC	Internal power supply IFC
P12_R	12-V supply voltage for relays
P5	5-V supply voltage
P12_R_ON	12-V supply voltage available

2.4.9.3 Controller

A controller is used on all IFC interface modules for the following functions:

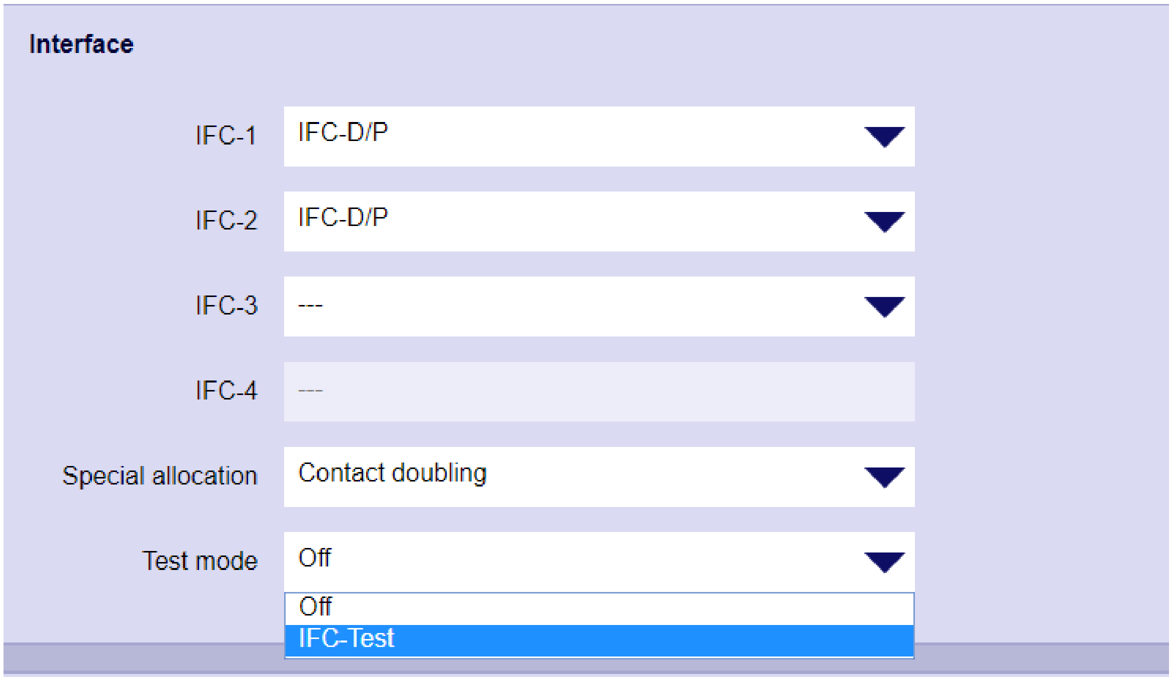
- Control of the data traffic from/to the PU4
- Sampling the signal inputs 1 to 4 and triggering an interrupt at the PU4 in case of changes.
- Switching the command relays via the signal outputs.
- Supervision functions

The controller is connected to the PU4 controller via an internal bus.

2.4.9.4 Test Mode

Overview

In order to switch over from normal to test mode with the service program PowerSys, select the **IFC-Test** in the **Test mode** list box under **Command interface**. In this mode, you can enter commands on the IFC module for each input with the Dual Inline Package (DIP) switches S1.1 to S1.4.



[sc_ifc_test, 1, --_--]

Figure 2-81 Selection of Testmode > IFC-Test

NOTE

For security reasons, after switching over to test mode, the controller signals all inputs as **off** regardless of the actual switch position. You can reach the state **on** by switching from **off** to **on** position. All switches must be in the **off** position beforehand. As long as test mode is active the IFC inputs are disabled.

Displays

The activated output relays are displayed with LEDs H1 to H4 (red), and the activated binary inputs with LEDs H5 to H8 (green).

Refer to *2.4.9.2 Description of Operation* for more details.

2.4.9.5 Slot and Module Identifier

The new IFC modules can also communicate with the old TPi-Bus (PU3). For this purpose, no additional signal from PU4CON (PU4 controller) can be used for IFC addressing.

A DIP switch S2 is added to each IFC module to indicate its slot address.

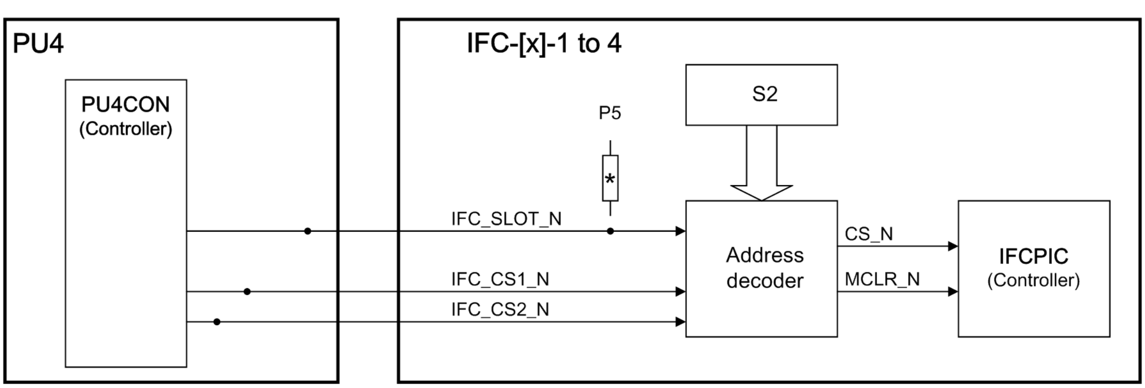


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Figure 2-82 IFC Addressing Used for SWT 3000

Table 2-31 Function of S2 Switch

Switch	Function
S2.1	IFC slot address selection
S2.2	IFC slot address selection
S2.3	PU3 or PU4 selection
S2.4	Not connected

IFC slot address is configured by changing the state of DIL switches, and it is independent of the position where it is located. The 4 slot addresses are mapped into different switching states. The assembled IFCs must have individual addressing, even when they are not configured.

Table 2-32 IFC Slot Address

Selection	S2.1 Position	S2.2 Position
IFC-1	Open = up position = OFF	Open = up position = OFF
IFC-2	Close = down position = ON	Open = up position = OFF
IFC-3	Open = up position = OFF	Close = down position = ON
IFC-4	Close = down position = ON	Close = down position = ON

NOTE

The Slot addresses IFC-3 and IFC-4 are only applicable in SWT 3000 stand-alone devices.

IFC modules can be used as spare in actual SWT 3000 with the PU3 module.

Table 2-33 PU3 or PU4 Selection

Selection	S2.3 Position
PU3	Close = down position = ON
PU4	Open = up position = OFF

The function of address decoder in IFC module is adapted as follows:

- Input
  - Input signals from DIP switches, which indicate the slot address of IFC module
  - Input signals from PU4CON (PU4 controller), which specify the required slot address for accessing IFC module
- Process
  Compare the required slot address with local address to see if it is matched.
- Output
  Output signals to IFCPIC (IFC controller) to indicate if the slot is selected.

IFC_SLOT_N	IFC_CS1_N	IFC_CS2_N	Function
1	0	0	Reset PIC on IFC-1 to IFC-4
0	0	1	Select IFC-1
0	1	0	Select IFC-2
0	1	1	Select IFC-3
0	0	0	Select IFC-4

NOTE

The Slot addresses IFC-3 and IFC-4 are only applicable in SWT 3000 stand-alone devices.

For connecting the redesigned IFCs to PU4, all IFCs are connected in parallel on a ribbon cable (26 pins) for TPi-Bus to the PU4 module.

NOTE

If the new IFC board is used as spare part in SWT 3000 with the PU3 module, use a suitably configured ribbon cable for the slot identification function.

For more details, refer to table *Table 2-33* For the selection of PU3 on the IFC module..

The IFC controller manages the input register (IFC_EREG) which is readable by PU4 controller. The PU4 controller can identify the IFC type (IFC-D/P or IFC-S) by reading the content of IFC_EREG.

IFC-P, IFC-D and IFC-S boards are based on the same Printed Circuit Board (PCB). The type depends on the various hardware assembling options. The assembling options can be identified via the status of the **TYPE** input of the IFC controller.

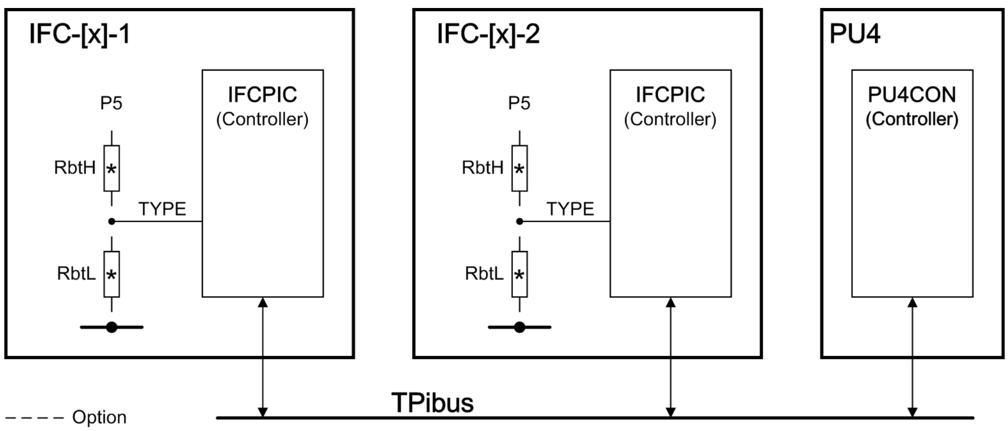

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Figure 2-83 Principle of IFC Type Identification

The assembling of the resistors RbtH and RbtL depends on the specific board type. The state of the board type input is readable by PU4 controller.

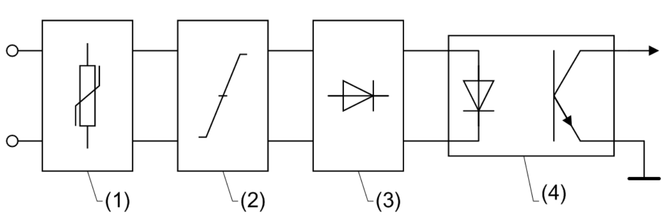
Table 2-34 IFC Type Configuration

RbtH	RbtL	TYPE	Comment
Not installed	0 Ω	0	IFC-D or IFC-P
22 KΩ	Not installed	1	IFC-S

2.4.9.6 Signal Acquisition via Binary Inputs

If the binary inputs (BI1 to BI4) of the module detect a signal, an interrupt request is sent to the PU4. The IFC module is connected to the PU4 via a ribbon cable via connector X3 at the front. If an interrupt is detected, PU4 can read the status of the binary inputs.

In order to suppress interference pulses, a signal must be applied to the binary input for at least 1 ms before the interrupt request is sent. The following figure shows the block diagram of a binary input:



[dwcsem34-051011-01.tif, 1, en_US]

Figure 2-84 Binary Inputs of Modules IFC-D and IFC-P

(1) Protective circuit
The protective circuit provides the required security against destruction and interference.

(2) Setting of the input rated voltage
You can set the input rated voltage to the values DC 24 V, DC 48/60 V, DC 110 V, and DC 250 V with the jumpers X43 to X58. The operating point is at 80 % of the selected voltage.
Refer to Chapter *Jumper Settings for the IFC Modules* for more details

(3) Rectifier
Rectification ensures that the input signal is polarity-neutral.

(4) Optocoupler
The optocoupler isolates the input circuit electrically from the electronic system.

2.4.9.7 Signal Output from the IFC-D/P Module

If there is an IFC-D module, the commands from the remote station are distributed via the relays K1 to K4. If there is an IFC-P module, the commands from the remote station are distributed via the relays K13 to K16. Compared with the IFC-P module, the relays of the IFC-D module are slower but they can switch more power.

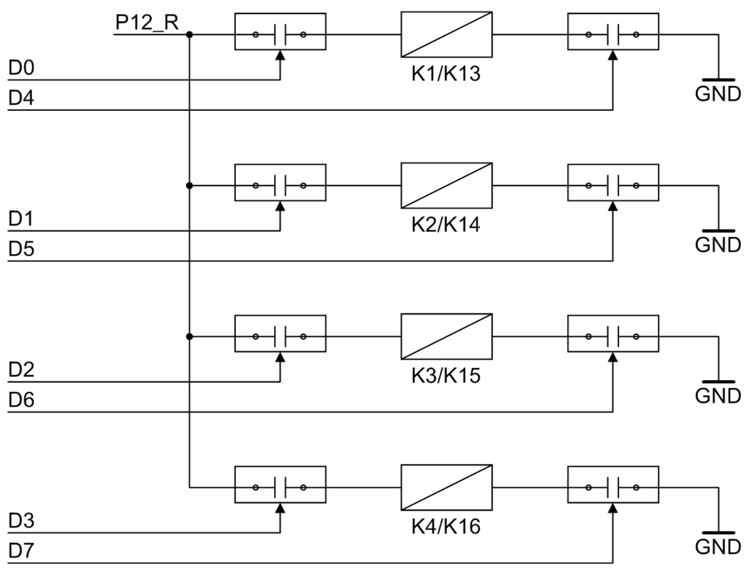


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Figure 2-85 Block Diagram of the Output Circuit of IFC-D/P

K1 - K4	Output Relays of Module IFC-D
K13 - K16	Output Relays of Module IFC-P
D0 - D7	Operation of the IFCx Controller

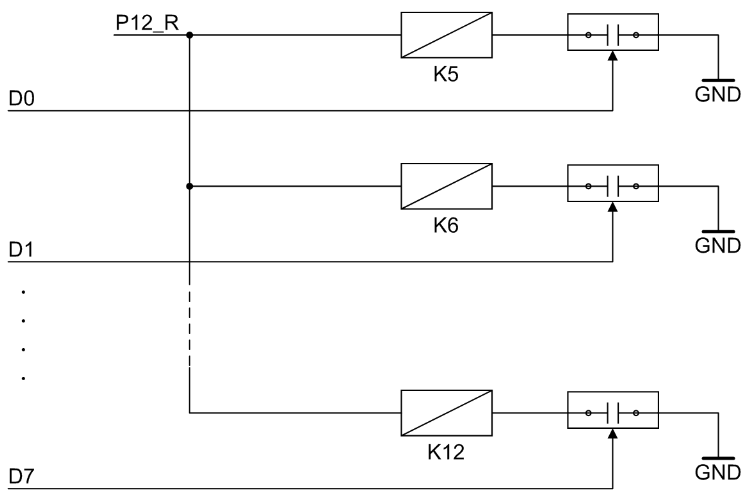
The following security systems are incorporated for sending commands without interference:

- PU4 must enable the supply voltage P12_R
- Relays are operated on a 2-pole basis

2.4.9.8 Signal Output from IFC-S Module

The messages are transmitted via the relays K5 to K12. These relays are identical with those relays on the IFC-D module. For 7 relays, one change-over contact per relay is brought out. The contact of relay K5 can be used as a make contact or break contact with jumper X42. All 8 signal relay contacts have a **common root (3A1)**.

The PU4 must enable the excitation voltage P12_R of the relay coils.



[dwcsem36-051011-01.tif, 1, en_US]

Figure 2-86 Block Diagram of the Output Circuit of IFC-S

2.4.9.9 Pinout of the IFC-x Module

The interface modules must be connected from the protective relay to the connector X1 (modular terminal block). The cable cross section must be up to 1.5 mm^2. **At least** 2 cables must be tied immediately at the terminals.

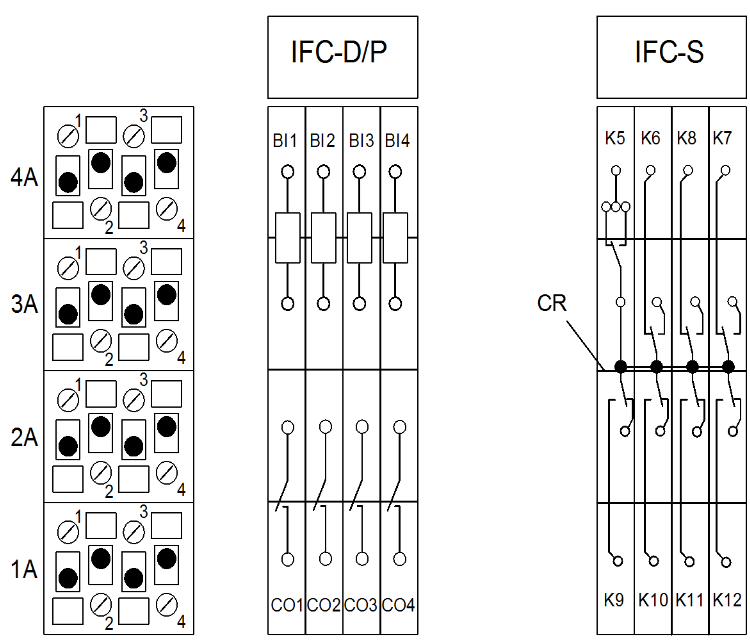


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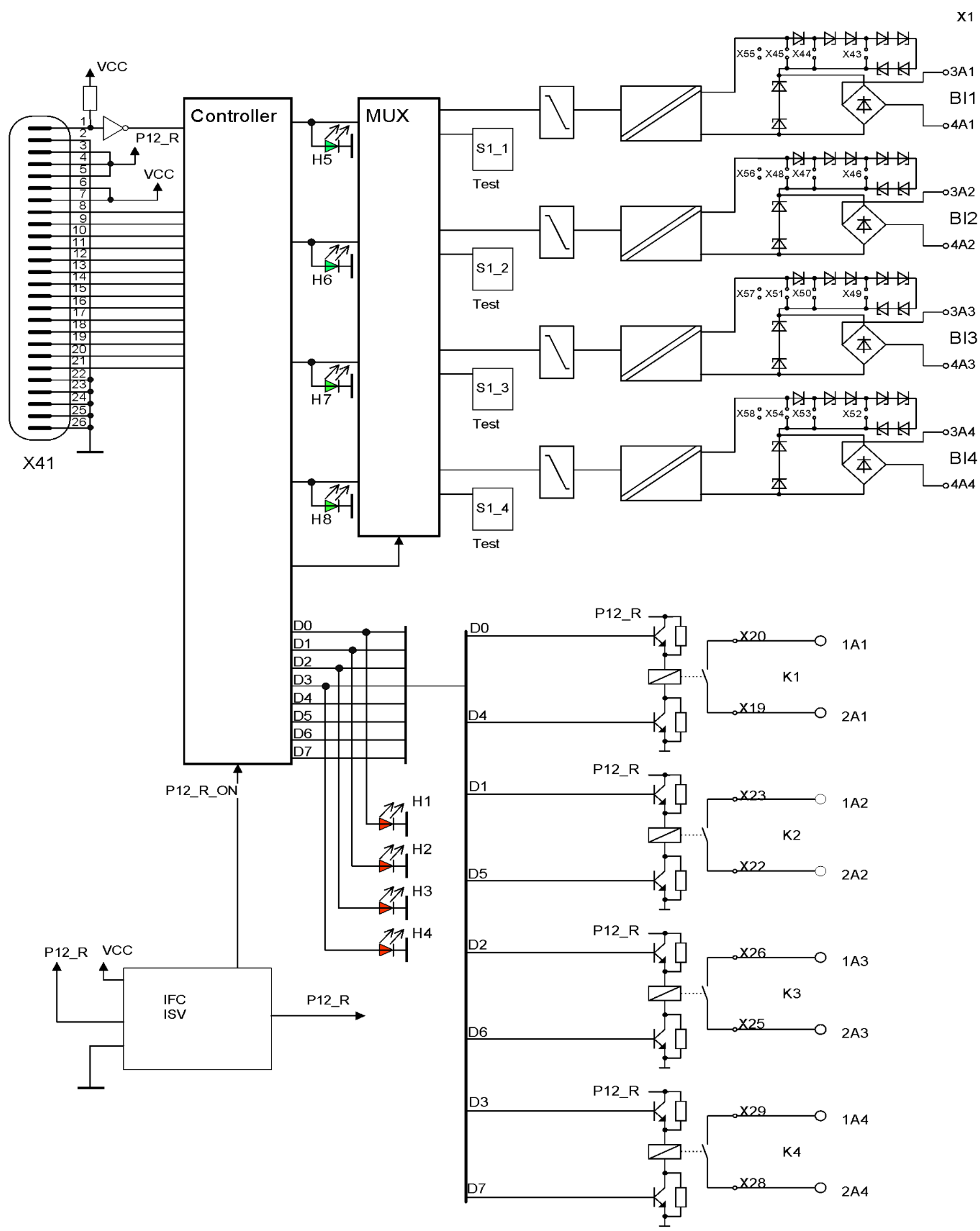
Figure 2-87 Pinout of the IFC-x Modules

IFC-D	Interface module direct tripping
IFC-P	Interface module permissive tripping
IFC-S	Interface module signaling
CR	Common root of relays K5 to K12
1A to 4A	Modular terminal block
BI1 to BI4	Binary inputs 1 to 4
CO1 to CO4	Command outputs 1 to 4

K5 to K8	Signaling of the binary inputs 1 to 4
K9 to K12	Signaling of the command outputs

2.4.9.10 Block Diagrams of IFC Modules

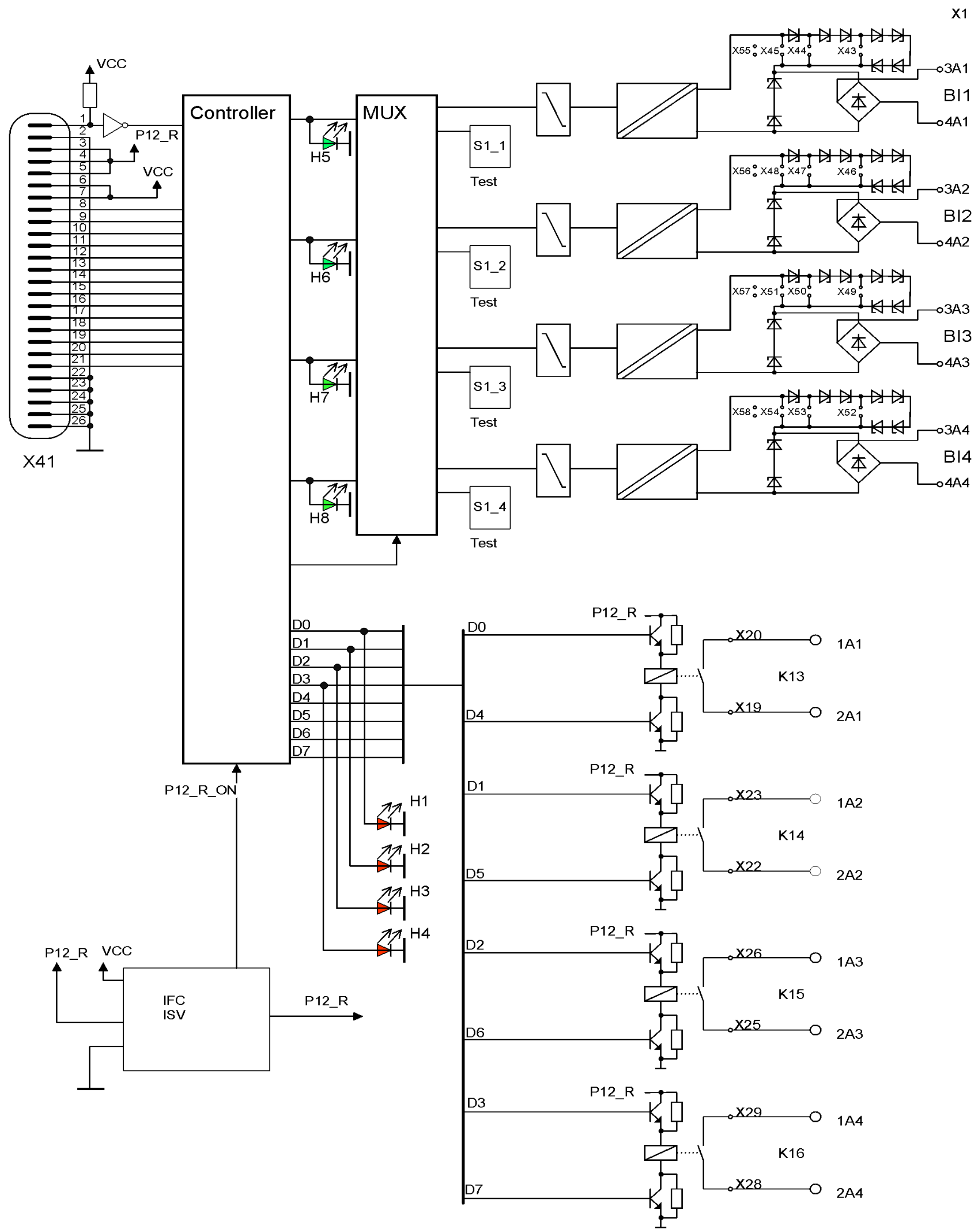
IFC-D Module



[dw_rgcsem01, 1, en_US]

Figure 2-88 Block Diagram of the IFC-D Module

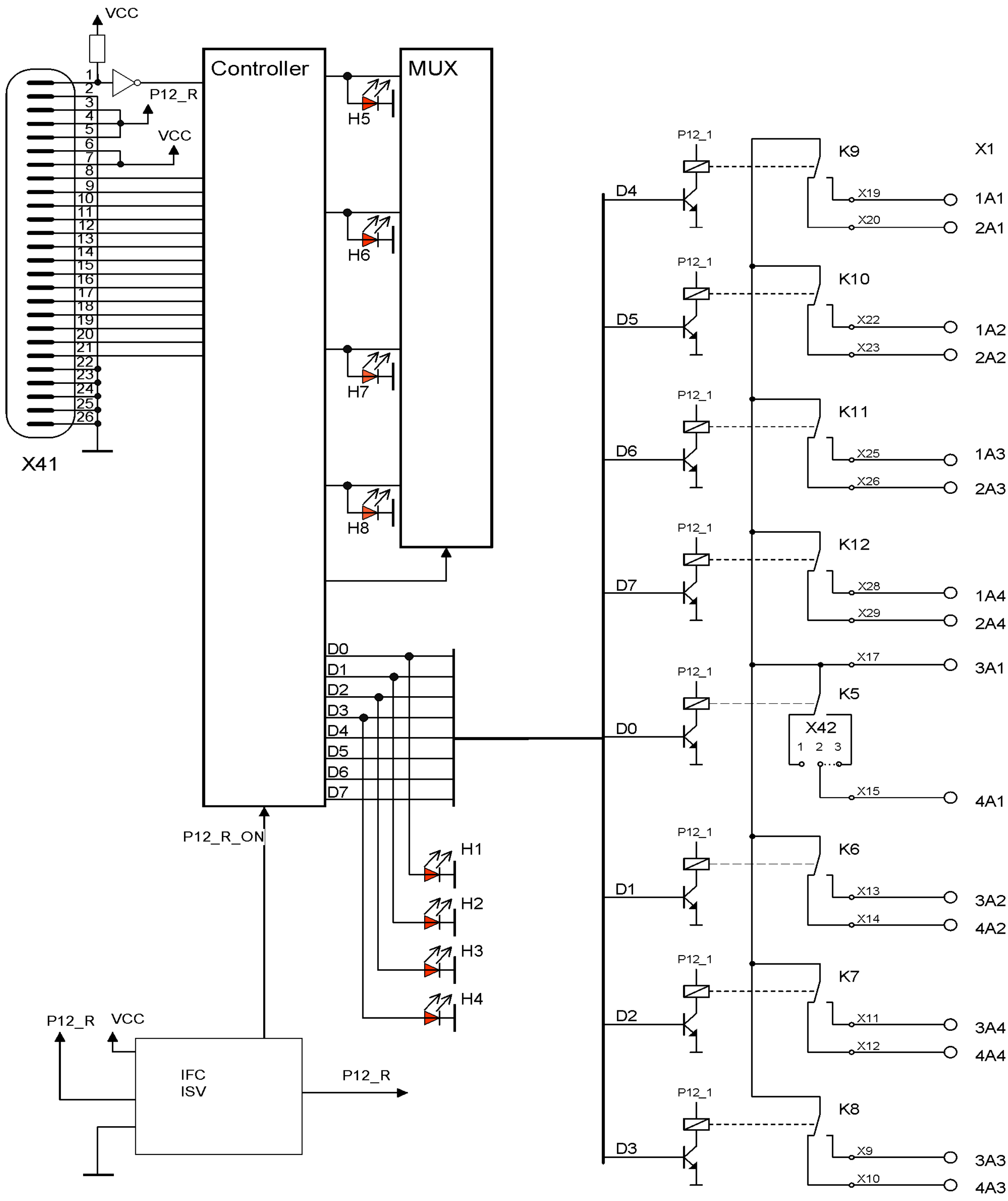
IFC-P Module



[dw_rgcsem02, 1, en_US]

Figure 2-89 Block Diagram of the IFC-P Module

IFC-S Module



[dw_rgcsem03, 1, en_US]

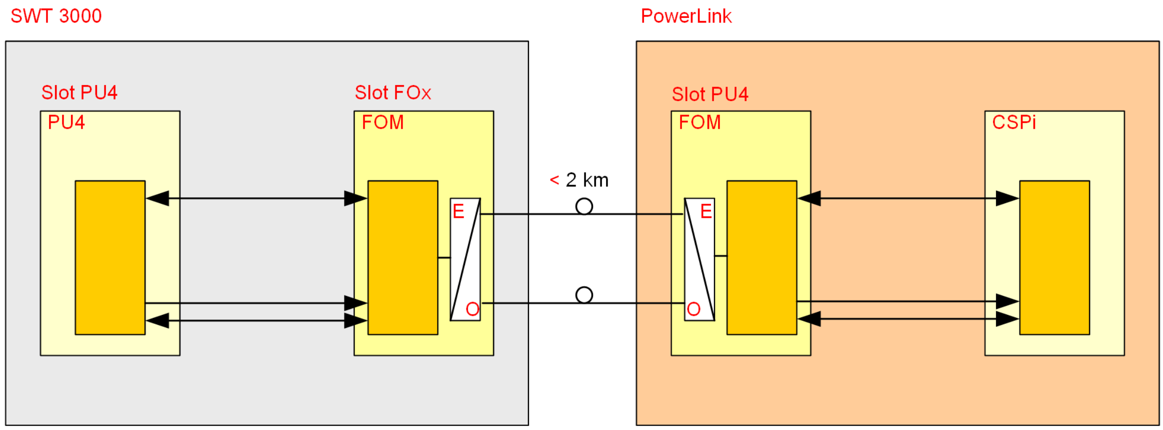
Figure 2-90 Block Diagram of the IFC-S Module

2.4.10 Fiber-Optic Modem for PowerLink 100

2.4.10.1 Overview

With the integrated Fiber-Optic Modules (FOM), it is possible to connect an SWT 3000 to the PowerLink PLC system or a multiplexer via fiber-optic cables.

2.4.10.2 Connection to the PowerLink PLC System



[dw_SWT_conswp, 2, en_US]

Figure 2-91 Connection of the SWT 3000 via Fiber-Optic Cable to the PowerLink

The SWT 3000 is connected via fiber-optic cables (for each transmission direction one fiber) to the PowerLink. The functional performance of the SWT 3000 is like an integrated SWT 3000 (iSWT). That is, all possible variants with iSWT can be carried out with the stand-alone SWT 3000 via fiber-optic cables. **The programming of the SWT 3000 in this case is only possible via PowerLink and the service program PowerSys**. In the PowerLink system, 2 SWT 3000 can be connected via fiber-optic cables (iSWT-1 and iSWT-2). The fiber-optic modules in Power Link are installed in the slots of the PU4.

NOTE

In order to integrate an SWT 3000 with PU4 into the PowerLink system, a PowerLink with CSPi (release 3.5.xxx or higher) is necessary.

The main transmission path of the SWT 3000 via Fiber-Optic cable is the PLC connection of the PowerLink via high-voltage line.
You can connect a digital alternative path of the SWT 3000 as follows:

- Direct electrical connection to the remote SWT 3000 device
- Optical connection via a second FOM

The S6 pilot wire for the switchover in the Alternate Multi-Purpose (AMP) operation is transmitted from the FOM to PowerLink.

Fiber-optic module	Small Form-factor Pluggable (SFP) module
Fiber type	Multi-mode with modules using 850-nm wavelength, single-mode with modules using 1300-nm wavelength
Wavelength	850 nm or 1300 nm
Optical connector	LC-connector
Range	Up to 2 km at 850 nm (depending on the attenuation of the fiber) No minimum attenuation limit for 1300 nm
2 x LED	Tx-Alarm and Rx-Alarm (RX + F6UE-Alarm)

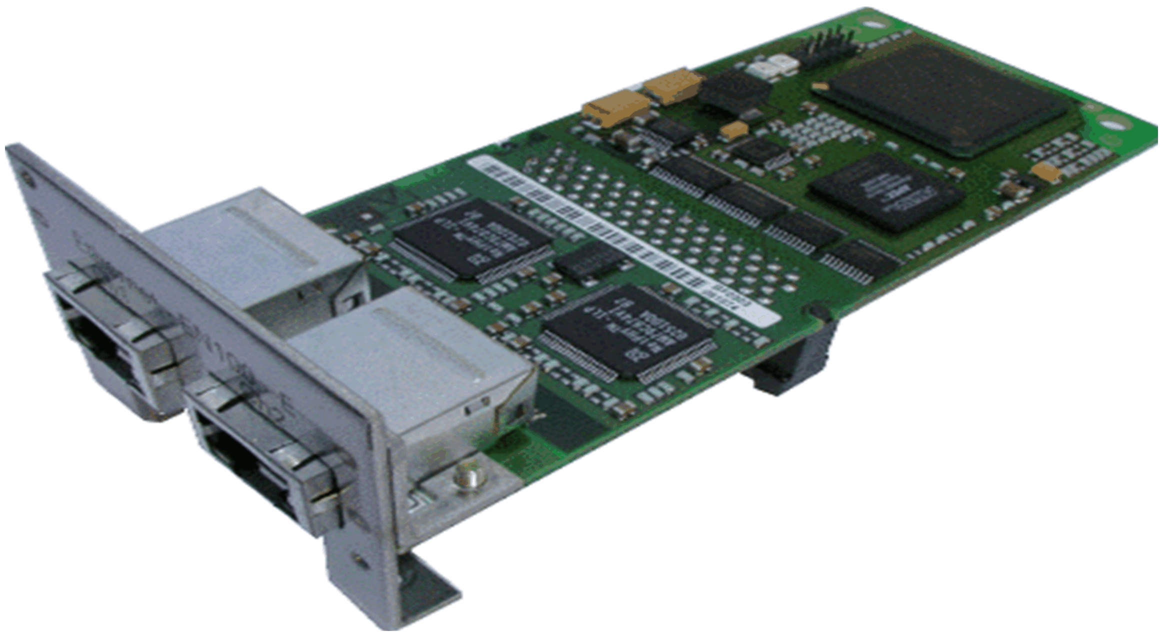
2.4.11 Ethernet EN100 Module Functional Description

2.4.11.1 Ethernet EN100 Module Functionality

The **Ethernet EN100 module** (EN100 module) enables the integration of SWT 3000 into 100-Mbit communication networks. These networks are used by process control, automation systems, and communications systems with the protocols according to International Electrotechnical Commission (IEC) 61850 standard. This standard permits uniform communication of the devices without gateways and protocol converters.

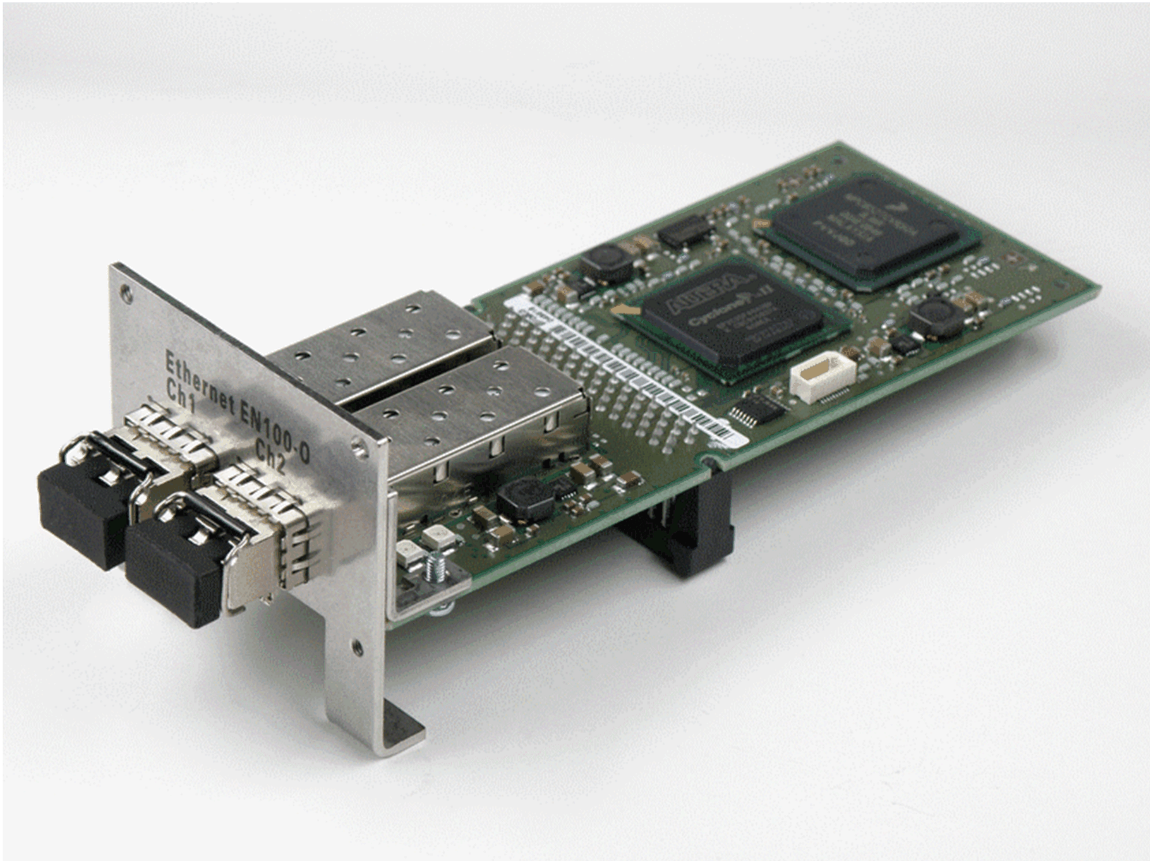
With 2 RJ45 connectors or with 2 Duplex-LC interfaces for a 1300-nm fiber-optic connection, 2 module types are available.

The following figures show the mechanical design of the EN100 module with electrical interfaces and fiber-optic interfaces for internal installation:



[scen100m-310111-01.tif, 1, en_US]

Figure 2-92 EN100 Module with Ethernet Interfaces (RJ45) for internal Installation



[scen1opt-210211-01.tif, 1, en_US]

Figure 2-93 EN100 Module with Duplex-LC Interfaces for internal Installation

The preceding modules can be used in the SWT 3000 device and are mounted on the solder side of the PU4 module via connector. These modules are connected electrically to the PU4 module via a D-sub plug connection and screwed to the PU4 module and device front panel.

The physical interface is always duplicated to permit redundant structures. One of the 2 interfaces is always active while the other interface is monitored passively. If a fault occurs on the active interface, switchover to the other interface is performed in a matter of milliseconds.

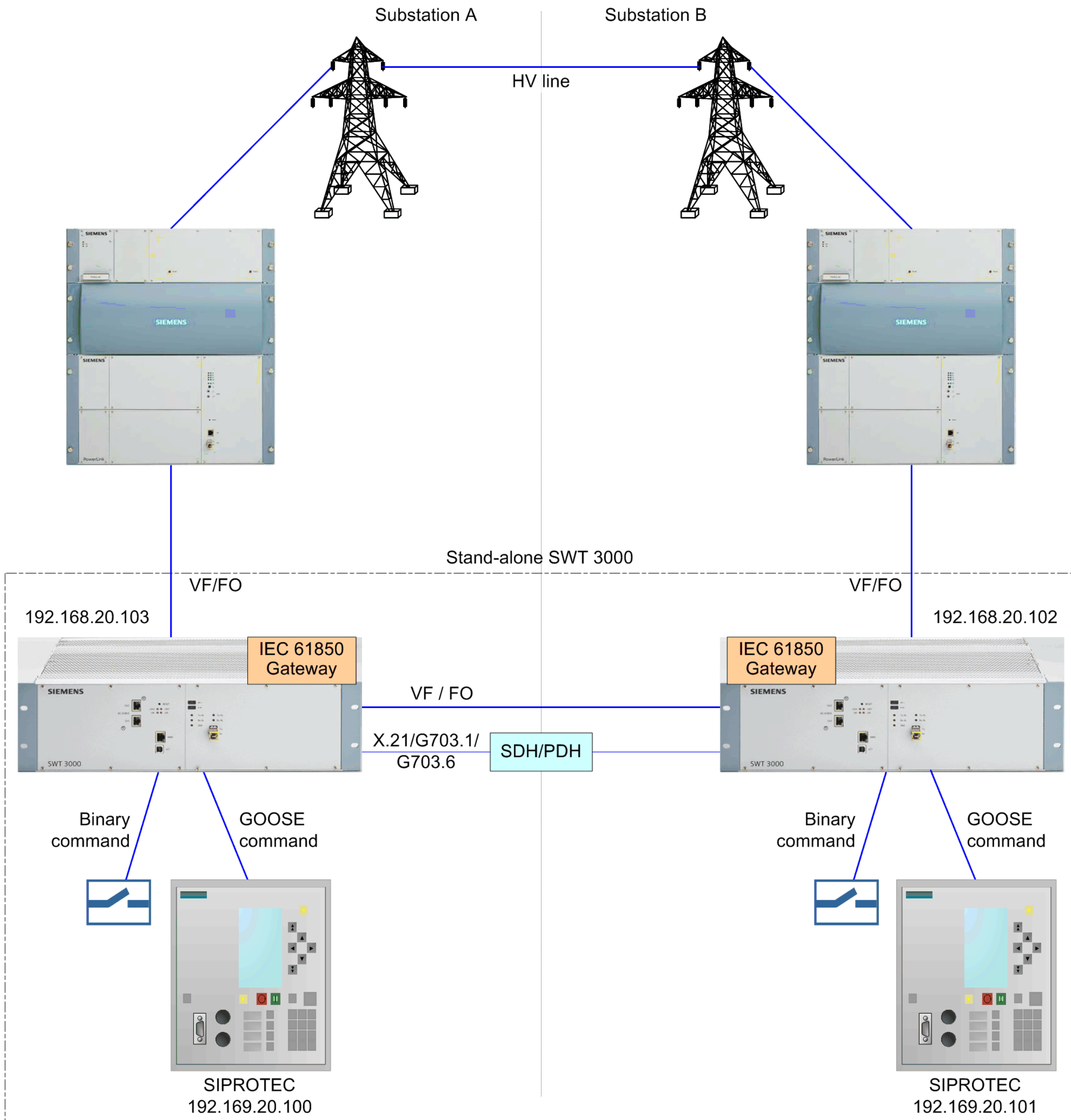
Both Ethernet connectors of the module with RJ45 interfaces and also the fiber-optic module interfaces are accessible from the front of the device. The fiber-optic version of the module comprises the entire functionality of the module with the electrical interfaces.

2.4.11.2 IEC 61850 Application Mode for SWT 3000

GGIO Mode

The binary command input and output of SWT 3000 are mapped one-to-one onto the standard-compliant object GGIO LN in IEC 61850. The parameterization of IEC 61850 is performed using the System Configurator (e.g. DIGSI). After importing SWT 3000 ICD file into System Configurator, it is possible to establish a GOOSE command mapping between protection relay and SWT 3000 device. SWT 3000 is realized as IEC 61850 GGIO gateway, it exchanges up to 8 I/O points between substations. On transmitting side, SWT 3000 receives GOOSE message from protection relay and re-codes to own special communication protocol. On the receiving side, SWT 3000 re-creates GOOSE message and sends to protection relay. The IEC 61850 protocol is implemented in Ethernet EN100 module.

In GGIO mode, the border of the IEC 61850 world is SWT 3000. That means no IEC 61850 related auxiliary data, like quality data, are transferred to the remote side. The GOOSE command is transmitted as long as the command input is active if the input command limit time is set to zero. For integrated SWT 3000 with alternative multi-purpose operation, the GOOSE command is only transferred for the input limit time.



[dw_iecapp_140115, 1, en_US]

Figure 2-94 IEC 61850 Application Mode for SWT 3000, Example

For the GGIO mode, the following SWT 3000 modes are possible:

- **Mode 3a** for analog and digital interfaces, max. 4 GOOSE commands supported
- **Mode 5D** for digital interfaces, up to 16 GOOSE commands supported

iSWT 3000 in PowerLink offers also EN100 and IFC interfaces in mode 3a for up to 4 commands.

IEC 61850 Logical Nodes Parameters for SWT 3000 Teleprotection with EN100 GOOSE Communication

According to the IEC 61850 model logical nodes are the building blocks of an Intelligent Electronic device (IED). A Logical Node (LN) represents the function within a physical device; it performs some operations for that function and is object defined by its data and methods. The users view of the logical nodes is the ICD file of the SWT 3000. A fixed set of ICD files is provided for SWT 3000.

Since the SWT 3000 related settings (communication interfaces, CMD timers) are configured via the service program PowerSys and thus ‘outside’ the IEC61850 world only a minimal set of Logical Node (LN) according to the IEC61850 model is used for the teleprotection signaling with EN100 GOOSE communication and for supervision. Refer to the following tables for the major data objects of Logical Nodes used in SWT 3000.

LLN: TXC_GGIO - Transmit command

Table 2-35 LLN: TXC_GGIO - Transmit command

GGIO class				
Data object name	**Common data class**	**Explanation**	**T**	**M/O**
LNName		Name composed of the class name, the LN-Prefix and LN-Instance- ID according to IEC 61850-7-2		
Data objects				
Common Logical Node Information				
Measured values				
Status Information				
Controls				
SPCSO1	SPC	Single point controllable status output. Command input 1, which acts as an input for the local SWT processing. Attribute ctlVal is assigned to the SWT command input. The input status is not trans-ferred transparent to the remote side! It depends on the actual SWT-Mode, how a change of ctlVal influences the command outputs on the remote SWT.		O
SPCSO2	SPC	Command input 2		O
SPCSO3	SPC	Command input 3		O
SPCSO4	SPC	Command input 4		O
SPCSO5	SPC	Command input 5		O
SPCSO6	SPC	Command input 6		O
SPCSO7	SPC	Command input 7		O
SPCSO8	SPC	Command input 8		O
SPCSO9	SPC	Command input 9		O
SPCSO10	SPC	Command input 10		O
SPCSO11	SPC	Command input 11		O
SPCSO12	SPC	Command input 12		O
SPCSO13	SPC	Command input 13		O
SPCSO14	SPC	Command input 14		O
SPCSO15	SPC	Command input 15		O
SPCSO16	SPC	Command input 16		O

LN: RXC_GGIO - Receive command

Table 2-36 LN: RXC_GGIO - Receive command

GGIO class				
Data object name	Common data class	Explanation	T	M/O
LNName		Name composed of the class name, the LN-Prefix and LN-Instance- ID according to IEC 61850-7-2		
Data objects				
Common Logical Node Information				
Measured values				
Status Information				
Controls				
SPCSO1	SPC	Single point controllable status output. Command input 1, which acts as an input for the local SWT processing. Attribute ctlVal is assigned to the SWT command input. The input status is not trans-ferred transparent to the remote side! It depends on the actual SWT-Mode, how a change of ctlVal influences the command outputs on the remote SWT.		O
SPCSO2	SPC	Command output 2		O
SPCSO3	SPC	Command output 3		O
SPCSO4	SPC	Command output 4		O
SPCSO5	SPC	Command output 5		O
SPCSO6	SPC	Command output 6		O
SPCSO7	SPC	Command output 7		O
SPCSO8	SPC	Command output 8		O
SPCSO9	SPC	Command output 9		O
SPCSO10	SPC	Command output 10		O
SPCSO11	SPC	Command output 11		O
SPCSO12	SPC	Command output 12		O
SPCSO13	SPC	Command output 13		O
SPCSO14	SPC	Command output 14		O
SPCSO15	SPC	Command output 15		O
SPCSO16	SPC	Command output 16		O

Table 2-37 LN: ITPC - Communication Interface

ITPC class				
Data object Name	**Common data class**	**Explanation**	**T**	**M/O**
LNName		Name composed of the class name, the LN-Prefix and LN-Instance- ID according to IEC 61850-7-2		
Data objects				
EEHealth	ENS	External equipment health. It reflects the alarm status of the SWT device. Possible values: 1: Ok (Green) no alarms active 2: Warning (Yellow) only none urgent alarms active 3: Alarm (Red) at least one urgent alarm is active		O

ITPC class				
Status information				
AlarmGen	SPS	SWT 3000 general alarm TRUE: (Alarm is active)		O
AlarmNU	SPS	SWT 3000 nun-urgent alarm TRUE: (Alarm is active)		O
AlarmRx	SPS	SWT 3000 receive alarm TRUE: (Alarm is active)		O
LosSig	SPS	Alarm situation: No signal received, indicates a channel problem of analog communication. Possible values: TRUE: RXALR of PU4 LIA is active. FALSE: RXALR of PU4 LIA is inactive.		O
LosSyn1	SPS	Alarm situation: Loss of synchronism of LID-1 Indicates that there is no synchronization between the trans-mitter and the re-ceiver, i.e., no communication is possible. Used in case of a digital communica-tion channel. Possible values: TRUE: LID-1 Sync-Loss alarm is active. FALSE: LID-1 Sync-Loss alarm is inactive.		O
LosSyn2	SPS	Alarm situation: Loss of synchronism of LID-2		O
TxCmdCnt1	INS	For diagnostics: Transmitted command 1 counters.		O
TxCmdCnt2	INS	For diagnostics: Transmitted command 2 counters.		O
TxCmdCnt3	INS	For diagnostics: Transmitted command 3 counters.		O
TxCmdCnt4	INS	For diagnostics: Transmitted command 4 counters.		O
TxCmdCnt5	INS	For diagnostics: Transmitted command 5 counters.		O
TxCmdCnt6	INS	For diagnostics: Transmitted command 6 counters.		O
TxCmdCnt7	INS	For diagnostics: Transmitted command 7 counters.		O
TxCmdCnt8	INS	For diagnostics: Transmitted command 8 counters.		O
TxCmdCnt9	INS	For diagnostics: Transmitted command 9 counters.		O
TxCmdCnt10	INS	For diagnostics: Transmitted command 10 counters.		O
TxCmdCnt11	INS	For diagnostics: Transmitted command 11 counters.		O
TxCmdCnt12	INS	For diagnostics: Transmitted command 12 counters.		O
TxCmdCnt13	INS	For diagnostics: Transmitted command 13 counters.		O
TxCmdCnt14	INS	For diagnostics: Transmitted command 14 counters.		O
TxCmdCnt15	INS	For diagnostics: Transmitted command 15 counters.		O
TxCmdCnt16	INS	For diagnostics: Transmitted command 16 counters.		O
RxCmdCnt1	INS	For diagnostics: Received command 1 counters.		O
RxCmdCnt2	INS	For diagnostics: Received command 2 counters.		O
RxCmdCnt3	INS	For diagnostics: Received command 3 counters.		O
RxCmdCnt4	INS	For diagnostics: Received command 4 counters.		O
RxCmdCnt5	INS	For diagnostics: Received command 5 counters.		O
RxCmdCnt6	INS	For diagnostics: Received command 6 counters.		O
RxCmdCnt7	INS	For diagnostics: Received command 7 counters.		O
RxCmdCnt8	INS	For diagnostics: Received command 8 counters.		O
RxCmdCnt9	INS	For diagnostics: Received command 9 counters.		O
RxCmdCnt10	INS	For diagnostics: Received command 10 counters.		O
RxCmdCnt11	INS	For diagnostics: Received command 11 counters.		O
RxCmdCnt12	INS	For diagnostics: Received command 12 counters.		O
RxCmdCnt13	INS	For diagnostics: Received command 13 counters.		O
RxCmdCnt14	INS	For diagnostics: Received command 14 counters.		O
RxCmdCnt15	INS	For diagnostics: Received command 15 counters.		O

ITPC class				
RxCmdCnt16	INS	For diagnostics: Received command 16 counters.		O
NumTxCmd	INS	Numbers of used binary transmit commands. Possible values: 0...16		O
NumRxCmd	INS	Numbers of used binary receive commands. Possible values: 0...16		O
TpcTxMod	ENS	Teleprotection application mode in Transmit direction for each command. Possible values: 0: Direct tripping 1: Permissive tripping		O
TpcRxMod	ENS	Teleprotection application mode in Receive direction for each command. Possible values: 0: Direct tripping 1: Permissive tripping		O
Measured values				
FerCh1	MV	Frame Error Rate of the communication channel LID-1. Used in case of a digital communication channel. This attribute is mapped to BER of DLE.		O
FerCh2	MV	Frame Error Rate of the communication channel LID-2.		O
CarLev	MV	Power of received signal (in dB), used in case of an analogue communication channel.		O
SigNsRat	MV	Signal to noise ratio (in dB), used in case of analogue communi-cation channel.		O

2.4.12 Remote Monitoring, Service Channel, and IP Network

2.4.12.1 General Information for iSWT 3000

For Remote Monitoring, SNMP and access via the IP network the corresponding interfaces of the PowerLink are used. For details, refer to *Chapter 5, SNMP and Remote Access*.

The Ethernet Interface connector on the PU4 module is disabled in case of an integrated SWT 3000 and must not be connected.

The access to the local PU4 service interface (USB B plug) is only required in case of an firmware upgrade via MemTool. In operating mode, the local (service) interface is connected to the controller of the CSPi module unit via iLAN and the user-service interface of the PowerLink is used for access to the iSWT.

2.4.12.2 Service Channel

The Service Channel (SC) is a transparent data transmission channel with the format 9600 bps, 8 data bits, 1 start bit, 1 stop bit, and no parity. The data transmission channel is only available when using a digital line interface of the iSWT 3000 (LID-1). It is available to the user as an asynchronous serial RS232 interface.

NOTE

The service channel in digital line interfaces is not supported in release P3.5.180 or higher. It is possible to recover SC function by downgrade DLEFPGA to former release via Memtool. The firmware image is located at PowerSys Px.y.zzz > Firmware > Package_zzz.cab > Pu4DleFpga_v00_01_32.jnk.

3 Installation and Commissioning

3.1 Installation

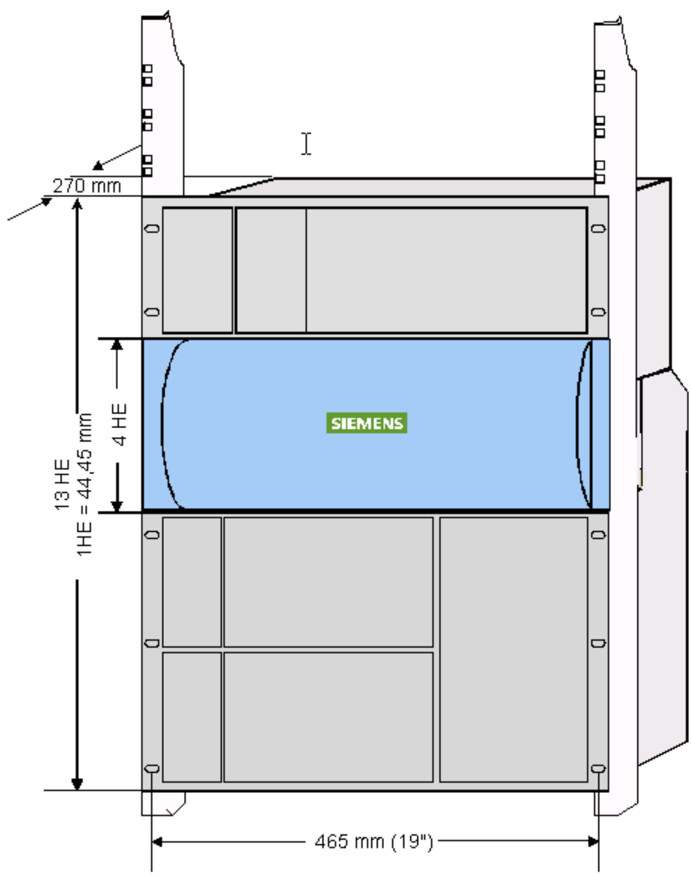
3.1.1 Installation of the Module Frames

3.1.1.1 Introduction

The module carriers are suitable for installation in 19" swing frames or mounting frames. The fastening elements which are required are included in the scope of delivery. No special tools are needed for the installation.

3.1.1.2 Dimensions of the PowerLink System

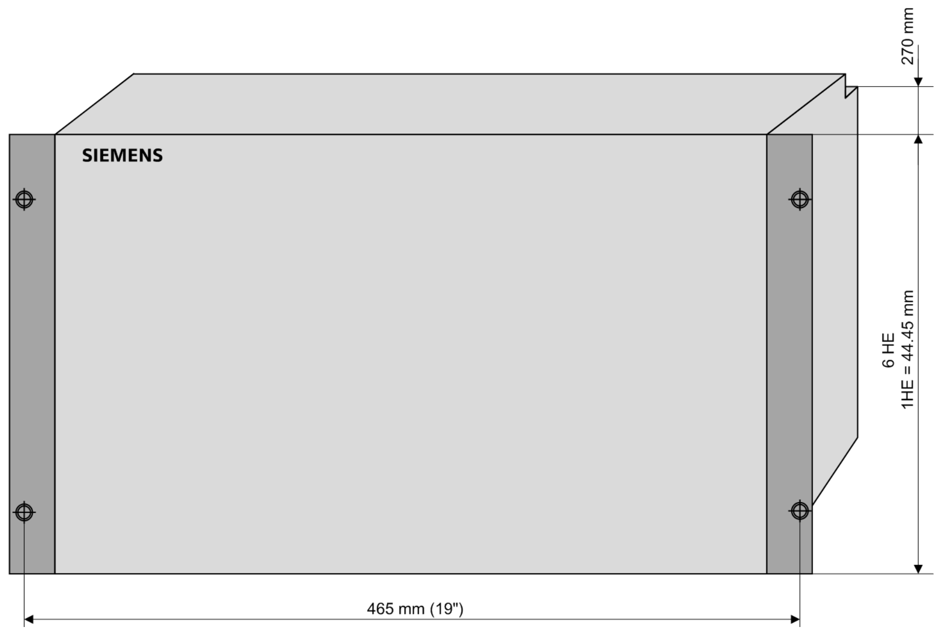
PowerLink 100



[dwdplsys-110111-01.tif, 1, en_US]

Figure 3-1 Dimensions of a PowerLink 100

PowerLink 50



[dw_pl50-mass-231014, 1, --_--]

Figure 3-2 Dimensions of a PowerLink 50

General

> **NOTE**
>
> Min. distance between two PowerLink devices is one unit of height (= 1.75 inches or 44.45 mm).

> **NOTE**
>
> A flyback diode should be used for any relays that is connected to an output of PowerLink or iSWT to avoid EMC influences.

3.1.1.3 Fire Prevention Kit

The mounting kit (7VR9656) is an optional kit to ensure the fire protection of the PowerLink 50/100 system in case it is mounted on a combustible surface.

The kit is obligatory for PowerLink Systems when the following facts apply simultaneously:

- The system is operated outside a closed cabinet that would provide fire protection (fire enclosure).
- The system is operated on a combustible surface.

> **NOTE**
>
> The system is compliant with the requirements for fire enclosures as stipulated in EN/IEC 60950-1 when the mounting kit is used.

The kit consists of the following items:

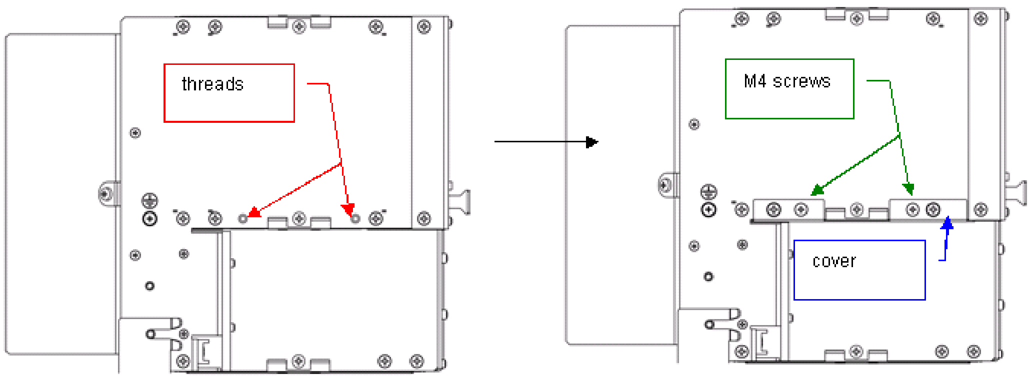
- 1 left side cover for the PLPA device with 2 M4 screws
- 1 right side cover for the PLPA device with 2 M4 screws

- 2 side covers for the upper CFS-2 device (only if 2 PowerLink Systems are installed in the same cabinet)
- 1 bottom cover for the CFS-2 device/lower CFS-2 (if 2 PowerLink Systems are installed in the same cabinet)

Assembly Instructions for the PLPA for PowerLink 100

Assembly of left side cover for the PLPA device:

Position the cover PLPA Left Side on the left side wall of the PLPA device as shown. Fasten the cover to the threads with the 2 supplied M4 screws.

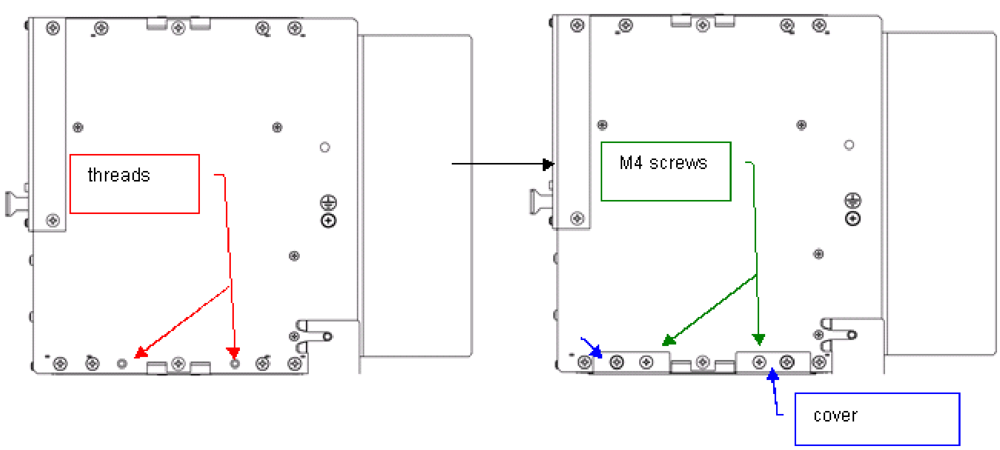


[dwaplpad-241110-01.tif, 1, en_US]

Figure 3-3 Assembly of left side cover for the PLPA device

Assembly of right side cover for the PLPA device:

Position the cover PLPA Right Side on the right side wall of the PLPA device as shown. Fasten the cover to the threads with the 2 supplied M4 screws



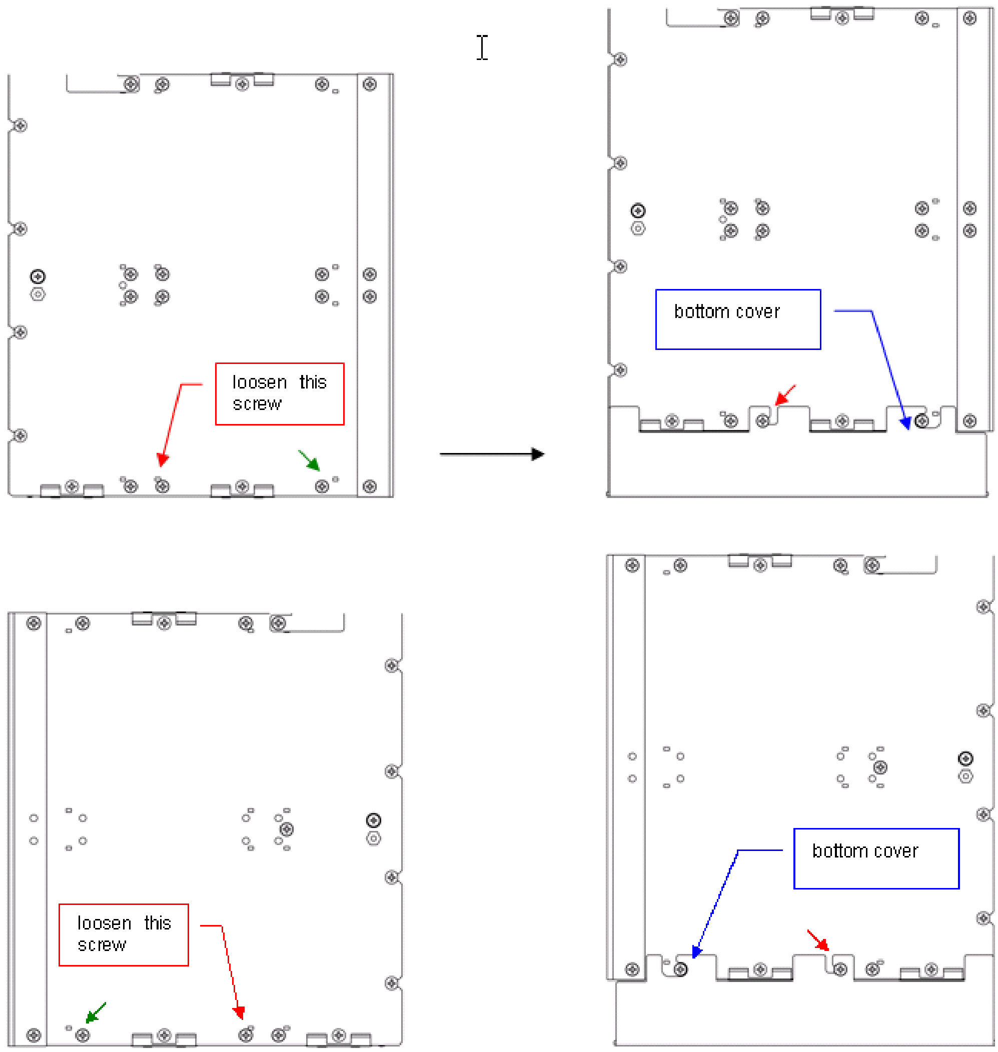
[dwarplpd-241110-01.tif, 1, en_US]

Figure 3-4 Assembly of right side cover for the PLPA device

Assembly Instructions for the CFS-2 Section for PowerLink 100

The following step applies only, if 2 PowerLink systems are to be installed on top of each other. The side covers shall be assembled to the upper CFS-2 (since the bottom cover could reduce the air flow for cooling the lower PLPA device, if it was installed on the upper CFS-2 device).

Loosen the screw (A) shown on the left side of the CFS-2 by 3 mm to 5 mm. – Do not remove the screw! Move the cover CFS Sides beneath the head of the screw (A) and position it with the other hole onto the head of another screw (B). Fasten the cover with the screw (A). Repeat this procedure with the second cover on the other side of the CFS-2 device.



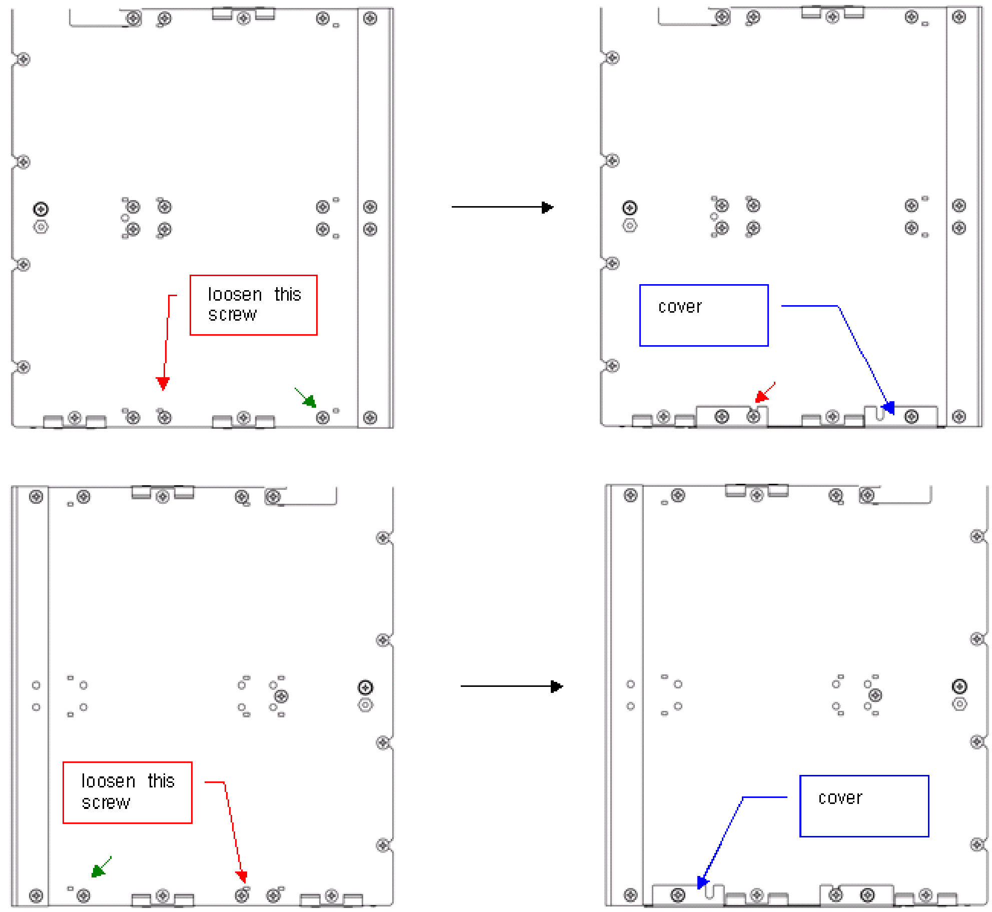
[dwabcfsd-241110-01.tif, 1, en_US]

Figure 3-5 Assembly of side covers for the CFS-2 device

The following step applies to the CFS-2 device (if only 1 PowerLink system is to be installed) or to the lower CFS-2 device (if 2 PowerLink systems are to be installed on top of each other).

Preferably, place the CFS-2 device with it's front side on a clean and soft surface.

Loosen the screws (A) on each side of the CFS-2 device as shown by 3 mm to 5 mm. – Do not remove the screws! Move the bottom cover CFS Bottom beneath these screws (A) and slightly down, locking it on the 2 other screw heads (B) as shown. Fasten the cover with the 2 screws (A).

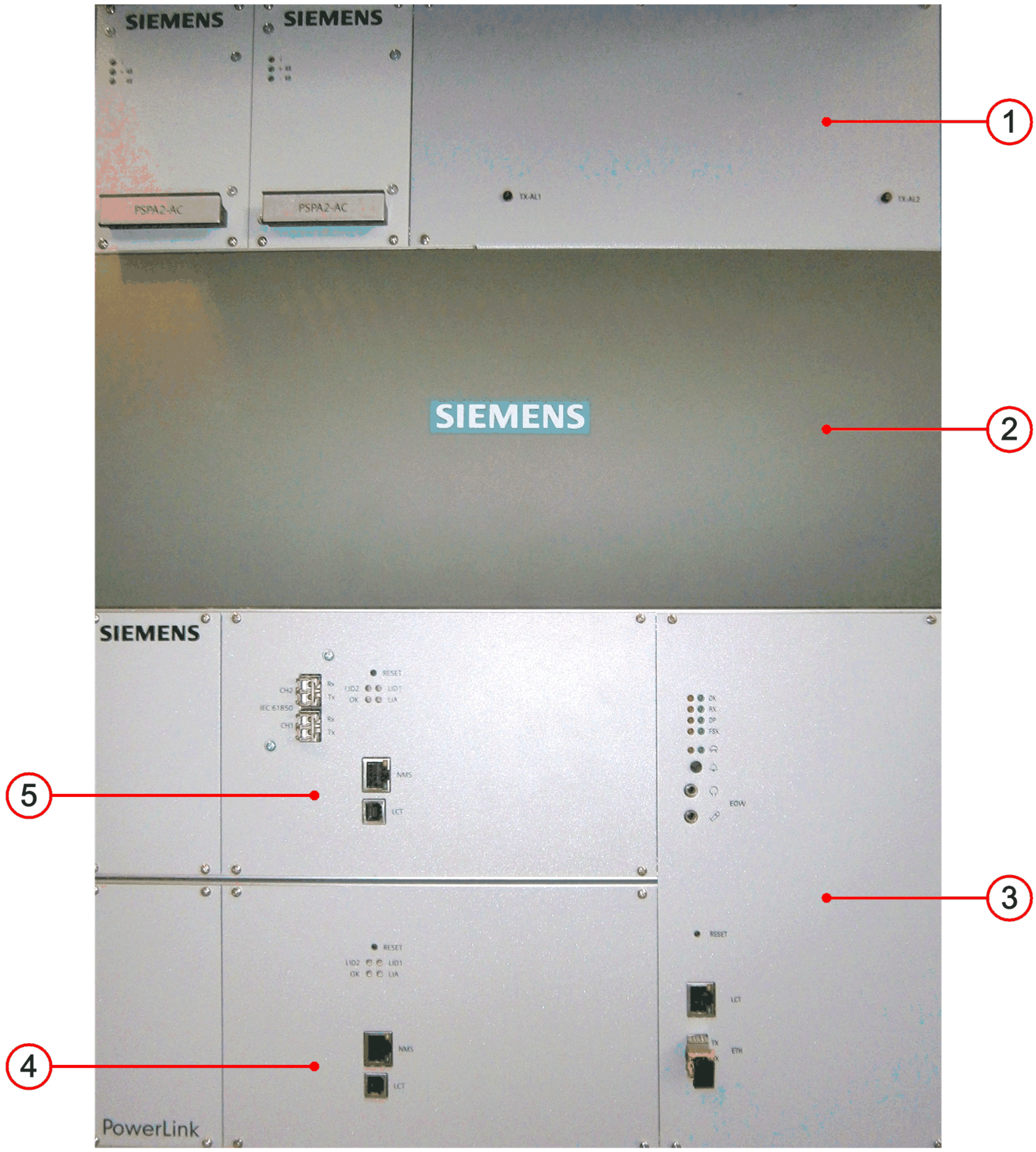


[dwascfsd-241110-01.tif, 1, en_US]

Figure 3-6 Assembly of the bottom cover for the CFS-2 device

3.1.1.4 Units of the PowerLink System

The PowerLink 100 is a double frame device with the following units.

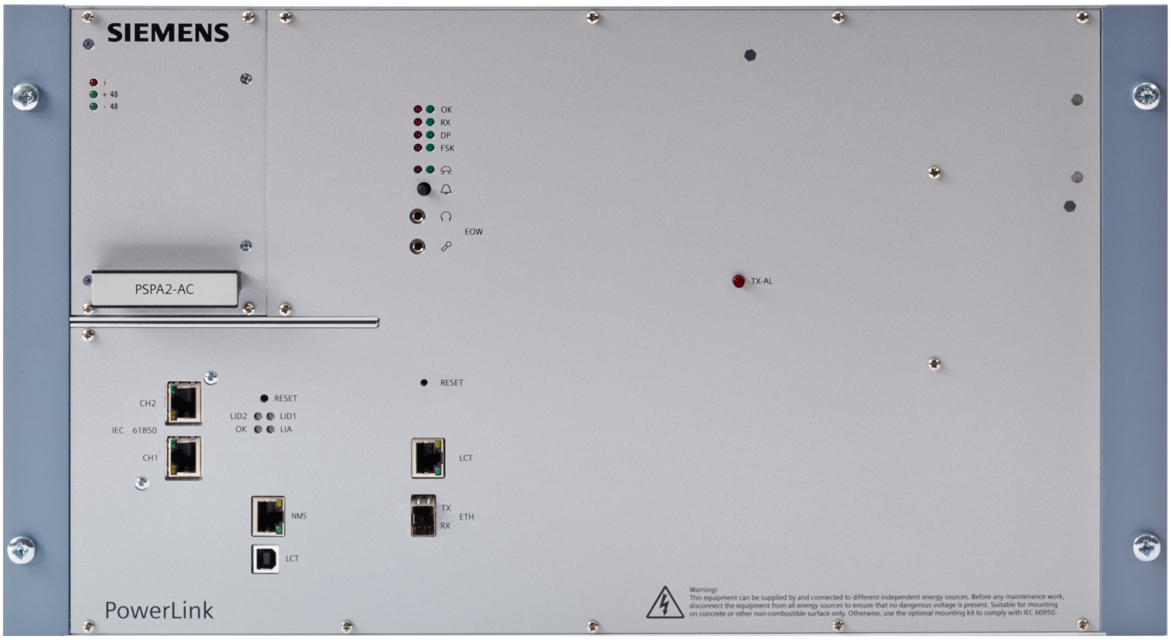


[dwplmodu-270813-01.tif, 1, --_--]

Figure 3-7 Units of the PowerLink 100 system

1	PLPA
2	PowerLink Connector panel
3	CFS-2
4	iSWT-A (iSWT 3000-1) *)
5	iSWT-B (iSWT 3000-2) *)
*	Option, depending on the configuration

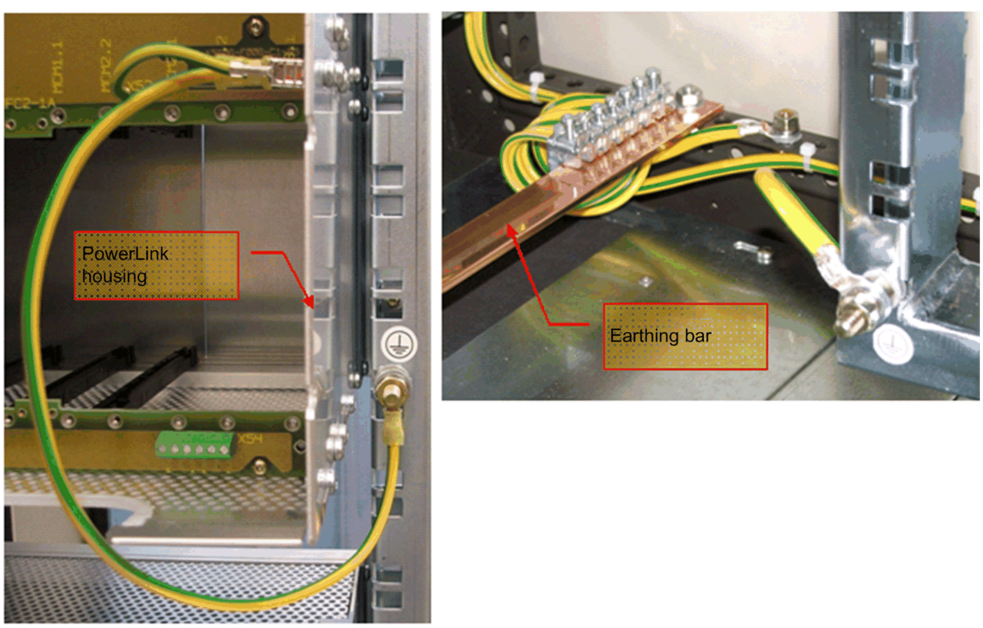
The PowerLink 50 is a single frame device with all components integrated.



[PowerLink_50S_front_geschl-ausschnitt, 1, --_--]

PowerLink 50 device

3.1.1.5 Protective Earth Connection



[dw_conpec-271114, 1, en_US]

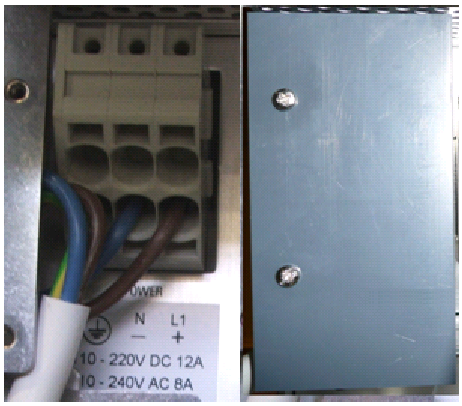
Figure 3-8 Connection of the PE conductor

The protective earth conductor of the PowerLink must be connected with the housing.

The connection of the PE conductor on PowerLink 50 is shown in *Figure 3-10*.

3.1.1.6 Connection of the Supply Voltage

PowerLink 100



[sc_consuv, 1, --_--]

Figure 3-9 Connection of the supply voltage for PowerLink 100

PowerLink 50

[PL50-ps-connection, 1, --_--]

Figure 3-10 Connection of the supply voltage for PowerLink 50

General

The AC supply voltage is connected to the terminals PE-N-L1.
In case of DC voltage the (-) is connected to the N and (+) to the L1 terminal.
The terminals are covered.

CAUTION

This equipment can be supplied by and connected to different independent energy sources.

In case the Powerlink System is mounted on a combustable surface, the use of the mounting kit (7VR9656, Fire prevention kit) is obligatory.

✧ Before any maintenance work, disconnect the equipment from all energy sources to ensure that no dangerous voltage is present.

CAUTION

An easily accessible all pole disconnect device with a contact gap of at least 3.0 mm must be included/ installed in the building-installation-wiring.

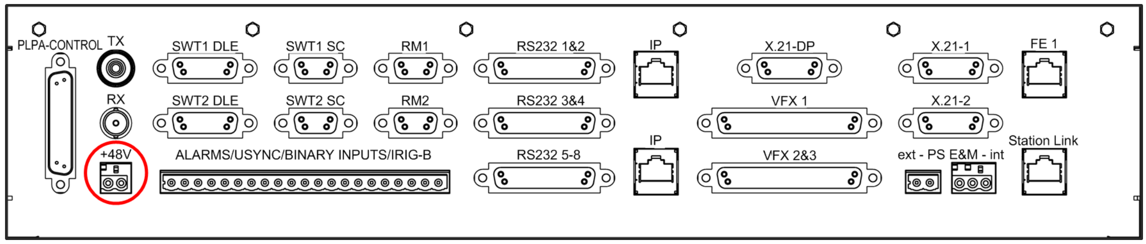
✧ The value of the external fuse has to be max. 16A!

3.1.1.7 PLPA Interface PA – CFS-2

Table 3-1 Pin assignment for the PLPA interface

PIN	Signal name
1	P48V
2	N48V
3	GND
4	P12V
5	N12V
6	
7	INHIBIT
8	I2C_SCL
9	I2C_SDA
10	PF_PLPA_1
11	PF_PLPA_2
12	PLE_SUEAN1
13	PLE_SAL1
14	P48V
15	N48V
16	GND
17	P12V
18	N12V
19	
20	
21	
22	SW_3dB
23	PLE_DR_L
24	PLE_SUEAN2
25	PLE_SAL2

3.1.1.8 Power Supply Connector for an Internal Device for PowerLink 100



[dwlocpsc-180913-01.tif, 1, en_US]

Figure 3-11 Location of Power Supply connector “+48V” (not assembled on actual release)

The connector is mounted on the connector panel on the left-hand side of the alarm outputs. It could be used for supplying a device located inside the cabinet with DC 48 V.
(I < 100 mA)

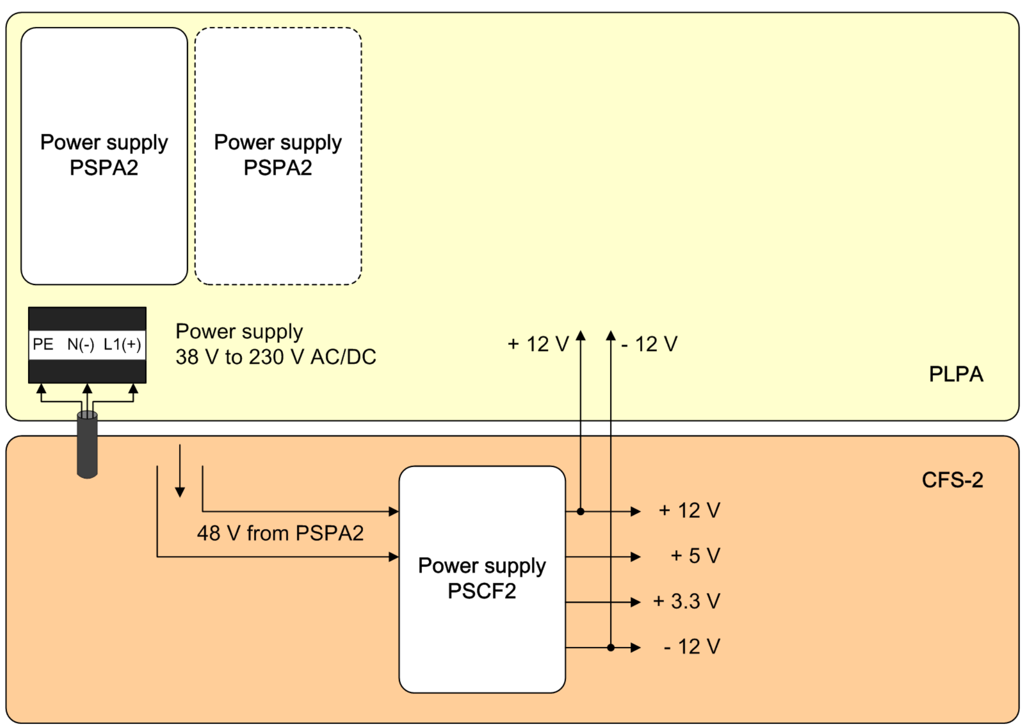
Table 3-2 Power Supply connector “+48V”

PIN	Signal name
1	+48 V *
2	GND

* pin 1 is at the right side of the connector!

3.1.1.9 Interconnection of the Power Supplies for PowerLink 100

The principle of the voltage distribution in the PowerLink system is shown in the figure below.

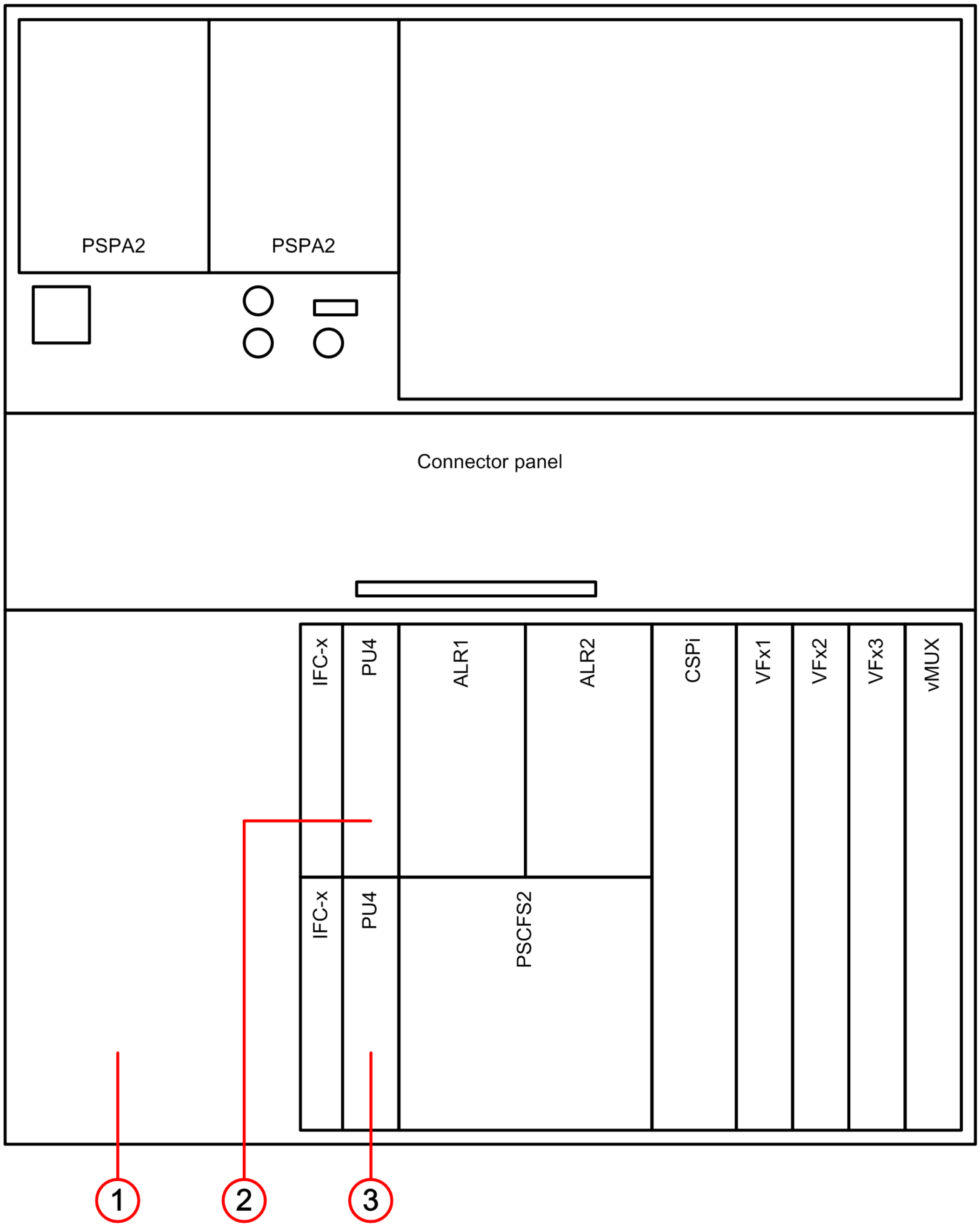


[dw_intpls-121214, 1, en_US]

Figure 3-12 Interconnection of the power supplies in the PowerLink system

3.1.1.10 Module Slot Positions in the PowerLink

PowerLink 100



[dw_slpplm_281114, 1, en_US]

Figure 3-13 Slot positions of the PowerLink modules PowerLink 100

(1) CFS-2 part
(2) Integrated SWT3000-2
(3) Integrated SWT3000-1

PowerLink 50

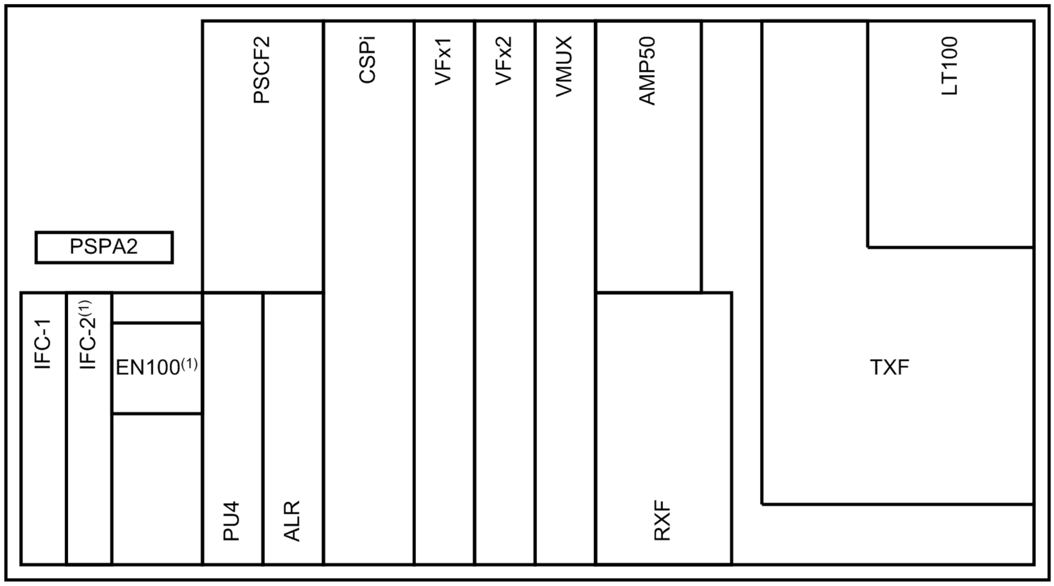


Figure 3-14 Slot positions of the PowerLink modules PowerLink 50

(1) IFC-2 or EN100

3.1.1.11 Mounting of Modules in the PowerLink System

This instruction applies for exchanging resp. mounting modules.

- For PowerLink 100, the module position in the CFS-2 part is shown in the *Figure 3-13*
- For PowerLink 50, the module position is shown in the *Figure 3-14*

It is not allowed to insert or remove modules in the PowerLink when the power supply is enabled!

CAUTION

Electrostatic sensitive devices are protected against destruction by electrostatic charge with protective structures at the inputs and outputs. In unfavorable cases, however, plastic floor coverings, non-conductive work surfaces, or clothing containing artificial fibers can result in such high charges.

These charges can damage or even destroy the electrostatic sensitive devices despite the protective networks mentioned. If a device is damaged, its reliability decreases drastically although the effects of the damage are noticeable a long time before.

✧ In order to ensure that electrostatic charges are completely eliminated when working on the system, comply with the following instructions in order to avoid moderate or minor damage:

✧ Before carrying out any work on the system, ground yourself with a wrist strap.

✧ When working on modules, always place them on a grounded conductive surface.

✧ Transport modules only in suitable protective bags.

For mounting (exchanging) modules in the PowerLink system please observe the following instruction:

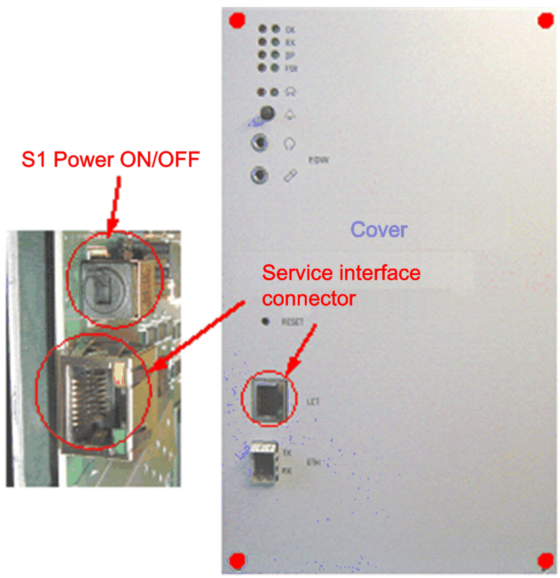
- For PowerLink 100, remove the cover of the CFS-2 module section (4 screws).
  For PowerLink 50, remove the front cover of the device.
- Disable the power supply (move the switch **S1** on the CSPi module above PC connector into **lower** position).

In case of exchanging a module:

- Remove the existing module and place it on a grounded, conductive surface.

Inserting the new module:

- Unpack the new module from the transport box and insert it into the corresponding slot position.
- Switch on the power supply (move the switch S1 on the CSPi module into upper position).
- Close the cover of the CFS-2 modules resp. the front cover of the device .

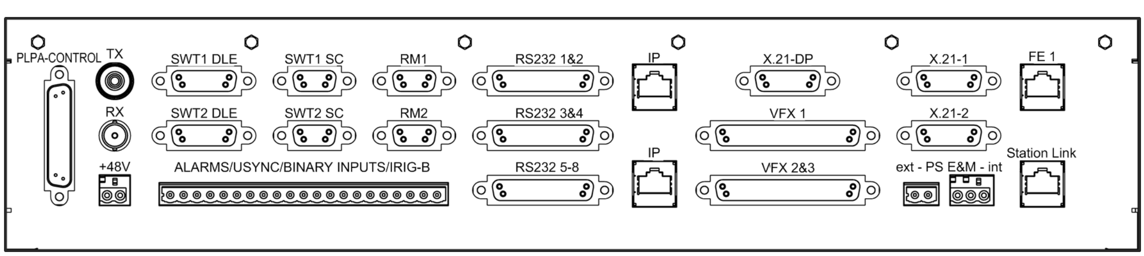


[dw_covsic-281114, 1, en_US]

In case of exchanging an existing module the system should work after the power supply is enabled. When inserting a **new module the first time**, the system needs a new commissioning (configuration, level setting etc.).
Please refer to the corresponding instruction in chapter *Commissioning* of this manual!

3.1.2 The Connector Panel for PowerLink 100 and PowerLink 50

3.1.2.1 Overview



[dwconpls-220813-01.tif, 1, en_US]

Figure 3-15 Connector panel of the PowerLink 100 system

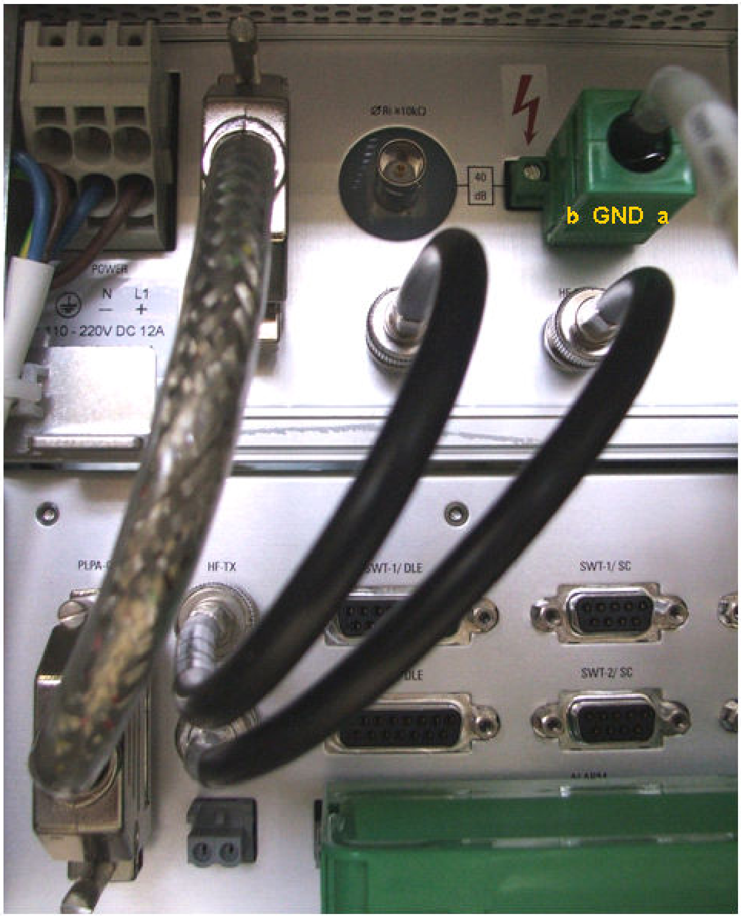
The connector panel serves for an easy connection of the interconnection of CFS-2 and PLPA unit as well as the connection of the various interfaces for voice, data, and alarms. The connectors for the protection signaling interface modules are at the rear side of the CFS-2 backplane.

NOTE

For PowerLink 50, the connectors are on the rear side of the device. For details see *Figure 2-16*.

3.1.2.2 Interconnection of PLPA 100 Unit and CFS-2

The figure below shows the interconnection of PLPA 100 and CFS-2 section. The SUB-D socket PLPA 100control on the CFS-2 has to be connected to the corresponding PLPA control SUB-D plug on the PLPA. The Tx and Rx BNC jacks on the CFS-2 have to be connected to the corresponding BNC jacks on the PLPA.

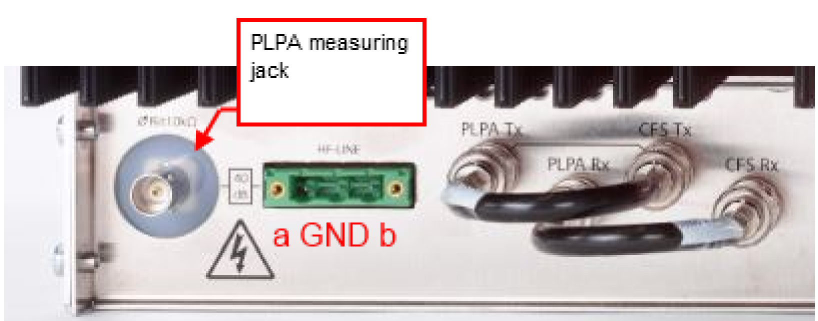


[sclnplcf-110111-01.tif, 1, en_US]

Figure 3-16 Interconnection of PLPA and CFS-2 section for PowerLink 100

3.1.2.3 Interconnection of PLPA 50 Unit and CFS-2

The figure below shows the interconnection of PLPA 50 unit and CFS-2 section. The SUB-D socket PLPA 50 control on the CFS-2 has to be connected to the corresponding PLPA control SUB-D plug on the PLPA. The Tx and Rx BNC jacks on the CFS-2 have to be connected to the corresponding BNC jacks on the PLPA.



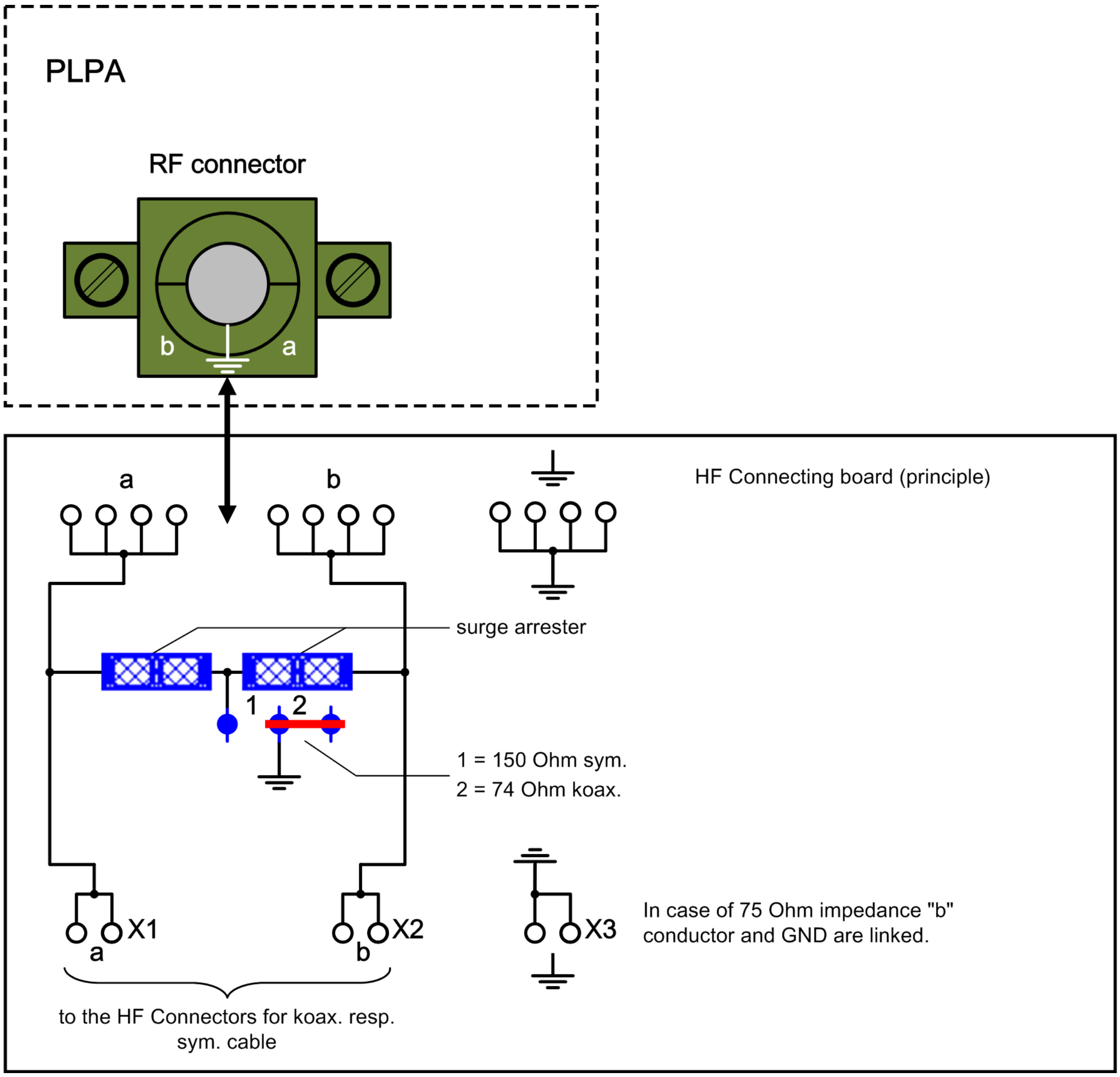
[PowerLink50S_rueck_Ausschnitt-PLPA, 2, --_--]

Figure 3-17 Interconnection of PLPA and CFS-2 section for PowerLink 50

3.1.2.4 Interconnection of PLPA Unit and HF-Connecting board

Overall Connection Diagram

The figure below shows the connection diagram from the PLPA RF connector to the HF connecting board:



[dw_plhfcb-271114, 1, en_US]

Figure 3-18 Overall connection diagram from the PLPA unit to the HF connecting board

A detailed drawing of the HF connecting board for coax. resp. sym. cable is shown in the figures *Figure 3-19* and *Figure 3-20*.

NOTE

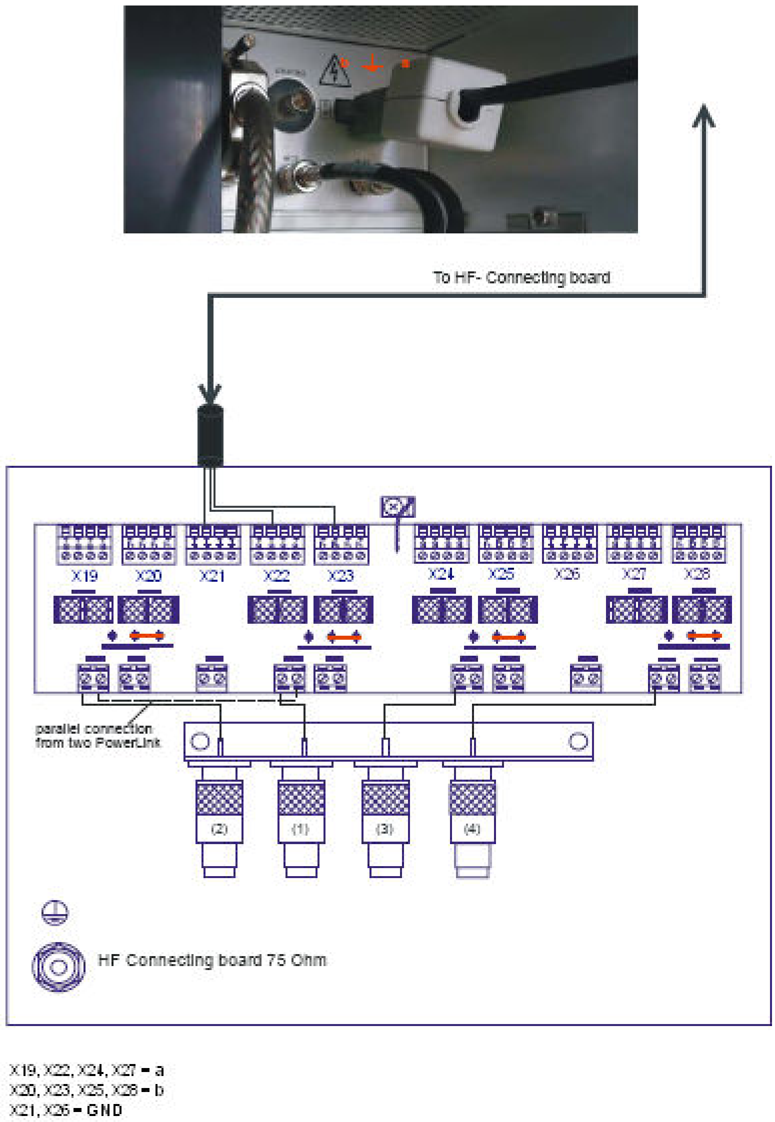
Please make sure that the “a” and “b” conductors are not exchanged!

In case of 75 Ohm impedance the “b” wire and GND are linked.

NOTE

One of the delivered ferrite cores has to be mounted near the PowerLink RF connector, the second one has to be mounted at the other end of the RF cable.

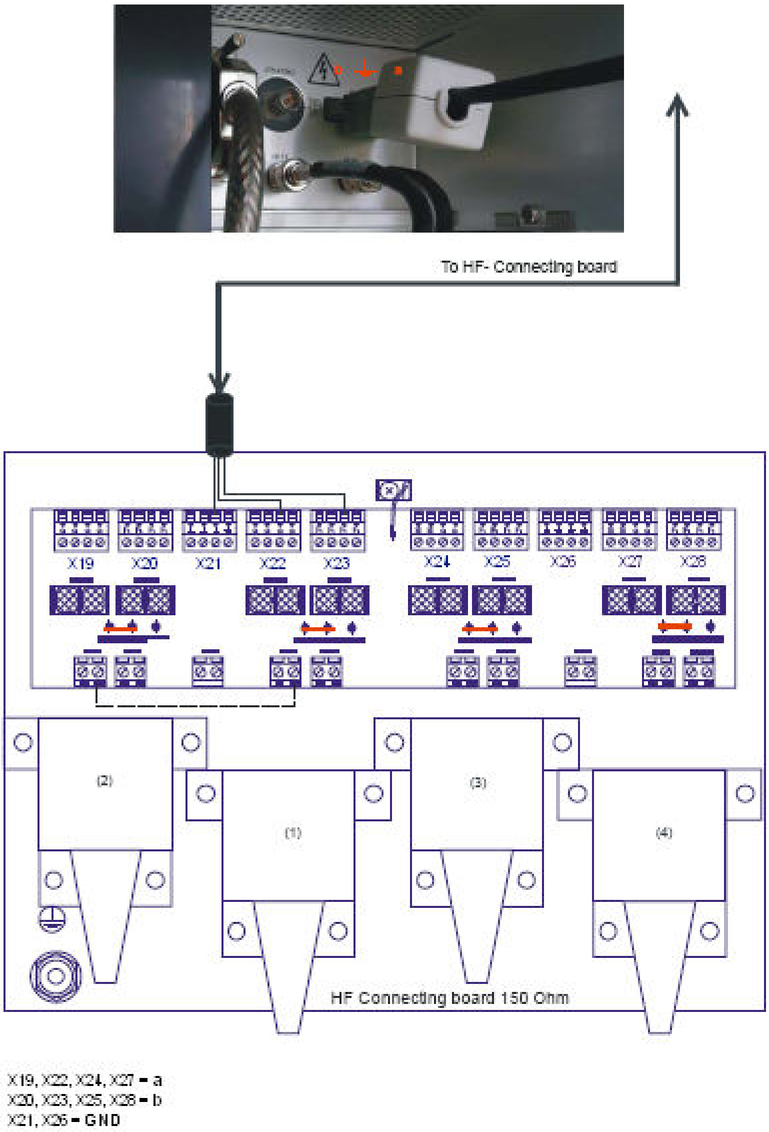
PowerLink Connector Panel – HF Connecting Board 75 Ohm



[cdlnp075-220813-01.tif, 1, en_US]

Figure 3-19 Interconnection of the PowerLink and the HF connecting board 75 Ohm

PowerLink Connector Panel – HF Connecting Board 150 Ohm



[cdinp150-241110-01.tif, 1, en_US]

Figure 3-20 Interconnection of the PowerLink and the HF connecting board 150 Ohm

Technical Data

Gas-filled surge arrester	
Nominal DC sparkover voltage	75 Ω Config: 4x230 V = 920 V DC; P to PE 150 Ω Config: 460 V DC; P,N, to PE
Impulse spark over voltage	75 Ω Config: 4x700 Vp= 2.8k Vp; P to PE 150 Ω Config: 1.4 kVp; P,N to PE

3.1.3 RS232 Interfaces

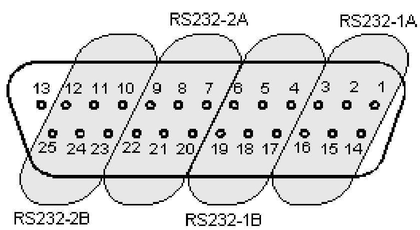
3.1.3.1 Overview

The RS232 interfaces are used for connecting data to the integrated multiplexer iMUX resp. vMUX. The interfaces 1 up to 4 can be connected as well to the integrated iFSK channels.

The RS232-1A up to 4A resp. RS232-1B up to 4B interfaces of the PowerLink system provide a **RS232 splitter**. The splitter is used in the polling mode of RTU (Remote Terminal Unit) via integrated FSK channels resp. iMUX or vMUX in order to connect a requested RTU **in the direction to the telecontrol center**.

3.1.3.2 Assignment of the RS232-1A/B up to -2A/B Interfaces

Table 3-3 Pin assignment of the RS232-1A up to 2A interfaces



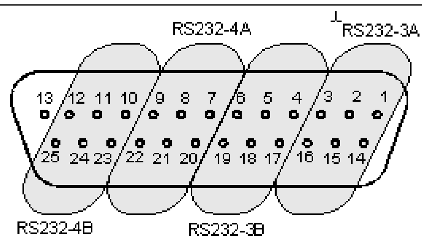
RS232-Signals (iMUX, vMUX resp. iFSK)
25 pin Sub-D connector female housing connected to FGND

PIN	Signal Name	Remarks
1	RS232_1_RXD (out)	RS232-1A
2	RS232_1_TXD1 (in)	RS232-1A
3	GND	
4	RS232_1_RXD (out)	RS232-1B[1)]
5	RS232_1R_TXD2 (in)	RS232-1B[1)]
6	GND	
7	RS232_2_RXD (out)	RS232-2A
8	RS232_2_TXD1 (in)	RS232-2A
9	GND	
10	RS232_2_RXD (out)	RS232-2B[1)]
11	RS232_2R_TXD2 (in)	RS232-2B[1)]
12	GND	
13		
14		
15		
16		
17	RS232_1R_RTS (in)	RS232-1B[1)]
18	RS232_1R_CTS (out)	RS232-1B[1)]
19	RS232_1R_CONTACT	RS232-1B[1)]
20		
21		
22		
23	RS232_2R_RTS (in)	RS232-2B[1)]
24	RS232_2R_CTS (out)	RS232-2B[1)]
25	RS232_2R_CONTACT	RS232-2B[1)]

[1)] For RTU in polling mode resp. vMUX “best effort” or Prio

3.1.3.3 Assignment of the RS232-3A/B up to -4A/B Interfaces

Table 3-4 Pin assignment of the RS232-3A up to 4A interfaces



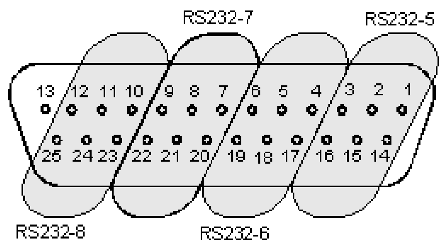
RS232-Signals (iMUX, vMUX resp. iFSK)
25 pin Sub-D connector female housing connected to FGND

PIN	Signal Name	Remarks
1	RS232_3_RXD (out)	RS232-3A
2	RS232_3_TXD1 (in)	RS232-3A
3	GND	
4	RS232_3_RXD (out)	RS232-3B[1)]
5	RS232_3R_TXD2 (in)	RS232-3B[1)]
6	GND	
7	RS232_4_RXD (out)	RS232-4A
8	RS232_4_TXD1 (in)	RS232-4A
9	GND	
10	RS232_4_RXD (out)	RS232-4B[1)]
11	RS232_4R_TXD2 (in)	RS232-4B[1)]
12	GND	
13		
14		
15		
16		
17	RS232_3R_RTS (in)	RS232-3B[1)]
18	RS232_3R_CTS (out)	RS232-3B[1)]
19	RS232_3R_CONTACT	RS232-3B[1)]
20		
21		
22		
23	RS232_4R_RTS (in)	RS232-4B[1)]
24	RS232_4R_CTS (out)	RS232-4B[1)]
25	RS232_4R_CONTACT	RS232-4B[1)]

[1)] For RTU in polling mode resp. vMUX “best effort” or Prio

3.1.3.4 Assignment of the RS232-5 up to -8 Interfaces

Table 3-5 Pin assignment of the RS232-5 up to 8 interfaces



RS232-Signals (iMUX resp. vMUX)
25 pin Sub-D connector female housing connected to FGND

PIN	Signal Name	Remarks
1	RS232_5_RXD (out)	RS232-5
2	RS232_5_TXD (in)	RS232-5
3	GND	
4	RS232_6_RXD (out)	RS232-6
5	RS232_6_TXD (in)	RS232-6
6	GND	
7	RS232_7_RXD (out)	RS232-7
8	RS232_7_TXD (in)	RS232-7
9	GND	
10	RS232_8_RXD (out)	RS232-8
11	RS232_8_TXD (in)	RS232-8
12	GND	
13		
14	RS232_5_RTS (in)	RS232-5
15	RS232_5_CTS (out)	RS232-5
16		
17	RS232_6_RTS (in)	RS232-6
18	RS232_6_CTS (out)	RS232-6
19		
20	RS232_7_RTS (in)	RS232-7
21	RS232_7_CTS (out)	RS232-7
22		
23	RS232_8_RTS (in)	RS232-8
24	RS232_8_CTS (out)	RS232-8
25		

3.1.4 Assignment of the Analog Interfaces VFx

3.1.4.1 Overview

PowerLink 100

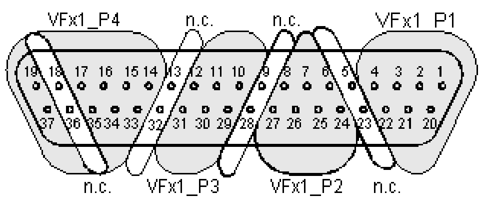
The analog interface modules VFx are used for the connection of analog signals in the frequency range from 300 Hz to 3840 Hz to the PowerLink. From the module in mounting position 2 only the ports 1 to 3 and in mounting position 3 only port 1 can be used. It is possible to route up to 5 analog voice channels (ports 1 and 2 of the VFx modules) to the vMUX (if available).

PowerLink 50

The analog interface modules VFx are used for the connection of analog signals in the frequency range from 300 Hz to 3840 Hz to the PowerLink. From the module VFX1 P1-3 and VFx2 the ports 1 to 3 can be used. From the module VFX1 P4 only port 4 can be used. It is possible to route up to 5 analog voice channels (ports 1 and 2 of the VFx modules) to the vMUX (if available).

3.1.4.2 VFX1 Module in Mounting Position 1 for PowerLink 100

Table 3-6 Pin assignment of the VFx1 connector



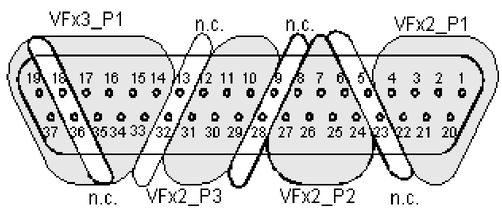
VFx1 SUB-D connector female 37 pin

PIN	Signal Name	Remarks	
1	VFX1_P1_W4IA	Port 1	4-wire input A
2	VFX1_P1_W24IOA	Port 1	4-wire output A resp. 2-wire in-/output A
3	VFX1_P1_S2IN	Port 1	S2 signaling IN (M-Lead)
4	VFX1_P1_S2OUT	Port 1	S2 signaling OUT (E-Lead)
5	n.c.	Not connected	
6	VFX1_P2_W4IA	Port 2	4-wire input A
7	VFX1_P2_W24IOA	Port 2	4-wire output A resp. 2-wire in-/output A
8	VFX1_P2_COMP	Port 2	Compander control
9	n.c.	Not connected	
10	VFX1_P3_W4IA	Port 3	4-wire input A
11	VFX1_P3_W4OA	Port 3	4-wire output A
12	VFX1_P3_S6INA	Port 3	S6 control wire IN A
13	n.c.	Not connected	
14	VFX1_P4_W4IA	Port 4	4-wire input A
15	VFX1_P4_W4OA	Port 4	4-wire output A
16	reserved		
17	reserved		
18	n.c.	Not connected	
19	VFX1_P4_S6INA	Port 4	S6 control wire IN A
20	VFX1_P1_W4IB	Port 1	4-wire input B
21	VFX1_P1_W24IOB	Port 1	4-wire output B resp. 2-wire in-/output B
22	VFX1_P1_COMP	Port 1	Compander control
23	n.c.	Not connected	
24	VFX1_P2_W4IB	Port 2	4-wire input B
25	VFX1_P2_W24IOB	Port 2	4-wire output B resp. 2-wire in-/output B
26	VFX1_P2_S2IN	Port 2	S2 signaling IN (M-Lead)
27	VFX1_P2_S2OUT	Port 2	S2 signaling OUT (E-Lead)
28	n.c	Not connected	
29	VFX1_P3_W4IB	Port 3	4-wire input B
30	VFX1_P3_W4OB	Port 3	4-wire output B
31	VFX1_P3_S6INB	Port 3	S6 control wire IN B

32	n.c.	Not connected	
33	VFX1_P4_W4IB	Port 4	4-wire input B
34	VFX1_P4_W4OB	Port 4	4-wire output B
35	reserved		
36	n.c.	Not connected	
37	VFX1_P4_S6INB	Port 4	S6 control wire IN B

3.1.4.3 VFX 2&3 Modules in Mounting Positions 2 and 3 for PowerLink 100

Table 3-7 Pin assignment of the VFX 2&3 connector



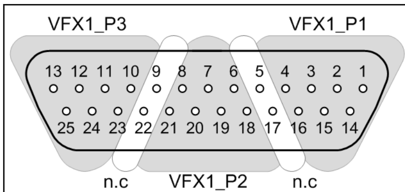
VFX 2&3 SUB-D connector female 37 pin

PIN	Signal Name	Remarks	
1	VFX2_P1_W4IA	Port 1	4-wire input A
2	VFX2_P1_W24IOA	Port 1	4-wire output A resp. 2-wire in-/output A
3	VFX2_P1_S2IN	Port 1	S2 signaling IN (M-Lead)
4	VFX2_P1_S2OUT	Port 1	S2 signaling OUT (E-Lead)
5	n.c.	Not connected	
6	VFX2_P2_W4IA	Port 2	4-wire input A
7	VFX2_P2_W24IOA	Port 2	4-wire output A resp. 2-wire in-/output A
8	VFX2_P2_COMP	Port 2	Compander control
9	n.c.	Not connected	
10	VFX2_P3_W4IA	Port 3	4-wire input A
11	VFX2_P3_W4OA	Port 3	4-wire output A
12	VFX2_P3_S6INA	Port 3	S6 control wire IN A
13	n.c.	Not connected	
14	VFX3_P1_W4IA	Port 1	4-wire input A
15	VFX3_P1_W4IOA	Port 1	4-wire output A resp. 2-wire in-/output A
16	VFX3_P1_S2IN	Port 1	S2 signaling IN (M-Lead)
17	VFX3_P1_S2OUT	Port 1	S2 signaling OUT (E-Lead)
18	n.c.	Not connected	
19	reserved		
20	VFX2_P1_W4IB	Port 1	4-wire input B
21	VFX2_P1_W24IOB	Port 1	4-wire output B resp. 2-wire in-/output B
22	VFX2_P1_COMP	Port 1	Compander control
23	n.c.	Not connected	
24	VFX2_P2_W4IB	Port 2	4-wire input B
25	VFX2_P2_W24IOB	Port 2	4-wire output B resp. 2-wire in-/output B
26	VFX2_P2_S2IN	Port 2	S2 signaling IN (M-Lead)
27	VFX2_P2_S2OUT	Port 2	S2 signaling OUT (E-Lead)
28	n.c.	Not connected	
29	VFX2_P3_W4IB	Port 3	4-wire input B

30	VFX2_P3_W4OB	Port 3	4-wire output B
31	VFX2_P3_S6INB	Port 3	S6 control wire IN B
32	n.c.	Not connected	
33	VFX3_P1_W4IB	Port 1	4-wire input B
34	VFX3_P1_W4IOB	Port 1	4-wire output B resp. 2-wire in-/output B
35	VFX3_P1_COMP	Port 1	Compander control
36	n.c.	Not connected	
37	reserved		

3.1.4.4 VFX1 P1-3 Module for PowerLink 50

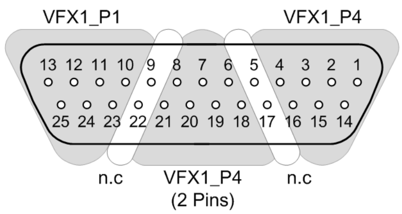
Table 3-8 Pin assignment of the VFX1 P1-3 connector



VFX1 P1-3 SUB-D connector female 25 pin			
PIN	**Signal Name**	**Remarks**	
1	VFX1_P0_W4IA	Port 1	4-wire input A
2	VFX1_P0_W24IOA	Port 1	4-wire output A resp. 2-wire in-/output A
3	VFX1_P0_S2IN	Port 1	S2 signaling IN (M-Lead)
4	VFX1_P0_S2OUT	Port 1	S2 signaling OUT (E-Lead)
5	n.c.	Not connected	
6	VFX1_P1_W4IA	Port 2	4-wire input A
7	VFX1_P1_W24IOA	Port 2	4-wire output A resp. 2-wire in-/output A
8	VFX1_P1_COMP	Port 2	Compander control
9	n.c.	Not connected	
10	VFX1_P2_W4IA	Port 3	4-wire input A
11	VFX1_P2_W4OA	Port 3	4-wire output A
12	VFX1_P2_S6INA	Port 3	S6 control wire IN A
13	reserved		
14	VFX1_P0_W4IB	Port 1	4-wire input B
15	VFX1_P0_W24IOB	Port 1	4-wire output B resp. 2-wire in-/output B
16	VFX1_P0_COMP	Port 1	Compander control
17	n.c.	Not connected	
18	VFX1_P1_W4IB	Port 2	4-wire input B
19	VFX1_P1_W24IOB	Port 2	2-wire in-/output B resp. 4-wire output B
20	VFX1_P1_S2IN	Port 2	S2 signaling IN (M-Lead)
21	VFX1_P1_S2OUT	Port 2	S2 signaling OUT (E-Lead)
22	n.c.	Not connected	
23	VFX1_P2_W4IB	Port 3	4-wire input B
24	VFX1_P2_W4OB	Port 3	4-wire output B
25	VFX1_P2_S6INB	Port 3	S6 control wire IN B

3.1.4.5 VFX1 P4 Module for PowerLink 50

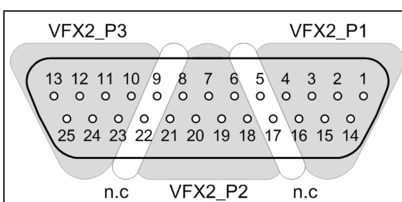
Table 3-9 Pin assignment of the VFX1 P4 connector



VFX1 P4 SUB-D connector female 25 pin			
PIN	**Signal Name**	**Remarks**	
1	VFX1_P3_W4IA	Port 4	4-wire input A
2	VFX1_P3_W4OA	Port 4	4-wire output
3	reserved		
4	reserved		
5	n.c.	Not connected	
6	VFX1_P3_S6INA	Port 4	S6 control wire IN A
7	reserved		
8	reserved		
9	n.c.	Not connected	
10	reserved		
11	reserved		
12	reserved		
13	reserved		
14	VFX1_P3_W4IB	Port 4	4-wire input B
15	VFX1_P3_W4OB	Port 4	4-wire output B
16	reserved		
17	n.c.	Not connected	
18	VFX1_P3_S6INB	Port 4	S6 control wire IN B
19	reserved		
20	reserved		
21	reserved		
22	n.c.	Not connected	
23	reserved		
24	reserved		
25	reserved		

3.1.4.6 VFX2 Module for PowerLink 50

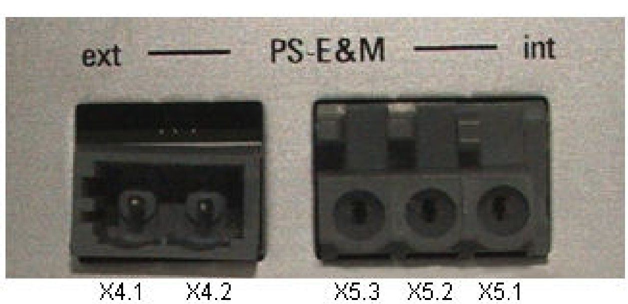
Table 3-10 Pin assignment of the VFX2 connector



VFX2 SUB-D connector female 25 pin		
PIN	**Signal Name**	**Remarks**

1	VFX2_P0_W4IA	Port 1	4-wire input A
2	VFX2_P0_W24IOA	Port 1	4-wire output A resp. 2-wire in-/output A
3	VFX2_P0_S2IN	Port 1	S2 signaling IN (M-Lead)
4	VFX2_P0_S2OUT	Port 1	S2 signaling OUT (E-Lead)
5	n.c.	Not connected	
6	VFX2_P1_W4IA	Port 2	4-wire input A
7	VFX2_P1_W24IOA	Port 2	4-wire output A resp. 2-wire in-/output A
8	VFX2_P1_COMP	Port 2	Compander control
9	n.c.	Not connected	
10	VFX2_P2_W4IA	Port 3	4-wire input A
11	VFX2_P2_W4OA	Port 3	4-wire output A
12	VFX2_P2_S6INA	Port 3	S6 control wire IN A
13	reserved		
14	VFX2_P0_W4IB	Port 1	4-wire input B
15	VFX2_P0_W24IOB	Port 1	4-wire output B resp. 2-wire in-/output B
16	VFX2_P0_COMP	Port 1	Compander control
17	n.c.	Not connected	
18	VFX2_P1_W4IB	Port 2	4-wire input B
19	VFX2_P1_W24IOB	Port 2	2-wire in-/output B resp. 4-wire output B
20	VFX1_P1_S2IN	Port 2	S2 signaling IN (M-Lead)
21	VFX2_P1_S2OUT	Port 2	S2 signaling OUT (E-Lead)
22	n.c.	Not connected	
23	VFX2_P2_W4IB	Port 3	4-wire input B
24	VFX2_P2_W4OB	Port 3	4-wire output B
25	VFX2_P2_S6INB	Port 3	S6 control wire IN B

3.1.4.7 PS E&M Connectors



[tdvfx2pn-040111-02.tif, 1, --_--]

Figure 3-21 The PS E&M connectors for external resp. internal supply voltage

Table 3-11 PS E&M ext connector (X4) for input of the external voltage

PIN	Signal Name
1	Vext +
2	Vext -

Table 3-12 PS E&M int connector (X5) for output of the internal voltage

PIN	Signal Name
1	+48V
2	-48V
3	GND

Table 3-13 Jumper W120 at the CFS-2 backplane

Jumper position W120	Remarks
1-2	Not used
2-3	Default setting

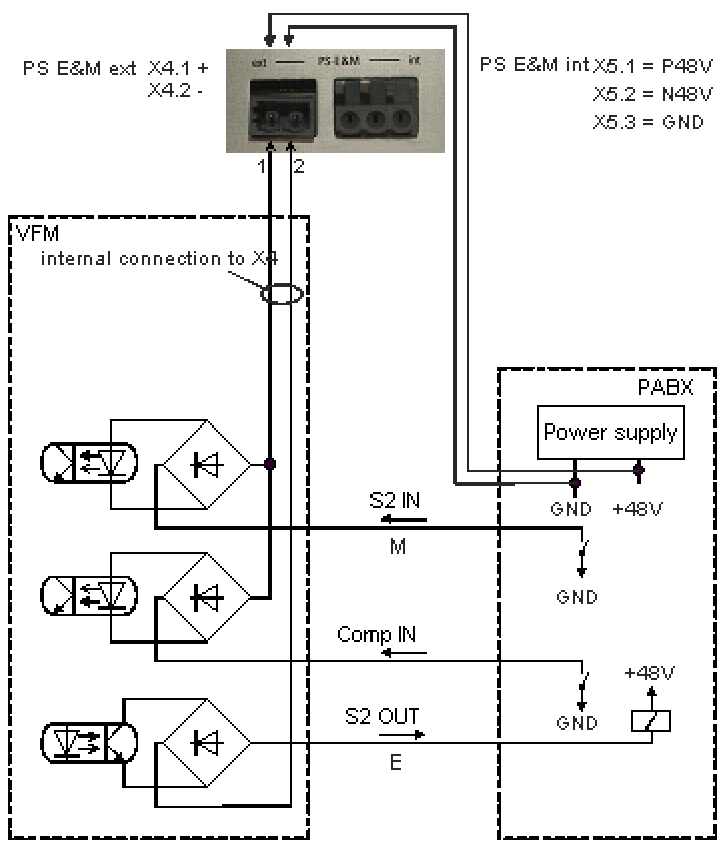
NOTE

The jumper W120 is located at the module side of the CFS-2 backplane between slot position 3 and 4.

Examples for connecting the power supply for the E&M signaling are shown in the next figures.

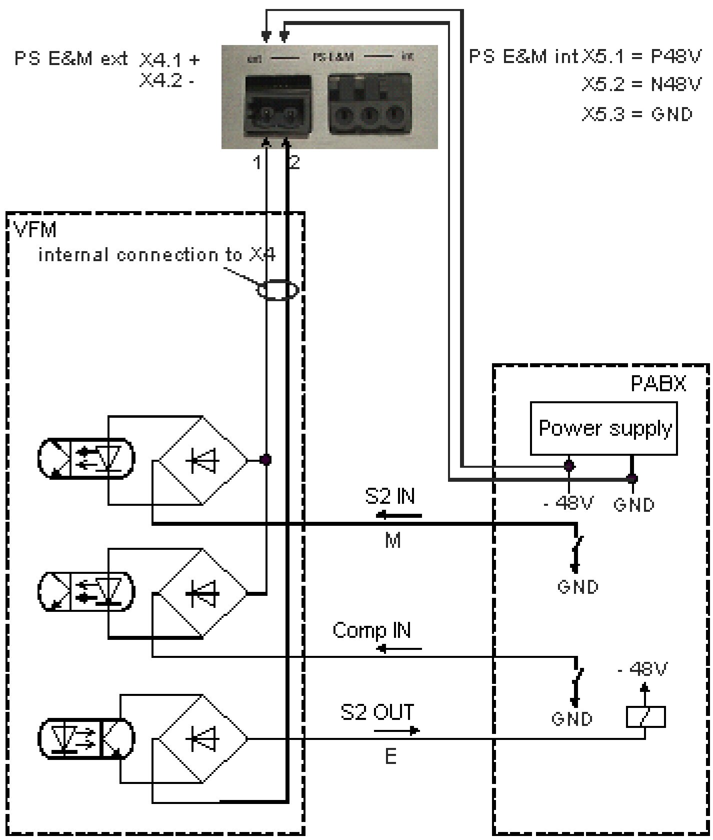
Wiring of the PS E and M Connectors

The connection of the external voltage supply for the S2 signaling wire from the exchange to the connector X4 is shown in the figure below:



[cdevsp48-291110-01.tif, 1, en_US]

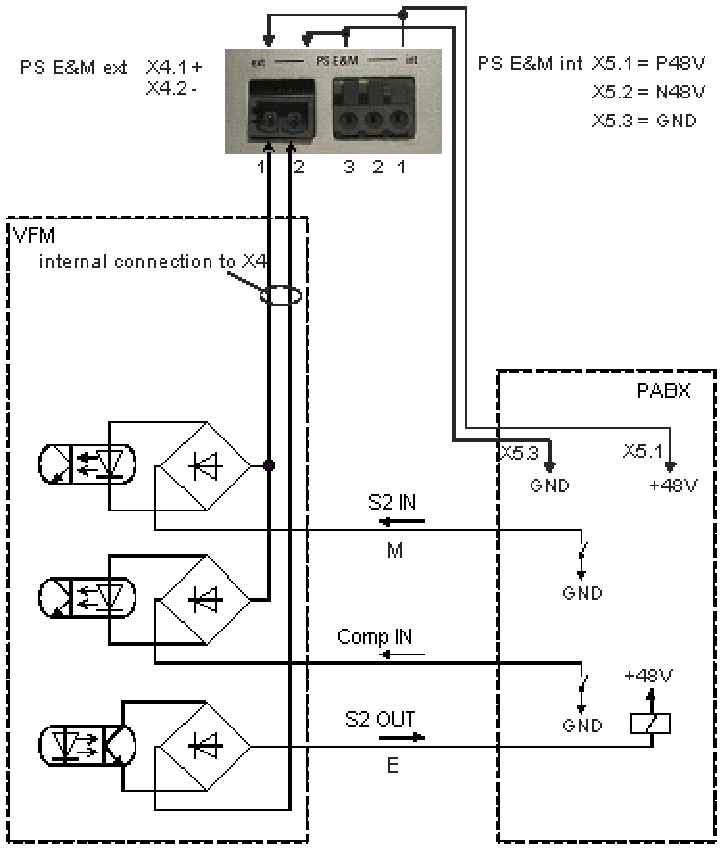
Figure 3-22 Using external supply voltage +48V for the signaling wire S2



[cdevsm48-291110-01.tif, 1, en_US]

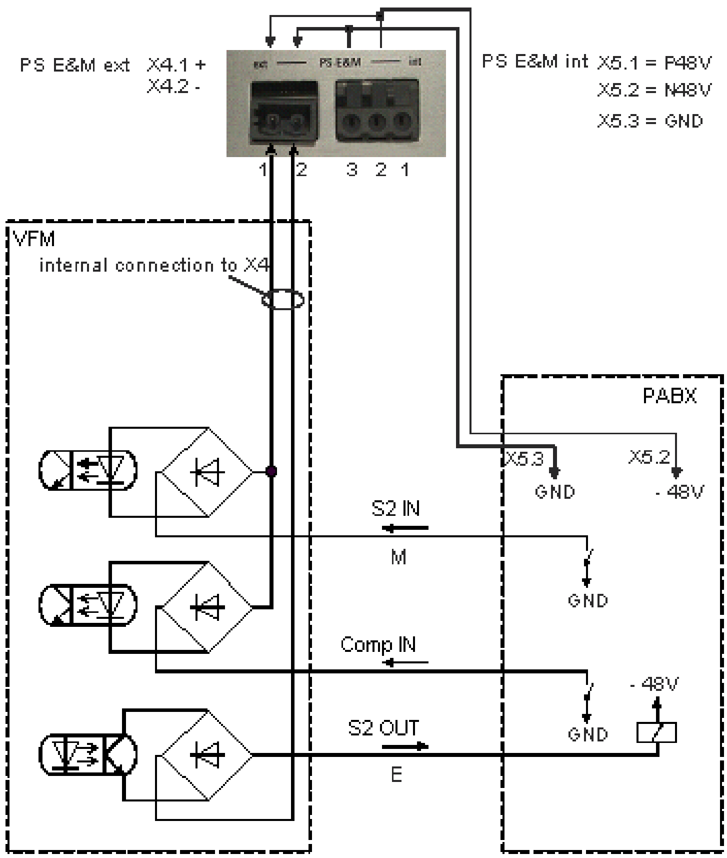
Figure 3-23 Using external supply voltage -48V for the signaling wire S2

When using the internal voltage supply of the PowerLink for the S2 signaling wire from the exchange the connectors X4 and X5 have to be looped like shown in the figures below:



[cdivsp48-291110-01.tif, 1, en_US]

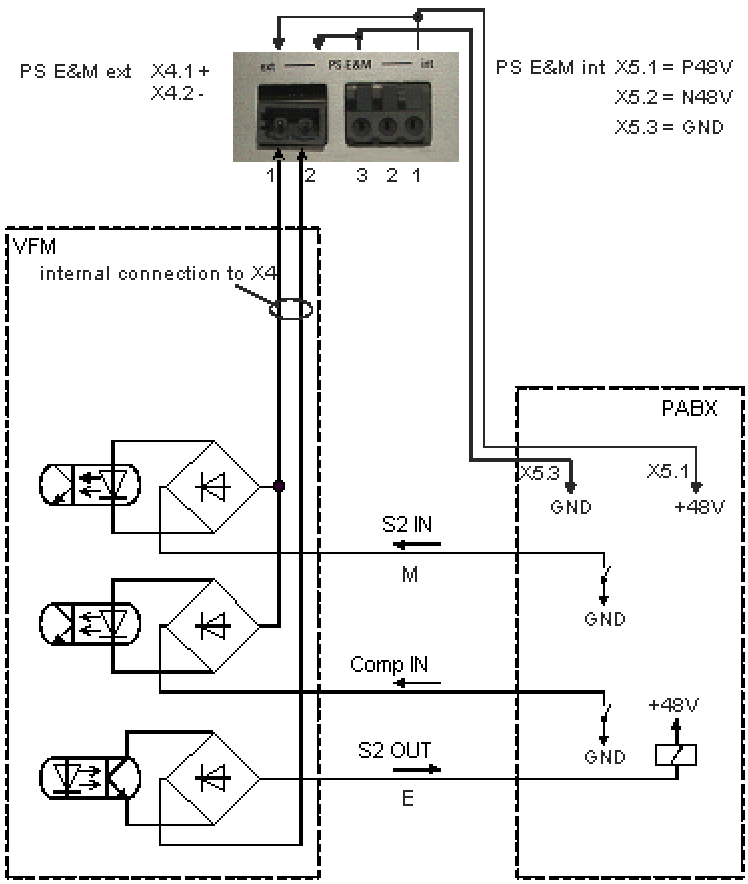
Figure 3-24 Using the internal voltage supply (GND and +48V) for the signaling wire S2



[cdivsm48-291110-01.tif, 1, en_US]

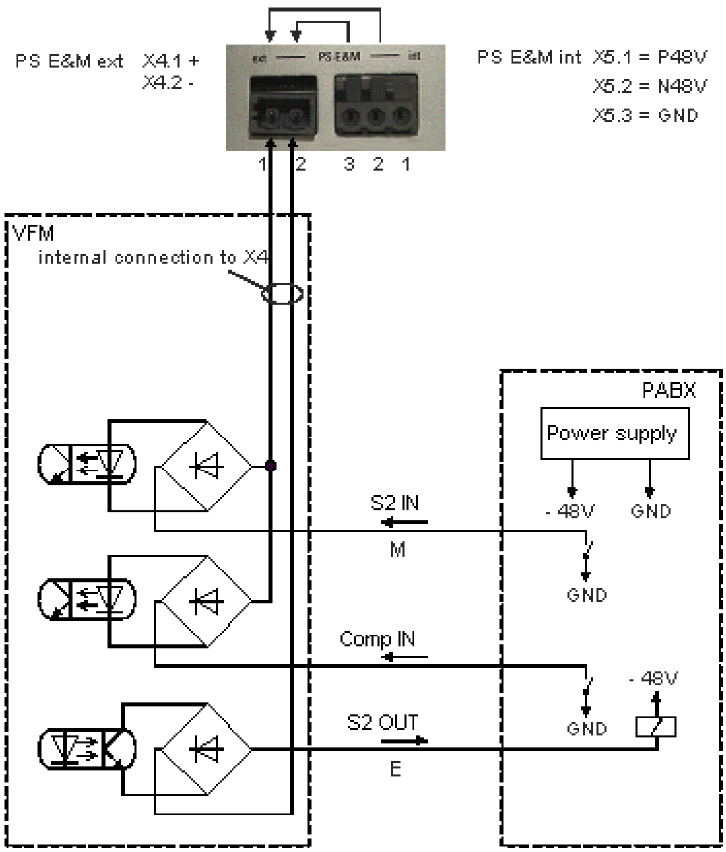
Figure 3-25 Using the internal voltage supply (GND and -48V) for the signaling wire S2

The connection between the PowerLink system and the exchange without galvanic isolation is shown in the next figure. This connection is only possible when the distance between the Power-Link and the exchange is very short, and both devices are using the same ground potential.



[cdcgap48-291110-01.tif, 1, en_US]

Figure 3-26 Connecting the S2 wire to the exchange without galvanic isolation using GND and +48V

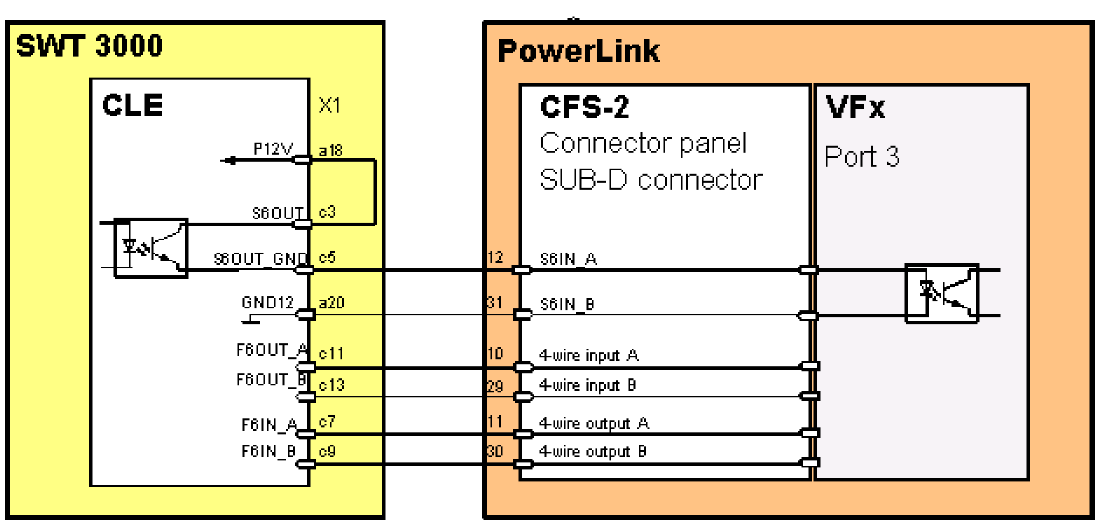


[cdcgam48-291110-01.tif, 1, en_US]

Figure 3-27 Connecting the S2 wire to the exchange without galvanic isolation using GND and -48V

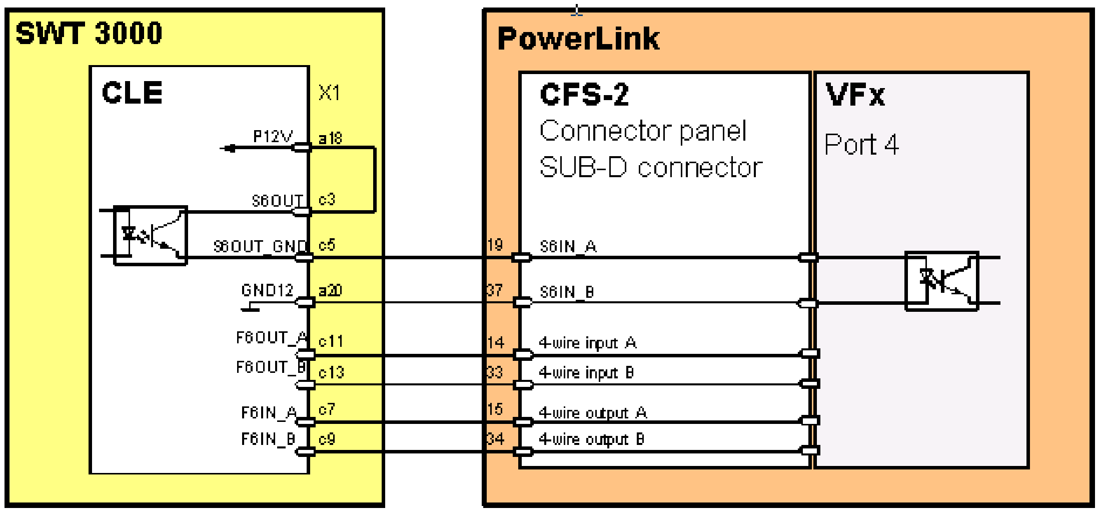
3.1.4.8 Connection of an External SWT 3000 to the VFx Modules

The connection of the CLE module from an external SWT 3000 to the SUB-D female connector of the VFx modules is shown in the figures below. In this case the VFx ports 3 resp. 4 must be used (ref. also to table *Pin assignment of the VFx_1 connector* and *Pin assignment of the VFx2-3 connector*.



[cdeswtp3-120813-01.tif, 1, en_US]

Figure 3-28 Connecting an external SWT 3000 to the port 3 of the VFx modules



[cdeswtp4-120813-01.tif, 1, en_US]

Figure 3-29 Connecting an external SWT 3000 to the port 4 of the VFx modules

3.1.4.9 Alarm Interface Connector

Alarm interface for PowerLink 100

With 2 alarm modules ALR up to 6 relay contacts are available at the alarm interface. The alarm indications are adjustable with the service program PowerSys.

Table 3-14 PowerLink 100 - Pin assignment of the CFS-2 alarm interface connector

PIN	Signal Name	Remarks
1	ALRS1_ALA1A	Alarm relay K1 from ALR 1 module
2	ALRS1_ALA1B	Alarm relay K1 from ALR 1 module
3	ALRS1_ALA2A	Alarm relay K2 from ALR 1 module
4	ALRS1_ALA2B	Alarm relay K2 from ALR 1 module
5	ALRS1_ALA3A	Alarm relay K3 from ALR 1 module
6	ALRS1_ALA3B	Alarm relay K3 from ALR 1 module
7	ALRS2_ALA4A	Alarm relay K1 from ALR 2 module
8	ALRS2_ALA4B	Alarm relay K1 from ALR 2 module
9	ALRS2_ALA5A	Alarm relay K2 from ALR 2 module
10	ALRS2_ALA5B	Alarm relay K2 from ALR 2 module
11	ALRS2_ALA6A	Alarm relay K3 from ALR 2 module
12	ALRS2_ALA6B	Alarm relay K3 from ALR 2 module
13	ALRS1_USYNCA	Clock synch. or IRIG-B input of ALR1 module
14	ALRS1_USYNCB	Clock synch. input or IRIG-B input of ALR1 module
15	BI2_A	Binary Input 2 from ALR 1
16	BI2_B	Binary Input 2 from ALR 1
17		
18		
19		
20		
21	FGND	

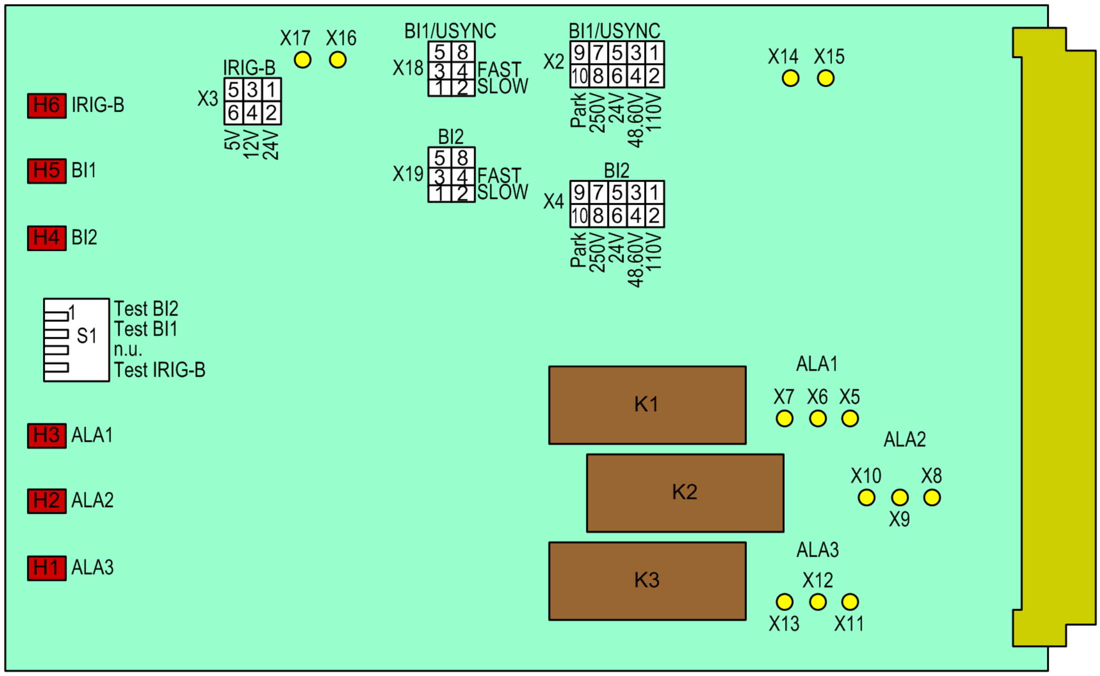
Alarm interface for PowerLink 50

With 1 alarm modules ALR up to 3 relay contacts are available at the alarm interface. The alarm indications are adjustable with the service program PowerSys.

Table 3-15 PowerLink 50 - Pin assignment of the CFS-2 alarm interface connector

PIN	Signal Name	Remarks
A1	ALRS_USYNCA	Clock synch. or IRIG-B input of ALR1 module
A5	ALRS_BI1A	Binary input from ALR 1 module
A8	ALRS_BI1B	Binary input from ALR 1 module
A11	n.c.	
A12	FGND	
A13	n.c.	
A14	ALRS_USYNC_L	
A15	ALRS_SLP_L	
A16	P5V	Power supply 5 V
A17	GND	
A18	P12V	Power supply 12 V
A21	ALRS_ALA1A	Alarm relay from ALR 1 module
A25	ALRS_ALA2B	Alarm relay from ALR 1 module
A28	ALRS_ALA2A	Alarm relay from ALR 1 module
A32	ALRS_ALA3A	Alarm relay from ALR 1 module
B11	n.c.	
B12	FGND	
B13	n.c.	
B14	n.c.	
B15	n.c.	
B16	P5V	Power supply 5 V
B17	ALRS_PD_L	
B18	P12V	Power supply 12 V
C3	ALRS_USYNCB	Clock synch. input or IRIG-B input of ALR1 module
C11	n.c.	
C12	FGND	
C13	ALRS_OUT1_L	Binary output from ALR1
C14	ALRS_OUT2_L	Binary output from ALR1
C15	ALRS_OUT3_L	Binary output from ALR1
C16	P5V	Power supply 5 V
C17	n.c	
C18	P12V	Power supply 12 V
C23	ALRS_ALA1B	Alarm relay from ALR 1 module
C30	ALRS_ALA3B	Alarm relay from ALR 1 module

Jumpers for the relay contacts on the ALR module



[scpjrca2-230913-01.tif, 1, en_US]

Figure 3-30 Position of the jumpers for the relay contacts on the ALR module

Table 3-16 Setting options for the ALR module

Jumpers					
	X2	X3	X4	X5-X13	X14 – X17
Binary Input 1 – used for Synchronisation with Sync Pulse					
250 V	X2 – 7/8 *)	open	---	---	X14 – X15 *)
110 V	X2 – 1/2	open	---	---	X14 – X15
48 V / 60 V	X2 – 3/4	open	---	---	X14 – X15
24 V	X2 – 5/6	open	---	---	X14 – X15
Debounce time		≈ 0.6 ms ≈ 1.0 ms	X18 – 3/4 X18 – 1/2		
Binary Input 1 – used for IRIG-B2					
24 V	open	X3 – 1/2	---	---	X16 – X17
12 V	open	X3 – 3/4	---	---	X16 – X17
5 V	open	X3 – 5/6	---	---	X16 – X17
Binary Input 2 – for future application					
250 V	---	---	X4 – 7/8 *)	---	---
110 V	---	---	X4 – 1/2	---	---
48 V / 60 V	---	---	X4 – 3/4	---	---
24 V	---	---	X4 – 5/6	---	---
Debounce time		≈ 0.6 ms ≈ 1.0 ms	X19 – 3/4 X19 – 1/2		

Alarm Output 1 Relay K1					
NC	---	---	---	X5 – X6 *)	---
NO	---	---	---	X6 – X7	---
Alarm Output 2 Relay K2					
NC	---	---	---	X8 – X9 *)	---
NO	---	---	---	X9 – X10	---
Alarm Output 2 Relay K3					
NC	---	---	---	X11 – X12 *)	---
NO	---	---	---	X12 – X13	---

NC=	Break contact
NO=	Make contact
*) =	Default setting
**)=	The max. length of the connecting cable for the binary inputs is 30 m

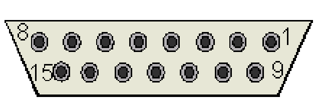
3.1.5 Assignment of the X.21-DP Interface

3.1.5.1 Overview

Table 3-17 Pin assignment of the X.21-DP interface

Pin	Signal Name	Remarks
1	FGND	Frame ground
2	X21_D_IN_A	X.21 (DCE) transmit (a) input
3		
4	X21_D_OUT_A	X.21 (DCE) receive (a) output
5		
6	X21_CL_OUT_A	Clock out + (DP in DCE mode)
7	X21_EXT_CL_A	Ext. clock in (DP in DTE mode)
8	GND	Signal ground
9	X21_D_IN_B	X.21 (DCE) transmit (b) input
10		
11	X21_D_OUT_B	X.21 (DCE) receive (b) output
12		
13	X21_CL_OUT_B	Clock out – (DP in DCE mode)
14	X21_EXT_CL_B	Ext. clock in (DP in DTE mode)
15		

The X.21-DP interface socket of the PowerLink connector panel



[dwsocdle-291110-01.tif, 1, en_US]

Figure 3-31 Pin arrangement of the 15-pol SUB-D sockets

Use screened cables for the connections.

CAUTION

If the vMUX board is equipped, the system internal board link disables the X.21-DP interface.

If vMUX is used, the X.21-DP interface is not available (but the interfaces X21-1 and X21-2 can be operated).

✧ vMUX board may not be mounted if X.21-DP is used.

3.1.6 Synchronous vMUX Interfaces X.21

3.1.6.1 Overview

The synchronous interfaces X.21-1 and X.21-2 serve for the connection of **synchronous data channels** to the **vMUX** of the PowerLink.
Use screened cables for the connections.

3.1.6.2 Synchronous vMUX User Interface – X.21-1

Table 3-18 Pin assignment of the X.21-1 interface

PIN	Signal Name	Remarks
1	FGND	Frame ground
2	X.21-1_D_IN_A	X.21 (DCE) transmit (a) input
3		
4	X.21-1_D_OUT_A	X.21 (DCE) receive (a) output
5		
6	X.21-1_CL_OUT_A	X.21 (DCE): Signal Timing (a)
7	X.21-1_CL_IN_A	
8	GND	Signal ground
9	X.21-1_D_IN_B	X.21-1_D_IN_B
10		
11	X.21-1_D_OUT_B	X.21 (DCE) receive (b) output
12		
13	X.21-1_CL_OUT_B	X.21 (DCE): Signal Timing (b)
14	X.21-1_CL_IN_B	
15		

3.1.6.3 Synchronous vMUX User Interface – X.21-2

Table 3-19 Pin assignment of the X.21-2 interface

PIN	Signal Name	Remarks
1	FGND	Frame ground
2	X.21-2_D_IN_A	X.21 (DCE) transmit (a) input
3		
4	X.21-2_D_OUT_A	X.21 (DCE) receive (a) output
5		
6	X.21-2_CL_OUT_A	X.21 (DCE): Signal Timing (a)
7	X.21-2_CL_IN_A	
8	GND	Signal ground

PIN	Signal Name	Remarks
9	X.21-2_D_IN_B	X.21 (DCE) transmit (b) input
10		
11	X.21-2_D_OUT_B	X.21 (DCE) receive (b) output
12		
13	X.21-2_CL_OUT_B	X.21 (DCE): Signal Timing (b)
14	X.21-2_CL_IN_B	
15		

3.1.7 Fractional E1 Interface

The fE1 interface serves for the connection of a 2 Mbps E1 frame from a digital exchange for the transparent transmission from 8 out of 30 voice channels via the vMUX.

Table 3-20 Pin assignment of the fractional E1 connector FE1

Pin	Signal Name	Remarks
1	FE1_Tx_A	Transmit data A
2	FE1_Tx_B	Transmit data B
3	FE1_RES1	n.u.
4	FE1_Rx_A	Receive data A
5	FE1_Rx_B	Receive data B
6	FE1_RES2	n.u.
7	FE1_RES3	n.u.
8	FE1_RES4	n.u.

The interface can be configured in **NT** (Network terminal) and in **TE** (Terminal equipment) mode. The **default configuration is the NT mode**, and in such a case a **direct cable** can be used to connect the PBX to the FE1 interface. If the **interface is configured as TE**, a **NT** system will be connected to the PowerLink with a **crossed** cable.

For the connections (screened) Cat5e cables have to be used.

3.1.8 Ethernet Interface

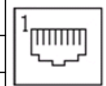
3.1.8.1 Overview

PowerLink offers Ethernet interfaces, 2 user and 1 service interface. The electrical Ethernet user interface (IP-1) is located at the connector panel. The optical Ethernet user interface (ETH) as well as the electrical Ethernet service interface (LCT) are located at the front cover of the module CSPi.

3.1.8.2 Ethernet Electrically (IP-1, LCT)

For connection a (screened) Cat5e cable has to be used.

Table 3-21 Pin assignment of the RJ45 Ethernet connector IP-1 and LCT

Pin	Signal Name	Remarks	
1	ETHU_Tx_P	Transmit data P	
2	ETHU_Tx_N	Transmit data N	
3	ETHU_RX_P	Receive data P	
4		n.u.	
5		n.u.	
6	ETHU_RX_N	Receive data N	
7		n.u.	
8		n.u.	

The signal standard at this interface complies with IEC 802.3

3.1.8.3 Ethernet Optically (ETH)

Fiber optic module:	SFP-Module
Fiber type:	Multi mode with modules using 850nm wave length single mode with modules using 1300nm wave length
Wave length:	850 nm or 1300 nm
Opt. connector:	LC-connector
Range:	approx. 3 km at 1300nm approx. 550m at 850nm (depending on module type)

For the connection two fibers are necessary. One for Tx and one for RX.

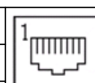
3.1.9 G703.1 Interface Connector (IP-2) for PowerLink 100

The G703.1 interface is an alternative connection for the Data Pump to an external device. In case of working with this interface, the transmission rate is fixed to 64 Kbps. The working condition is “contra directional clock timing”.

The G703.1 interface is located at the connector panel on the CFS-2 (IP-2).

A (screened) Cat5e cable has to be used.

Table 3-22 Pin assignment of the RJ45 G703.1 connector IP-2

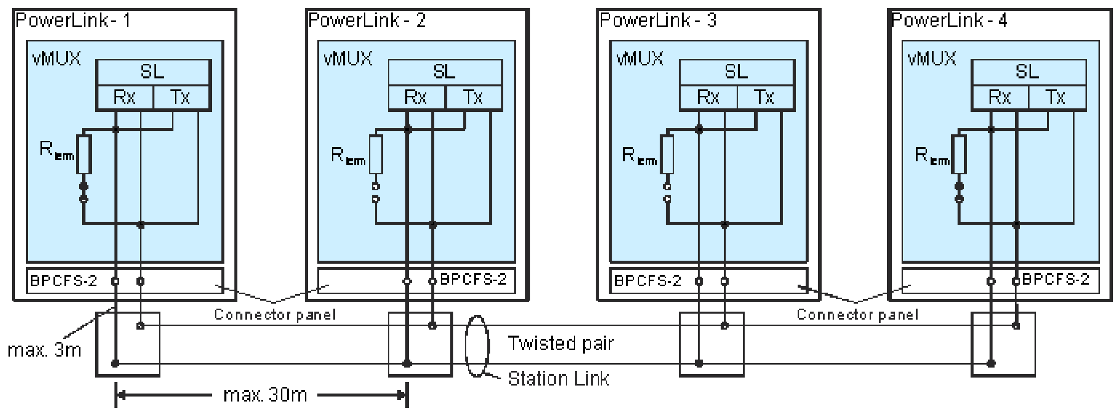
Pin	Signal Name	Remarks	
1	G703_TX_P	Transmit data P	
2	G703_TX_N	Transmit data N	
3	G703_RX_P	Receive data P	
4		n.u.	
5		n.u.	
6	G703_RX_N	Receive data N	
7		n.u.	
8		n.u.	

The signal standard at this interface complies with ITU G703.1

3.1.10 StationLink Connector

The station link RJ45 connector is located on the PowerLink connector panel.

The station link (SL) offers the routing of channels between up to four different PowerLink equipments. The port mapping is carried out in the receiver. Local ports of the PowerLinks can't be routed.



[cdstlink-120813-01.tif, 1, en_US]

Figure 3-32 The station link principle connection

The maximum SL device distance is 30m. The max. distance between PowerLink SL connector and Station Link bus is 3m.

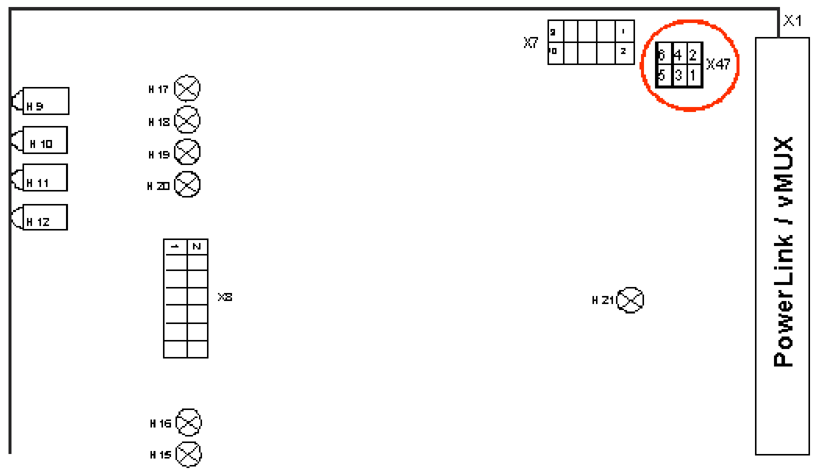
For all SL connections only screened Cat5e cables have to be used!

Table 3-23 Pin assignment of the station link connector SL

Pin	Signal Name	Remarks
1	SL_RES1	n.u.
2	SL_RES2	n.u.
3	SL_RES3	n.u.
4	SL_A	Station Link (a)
5	SL_B	Station Link (b)
6	SL_RES4	n.u.
7	SL_RES5	n.u.
8	SL_RES6	n.u.

StationLink Termination

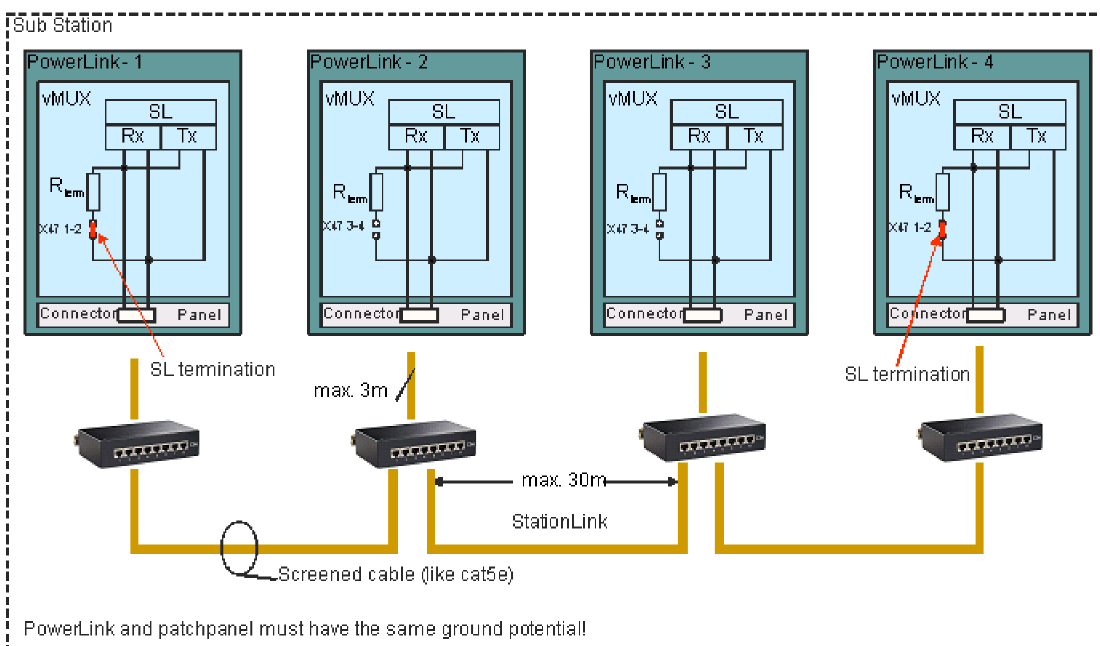
The station link bus must be terminated on both ends (in two PowerLink equipments). Refer also to Chapter *3.1.10 StationLink Connector* (PowerLink-1 and 4) resp. *Figure 3-110*. For this purpose a termination resistance R_{term} is available which is located on the vMUX board. It has to be activated with jumper X47.



[tdx47slt-291110-01.tif, 1, en_US]

Figure 3-33 Location of the jumper X47 on the vMUX for activating the SL termination resistance

Jumper position X47	Function
1 - 2	Station Link terminated
3 - 4	Station link not terminated Park position (default setting)
5 - 6	Not used



[cdstli50-120813-01.tif, 1, en_US]

Figure 3-34 Station Link with four PowerLink 50/100

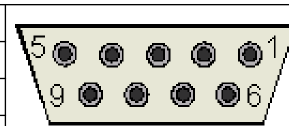
3.1.11 RM Interfaces

3.1.11.1 RM Interface RM-1

The remote access interface RM-1 could be used alternatively to the Ethernet service interface, located on the CSPi. In this case the connection between the service PC and PowerLink is done via an RS232 interface.

The RM-1 interface has to be used for software download with MemTool to the CSPi. Also the RM-1 interface can be used as IPCON terminal (see Chapter *Diagnostic*).

Table 3-24 Pin assignment of the interface RM-1

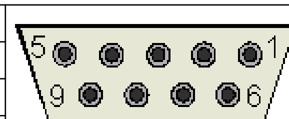
	Pin	Signal Name	
	1		
	2	RM-1_RXD (out)	
	3	RM-1_TXD (in)	
	4		
	5	GND	
	6		
	7		
	8		
	9		

3.1.11.2 RM Interface RM-2 for PowerLink 100

The RM-2 interface (Remote Access) of the PowerLink system has the same characteristics like the SSB interface of the SWT 3000 systems.

For example, it is possible to connect the PowerLink to a remote access server (RAS) via the interface RM-2 This allows users to gain access to the system from a remote location. Further information can be found in the Chapter *SNMPand Remote Access*.

Table 3-25 Pin assignment of the interface RM-2

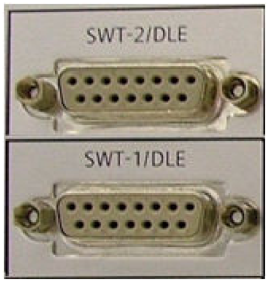
	Pin	Signal Name	
	1		
	2	RM-2_RXD (out)	
	3	RM-2_TXD (in)	
	4		
	5	GND	
	6		
	7	RM-2_RTS (in)	
	8	RM-2_CTS (out)	
	9		

3.1.12 Integrated SWT 3000

3.1.12.1 Assignment of the Interface DLE for PowerLink 100

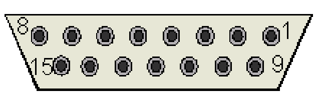
For the iSWT the **digital line interface LID-1** is available through expansion of the PU4 module with the interface module to digital transmission paths DLE (digital line equipment). The hardware interfaces X.21 (up to 64kbit/s), G703.1 (64kbit/s) and G703.6 (2Mbit/s HDB3-coded balanced or coaxial) can be selected on the LID, although only one can be used.

Table 3-26 Pin assignment of the digital line equipment SWT-x/DLE



Pin	Signal Name	X.21 Signal (DTE)	G703.1 Signal	G703.6 Signal
1	FGND	GNDS / Shield	GNDS	GNDS
2	DLE_TXD_A (out)	X21_TxD_A1	DO11	DO11
3				
4	DLE_RXD_A (in)	X21_RxD_A1	DI11	DI11
5				
6	DLE_RXC_A (in)	X21_RxC_A1		
7	DLE_TXC_A (out)	X21_TxC_A1		
8	GND	GND / Signal	GND	GND
9	DLE_TXD_B (out)	X21_TxD_B1	DO12	DO12
10				
11	DLE_RXD_B (in)	X21_RxD_B1	DI12	DI12
12				
13	DLE_RXC_B (in)	X21_RxC_B1		
14	DLE_TXC_B (out)	X21_TxC_B1		
15				

SWT-1 first integrated SWT
SWT-2 second integrated SWT
DLE digital line equipment



[dwsocdle-291110-01.tif, 1, en_US]

Figure 3-35 Sockets for connecting the DLE from the iSWT 3000

Table 3-27 Signals for the X-21 interface from the SWT-1

Signal Name	Function
X21_RxD_A1	Input: X.21 Receive data signal a
X21_RxD_B1	Input: X.21 Receive data signal b
X21_TxD_A1	Output: X.21 Transmit data signal a
X21_TxD_B1	Output: X.21 Transmit data signal b
X21_RxC_A1	Input: X.21 Receive clock signal a
X21_RxC_B1	Input: X.21 Receive clock signal b
X21_TxC_A1	Output: X.21 Transmit clock signal a
X21_TxC_B1	Output: X.21 Transmit clock signal b
GNDS	Shielding
GND	Signal reference potential

Table 3-28 Signals for the G703.1 and G703.6- interface from the SWT-1

Signal Name	Function
DI11	Data in signal 1
DI12	Data in signal 2

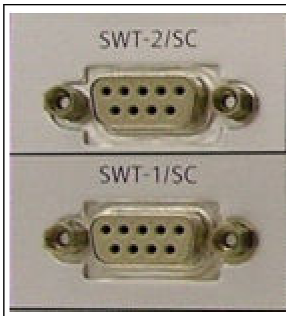
Signal Name	Function
DO11	Data out signal 1
DO12	Data out signal 2
GNDS	Shielding
GND	Signal reference potential

The pin assignment and signal names of SWT-1/DLE and SWT-2/DLE are identical.

3.1.12.2 Assignment of the Service Channel Interface SC for PowerLink 100

The service channel (SC) is a transparent data channel (format 9600 bps, 8 data bits, 1 start bit, 1 stop bit, no parity) that is only available when using a **digital line interface** (LID-1). Further information can be found in the chapter *System Description*.

Table 3-29 Socket for connecting the SC for the iSWT 3000

	PIN	Signal Name	
	1		
	2	SC_RXD (in)	
	3	SC_TXD (out)	
	4		
	5	GND	
	6		
	7	SC_RTS	
	8	SC_CTS	
	9		

SWT-2	second iSWT
SC	service channel

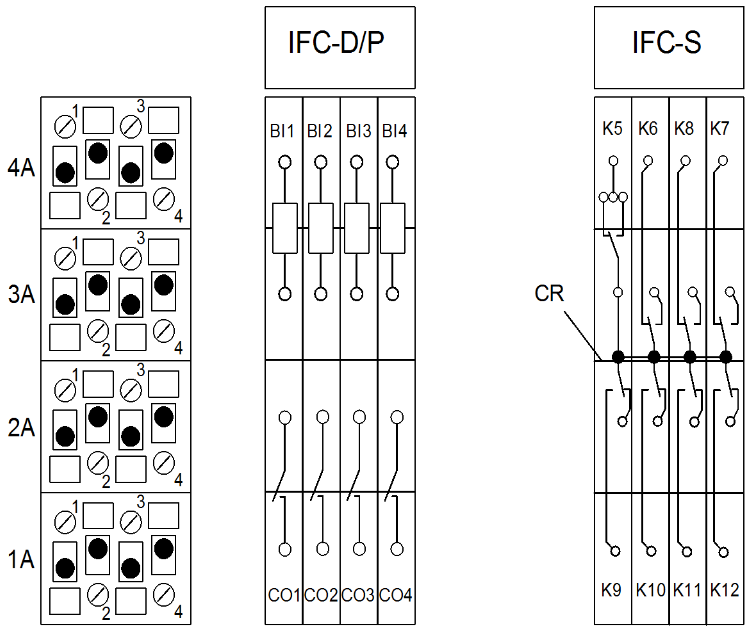
Pin 1-4-6 are looped!

3.1.12.3 Pin Assignment of the IFC-x Module

The IFC interface modules must be connected from the protective relay to connector X1 (modular terminal block) (cable cross section up to 1.5 mm^2). **MINIMUM** 2 cables have to be tied immediately at the terminals.

NOTE

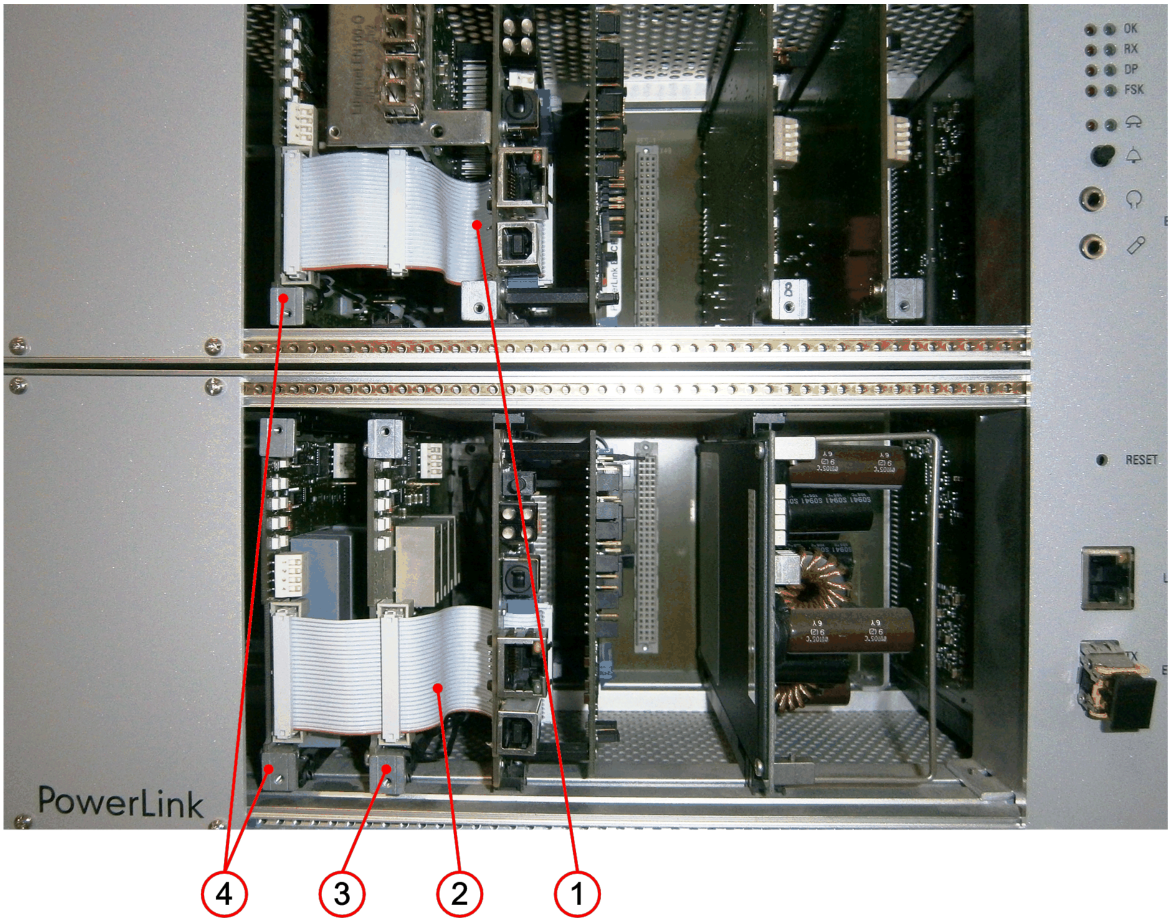
Use flyback diodes for any relays that are connected to an output SWT to avoid EMC influences.



[dwpinifc-060711-01.tif, 1, en_US]

Figure 3-36 Pinout of the IFC-x Modules

IFC-D	Interface module direct tripping
IFC-P	Interface module permissive tripping
IFC-S	Interface module signaling
CR	Common root of relays K5 to K12
1A to 4A	Modular terminal block
BI1 to BI4	Binary inputs 1 to 4
CO1 to CO4	Command outputs 1 to 4
K5 to K8	Signaling of the binary inputs 1 to 4
K9 to K12	Signaling of the command outputs



[dwpinifc-270813-01.tif, 1, --_--]

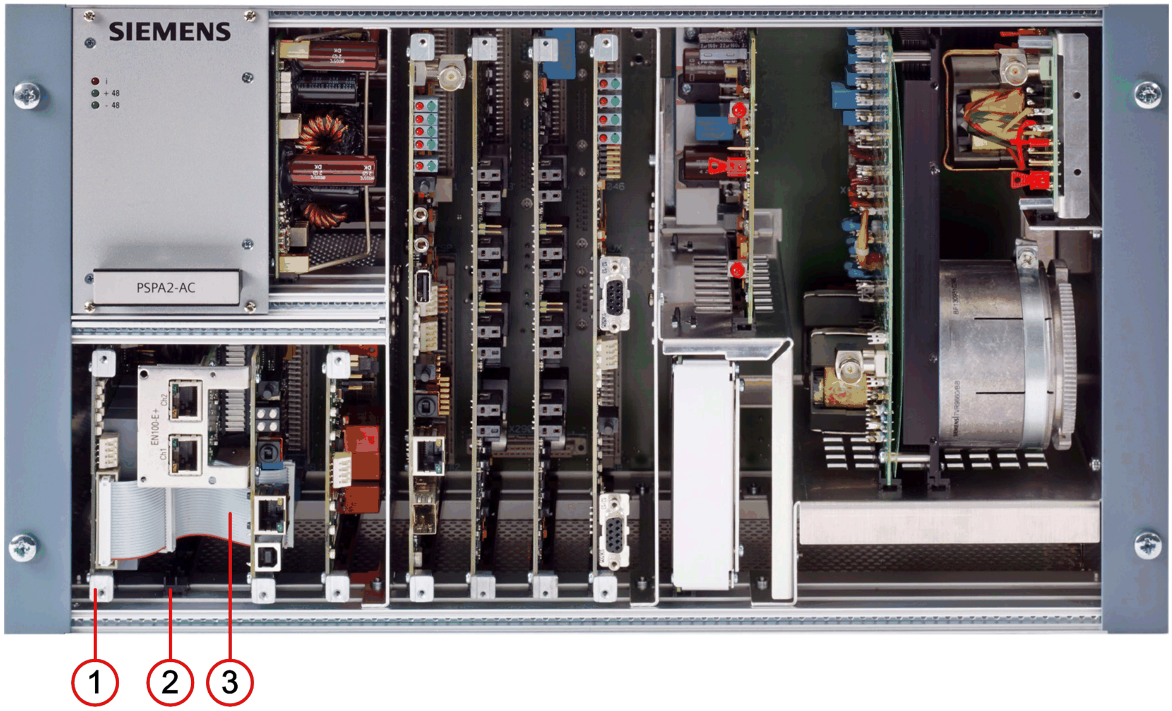
Figure 3-37 Slot positions of IFC-x modules in the iSWT 3000 system for PowerLink 100

(1) iSWT-B (iSWT 3000-2)
(2) iSWT-A (iSWT 3000-1)
(3) Slot position IFC-2
(4) Slot position IFC-1

NOTE

The IFC connectors are located at the PowerLink backplane!

PowerLink 50



[dw_pl50s_Front-offen-3legendenpkt, 1, --_--]

Figure 3-38 Slot positions of IFC-x modules in the iSWT 3000 system for PowerLink 50

(1) Slot position IFC-1
(2) Slot position IFC-2 or EN 100
(3) iSWT

3.2 General Commissioning Sequence

3.2.1 Removing of Printed Circuit Boards

NOTE

The power supply of PowerLink has to be switched off, before it is allowed to remove one of the printed circuit boards.

3.2.2 Software Release

NOTE

In both PowerLink of one link, the software release has to be the same.

In case of using StationLink, all PowerLink connected to one StationLink also have to have the same software release.

It is prohibited that within one link different software releases are used.

3.2.3 PLPA Section

For commissioning the PLPA section the program "PLPAStraps" is available. This program has to be installed on your PC as well as the service program "PowerSys". The program PLPAStraps calculates the necessary jumper and straps settings depending on the transmit and receive frequency for all modules in the PLPA section of the PowerLink.

Start with the tuning of the transmit filter TXF-1 and TXF-2. Then tune the receive filter RXF. For details refer to *Strapping Options of the PLPA Section*.

3.2.4 Carrier Frequency Section

Dongle

All services have to be enabled through the dongle. For more information or dongle upgrade refer to *8.6.2 Dongle Info*.

Start with the system configuration

- For configuration without iSWT 3000 refer to *3.6 System Configuration*.
- For configuration with iSWT 3000 refer to *3.17.5 System Configuration for iSWT 3000*.

HF Configuration

Now the HF configuration has to be carried out. Here the HF bandwidth, the frequency grid the transmit resp. receive frequency, the frequency order and the function with or without AXC must be defined. For more details refer to *3.7.1 The HF Configuration Form*.

Service configuration for voice F2, data F3, teleprotection F6 or DP

Configuration sequence:

- Service voice (if existing). For more details refer to *3.10 Voice Transmission (Service F2)*.
- Service data (if existing). For more details refer to *3.13 Data Transmission (Service F3)*.
- Protection signaling in multi purpose operation (if existing). For more details refer to *3.17.7.3 Multi Purpose Operation*.

- The function Data Pump DP (if existing). For more details refer to *3.15 Data transmission via Data Pump*.
- Data transmission via iMUX. For more details refer to *3.15.1 iMUX*.
- Voice and data transmission via vMUX. For more details refer to *3.16.2 System Configuration*.

Further configuration

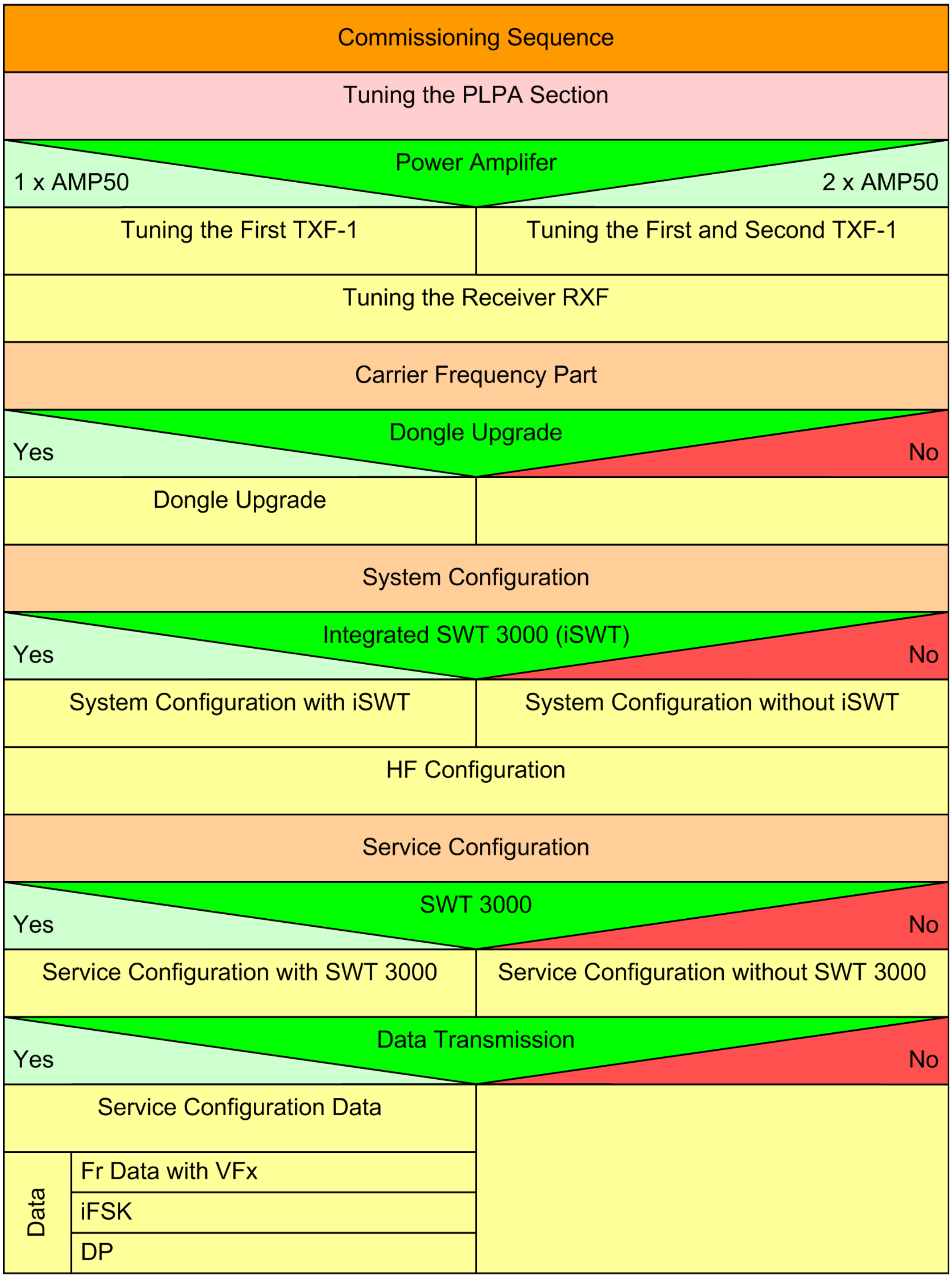
After service configuration continue with the further configuration options like:

- ADC adjustment *3.8.1 ADC Adjustments*.
- iSWT 3000 settings *3.18 Configuration of an iSWT*.
- RM configuration *3.21.3 Remote Monitoring / Remote Configuration RM*.
- DP configuration *3.15.6 Supervision of the Transmission Line with the Data Pump*.
- ALR alarm settings *3.21.4 PowerLink Alarm Configuration - ALR Module*.

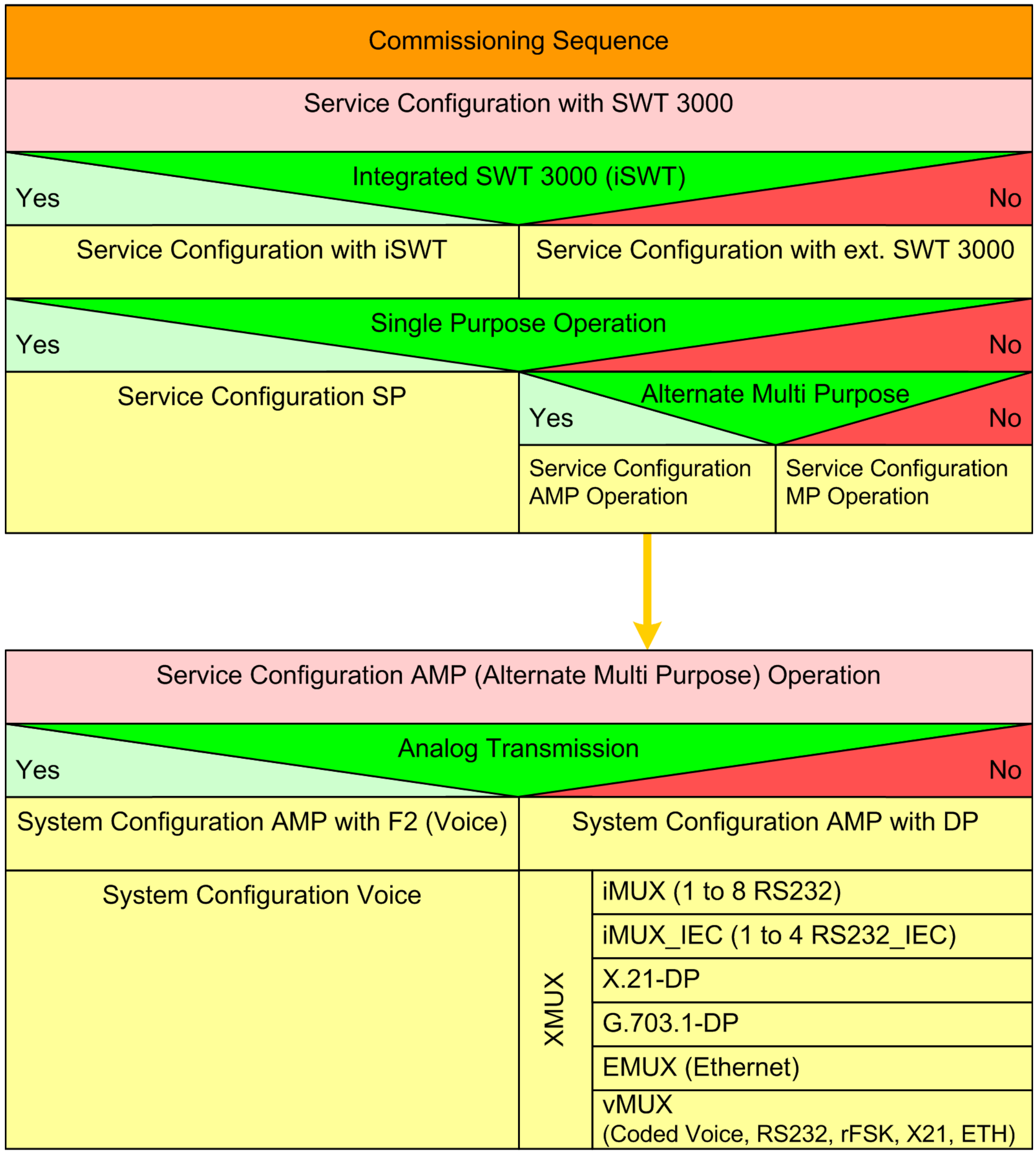
TX Level setting

After the service configuration has been completed the Tx level have to be set. For more details refer to *3.19 Tx Level Adjustment*.

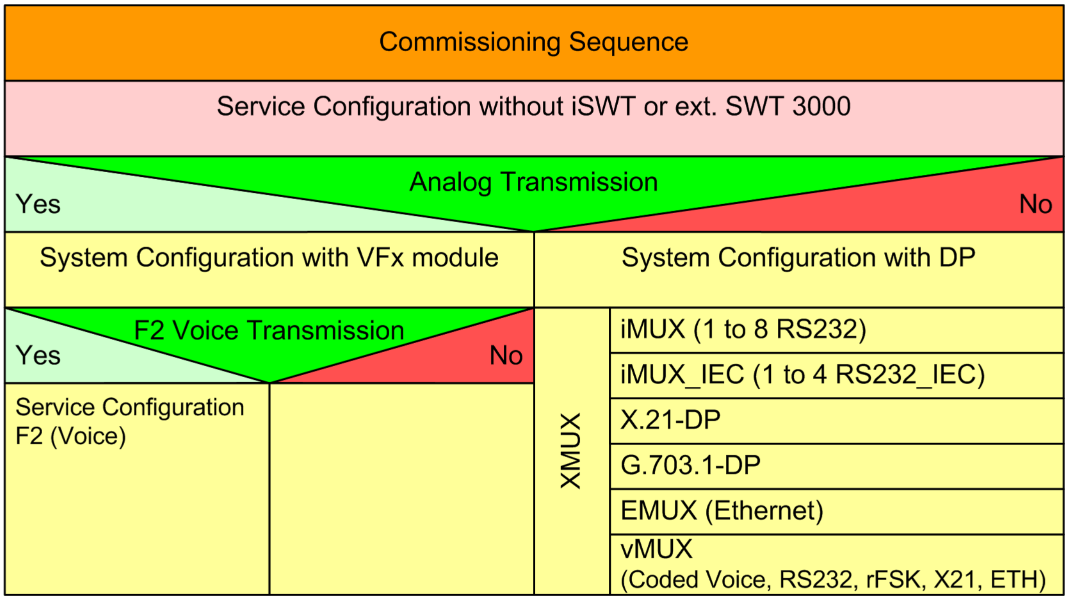
Commissioning Sequence



[dwpasid1-291110-01.tif, 1, en_US]



[dwpasid2-291110-01.tif, 1, en_US]



[dwpasid3-291110-01.tif, 1, en_US]

WARNING

- The mains terminals are permanently connected to the supply voltage also when the mains switch is in "OFF" position. Safety disconnection in the DC-, AC-Auxiliary power supply distribution is necessary!

NOTE

Service personnel must read the instruction manual **before** working with the PowerLink equipment. It is highly recommended that the service personnel has attended a **training course on the equipment**.

All settings required for configuration, leveling and equalization can be performed only via the service PC.

3.2.5 Test Setup and Tools

Required Measurement Devices and Accessories

Level oscillator	Frequency range: 0.2 to 1000 kHz
Send level	-60 to > 0 dB
Output impedance	= 75 Ω, 150 Ω, 600 Ω and Ri ≈ 0 Ω
Level meter	Frequency range: 0.2 to 1000 kHz
Receive level	-100 dB to +10 dB
Input impedance	Ri≥10 kΩ, switchable to 75 Ω, 150 Ω, 600 Ω
Multimeter for DC and AC voltage	
Set of measuring lines	Connecting lines between PowerLink and measurement devices Ordering designation: 7VR9005

NOTE

It is recommended to have separate devices for level oscillator and level meter.

Service PC	IBM compatible
Operating system	MS Windows 10 or higher / x64 version
Processor	i5 or better (or processor with equivalent performance)
Clock	min. 1 GHz
System memory	1 GB
Ethernet interface	10/100Base-T
Serial interface	RS 232
Printer interface	LPTx (optional)
Additional needed Software	Microsoft .NET Framework (part of PowerSys package)

Rules for the Test Setup

To ensure measuring results are not corrupted, a number of basic rules must be observed when installing the test setup:

NOTE

The ground connections of the measurement devices must be connected to each other and from **one** point to the test item. For connections between level oscillator/level receiver and the PowerLink, use only the low-capacitance measuring lines quoted above.

3.2.6 Dummy Load for PowerLink

CAUTION

Hot surface! Do not touch! Do not cover the ventilation openings!

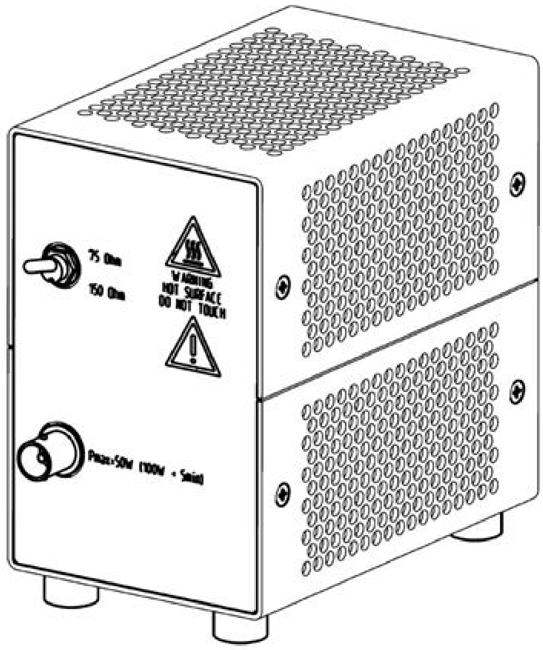
Risk of injury and fire hazard!

- Do not cover the ventilation openings.
- Do not operate longer than 5 min.
- Mount the device on flat surfaces.
- Allow the device to cool down after use.

NOTE

The dummy load is not included in delivery of the PowerLink.

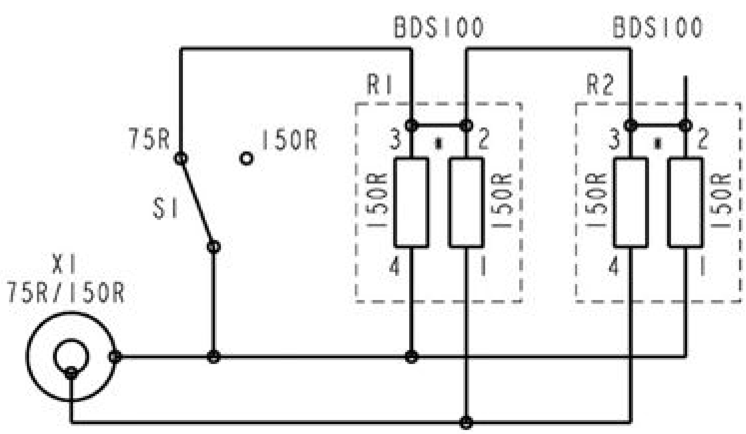
The dummy load serves for termination of the PowerLink HF output in case the system is not connected to the transmission line.



[dwdmylpl-021210-01.tif, 1, en_US]

Figure 3-39 Dummy load for the PowerLink

The input impedance is selectable between 75 or 150 Ohm.

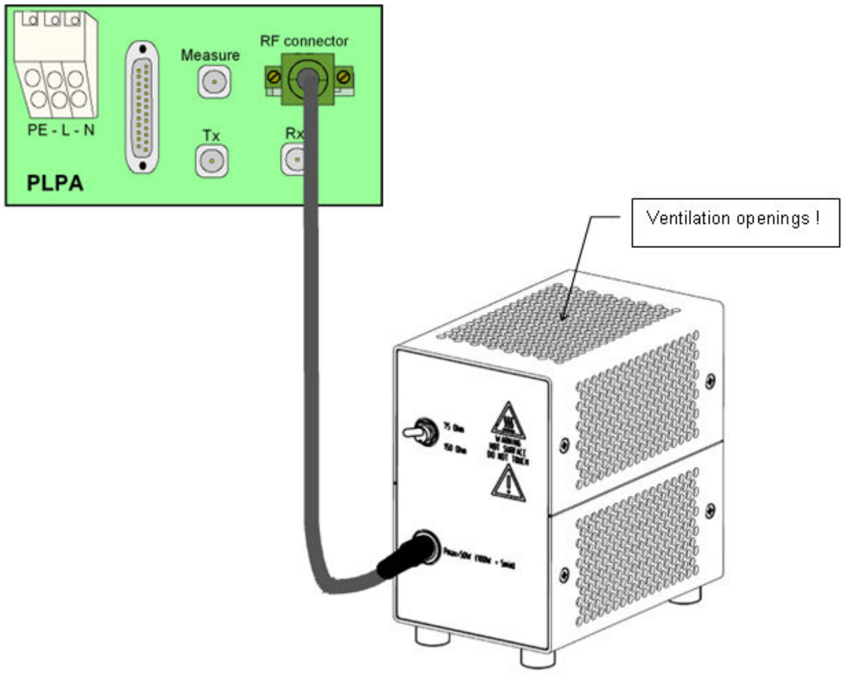


[cdcddmyl-021210-01.tif, 1, en_US]

Figure 3-40 Circuit diagram of the dummy load

Installation

The connection is carried out by means of the connection cable delivered with the dummy load. Please connect **first** the cable with the **safety BNC plug** to the dummy load and then the RF connector.



[cdcndmyl-021210-01.tif, 1, en_US]

Figure 3-41 Connection of the dummy load

CAUTION

Hot surface! Do not touch! Do not cover the ventilation openings!

Risk of injury and fire hazard!

- Do not cover the ventilation openings.
- Do not operate longer than 5 min.
- Mount the device on flat surfaces.
- Allow the device to cool down after use.

WARNING

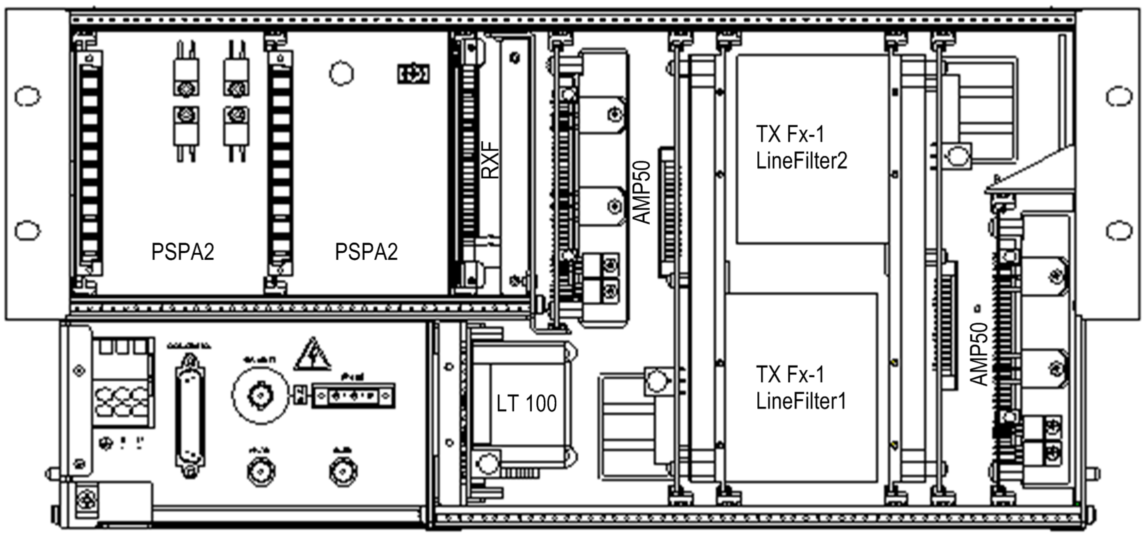
- Hot surface! Do not touch!

3.3 Strapping Options of the PLPA Section

3.3.1 The PLPA Equipment

3.3.1.1 Structural Design

PowerLink 100



[tdmlpaeq-180913-01.tif, 1, en_US]

Figure 3-42 Module location in the PLPA 100 equipment in PowerLink 100

The PLPA 50 section consists of a single-tier (5 units of height) module frame and contains the power supply (PSPA2), the power amplifier AMP50, line filter TXF1 (or TXF2), line transformer unit LT100 and the RXF receiver module.

PLPA 50 with 2 power supply modules PSPA2 means, PowerLink is working with redundant power supply.

The PLPA 100 section consists of a single-tier (5 units of height) module frame and contains 2 power supplies (PSPA2), 2 power amplifier AMP50, 2 line filter TXF1 (or TFX2), 1 line transformer unit LT100 and the RXF receiver module.

PowerLink 50

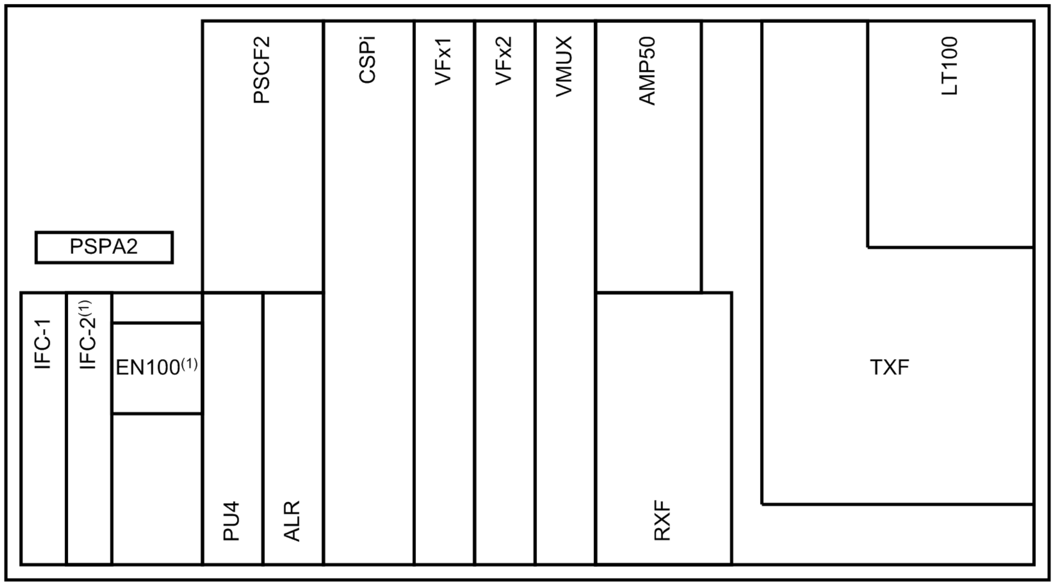


Figure 3-43 Module location of the PLPA in PowerLink 50

(1) IFC-2 or EN100

The module frame of PowerLink 50 contains 1 power supply (PSPAx), the power amplifier AMP50, line filter TXF1 (or TXF2), line transformer unit LT100 and the RXF receiver module.

General

NOTE

For HF-bandwidth 24 kHz or 32 kHz, the line filter TXF2 has to be used.

NOTE

All strap settings in the PLC line equipment have to be established by means of the software program **PLPAStraps**.

3.3.1.2 LB and HB Versions of PLPA Modules

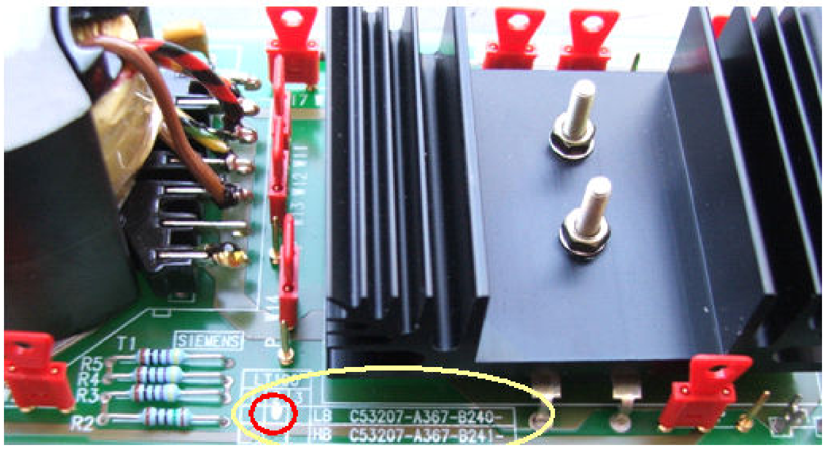
For carrier frequencies in the range from 24 kHz to 500 kHz (LB) and 500 kHz to 1 MHz (HB) **different modules** have to be used in the PLPA like shown in the table below:

Table 3-30 Module versions for the PLPA section

Carrier Frequency range [kHz]	Amplifier type	TX Filter	Line transformer	Receiver
24 to 500	AMP50–**LB** C53207-A367-B210 4	TXF1-**LB** C53207-A367-B230 2 (BW: 4 kHz to 16 kHz)	LT100-**LB** C53207-A367-B240 2	RXF-**LB** C53207-A367-B220 2
		TXF2-**LB** C53207-A367-B232 2 (BW: 4 kHz to 32 kHz)		

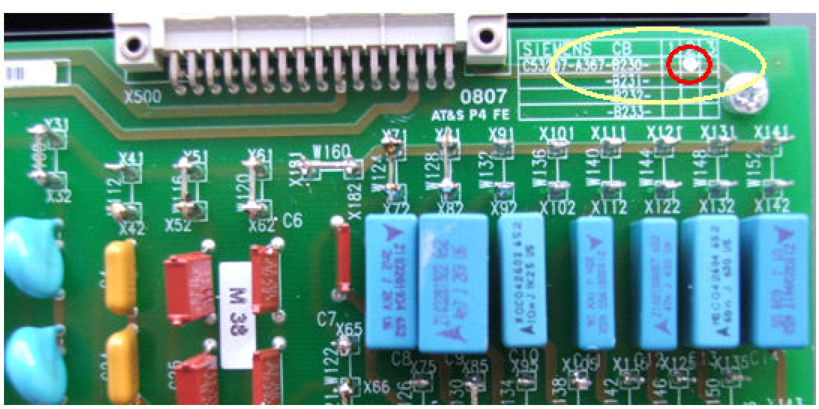
Carrier Frequency range [kHz]	Amplifier type	TX Filter	Line transformer	Receiver
500 to 1000	AMP50-**HB** C53207-A367-B211 4	TXF1-**HB** C53207-A367-B231 2 (BW: 4 kHz to 16 kHz)	LT100-**HB** C53207-A367-B241 2	RXF-**HB** C53207-A367-B221 2
		TXF2-**HB** C53207-A367-B233 2 (BW: 4 kHz to 32 kHz)		

The corresponding type is shown on the PCB



[sclt100l-291110-01.tif, 1, en_US]

Figure 3-44 Example of the LT100-LB version



[sctxf1lb-291110-01.tif, 1, en_US]

Figure 3-45 Example of the TXF1-LB version

3.3.2 The Program PLPA Straps

3.3.2.1 General

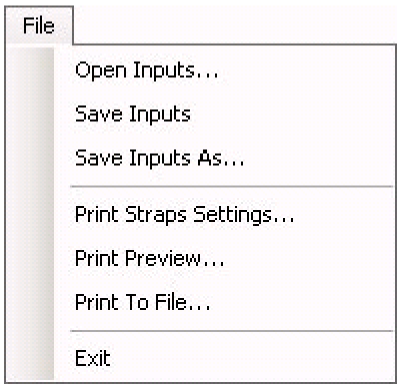
This program is part of the PowerSys package. The program has to be installed on the service PC. Run the <**PLPAStraps Setup**> file and follow the instructions on the screen. Refer to Chapter *Service Program PowerSys and MemTool, The Program PLPAStraps*

3.3.2.2 Application

The program PLPAStraps is calculating the necessary jumper settings for all modules in the PLPA section of the PowerLink.

3.3.2.3 The Menu <File>

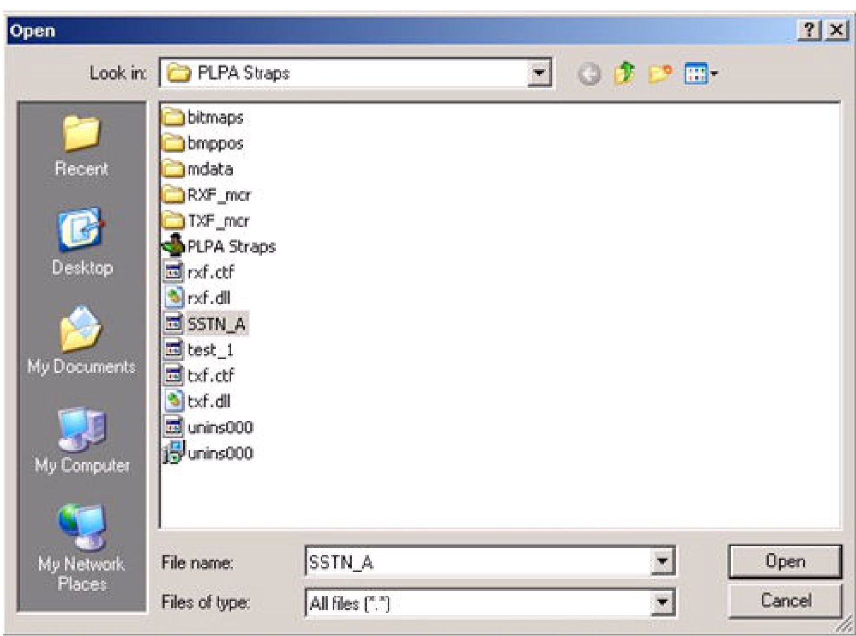
After the program PLPAStraps has been started an existing file can be opened <**Open**>. Further the saving of the entries <**Save**> or print out of an existing file <**Print**> is carried out. With <**Exit**> the program is aborted.



[scmnfile-291110-01.tif, 1, en_US]

Figure 3-46 The menu <File>

3.3.2.4 Selecting an Existing File (Open Inputs...)

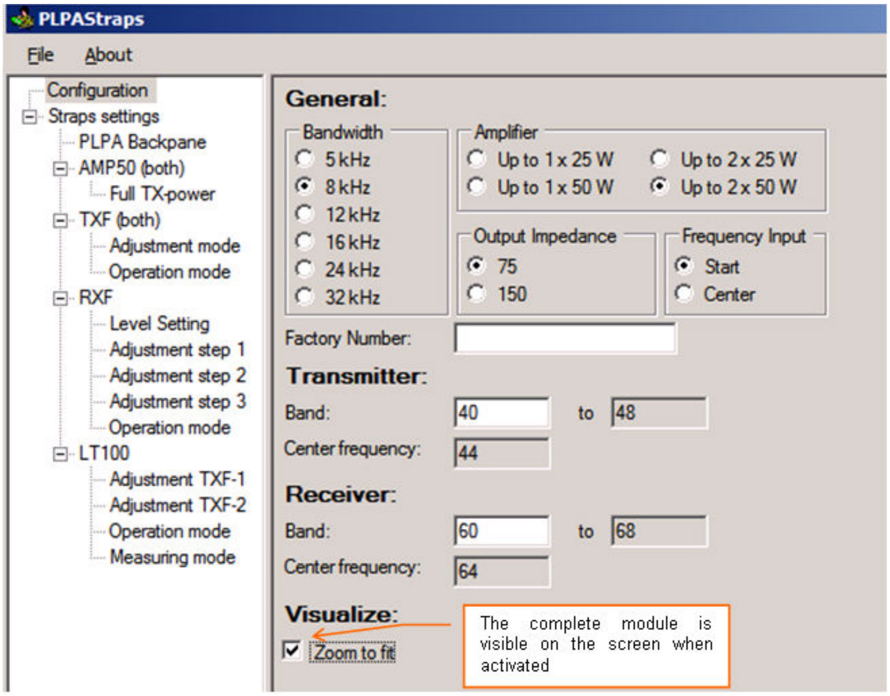


[scslexfl-291110-01.tif, 1, en_US]

Figure 3-47 Selection of an existing file

3.3.2.5 Configuration Inputs

With click on **<Configuration>** the following input form is opened.



[scplpasf-291110-01.tif, 1, en_US]

Figure 3-48 The PLPAStraps configuration form

First enter the general settings of the PowerLink like transmit filter single or dual coil, one or two power supplies, bandwidth, the amplifier power and the output impedance. The frequency input is possible for the start frequency of the TX resp. RX band or for the center frequency.

The Factory Number of the equipment is an optional entry. When the frequencies for the transmitter and receiver are entered, the corresponding band and center frequency is displayed immediately.

NOTE

The TX and the RX frequencies have to be both in the low band (24 kHz to 500 kHz) or in the high band (500 kHz to 1000 kHz). Working with mixed frequency band is not possible.

Entering mixed frequency bands causes the error message Invalid frequency values (Band mixture)! by the program.

Table 3-31 PLPAStraps Configuration

Selection	Settings	Remarks
Transmit filter	Single Coil	Transmit filter bandwidth: 5 to 16 kHz
	Dual Coil	Transmit filter bandwidth: 5 to 32 kHz
Power Supply	Single	One power supply
	Dual	Two power supplies • must be for two amplifiers • Second power supply used as redundant power supply (available for one amplifier)
Bandwidth		Bandwidth of PowerLink
Amplifier	Up to 1 x 25 W Up to 1 x 50 W Up to 2 x 25 W Up to 2 x 50 W	One or two amplifiers used. Each amplifier can be set to reduced output power.
Output Impedance	75	Output impedance 75 Ohm

Selection	Settings	Remarks
	150	Output impedance 150 Ohm
Frequency Input	Start Center	Transmit and Receive frequency input done with the start frequency of the transmission band Transmit and Receive frequency input done with the center frequency of the transmission band
Factory Number		Optional entry, (remark)
Transmitter		Enter start or center frequency Show start, stop and center frequency
Receiver		Enter start or center frequency Show start, stop and center frequency
Visualize		The complete module is visible on the screen when activated

NOTE

Save your configuration in a file for easy reuse of this values.

3.3.2.6 Straps Settings

PLPA Backplane

Select the default settings according PLPAStraps program.

AMP50

The strap setting for the amplifier module AMP50 can be selected for the full or half Tx-power.

TXF

When selecting <**TXF / Operation mode**> the necessary strap settings for the TXF in the normal operation mode is calculated from the program and displayed subsequently. For the filter adjustment a slightly different strap setting is necessary. It is displayed with click on <**TXF / Adjustment mode**>. In case of using a 100 W power amplifier 2 AMP50 and 2 TXF modules are necessary. The strap settings are the same in both modules.

RXF

The strap settings for the receiver module RXF in the normal mode is calculated when selecting <**RXF / Operation mode**>. For the filter adjustment a slightly different setting is necessary. It is displayed with click on <**RXF / Adjustment Step 1 to 3**>. A final RX level correction for Receive Level Adjustment is required.

LT100

The strap setting for the LT100 module in the normal mode is calculated when selecting <**LT100 / Operating mode**>. For tuning the TXF in position 1 resp. 2 click on <**LT100 / Adjustment TXF-1**> resp. TXF-2.

Setting **LT100 / Measuring** activates the LT100 BNC Connector to the level meter.

3.3.3 Tuning of the Transmit Filter (TXF-XB)

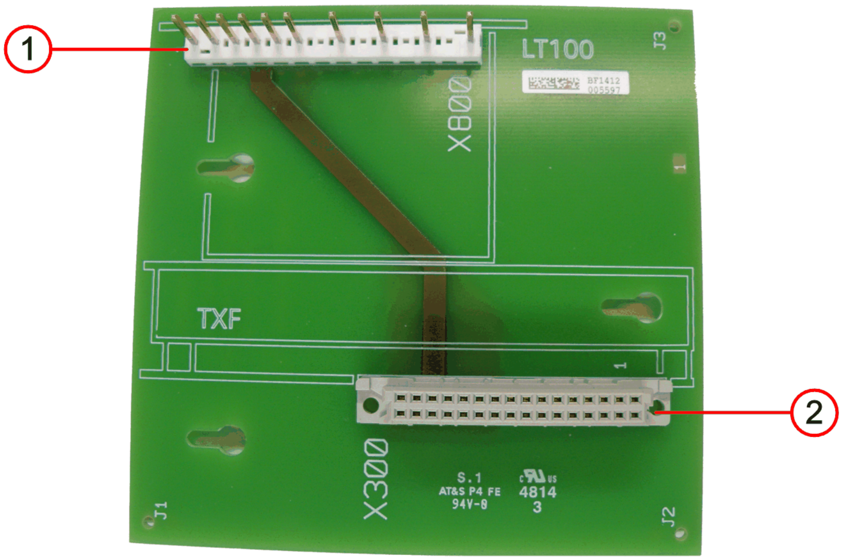
3.3.3.1 General

NOTE

The following description applies to the low band or high band version of the modules. Therefore the module names are extended with XB.

3.3.3.2 Adjustment Module in PowerLink 50

The adjustment module allows the user to adjust the frequency of the Transmit Filter (TXF-XB) in the Power-Link 50 device.

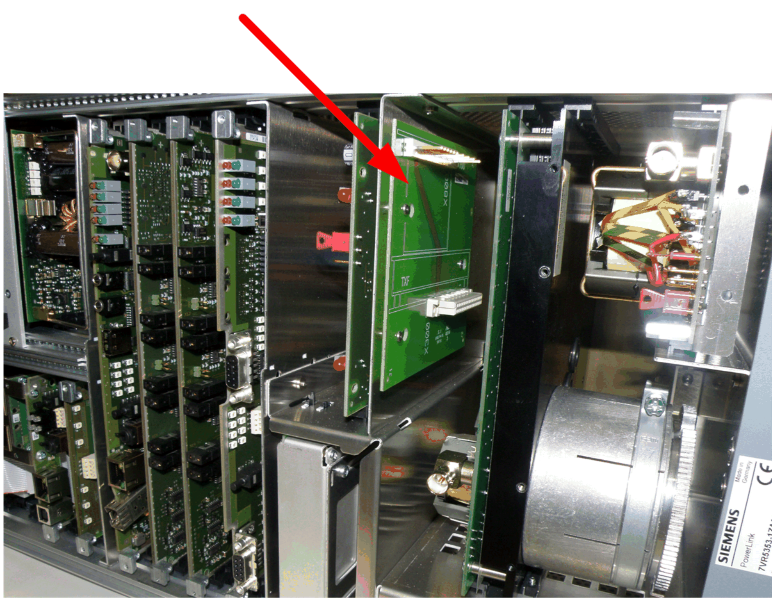


[ScAdjusmod-220115, 1, --_--]

Figure 3-49 Adjustment Module

(1) X800: Connector towards LT100 Module

(2) X300: Connector towards TXF-XB Module



[ScAdjusdev-220115, 1, --_--]

Figure 3-50 Location of the Adjustment Module in the PowerLink 50

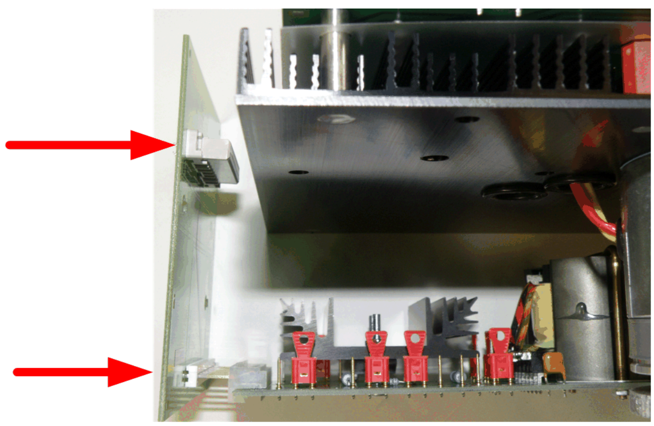
Mounting the Adjustment Module

CAUTION

Hazardous voltages may occur if the power is switched on and a signal is transmitted via the amplifier (TXF adjustment in operation mode).

- ✧ Before mounting the adjustment module with the LT100 and TXF modules, make sure that the power supply of the device is switched off.

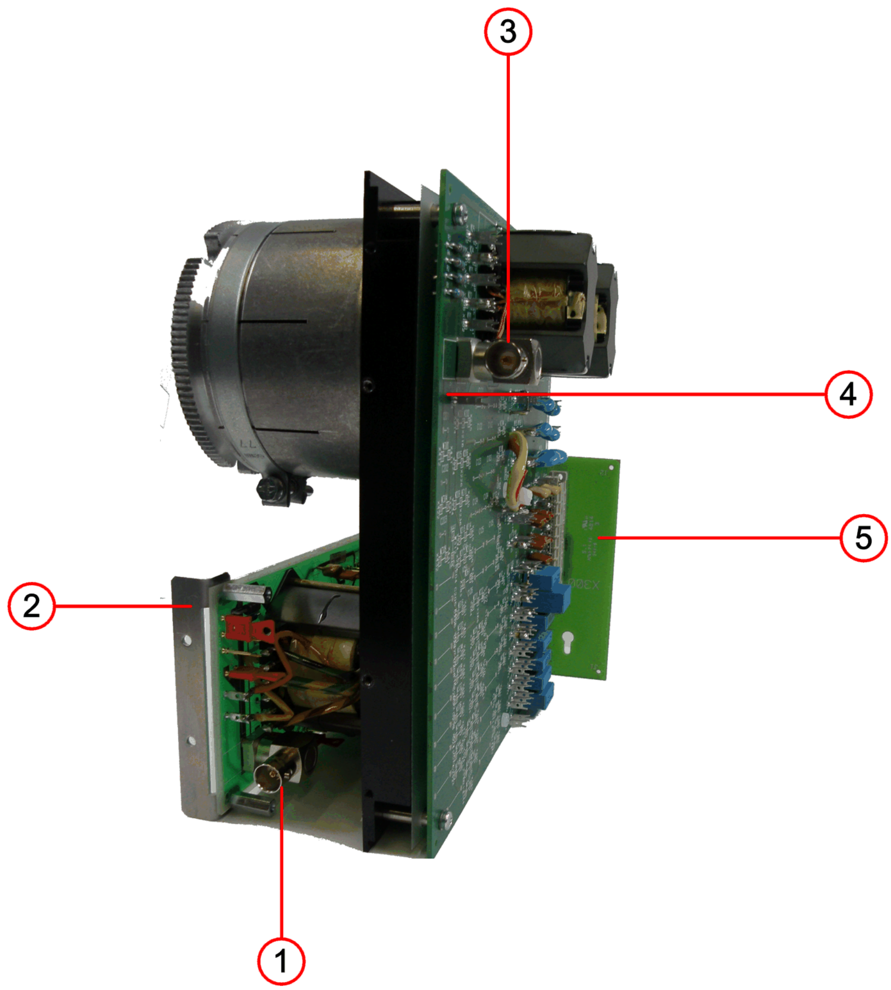
- ✧ Pull out both LT100 and TXF modules from the module frame and connect the adjustment module to both modules as shown in *Figure 3-51*.



[Scadjustbegin-220115, 1, --_--]

Figure 3-51 Mounting the Adjustment Module on the LT100 and TXF Modules

- ✧ Make sure that each connector is engaged properly in the right module.



[Scadjustend-220115, 1, --_--]

Figure 3-52 View of all mounted modules - Ready to be adjusted

(1) LT100 BNC Connector to the Level Meter, Ri = 75 Ohm

(2) LT100

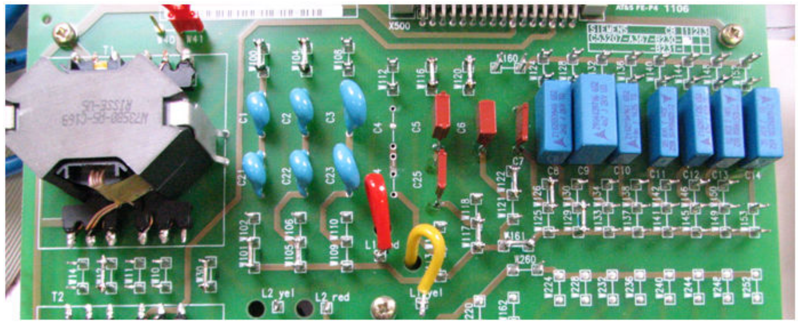
(3) TXF BNC Connector to the Level Oscillator, Ri = 75 Ohm, 0 dB

(4) TXF-XB

(5) Adjustment Module

3.3.3.3 Coarse Tuning of the Transmit Filter

The straps displayed from the program PLPAStraps with selecting <**TXF / Adjustment mode**> have to be soldered on the capacitor bank module (CB) of the TXF1-XB unit.



[sccbmtxb-291110-01.tif, 1, en_US]

Figure 3-53 The CB module of the TXF1-XB unit (top view)

In case of a 100 W power amplifier 2 TXF1-XB units are existing. The settings on the second CB module are identical.

3.3.3.4 Fine Tuning of the TXF1 Line Filter 1

Switch off the power supply

NOTE

ATTENTION!

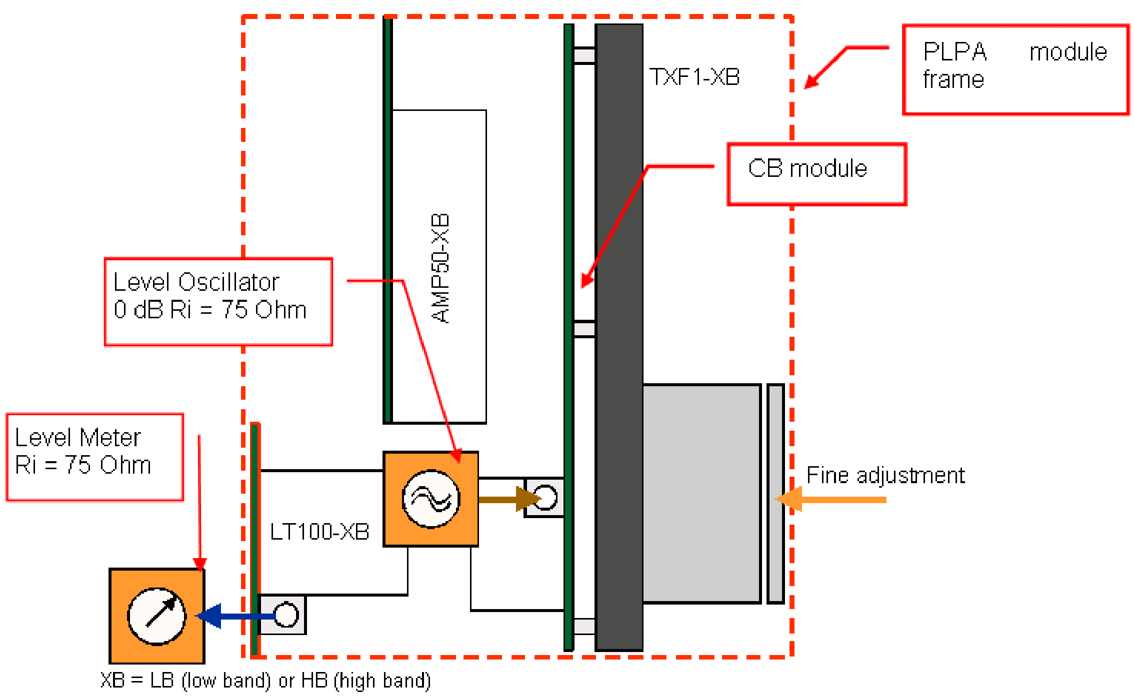
Hazardous voltages may occur if the power is switched on and a signal is transmitted via the amplifier (TXF adjustment in operation mode).

In case of a PowerLink with 2 power amplifiers the second TXF1-XB module may be removed from the module frame to allow better access.

Select now TXF Adjustment mode and <**LT100 / Adjustment TXF-1**> in the PLPAStraps program and modify the corresponding straps to start with the fine adjustment of the TXF1-XB line filter 1.

Basically an oscillator with an impedance of 75 Ω and a selective level meter are sufficient for filter tuning.

The test setup is shown in the figure below:



[dwtstxbf-120813-01.tif, 1, en_US]

Figure 3-54 Test setup for the TXF1-XB fine tuning

Inject the corresponding frequency with 0 dB Ri = 75 Ohm.

Connect the level meter with Ri = 75 Ohm. The expected min. level is -16 dB ±1 dB.

For the filter adjustment the strap setting is displayed with click on <**TXF / Adjustment mode**> in the PLPA-Straps program. In case of using a PowerLink with 2 power amplifiers 2 AMP50-XB and 2 TXF1-XB modules are necessary.

NOTE

TXF1-XB: First order filter

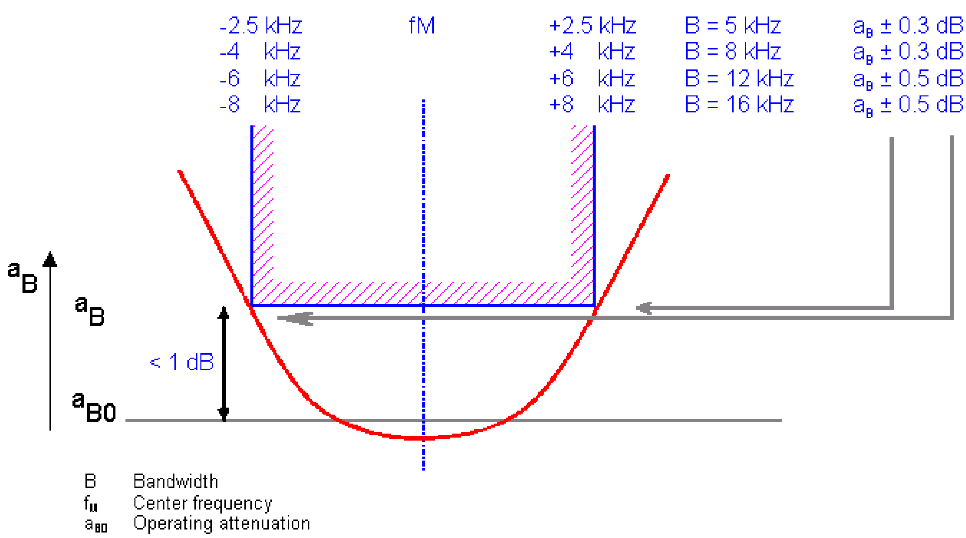
TXF2-XB: Second order filter

TXF-1: Transmit line filter 1

TXF-2: Transmit line filter 2

3.3.3.5 Tuning Procedure

The TXF1-XB filter has to be tuned to a minimum pass band attenuation within the below illustrated tolerances and with a characteristic attenuation which is symmetrical to the center frequency.



[dwpbatxf-291110-01.tif, 1, en_US]

Figure 3-55 Pass band attenuation of the 50 W Transmit Line Filter TXF1

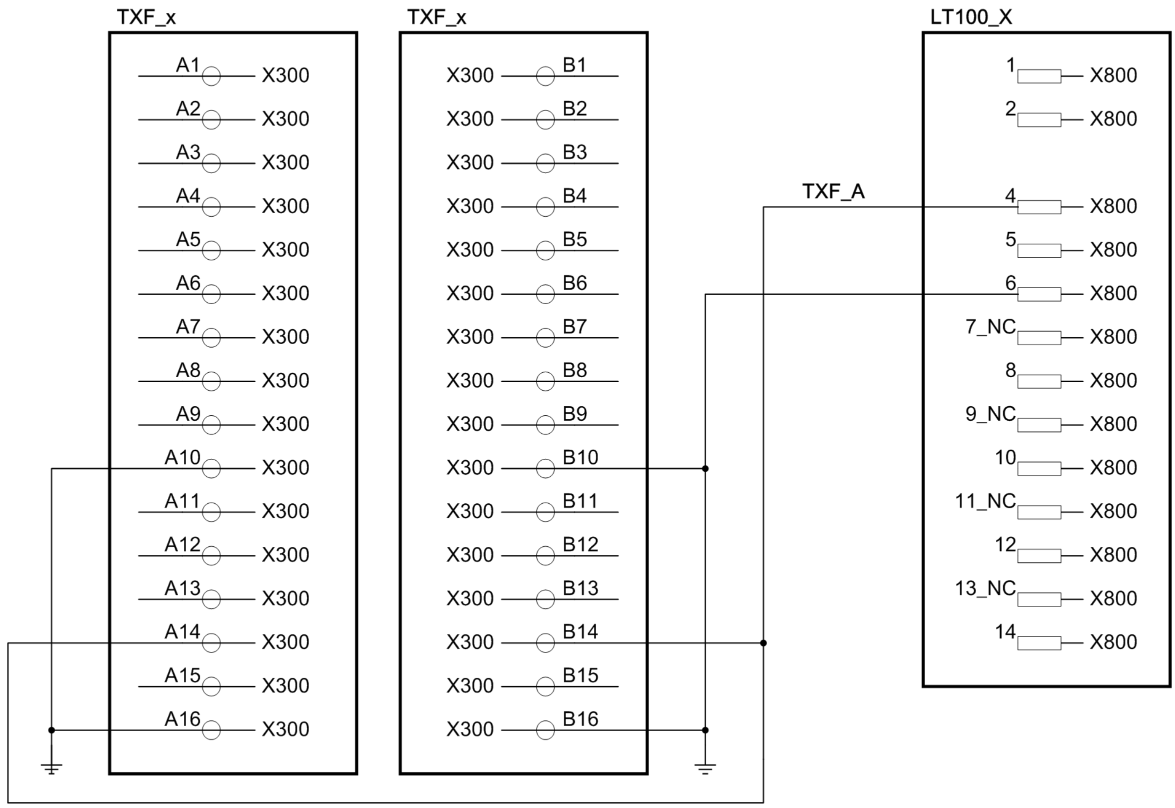
The fine tuning (inductive) to the desired attenuation characteristic within the specified tolerances has to be reached with tuning of the coil in the transmit line filter. The following sequence is recommended:

- Tune to minimum attenuation at the center frequency f_M.
- Tune to symmetrical attenuation at the pass band limits fM ± ½ Bandwidth. (The difference may be not more than given in the figure above). The level difference from f_M to the band limit has to be < 1 dB.

NOTE

The adjusted filter characteristic can be altered slightly when tightening the coil with the spanner. If necessary the spanner has to be reopened and the deviation has to be corrected.

For PowerLink 50, use the adaptive test socket for TX filter tuning.



[dw_PL50-klemmenbelegung-191114, 1, --_--]

Figure 3-56 Test socket for TX filter tuning

3.3.3.6 Fine Tuning of TXF1 Line Filter 2

Remove the first line filter after the fine adjustment has been completed and start the same procedure like described before with the **second line filter**. The measurement is done in the **slot of the line filter 1** and in this case the strap setting of the LT100-XB module remains in the same position. Start with the fine adjustment like described under tuning procedure.

NOTE

In case of tuning high band filters, it is recommended to do the measurement of the second line filter in the slot of line filter 2. Therefore the straps on the LT100-XB has to be changed to the position <**Adjustment TXF-2**> given from the program PLPAStraps.

NOTE

After conclusion of the filter tuning the straps on the LT100-XB as well as TXF1-XB module(s) have to be brought into the normal operating position.

3.3.3.7 Fine Tuning of the TXF2 Line Filter 1

Switch off the power supply.

NOTE

ATTENTION

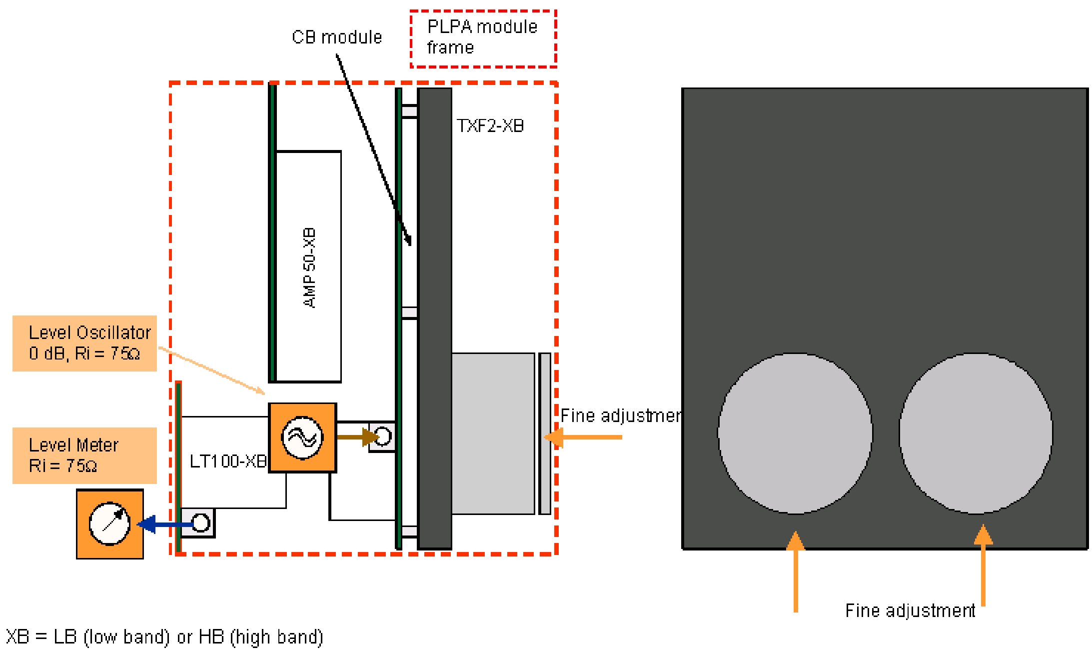
Hazardous voltages may occur if the power is switched on and a signal is transmitted via the amplifier (TXF adjustment in operation mode).

In case of a using a PowerLink with 2 amplifiers the second TXF2-XB module may be removed from the module frame to allow better access.

Select now TXF Adjustment mode and <**LT100 / Adjustment TXF-1**> in the PLPAStraps program and modify the corresponding straps to start with the fine adjustment of the TXF2-XB line filter 1.

Basically an oscillator with an impedance of 75 Ω and a selective level meter are sufficient for filter tuning.

The test setup is shown in the figure below:



[dwtstxf2-120813-01.tif, 1, en_US]

Figure 3-57 Test setup for the TXF2-XB fine tuning

Inject the corresponding frequency with 0 dB Ri = 75 Ohm.

Connect the level meter with Ri = 75 Ohm. The expected min. level is -16 dB ± 1 dB.

NOTE

TXF1-XB: First order filter

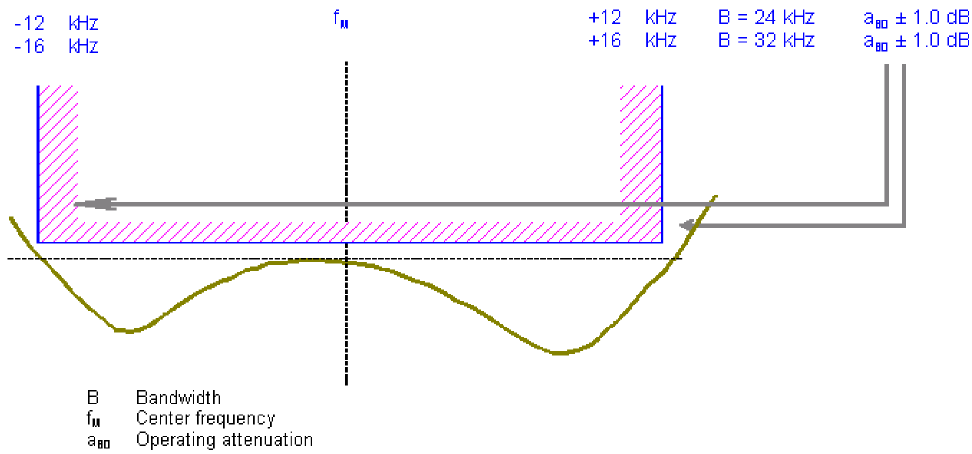
TXF2-XB: Second order filter

TXF-1: Transmit line filter 1

TXF-2: Transmit line filter 2

3.3.3.8 Tuning Procedure

The TXF2-XB characteristic of the attenuation is shown in the figure below.



[dwpbatf2-291110-01.tif, 1, en_US]

Figure 3-58 Pass band attenuation of the 50 W Transmit Line Filter TXF2

The fine tuning (inductive) to the desired attenuation characteristic within the specified tolerances has to be reached with tuning of the coil in the transmit line filter. The following sequence is recommended:

Adjustment mode step 1:

Fine adjustment with T201 and T202 to the same and maximum level for the center frequency fm ± ¾ *bandwidth, the difference to the fed level is approx. -40 dB.

- 1 Tune to minimum attenuation with the 2 coils of TXF2 at the center frequency f_M. displayed from the PLPAStraps program after click on <**Straps settings / TXF / Adjustment mode**>.
- 2 Tune to symmetrical attenuation at the pass band limits fM ± ½ Bandwidth. (The difference may be not more than given in the figure above). The level difference from f_M to the band limit has to be < 2 dB.

NOTE

The center frequency f_M for tuning the filter is not identically with the center frequency f_M of the transmission band.

NOTE

The adjusted filter characteristic can be altered slightly when tightening the coil with the spanner. If necessary the spanner has to be reopened and the deviation has to be corrected.

3.3.3.9 Fine Tuning of TXF2 Line Filter 2

Remove the first line filter after the fine adjustment has been completed and start the same procedure like described before with the **second line filter**. The measurement is done in the **slot of the line filter 1** and in this case the strap setting of the LT100-XB module remains in the same position. Start with the fine adjustment like described under tuning procedure.

NOTE

In case of tuning high band filters, it is recommended to do the measurement of the second line filter in the **slot of line filter 2**. Therefore the straps on the LT100-XB has to be changed to the position <**Adjustment TXF-2**> given from the program PLPAStraps.

NOTE

After conclusion of the filter tuning the straps on the LT100-XB as well as TXF2-XB module(s) have to be brought into the normal operating position.

3.3.4 Tuning of the Receive Filter (RXF-XB)

3.3.4.1 General

NOTE

The following description applies to the low band or high band version of the modules. Therefore the module names are extended with XB.

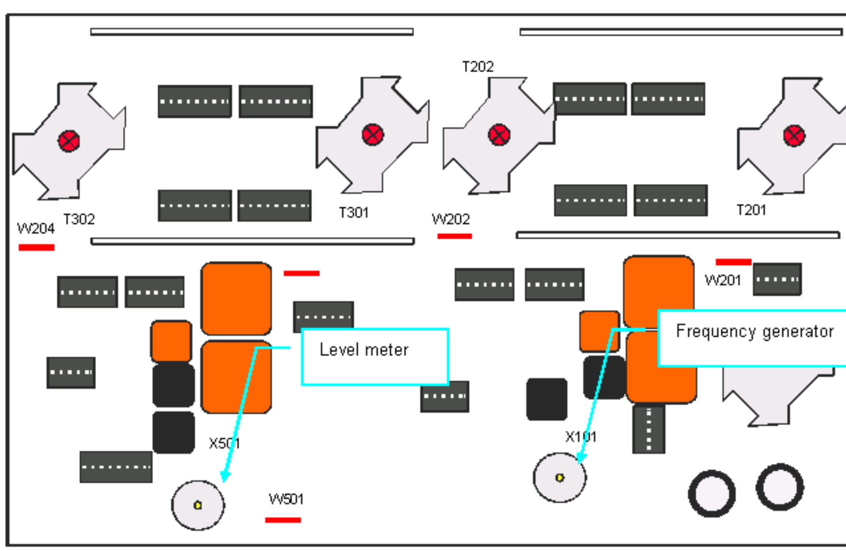
3.3.4.2 Coarse Tuning of the Receive Filter

The adjustments for the filter bandwidth 5 kHz, 8 kHz, 12 kHz, 16 kHz, 24 kHz resp. 32 kHz as well as for the coarse tuning of the receive filter are determined by means of the PLPAStraps program (ref. to *3.3.2.5 Configuration Inputs*).

For the tuning the RXF-XB module has to be removed from the PLPA module frame. The DIL switches displayed from the program PLPAStraps with selecting <**Straps settings / RXF / Adjustment step 1**> have to be adjusted on the RXF-XB module.

3.3.4.3 Fine Tuning of the RXF-XB

For the fine tuning the frequency generator (Rout = 75 Ohm impedance) has to be connected to the BNC-jack X101. Connect the level meter (Ri = 75 Ohm impedance) to the BNC-jack X501. Feed in a level of 0 dB.



[tdalserf-291110-01.tif, 1, en_US]

Figure 3-59 Allocation of setting elements on the receiver module RXF

Adjust the straps as well as the DIL switches according the PLPAStraps program (red marked).

Adjustment mode step 1:

Select within PLPAStraps <**Straps settings / RXF / Adjustment step 1**>, and adjust the straps according the PLPAStraps program (red marked). In this step the same settings as under coarse tuning.

Fine adjustment with T201 and T202 to the same and maximum level for the center frequency fm ± ¾ *bandwidth, the difference to the fed level is approx. -40 dB.

Adjustment mode step 2:

Select within PLPAStraps <**Straps settings / RXF / Adjustment step 2**>, and adjust the straps according the PLPAStraps program (red marked). Fine adjustment with T301 and T302 to the same and maximum level for the center frequency fm ± ¾ *bandwidth.

Adjustment mode step 3:

Select within PLPAStraps <**Straps settings / RXF / Adjustment step 3**>, and adjust the straps as well as the DIL switches according the PLPAStraps program (red marked). Adjustment with T301 only, to the same level for the center frequency fm ± ¾ *bandwidth

3.3.4.4 Operation Mode

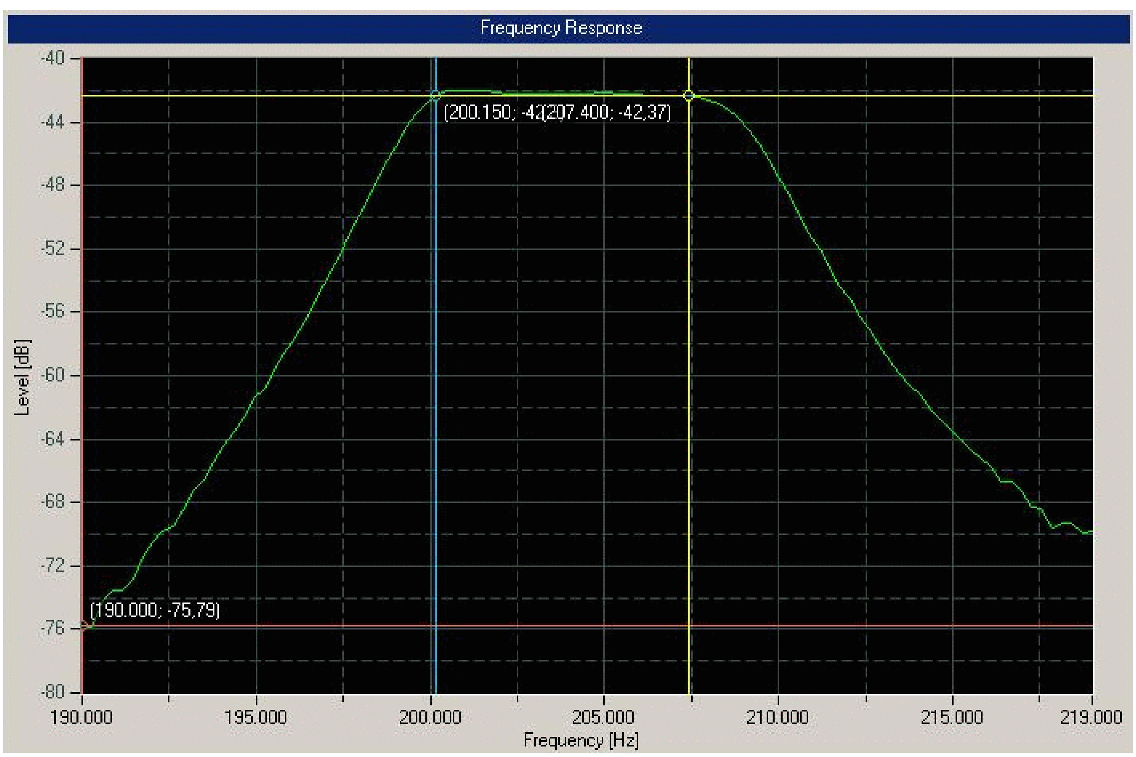
After the fine tuning has been completed adjust the straps to normal operation mode as shown according the PLPAStraps program when selecting <**Straps settings / RXF / Operation mode**> (red marked in *Figure 3-59*).

3.3.4.5 Level Adjustment

The receive level adjustment for PowerLink is done as given in Chapter *Receive Level Adjustment*.

NOTE

For level adjustment it may be necessary to change the setting of DIL switches on the RXF-XB module. Therefore the housing of the RXF-XB unit should be mounted after the level adjustment.



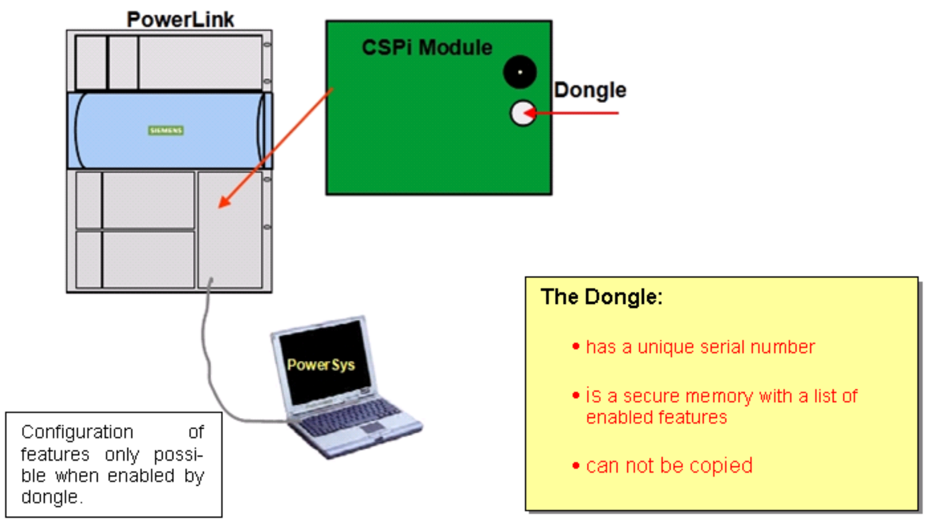
[ugimm027-200913-33.tif, 1, --_--]

Figure 3-60 Example for filter characteristic after RXF-XB Fine Tuning

3.4 Dongle

3.4.1 Overview

The various features of the PowerLink system are mainly implemented in the software. Only a low amount of hardware is necessary. All configurable features of the system are fixed in a firmware ordering number (FW-MLFB) and have to be enabled. This is carried out in the factory using a dongle which is located on the CSPi module.



[dwensfdg-120111-01.tif, 1, en_US]

Figure 3-61 Enabling of the software features with a dongle

3.4.2 Features Which Have to be Enabled

The teleprotection signaling (F6) is always enabled. All other services have to be enabled by the dongle.

Basic features	Possible Selection
Voice channels F2	0 to 3
Data channels F3	0 to 2
Teleprotection F6	always enabled
Data Pump	0/1
Integrated FSK channel (iFSK)	0 to 4
Data channels via iMUX	0/4/8*
CSPi features	
max. HF-Bandwidth [kHz]	always enabled
SNMP agent	0/1
Ethernet (remote bridging)	0/1
Add-on features	
Service telephone	0/1
Remote Monitoring	0/1
Dynamic Data Pump	0/1
vMUX features	
Compressed voice channels	0 to 8
fE1	0/1

Basic features	Possible Selection
rFSK channels	0 to 2
X.21 channels	0 to 2

* also for vMUX

3.4.3 Dongle Upgrade

Additional features can be enabled afterwards in an existing dongle via dongle upgrade on site.

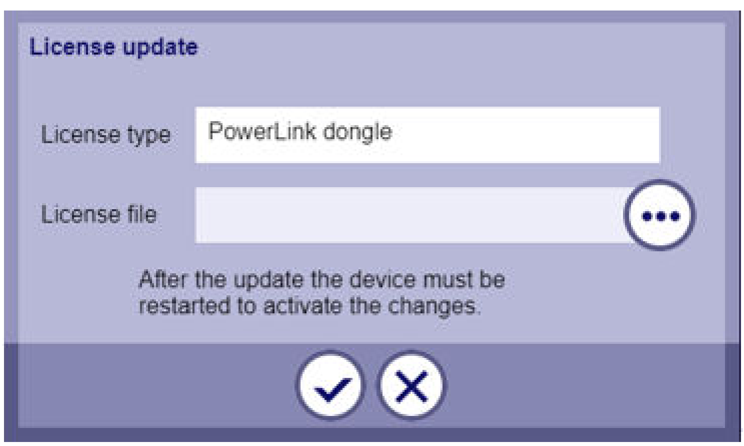
Considerations before the dongle upgrade:

- Which hardware is existing?
- Must additional HW modules be ordered for using the new dongle?
- Is the function of the system still ensured?
- Is a change of the bandwidth or transmit power required after a dongle upgrade?

The customer orders additional features based on the serial number of the dongle. The new licensed features and the serial number are stored in new dongle file in the factory. The new dongle file will be sent to the customer by email.

The update of PowerLink on site is carried out with the PowerSys program using this file. The program connection to the PowerLink must be established.

Start the upgrade from PowerSys main menu > Update license..., select the dongle file and click OK button to update the dongle in the device. A restart of the device is required to activate the new dongle file.



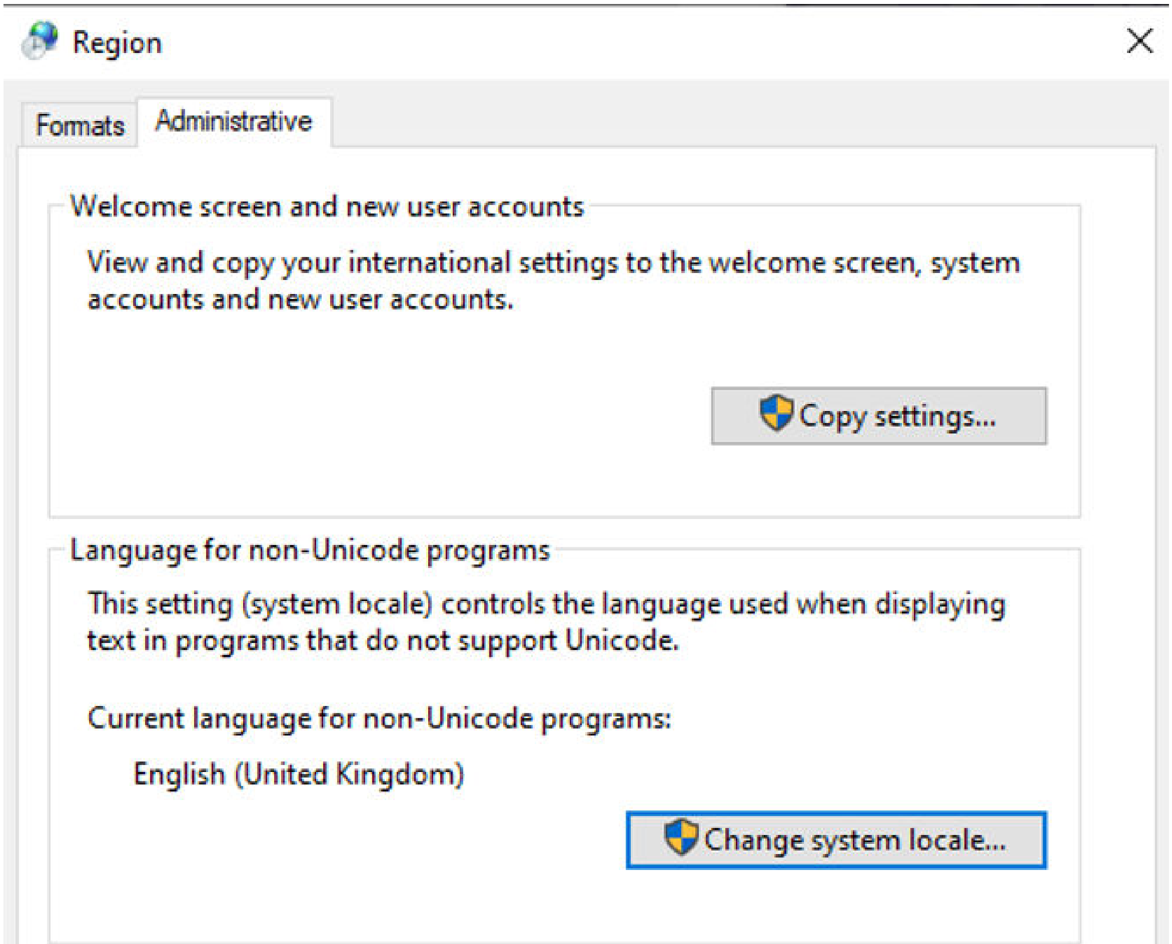
[sc_dongle_upgrade, 1, --_--]

Figure 3-62 License update dongle

Region settings

The language for non-Unicode programs settings other than "German", "English" may cause a dongle update fail.

- Open the operating system’s Region Settings. For example, by typing "region settings" into the task bar search box.
- In the Region Settings window, click Language and then click Administrative language settings.
- In the Region dialog, on the Administrative tab, click "Change system locale".
- In the opened dialog, select the desired Unicode language, e.g., English (UK), from the Current system locale list.
- Click OK. You may need to restart the computer to apply the changes.



[sc_region_settings, 1, --_--]

3.5 Configuration with the Service PC

3.5.1 Service PC Connection to PowerLink via Ethernet Interface

3.5.1.1 DHCP Server

DHCP Server enabled

The service PC is usually connected to the PowerLink via the Ethernet 10/100Base interface, located at the front of the module CSPi. For the connection to the service PC PowerLink is equipped with its own DHCP server. This causes that PowerLink assigns the IP-address to the service PC automatically. This requires that the PC is set to obtain an IP address automatically. Then the service PC will obtain the IP address within the address range of the DHCP server.

Default address PowerLink:	192.168.20.5
IP address range of the DHCP server:	192.168.20.10-15

DHCP server disabled

When the DHCP server of PowerLink is disabled, the service PC connected to PowerLink must be assigned a fixed IP address. Otherwise PowerLink can not be reached.

The IP addresses you assign to the computer must be from the correct IP network. This means that the IP address is determined by the IP setting in PowerLink.

The following table indicate the IP address range available according to the factory settings. The table also list the addresses for subnet mask, default gateway and DNS server. These 3 entries are also required for the computer's IP settings.

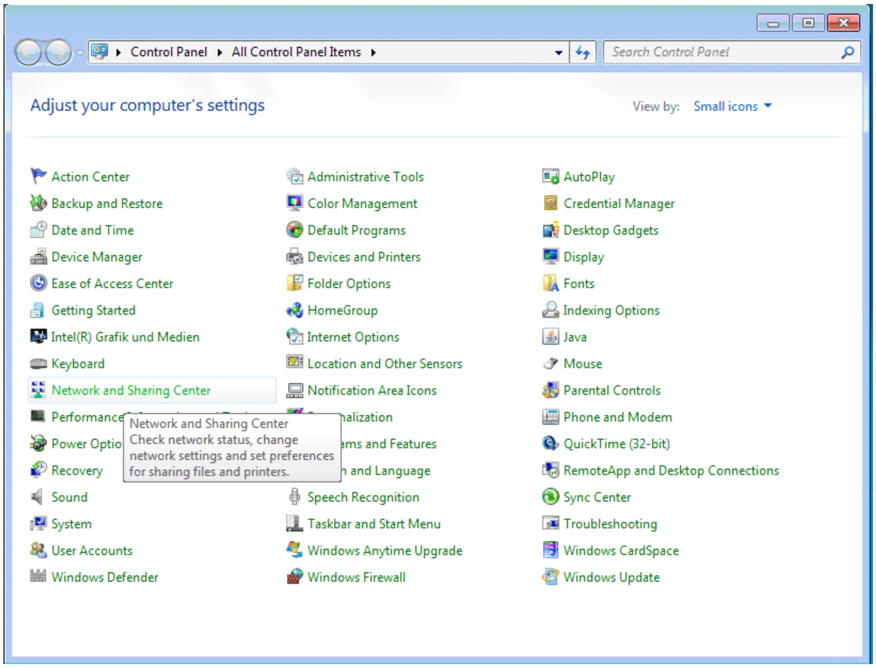
Settings	Addresses
IP address range for assigning to Service PC	192.168.20.16-254
Subnet mask	255.255.255.0
Default gateway	192.168.20.5
DNS server	192.168.20.5

Service PC Network Setting

The actual Internet Protocol (TCP/IP) properties of the service PC can be checked or adapted. How to check the setting:

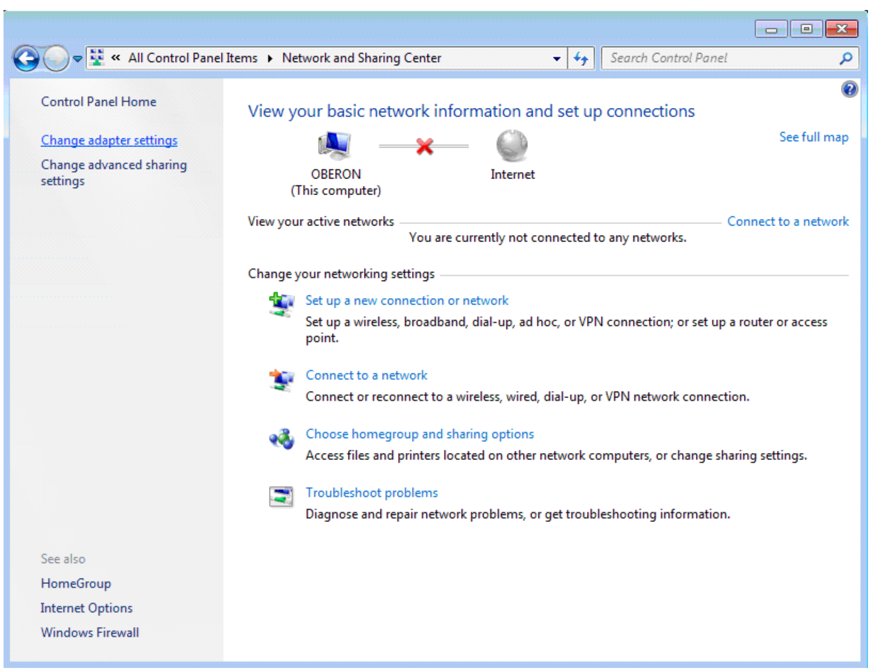
3.5.1.2 Service PC Network Setting for Windows

- Start the control panel and choose Network and Sharing Center.



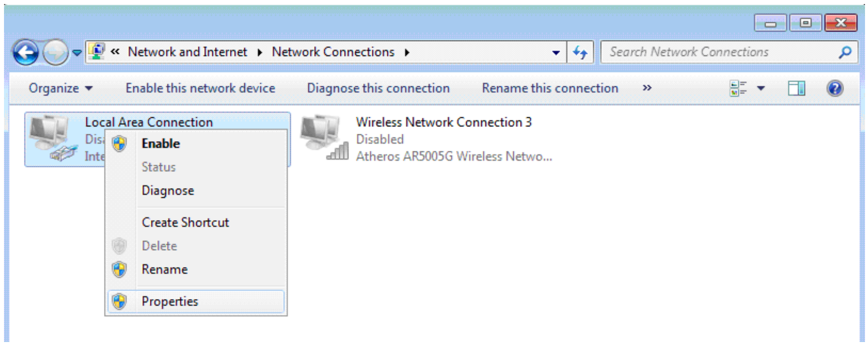
[scwin7cp-140711-01.tif, 1, --_--]

- Choose Network Connections.



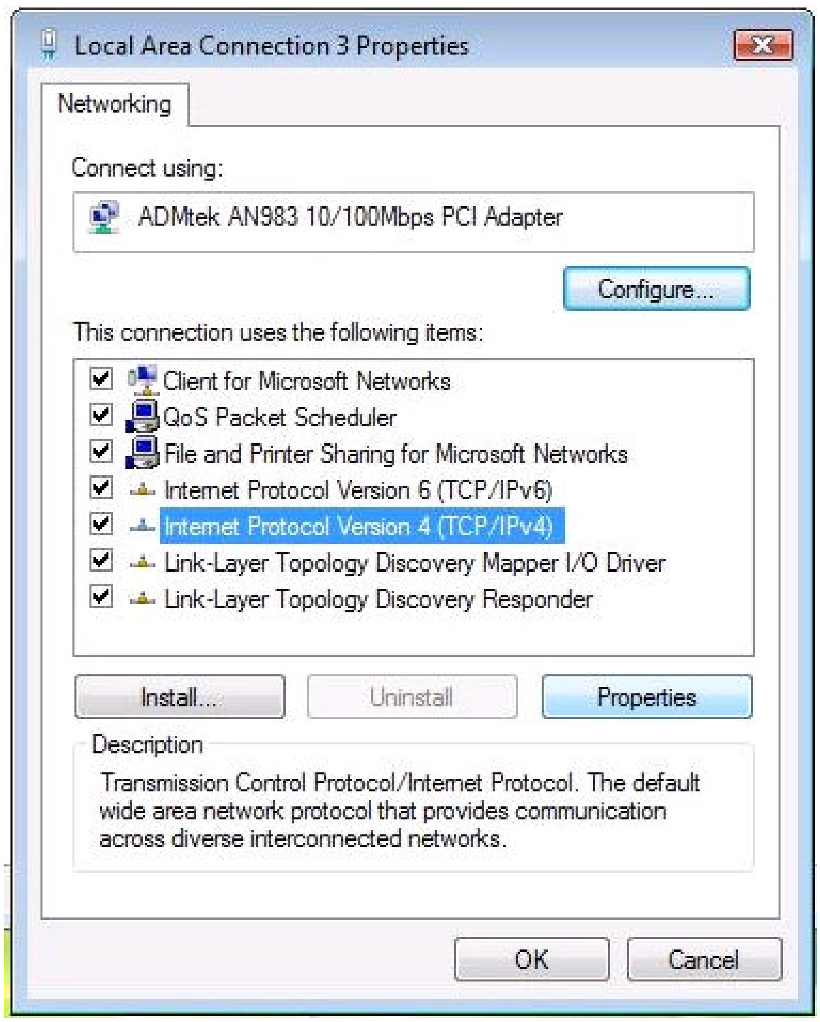
[scnwconn-140711-01.tif, 1, --_--]

- Choose Local Area Connection.

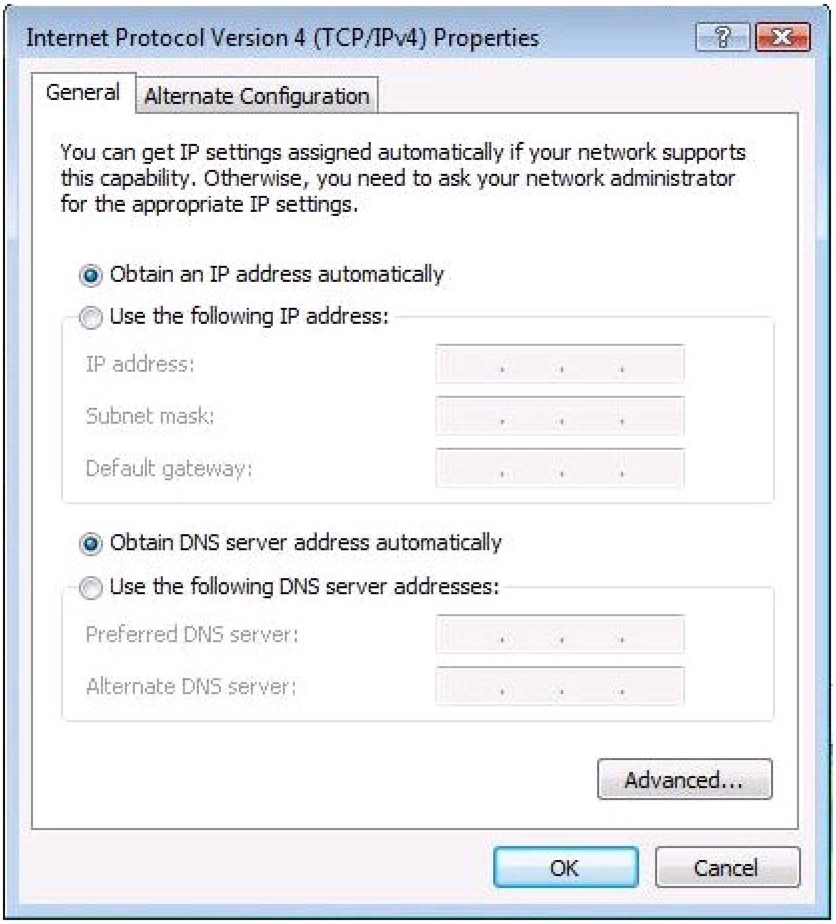


[scchslan-140711-01.tif, 1, --_--]

- Scroll down to Internet Protocol (TCP/IP) and choose Properties.



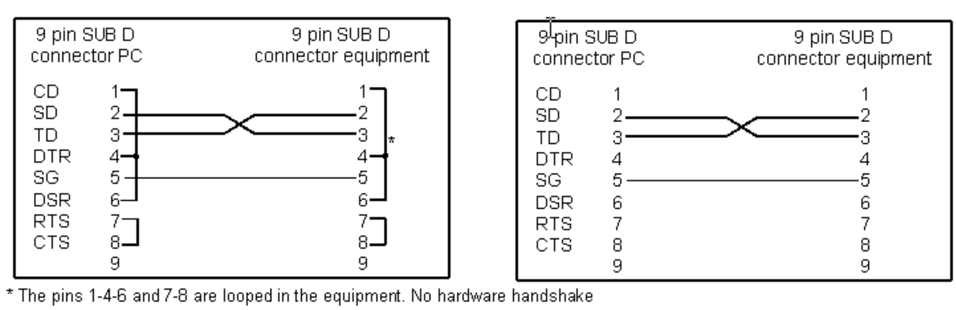
[scctcpip-140711-01.tif, 1, --_--]



[sctcpipp-140711-01.tif, 1, --_--]

3.5.2 RS232 Serial Cable for Connecting PowerLink via RM-1 Connector

The RS232 connection cable is necessary for downloading firmware via MemTool (as described in *PowerLink Web Interface Service Program PowerSys and MemTool Flash Programming*) via the RM1 connector. Also the communication between PowerSys and PowerLink is possible alternatively to the Ethernet communication via the RM1 connector.



[sccncspc-301110-01.tif, 1, en_US]

Figure 3-63 Connecting cable for the Service PC

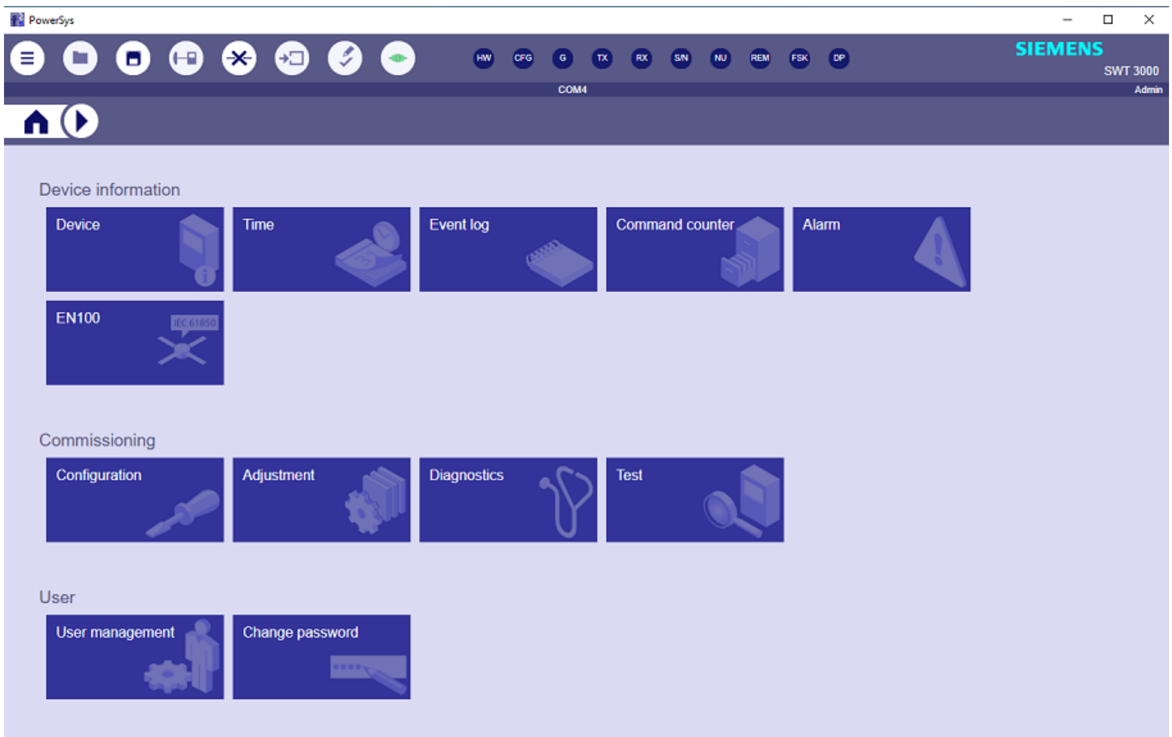
* The pins 1-4-6 and 7-8 are looped in the equipment. No hardware handshake

NOTE

Instead of the shown connecting cable from Siemens on the left side also a standard cable without straps in the connector (shown on the right side) could be used.

3.5.3 PowerSys

The Service program PowerSys is required for commissioning, maintenance, and diagnosis of the PowerLink or SWT 3000 device.



[sc_powersys_dashboard, 1, --_--]

Figure 3-64 PowerSys dashboard

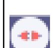
Header

It is always located on top and contains a toolbar with iconic buttons. It provides a drop-down menu, toolbar and alarm status bar. Additionally, it holds the Siemens logo and the product name.

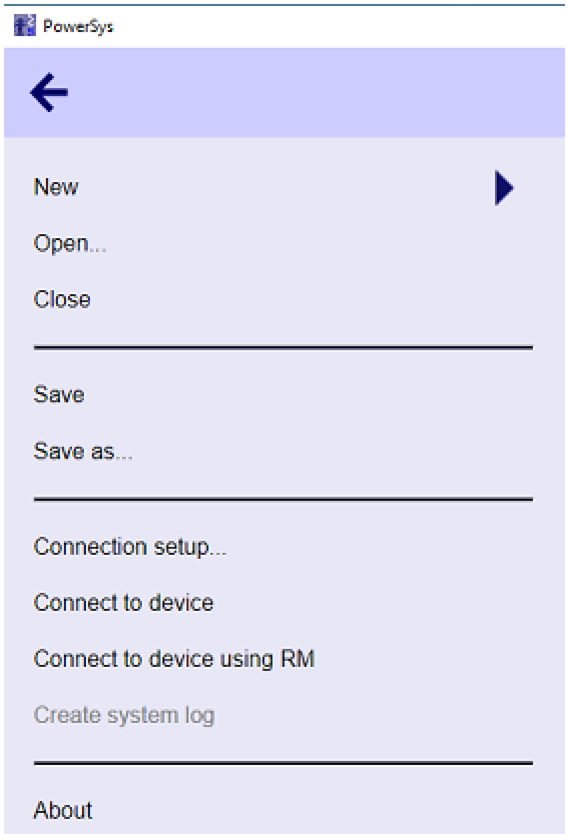
The shown product name is changed dynamically depending on the loaded device database (SWT 3000 or PowerLink).

A toolbar is a prominently visible panel containing controls such as iconic buttons that directly invoke frequently used application functions.

[sc_powersys_header, 1, --_--]

Toolbar button	Description
Main menu	Drop down menu provides device connection and file operation functions.
Open	Opens the parameter from a configuration file. After the file has been loaded, the data can be modified or programmed to the device. *.ddb configuration file for device SWT 3000 and PowerLink 50/100 *.xml configuration file for device PowerLink IP / CM
Save	Save the changes to the configuration file.
Connect	Establishing the connection to the device. The program attempts to establish a connection to the device and then loads the data into PC. The program detects from which device (PowerLink or SWT 3000) the data were read and automatically changes to the appropriate dashboard view.
Disconnect	Disconnecting the established connection.
Send configuration	Send the offline configuration file or online changed parameters to device. Device is programmed and reset automatically after send offline configuration file.
Program device	Program the changed parameters to device. Device is reset automatically after programming is successful and ready for operation again afterwards. If changing an existing PowerLink or SWT 3000 configuration, use the “Clear device setting” test command before programming the new configuration to device.
Connection status	Indicates the connection Device is online. Device is offline.

The main menu contained cover all available application functionality, including actions for control of the application.



[sc_powersys_menu, 1, --_--]

Menu	Description
Menu > New	Create a device configuration file (.ddb). Select device type and parameter release version. After that, choose the name and place of storage of the configuration file in which the data is stored.
Menu > Open...	Same function as Open toolbar button.
Menu > Close	Same function as Close toolbar button.
Menu > Save	Same function as Save toolbar button.
Menu > Save as...	Save the changes as another configuration file without replace existing file.
Menu > Connection setup...	The communication to the device can be carried out either via the serial interface or via a TCP/IP connection from the service PC. • For a configuration of the serial interface, select the proper serial port with the Serial port to device list box. • For a configuration of the TCP/IP interface, select the proper IP address, port number and with or without SSL. The selection must be in accordance with device settings. The configuration is done after clicking the Ok button. User preference settings (Connect method, COM, IP address, RM, Language, Last accessed file path...) will be stored in user profile for next use.
Menu > Connect to device	Same function as Connect toolbar button.

Menu	Description
Menu > Connect to device using RM	Establishing the connection to the remote device using RM. RM must be configured in device. RM link must be established. The RM address of the connected remote device is set with the Connection setup menu. After the connection is established, all data of the remote device are downloaded. The duration of this procedure depends on the transmission data rate (50 bps or 300 bps). With the remote monitoring function, device data can be transmitted between one of the following cases: • The terminals of one or more carrier frequency (CF) routes • 2 PowerLink or SWT 3000 units • RM connection can be established over a chain of equipment
Menu > Create system log	If problems occurre in a PowerLink or SWT 3000 connection, this function can be used to create a zip file containing important system information including the device configuration or the event log from the device. Select the folder for storing the zip file. To create the system log takes serval minutes to complete, depending on the size of the log file.
Menu > About	About information (release version and date)

Alarm status bar

An alarm status bar displays the frequently monitored alarm status, like virtual LED of the device. The alarm is monitored periodically. If alarm is detected, the related alarm icon is changed to red color.

[sc_powersys_alarmstatus_bar, 1, --_--]

Alarm	Description
HW	Hardware alarm
CFG	Configuration fault
G	General alarm
TX	Transmitter alarm
RX	Receiver alarm
S/N	Signal to noise alarm
NU	Non urgent alarm
REM	Fault in the remote device
FSK	FSK alarm (available only in PowerLink if FSK is used)
DP	DP switched to secondary bitrate (available only in PowerLink if DP is used)

Info bar

The info bar is located between the header and the breadcrumb path. In the info bar provide short messages to the user. It shows on the left the opened file name, on the middle the COM port number, IP address and device name and on the right the name of the user that is currently logged in.

The normal mode indicates normal operation mode.

[sc_infobar_normal_mode, 1, --_--]

Figure 3-65 Normal mode

The attention mode indicates that the application is not in the normal mode in order to avoid misunderstandings (e.g. IFC-Test).

[sc_infobar_attention_mode, 1, --_--]

Figure 3-66 Attention mode

Breadcrumb

A breadcrumb is used for navigating and showing the current path within the current task. It can be used to step higher via the home icon or path element. Furthermore, it is possible to navigate quickly via tap on the separator elements between the single path elements.

[sc_powersys_breadcrumb, 1, --_--]

Dashboard

A dashboard gives the user an overview of all available areas and helps him to navigate through the application. It consists of several tiles which are grouped by theme.

The dashboard is changed dynamically when different device database are loaded (SWT 3000 or PowerLink).

The navigated working area is the screen space available for viewing or editing the content which is represented by breadcrumb path. In this area everything is shown with which the user works in the application, e.g. logs, configurations.

- Device information - Group for device information, alarm status and event log.
- Commissioning - Group for device configuration, adjustment, diagnostic and test commands.
- User management - Group for user management and change password.

[sc_explanation_dashboard, 1, --_--]

Figure 3-67 PowerSys dashboard

3.6 System Configuration

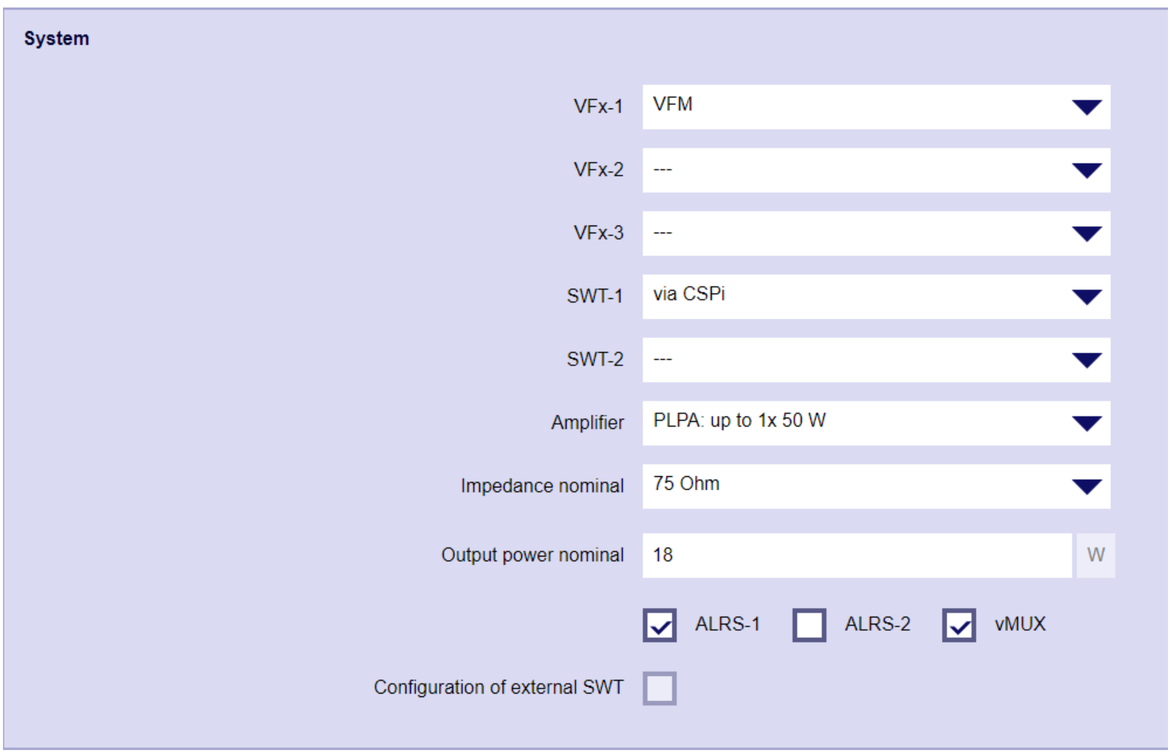
With PowerLink - Configuration - System the hardware of the system is defined.

For PowerLink 100, up to 3 VFx interface modules for connection of voice, external VF data channels resp. teleprotection signals can be used in the system and have to be defined if existing. Additionally up to 2 protection signaling devices (SWT 3000-1 and SWT 3000-2), up 2 ALR modules and the vMUX multiplexer can be integrated.

For PowerLink 50, up to 2 VFx interface modules for connection of voice, external VF data channels resp. teleprotection signals can be used in the system and have to be defined if existing. Additionally 1 protection signaling devices (SWT 3000-1), 1 ALR module and the vMUX multiplexer can be integrated.

NOTE

Unsupported features or hardware of PowerLink 50 are not blocked in the PowerSys configuration menus.



[sc_configuration_system, 1, --_--]

Figure 3-68 The system configuration form

VFx-1 to VFx-3 setting options: VFM, VFS or VFO. Each module has 4 ports for the input of analog voice, data resp. teleprotection signals. The difference of the modules is always the port 1. The ports 2 up to 4 are on each module identical (ref. also to system description).

Table 3-32 Port 1 difference of the VFx type

Module Type	Use of port 1
VFM	Analog voice channel with E&M signaling
VFS	Telephone interface FXS
VFO	Telephone interface FXO

Table 3-33 Setting options for the PowerLink System Configuration

Adjustment	Settings options	Remarks
VFx-1 to VFx-3 [1)]	VFM, VFS, VFO resp. --- (off)	System configuration for equipped VFx module(s). Refer to *Table 3-32*.
iSWT 3000-1, iSWT 3000-2[1)]	--- (off)	No iSWT integrated
	via CSPi	integrated iSWT 3000 system, transmission via PLC
	via FOM[1)]	remote iSWT 3000 system connected via FOM, transmission via PLC
	digital only[1)]	SWT 3000 system for **exclusive digital** transmission (via DLE / LID) inserted
vMUX	☐ / ☑	System configuration for vMUX, if equipped.
Amplifier	PLPA: up to 1x 25 W PLPA: up to 2x 25 W[1)] PLPA: up to 1x 50 W PLPA: up to 2x 50 W[1)] PLPA-HB: up to 1x 40 W PLPA-HB: up to 2x 40 W[1)] resp. no PLE (TEST)	Configuration of the PLPA amplifier type according to the hardware equipment.
Impedance nominal	75 Ohm, 150 Ohm resp. unknown	Impedance of the HF output; Unknown only for Test
Output Power nominal	PLPA (-LB): 9 W up to 25 W resp. 18 W up to 50 W resp. 35 W up to 100 W[1)]	Configurable min. and max. values depending on PLPA type. For specific required adjustments, refer to the Notes below.
	PLPA-HB: 14 W up to 40 W resp. 28 W up to 80 W[1)]	
ALR-1, ALR-2[1)]	☐ / ☑	System configuration for equipped ALR module(s)
Configuration of external SWT via PowerLink	☑	External SWT 3000 device (connected **via FOM**) is configured via PowerLink 100. Recommended setting for FOM connected SWT
	☐	Not configurable (no SWT via FOM available)
[1)] for PowerLink 100		

NOTE

In case of PowerLink 50/100 High Band or if using adjacent Tx and Rx bands it is necessary to reduce the output power of the PLPA.

3.7 HF Configuration

3.7.1 The HF Configuration Form

In the HF configuration form the HF-bandwidth, the frequency grid, the transmit resp. receive frequency and the frequency order has to be defined.

[sc_configuration_hf, 1, --_--]

Figure 3-69 HF configuration

Table 3-34 Setting options for the HF Configuration

Adjustment	Setting options	Remarks
HF-Bandwidth	2.5, 3.75, 5 resp. 7.5 kHz 2, 4, 8, 12, 16, 24, resp. 32 kHz	for use in the 2.5 kHz frequency grid for use in the 4 kHz frequency grid
Frequency grid	2.5 resp. 4 kHz	
Transmit start frequency	24 up to 1000 kHz	transmit and receive line filter must be adjusted accordingly
Transmit end frequency	-	
Frequency order **)	regular resp. inversed	
Receive start frequency	24 up to 1000 kHz	transmit and receive line filter must be adjusted accordingly
Receive end frequency	-	
Frequency order	regular resp. inversed	
AXC	--- (off) manual on automatic level 1 – 4 adaptive	without AXC with AXC for adjacent band operation according to table *Table 3-38**) for alarm criteria refer to Chapter *AXC Automatically Activated* continuously adaption to the actual line conditions

*) For **ADC adjustments** refer to table *Table 3-40*.

) In case of **adjacent band operation or **activated AXC** function refer to the recommendations in Chapter *Frequency order for adjacent Tx- and Rx-bands*

NOTE

Without AXC function, a frequency gap between transmit- and receive frequency band as given in Chapter *Frequency order for adjacent Tx- and Rx-bands* is required.

3.7.2 AXC Adaptive

If the AXC function is adjusted to adaptive the automatic crosstalk cancelling will be carried out continuously. PowerLink is adapting the input conditions for the received signal depending on the transmitted signal and the actual line conditions.

The adaptive AXC mode is the recommended setting for most common conditions with adjacent transmission bands.

In case of non adjacent band the AXC function has to be switched off. Otherwise the signal quality get worse.

NOTE

In case of adjacent band operation the AXC function must be activated.

In case of non adjacent band operation the AXC function must not be activated, otherwise the signal quality will be influenced negatively.

In case the PowerLink works in Single Purpose Operation with an (i)SWT 3000 exclusively, the AXC function has to be deactivated by all means.

3.7.3 AXC Automatically Activated

The function AXC automatically activated (AAA) allows an activation of AXC depending on the behavior of selected alarm sources. The criteria of AAA are affected on one hand by the digital otherwise by the analog alarm sources of the PowerLink – System. These 2 characteristics are considered in quantifying the levels of automatic AXC activation.

Table 3-35 Levels for automatic AXC activation

Level	Quantifying levels	
---	Autom. AXC activation turned off	
1	Analog as well as digital alarm criteria quantifying level:	Low
2	Analog as well as digital alarm criteria quantifying level:	Medium
3	Analog as well as digital alarm criteria quantifying level:	High
4	Analog as well as digital alarm criteria quantifying level:	Very High

Alarm criteria causing automatic AXC activation can be seen in the tables below:

Table 3-36 Alarm criteria for automatic AXC activation for PowerLink without iSWT 3000

		Level 1		Level 2		Level 3		Level 4	
Alarm resp. operating status	**Alarm source**	**AXC Start after [min]**	**Repetion [min]**	**AXC Start after [min]**	**Repetion [min]**	**AXC Start after [min]**	**Repetion [min]**	**AXC Start after [min]**	**Repetion [min]**
Reset		im	--	im	-	im	-	im	-

		Level 1		Level 2		Level 3		Level 4	
Change of Tx resp. Rx level		im	-	im	-	im	-	im	-
Level of SysPil out of range	analog	im	30	im	20	im	10	im	5
ADC overflow	analog	5	50	4	40	3	30	2	30
AGC out of range	analog	-	-	-	-	-	-	2	30
SNR alarm	analog	-	-	-	-	-	-	2	30
Receive alarm of iSWT 3000-x	analog	-	-	-	-	-	-	-	-
Rx alarm of iFSK	analog	-	-	-	-	5	10	im	5
Data Pump not synchronized	digital	-	-	5	10	2	10	2	5
Data Pump Blockerrors (40/20/10/5) [%]	digital	-	-	2	30	2	30	2	30
Number of DP resync. within 5 min interval	digital	20	60	10	50	7	40	5	30
xMUX not synchronized	digital	-	-	5	10	2	10	2	5
im = immediately									

Table 3-37 Alarm criteria for automatic AXC activation for PowerLink with iSWT 3000

		Level 1		Level 2		Level 3		Level 4	
Alarm resp. operating status	**Alarm source**	**AXC Start after [min]**	**Repetion [min]**	**AXC Start after [min]**	**Repetion [min]**	**AXC Start after [min]**	**Repetion [min]**	**AXC Start after [min]**	**Repetion [min]**
Reset		im	-	im	-	im	-	im	-
Change of Tx resp. Rx level		im	-	im	-	im	-	im	-
Level of SysPil out of range	analog	-	-	30	30	10	10	5	5
ADC overflow	analog	-	-	50	50	40	40	30	30
AGC out of range	analog	-	-	-	-	-	-	2	30
SNR alarm	analog	-	-	-	-	-	-	2	30
Receive alarm of iSWT 3000-x	analog	-	-	2	10	im	10	im	5
Rx alarm of iFSK	analog	-	-	-	-	5	10	im	5
Data Pump not synchronized	digital	-	-	5	10	2	10	2	5
Data Pump Blockerrors (40/20/10/5) [%]	digital	-	-	2	30	2	30	2	30
Number of DP resync. within 5 min interval	digital	-	-	10	50	7	40	5	30

		Level 1		Level 2		Level 3		Level 4	
xMUX not synchronized	digital	-	-	5	10	2	10	2	5
im = immediately									

3.7.4 AXC Manually Activated

[sc_axc_start_manually, 1, --_--]

Figure 3-70 The (manually activated) AXC function can be started in <**Test - General**>.

NOTE

If the AXC function is adjusted to manual it will carry out the crosstalk cancellation once after re-start of the equipment. After this the AXC function has to be started manually ref. to figure above.

3.7.5 Definition of the Adjacent Mode

Table 3-38 Definition of adjacent mode

HF-Bandwidth	Adjacent mode: when the gap between the Tx and Rx band is
32 kHz	≤ 24 kHz
24 kHz	≤ 18 kHz
16 kHz	≤ 12 kHz
12 kHz	≤ 9 kHz
8 kHz	≤ 6 kHz
7.5 kHz	≤ 6.25 kHz
5 kHz	≤ 3.75 kHz
4 kHz	≤ 4 kHz
3.75 kHz	≤ 3.75 kHz
2.5 kHz	≤ 3.75 kHz

All larger frequency gaps are non-adjacent mode

3.7.6 Frequency Order Using Adjacent Tx- and Rx-Bands

In case of **adjacent Tx and Rx bands** and activated AXC function the following rules have to be observed:

Table 3-39 Frequency order for adjacent Tx- and Rx-bands

Service	F6 Modulation	HF Bandwidth	Frequency order lower / upper frequency band
DP only		all	regular / inversed
DP and AMP	coded / uncoded	all	regular / inversed
DP and F2 / F3 / F6	coded / uncoded	all	inversed / regular
F2 / F3 / F6 (AMP/MP)	coded / uncoded	all	regular / inversed
F6 SP Mode 1	uncoded	2 kHz only	inversed / regular

Service	F6 Modulation	HF Bandwidth	Frequency order lower / upper frequency band
F6 SP Mode 1	uncoded	all (except 2,0 kHz)	regular / inversed
F6 SP Mode 1	coded	all (except 2,0 kHz)	inversed / regular
F6 SP Mode 2, 3, 4	uncoded	all	regular / inversed
F6 SP Mode 5A	uncoded	all	inversed / regular
F6 SP Mode 2, 3a, 3b, 4	codeda	all	inversed / regular

DP Data Pump
MP Multi purpose operation
AMP Alternate multi purpose operation
SP Single purpose operation

For the HF configuration of the PowerLink system refer to *3.7 HF Configuration*.

NOTE

For the ADC adjustment refer to *3.8.1 ADC Adjustments*.

3.8 Configuration Options

3.8.1 ADC Adjustments

Especially in the adjacent mode of the PowerLink the analog / digital converter ADC in the receive path has to be adjusted according the following rules

[sc_configuration_options_adc, 1, --_--]

Figure 3-71 <Configuration – Options> for adjustment of the ADC

Table 3-40 Rules for adjustment of the ADC

Tx/Rx Bands	Service	max. Line attenuation (from Tx-output to Rx-input)	ADC Adjustment
Non adjacent	analog	*) dB	12 dB
	DP	*) dB	12 dB
	DP + analog	*) dB	12 dB
Adjacent	analog	15 dB	12 dB
	analog	25 dB	20 dB
	analog	35 dB	26 dB
	DP	25 dB	20 dB
	DP + analog	25 dB	20 dB

*) according minimum receive level and required SNR

3.8.2 Output Gain

For test purpose only! In case of low attenuation of the transmission line the output gain can be reduced with this adjustment. Range 10 % up to 100 % in steps of 1 %. The Tx level is adjusted in the Tx-leveling menu, refer to chapter *3.19.1 TX Level Setting*.

Default setting: 100 %

3.8.3 Auto Reset

If the system detects a fault, an auto reset is carried out, if this function is activated (☑)

Default setting: activated (☑)

3.8.4 Test Mode and Diagnostic LED

Refer to chapter *Diagnostics and Error Handling*.

Default setting: normal mode

3.8.5 Quality Data Interval

Refer to chapter *Diagnostics and Error Handling*.

Default setting: 15 minutes

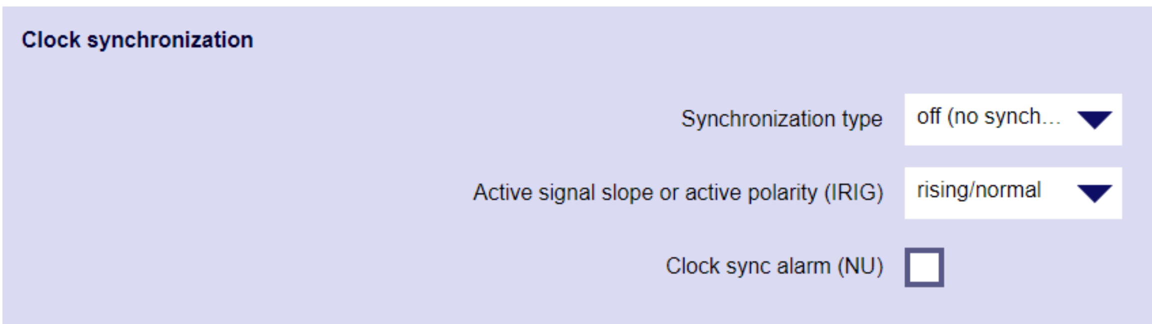
3.8.6 xMUX Supervision

Refer to chapter *Diagnostics and Error Handling*.
Default setting: low

3.8.7 Clock Synchronization

3.8.7.1 Sync. type

The following tables describe the configuration options for local clock synchronization of the Real Time Clock in PowerLink (CSPi) and the corresponding configuration for the iSWT 3000 (PU4).



[sc_clock_synchronization, 1, --_--]

Configuration - Clock synchronization / Configuration - iSWT-x - Clock synchronization

Table 3-41 Configuration parameters for Clock synchronization

PowerLink (CSPi) Configuration (PowerSys: PowerLink > Configuration > Options > Clock synchronization)			**iSWT 3000 - Configuration (PowerSys: PowerLink > Configuration > iSWT 3000-x > Clock synchronization)**				**ALR-1 (BI 1)**
Sync.Type	active signal slope or active polarity	Clock sync alarm (NU)	**Local sync**	Sync pulse every	active signal slope or active polarity	Clock sync alarm (NU)	**Input of clock sync. signal**
off (no synchronization)	---	---	off	---	---	---	3)
USYNC signal (sync interval minute)	rising or falling	on/off	USYNC signal	minute	1)	1)	2)
USYNC signal (sync interval hour)	rising or falling	on/off	USYNC signal	hour	1)	1)	2)
IRIG-B00x (sync. only)	normal or inverted	on/off	IRIG B00x (sync. only)	---	1)	1)	2)
IRIG-B000 (sync + RTC time adj.)	normal or inverted	on/off	IRIG B000 (RTC time adj.)	---	1)	1)	2)
IRIG-B004 (sync + RTC time & date adj.)	normal or inverted	on/off	IRIG B000 (RTC time & date adj.)	---	1)	1)	2)

PowerLink (CSPi) Configuration (PowerSys: PowerLink > Configuration > Options > Clock synchronization)			iSWT 3000 - Configuration (PowerSys: PowerLink > Configuration > iSWT 3000-x > Clock synchronization)				ALR-1 (BI 1)
NTP sync (sync & RTC time & date adj. for CSPi only)	---	on/off	---	---	---	---	3)
NTP sync & USYNC output (sync+RTC time & date adj. for CSPi+iSWT)	---	on/off	USYNC signal	minute	rising	1)	4)

1) same setting as used for CSPi

2) Input BI1 on ALR 1 is used as for USYNC or IRIG B signal

3) Input BI1 on ALR 1 can be used as alarm input.

4) Input BI1 on ALR 1 must be not be wired!

Table 3-42 Description of the RTC Synchronization types

Synchronization Adjustment	Remarks
OFF	RTC synchronization is disabled
USYNC signal (minute or hour)	An external impulse is received via the USYNC input every minute resp. hour. The active signal slope rising or falling is synchronizing the RTC seconds. The synchronization is done when the second counter is within the “synchronization window”: seconds > 35 ➔RTC time set to xx:xx:59 seconds < 25 ➔RTC time set to xx:xx:00 If the second counter is within the “synchronization window” the Usync alarm is cleared and a entry about a successful Usync is written in the event memory. If the second counter is outside the “synchronization window” will cause a Usync alarm and the entry Usync failed in the event memory. If no USYNC signal is detected within 70 seconds one alarm entry in the event memory is generated.
IRIG-B00x (sync only)	The IRIG-B message is received via the USYNC input and decoded. With each change of the IRIG-B minutes the RTC seconds are synchronized. The IRIG-B signal and RTC synchronization are supervised. In case of error the Usync alarm is generated.
IRIG-B000 (RTC time adj.)	The IRIG-B message is received via the USYNC input and decoded. With each change of the IRIG-B minutes the RTC seconds are synchronized. Additional the IRIG-B-time (hour, minutes, seconds) is compared with the RTC time of the iSWT. In case of a difference the IRIG-B values are taken over into the RTC. The IRIG-B signal and RTC synchronization are supervised. In case of error the Usync alarm is generated.
IRIG-B004 (RTC time&date adj.)	The IRIG-B message is received via the USYNC input and decoded. With each change of the IRIG-B minutes the RTC seconds are synchronized. Additional the IRIG-B-time & date is compared with the RTC time & date of the iSWT. In case of a difference the IRIG-B values are taken over into the RTC. The IRIG-B signal and RTC synchronization are supervised. In case of error the Usync alarm is generated.

Synchronization Adjustment	Remarks
NTP-Sync	Synchronization of the RTC (date and time of the CSPi) via the network time protocol. IP address and polling interval of the NTP server are configured via the CSPi Webinterface. The receive interval of the NTP telegram from the NTP-Agent is supervised. In case of timeout the Usync alarm is generated
NTP sync & USYNC output	Synchronization of the RTC (date and time) for CSPi and iSWT via the network time protocol. An internal USYNC output to the iSWT 3000 is generated by the CSPi (sync. interval 1 minute). IP address and polling interval of the NTP server are configured via the CSPi Webinterface. The receive interval of the NTP telegram from the NTP-Agent is supervised. In case of timeout the Usync alarm is generated.

3.8.7.2 Active Signal Slope or Active Polarity (IRIG)

Table 3-43 RTC Active Signal Slope or Active Polarity (IRIG) for CSPi Clock

Settings	Remark
rising/normal	The active signal slope is rising
falling/inverted	The active signal slope is falling

3.8.7.3 Clock Sync Alarm (NU)

Table 3-44 Clock Sync Alarm CSPi Clock

Settings	Remark
Clock Sync Alarm (NU) ☐	In case of clock sync. failed no alarm is activated.
Clock Sync Alarm (NU) ☑	In case of clock sync. failed an non urgent alarm is activated.

3.8.8 CSPi Date/Time Setting

After the data have been imported from a connected device, date and time of the CSPi can be set in <Time>
If an iSWT is configured, the clock of both, CSPi and iSWT are adjusted.

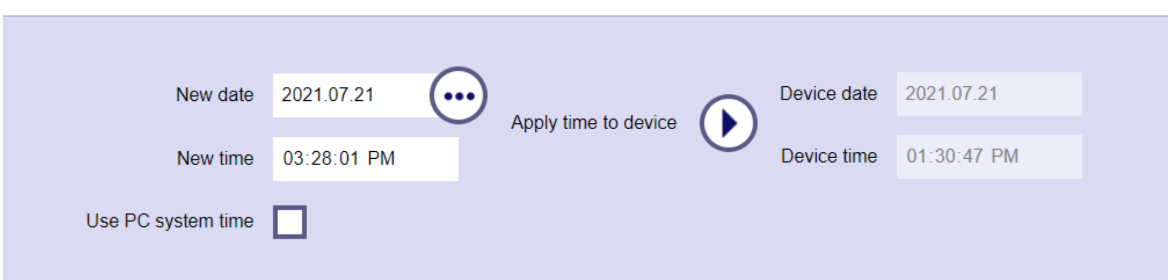


Figure 3-72 Setting of date and time of CSPi

For the time adjustment the option <**use PC system time**> or a manual adjusted <**new date**> resp.<**new time**> can be used. The internal clock is adjusted when operating the <**Apply**> or <**OK**> button.

3.9 Configuration of the Services

3.9.1 General Information

In the service form the type and number of services like voice (F2), data (F3) or protection signaling (F6) have to be defined.

NOTE

The services which can be selected depend on the firmware ordering number which is stored in the dongle on the CSPi module, and the interface modules VFx. For further information refer to the section *3.4.2 Features Which Have to be Enabled*

Table 3-45 Possible services which are selectable in the service configuration form

Basic features	Selection PowerLink 50	Selection PowerLink 100
Voice channels F2	0 to 2	0 to 3
Data channels	0 to 2	0 to 2
Teleprotection F6	always enabled	always enabled
Data Pump	0/1	0/1
Ethernet (transmission via Data Pump)	0/1	0/1
Integrated FSK channel (iFSK)	0 to 4	0 to 4
Data channels via iMUX *)	0/4/8	0/4/8
Add-on features		
Service telephone	0/1	0/1
Remote Monitoring	0/1	0/1
Dynamic Data Pump	0/1	0/1
vMUX features		
Voice channels (compressed voice)	0 to 8	0 to 8
fE1	0/1	0/1
rFSK channels	0 to 2	0 to 2
X.21 channels	0 to 2	0 to 2

*) Asynchronous data channels via iMUX / vMUX

In the PowerLink system maximum 4 different services can be defined.

3.9.2 Service Allocation

To prevent malfunction due to different order of service allocation for the devices in 1 PLC link, the services have to be defined always in the following order:

Table 3-46 Service Allocation

1. Service	Voice F2
2. Service	Data F3
3. Service	Protection F6
4. Service	Data Pump

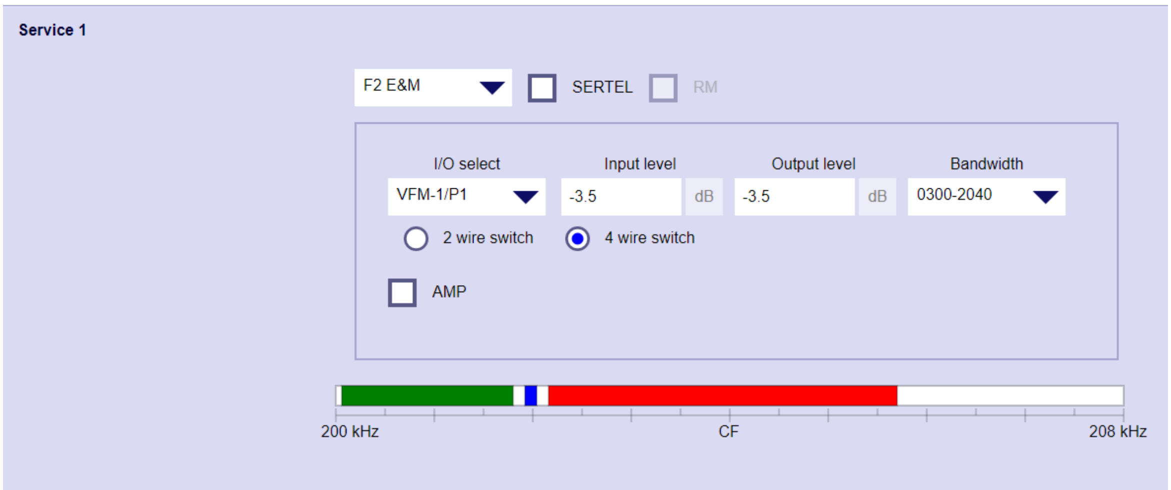
NOTE

The **bandwidth** and allocation of the services in the PowerLink systems from 1 link must be identical!

3.10 Voice Transmission (Service F2)

3.10.1 Overview

The following figure shows the configuration of a voice channel as service 1. The VFM-1 module displayed for the I/O of the voice signal has to be set in the PowerLink system configuration before. The provided type of voice signal (F2 E&M F2 office resp. F2 subscriber) depends on the module type(s) set in the system configuration



[sc_service_F2_em, 1, --_--]

Figure 3-73 <Configuration - Service> Setting a voice channel as service 1

After selection of the service type, the input resp. output of the signal has to be defined with <**I/O Select**> in this example Port 1 of the VFM module in slot pos. 1). Then the input and output level of the fed voice signal is adjusted.

Table 3-47 Settings of the input and output levels for the voice interfaces

Voice Interface	Input Level dB	Output Level dB
E&M	-3,5	-3,5
FXS	0	-7
FXO	-7	0

Additionally the bandwidth for transmitting the voice channel in the PowerLink system must be defined (here 300 Hz – 2040 Hz). The corresponding pilot channel is determined automatically from the system.

At the lower end of the service form the allocation of the PowerLink transmission band is displayed. It shows the position of the voice transmission band (green) and the corresponding pilot channel (blue).

3.10.2 The VFS Module

The interface FXS (first port of the VFS) is used to connect an analog telephone subscriber to the PowerLink.

Possible Configurations:

FXS <-> FXS
Direct connection between 2 subscriber (hotline)

FXS <-> FXO
Connection of a subscriber to an exchange (using 2wire-subscriber-interface of exchange)

FXS <-> 4wire E&M

Connection of subscriber to exchange (using 4wire-trunk-line-interface of exchange)

Settings

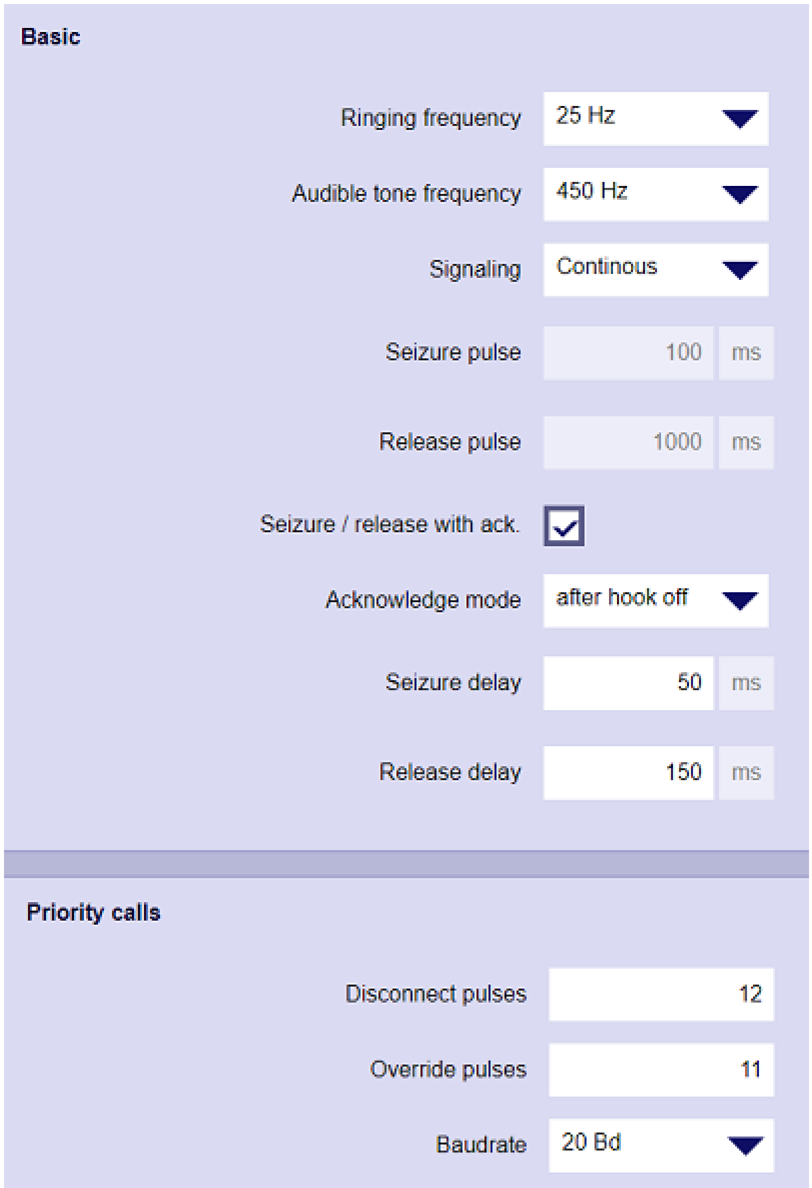


Figure 3-74 Settings for VFS module

Name	Value	Description
Seizure/release with acknowledge	y/n	In most signaling modes it is used to acknowledge the seizure or release of the channel. In special cases this feature can be deactivated by selecting “no” (depending on the E&M signaling protocol of the exchange)
Audible tone frequency	450/800 Hz	When calling the subscriber an audible tone signal will be send back. The frequency can be selected
Signaling	continuous/impulse	2 different E&M signaling protocols are possible: continuous signaling When seizure the channel the E&M-Wire is switched “on” and will stay in this state during the telephone call until the channel is released. impulse signaling When seizure the channel a short seizure pulse is transmitted via the E&M-Wire. The E&M-Wires stay in the “off” state during the telephone call. To release the channel a long release impulse is transmitted.
Acknowledge mode	immediately/after hook off	The FXS can acknowledge an incoming call from the remote station immediately or after hook off.
Baud rate	20/40 Bd	Baud rate of disconnect – and override impulses can be selected (depending on exchange)
Ringing frequency	25/50/60 Hz	The ringing current from the FXS to the subscriber can be selected. Value depends on the used subscriber.
Seizure delay	1 to 255 ms in steps of 1 ms	Suppression of short seizure pulses due to noise bursts.
Release delay	60 to 255 ms in steps of 1 ms	Suppression of short interruptions
Disconnect impulses	0 to 125 in steps of 1	Number of pulses to set up a priority call (disconnect); depends on exchange
Override impulses	0 to 125 in steps of 1	Number of pulses to set up a priority call (override); depends on exchange
Release pulse	1 to 65 535 ms	Duration of release pulse
Seizure pulse	5 to 250 ms	Duration of seizure pulse

Recommended Adjustments Depending on the Configuration Mode:

Table 3-48 FXS settings

	FXS <-> FXS	FXS <-> FXO	FXS <-> E&M continuous signaling	FXS <-> E&M impulse signaling
Seizure/release with acknowledge	y	y	y(n)	y(n)
Audible tone frequency	800 (450)	800 (450)	800 (450)	800 (450)
Signaling	continuous	continuous	continuous	impulse

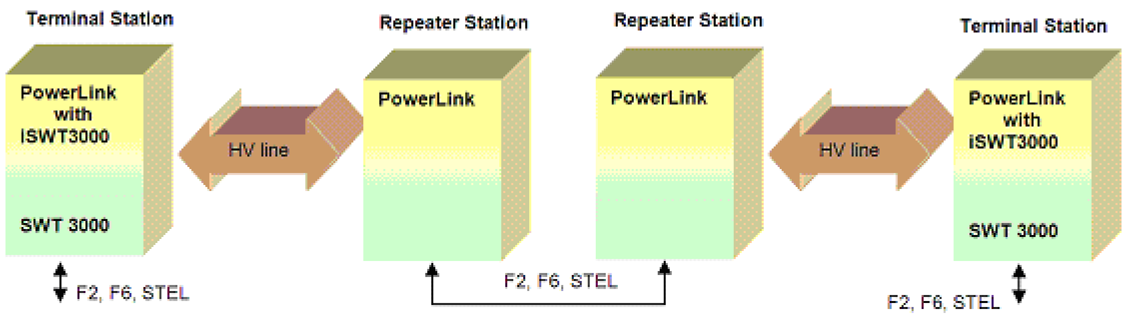
	FXS <-> FXS	FXS <-> FXO	FXS <-> E&M continuous signaling	FXS <-> E&M impulse signaling
Acknowledge mode	after hook off	after hook off	immediately (after hook off)	immediately (after hook off)
Baud rate	n.a.	20 (40)	20 (40)	20 (40)
Ringing frequency	25/50/60 Hz	25/50/60 Hz	25/50/60 Hz	25/50/60 Hz
Seizure delay	50 ms	50 ms50 ms	50 ms	50 ms
Release delay	150 ms	150 ms	150 ms	150 ms
Disconnect impulses	n.a.	12	12	12
Override impulses	n.a.	11	11	11
Release pulse	n.a.	n.a.	n.a.	1000 ms
Seizure pulse	n.a.	n.a.	n.a.	100 ms

3.11 TP-Repeater Service

3.11.1 Overview

The TP-Repeater provides the protection-signal forwarding on voice-frequency level with the advantages of:

- No SWT 3000 hardware needed on repeater station.
- Reduction of transmission time because of no coding/decoding time carried out by the SWT 3000 in the repeater station. The additional transmission delay caused by the TP-Repeater is less than 14 ms.

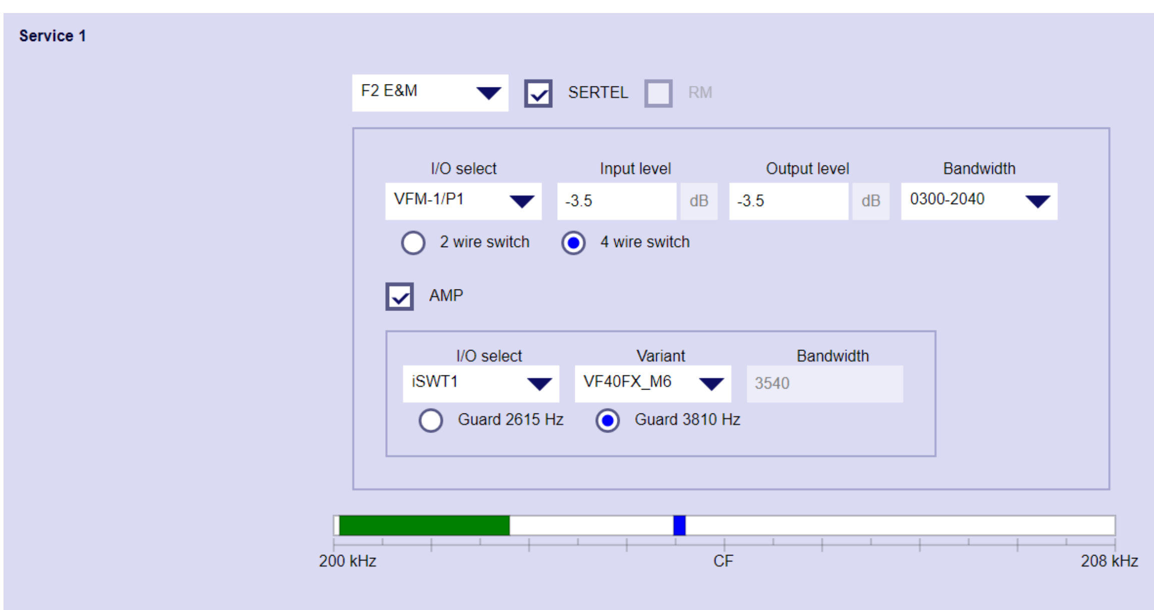


[losoltpr-120813-01.tif, 1, --_--]

Figure 3-75 Solution with TP-Repeater

3.11.2 Configure the Services in PowerLink Terminal Station

Configure the terminal PowerLink with service type **F2 AMP**. The voice channel E&M, subscriber, and office depend on the VFX module.



[sc_service_example_terminal_station, 1, --_--]

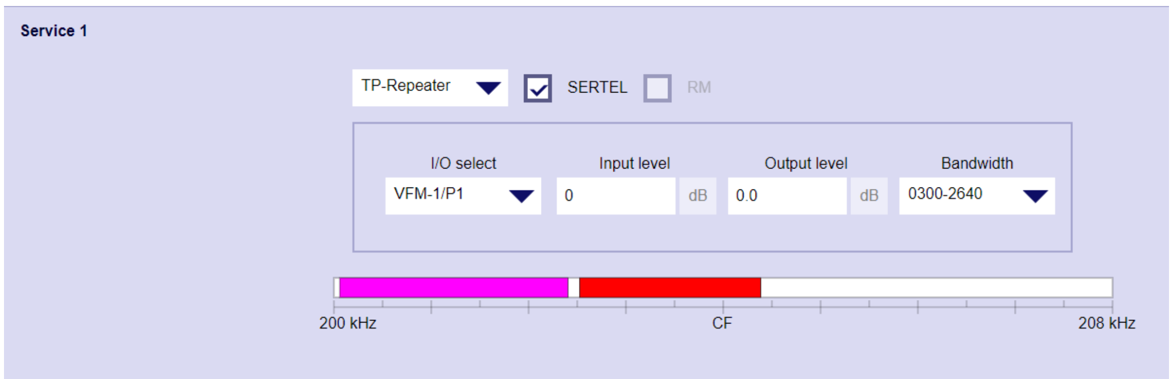
Figure 3-76 Service-configuration example for terminal

NOTE

Do not configure RM or F3 service band between F2 voice and guard tone. The standard multiple-purpose setup like F2 + F3 + RM + Guard is not supported for the TP-Repeater service. For this reason, Siemens recommends that **terminals** only use a bandwidth from **300 Hz to 2400 Hz or 300 Hz to 3600 Hz**.

3.11.3 Configure Powerlink of the TP-Repeater Station

Configure the TP-Repeater PowerLink with service type TP-Repeater.



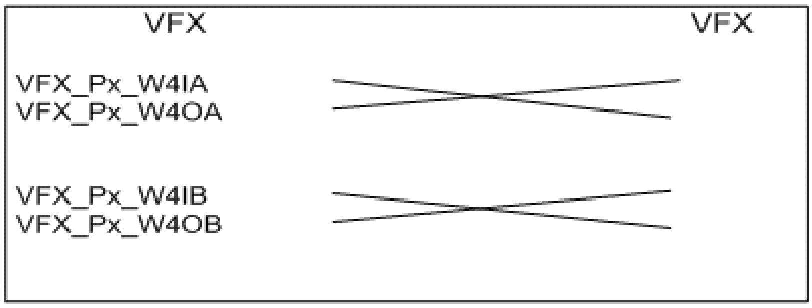
[sc_service_tp_repeater, 1, --_--]

Figure 3-77 Service configuration for TP-Repeater

Table 3-49 TP-Repeater service configuration

Adjustment	Setting options	Remarks
Type	TP-Repeater	Up to 4 TP-Repeater services can be configured, if sufficient HF bandwidth is available
SERTEL	☐	The STEL function not used
	☑	The STEL function can be enabled temporarily between terminal and TP-Repeater by clicking STEL activation command in <**Power-Link – Commands**>.
I/O Select	e.g. VFM-1/P1	All VFX ports can be selected except VFS port 1 and VFO port 1.
Input Level	0 dB	**Must be 0 dB** for TP-Repeater service
Output Level	0 dB	**Must be 0 dB** for TP-Repeater service
Bandwidth		Must be configured according the guard position of terminal:
	0300-2640 0300-3840	AMP Guard position is 2615 Hz AMP Guard position is 3810 Hz
RM	☐	Disable RM service
	☑	Ensable RM service
Allocation of trans-mission band		The frequency bar with pink color shows the TP-Repeater service bandwidth. Note that F2 pilot has been included in the TP-Repeater bandwidth.

The TP-Repeater I/O ports are connected with a VFX crossover cable as shown in the figure below. The pin signal is listed in *Table 3-50*. 4-wire operation is fixed for the TP-Repeater service.



[dwvfx4wr-140711-01.tif, 1, --_-]

Figure 3-78 VFX 4-wires crossover cable

Table 3-50 VFX 4-wires signal

Signal name	Remark
VFX_Px_W4IA	4-wire input A
VFX_Px_W4OA	4-wire output A
VFX_Px_W4IB	4-wire input B
VFX_Px_W4OB	4-wire output B

NOTE

RM is forwarded via the existing RM-1 interface. The RS232 crossover cable must be connected between both RM-1 interfaces of the TP-Repeater.

NOTE

If the TP-Repeater is combined with other services, the setup sequence must follow the rules:

- TP-Repeater must be configured before services F3, F6, DP, for example:
  TP-Repeater + F2 + F3 + DP.
- TP-Repeater can be configured before or after service F2, for example:
  TP-Repeater + F2 + F3 + F6 or
  F2 + TP-Repeater + F3 + F6.

NOTE

If TP-Repeater is at service 1, only F2 + AMP can be repeated.
If TP-Repeater is configured after F2 service, e.g. Service 1 = F2, Service 2 = TP-Repeater, then F2 / F6 can also be repeated.

NOTE

RM may be assigned at F6+iSWT1 channel, but never at F6+iSWT2 channel nor F2+iSWT channel.

NOTE

With the form <**PowerLink – Adjustments – TX-Leveling**> a fully automatic transmit level setting of the configured services is performed. Manual change of ACN is not permitted.

3.11.4 ACE with TP-Repeater

The ACE number must be configured the same for all PowerLink used in both terminal and TP-Repeater stations. It is configured in form <**Configuration – ACE**>.

[sc_ace_service1, 1, --_--]

Figure 3-79 ACE configuration for TP-Repeater

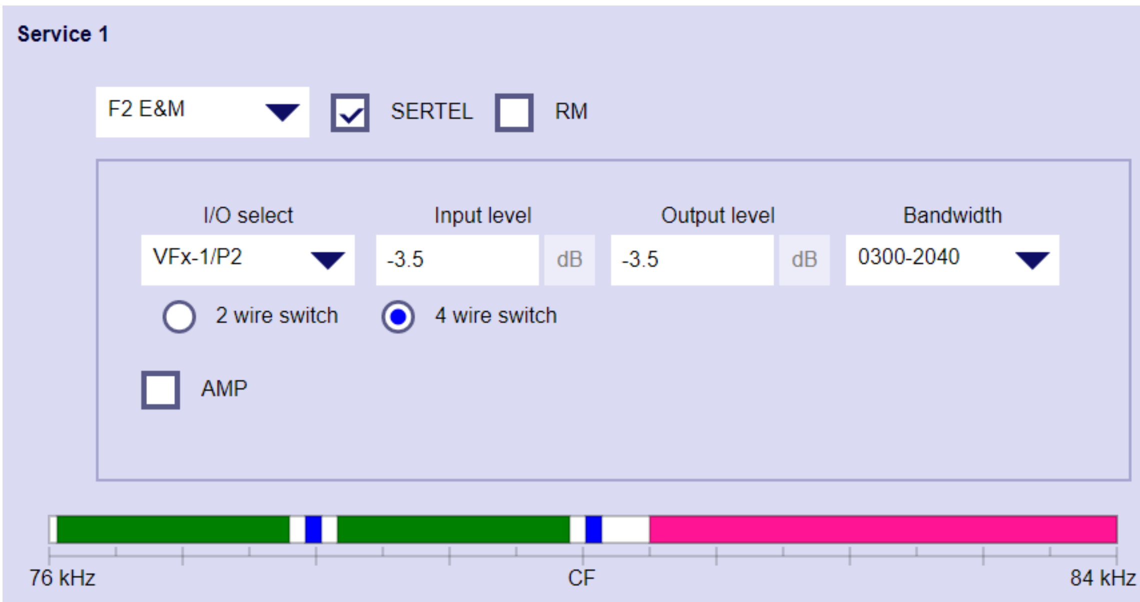
Table 3-51 ACE configuration

Adjustment	Setting options	Remarks
Start Code	1 to 10	To prohibit collision in a transit station with a neighboring link, 2 corresponding terminals of a link must be programmed with the same start code which is different for the next link. For the TP-Repeater service, this value must be the same for all terminals and TP-Repeater stations.

3.12 Service Telephone (STEL)

3.12.1 Configuration and Operation of Service Telephone

The service telephone is transmitted via the service F2 resp. Data Pump (DP) and must be enabled in the dongle. The following example shows a configuration with 2 voice channels (Service 1 and 2) and a Data Pump (Service 3). The service telephone can be configured in 1 of these services.



[sc_servicetelephone_via_service1, 1, --_--]

Figure 3-80 Transmission of the service telephone via the service 1

Activating the service telephone

For activating the service telephone the SERVICE-TEL push-button on the CSPi has to be pressed for at least 5 seconds. At the local station this is indicated by slow blinking of the LED SERVICE-TEL.

The remote station receives a call signal, indicated by buzzer and fast blinking of the LED SERVICE-TEL, which has to be confirmed with the SERVICE-TEL button within 1 minute (otherwise the SERVICE TEL LED and the call signal is switched off).

After accepting the call the LED SERVICE-TEL changes from fast blinking to steady light, the corresponding service is interrupted and the **general alarm is activated**.

If a station is called **during the activated Service telephone** (by pressing the SERVICE-TEL push button for 5 second) the call signal in the remote station is activated and the SERVICE TEL LED changes to fast blinking. If the SERVICE-TEL button in the called station is pressed within 1 minute the call signal is switched off and the SERVICE-TEL LED changes to steady light. Otherwise the call signal is switched off automatically after 1 minute and the SERVICE-TEL LED remains fast blinking.

For terminating the SERVICE-TEL mode the SERVICE-TEL push-button has to be pressed for min 5 seconds in both stations.

After terminating the SERVICE-TEL mode the corresponding service is switched on again and the general alarm is switched off.

NOTE

Using the service telephone is interrupting the corresponding service and causes general alarm.

3.12.2 Service Telephone function in TP-Repeater stations

If STEL is configured for both terminal and repeater stations, only STEL between terminal stations is possible by default. If one terminal starts STEL, the terminal at the opposite end can accept an STEL call request and start communication.

STEL between the terminal and the TP-Repeater station is only available for commissioning purpose. During the commissioning and use of STEL on a TP-Repeater, the teleprotection function as well as the telephone-data transmission are blocked.

Enable STEL on TP-Repeater

STEL can be enabled temporarily on TP-Repeater with the following steps:

- Configure STEL in both terminal station and TP-Repeater station.
- Enable STEL in TP-Repeater station by clicking the Activate STEL on TP-Repeater button
- Click the **Yes** button in the opened warning dialog

Then STEL is enabled on TP-Repeater, and the **Activate STEL on TP-Repeater** button is changed to **Deactivate STEL**.

After that, you can start STEL between terminal and TP-Repeater by pressing the STEL and DIAG buttons together on the CSPi board.

NOTE

As long as the STEL is activated in the repeater station no F6 protection commands can be transmitted via the link.

Table 3-52 Test > General > Activate STEL command

Command	Remarks
Activate STEL on TP-Repeater	STEL on TP-Repeater is only for commissioning purpose. If you click the **Activate STEL** button, the warning-message dialog opens. After acceptance, the STEL on TP-Repeater is enabled temporarily and the button is changed to **Deactivate STEL**. **ATTENTION** If STEL is enabled temporarily, the Teleprotection and F2 functions become unavailable until you click the Deactivate STEL button. This button is only enabled if STEL is configured in the TP-Repeater service.

Disable STEL on TP-Repeater

STEL can be disabled by sending a Deactivate STEL command or it is disabled automatically if the communication session of PowerSys is lost, for example, if you close PowerSys directly.

Table 3-53 STEL deactivation-command configuration

Command	Remarks
Deactivate STEL	Disable STEL on a TP-Repeater.

3.13 Data Transmission (Service F3)

3.13.1 Possibilities of the Data Transmission

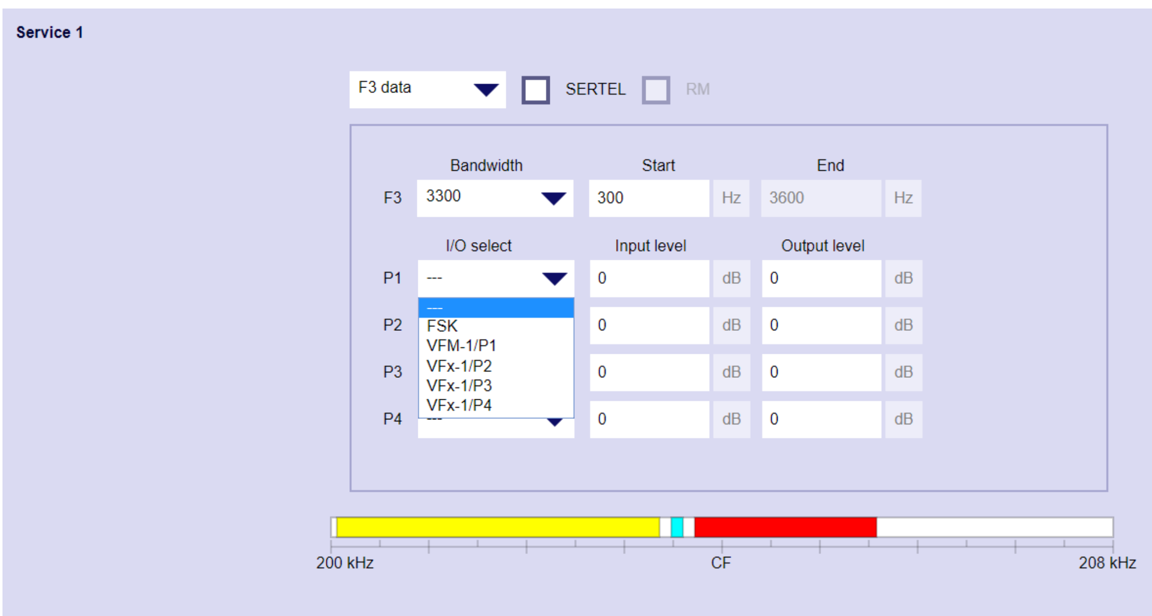
For data transmission F3 the PowerLink system offers various possibilities:

- Connection of an modem via the VFx interface modules. The input/output level for each port is adjustable.
- via the RS232 interfaces with up to 4 Frequency Shift Keying (FSK) channels adjustable from 50 up to 2400 Bd.
- As combination via the RS232 interfaces with up to 4 FSK channels and a VFx input.

Additionally the data transmission can be carried out:

- via the RS232 interface with up to 8 asynchronous channels from 300 bps to 115200 bps connected to an integrated multiplexer iMUX and the function Data Pump.

Maximum 2 F3 services can be configured in the PowerLink system.



[sc_service_F3_data, 1, --_--]

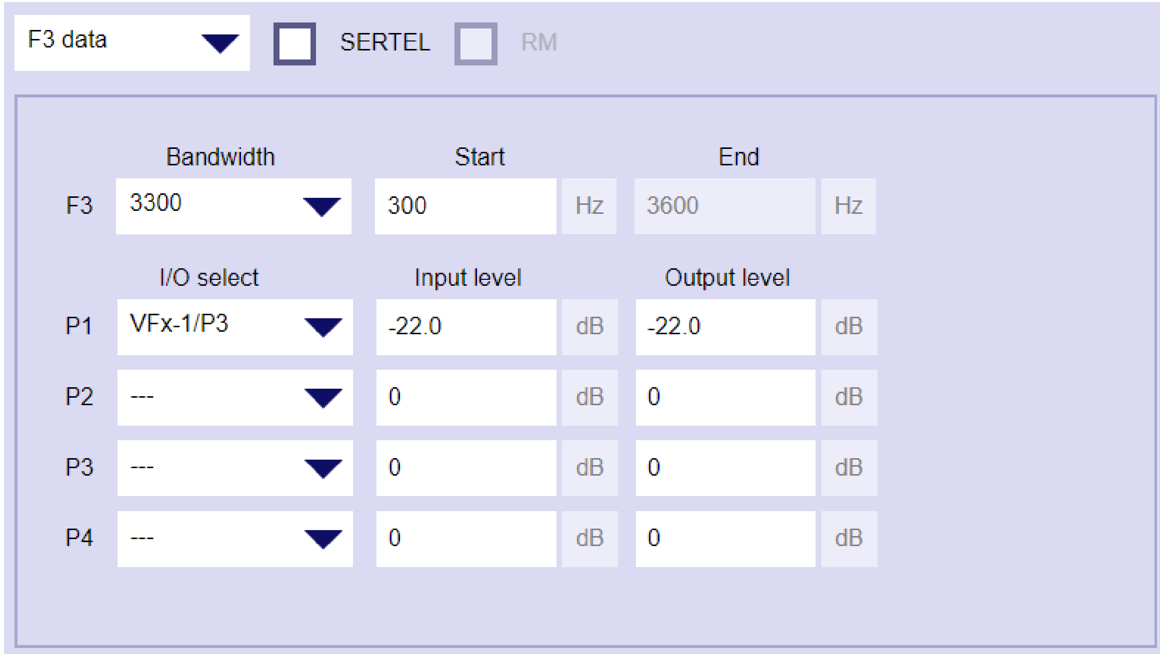
Figure 3-81 Configuration of a F3 data service

NOTE

FSK in the figure above appears only if enabled in the dongle!

3.13.2 Connection of an Modem via VFx Module

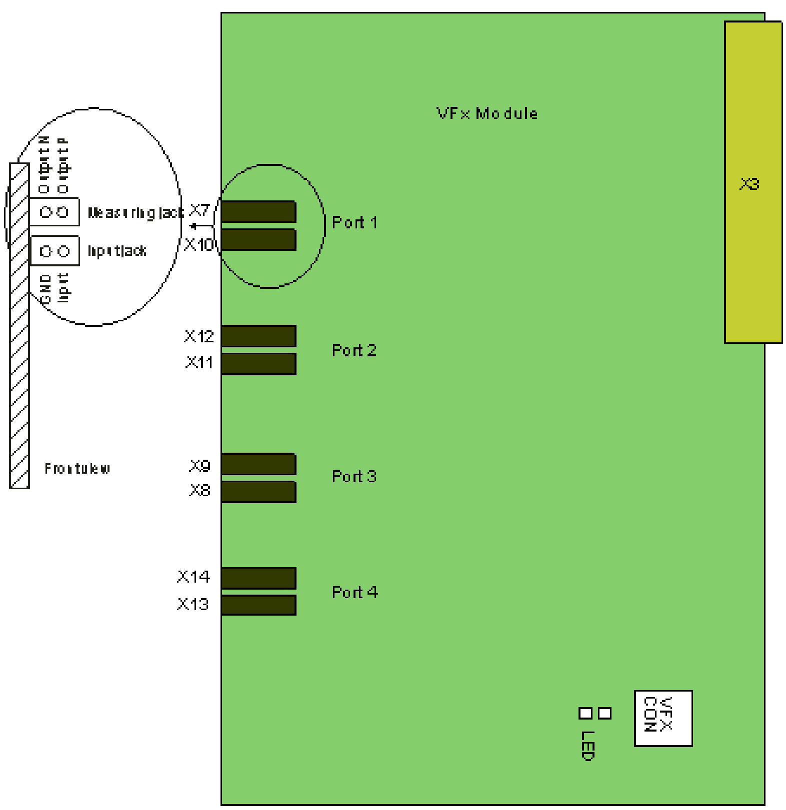
After the service type F3 has been defined the service form displays the configuration for the data channel:



[sc_service_F3_data_VFx, 1, --_--]

Figure 3-82 Configuration of the data channel via port 3 of an VFx interface

The available ports of the VFx module are displayed under <**I/O Select**>. The VFx-1 module displayed for the I/O of the data signal has to be set in the PowerLink system configuration previously. Then the input resp. output level has to be adjusted.



[dwmsinjk-301110-01.tif, 1, en_US]

Figure 3-83 The measuring and input jacks of the VFx modules

3.13.3 Considerations About Level Adjustment

Generally all data channels have to feed into the VFx ports with nominal level:

Table 3-54 Nominal level of data channels

Data channel	Nominal level (P)	Allocated channel number (ACN)
50 Baud	-22.5 dB	1
100 Baud	-19.5 dB	1,4
200 Baud	-16.5 dB	2
600 Baud	-13.5 dB	2.8
1200 Baud	-10.5 dB	4
2400 Baud	-7.5 dB	5.7

The input resp. output level has to be adjusted to the level of the feeding channel. **If several channels are connected**, the input/output level must be adjusted to the **peak level** of the data channels:

Calculation of the **peak level**:

Ps = -22.5 + 20*log(ACN)

Example:

2 x 50 Bd : ACN = 1 ; P1 = -22.5 dB

2 x 600 Bd : ACN = 2.8 ; P2 = -13.5 dB

ACN: (2*1 + 2*2,8) = **7.6**

Peak level:

Ps = -22.5 + 20*log(7.6) = **-4.8 dB**

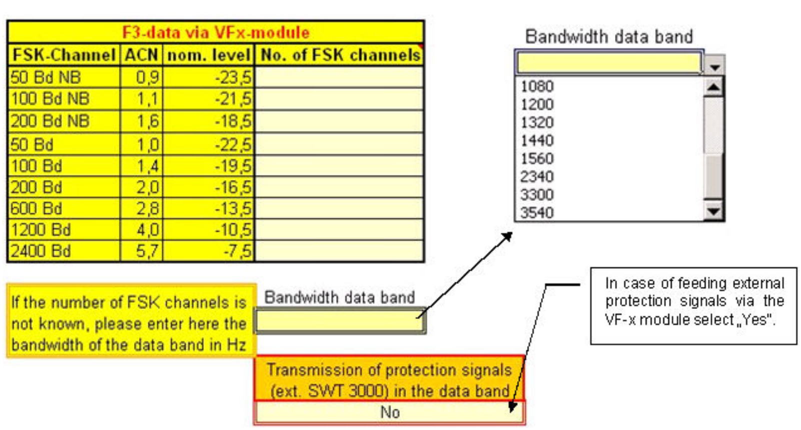
This peak level has to be adjusted for the input and output level of the VFx port! The peak level as well as the ACN calculation is carried out also with the Excel program "F3_via_vfx_leveling_xx_xx.xls" (part of the PowerSys software package).

NOTE

If several VFx ports are used for the data transmission, the **peak level and ACN** has to be calculated and adjusted for each port separate!

Operating the F3_via_vfx_leveling_xx_xx.xls program

For the data input the program offers 2 possibilities as shown in the figure below.



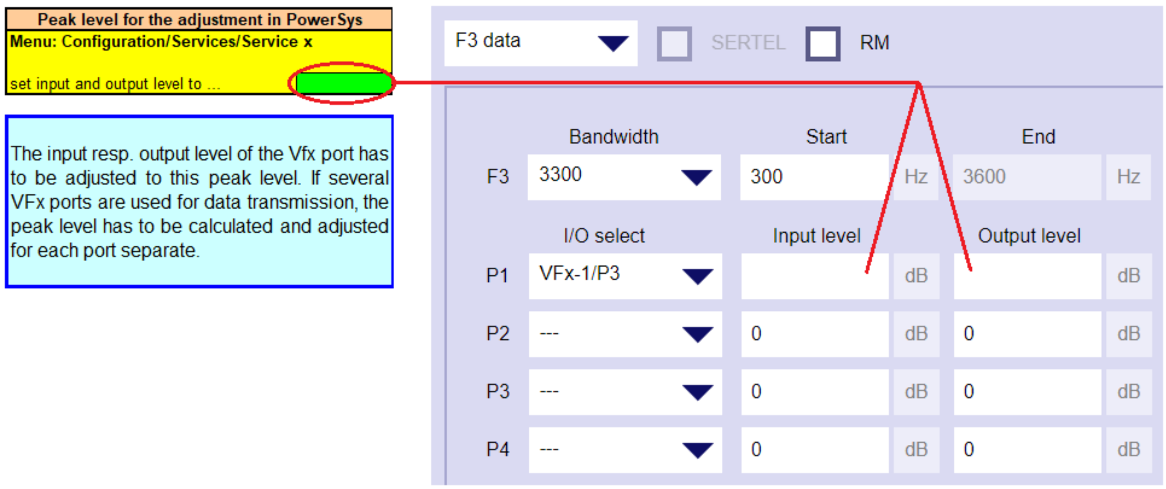
[scdinlcp-301110-01.tif, 1, en_US]

Figure 3-84 Data input of the level calculation program

Either the number of the corresponding FSK channels has to be entered or the bandwidth of the F3 data channel.

Peak Level Adjustment

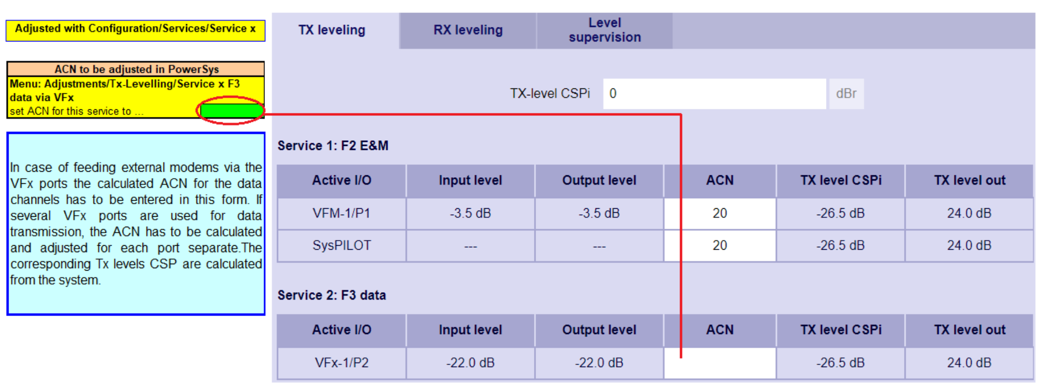
Subsequently the program shows the peak level which has to be adjusted for the corresponding VF-x ports (refer to *Figure 3-85*) and the allocated channel number (ACN) (refer to *Figure 3-86*) which has to be modified in the form PowerLink adjustments Tx leveling.



[sc_peaklevel_adjustment, 1, --_--]

Figure 3-85 The peak level adjustment

Adjustment of the Allocated Channel Number (ACN)



[sc_acn_adjustment, 1, --_--]

Figure 3-86 ACN adjustment according the peak level calculation

The adjustment of the ACN is carried out with a double click on the corresponding number in the Tx-leveling form. Now the value displayed in the field “ACN to be adjusted in PowerSys” has to be entered.

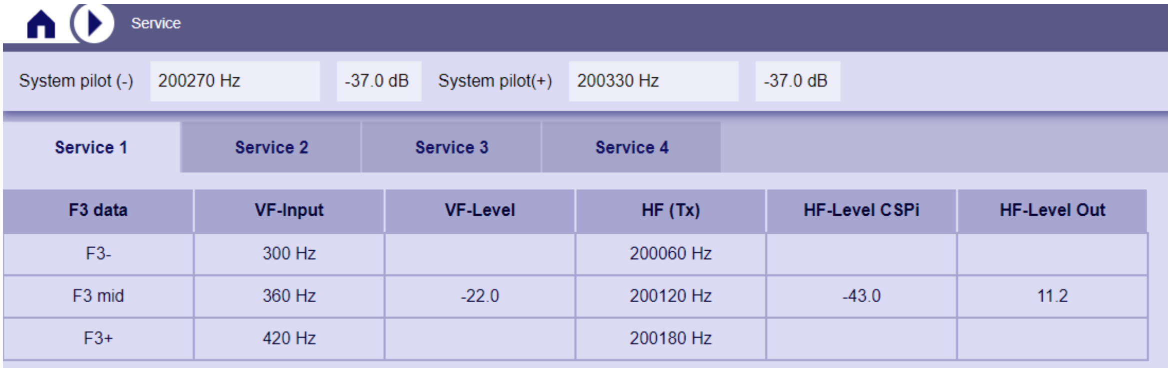
With click on the <**Apply**> resp. <**OK**> button the new value for the ACN is taken over and all transmit levels of the PowerLink are new adjusted.

NOTE

The HF level displayed in the PowerLink shows the peak level! All external data channels have to feed with the nominal channel level!

The next section gives detailed explanations for the measurement of external F3 voice frequencies in the HF range

Display of the HF Output Level for Data via VFx



[sc_service_F3_data_HF-level, 1, --_--]

Figure 3-87 Display of the F3 data band and the HF output level

The display of the HF-Level CSPi in <**Service**> is calculated for the VF **peak level** (this is the level adjustment of the VFx ports). Since all external data channels **feed with the nominal channel level**, the HF output is corresponding lower.

The “VF-Input” shows the limits of the data band adjusted in the service configuration. When feeding a defined voice frequency this can be measured by calculating first the frequency offset. For that purpose 1 of the displayed VF frequencies has to be subtracted from the HF. In the example shown in *Figure 3-87* the offset is 70525 Hz – 300 Hz = 70225 Hz (the data band is adjusted from 300 Hz up to 3600 Hz). Subsequently the offset has to be added to the feeding frequency to find the HF.

Example for feeding a voice frequency into the data band shown in *Figure 3-87*.

Table 3-55 Measuring an external voice frequency in the HF range of the data band

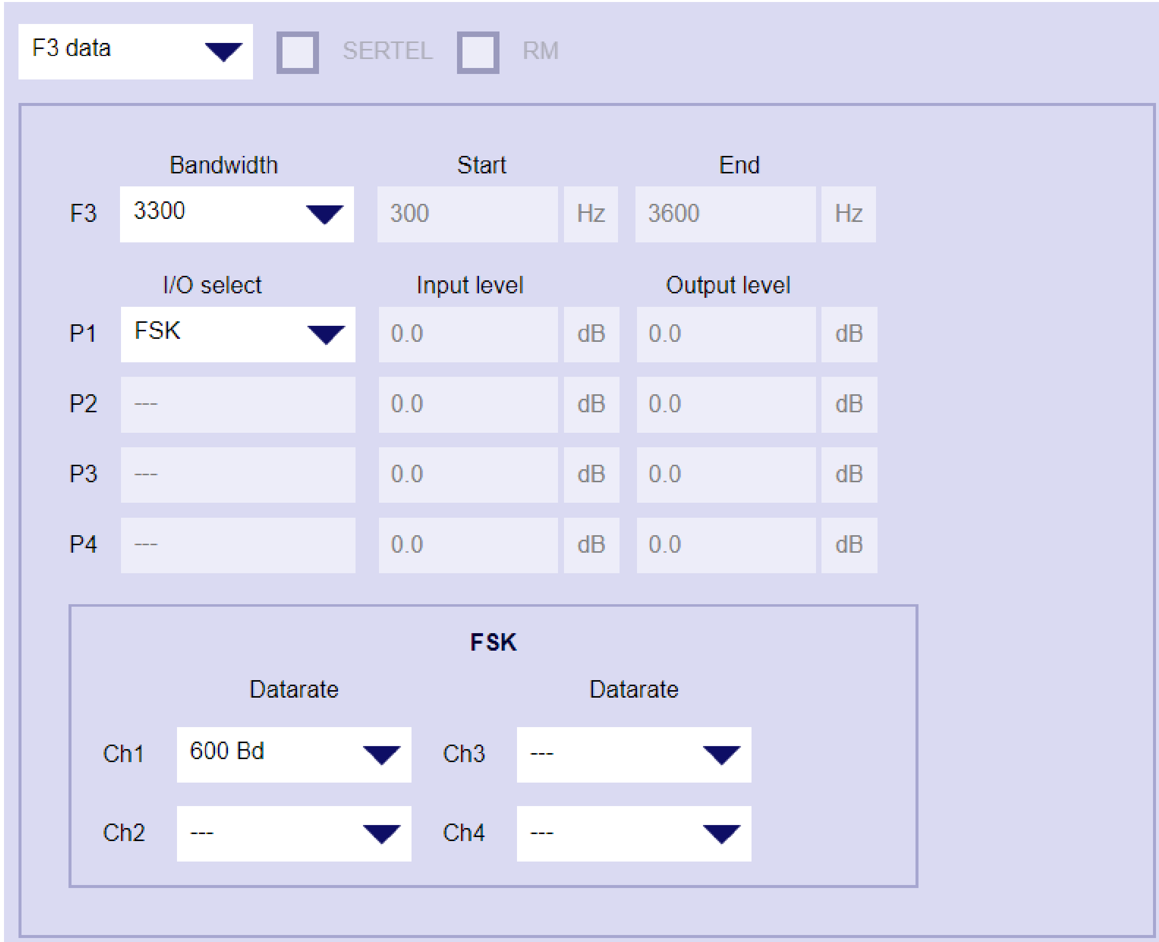
Feeding VF Frequency	Feeding level	Offset	HF Frequency	Output level CSPi
3260 Hz	-13.5 dB	70225 Hz	70225 Hz + 3260 Hz = 73485 Hz	-28.8 dB -13dB*) = -41.8 dB

*) the level of the data channel is 13 dB less than the peak level

The VF output level of the corresponding VF-x port in the remote station is again -13.5 dB.

3.13.4 System Configuration for iFSK Channel Transmission

Via the RS232 interfaces of the PowerLink system up to 4 Frequency Shift Keying (iFSK) channels adjustable from 50 up to 2400 Bd can be transmitted. The transmission of the iFSK channels is carried out in 1 or 2 F3 data bands (selectable).



[sc_service_f3_data_fsk, 1, --_--]

Figure 3-88 Configuration of the service F3 for FSK channels

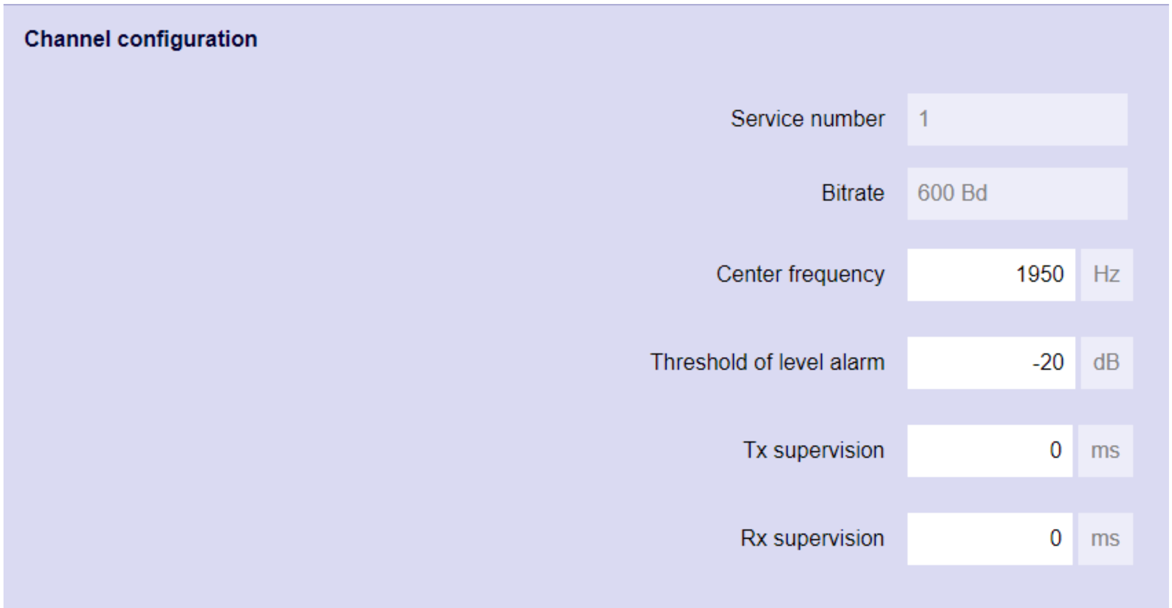
The 4 possible iFSK channels are transmitted within the bandwidth 3300 Hz. The setting options for adjustment of the bit rates are shown in the table below:

Table 3-56 Adjustable bit rates for the iFSK channels

System	Nominal Bit rate	max. Bit rate
FM 120	50	85
FM 240	100	170
FM 480	200	340
50 Bd NB	50	60
100 Bd NB	100	120
200 Bd NB	200	240
600 Bd	600	880
1200 Bd	1200	1300
2400 Bd	2400	2500

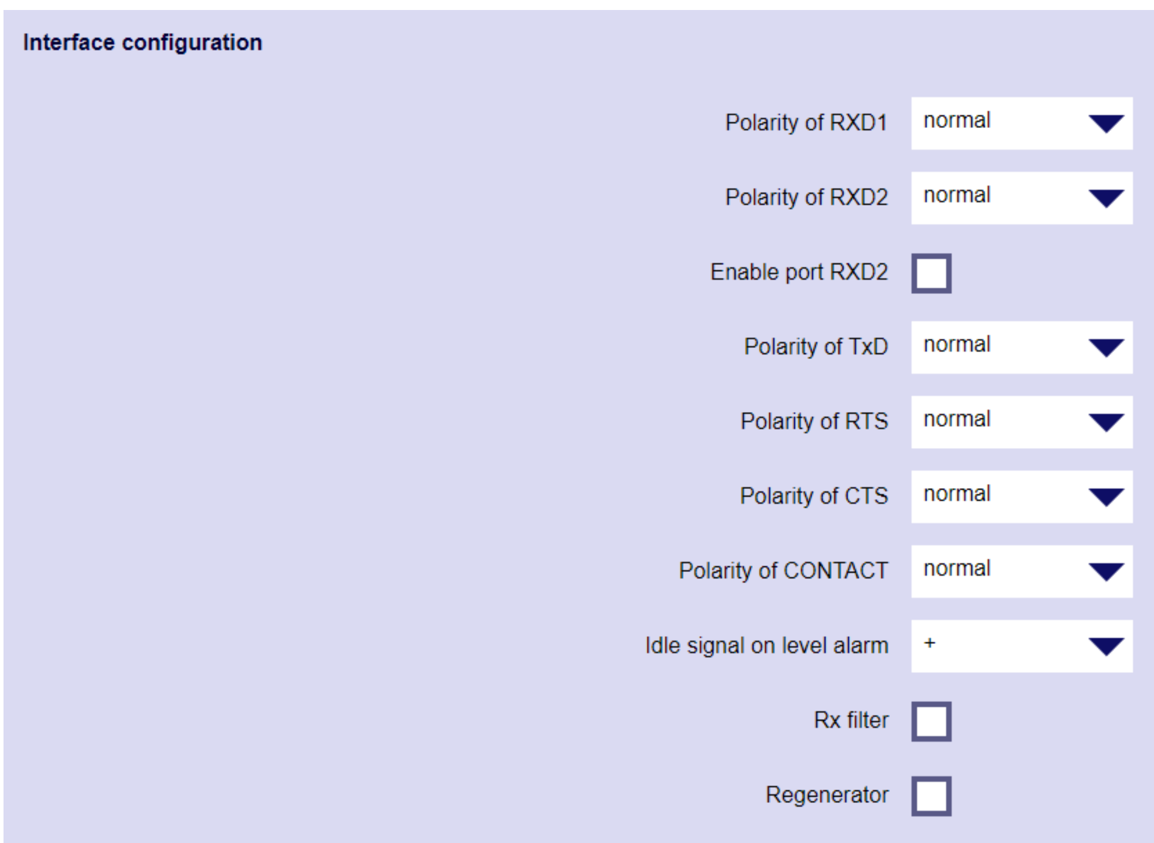
iFSK Channel Configuration

After the number of iFSK channels and the corresponding bit rates are adjusted with <**Configuration – Services**> the further settings for each channel have to be defined in <**Configuration – FSK**>.



[sc_fsk_channel_configuration, 1, --_--]

Figure 3-89 FSK - Channel configuration



[sc_fsk_channel_interface_configuration, 1, --_--]

Figure 3-90 FSK - Interface configuration

[sc_fsk_channel_command, 1, --_--]

Figure 3-91 FSK Command

NOTE

In case of a vMUX configuration with rFSK channels the FSK channel configuration menu of these channels is disabled. The rFSK channels are configured with the vMUX Channel Setup.

Each iFSK channel needs a center frequency which is determined automatically from the system. The frequency deviation as well as the channel level results from the adjusted bit rates and is also calculated from the system. For manual adjustments make sure, that the channels don’t overlap and observe the grid distance.

The required bandwidth for the iFSK channels depends on the baud rate and is shown in the table below.

Table 3-57 Definition of the iFSK bit rates

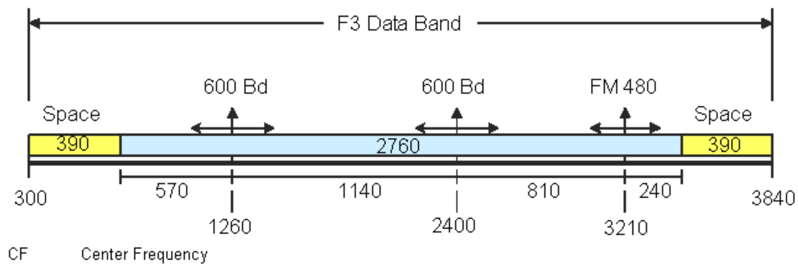
No.	System	Nominal Bit rate	max. Bit rate	Grid distance Hz	Bandwidth Hz	FM deviation Hz	Nominal channel level dBr
1	FM 120	50	85	120	100	±30	-22.5
2	FM 240	100	170	240	200	± 60	-19.5
3	FM 480	200	340	480	400	±120	-16.5
4	50 Bd NB	50	60	90	75	± 22.5	-24.5
5	100 Bd NB	100	120	180	150	± 45	-21.5
6	200 Bd NB	200	240	360	300	± 90	-18.5
7	600 Bd	600	880	1140	1000	± 200	-13.5
8	1200 Bd	1200	1300	1710	1440	± 400	-10.5
9	2400 Bd	2400	2500	3400	2720	± 800	-7.5

Example of iFSK Channel Location in a Data Band

The following figure shows the location of two 600 Bd and one 200 Bd (FM480) iFSK channels in a data band with 3540 Hz bandwidth.

NOTE

The iFSK channels are automatically located in the center of the corresponding F3 data bands!



[dwscifsk-301110-01.tif, 1, en_US]

Figure 3-92 Location of different iFSK channels in a data band

Remarks:

The grid distance for 600 Bd iFSK is 1140 Hz. Therefore a gap of 570 Hz to the lower band frequency must be taken into account for calculating the channel center frequency. When calculating the center frequency for the next 600 Bd channel, the grid distance of 1140 Hz for 600 Bd has to be added.

For calculating the gap between the 600 Bd and the 200 Bd (FM480) channel half of the grid distances from the corresponding systems (1140 Hz / 2 = 570 Hz; 480 Hz / 2 = 240 Hz; 570 Hz + 240 Hz = 810 Hz) have to be added.

The min. bandwidth for the 3 iFSK channels is 2760 Hz, including the gap of 570 Hz for the 600 Bd channel and 240 Hz for the FM480 channel at the beginning and end of the band.

Placing the required bandwidth in the middle of the data band results in a space of 390 Hz ((3540 Hz – 2760 Hz) / 2 = 390 Hz) at the beginning and the end of the F3 transmission band.

NOTE

The same rules for frequency space, have to be considered in case of working with external FSK channels.

Further Setting Options

The polarity of the interface RxD, TxD, CTS, RTS data lines can be adjusted to normal <**norm**> (default setting) or inverted <**inv**>.

Port RxD2 enabled:

Devices which are connected to the RxD2 port (RS232 B-Port) port must **activate a RTS** signal for **data transmission**! With this checkbox, the RxD2 port has to be enabled for using.

Rx-Filter:

A steep receive filter is activated by using this checkbox.

Default setting: Rx-Filter deactivated

Idle Signal on Level Alarm:

With this setting option the Idle-Signal polarity (+ or -) of the iFSK channel in case of a level alarm can be selected.

Default setting: < + >

Regenerator function:

When the regenerator function is activated, it must be ensured, that the **bit rate fed to the RS232** interface and the **adjusted baud rate of the iFSK channel is identical**. Within the receiver the signal is regenerated.

Default setting: Regenerator deactivated

Commands:

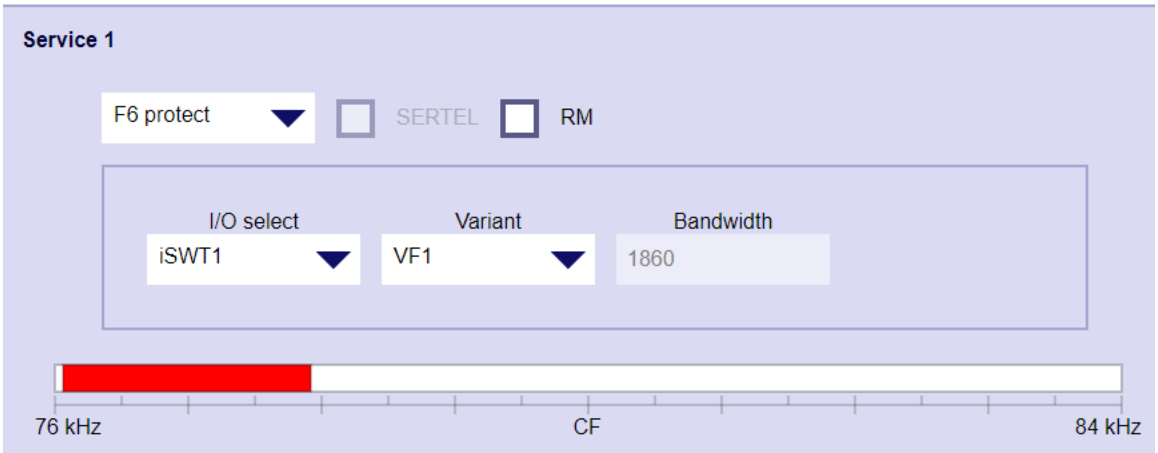
With the commands menu different test modes and loop commands can be activated. It is also possible to initiate the Equalization of the iFSK channel from the commands menu. The commands are activated by the Send button.

To return to normal operation the Command Normal mode has to be selected (default setting).

3.14 Service Configuration F6 Protection

With the service F6 Protection the transmission service for an integrated or an external SWT 3000 is configured. The service reserves a certain bandwidth for the teleprotection service either for the Single Purpose (SP)operation of the iSWT 3000 in PowerLink or the Multi-Purpose (MP) operation of the teleprotection signaling in conjunction with other PowerLink services.

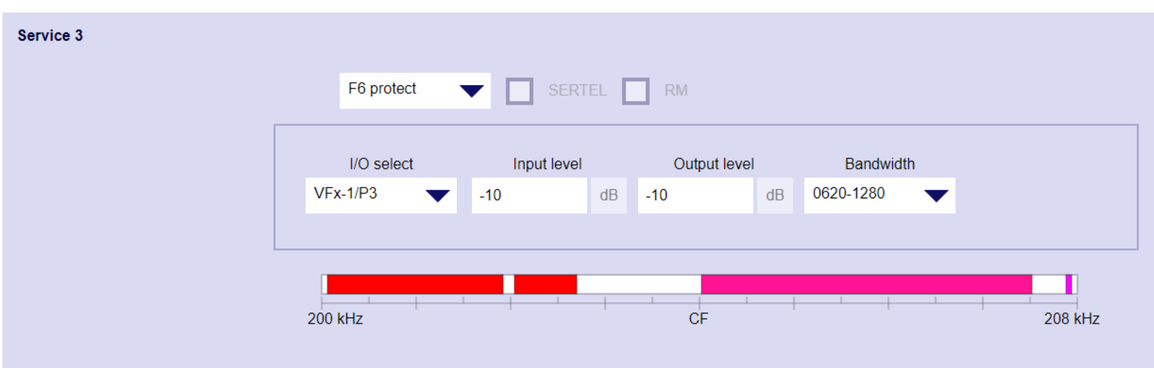
The In-/Output selection is either a configured iSWT or a VF-port 3 or 4 of a VFx module for connection of an external SWT 3000. For an integrated SWT 3000 the bandwidth is automatically assigned with selection of the iSWT- Variant.



[sc_service_F6_protect, 1, --_--]

Figure 3-93 Service configuration F6 Protection, e.g. for iSWT 3000 (Single Purpose)

For the configuration of a VFx connection to an external SWT 3000 the I/O levels have to be adjusted to the I/O levels of the SWT 3000 device (CLE module). The required bandwidth of the Service F6 depends on the configuration of the SWT 3000 (protection mode and variant).



[sc_service_F6_protect_VFx, 1, --_--]

Figure 3-94 Service configuration F6 Protection, e.g. for VFx-1/ Port 3 (Multi-Purpose)

For details, refer to Chapter *System Configuration with Protection Signaling SWT 3000*.

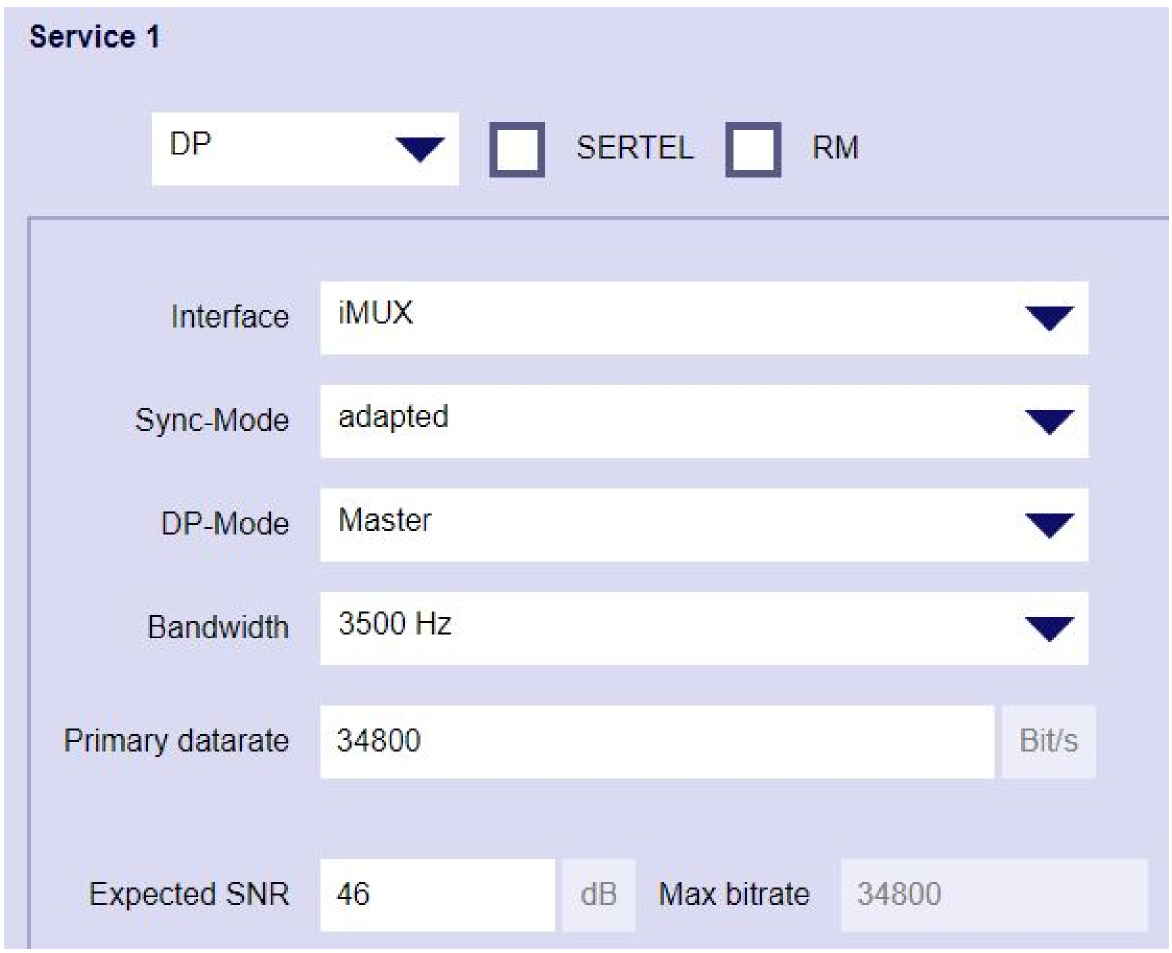
3.15 Data transmission via Data Pump

3.15.1 iMUX

With the integrated multiplexer (iMUX) and the function Data Pump up to 8 asynchronous data channels with 1.2 Kbps up to 19.2 Kbps connected to the RS232 interfaces can be transmitted.

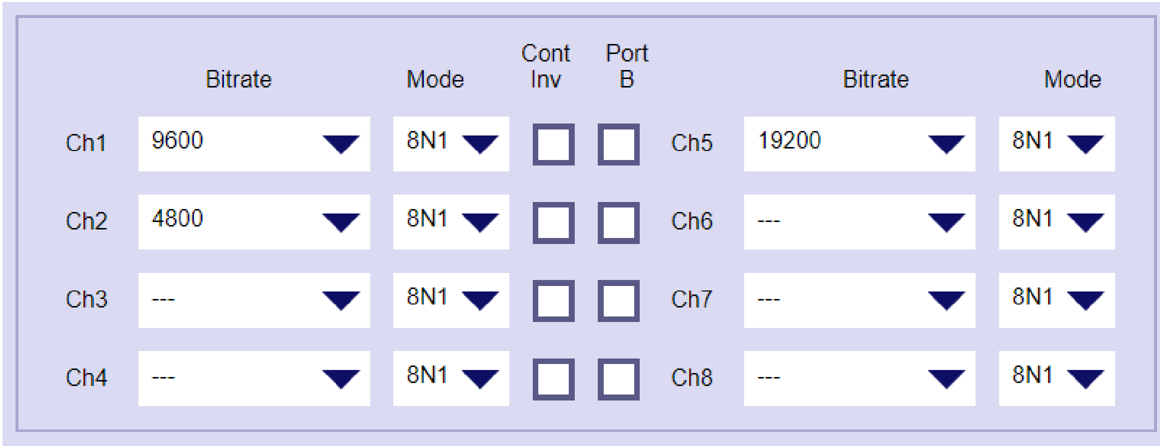
Setting the Service Configuration

The service type for the above mentioned function must be DP (Data Pump). The DP interface is the integrated multiplexer iMUX. Select iMUX-IEC in case of connecting a RTU using IEC messages.



[sc_service_dp_imux, 1, --_--]

Figure 3-95 Configuration for the transmission of RS232 interfaces via Data Pump



[sc_service_dp_imux_channel, 1, --_--]

Figure 3-96 Configuration data channels

Setting Options for the iMUX

The iMUX has an priority management. Total bit rates assigned to the RS232 ports 1A/B to 4A/B m**ay not exceed the aggregate bit rate of the DP**. Then the transmission of this channels is guaranteed.

Devices which are connected to the RS232-**1B** up to RS232-**4B** ports must **activate a RTS** signal for **data transmission**! Activating the RTS signal via contact (via pin 9) is also possible. The contact can be inverted with activating the "Cont inv" at the corresponding channel (ref. to the figure above).

The bit rates assigned to RS232 ports 5 to 8 will be transmitted, if the transmission capacity is available (handshake signals RTS, CTS). Each channel can be adjusted to 1200, 2400, 4800, 9600 resp. 19200 bps. The supported UART modes are:

7N1, 7N2, 7E1, 7E2, 7O1, 7O2, 8N1, 8N2, 8E1, 8E2, 8O1 resp. 8O2 (data bits, parity, stop bits).

Setting Options for the Data Pump

Table 3-58 Setting options for the Data Pump with iMUX connection

Adjustment	Setting options	Remarks
Interface	iMUX	For connection of up to 8 asynchronous data channels via the RS232 interfaces.
	iMUX-IEC	For connection of RTU's transmitting IEC messages
Sync-Mode	adapted	**Optimized connection** between the 2 Data Pumps with best adaptation to the transmission path.
	dynamic	Fallback bit rate for adverse weather conditions. **Highest availability**! (Must be enabled in the dongle)
DP Mode	Master	Adjust the other DP to Slave
	Slave	Adjust the other DP to Master
Bandwidth	3500 – 31 500 Hz	
Data rate	9600 up to 64 000 bps	Normal data rate in sync mode adapted.

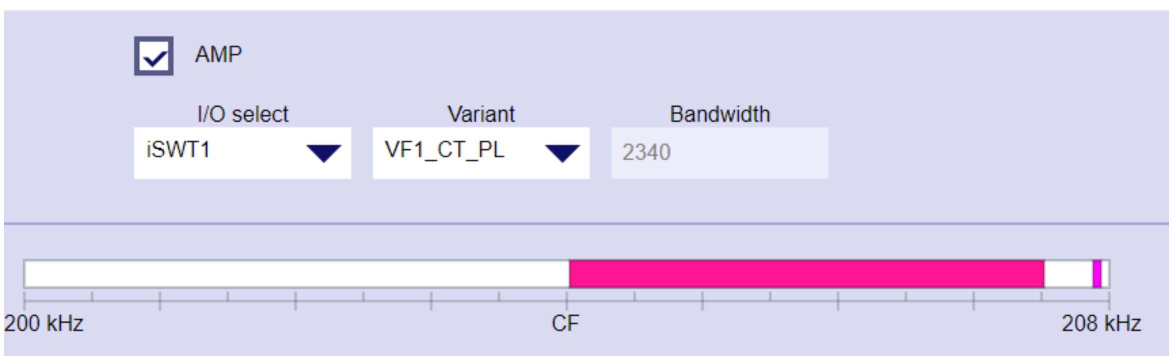
Adjustment	Setting options	Remarks
Primary data rate	10 000 up to 64 000 bps	Normal data rate in sync mode dynamic. The primary data rate **can't be higher adjusted** than the **bit rate calculated** with the bit rate estimation.
Secondary data rate	9600 up to 63 600 bps	Fallback data rate is only adjustable in sync mode dynamic. When the DP is working with the **secondary data** rate the **DPALR** is activated.

Table 3-59 Lower Data Pump Data Rate depending on Data Pump Bandwidth

Data Pump	Bandwidth [kHz]	min. lower Data Rate [bps]
	> 7.5	9 600
	11.5	14 400
	15.5	20 000
	23.5	32 400
	31.5	44 000

A bit rate estimation is performed from the system after the expected SNR is entered.

Additional the teleprotection with integrated SWT 3000 in AMP mode and the transmission of remote monitoring channel RM is possible.



[sc_service_dp_imux_amp, 1, --_--]

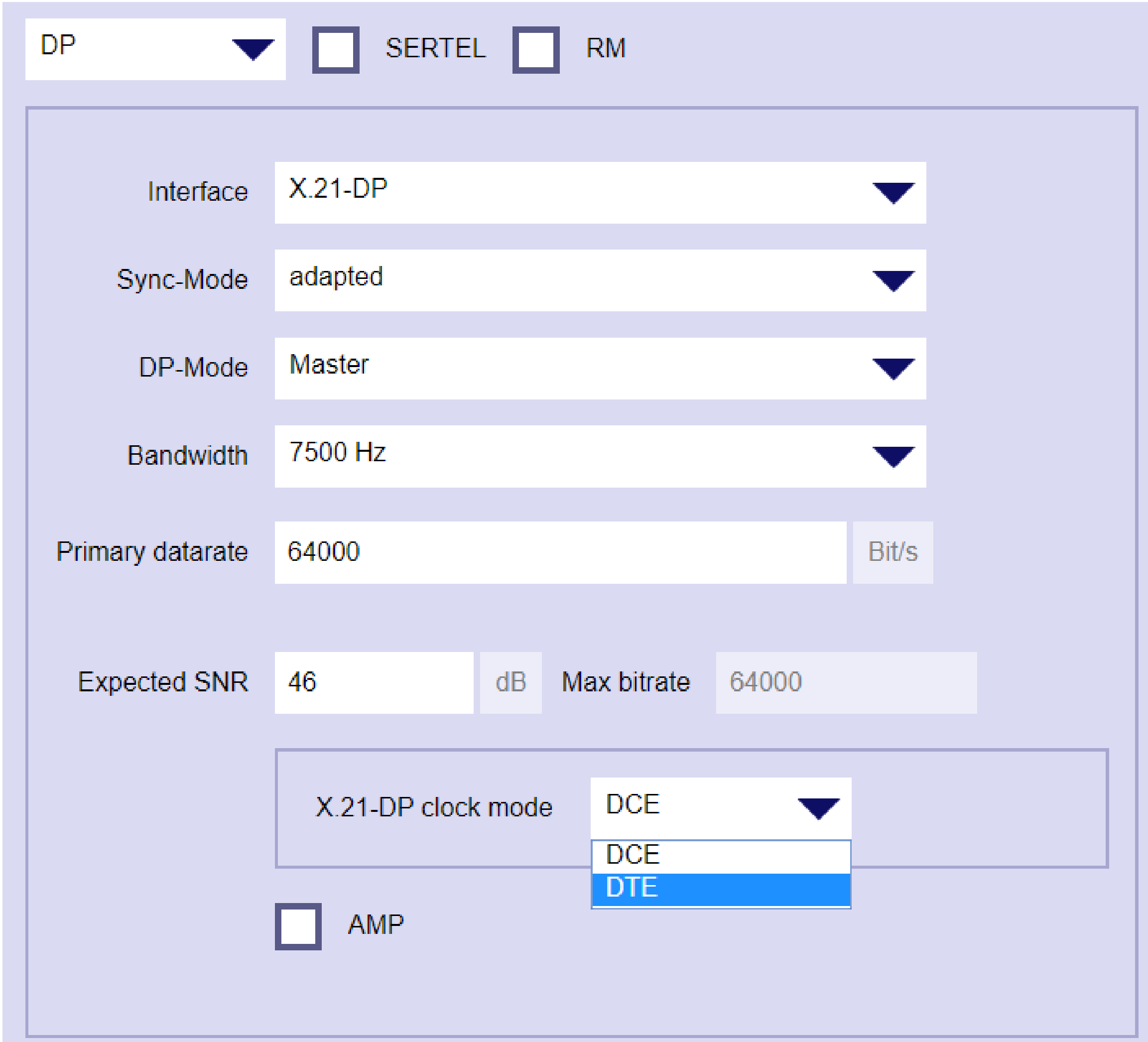
Figure 3-97 Configuration of iSWT 3000 in AMP mode and RM channel

NOTE

The transmission of protection signals interrupts the Data Pump and with it the iMUX function!

3.15.2 Synchronous Interface X.21-DP

With the service Data Pump DP also a synchronous interface X.21 for connecting an external multiplexer is available in case the vMUX is not equipped. In this mode the iMUX can't be used.



[sc_service_dp_X21, 1, --_--]

Figure 3-98 Configuration of the DP for connecting an external multiplexer via X.21-DP interface

Table 3-60 Setting options for the Data Pump with X.21-DP interface

Adjustment	Setting options	Remarks
Interface	X.21-DP	Synchronous interface for connection of an external multiplexer
Sync-Mode	adapted	**Optimized connection** between the 2 Data Pumps with best adaptation to the transmission path.
	dynamic	Fallback bit rate for adverse weather conditions. **Highest availability**! (Must be enabled in the dongle)
DP Mode	Master Slave	Adjust the other DP to Slave Adjust the other DP to Master
Bandwidth	3500 – 31 500 Hz	
Data rate	9600 up to 320 000 bps	Normal data rate in sync mode adapted.

Adjustment	Setting options	Remarks
Primary data rate	10 000 up to 320 000 bps	Normal data rate in sync mode optimized. The primary data rate **can't be higher adjusted** than the **bit rate calculated** with the bit rate estimation
Secondary data rate	9600 up to 288 000 bps	Fallback data rate only adjustable in sync mode dynamic. When the DP is working with the **secondary data** rate the **DPALR** is activated

Table 3-61 Lower Data Pump Data Rate depending on Data Pump Bandwidth

Data Pump	Bandwidth [kHz]	min. lower Data Rate [bps]
	> 7.5	9 600
	11.5	14 400
	15.5	20 000
	23.5	32 400
	31.5	44 000

Table 3-62 Additional setting options for the X.21-DP interface

Adjustment	Setting options	Remarks
X.21-DP clock mode	DCE	The clock is provided for the connected multi-plexer. **This adjustment is necessary for the DP synch. mode dynamic** !
	DTE	The clock is expected from the connected MUX. (Only for DP Master adjustable).

3.15.3 Synchronous Interface G703.1-DP

With the service Data Pump DP also a synchronous interface G703.1 for connecting an external multiplexer with a G703.1 interface is available in case the vMUX is not equipped. In this mode the **iMUX can't be used**.

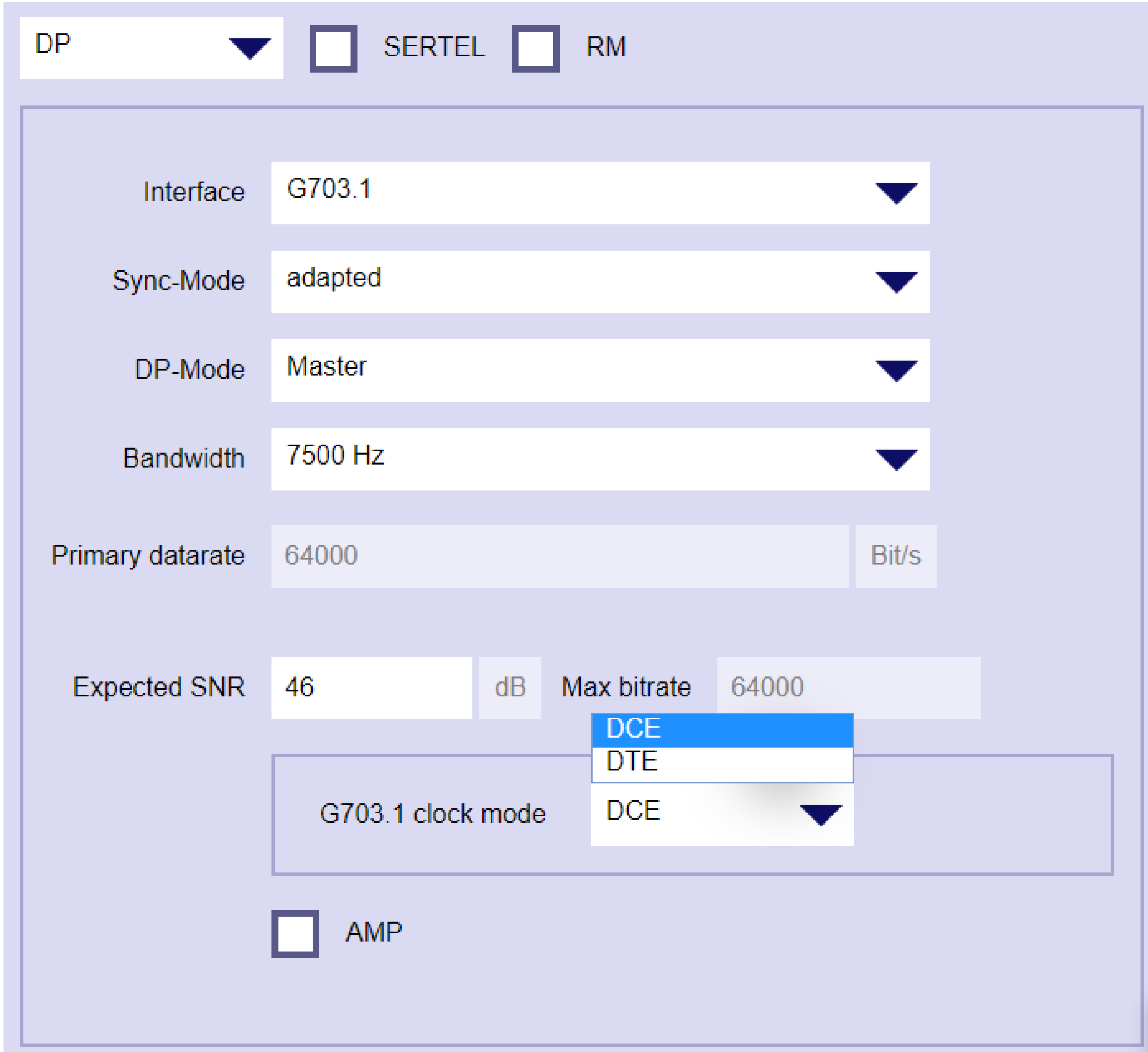


Figure 3-99 Configuration of the DP for connecting an external multiplexer via G703.1-DP interface

Table 3-63 Setting options for the Data Pump with G703.1-DP interface

Adjustment	Setting options	Remarks
Interface	G703.1	Synchronous interface for connection of an external multiplexer
Sync-Mode	adapted	**Optimized connection** between the 2 Data Pumps with best adaptation to the transmission path.
	dynamic	not available
DP Mode	Master	Adjust the other DP to Slave
	Slave	Adjust the other DP to Master
Bandwidth	3500 – 31 500 Hz	Minimum 6500 Hz required for Data rate 64000 bps
Data rate	64 000 bps	Fixed data rate in sync mode adapted.

Table 3-64 Additional setting options for the G703.1-DP interface

Adjustment	Setting options	Remarks
G703.1 clock mode	DCE	The clock is provided for the connected multi-plexer.
	DTE	The clock is expected from the connected MUX. (Only for DP Master adjustable).

3.15.4 Ethernet Multiplexer EMUX

PowerLink together with the EMUX offers 2 possibilities to transmit Ethernet TCP/IP data.

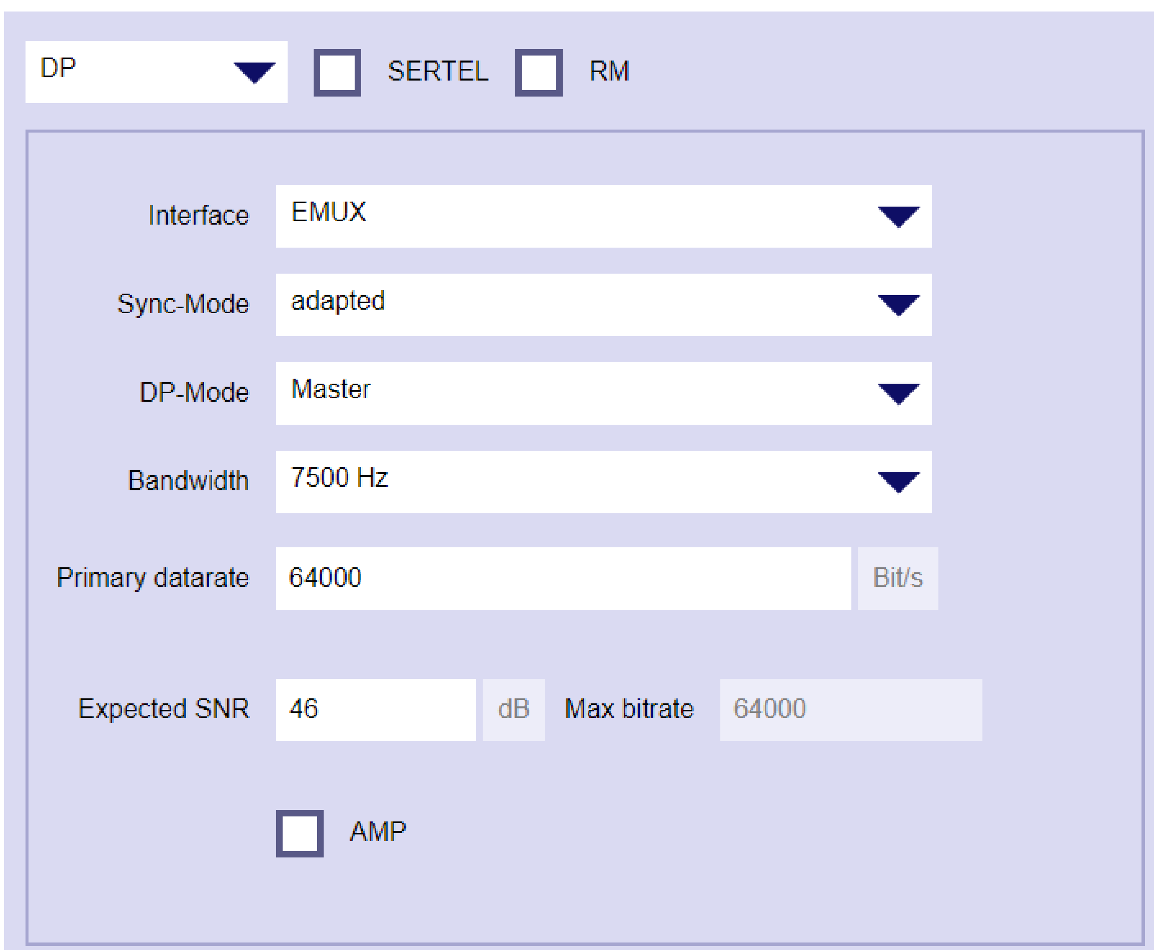
- PowerLink is transmitting Ethernet TCP/IP data via the Data Pump only. ("Ethernet bridging")
- TCP/IP data is multiplexed with the vMUX data and transmitted via the Data Pump.

System Configuration

VFx modules are not necessary, iSWT 3000 can be used additionally for transmitting teleprotection signals in the alternate multi purpose mode.

For the transmission via the high voltage line the **service Data Pump (DP)** is used. In this case the **X.21-DP resp. the G703.1-DP interface of the PowerLink is not available**. Connection of an external MUX to this interfaces will disturb the PowerLink function!

The corresponding service configuration is shown in the figure below:



[sc_service_EMUX, 1, --_--]

Figure 3-100 Configuration of the service Data Pump with EMUX

Setting Options for the Data Pump

The setting options for the Data Pump like Sync-Mode, DP-Mode, Bandwidth, Primary data rate resp. Secondary data rate (in case of sync mode dynamic) are shown in the table below:

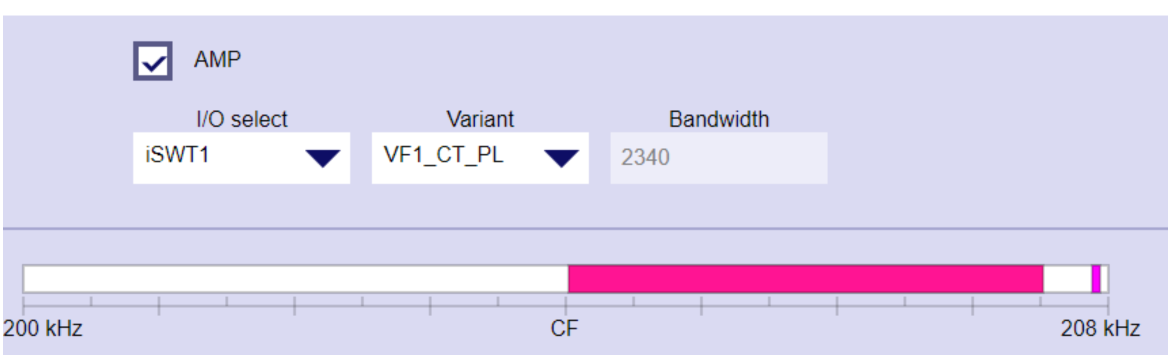
Table 3-65 Setting options for the Data Pump with vMUX connection

Adjustment	Setting options	Remarks
Interface	EMUX	
Sync-Mode	adapted	**Optimized connection** between the 2 Data Pumps with best adaptation to the transmission path.
	dynamic	Fallback bit rate for adverse weather conditions. **Highest availability**! (Must be enabled in the dongle)
DP Mode	Master	Adjust the other DP to Slave
	Slave	Adjust the other DP to Master
Bandwidth	3500 – 31 500 Hz	
Data rate	9600 up to 320 000 bps	Normal data rate in sync mode adapted.
Primary data rate	10 000 up to 320 000 bps	Normal data rate in sync mode dynamic. The primary data rate **can't be higher adjusted** than the **bit rate calculated** with the bit rate estimation.
Secondary data rate	9600 up to 288 000 bps	Fallback data rate is only adjustable in sync mode dynamic. When the DP is working with the **secondary data** rate the **DPALR** is activated.

Table 3-66 Lower Data Pump Data Rate depending on Data Pump Bandwidth

Data Pump	Bandwidth [kHz]	min. lower Data Rate [bps]
	> 7.5	9 600
	11.5	14 400
	15.5	20 000
	23.5	32 400
	31.5	44 000

Additional the teleprotection with integrated SWT 3000 in AMP mode. (refer also to Chapter *Alternate Multi Purpose Operation with DP*) and the transmission of remote monitoring channel RM is possible.



[sc_service_dp_imux_amp, 1, --_--]

Figure 3-101 Configuration of iSWT 3000 in AMP mode and RM channel

NOTE

The transmission of protection signals interrupts the Data Pump and with it the EMUX function!

3.15.5 Dynamic DP 5 steps

Dynamic Data Pump with 5 steps provides one primary data rate and up to four secondary data rates. The primary data rate is able to transmit all configured services as of today. The secondary data rate can only transmit service of dedicated priority. When DP is working with one of the secondary data rates the DPALR (DP Alarm) is activated. In normal case and after restart the Data Pump is working always with the primary data rate.

The interface type for the above mentioned function must be vMUX or X.21-DP.

Setting the Service Configuration

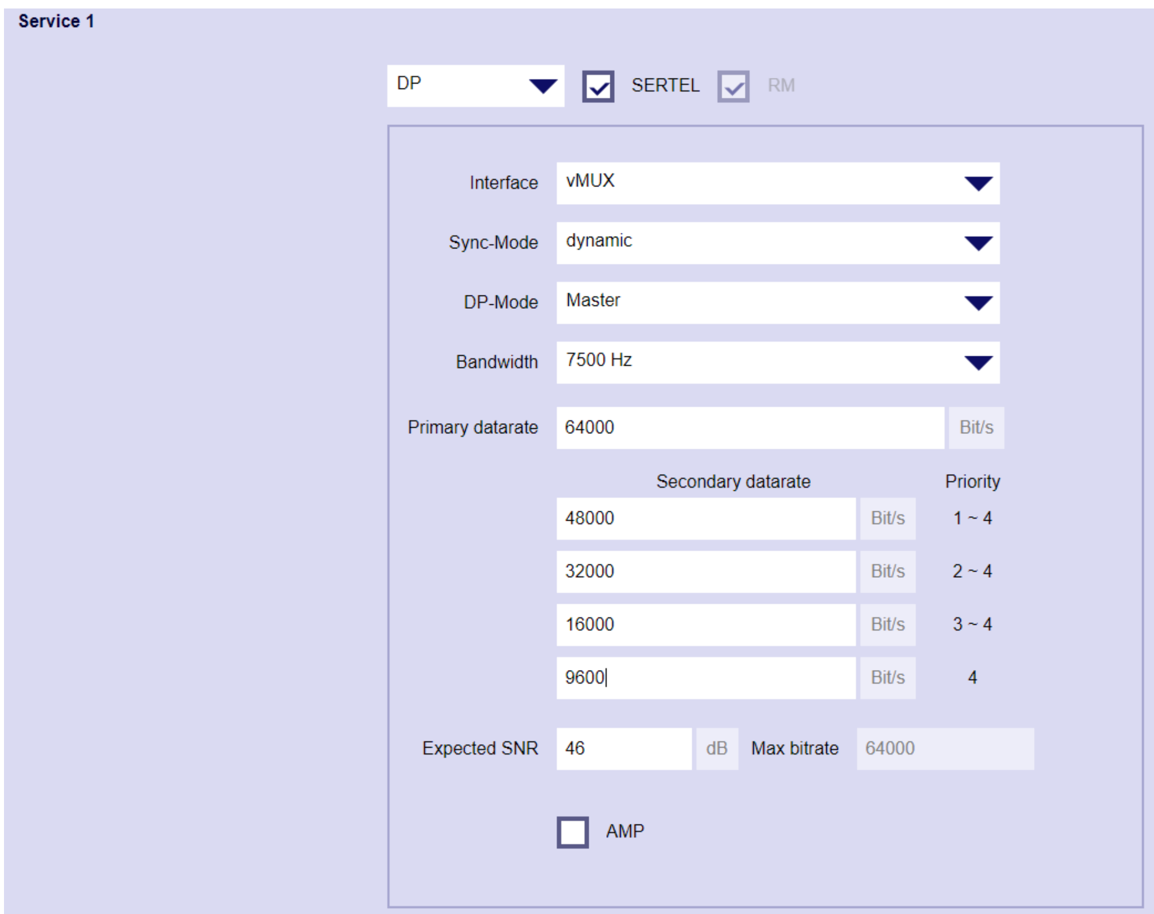


Figure 3-102 Dynamic DP with 5 steps

When adjusting DP sync-mode to dynamic, a primary and maximum of four secondary data rates can be adjusted. The minimum valid data rate depends on DP bandwidth, see table below.

0 Bit/s means the step is not used. It is not possible to have a gap in the secondary rates set to 0. In the default setting, secondary data rates 2, 3, 4 are not configured.

The primary data rate can't be adjusted higher than the bit rate calculated with the bit rate estimation.

The restriction for next step data rate setting is that the DP must gain 6dB SNR with less data rate to transmit, which is controlled by PowerSys.

The down switch resp. up switch criterias are depending on 2 adjustments:

The up switch after T-up (range 10 to 60 minutes in steps of 1 minute).

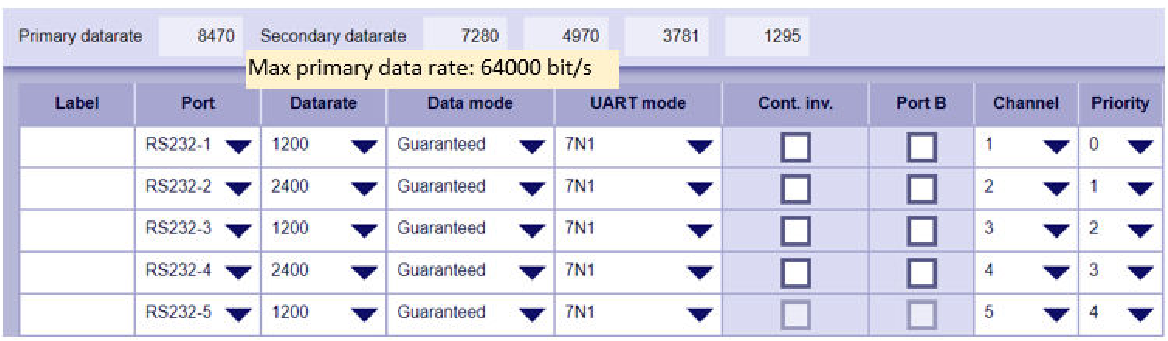
If the DP is working with one of the secondary data rate and the SNR for a higher configured data rate is available for the adjusted T-up time it will switch up to the available data rate.

The down switch after an adjustable time without sync or after sync fail counter (range 1 to 10 minutes in steps of 1 minute).

If this is exceeded the DP will switch down to the next step data rate (if the next step data rate is valid).

vMUX configuration

The configuration of the vMUX is carried out in the form "Configuration - vMUX -Channel setup



[sc_configuration_vMUX_channel_setup, 2, --_--]

Figure 3-103 Configuration of vMUX

The vMUX has a priority management. Selection of priority is only possible when DP sync mode is dynamic!

Each vMUX channel can be dedicated to a priority. Priority 0 is the lowest, and it can only run in the primary data rate. If the DP data rate reduces to next step, data with priority 0 cannot be transmitted. Priority 4 is the highest. It is recommended to assign a higher priority to urgent data so that it can be transmitted at even bad line condition. The allocated data displayed in the toolbar shall not exceeding the max value.

Priority for dynamic DP 5 steps

Priority	Remark
0	data can only be transmitted in primary data rate
1	data can be transmitted in primary data rate, or secondary data rate 1
2	data can be transmitted in primary data rate, or secondary data rate 1 / 2
3	data can be transmitted in primary data rate, or secondary data rate 1 / 2 / 3
4	data can be transmitted in primary data rate, or secondary data rate 1 / 2 / 3 / 4

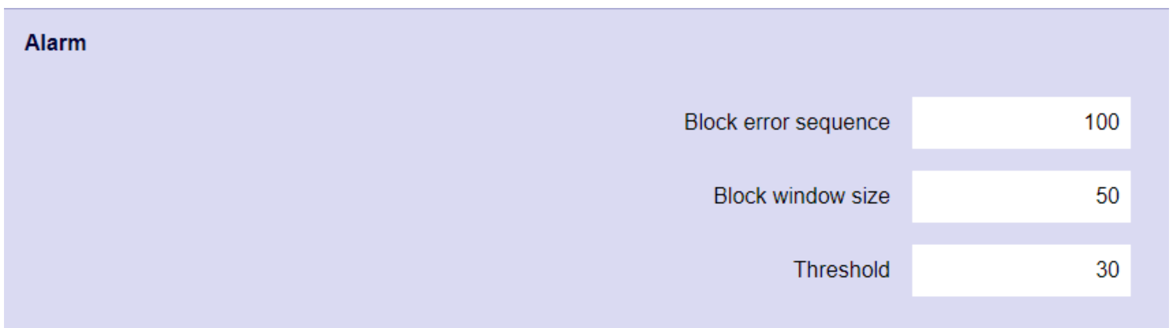
The priority settings for all vMUX channels are similar.

3.15.6 Supervision of the Transmission Line with the Data Pump

Alarm Configuration

Each transmission error is recognized in the Data Pump as a block error. The block error rate is supervised continuously serving the criteria for restart with regard to:

- a number of continuous following errored blocks. This is recognized as loss of the transmission channel and a restart is executed. The adjustment is made in the menu <**Configuration - DP - Alarm**> **Block error sequence**
- the increase of block error rate without attention of impulse noise. A restart is executed. The adjustment is made in the menu <**DP**>/<**Alarm**> **Block window size** and **Threshold**. The number of blocks which have to be supervised is adjusted with "Block window size" and the number of errored blocks per window with "Threshold". If the threshold is exceeded in **3 successive windows** a restart of the Data Pump is executed



[sc_configuration_dp_alarm, 1, --_--]

Figure 3-104 Data Pump alarm configuration

Example for the Alarm Setting

Block error sequence = 100

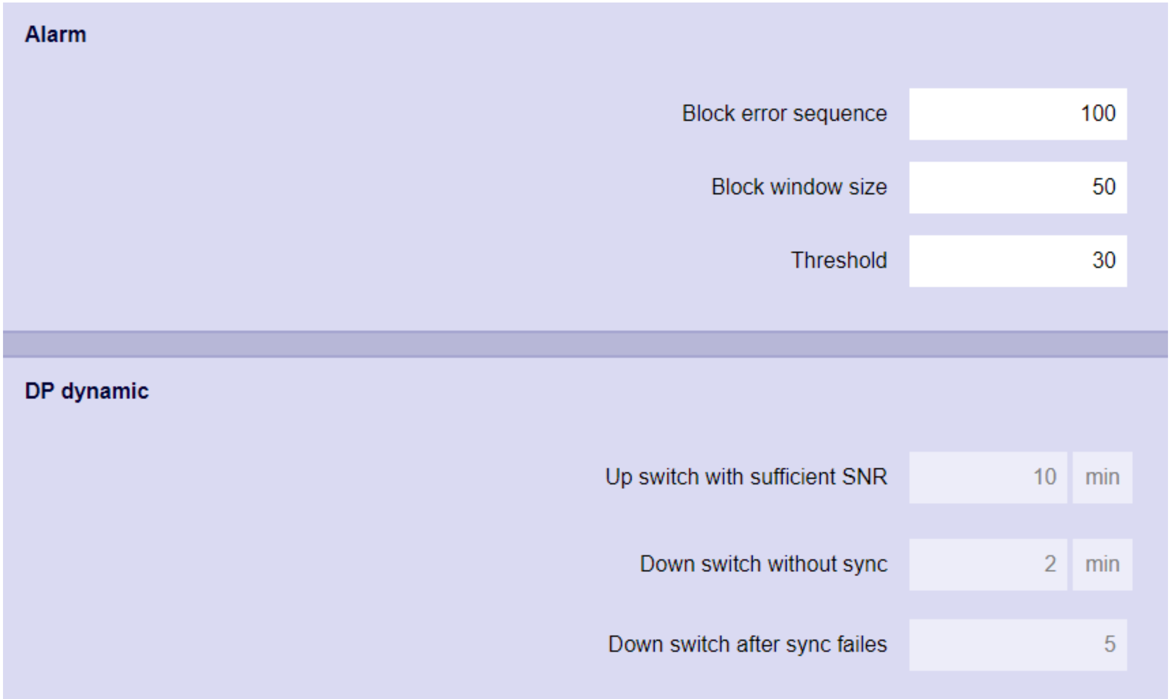
more than 1**00 blocks defective in sequence** (short disturbers) will cause a Restart. The duration of a block depends on the bandwidth of the DP (15 ms for 7.5 kHz and 8 kHz; 22.5 ms for 5 kHz). A new synchronization is carried out after 100 * 15 ms (in case of 8 kHz bandwidth), that means after a disturbance from 1.5 s duration.

1.5 s is the maximum bypass time for a disturbance. Higher values for the block error sequence are not sensible. Normally the restart is already carried out due to the second criterion:

Block window size = 50 and the Threshold = 30

With this adjustment 50 blocks are permanent supervised. If more than 30 of the 50 blocks mentioned before are faulty in **3 successive windows** in any sequence (ratio 90 : 150 = 0.6) a new start is carried out. The ratio between block error rate and bit error rate is about 100:1. The threshold for the new start corresponds to a bit error rate of 0.6 / 100 = $6*10^{-3}$

Adjustments for the Sync-Mode Dynamic



[sc_configuration_dp, 1, --_--]

Figure 3-105 Setting options for the sync-mode dynamic

When adjusting the sync-mode to “dynamic” a “primary” and a “secondary” data rate can be adjusted. In normal case and after restart the Data Pump is working always with the “primary” data rate.

The down switch resp. up switch criteria are depending on 2 adjustments:

- **The up switch after T-up** (range 10 to 60 minutes in steps of 1 minute).

If the DP is working with the **secondary** data rate and the SNR for the primary data rate is available for the adjusted **T-up time** it will change back to the primary data rate.

- **The down switch**
  after an adjustable time without sync or
  after sync fail counter (range 1 to 10 in steps of 1).

Here the number of sync failures resp. sync aborts is defined which occur in the supervisory time fixed in the first (T-up) adjustment.

If this is exceeded and the DP is working with the **primary** data rate it will change to the secondary data rate.

NOTE

When the **DP** is adjusted to the **dynamic** sync mode, the connected **multiplexer** must be adapted to the primary resp. secondary data rate. Therefore the X.21 interface of the multiplexer has to be set to **DTE** mode.

When the DP is working with the **secondary data** rate the **DPALR** is activated!

3.16 The Versatile Multiplexer vMUX

3.16.1 Overview

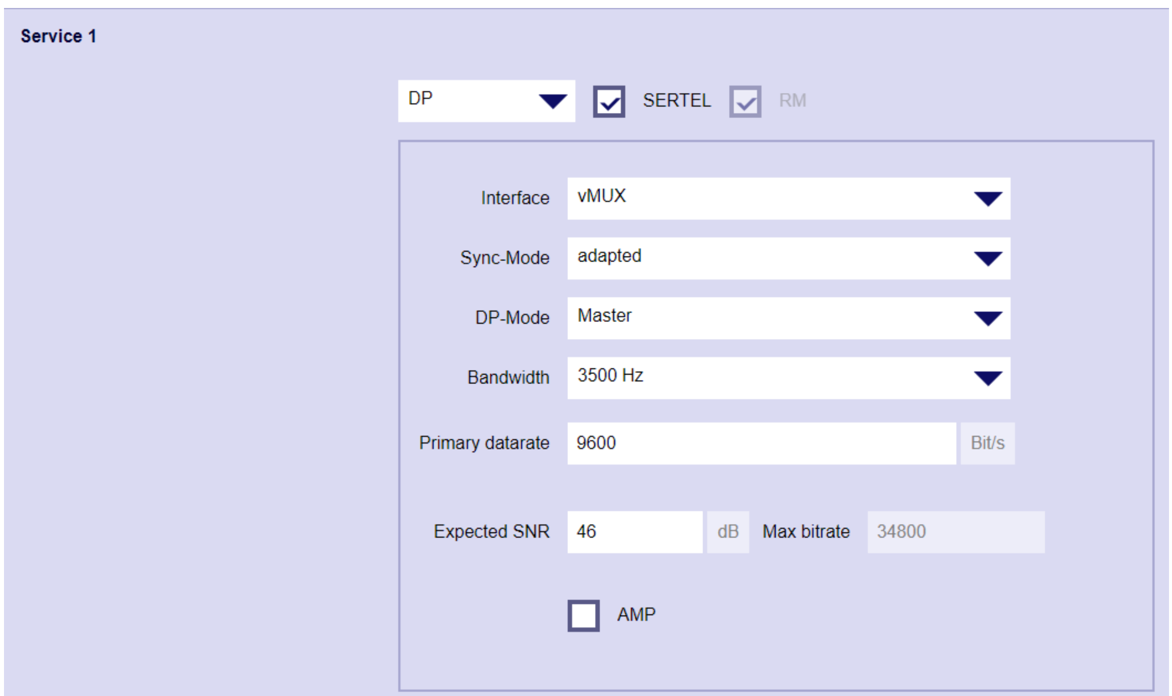
The vMUX makes it possible for PowerLink to compress speech, process data services, multiplex speech and different data services (including Ethernet) and transmit them via PLC.

The vMUX is a separate module and located in the PowerLink carrier frequency section CFS-2 (refer also to the chapter *System Description* of this manual).

3.16.2 System Configuration

For the transmission via the high voltage line the **service Data Pump (DP)** is used. In this case the **X.21-DP interface resp. the G703.1-DP interface of the PowerLink is not available**. Connection of an external MUX to this interfaces will disturb the vMUX function!

The corresponding service configuration is shown in the figure below:



[sc_service_dp_vmux, 1, --_--]

Figure 3-106   Configuration of the service Data Pump with vMUX

3.16.3 Setting Options for the DP

The setting options for the Data Pump like Sync-Mode, DP-Mode, Bandwidth, Primary data rate resp. Secondary data rate (in case of sync mode dynamic) are shown in the table below:

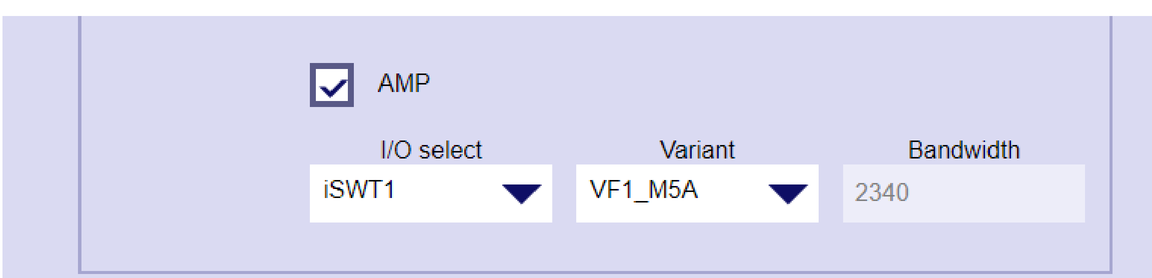
Table 3-67 Setting options for the Data Pump with vMUX connection

Adjustment	Setting options	Remarks
Interface	vMUX	
Sync-Mode	adapted	**Optimized connection** between the 2 Data Pumps with best adaptation to the transmission path.
	dynamic	Fallback bit rate for adverse weather conditions. **Highest availability!** (Must be enabled in the dongle)
DP Mode	Master	Adjust the other DP to Slave
	Slave	Adjust the other DP to Master
Bandwidth	3500 – 31 500 Hz	
Data rate	9600 up to 256 000 bps	Normal data rate in sync mode adapted.
Primary data rate	10 000 up to 256 000 bps	Normal data rate in sync mode dynamic. The primary data rate **can't be higher adjusted** than the **bit rate calculated** with the bit rate estimation.
Secondary data rate	9600 up to 224 000 bps	Fallback data rate is only adjust-able in sync mode dynamic. When the DP is working with the **secondary data** rate the **DPALR** is activated.

Table 3-68 Lower Data Pump Data Rate depending on Data Pump Bandwidth

Data Pump	Bandwidth [kHz]	min. lower Data Rate [bps]
	> 7.5	9 600
	11.5	14 400
	15.5	20 000
	23.5	32 400
	31.5	44 000

Additional the teleprotection with integrated SWT 3000 in AMP mode (refer also to *Alternate Multi Purpose Operation with DP* and the transmission of remote monitoring channel RM is possible.



[sc_service_dp_vmux_amp, 1, --_--]

Figure 3-107 Configuration of iSWT 3000 in AMP mode

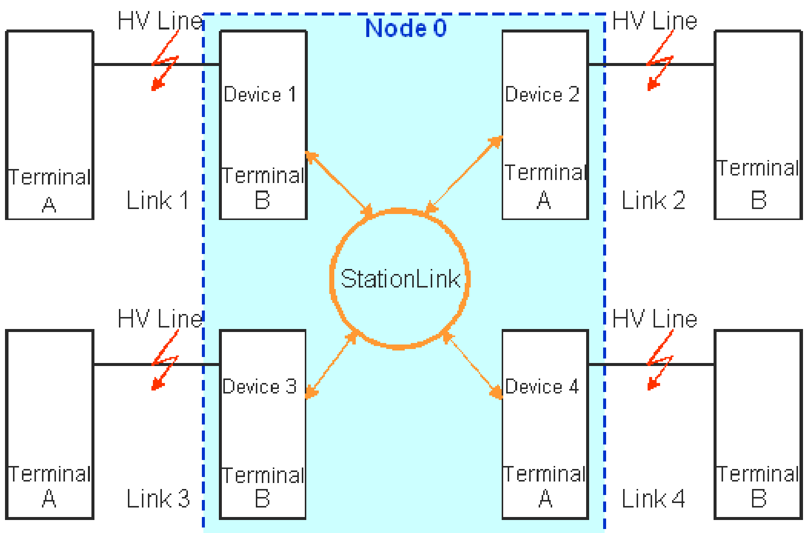
NOTE

The transmission of teleprotection signals interrupts the Data Pump and with it the vMUX function!

3.16.4 vMUX and Station Link

3.16.4.1 Overview

The StationLink SL is a 2 wire bus system. It provides the routing of vMUX voice and data channels between max. 4 PowerLink 50/100 equipments in 1 substation each with up to 16 user channels.



[loslm4pl-110111-01.tif, 1, en_US]

Figure 3-108 StationLink with max 4 PowerLink 50/100 in 1 substation

Terminal A resp. B	PowerLink50/100 with vMUX
Link 1 . . 4	PLC links
HV Line	High voltage line
Node 0	StationLink

The figure above shows 4 PLC links (Link 1 – 4) with the terminals A and B which are connected to a StationLink in 1 substation. This StationLink is defined in a node number (0...1023). The connected PowerLink systems in this node are defined with device 1 up to device 4.

The maximum SL device distance is 30 m. The max. distance between PowerLink SL connector and Station Link bus is 3 m. Use **screened cables**!

NOTE

For more details of the PowerLink connector panel and the pin assignment of the StationLink connector refer to the chapter *Installation* in this manual.

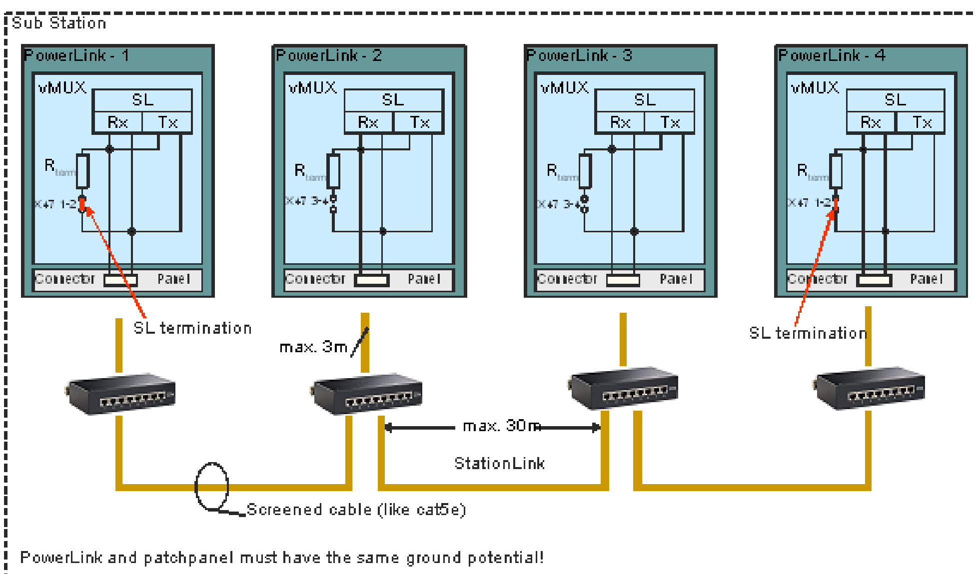
3.16.4.2 StationLink Termination

The StationLink bus must be terminated on both ends (in 2 PowerLink equipment). Refer also to *Figure 3-109*. For this purpose a termination resistance Rterm is available which is located on the vMUX board. It has to be activated with jumper X47.

[tdljpx47-011210-01.tif, 1, en_US]

Figure 3-109 Location of the jumper X47 on the vMUX for activating the SL termination resistance

Jumper position X47	Function
1-2	StationLink terminated
3-4	StationLink not terminated Park position (default setting)
5-6	Not used



[cdsl4p51-011210-01.tif, 1, en_US]

Figure 3-110 StationLink with 4 PowerLink 50/100

3.16.4.3 vMUX Station Address Form

For **each** PowerLink 50/100 which is connected to a StationLink the

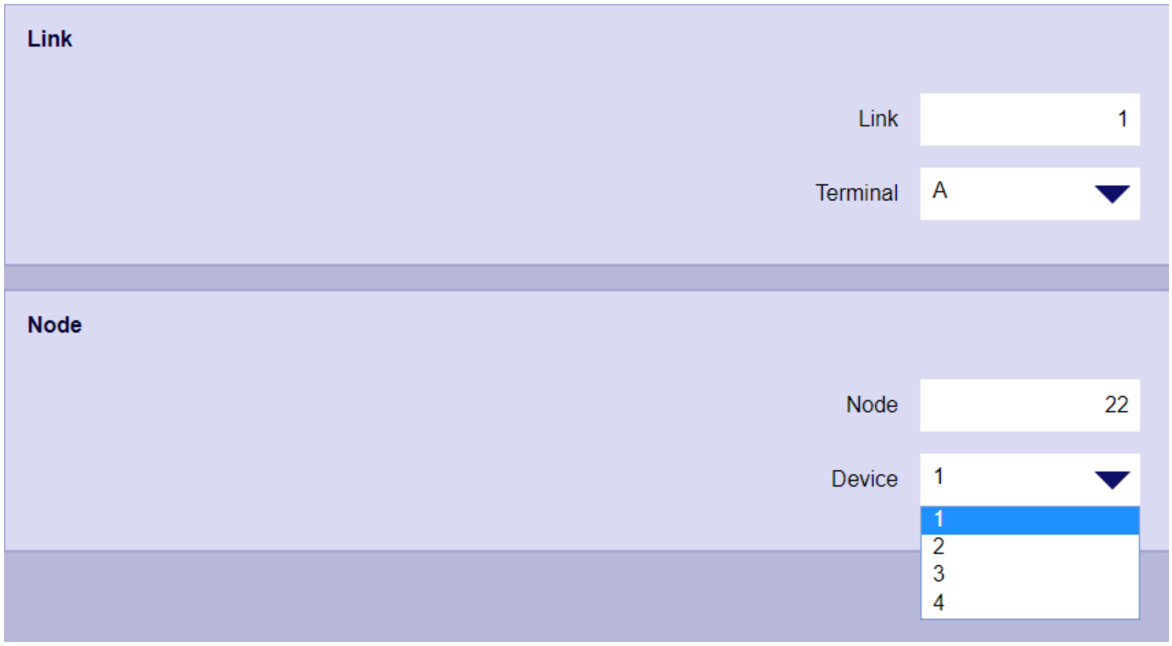
Link settings: Link (0 to 2047), Terminal (A resp. B)

and the

Node settings: Node (number 0 to 1023); Device (1 to 4)

have to be defined in the vMUX Station Address form. For more details refer to *Figure 3-108*

The Link settings are optional. The Node settings are needed for identification of the PowerLink in the PLC network.



[sc_vmux_station_address, 1, --_--]

Figure 3-111 The vMUX Station Address form

NOTE

The settings are only required when a routing of voice and data channels between several PowerLink systems via SL is requested.

After the vMUX station address is defined continue with the configuration of voice and data channels as described subsequently.

3.16.5 vMUX Configuration for Asynchronous Data

3.16.5.1 vMUX Channel Setup - RS232

The configuration of the vMUX is carried out in the form <**Configuration – vMUX – Channel Setup**>.

Label	Port	Datarate	Data mode	UART mode	Cont. inv.	Port B	Channel	Priority
RS232-Ch1	RS232-1	19200	Guaranteed	8N1	☐	☐	1	1
RS232-Ch2	RS232-2	9600	IEC-101	7N1	☐	☐	2	2
RS232-Ch3	RS232-3	38400	Best effort	7E1	☐	☑	3	3
	---	---	---	7N1	☐	☐	---	0
	---	---	---	7N1	☐	☐	---	0
	---	---	---	7N1	☐	☐	---	0
	---	---	---	7N1	☐	☐	---	0
	---	---	---	7N1	☐	☐	---	0

[sc_vmux_channel_rs232, 1, --_--]

Figure 3-112 Configuration of asynchronous data channels local ports via vMUX

The vMUX has an priority management. Channels with activated priority (Prio ☑) **may not exceed the secondary data rate of the DP**. Then the transmission of this channels is guaranteed.

Selection of priority is only possible in the **Data Pump sync. mode is set to dynamic**!

Devices which are connected to the RS232-**1B** up to RS232-**4B** ports (e.g. RTU in polling mode) must **activate a RTS** signal (positive voltage) for **data transmission**! In this case the "Port B" check box has to be activated! Instead of a voltage a contact can be used for activating the RTS signal. It has to be connected to pin 19 resp. 25 of the SUB-D socket. RTS is activated when the contact is connected to GND. The contact can be inverted with activating the "Cont. inv." ☑ at the corresponding channel (ref. to the figure above).

For data mode adjustment "**best effort**" resp. transmission **without "Prio**" use in case of RS232-**1 up to 4** interfaces the **B ports!**. In this case the "Port B" check box has to be activated!

Setting Options for the Asynchronous Data Transmission via vMUX:

Table 3-69 Setting options for async. data channels

Adjustment		Setting options	Remarks
Local Port	Label	Identifier	Enter here a name (abbreviation) for identification of the data channel.
	Port	RS232-1 up to 8 *)	Devices which are connected to the RS232-1B up to RS232-4B ports must activate the RTS signal for data transmission
	Data rate	300, 600, 1200, 2400, 4800, 9600 , 19 200, 38 400, 57 600 resp. 115 200 bps	
	Data Mode	Guaranteed	**G**uaranteed **c**hannel: The channel is always transmitted
		IEC-101	The channel is always transmitted and is designed for connection of RTU's transmitting IEC messages
		Best effort	**Not guaranteed** channel. This channel is only transmitted if the transmission capacity is available. Use in case of RS232-**1 up to 4** interfaces the **B ports**
	UART Mode	7N1, 7N2, 7E1, 7E2, 7O1, 7O2, 8N1, 8N2, 8E1, 8E2, 8O1 resp. 8O2 (data bits, parity, stop bits).	UART mode of the connected RTU
	Cont. inv.	☐	Not checked Contact connected to GND activates RTS signal
		☑	Checked Open contact activates RTS signal (Contact: RS232_xR_Contact; refer to Chapter *Installation* RS232 interfaces)
	Port B	☐	Port B not used
		☑	Port B connected
Power Line	Channel (Ch)	1 up to 16	Power Line transmission channel
	Prio	☑ = ON	Adjustment **only** possible if DP sync mode **dynamic** is activated. Channels with Priority are transmitted also with the secondary Data Pump bit rate.
		☐=OFF	Channels are only transmitted with the **primary** Data Pump bit rate. Use in case of RS232-**1 up to 4** interfaces the **B ports**

*) the actual number of data channels depends on the dongle settings

3.16.5.2 StationLink Connection for Multicast Function

In this form it is possible to define up to 3 devices connected to the StationLink for the multicast function.

Multicast for vMUX over SL means, that a RTU signal is not only sent to 1 SL target but to all which are selected. Normally in RTU mode there is a multiplexing between a local port and 1 SL port. If multicast is enabled, all SL targets are possible (for further details refer to chapter *System Description*).

Label	Channel	Priority	Dest. 1 dev.	Channel	Dest. 2 dev.	Channel	Dest. 3 dev.	Channel
RS232-Ch1	1	1	2	1	3	4	4	7
RS232-Ch2	2	2	2	5	2	---	2	---
RS232-Ch3	3	3	2	---	2	---	2	---
	0	0	2	---	2	---	2	---
	0	0	2	---	2	---	2	---
	0	0	2	---	2	---	2	---
	0	0	2	---	2	---	2	---
	0	0	2	---	2	---	2	---

[sc_stationlink_multicast, 1, --_--]

Figure 3-113 StationLink settings for the RTU in multicast mode

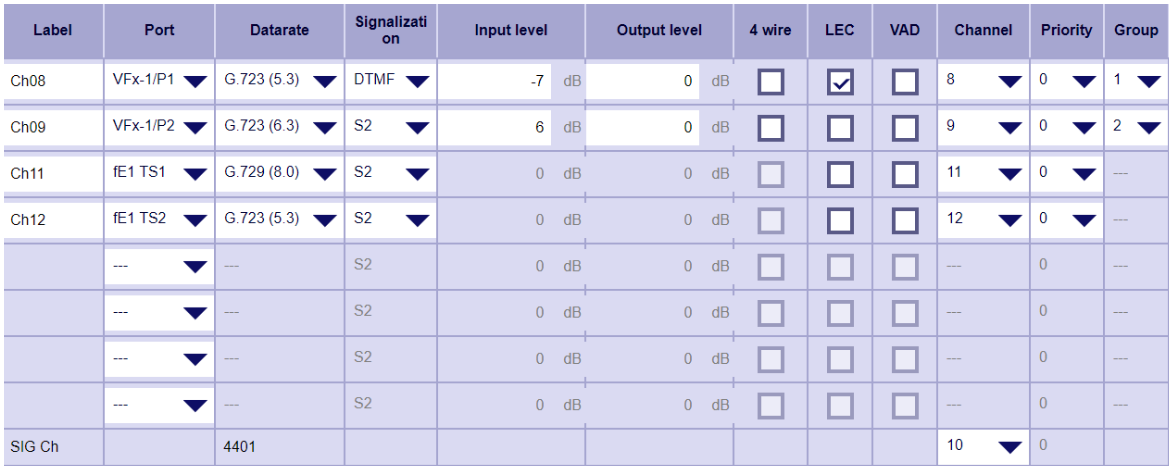
Table 3-70 Setting options for RS232 StationLink connection

SL-Connection	Adjustment	Setting options	Remarks
	Label	taken over from local port settings	Refer to *Figure 3-112*
	Ch	taken over from local port settings	Refer to *Figure 3-112*
	Prio	taken over from local port settings	Refer to *Figure 3-112*
	Dest (Dev.)	1 up to 4	Target device. The selectable devices depend on the setting of the vMUX station address
	Channel (Ch.)	1 up to 16	VL (vMUX link) transmission channel of the target device

3.16.6 Configuration Voice

3.16.6.1 vMUX Channel Setup - Voice

The interfaces for the analog voice channels are located on the VFx modules in the slot positions VFx-1 up to VFx-3. The connection of the voice channels is carried out via SUB-D plug sockets on the PowerLink connector panel. Via the modules in slot position 1 and 2 in each case 2 voice channels and via the module in slot position 3, 1 voice channel can be connected.

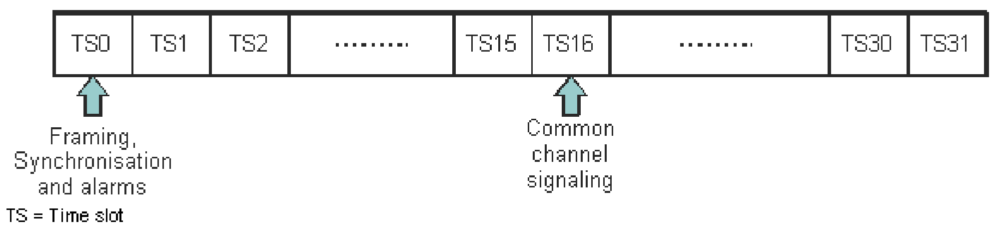


Label	Port	Datarate	Signalization	Input level	Output level	4 wire	LEC	VAD	Channel	Priority	Group
Ch08	VFx-1/P1	G.723 (5.3)	DTMF	-7 dB	0 dB	☐	☑	☐	8	0	1
Ch09	VFx-1/P2	G.723 (6.3)	S2	6 dB	0 dB	☐	☐	☐	9	0	2
Ch11	fE1 TS1	G.729 (8.0)	S2	0 dB	0 dB	☐	☐	☐	11	0	---
Ch12	fE1 TS2	G.723 (5.3)	S2	0 dB	0 dB	☐	☐	☐	12	0	---
	---	---	S2	0 dB	0 dB	☐	☐	☐	---	0	---
	---	---	S2	0 dB	0 dB	☐	☐	☐	---	0	---
	---	---	S2	0 dB	0 dB	☐	☐	☐	---	0	---
	---	---	S2	0 dB	0 dB	☐	☐	☐	---	0	---
SIG Ch		4401							10	0	

[sc_channel_vmux_voice, 1, --_--]

Figure 3-114 Configuration of voice channels via VFx modules

It is possible to transmit up to 8 voice channels (selectable time slots TS1 to TS15 resp. TS17 to TS31) from a 2 Mbps E1 frame of a digital telephone exchange. The exchange is connected via the fE1 interface on the PowerLink 50/100 connector panel.



[dwfe1frd-011210-01.tif, 1, en_US]

Figure 3-115 fE1 frame definition

For each fE1 channel an additional bit rate for the signaling channel has to be included in the required bit rate. The required bit rate for the signaling channel depending on the number of channels will be as follows calculated: 2400 * sum(3^(-n/6)).

n = 0 to k - 1 where k is the number of configured channels. The signaling data are transmitted via a separate vMUX channel which is created automatically from the service program.

Setting Options for Voice Channels via vMUX:

Table 3-71 Setting options for voice channels via vMUX

Adjustment		Setting options	Remarks
Lokal Port	Label	Identifier	Enter here a name (abbreviation) for identification of the voice channel.
	Port	VFx-1 module in slot 1 VFx-2 module in slot 2 VFx-3 module in slot 3	Via the modules in slot position 1 and 2 max. 2 voice channels and via the module in slot position 3 max. 1 voice channel can be connected. *)
		fE1 TS1 to TS15	Fractional E1 time slot 1 to 15 *)
		fE1 TS17 to TS31	Fractional E1 time slot 17 to 31 *)
	Data rate	G.723 5.3 Kbps G.723 6.3 Kbps G.729 8.0 Kbps	Type of voice compression
	Signalization	S2 DTMF MFC	Signaling of the voice channel
	Input level Output level	+20 up to -60 dB +14 up to -60 dB	Only valid for analog voice channels
	4 wire	☑	Only for VFM modules
		☐	VFM; VFS; VFO modules
	LEC	☑ ☐	Line echo canceller ON Line echo canceller OFF
	VAD	☑ ☐	Voice activity detection checked = active. For more details refer to *3.16.6.2 vMUX Adjustments for Voice Transmission*
Power Line	Ch (Channel)	1 up to 16	Power Line transmission channel
	Prio	☑ =ON	Adjustment only possible if DP sync mode **dynamic** is activated. Channels with Prio are transmitted also with secondary bit rate.
		☐ =OFF	Channels are only transmitted with the primary Data Pump bit rate
	Grp	--, 1, 2	Only for VFx voice channels. Serves for defining dynamic VFx channel groups. For more details refer to *3.16.6.2 vMUX Adjustments for Voice Transmission*

*) the actual number of voice channels depends on the dongle settings

3.16.6.2 vMUX Adjustments for Voice Transmission

Voice Activity Detection VAD

When the VAD check is activated the channel, a static channel, optimizes the bit rate when there is no speech transmission. That means, when no one is speaking the channel is transmitting a very low amount of “Best effort” data, but the channel is always reserved for voice.

Voice Groups

This is a group of configured voice channels (connected terminals/telephones) that are being transmitted through some common Power Line Channel. If no channel is active, nothing is being sent. If there is only 1 configured Power Line Channel and is being used, a second telephone would get the busy tone if it tries to make a call.

Both features are independent from each other.

Label	Port	Datarate	Signalization	Input level	Output level	4 wire	LEC	VAD	Channel	Priority	Group
Ch08	VFx-1/P1	G.723 (5.3)	DTMF	-7 dB	0 dB	☐	☑	☐	8	0	1
Ch09	VFx-1/P2	G.723 (6.3)	S2	6 dB	0 dB	☐	☐	☐	9	0	2
Ch11	fE1 TS1	G.729 (8.0)	S2	0 dB	0 dB	☐	☐	☐	11	0	---
Ch12	fE1 TS2	G.723 (5.3)	S2	0 dB	0 dB	☐	☐	☐	12	0	---
	---	---	S2	0 dB	0 dB	☐	☐	☐	---	0	---
	---	---	S2	0 dB	0 dB	☐	☐	☐	---	0	---
	---	---	S2	0 dB	0 dB	☐	☐	☐	---	0	---
	---	---	S2	0 dB	0 dB	☐	☐	☐	---	0	---
SIG Ch		4401							10	0	

[sc_channel_vmux_voice, 1, --_--]

Figure 3-116 Dynamic voice channels

It is not restricted to 1 active Power Line channel. For example, 5 VFx channels can be defined as a voice group using 3 Power Line Channels. The only restriction (because vMUX works only with 5 VFx channels) is the definition of up to 2 voice groups.

NOTE

All voice channel assigned to 1 group must have the **same** voice compression data rate!

3.16.7 vMUX Configuration for Synchronous Data Channels (X.21, Ethernet)

Synchronous User Interfaces X.21-1 / X21.2 and Ethernet Interface

The synchronous data interfaces X.21-1 resp. X.21-2 are located on the vMUX module. The connection of the data channels is carried out via 15-pin SUB-D plug sockets on the PowerLink connector panel.

Label	Port	Datarate	Master	Channel	Priority
Ch4	X.21-1	9600 bit/s	☐	4	0
Ch13	X.21-2	9600 bit/s	☐	13	0

[sc_channel_x21, 1, --_--]

Figure 3-117 Configuration of the synchronous data channels X.21 via vMUX

Table 3-72 Setting options for the synchronous data channels

Adjustment		Setting options	Remarks
Local Port	Label	Identifier	Enter here a name (abbreviation) for identification of the data channel.
	Port	X.21-1 X.21-2	15-pin SUB-D plug sockets for Synchronous user interface 1 resp. 2
	Data Rate	9600 up to 192 000 bps	
	Master	☑	**X.21 Clock Master**. For connection of several PowerLink routes via StationLink observe a Master-Slave sequence for the X.21 data channels
		☐	X.21 Clock Slave
Power Line	Channel (Ch)	1 up to 16	Power Line transmission channel
	Prio	☑	Adjustment only possible if DP sync mode **dynamic** is activated. Channels with Prio are transmitted also with secondary bit rate
		☐	Channels are only transmitted with the primary Data Pump bit rate

[sc_channel_ethernet, 1, --_--]

Figure 3-118 Configuration of the Ethernet channels via vMUX

Table 3-73 Setting options for the Ethernet channels

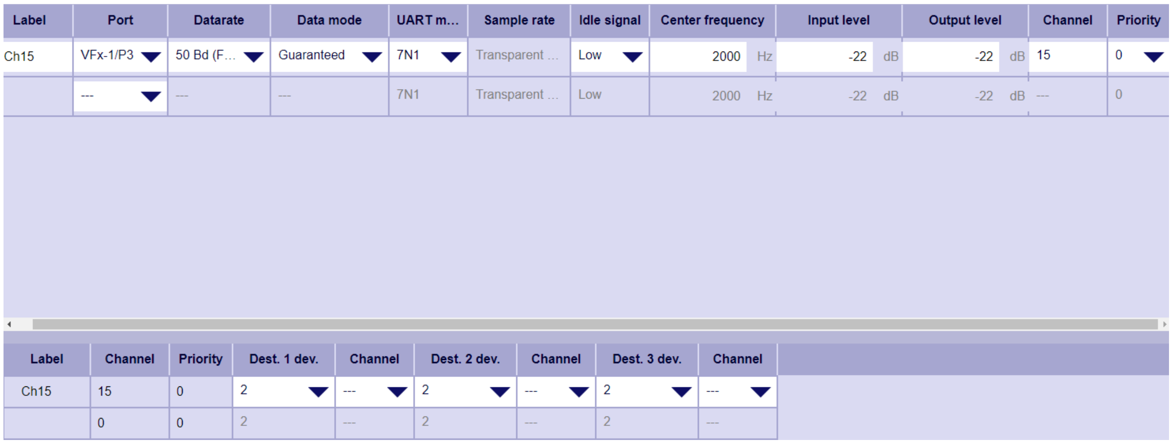
Adjustment		Setting options	Remarks
	Label	Identifier	Enter here a name (abbreviation) for identification of the data channel.
	Data rate	n.a.	Calculated by PowerSys. Depending on the available data rate of the Data Pump and the used data rate of the configured services, PowerSys provides the free data rate for TCP/IP transmission. In case of sync. mode dynamic, the available data rate is calculated for the primary as well as for the secondary data rate of the Data Pump.
Power Line	Channel (Ch)	1 up to 16	Power Line transmission channel
	Prio	☑	Adjustment only possible if DP sync mode **dynamic**is activated. Channels with Prio are transmitted also with secondary bit rate.
		☐	Channels are only transmitted with the primary Data Pump bit rate

3.16.8 Setting Options for rFSK Channels via vMUX

The rFSK function allows the transmission from analog FSK channels (e.g. from a RTU with integrated modem) via the PowerLink 50/100 vMUX.

The connection of the data channels is carried out via the port 2, 3 or 4 in VFx slot 1 or port 2 or 3 in VFx slot 2 using the SUB-D plug sockets on the PowerLink connector panel.

In case of using VFM, the connection of the data channels can also be carried out via the port 1 in all slots.



[sc_channel_rfsk, 1, --_--]

Figure 3-119 Configuration of the rFSK channels

NOTE

1 rFSK channel occupies 2 iFSK channels.

Table 3-74 Setting options for rFSK-1 resp. rFSK-2 channels

Adjustment	Setting Options	Remarks
Label	Identifier	Enter here a name (abbreviation) for identification of the rFSK channel.
Data rate	50 Bd (FM120) 100 Bd (FM240) 200 Bd (FM480) 50 Bd NB 100 Bd NB 300 Bd *) 600 Bd 1200 Bd 2400 Bd	Baud rate of the rFSK channel
Data Mode	guaranteed	**G**uaranteed **c**hannel: The channel is always transmitted
	IEC-101	The channel is always transmitted and is designed for connection of RTU’s transmitting IEC messages
	Transparent	The channel is transmitted without UART adjustment using a sample rate instead of that.
UART Mode	7N1, 7N2, 7E1, 7E2, 7O1, 7O2, 8N1, 8N2, 8E1, 8E2, 8O1 resp. 8O2 (data bits, parity, stop bits).	UART mode of the connected RTU. Only visible in the data mode guaranteed resp. IEC-101.
Sample rate	Transparent 1200 Transparent 2400 Transparent 4800 Transparent 9600 Transparent 19200	The Sample rate in bps is only visible in case of data mode “**Transparent**”

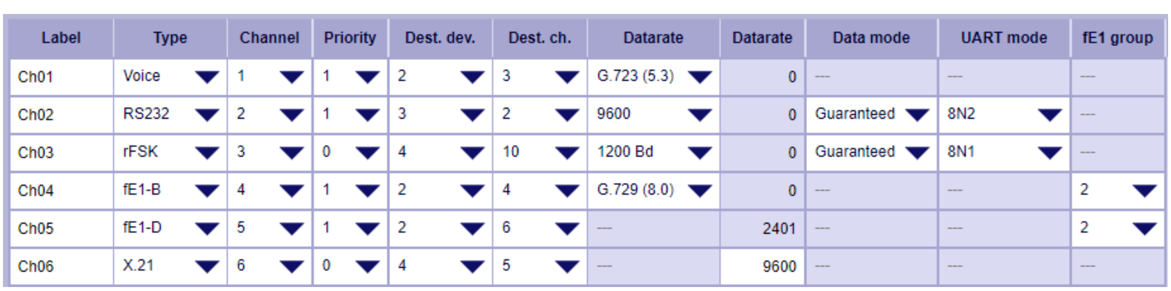
Adjustment	Setting Options	Remarks
Port	VFx-1/P2; VFx-1/P3; VFx-1/P4 VFx-2/P2; VFx-2/P3	VFx-1/P2 = VF module type x in slot 1 /Port 2 etc.
Center frequency	338 to 3763 Hz	Adjust here the **center** frequency of the connected analog FSK channel
Input level	+10 up to -60 dB	Adjust here the input resp. output level of connected analog FSK channel
Output level	+10 up to -60 dB	
Idle signal	High	Upper frequency in case of idle status
	Low	Lower frequency in case of idle status
Power Line Ch Prio		
Channel	1 up to 16	**vMUX** transmission channel
Prio	☑ =ON	Adjustment **only possible** if DP sync mode **dynamic** is activated.
	☐ =OFF	Channels with Prio are transmitted also with secondary bit rate.
SL-Conn. (Dest.) = StationLink Connection (Destination 1-3)		
Device (Dev.)	1 up to 4	PowerLink**device 1 to 4** defined in the **vMUX Station address settings** refer to *vMUX Station Address Form*
Channel (Ch.)	1 up to 16	Power Line transmission channel for this device

*) 300 Bd not available in transparent mode

3.16.9 Setting Options for the StationLink

In this forms the routing of voice and data channels between up to 4 PowerLink systems in 1 Node via StationLink is carried out.

Complete first the settings in the vMUX StationLink Address form.



Label	Type	Channel	Priority	Dest. dev.	Dest. ch.	Datarate	Datarate	Data mode	UART mode	fE1 group
Ch01	Voice	1	1	2	3	G.723 (5.3)	0	---	---	---
Ch02	RS232	2	1	3	2	9600	0	Guaranteed	8N2	---
Ch03	rFSK	3	0	4	10	1200 Bd	0	Guaranteed	8N1	---
Ch04	fE1-B	4	1	2	4	G.729 (8.0)	0	---	---	2
Ch05	fE1-D	5	1	2	6	---	2401	---	---	2
Ch06	X.21	6	0	4	5	---	9600	---	---	---

[sc_channel_stationlink, 1, --_--]

Figure 3-120 StationLink configuration

Enter first an identifier for the corresponding channel. Then select the type of service: Voice, RS232, rFSK, X.21, fE1-B (speech channel) resp. fE1-D (signaling channel).

After that you choose the routing of the channels via the StationLink within the connected Power Link, followed by the specification of the channels.

Table 3-75 Setting options for the StationLink

Adjustment	Setting Options	Remarks
Label	Identifier	Enter here a name (abbreviation) for identification of the service.
Type	Voice RS232 rFSK X.21 fE1-B fE1-D	Voice channel RS232 data rFSK data X.21 data fE1 signalization channel fE1 data channel
Power Line Ch Prio		
Channel	1 up to 16	**vMUX** transmission channel
Prio	☑ =ON	Adjustment only possible if DP sync mode **dynamic** is activated. Channels with Prio are transmitted also with secondary bit rate.
	☐ =OFF	Channels are only transmitted with the primary Data Pump bit rate.
SL-Conn. (Dest.) = StationLink Connection **(Destination 1-3)**		
Device (Dev.)	1 up to 4	PowerLink **device 1 to 4** defined in the **vMUX Station address settings** refer to *vMUX Station Address Form*.
Channel (Ch.)	1 up to 16	Power Line transmission channel for this device

You find a detailed description about the adjustments like data rate, data mode or UART for async. data *3.16.5.1 vMUX Channel Setup - RS232*, for voice *3.16.6.1 vMUX Channel Setup - Voice*, for sync. data *Synchronous User Interfaces X.21-x, Page 75*, for rFSK channels *3.16.8 Setting Options for rFSK Channels via vMUX*.

Detailed examples of using the StationLink for the channel routing of Point-to-Point and Point-to-Multipoint connections are provided in chapter *7.6 Examples of Using the vMUX and StationLink*.

NOTE

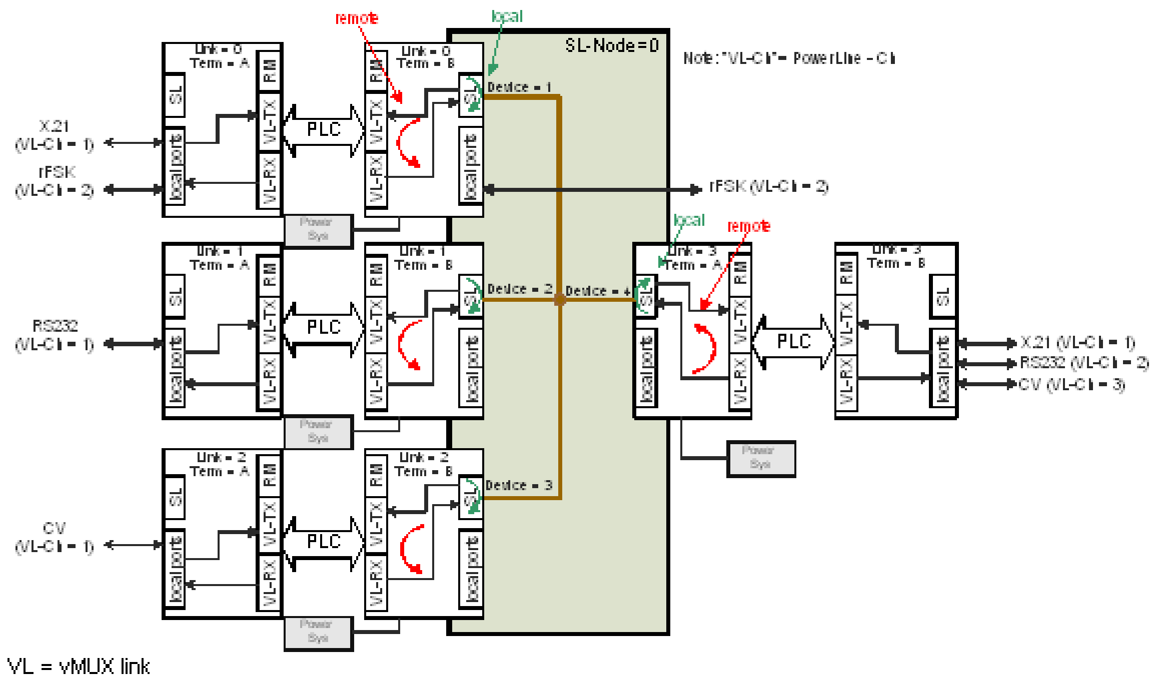
For transmission of a fE1 voice channel via StationLink the B- (signalization) channel as well as the D- (data) channel has to be configured in the setting options for the StationLink.

NOTE

Ethernet data is not transmitted via StationLink.

3.16.10 StationLink Test Loops

In the PowerLink command form it is possible to switch StationLink test loops (local loop resp. remote loop). The data traffic via StationLink is interrupted in this case.



[cdsltlpr-120813-01.tif, 1, en_US]

Figure 3-121 SL test loops principle

The test loops are activated in <**Test - Loop**>. The adjustments are taken over online.

[sc_test_stationlink_loop, 1, --_--]

Figure 3-122 StationLink loop settings

If "StationLink **local loop**" is selected the data are not sent to the StationLink but just back.

Example from *Figure 3-121*:

If **local loop** is selected in Device 1 the data of the X.21 channel are sent back to Terminal A Link 0

If StationLink **remote loop** is selected the received data are sent back with its own device address. In this case the corresponding device can receive the data and it is proved that the StationLink is working properly.

If **remote loop** is selected in Device 1 the data of the X.21 channel are sent back via the StationLink to Device 4 Terminal A.

In order to test several connections at the same time, the test loops are **not** automatically cancelled after the connection to the service PC is interrupted.

3.17 Protection Signaling iSWT

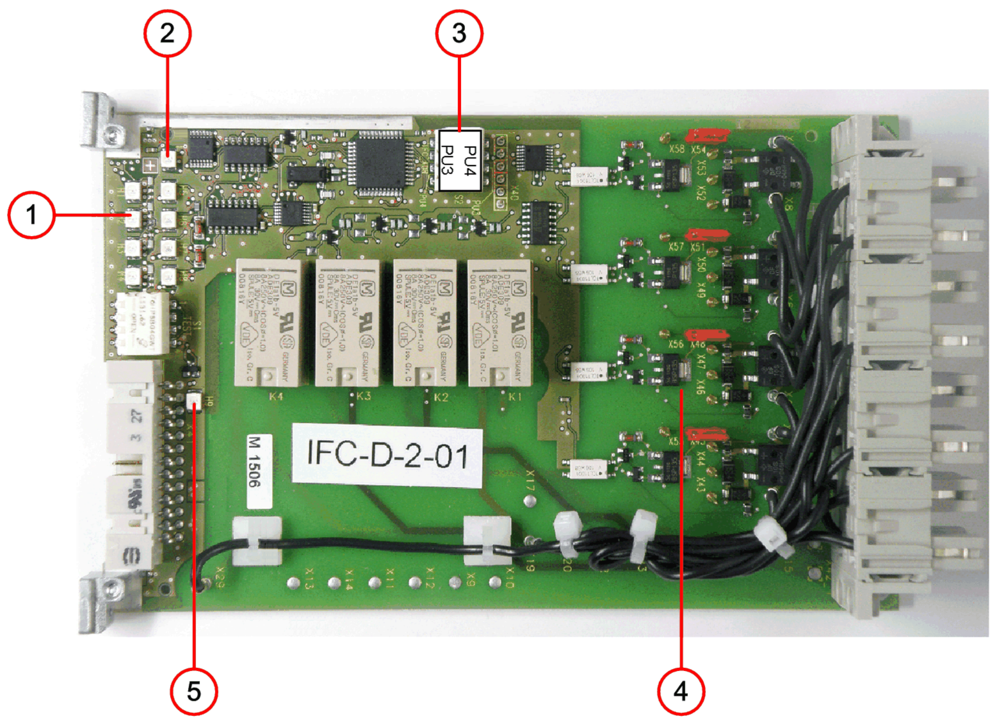
3.17.1 Jumper Settings for iSWT 3000 Modules

NOTE

The program SWTStraps can be used as a graphical utility to find the correct jumper settings for the SWT 3000 modules. The program is supplied with the PowerSys software package.

3.17.2 Jumper Settings for IFC Modules

3.17.2.1 Overview



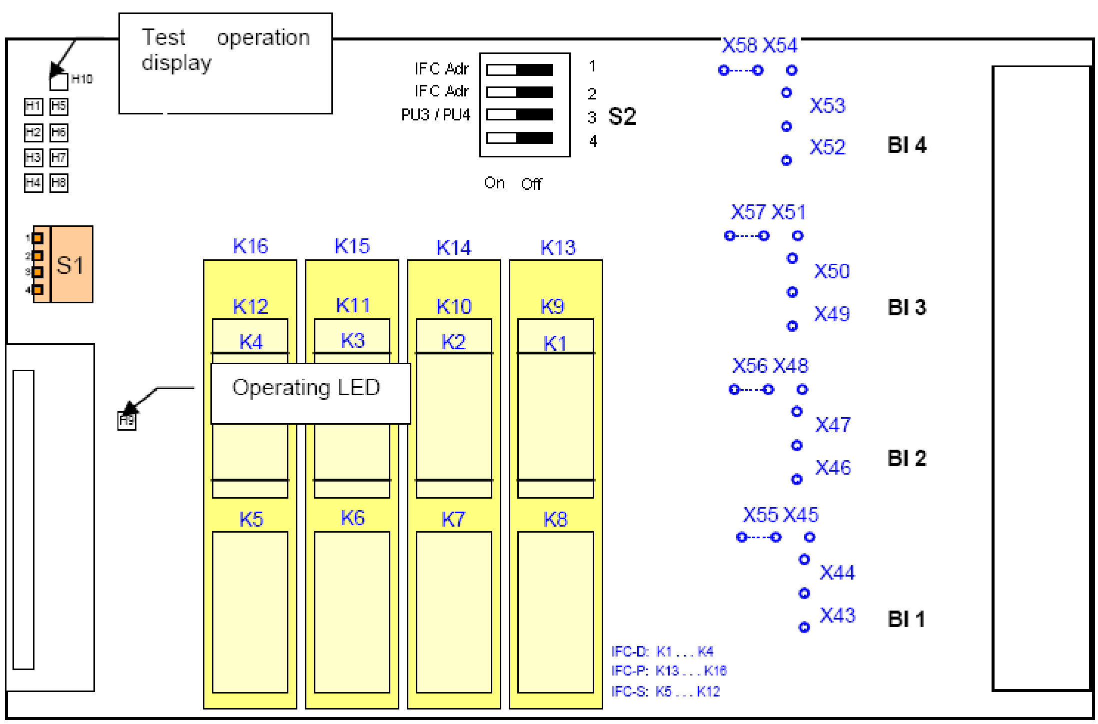
[scjumper-220513-01.tif, 2, en_US]

Figure 3-123 Position of Jumpers for the IFC-Modules

(1) LED H1 to H4 (red): activated outputs
LED H5 to H8 (green): activated inputs
(2) Test Operation Display (H10)
(3) S2: IFC Slot Address Selection (S2.1, S2.2) and PU3 / PU4 switch:
S2.3: closed/down - PU3
S2.3: open/up - PU4
(4) Jumpers X43 to X58
(5) Operating LED (H9)

Table 3-76 Assignment of Jumpers X43 to X58

Signal Input	250 V	110 V	48 V/60 V	24 V
BI1	**X55 = inserted** X43 = open X44 = open X45 = open	X55 = open **X43 = inserted** X44 = open X45 = open	X55 = open X43 = open **X44 = inserted** X45 = open	X55 = open X43 = open X44 = open **X45 = inserted**
BI2	**X56 = inserted** X46 = open X47 = open X48 = open	X56 = open **X46 = inserted** X47 = open X48 = open	X56 = open X46 = open **X47 = inserted** X48 = open	X56 = open X46 = open X47 = open **X48 = inserted**
BI3	**X57 = inserted** X49 = open X50 = open X51 = open	X57 = open **X49 = inserted** X50 = open X51 = open	X57 = open X49 = open **X50 = inserted** X51 = open	X57 = open X49 = open X50 = open **X51 = inserted**
BI4	**X58 = inserted** X52 = open X53 = open X54 = open	X58 = open **X52 = inserted** X53 = open X54 = open	X58 = open X52 = open **X53 = inserted** X54 = open	X58 = open X52 = open X53 = open **X54 = inserted**



[scifcjum-010813-01.tif, 1, en_US]

Figure 3-124 Position of jumpers X43 to X58

The second interface module is used in the case of an **IFC-D/P** module for doubling the output contacts. The binary inputs are only connected to **one** module (in slot IFC-1).

If the IFC-S module is used, jumpers X43 to X58 are not provided because the binary inputs do not exist. The module contains 8 signaling relays. For 7 relays, one change-over contact is brought out in each case. The contact of relay K5 can be used as a make contact or a break contact with jumper X42. All 8 signaling contacts have a **common root (3A1)**.

3.17.2.2 DIP Switches on IFC Modules

There are 2 Dual Inline Package (DIP) switches added to each IFC modules:

- DIP switch S1 for the **Test Mode**.
  The activated output relays are displayed with LEDs H1 to H4 (red), and the activated binary inputs with LEDs H5 to H8 (green).
  For detailed information, refer to *3.18.3 Command Interface* and *2.4.9.4 Test Mode*.
- DIP switch S2 for the selection of PU3 and PU4 module and to indicate the slot address of each IFC module.
  For detailed information, refer to *2.4.9.5 Slot and Module Identifier*.

Table 3-77 Function of S2 Switch

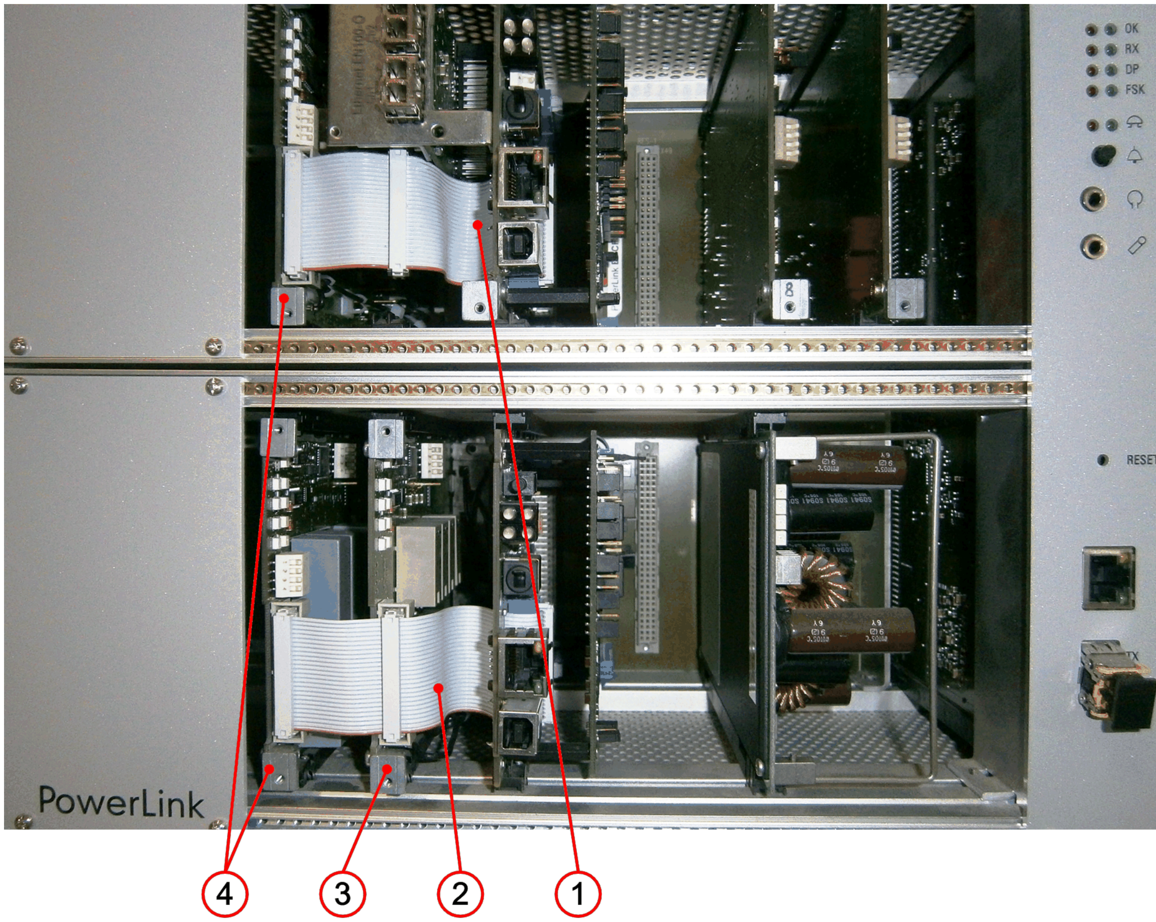
Switch	Function
S2.1	IFC slot address selection
S2.2	IFC slot address selection
S2.3	PU3 or PU4 selection
S2.4	Not connected

Table 3-78 IFC Slot Address

Selection	S2.1 Position	S2.2 Position
IFC-1	Open = up position = OFF	Open = up position = OFF
IFC-2	Close = down position = ON	Open = up position = OFF
IFC-3	Open = up position = OFF	Close = down position = ON
IFC-4	Close = down position = ON	Close = down position = ON

Table 3-79 PU3 or PU4 Selection

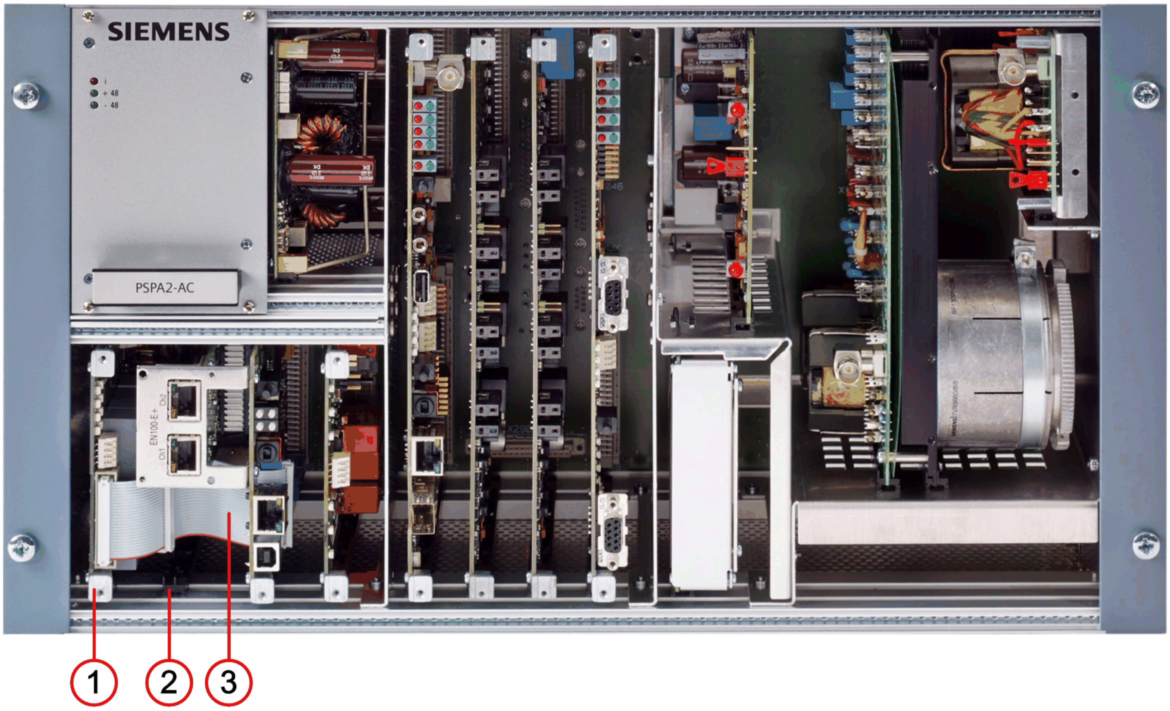
Selection	S2.3 Position
PU3	Close = down position = ON
PU4	Open = up position = OFF



[dwpinifc-270813-01.tif, 1, --_--]

Figure 3-125 Slot positions of IFC-x modules in the iSWT 3000 system - PowerLink 100

(1) iSWT-B (iSWT 3000-2)
(2) iSWT-A (iSWT 3000-1)
(3) Slot position IFC-2
(4) Slot position IFC-1



[dw_pl50s_Front-offen-3legendenpkt, 1, --_--]

Figure 3-126 Slot positions of IFC-x modules in the iSWT 3000 system - PowerLink 50

(1) Slot position IFC-1
(2) Slot position IFC-2 or EN 100
(3) iSWT

NOTICE

Changing the position of an IFC module without changing its address may lead to a failure in the transmission.

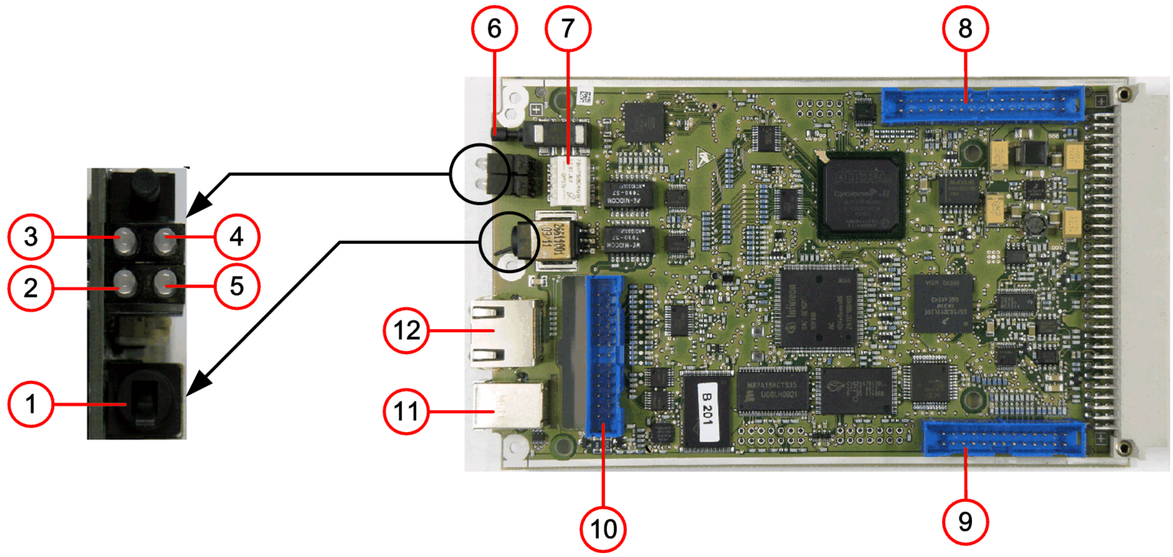
The IFC module will be detected on a wrong slot. No information or wrong information may be transmitted to the corresponding protection relay.

✧ Make sure that the IFC module is in the right slot.

NOTE

The slots IFC-3 and IFC-4 are available only in PU4-mode of stand alone SWT 3000.

3.17.3 Jumper Settings for PU4 Module



[le_pu4jum, 1, en_US]

Figure 3-127 Position of Jumpers, Input and Signaling Elements on the PU4 Module

1	S2: Power ON/OFF
2	LED OK/GBAL
3	LED Status Interface LID-2
4	LED Status Interface LID-1
5	LED Status Interface LIA
6	S1: Reset button
7	S3 (3.1 to 3.4)
8	Connection on DLE
9	Connection on DLE
10	Connection of the IFC Modules
11	LCT: Service Interface (USB)
12	NMS: Ethernet Interface

The Digital line equipment is not applicable for PowerLink 50.

Table 3-80 Function of the S3 DIP Switch on the PU4 Module

Switch Number	Position	Function
S3.1	OFF ON	Normal operation Programming with Memtool
S3.2	OFF ON	Monitor inactive Monitor active
S3.3	OFF ON	Disable debugger Enable debugger
S3.4	OFF ON	Disable initialization in monitor Enable initialization in monitor

NOTE

For normal operation all switches must be in the **OFF**-position.

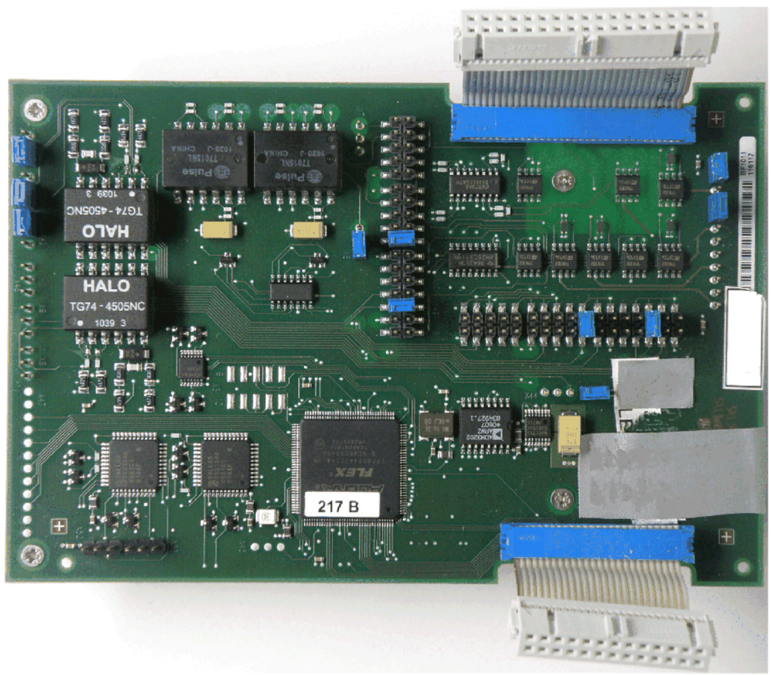
3.17.4 Jumper Settings for DLE Module

3.17.4.1 Overview

NOTE

The Digital Line Equipment DLE is only available in PowerLink 100.

When using digital line interfaces, links must be set on the DLE module. Module DLE is designed as a self-contained PC board that is connected electrically to the PU4 via a ribbon cable and mechanically via spacer sleeves. All external interfaces are routed via the PU4 module.



[scdlejum-301111-01.tif, 1, en_US]

Figure 3-128 Position of the Jumpers on the DLE Module

3.17.4.2 Jumper Settings for the Selection of Digital Line Interfaces LID-1

Table 3-81 Interface Selection for the LID-1

Interface	X48	X49	X42	X43	X6	X4	X5	X20	X21
X.21	1-2 11-12	1-2 11-12	1-2	2-3	2-3	2-3	2-3	1-2	1-2
G703.1	3-4 13-14	3-4 13-14	1-2	2-3	2-3	2-3	2-3	2-3	2-3
G703.6 symmetric	5-6 15-16	5-6 15-16	1-2	2-3	2-3	2-3	2-3	2-3	2-3
G703.6 asymmetric	7-8 15-16	5-6 15-16	2-3	1-2	1-2	1-2	1-2	1-2	1-2

3.17.4.3 Selection of the Input Gain for G703.6 Interfaces

Table 3-82 Selection of the Input Gain for G703.6 Interfaces

Input gain	LID-1
12 dB	X53 / 2-3
43 dB	X53 / 1-2

3.17.5 System Configuration for iSWT 3000

In the PowerLink 100 system, up to 2 iSWT 3000 can be used.
In the PowerLink 50 system, 1 iSWT 3000 can be used.
The iSWT 3000 have to be defined in the system configuration.

Table 3-83 Setting options for the iSWT 3000

iSWT Option	Signification
via CSPi	using the SSI interface of the iSWT for protection signaling
via FOM	connection of an external SWT 3000 via optical fiber module FOM
digital only	using the digital interface of the iSWT for protection signaling

3.17.6 External SWT 3000 Connection to PowerLink

3.17.6.1 Fiber-Optic Connection

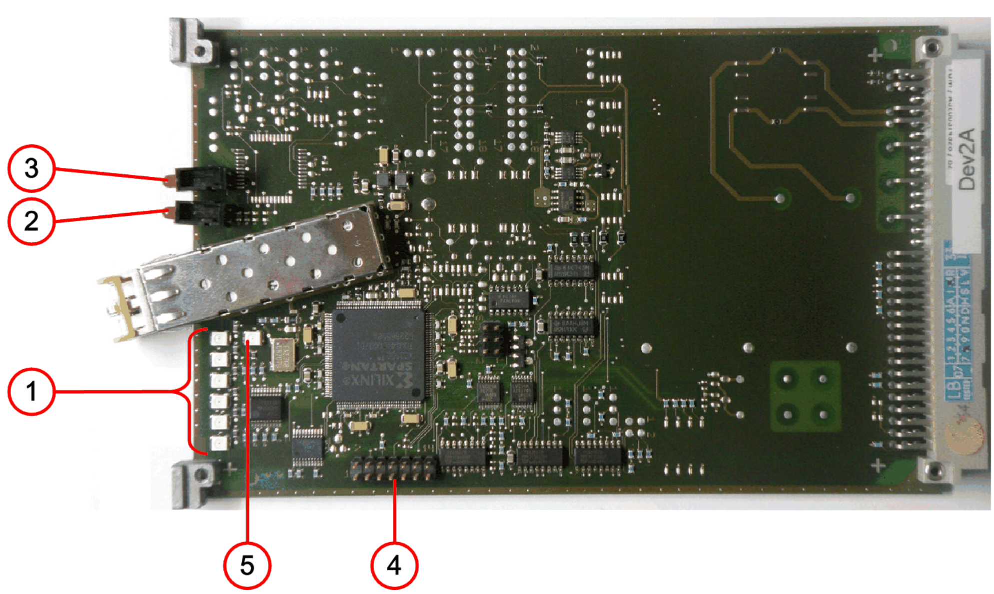
With the FOM, it is possible to connect up to 2 external SWT 3000 via fiber-optic cable to the PowerLink PLC system (for each transmission direction one fiber).

In the PowerLink 100 system, 2 SWT 3000 can be connected via fiber-optic cables (iSWT-1 and iSWT-2).

Fiber-optic modules are installed in the slots of the PU4.

In the PowerLink 50 system, the connection of an iSWT 3000 via fiber-optic cables is not supported.

The PU4 in the external SWT 3000 is connected to the iLAN interface and its Serial Synchronous Interface (SSI) via FOM to PowerLink. From the point of view of the PowerLink, the external SWT 3000 is considered **like integrated**, because the internal iLAN of the system is extended through the fiber-optic connection.



[scfomled-220513-01.tif, 1, en_US]

Figure 3-129 Position of the LED on the FOM

(1) LED H4 to H9: Diagnosis
(2) LED H3 Rx-Alarm
(3) LED H2 Tx-Alarm
(4) Programming Interface
(5) LED H1: FPGA Readiness

On the FOM, no jumper settings are required. The LED indications are described in the following table:

Table 3-84 Signification of the Alarm LED on the FOM

LED		LED Indication when Lighted	LED Indication with FOS3 for C37.94
H1	red	FPGA not ready	FPGA not ready
H2	red	**Tx-Alarm** F6 supervisory alarm	**Tx-Alarm** F6 supervisory alarm
H3	red	**Rx-Alarm**	**Rx-Alarm**
H4	yellow	ILAN high	**LOS alarm** (“lose of signal” alarm) LED on: DCE and DTE not synchronized or when in sync state, there are at least two bit errors in consecutive 8 C37.94 frames
H5	yellow	BUF alarm Buffer overflow or under run Source: Supervisory circuit of FPGA	**AIS alarm** (“Alarm Indication Signal” alarm) LED on: “all ones” received. The multiplexer lost the higher order link, it will send all one in the data bits to SWT3000.
H6	yellow	MOD-alarm Modulation alarm, carrier frequency at the optical receiver not detected	**RDI alarm** (“remote defect indicator” alarm) LED on: remote side of C37.94 connection entered a LOS alarm state.
H7	yellow	COM-alarm Communication alarm at the electrical interface	Debug information (for test purpose)
H8	yellow	SFP_LOS The received optical power is below the receiver sensitivity Loss of signal	Debug information (for test purpose)
H9	yellow	S6 asserted	Debug information (for test purpose)

NOTE

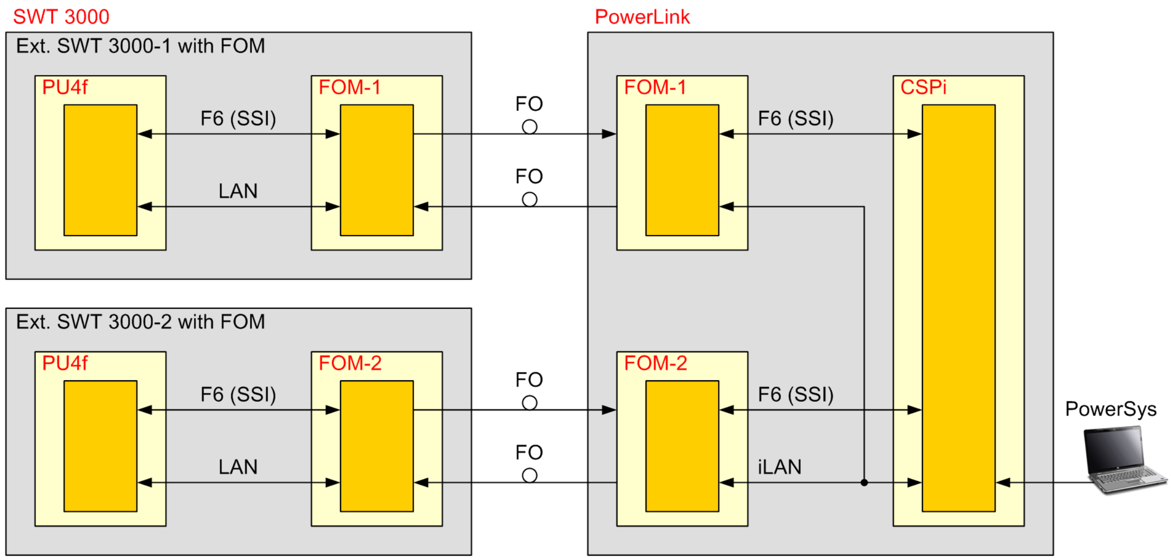
If there is a FOM connection to PowerLink, the configuration of the external SWT 3000 is executed via the PowerLink with the **service program PowerSys**. **The service interface of the PU4 in the external SWT 3000 cannot be used**.

3.17.6.2 iSWT 3000 via FOM for PowerLink 100

With this system configuration it is possible to connect up to 2 external SWT 3000 via optical fiber to the PowerLink system (for each transmission direction 1 fiber). This is considered in the PowerLink like iSWT 3000.

In the PowerLink 50 system, the connection of a iSWT 3000 via fiber-optic cables is not supported.

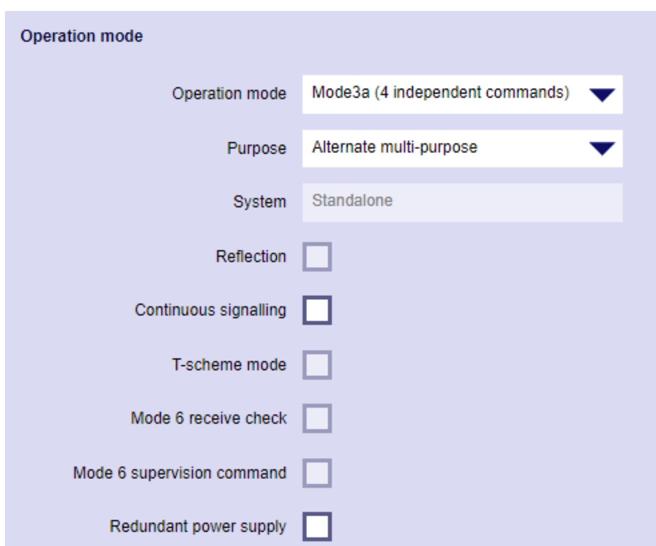
The FOM in the PowerLink device modules are installed in the slots of the PU4. In SWT 3000 the FOM is located in slot FOM-1/CLE. Optionally a second FOM for a digital alternate path can be installed in slot FOM-2.



[dwiswtfo-010813-01.tif, 1, en_US]

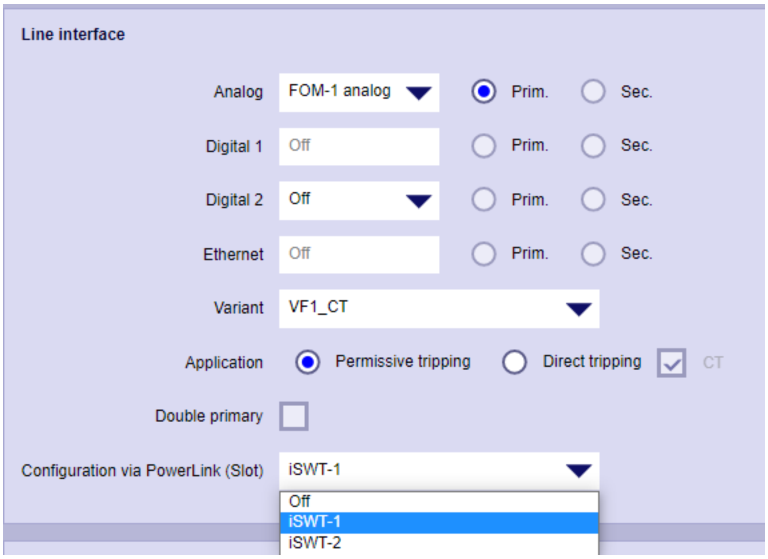
Figure 3-130 Configuration of 2 external SWT 3000 via FOM and the PowerLink

The basis (hardware) configuration for settings of the external SWT is carried out at the external SWT 3000 device with the PowerSys program, as shown in the following figures.



[sc_swt_fom_operationmode, 1, --_--]

Figure 3-131 Configuration of the operation mode of the external SWT 3000 with FO connection to Power-Link



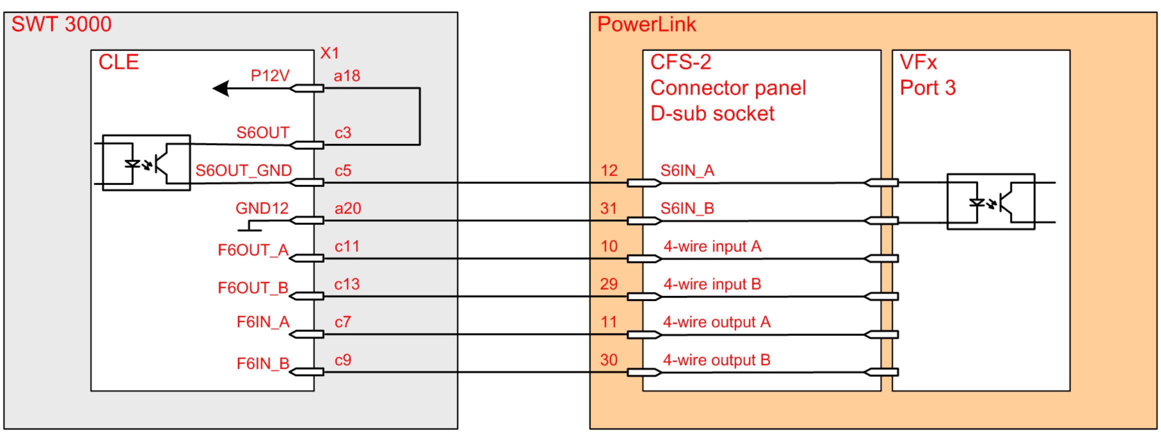
[sc_swt_fom_lineinterface, 1, --_--]

Figure 3-132 Configuration of the line interface of the external SWT 3000 with FO connection to PowerLink

The further settings like VF variant, must be executed via the PowerLink. In this case the same settings from the external SWT 3000 must be defined in the configuration of the (iSWT 3000) PowerLink.

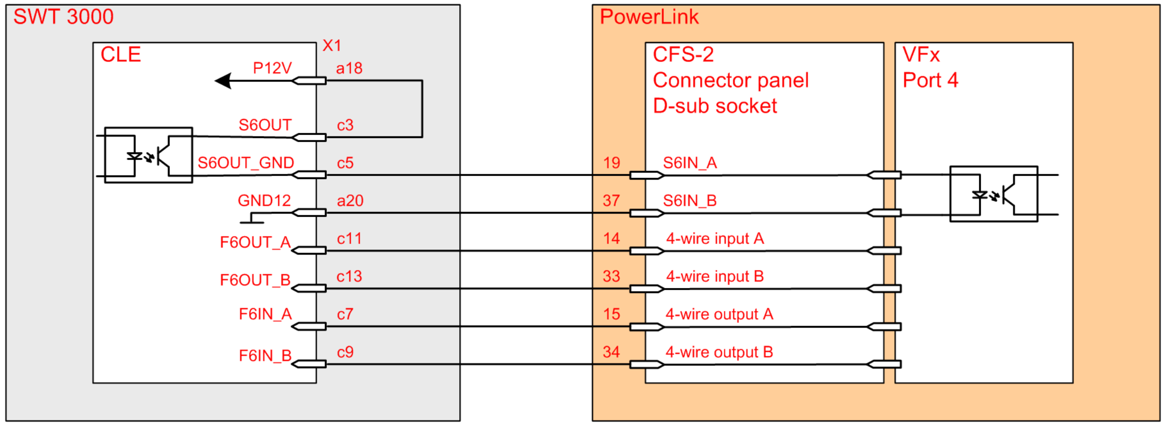
3.17.6.3 CLE connection of an External SWT 3000 to the PowerLink 50/100

The connection of the CLE module from an external SWT 3000 to the VFx modules is carried out via D-sub sockets. The principle is shown in the following figures. In this case, the VFx ports 3 or 4 must be used.



[dwcovfx3-110711-01.tif, 1, en_US]

Figure 3-133 Connecting an External SWT 3000 to Port 3 of the VFx Modules



[dwcovfx4-110711-01.tif, 1, en_US]

Figure 3-134 Connecting an External SWT 3000 to Port 4 of the VFx Modules

3.17.7 Operating Mode with PLC Equipment

3.17.7.1 Overview

Power system protection signals can be transmitted over the high-voltage overhead line. These signals are protected within the PLC equipment. For this purpose, the devices of the SWT 3000 system are connected to special inputs and outputs of the PLC unit. If you are using a PowerLink system, the integration of SWT 3000 is only possible in a PowerLink system with CSPi.

When using PLC equipment, several variants of teleprotection signaling are possible as described in the following cases:

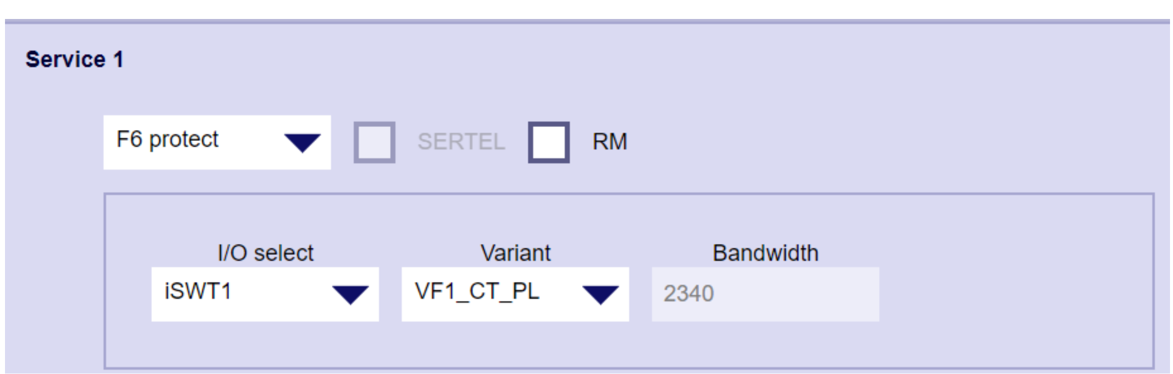
- Single Purpose (SP) operation
- Multi-Purpose (MP) operation
- Alternate Multi-Purpose (AMP) operation

3.17.7.2 Single Purpose Operation

In this operating mode, the transmission band of the PowerLink is used exclusively for teleprotection signaling. The greatest transmission distances are reachable in this mode with maximum security against impulse noise and minimum signal transmission time.

The following equipment combinations are possible:

- SWT 3000 remote with VF or optical connection to PowerLink
- SWT 3000 integrated in PowerLink



[sc_service_F6_protect_single_purpose, 1, --_--]

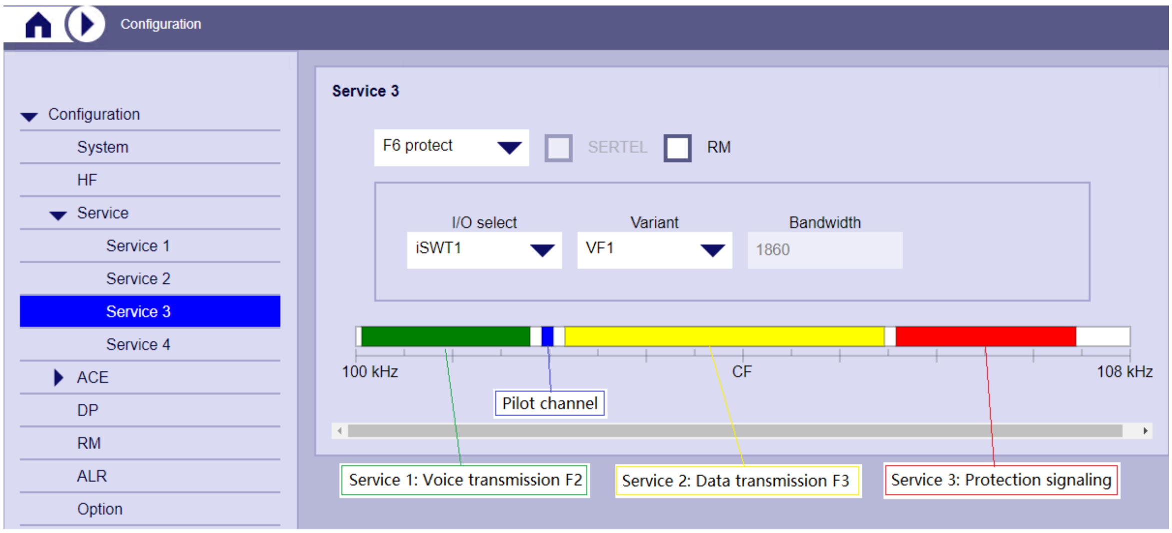
Figure 3-135 Configuration example for Single Purpose Operation of an iSWT 3000

3.17.7.3 Multi Purpose Operation

In this operating mode, the teleprotection signals are simultaneously transmitted with voice and data signals. The distribution of the available transmission power (between the services, which must be transmitted) results in shorter transmission ranges. The command transmission times are the same as in single purpose operation.

The following equipment combinations are possible:

- SWT 3000 remote with VF or optical connection to PowerLink
- SWT 3000 integrated in the PowerLink



[sc_example_multipurpose_iswt, 1, --_--]

Figure 3-136 Example for Multi Purpose Operation of an iSWT 3000

3.17.7.4 Alternate Multi Purpose Operation

Normal operation	In this operating mode, the transmission band is used for the transmission of voice (F2) and data, or Data Pump (DP) as long as there is no protection case. In the idle state, that is, the high-voltage system is operating the signals of all services including the guard tone are transmitted simultaneously. The pilot of the PLC system is used as the guard tone in this operating mode.
Protection mode	While the protection command is being transmitted, the voice or DP transmission is interrupted. This operating mode saves frequency space but results in shorter transmission ranges and higher signal transmission times than with single purpose or multi-purpose operation.

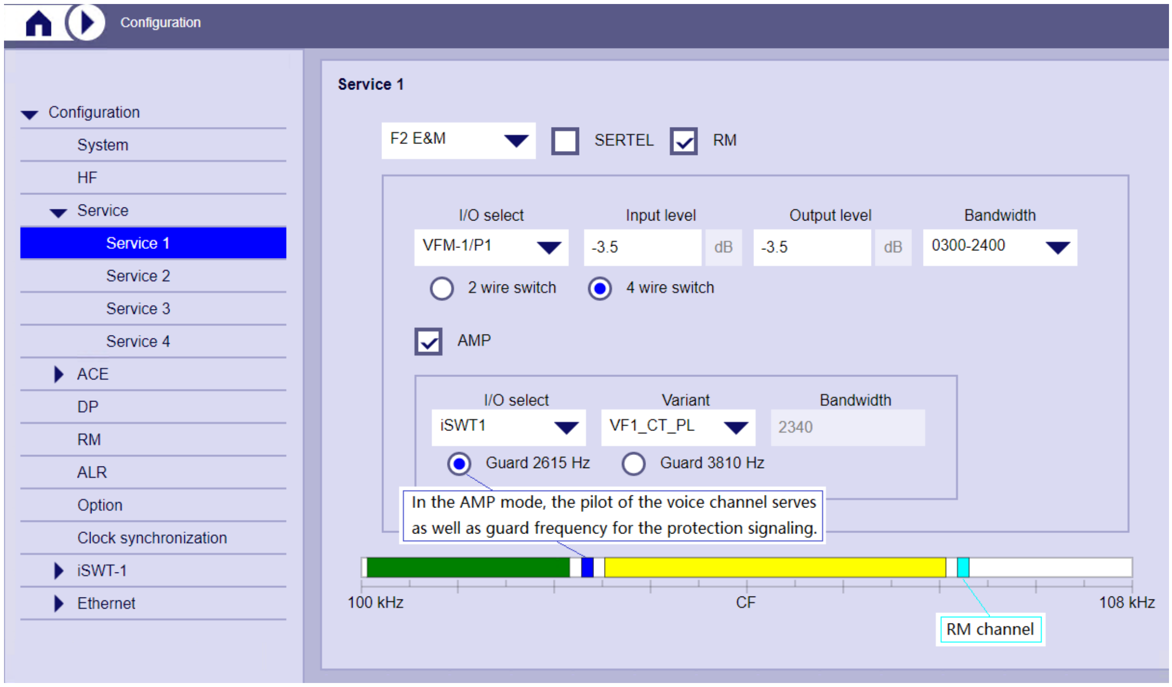


Figure 3-137 Alternate Multi Purpose Operation with a voice channel

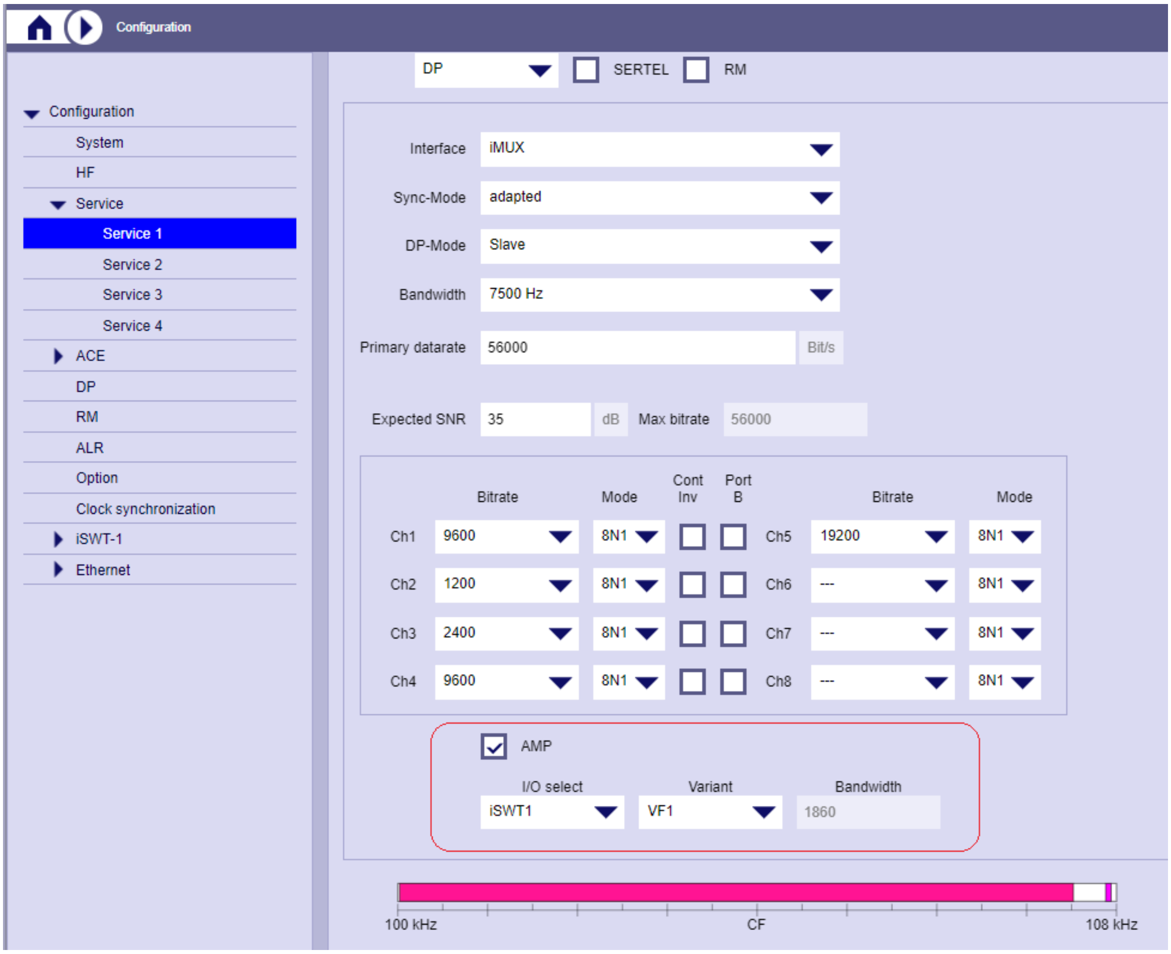
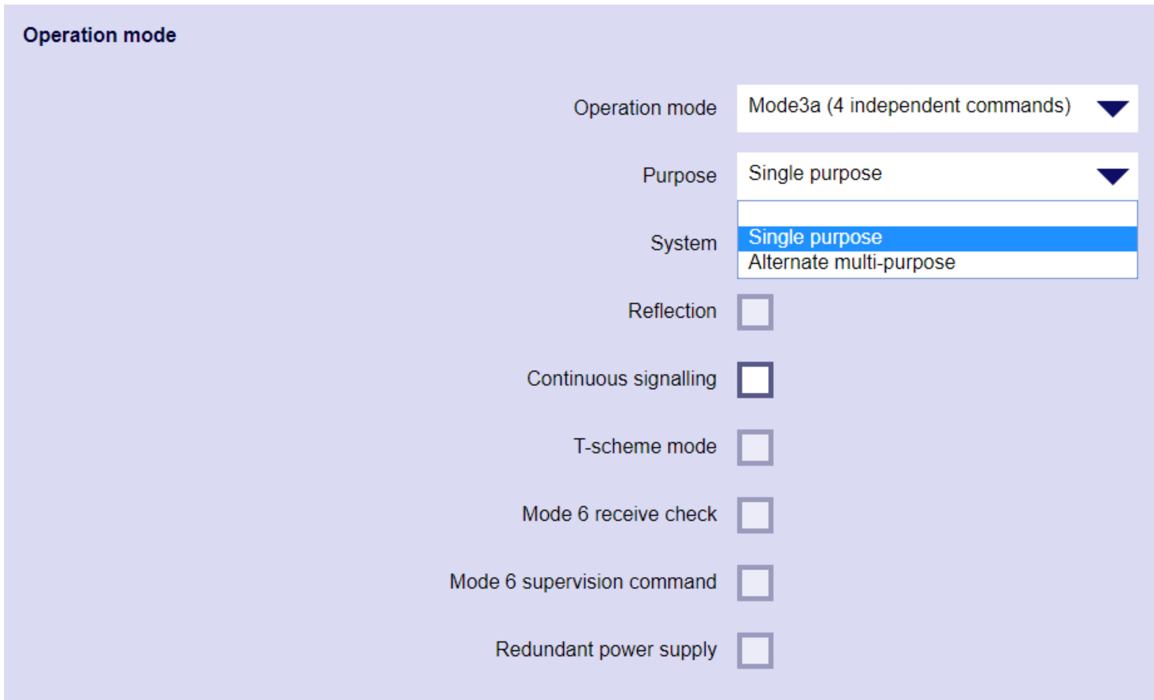


Figure 3-138 Alternate Multi Purpose Operation with the service DP

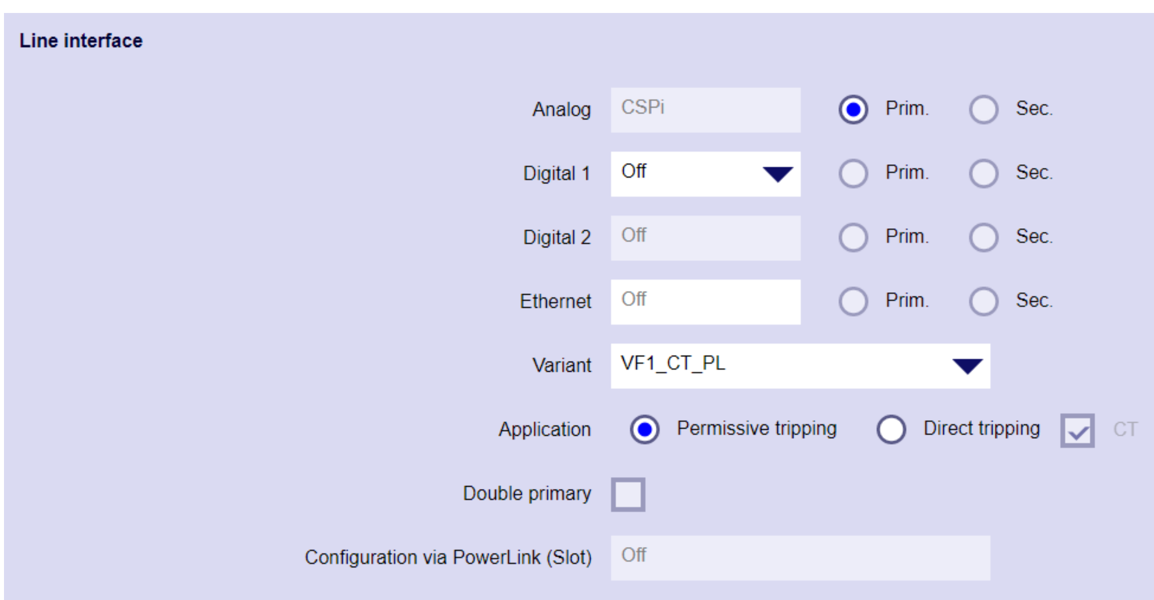
3.18 Configuration of an iSWT

3.18.1 Single or Multi Purpose Operation



[sc_iswt_single_alternate_multi_purpose, 1, --_--]

Figure 3-139 Example of the system configuration of an iSWT 3000 in SP resp. MP operation mode



[sc_iswt_variant, 1, --_--]

Figure 3-140 Example of variant configuration

The figures above show the system configuration of an iSWT 3000 working in the single purpose (SP) operation mode. Here the adjustment <**single purpose**> must be activated. The connection of the analog interface is carried out digital to the CSPi module.

The same setting is necessary if the protection signals are transmitted with other services like voice and data. From the point of view of PowerLink system this is considered as **multi purpose** (MP) operation. The iSWT 3000 distinguishes only between single resp. alternate multi-purpose operation.

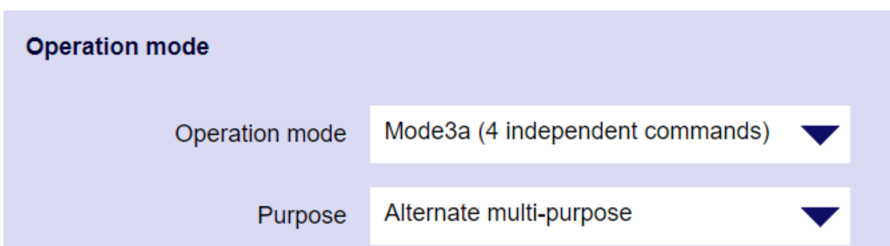
In the single or multi purpose mode the frequency variants VF1 up to VF5, VF1_CT or VF3_CT, VF1_M5A, VF3_M5A and NB1, can be used. The variant depends on the operation mode of the iSWT 3000 (refer to *Table 3-85*). The variant **NB1 is only suitable for the single purpose** (resp. multi purpose) operation and the **operation modes 1, 2, 3 and 4**.

NOTE

The further setting options like connection, operation mode, variant etc. are identical with the alternate multi purpose operation and described in this section.

If **continuous commands** are transmitted with the iSWT 3000, the option "**Continuous signaling** ☑" must be activated. In this case the iSWT 3000 sends the guard tone for 170 ms at cyclical intervals so that a connection can be re-established automatically after a line interruption or failure of a device. In this case the **command output time must be extended accordingly** (see timer settings).

3.18.2 Alternate Multi Purpose Operation



[sc_iswt_alternate_multi_purpose, 1, --_--]

Figure 3-141 Example of the system configuration of an iSWT 3000 in AMP operation mode

The figure above shows the system configuration for an iSWT 3000 in the alternate multi purpose operation. Here the adjustment <**alternate multi purpose**> must be activated. The connection of the analog interface is carried out digital to the CSPi module. The alternate multi purpose operation is possible with the service voice (F2) or Data Pump (ref. to section service configuration).

NOTE

The frequency variant NB1 can not be used in AMP mode. For **frequency measurement** switch **AMP Meas "ON"** in the <**iSWT-x - Test**> form.

Operating Mode

The following settings are possible:

Table 3-85 Selection of the operation modes

Operating mode	Possible frequency variant
Mode 1 (double system protection)	Variants VF1, VF3 or VF5 resp. VF1_CT or VF3_CT
Mode 2 (single-phase protection)	Variants VF1 and VF3 resp. VF1_CT or VF3_CT
Mode 3 (4 commands with priority)	Variants VF1 and VF3
Mode 3a (4iC) (4 independent commands)	Variants VF1_CT or VF3_CT
Mode 3b (2 plus 2)	Variants VF1_CT or VF3_CT

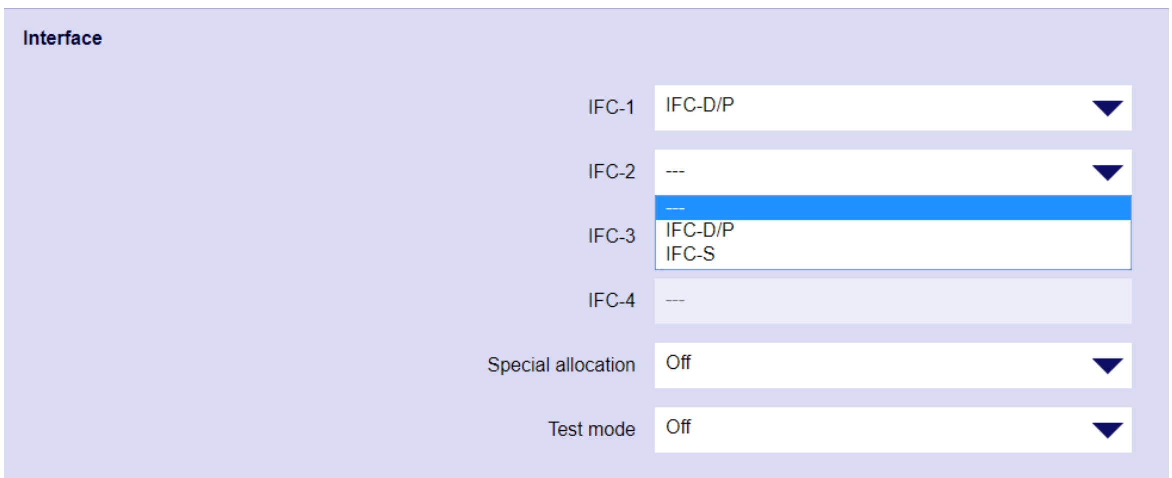
Operating mode	Possible frequency variant
Mode 4 (only 1 command active)	Variants VF1 and VF3 resp. VF1_CT or VF3_CT
Mode 5A (3 independent commands)	Variants VF1 M5A and VF3 M5A

The menu option <**Reflection**> ☑"Yes" or ☐"No " offers the additional option of reflecting the received command if there is no local excitation (setting "Yes").

This setting is only evaluated by the device in the operation modes "Mode 1 (Double system protection)" or "Mode 2 (Single-phase protection)". In these modes the fourth binary input of the IFC D/P module can be used for excitation. In the operation mode Mode 3, 3a, 3b, resp. Mode 4, this input is provided for input of the fourth command.

3.18.3 Command Interface

In the menu the number and type of the interface module IFC-x are defined. In addition test mode is selectable.



[sc_iswt_interface, 1, --_--]

Figure 3-142 Defining the Interface modules IFC

Interfaces

Only IFC-D or IFC-P modules can be inserted at the corresponding slot IFC1. Slot IFC2 can also be equipped with the IFC-D/P modules or alternatively with the IFC-S module. When a second IFC-D/P module is existing only the output relays from the module can be used, because the max. number of commands is 4. In this case the function contact doubling must be activated.

Test Mode

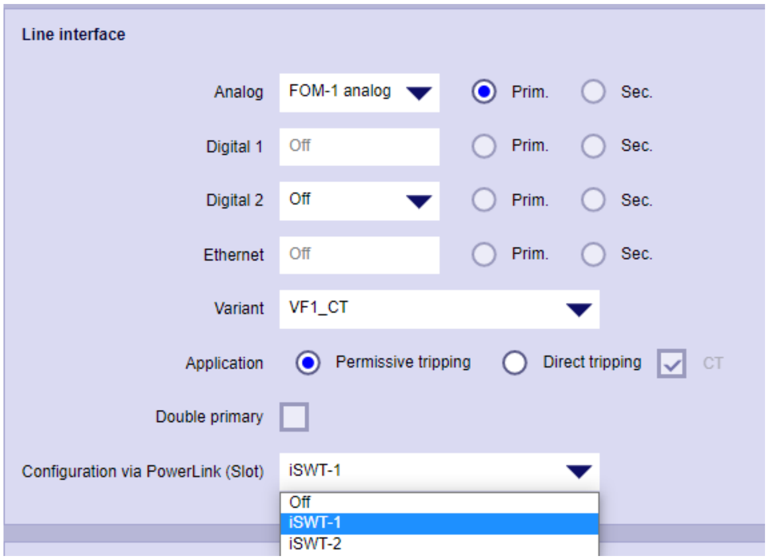
Switch over to test mode with the setting <**Test mode**>. In this mode you can enter commands on the IFC module for every input by means of DIL switches S1.1 to S1.4 on the IFC module

NOTE

For security reasons after switching over to test mode all inputs are signaled by the controller as "off" regardless of the actual switch position. The "ON" state can only be reached by switching **all** switches to the "**Open**" position and then "ON".

To prevent false trips, make sure that the command outputs in the remote station are disconnected from protection relay

Application



[sc_swt_fom_lineinterface, 1, --_--]

Configuration of application

coded transmission:

Due to the operating mode it is possible to switch over to the coded transmission if this button is enabled.

direct tripping:

This adjustment offers a higher transmission security of the analog communication interface. It should be selected when using protection systems with intertripping. The transmission time is approx. 5 ms longer compared with the adjustment <**permissive**>.

permissive tripping:

This adjustment should be selected when using permissive protection systems.

Configuration via PowerLink Slot

In case of an FOM connection from an external SWT3000 this is considered like integrated (iSWT-1 resp. 2). In this case it must be defined which FOM module (in slot iSWT1 resp. iSWT2) of the PowerLink is used for the configuration of the external SWT 3000 ref. also to *iSWT via FOM*

3.18.4 Output Allocation

Output	Enable	Output port	Name	Output	Enable	Output port	Name
(1)	☑	IFC-1/OUT1	IED X POTT RX	(9)	☐		
(2)	☑	IFC-1/OUT2	IED X DEF RX	(10)	☐		
(3)	☑	IFC-1/OUT3	IED Y POTT RX	(11)	☐		
(4)	☑	IFC-1/OUT4	IED Y DEF RX	(12)	☐		
(5)	☐			(13)	☐		
(6)	☐			(14)	☐		
(7)	☐			(15)	☐		
(8)	☐			(16)	☐		

[sc_output_allocation, 2, --_--]

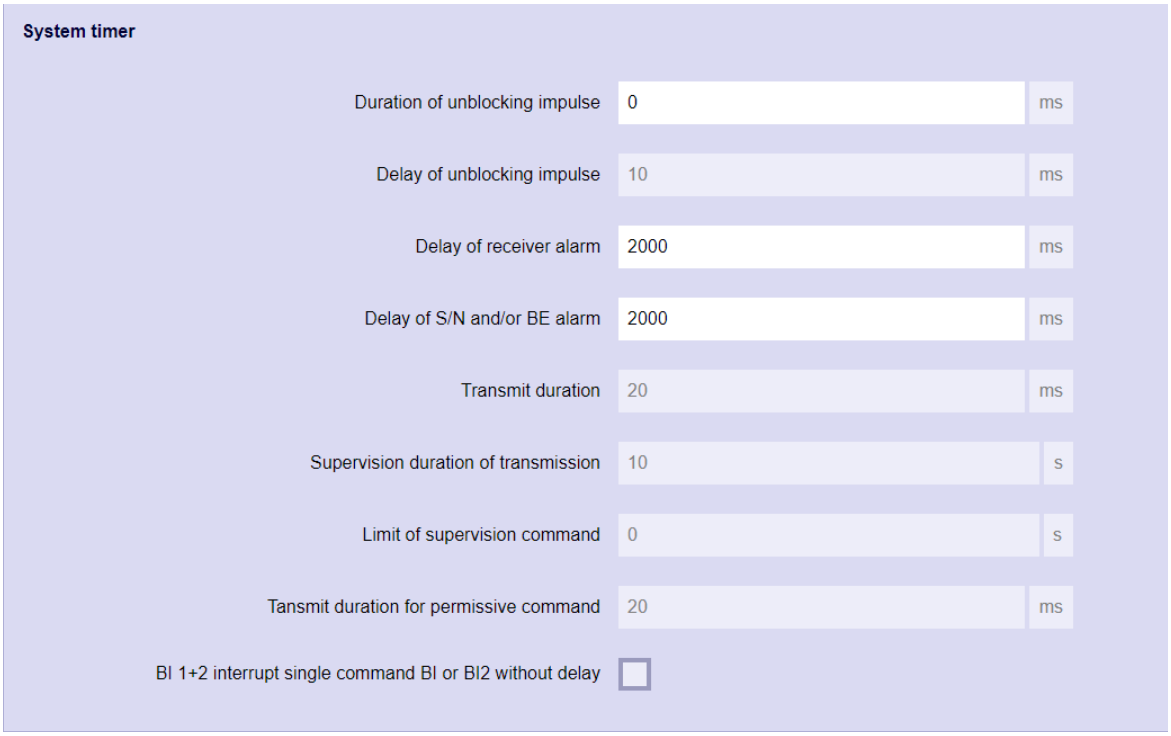
Figure 3-143 Command output allocation

In the iSWT 3000 every possible combination of binary inputs (IN1 to IN4) is permanently assigned to a protection frequency depending on the operating mode (Mode 1 to Mode 5A) and the function Un-blocking "On" or "Off".

At the receive end, every protection frequency can be assigned to 1 or more signal outputs (OUT1 to OUT4) with the output allocation for the operation mode **3a and 5A**. In digital operation it is also possible to assign the outputs to the activated binary inputs for the operation mode **5D**.

Each command input / output has a naming text field with maximum 16 characters. The configured command name will be displayed in timer configuration, command counter and event log. It is helpful to better understand offline without circuit diagram which command has been configured or tripped. The command name is only configurable in free allocation mode (Mode 3a / 3b / 5D).

3.18.5 Timer Setting Options for the iSWT 3000



[sc_system_timer, 1, --_--]

Figure 3-144 The iSWT 3000 timer configuration

Table 3-86 Settings of the iSWT 3000 timer configuration

Selection	Settings	Remarks
Duration of unblocking impulse	30 to 300 ms in steps of 10 ms	"0" setting means no unblocking signal. **Note**: If using the unblocking function the Relay outputs in the operation modes 1 and 2 are different than without unblocking
Delay of unblocking impulse	10 to 100 ms in steps of 1 ms	Adjustment only possible when duration of unblocking is >0 ms
Delay of receiver alarm	0 to 2000 ms in steps of 50 ms	Delay time for activation of the receive alarm **relay**.
Delay of S/N alarm	0 to 2000 ms in steps of 50 ms	Delay time before output of the S/N alarm signal.
Transmit Duration (Only when switching functions in the system configuration or MCM is parameterized.)	15 to 100 ms in steps of 5 ms (for mode 3 or 6)	Transmission time of each activated single command (displayed only with switching functions **Mode 3**).
Supervision duration of transmission	5 to 30 s in steps of 1 s	Supervision of the transmit duration in MCM mode. After the adjusted time is exceeded the system is mandatory switched back from AMP to “normal” transmission mode.

Selection	Settings	Remarks
Transmit Duration for permissive command	15 ms or 20 ms	Only for Mode 3b. (Default is 20 ms)
BI1+2 interrupt single command BI1 or BI2 without delay	Enabled	Only for Mode 3b. (Default is unchecked) **Checked:** Permissive command 1 or 2 transmission can switch to input combination 1+2 without waiting for minimal transmission duration time-out. **Unchecked:** Function not enabled.

Timer Settings for the Command Input

Input	Time		Input	Time		Input	Time	
(1)	0	ms	(9)	0	ms	(17)	0	ms
(2)	0	ms	(10)	0	ms	(18)	0	ms
(3)	0	ms	(11)	0	ms	(19)	0	ms
(4)	0	ms	(12)	0	ms	(20)	0	ms
(5)	0	ms	(13)	0	ms	(21)	0	ms
(6)	0	ms	(14)	0	ms	(22)	0	ms
(7)	0	ms	(15)	0	ms	(23)	0	ms
(8)	0	ms	(16)	0	ms	(24)	0	ms

[sc_timer_input_limitation, 1, --_--]

Figure 3-145 Input limitation

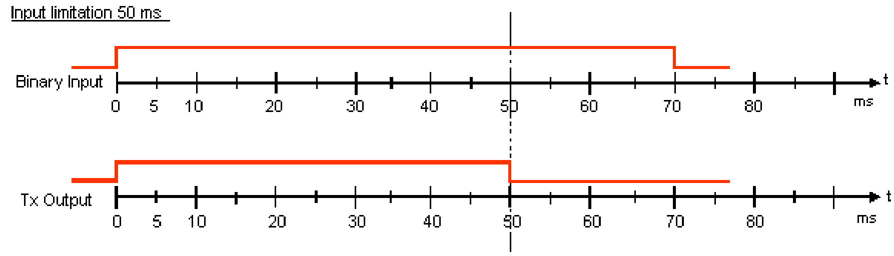
Input	Time		Input	Time		Input	Time	
(1)	20	ms	(9)	20	ms	(17)	20	ms
(2)	20	ms	(10)	20	ms	(18)	20	ms
(3)	20	ms	(11)	20	ms	(19)	20	ms
(4)	20	ms	(12)	20	ms	(20)	20	ms
(5)	20	ms	(13)	20	ms	(21)	20	ms
(6)	20	ms	(14)	20	ms	(22)	20	ms
(7)	20	ms	(15)	20	ms	(23)	20	ms
(8)	20	ms	(16)	20	ms	(24)	20	ms

[sc_timer_input_extension, 1, --_--]

Figure 3-146 Input extension

Table 3-87 Setting options for limitation of input command

Command input	Setting options	Comments
Limitation of input command	0 to 1000 ms in steps of 1 ms (for AMP mode)	"0" setting means no limitation. The transmission of the tripping signal is stopped when this value is exceeded.



[dwinlm50-011210-01.tif, 1, en_US]

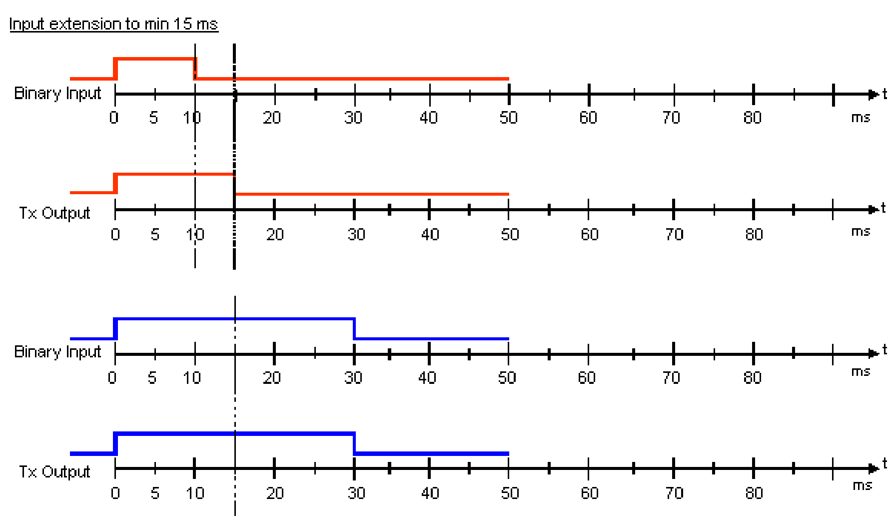
Figure 3-147 Example for input limitation set to 50 ms

Table 3-88 Setting options for input command extension to min.

Command input	Setting options	Comments
Input command extension min.	0 to 100 ms in steps of 1 ms	0 = no extension

The commands at the binary input are extended to adjusted value in case they are shorter. If they are longer this adjustments is irrelevant.

The figure below shows 1 command (red) at the binary input with a length of 10 ms. This is extended to 15 ms. The next command (blue) has a length of 30 ms. This command is not extended.



[dwince15-011210-01.tif, 1, en_US]

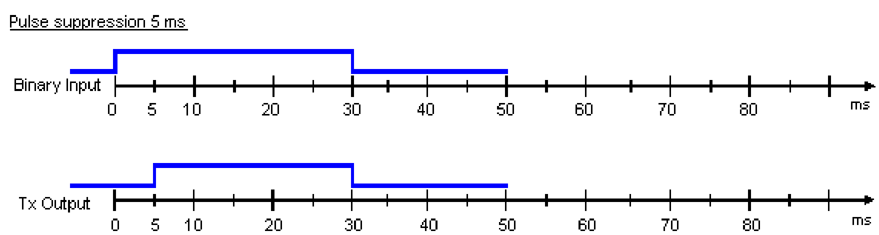
Figure 3-148 Example for an input command extension to min 15 ms

With Command Input-2 a pulse suppression in the range 0 – 100 ms in steps of 1 ms can be adjusted for each released binary input.

Input	Time		Input	Time		Input	Time	
(1)	0	ms	(9)	0	ms	(17)	0	ms
(2)	0	ms	(10)	0	ms	(18)	0	ms
(3)	0	ms	(11)	0	ms	(19)	0	ms
(4)	0	ms	(12)	0	ms	(20)	0	ms
(5)	0	ms	(13)	0	ms	(21)	0	ms
(6)	0	ms	(14)	0	ms	(22)	0	ms
(7)	0	ms	(15)	0	ms	(23)	0	ms
(8)	0	ms	(16)	0	ms	(24)	0	ms

[sc_timer_input_suppression, 1, --_--]

Figure 3-149 Input suppression



[dwplssp5-021210-01.tif, 1, en_US]

Figure 3-150 Example for a pulse suppression of 5 ms

NOTE

Commands which are **shorter** than the adjusted pulse suppression time are **not** transmitted by the iSWT!

Timer Settings for the Command Output

Output	Time		Output	Time		Output	Time	
(1)	0	ms	(9)	0	ms	(17)	0	ms
(2)	0	ms	(10)	0	ms	(18)	0	ms
(3)	0	ms	(11)	0	ms	(19)	0	ms
(4)	0	ms	(12)	0	ms	(20)	0	ms
(5)	0	ms	(13)	0	ms	(21)	0	ms
(6)	0	ms	(14)	0	ms	(22)	0	ms
(7)	0	ms	(15)	0	ms	(23)	0	ms
(8)	0	ms	(16)	0	ms	(24)	0	ms

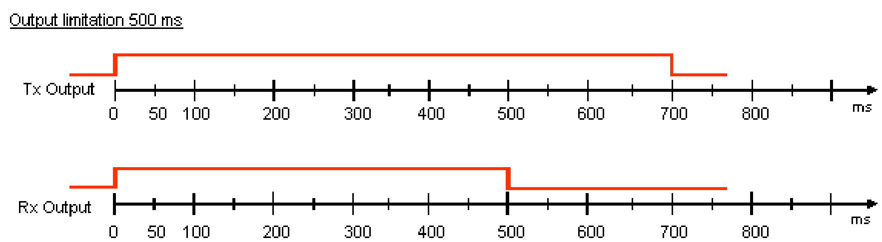
[sc_timer_output_limitation, 1, --_--]

Figure 3-151 Output limitation

Table 3-89 Setting ranges for limiting or increasing the output time

Command output	Setting options	Comments
Limitation of output command	0 or to 500 ms	0 = no limitation

The command in the example below is transmitted for 700 ms (Tx output). With the activated out-put limitation the command output is switched off after 500 ms.



[scactocl-021210-01.tif, 1, en_US]

Figure 3-152 Example of an activated output command limitation

Output	Time		Output	Time		Output	Time	
(1)	15	ms	(9)	15	ms	(17)	15	ms
(2)	15	ms	(10)	15	ms	(18)	15	ms
(3)	15	ms	(11)	15	ms	(19)	15	ms
(4)	15	ms	(12)	15	ms	(20)	15	ms
(5)	15	ms	(13)	15	ms	(21)	15	ms
(6)	15	ms	(14)	15	ms	(22)	15	ms
(7)	15	ms	(15)	15	ms	(23)	15	ms
(8)	15	ms	(16)	15	ms	(24)	15	ms

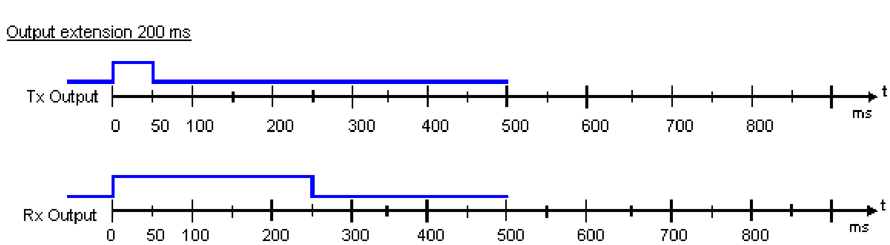
[sc_timer_ouput_extension, 1, --_--]

Figure 3-153 Output extension

Table 3-90 Setting ranges for the output command extension

Command output	Setting options	Comments
Output command extension	0 to 2000 ms in steps of 5 ms	

The command in the example below is transmitted for 50 ms (Tx output). With the output com-mand extension on the Rx output it is extended for 200 ms.



[dwoex200-021210-01.tif, 1, en_US]

Figure 3-154 Example for an output extension of 200 ms

Setting Options for the iSWT 3000 <Alarms>

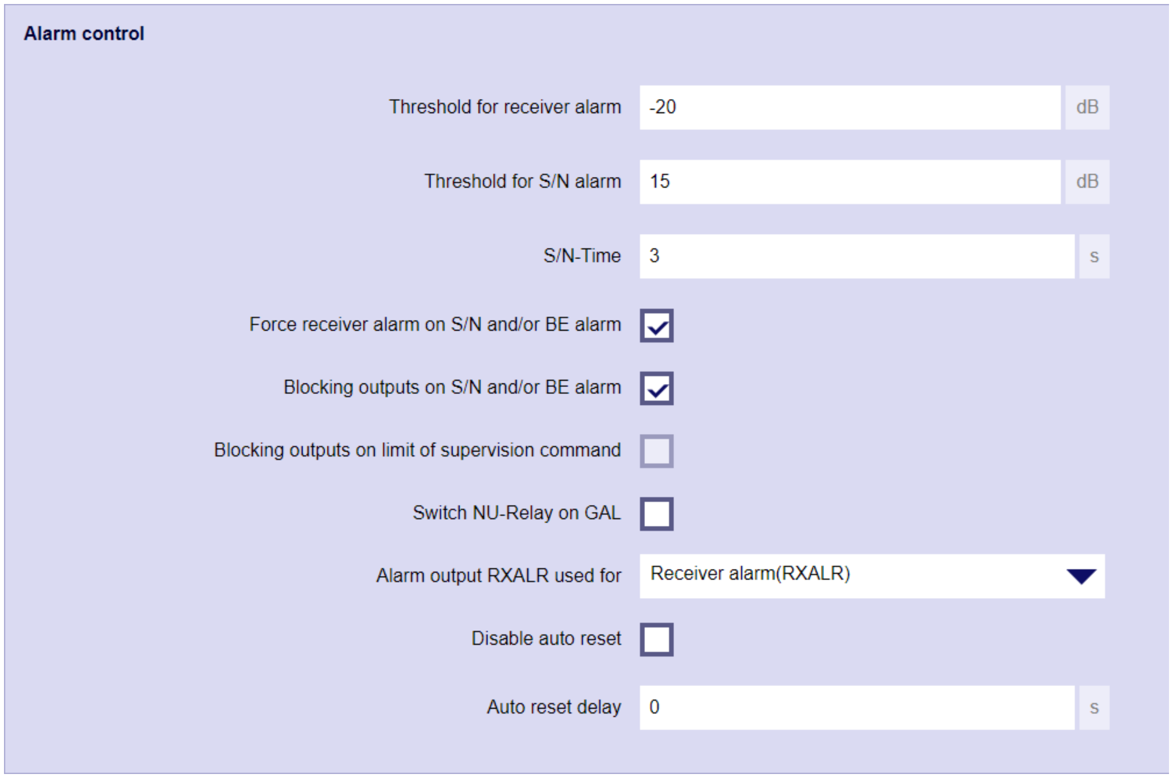


Figure 3-155 The iSWT 3000 Alarm Settings

Table 3-91 Setting options for the iSWT 3000 alarm settings

Selection	Setting options	Comments
Threshold for receive level alarm	-30 to -10 dB in steps of 5 dB	When the PU4 input level drops about the adjusted value, this is causing receive alarm
Threshold for S/N alarm	-20 to -10 dB in steps of 5 dB	In case of an worse SNR then adjusted this is causing S/N alarm. -20 dB is the most sensitive adjustment.
S/N Time	1 up to 30 sec in steps of 1 sec.	Measuring time for the signal to noise ratio
Force receiver alarm on S/N and/or BE alarm	☑	Receive alarm relay is activated in case of S/N alarm or bit error alarm
	☐	Function deactivated
Blocking outputs on S/N and/or BE alarm	☑	Command output disabled in case of S/N alarm or bit error alarm
	☐	Function deactivated
Switch NDR relay on GAL	☐	Only for stand alone devices
Alarm output EALR used for The **output RXALR** can be allocated to an alarm output in the alarm configuration (ref. to *Figure 3-179*	Receive Alarm (EALR)	Default setting
	unblocking (UNBL)	Time of the unblocking impulse must be more than 0 ms.
	input limitation alarm (INPLIM)	Function must be activated (ref. to *Table 3-87*

3.18.6 Setting Recommendations for the iSWT 3000 Timer Configuration

Broadband Versions

Table 3-92 Timer settings for broadband versions

SP operation	Timer			Command input		Command output	
	Duration of the Un-blocking pulse	EALR relay delay [ms]	S/N alarm delay [s]	Pulse suppression [ms]	Command extension to min. [ms]	Limiting of output time [ms]	*) Increase in output time by [ms]
Double system protection	0	2000	2	0	15	to 500	0
Single-phase protection	0	2000	2	0	15	to 500	0
Switching functions	0	2000	2	0	15	none	100

Switching functions: Time slot 20ms

*) If continuous signaling is activated the increase in the output time must be set to min. 180 ms

Table 3-93 Alarm settings for broadband versions

SP operation	Alarms			
	Threshold for EAL in [dB]	Activate EALR in case of S/N alarm	Disable the outputs in case of S/N alarm	Switch NDALR relays in case of GAL
Double system protection	-30	yes	no	no
Single-phase protection	-30	yes	no	no
Switching functions	-30	yes	no	no

Table 3-94 Timer settings for alternate purpose operation

AMP operation	Timer			Command input		Command output	
	Duration of the Un-blocking pulse	EALR relay delay [ms]	S/N alarm delay [s]	Pulse suppression [ms]	Command extension to min. [ms]	Limiting of output time [ms]	*) Increase in output time by [ms]
Double system protection	0	2000	2	0	15	to 500	0
Single-phase protection	0	2000	2	0	15	to 500	0
Switching functions	0	2000	2	0	15	none	100

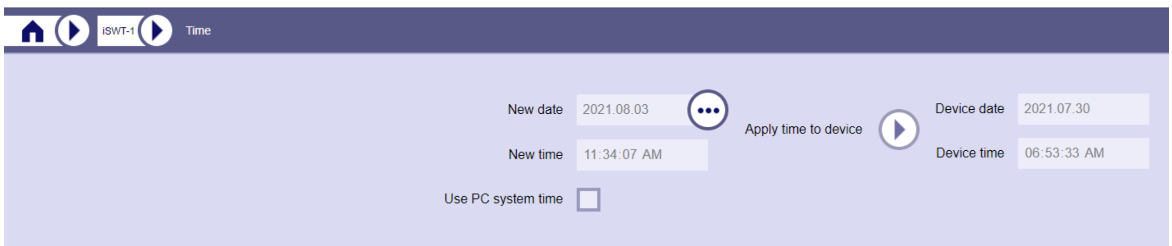
Switching functions: Time slot 20 ms

Table 3-95 Alarm setting for alternate multipurpose operation

AMP operation	Alarms
	Threshold for EAL in [dB]
Double system protection	-20
Single-phase protection	-20
Switching functions	-20

3.18.7 iSWT 3000 Date/Time

It is only possible to set the time and date after the data have been imported from a connected device.



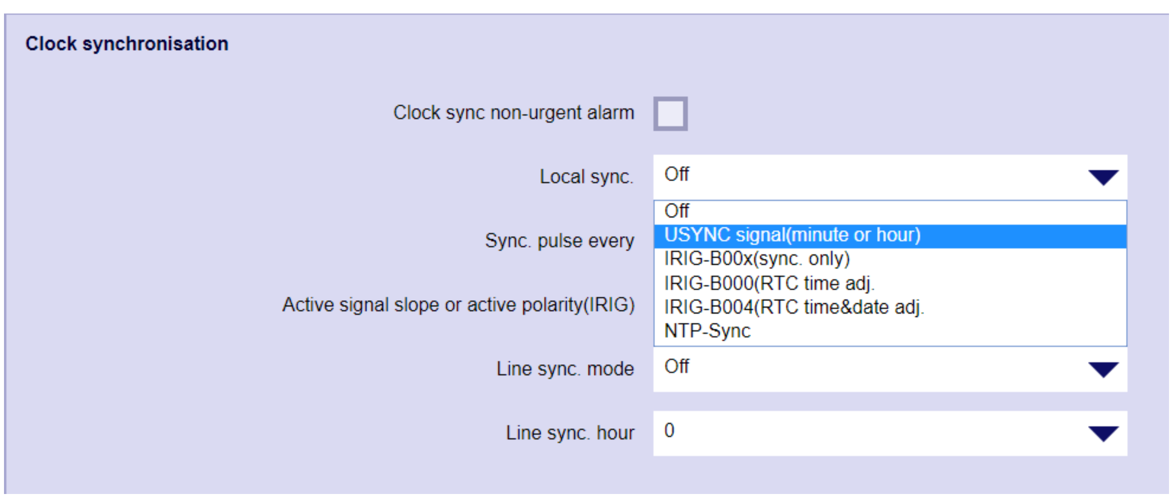
[sc_iswt_time, 1, --_--]

Figure 3-156 Setting of date and time of an iSWT 3000

For the time adjustment the option <**use PC system time**> or a manual adjusted <**new date**> resp. <**new time**> can be used. The internal clock is adjusted when operating <**Apply time to device**>.

3.18.8 Clock Synchronization

The system-internal clock can be synchronized by an external clock. The clock synchronization input (USYNC) on the module ALR (terminal a1/c3) is provided for this. The operating point of the input voltage can be set.



[sc_iswt_clock_synchronisation, 1, --_--]

Figure 3-157 Options for the iSWT 3000 clock synchronization

The setting options for the local sync are described in the table below.

Table 3-96 Setting options for the local clock synchronization of the iSWT 3000

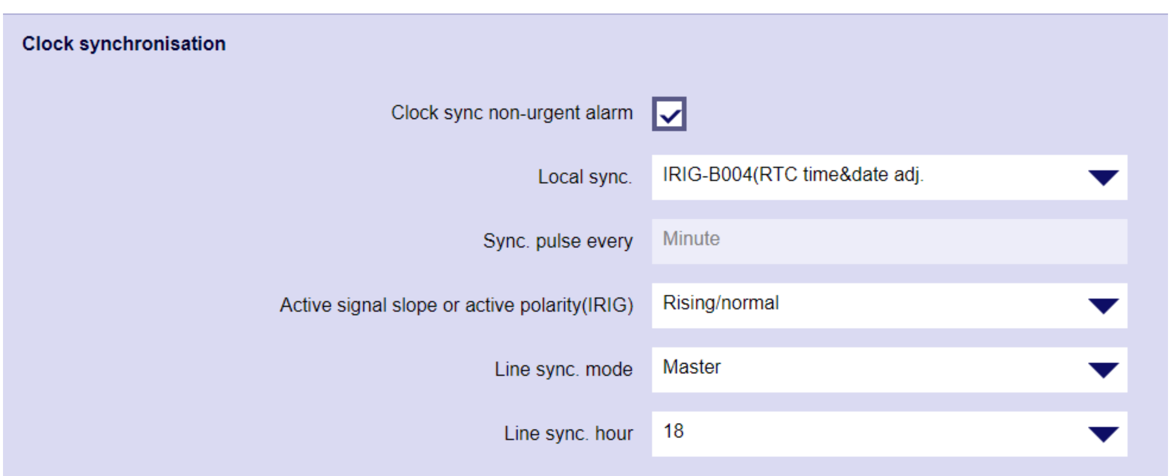
Adjustment local sync	Remarks
OFF	No local clock synchronization
USYNC signal (minute or hour)	An external impulse is received via the USYNC input every minute resp. hour. The active signal slope rising or falling is synchronizing the RTC seconds. Note: If the local sync setting of CSPi is adjusted to NTP, iSWT receives a sync signal from the CSPi
IRIG-B00x (sync only)	The IRIG-B message is received via the USYNC input and decoded. With each change of the IRIG-B minutes the RTC seconds are synchronized
IRIG-B000 (RTC time adj.)	The IRIG-B message is received via the USYNC input and decoded. With each change of the IRIG-B minutes the RTC seconds are synchronized. Additional the IRIG-B-time (hour, min-utes, seconds) is compared with the RTC time of the iSWT. In case of a difference the IRIG-B values are taken over into the RTC.
IRIG-B004 (RTC time&date adj.)	The IRIG-B message is received via the USYNC input and decoded. With each change of the IRIG-B minutes the RTC seconds are synchronized. Additional the IRIG-B-time & date is compared with the RTC time & date of the iSWT. In case of a difference the IRIG-B values are taken over into the RTC.
NTP-Sync	Synchronization of the RTC with the network time protocol. This function requires additional a SNMP Server V1.32 or higher

NOTE

In case of IRIG-B sync:

For input voltages of 5 V and 12 V the actual alarm module ALR (refer to *3.21.4 PowerLink Alarm Configuration - ALR Module* is required.

In the configuration form for the clock synchronization additional a non urgent alarm (NUALR) can be acti-vated in case of USYNC failure (see figure below).



[sc_iswt_clock_synchronisation_nu_alarm, 1, --_--]

Figure 3-158 Activation of NU alarm in case of USYNC failure

Line Clock Synchronization

It is also possible to synchronize the clock through 1 of the devices via the connecting route (line sync. mode <**off**>, <**Master**>, <**Slave**>. The device that is to perform the synchronization is designated as the “master” and the device to be synchronized as the “slave” [2]. This means that it is only necessary to synchronize 1 device (the master) externally [1].

The line synchronization is performed once a day at 24:00 resp. at the time defined with <**Line sync. hour**>. by transmitting the synchronizing tone (fs). The difference in time between master and slave must not be greater than 30 sec otherwise clock synchronization is not possible. The maximum difference in the time between master and slave is thus the signal run time.

Select <**Line synch.**> <**off**> for both devices if both devices are provided with external synchronizing pulses [3]. In this case synchronization between the devices is **not** implemented.

3.19 Tx Level Adjustment

3.19.1 TX Level Setting

At **Configuration – System** the type of amplifier has to be selected.

PLPA amplifier

Select the provided hardware and power amplifier (PLPA: up to 1 x 25 W; up to 1 x 50 W etc.). Select the impedance of the HF output and adjust the output power.

Output power adjustment:

For some reasons it is necessary to adjust the output power to a certain value:

- in case of limitations by regulation authorities
- for frequency planning (re-use of the frequency band)
- overload of the amplifier by out-of-band signals

Using adjacent Tx and Rx bands it is necessary to reduce the output power according the following tables:

Table 3-97 Max output power adjustment PowerLink 50/100 Low Band

Amplifier	Mode	PowerLink 50/100-LB max. output power [Watt] 24 – 500 kHz
PLPA: up to 1 x 25 W	NADJ ADJ	25 W (+44 dBm)
PLPA: up to 1 x 50 W	NADJ	50 W (+47 dBm)
	ADJ*)	32 W (+45 dBm)
PLPA: up to 2 x 25 W	NADJ ADJ	50 W (+47 dBm)
PLPA: up to 2 x 50 W	NADJ	100 W (+50 dBm)
	ADJ *)	63 W (+48 dBm)

*) The PLPA output power in adjacent mode corresponds with the output power of PowerLink with PLE
LB = Low frequency band

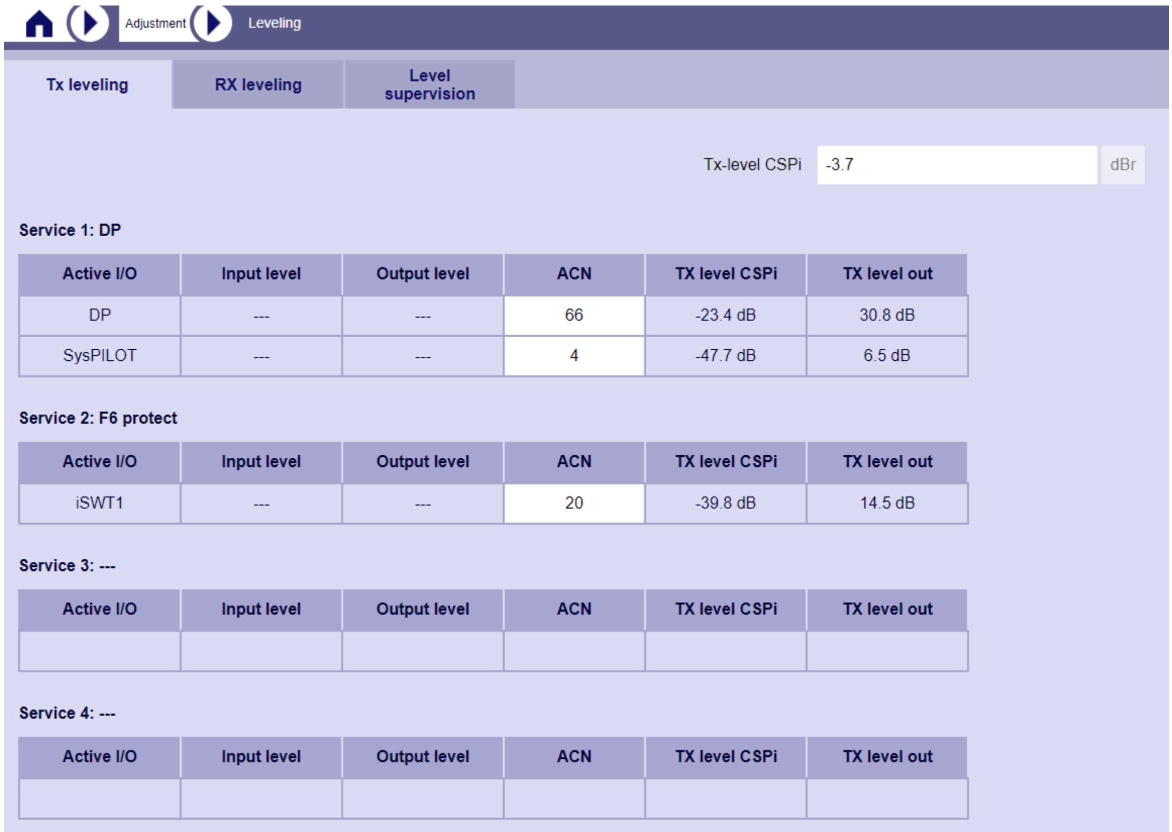
Table 3-98 Max output power adjustment PowerLink 50/100 High Band

Amplifier	Mode	PowerLink 50/100-HB max. output power [Watt]				
		500 kHz - 600 kHz	600 kHz -700 kHz	700 kHz - 800 kHz	800 kHz - 900 kHz	900 kHz - 1000 kHz
PLPA: up to 1 x 25 W	NADJ ADJ	20 W	18.5 W	17 W	15.5 W	14.5 W
PLPA: up to 1 x 50 W	NADJ ADJ	40 W	37 W	34 W	31 W	29 W
PLPA: up to 2 x 25 W	NADJ ADJ	40 W	37 W	34 W	31 W	29 W
PLPA: up to 2 x 50 W	NADJ ADJ	80 W	74 W	68 W	62 W	58 W

HB = High frequency band

3.19.2 TX Leveling with PLPA

With the form <**Adjustment - Leveling - TX-Leveling**> a fully automatic transmit level setting of the configured services is performed. Depending on the selected amplifier and the adjusted output power the corresponding TX level output is shown.



[sc_adjustment_leveling, 1, --_--]

Figure 3-159 Tx level setting with PLPA amplifier

The Tx output level of the SysPil has to be measured (refer to *3.19.4 Measuring the Tx Levels at the PLPA Output*) and verified with the displayed values. In case of difference a correction may be carried out with the Tx Level CSPi fine adjustment. The adjustable range is -4.5 dBr up to +1.0 dBr in steps of 0.1 dB (default: 0.0 dBr).

The values displayed under Tx Level CSPi can be measured at the HF output CSPi.

3.19.3 Tx Level Setting DP

When using the Data Pump function DP the signal generator has to be used for the level setting. The signal generator is located in the form <**Test - Signal generator**>.

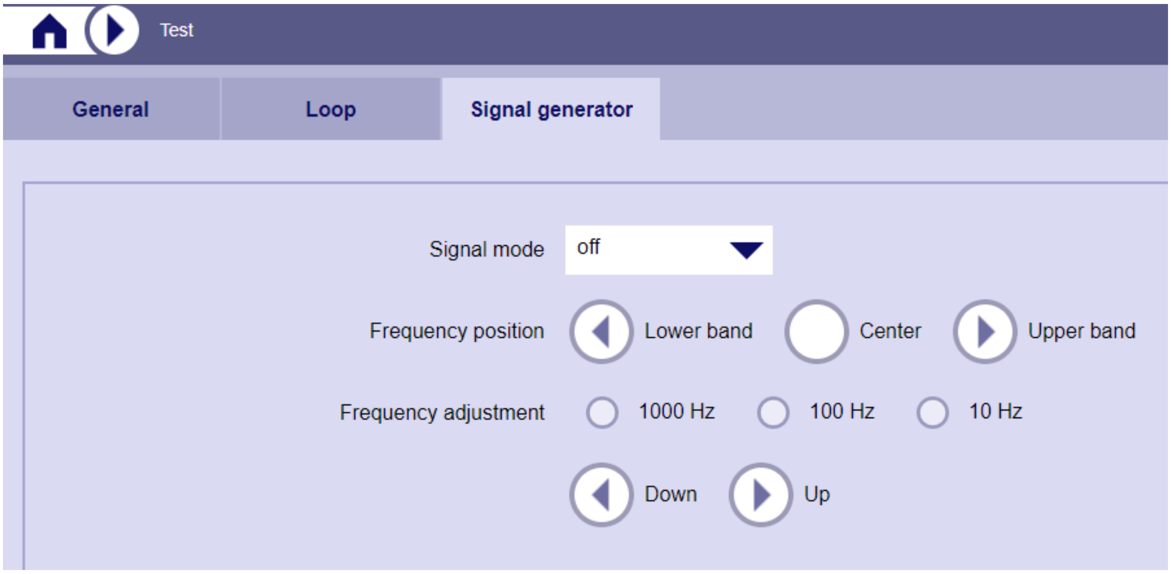


Figure 3-160 The signal generator of the Data Pump

When the signal generator is on it is generating the center frequency. With the button “upperB” resp. “lowerB” it can be adjusted to the upper resp. lower band limit. Additional it is possible to adjust the frequency of the signal generator in steps of 10, 100 resp. 1000 Hz. The corresponding HF frequencies are calculated from the PowerSys program and displayed in the form <**Service**>.

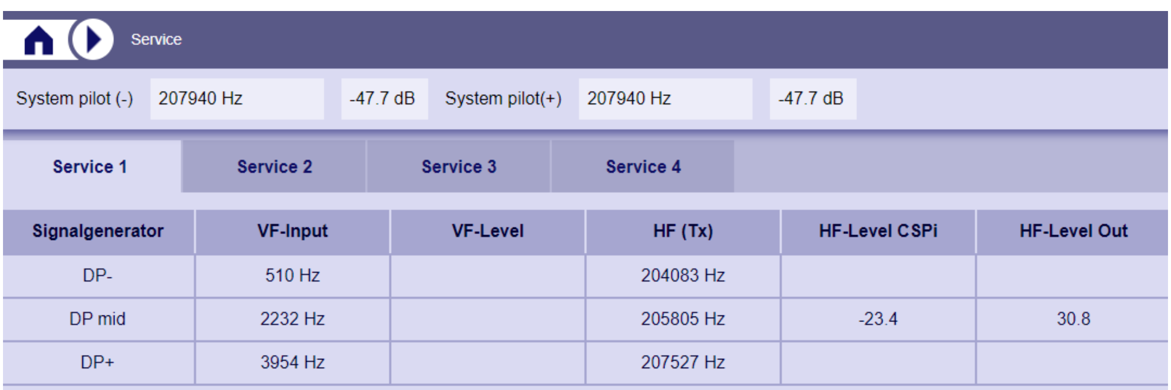
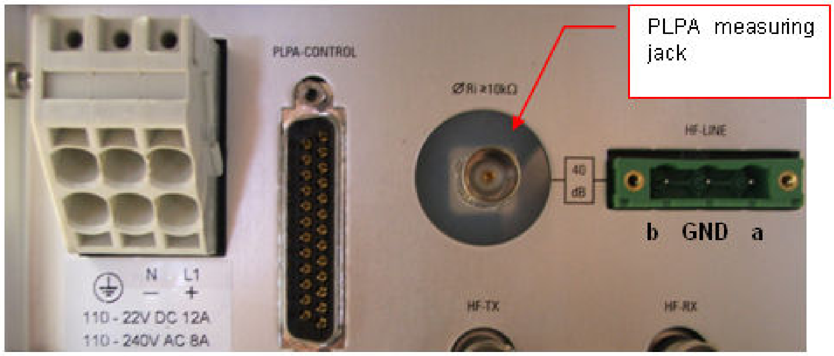


Figure 3-161 Display of the HF frequencies for the service Data Pump

Additional to the signal generator the system pilot is displayed from the service program and has to be checked. The min HF output level from the service can be calculated by adding the displayed gain from the corresponding amplifier to the HF level CSPi.

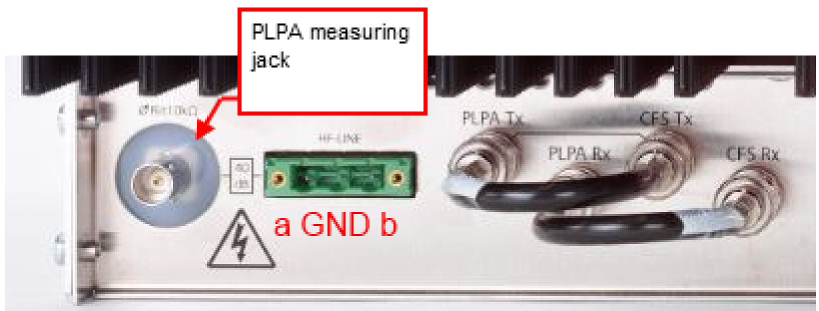
3.19.4 Measuring the Tx Levels at the PLPA Output

The Tx levels and frequencies for the various services displayed in the PowerSys menu <**Information – Services**> can be measured at the PLPA output measuring jack. Compared with the signal at the HF output to the line, **the signal is 40 dB reduced**. This makes it possible to use level meters without additional pre-attenuator.



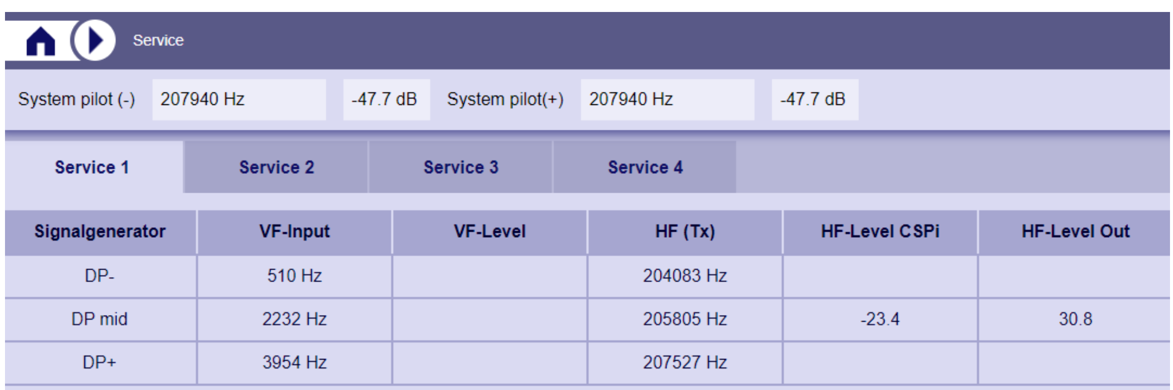
[scmstxlp-021210-01.tif, 1, en_US]

Figure 3-162 Measuring the Tx levels at the PLPA - PowerLink 100



[PowerLink50S_rueck_Asusschnitt-PLPA, 2, --_--]

Figure 3-163 Measuring the Tx levels at the PLPA - PowerLink 50



Signalgenerator	VF-Input	VF-Level	HF (Tx)	HF-Level CSPi	HF-Level Out
DP-	510 Hz		204083 Hz		
DP mid	2232 Hz		205805 Hz	-23.4	30.8
DP+	3954 Hz		207527 Hz		

[sc_service1, 1, --_--]

Figure 3-164 The Menu <Service>

NOTE

During the level measurement the HF- line output of the equipment has to be terminated with the dummy load that has to be set to corresponding impedance. Otherwise the measured level will be wrong.

Table 3-99 Level calculation for different impedances

Power Amplifier	Level [dBm]	Level at 600 Ohm	Level at 150 Ohm	Level at 75 Ohm
25 W	10*lg(25W/1mW) = 44	44 dBm	38 dB	35 dB
50 W	10*lg(50W/1mW) = 47	47 dBm	41 dB	38 dB
100 W	10*lg(100W/1mW) = 50	50 dBm	44 dB	41 dB

The max. output level of the amplifier can be calculated also by using the formula below

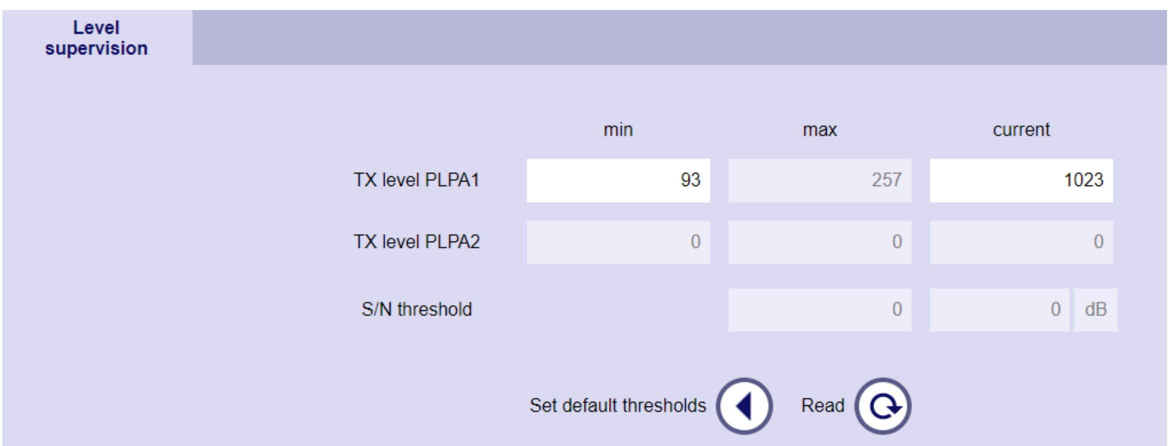
$$L[db] = 10 \cdot \log(P/((0.775^2)/R))$$

[fomxolma-201113-01.tif, 1, en_US]

L = Output level in dB
P = Output power in Watt
R = Impedance in Ohm
Power and voltage level have the same value at a impedance of 600 Ohm.

3.19.5 TX Level Supervision

In the menu < **Adjustment – Leveling – Leveling supervision**> thresholds can be set for the Tx level supervision. Tx alarm is activated when the value of the current level is less than the adjusted min value.



[sc_adjustment_level_supervision, 1, --_--]

Figure 3-165 Threshold setting for the Tx level supervision

It is recommended that the current values are read when the link is in **normal operation**. The supervisory is activated with the button <**Set default thresholds**>.

NOTE

The supervision is switched off, when the **min. values are set to "0"**!

S/N Threshold

With this adjustment the threshold for the S/N supervision of the system pilot is set. The range is between -40 (most sensitive value) and 0 dB. The setting is only possible for analog services. In case of using Data Pump only, this setting is not activated, because the Data Pump has its own S/N supervision.

3.20 Receive Level Adjustment

3.20.1 General Information

The receive level of the PowerLink is adjusted by setting the DIL switches in the Receive Filter module (RXF-XB). The adjustment procedure is supported by the program PLPAStraps (version 1.4 or higher) with the menu: ... / RXF / Level Correction. The subsequent chapters describe the procedure in detail.

NOTE

For setting the target value of the RX level, the weather conditions have to be taken into account. In case of bad weather conditions (e.g. heavy rain, snow, ice) during commissioning of PowerLink the line attenuation is higher than during good weather conditions (e.g. summertime, sunny weather).

That means, that the target value of the RX Level can vary between 50% and 75%.

NOTE

The input level of the equipment depends on the transmit power of the remote PowerLink, the line attenuation, the settings of input attenuation and gain inside the RXF-XB.

NOTE

After changing of any value in PLPAStraps, do not forget to save your PLPAStraps configuration in a file for easy reuse of this values.

RX level reduction

Reducing the RX level from PowerLink is possible by adjusting the input attenuation and the gain on RXF-XB module.

Input attenuation

The input attenuation prevents the RXF-XB from intermodulation. In case of bad Data Pump SNR a higher input attenuation may be helpful, on the other hand the SNR will drop if the input attenuation is too high.

The input attenuator is selected between 3 dB and 18 dB and set by means of the switch S101. The corresponding switch positions are displayed when selecting <**RXF / Level correction**>.

Basic Gain

The RXF-XB basic gain has to be set according the desired AGC range for increasing input level. An AGC position of 75% provides a control range for increasing input level of approximately 12 dB. If the AGC value is too high or clipping of the CSPi input analog - to - digital converter (ADC) occurs, a lower RXF-XB gain is necessary (e.g. -20 dB instead of -10 dB).

The selected basic gain of the RXF-XB is set between 0 dB and -30 dB by means of the switch S401 (S401.1 to S401.4). The corresponding switch positions are displayed when selecting <**RXF / Level correction**>.

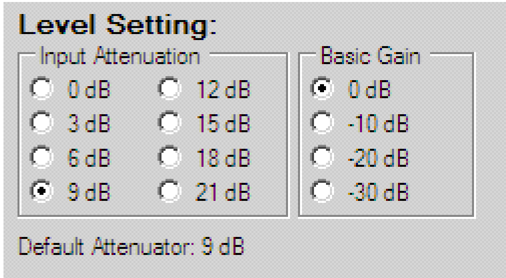
Remark: A change of 1% of AGC position correlates to a change of approximately 0.5 dB of the level.

3.20.2 Basic Level Setting

The basic level setting has to be done first.

Run the program PLPAStraps and fill in the configuration (menu <**Configuration**>) of the equipment, or open the file that contains this information.

By switching to PLPAStraps menu <**Straps settings / RXF / Level Correction**> the default values for the configuration are calculated according the frequency and bandwidth. With selection of ‚<**Straps settings / RXF / Level Correction**> the following menu appears:



[scrxflst-180913-01.tif, 1, --_--]

Figure 3-166 PLPAStraps Setting options for RXF level setting

NOTE

Values have to be added! The result has to be marked as Input attenuation.

Example shows: 9 dB + 0 dB If the result of the addition is more than the highest possible input attenuation adjustment, select the highest possible input attenuation.

In addition to the calculation of PLPAStraps, it is necessary to correct the adjustment of the input attenuation according to the used configuration as shown in the table below.

Table 3-100 RXF-XB level setting

Tx-Rx-bands	Service	max. line attenuation **)	default input attenu-ation plus *)	Basic Gain
NADJ	analog	5 dB	9 dB	0 dB
	analog	15 dB	6 dB	0 dB
	analog	25 dB	3 dB	0 dB
	analog	> 25 dB	0 dB	0 dB
	DP / DP+analog	5 dB	9 dB	0 dB
	DP / DP+analog	15 dB	6 dB	0 dB
	DP / DP+analog	25 dB	3 dB	0 dB
	DP / DP+analog	> 25 dB	0 dB	0 dB
ADJ	analog	5 dB	9 dB	0 dB
	analog	15 dB	9 dB	0 dB
	analog	25 dB	6 dB	0 dB
	analog	> 25 dB	3 dB	0 dB
	DP / DP+analog	5 dB	9 dB	0 dB
	DP / DP+analog	15 dB	9 dB	0 dB
	DP / DP+analog	25 dB	6 dB	0 dB

NADJ Non adjacent
ADJ adjacent
*) select the result as input attenuator of RXF if possible, otherwise select the highest possible input attenuation
**) complete transmission path from Tx output to Rx input

After marking the calculated value for input attenuation the actual setting for DIL-switch **S101** is calculated and shown on the screen.

Switch off PowerLink, remove the RXF module from PowerLink and readjust the DIL-switch **S101** of the RXF module. After the adjustment insert the RXF module into PowerLink and switch on the equipment.

3.20.3 All Operations except Single Purpose

For all PowerLink configurations except of the Single Purpose Operation of an (i)SWT 3000 the Automatic Gain Control (AGC) is active. The adjustment of the working point is done by the AGC. The input gain actuator is fixed to the position Max. The position of the input gain actuator can not be changed by the user.

In case of overflow is indicated check the **ADC** settings in *Rules for adjustment of the ADC*.

[sc_adjustment_rx_leveling, 1, --_--]

Figure 3-167 The PowerSys Adjustment – RX-Leveling

The RX Level is adjusted by the AGC. The actual value of the AGC is indicated by the RX Level bar chart. The RX Level indication should be approximately in the position 75. (The exact value of the AGC position is shown in <**Diagnostics - Measurement point**>)

In case the position of the RX Level is higher than the target value (approximately 75, depending on the weather conditions), it is necessary to reduce the receive level in the RXF-XB module to avoid overload of the receive path.

NOTE

The input level of the equipment depends on the transmit power of the transmitter, the line attenuation and the settings of input attenuation and gain inside the RXF-XB.

RX Leveling

In case the actual RX Level is not within the target range, the working point for the AGC has to be adjusted in the following way:

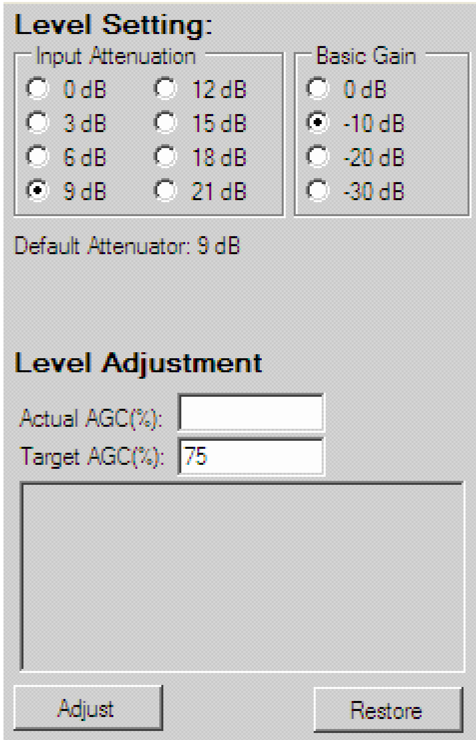
Actual RX Level higher than target value

If the actual value is within ±4 % of the target value the leveling of the equipment is done.

Otherwise run the program PLPAStraps and fill in the configuration (menu <**Configuration**>) of the equipment, or open the file that contains this information.

Change to the menu <**Straps settings / RXF / Level Correction**>

Decrease the actual setting of Basic Gain by -10 dB (e.g. change from 0 dB to -10 dB).



[scrxflvl-120813-01.tif, 1, --_--]

Figure 3-168 PLPAStraps Setting options for RXF leveling

After marking the new value for Basic Gain the actual setting for DIL-switch S401 is calculated and shown on the screen.

Switch off PowerLink and readjust the DIL-switch **S401** of the RXF module. Then insert the RXF module into PowerLink, switch on the equipment and check the actual value of “RX Level” with PowerSys.

Continue with RX Leveling.

NOTE

If the actual value of RX Level is still higher than the target value while Basic Gain is in the position -30 dB,

* the input attenuator of RXF can be increased (e.g. 12 dB instead of 9 dB)

*or the transmit level of the remote PowerLink can be reduced

(ref. to TX level fine adjustment). to decrease the input level of PowerLink.

Actual RX Level lower than target value

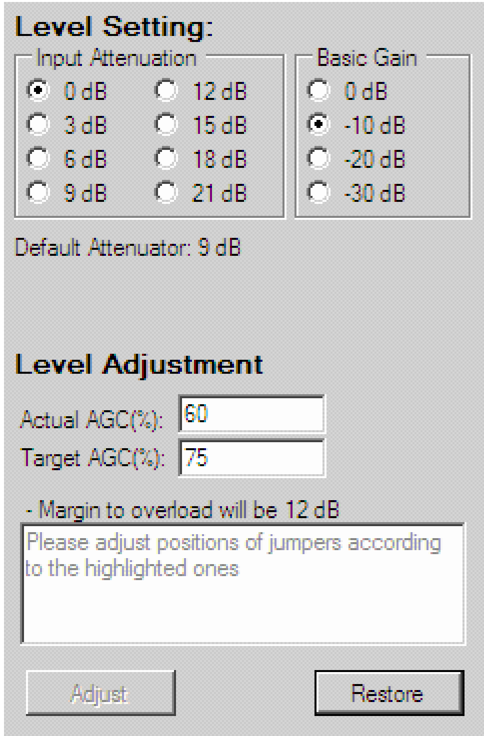
If the actual value is within ±4 % of the target value the leveling of the equipment is done.

Otherwise run the program PLPAStraps and fill in the configuration (menu <**Configuration**> of the equipment, or open the file that contains this information.

Change to the menu <**Straps settings / RXF / Level Correction**>

Fill in the input parameters

- actual value of AGC
- target value of AGC
- push the Adjust button



[scrxflv2-120813-01.tif, 1, --_--]

Figure 3-169 PLPAStraps Setting options for RXF leveling

Depending on this information the program PLPAStraps calculates the necessary output amplification of the RXF module and shows the actual setting for DIL-switch **S501** on the screen. In addition the program shows the information about the margin to overload depending on the target setting.

Switch off PowerLink and readjust the DIL-switch **S501** of the RXF module. Then insert the RXF module into PowerLink, switch on the equipment and check the actual value of “RX Level” with PowerSys. Now the actual RX Level should be close to the chosen target value.

If the actual value of the RX Level is indicated correctly, switch of PowerLink remove the RXF module and mount the housing of the RXF module. Now the RXF module is ready for working.

Pushing the Restore button all switches will be displayed in blue.

3.20.4 Single Purpose Operation

When PowerLink is working in Single Purpose Operation the Automatic Gain Control (AGC) is switched off. Thus the receive level of the PowerLink has to be adjusted to a fix working point.

The adjustment of the RX level working point is executed in two steps

- 1. Adjustment of Basic Gain, Receive Level attenuation and RXF output amplifier in the Receive Filter module RXF-XB and
- 2. Adjustment of the “Input gain” controller in the menu <**PowerLink – Adjustments – RX-Leveling**>.

NOTE

For setting the target value of the RX level, the weather conditions have to be taken into account. In case of bad weather conditions (e.g. heavy rain, snow, ice) during commissioning of PowerLink the line attenuation is higher than during good weather conditions (e.g. summertime, sunny weather).

That means, that the target value of the RX Level can vary between 50% and 75%.

NOTE

The input level of the equipment depends on the transmit power of the remote PowerLink, the line attenuation, the settings of input attenuation and gain inside the RXF-XB.

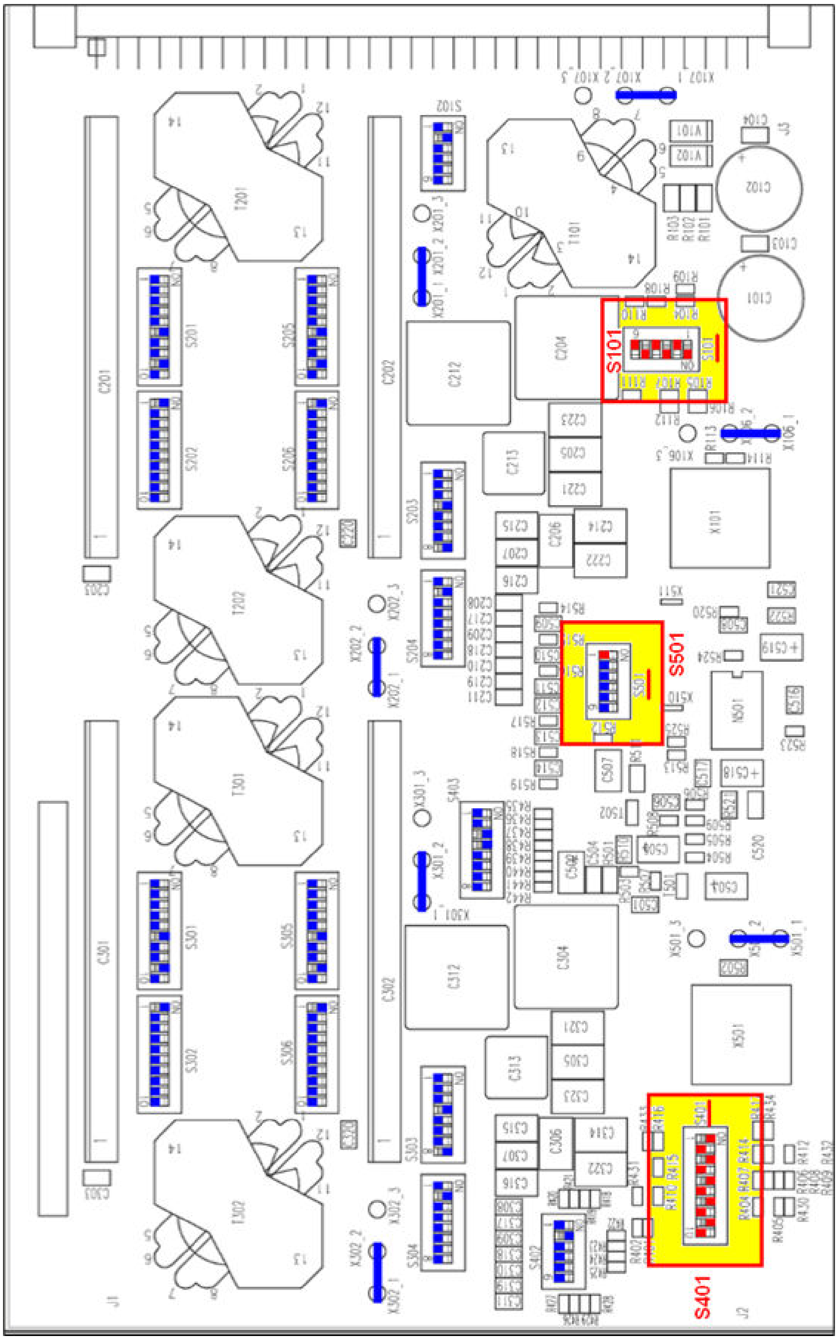
NOTE

After changing of any value in PLPAStraps, do not forget to save your PLPAStraps configuration in a file for easy reuse of this values.

Adjustment of the RXF-XB module

In order to prevent an intermodulation of the TX signal to the RX signal and an ADC overflow (“Clipping”) the RX filter module has to be adjusted with a **maximum attenuation**.

Switch off PowerLink and remove the RXF-XB module for the adjustment. Refer to the figure and tables below for adjustment of the switches S101, S401 and S501 to the proposed settings.



[scrxfspu-010813-01.tif, 1, en_US]

Figure 3-170 Adjustment of RXF-XB module for F6 - Single purpose configuration

S101 RXF Input Attenuator
S401 RXF Output Attenuator (Basic Gain)
S501 RXF Output Amplifier

Table 3-101 Adjustment of RXF-XB module for F6 - Single purpose configuration

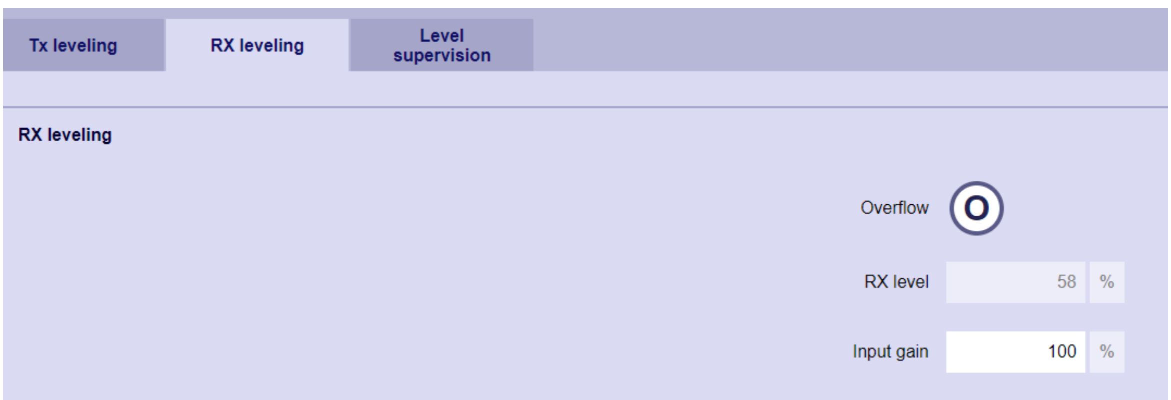
	S101	S401	S501
Switch position	RXF Input Attenuator	RXF Output Attenuator (Basic Gain)	RXF Output Amplifier
.1	On	On	Off

	S101	S401	S501
.2	Off	Off	Off
.3	On	On	Off
.4	Off	Off	Off
.5	On	On	Off
.6	Off	Off	Off
.7	-	On	-
.8	-	Off	-
.9	-	On	-
.10	-	Off	-

RX Leveling with PowerSys

After adjustment of the RXF-XB module the fine adjustment of the working point of the input signal is made by the input gain actuator in PowerSys menu <**Adjustment - RX Leveling**> adjustable for the Single Purpose (SP) operation.

Adjust the <**Input Gain**> to a level position of **approximately 80 %**, where the displayed <**RX Level**> reaches a value of approximately 20 %. The exact value can also be checked in the menu <**Information – System**>.



[sc_adjustment_rx_leveling, 1, --_--]

Figure 3-171 PowerSys form Adjustment - RX Leveling for F6 protection, Single purpose

Hints for the adjustment of the <**Input Gain**> actuator:

- The RX level shows the level in percent, whereas the adjustment range of the <**Input Gain**> is logarithmic in dB. Minor adjustment changes therefore result in higher changes of the level position in the RX level - it requires a sensitive flair by the operator.
- The above given adjustment proposal of approximately 20 % RX level indication is given as a rule of thumb for a PLPA 50 Watt and an average line attenuation of approximately
  - 15 dB with adjacent TX / RX bands resp.
  - 20 dB with non adjacent TX / RX bands

  Lower line attenuation will result in a higher RX level indication. For a higher line attenuation the displayed RX level is accordingly lower.

The input level of the equipment depends on the transmit power of the remote transmitter, the line attenuation and the settings of input attenuation and gain inside the RXF-XB. For setting the target value of the RX level, the weather conditions have to be taken into account. In case of bad weather conditions (e.g. heavy rain, snow, ice) during commissioning of PowerLink the line attenuation is higher than during good weather conditions (e.g. summertime, sunny weather). That means, the target value of the RX Level can vary between 50% and 75%.

In case of an ADC overflow check first the ADC settings according to Chapter *3.8.1 ADC Adjustments*. If the ADC still overflows afterwards, make sure the switches in RX filter module are correctly set to the maximum attenuation. Readjust the <**Input Gain**> actuator to a lower level. If the input level is still to high the transmit level of the remote transmitter has to be reduced.

In case the receive level is too low it may be required to readjust the RXF-XB module to a lower attenuation.

If the actual value of the RX Level is indicated correctly, switch off PowerLink remove the RXF-XB module and mount the housing of the Receive Filter module. Now the RXF-XB module is ready for working.

NOTE

In case the PowerLink works in Single Purpose Operation with an (i)SWT 3000 exclusively the Automatic Crosstalk Cancellation (AXC) function has to be deactivated by all means. For details, refer to Chapter *HF Configuration*.

3.20.5 RX LED Indication

[sccspild-021210-01.tif, 1, en_US]

Figure 3-172 CSPi LED

Table 3-102 RX LED

State	Reasons
Off	a) power off or b) system failure!
green	Receiver ok. Pilot alarm is off. AGC alarm is off, Signal to noise alarm is off
green slow blinking	Overload in receive path – input level to high). (AGC reached 100%)
green fast blinking	Signal to noise alarm
red	MODDSP error
red slow blinking	Level alarm! Pilot alarm is on
red fast blinking	ADC overflow, see also display overflow in the form <**Adjustments – RX leveling**>. For further adjustment from the ADC ref. to *ADC Adjustments*

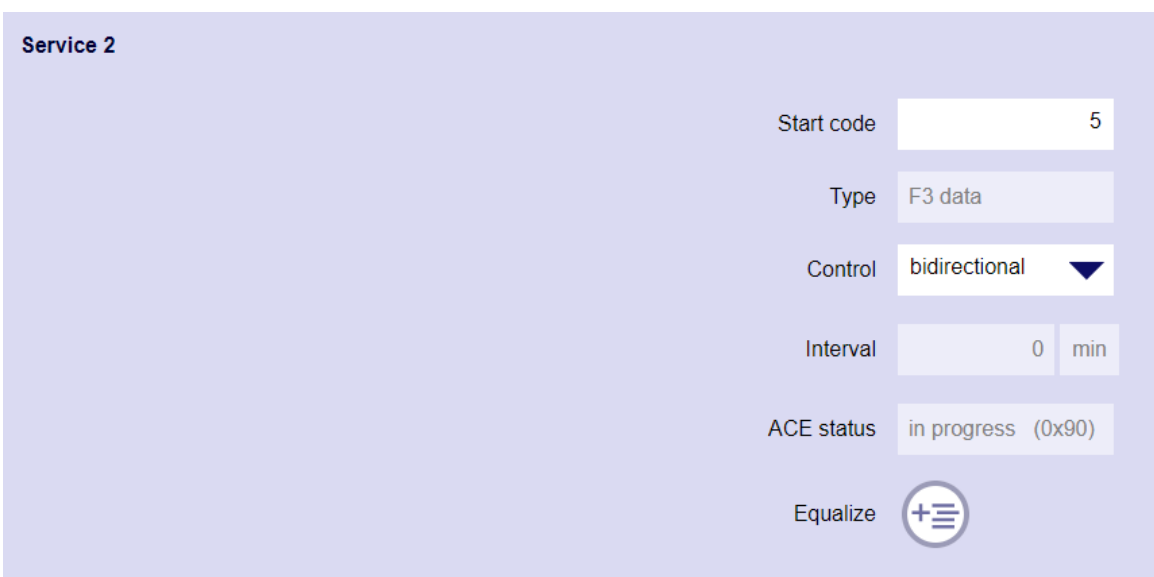
3.21 Futher Configuration Settings and Adjustment Options

3.21.1 Configuration of Automatic Channel Equalization ACE

The PowerLink system contains an automatic channel equalizer (ACE) which equalizes attenuation distortions occurring during transmission via the high-voltage line. Equalization takes place in the receiver of the PowerLink channel, separately for voice (F2) and data (F3) services. The protection channel (F6) is not equalized. The ACE interrupts transmission of the corresponding service.

[sc_ace_ser1, 1, --_--]

Figure 3-173 Setting of the ACE for a voice channel



[sc_ace_ser2, 1, --_--]

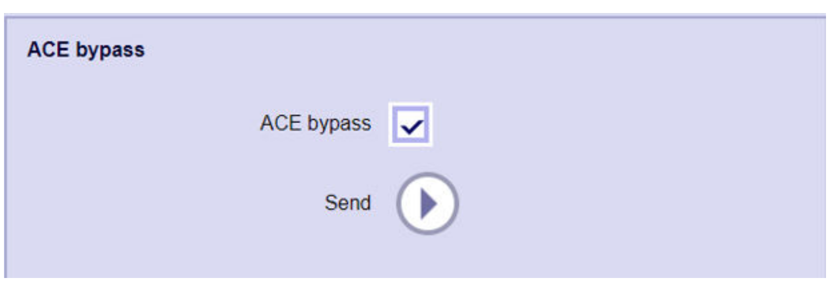
Figure 3-174 Setting of the ACE for a voice channel

Table 3-103 Setting options for the ACE

Selection	Setting Options	Remarks
Start code	1-10	To prohibit collision in a transit station with a neighboring link, 2 corresponding terminals of a link must be programmed with the **same** start code which is different for the next link.
Control	Off, bidirectional	off: ACE is off bidirectional: ACE is on. Both directions are equalized. For F2 service, it is fixed to bidirectional. For F3 service, it is configurable. It is set to "bidirectional" by default if F3 bandwidth is greater than or equal to 600 Hz. If the line condition is not good, it can be set to "off" for a better data transmission quality. ACE must be set to "off" if the bandwidth is less than 600 Hz.
Interval (voice channel only)	0	If set to "0" autom. channel equali-zation has to be started manually.
	1 to 60 min.	If set between "1 to 60min", autom. channel equalization is started at the programmed intervals when no voice signal is transmitted.
Equalize		starting the ACE
ACE status		Display of the ACE status for the corresponding service: in progress resp. enabled

3.21.2 Adjustment Option ACE Bypass

With the menu <**Adjustment –Service option**> an ACE bypass can be set for the service 1 up to 4 (depending on the system configuration). The ACE function is only available for speech and data bands.



[sc_ace_bypass, 1, --_--]

Figure 3-175 ACE Bypass setting

The bypass is activated with at the corresponding service and operating the “Send” button! With the activa-tion of the bypass the corresponding service is working without equalization.

NOTE

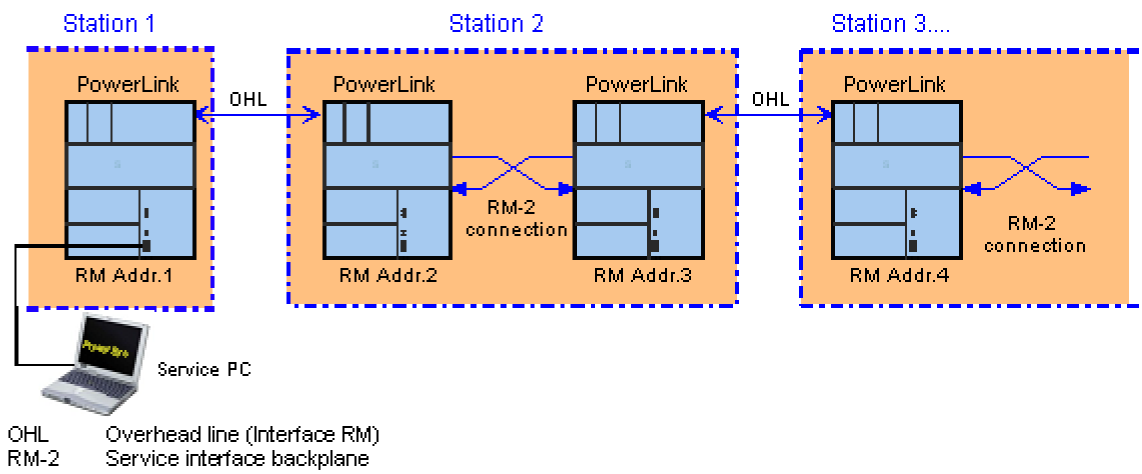
The activated bypass is only available for test purposes and **causes General Alarm** because it interrupts the normal operation mode of the system.

3.21.3 Remote Monitoring / Remote Configuration RM

With the optional service "Remote Monitoring" (RM), configuration data can be transmitted between the devices of 1 or more PowerLink routes (refer also to chapter *System Description*.

Via an additional interface (RM-2) up to 5 transmission routes can be coupled. It is possible to mix PowerLink transmission links with SWT 3000 links in arbitrary sequence.

The interface RM-2 ist not available for PowerLink 50.



[dwrcprmf-120813-01.tif, 1, en_US]

Figure 3-176 Example of a route coupling with the RM function

Table 3-104 Options for the RM channel configuration

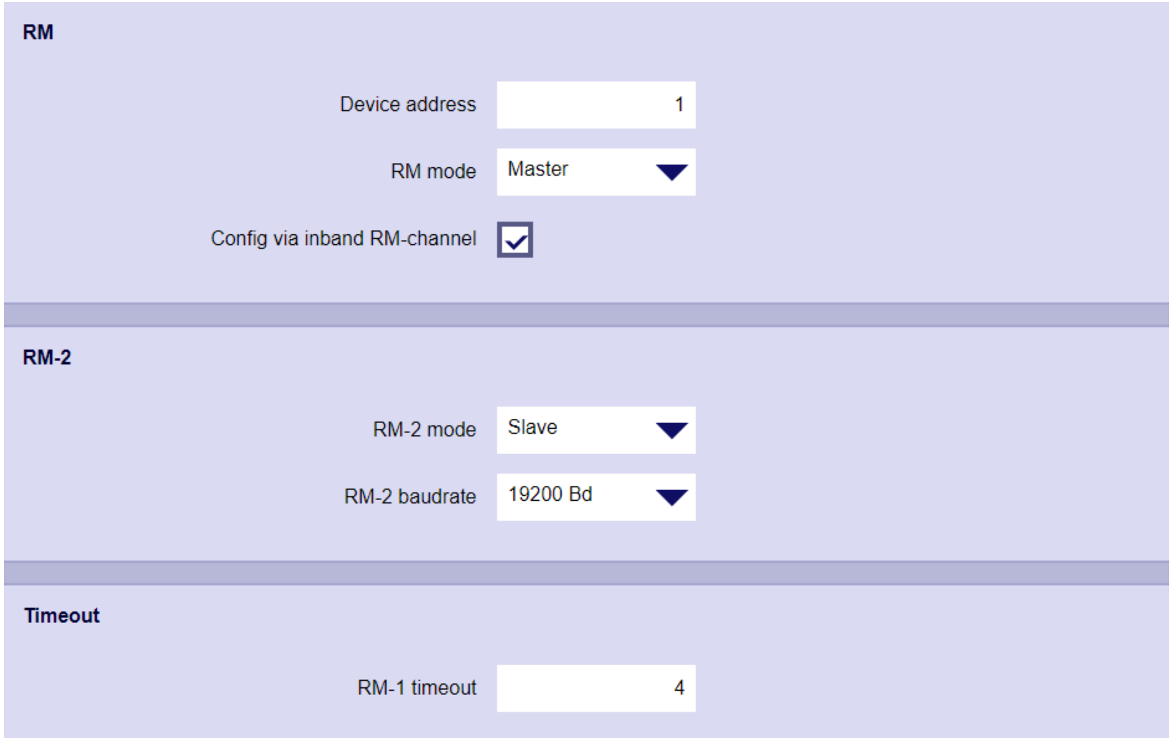
Service	RM Transmission
Voice (F2) only	The RM channel must be defined with a separate service. The number of services is in this case reduced!
Data (F3) only	The system pilot is used for the RM channel
Voice and data	A separate RM channel is necessary which can be activated in the service configuration for data (no separate service).
Integrated protection F6 SP/MP	The guard tone of the iSWT 3000 is used for the RM transmission
External F6	The RM channel must be defined with a separate service. The number of services is reduced in this case!
Data Pump	The RM channel is transmitted with 300 Bd in the overhead of the Data Pump.

The user has an option to allow a configuration of the device via RM service. For this an additional check box is available in the **RM configuration** form (refer to *Figure 3-177*).

NOTE

Also with enabled RM configuration it is still **not permitted** to change the HF resp. System configuration via RM!

After the RM service has been activated in the service configuration the device address, and the RM mode has to be defined in the form PowerLink - Configuration – RM.



[sc_configuration_rm, 1, --_--]

Figure 3-177 Configuration of the RM function

Table 3-105 Setting options for the RM configuration

Selection	Setting Options	Remarks
RM device address	0 to 249	
RM Mode	Master	Set the **remote** station as a slave
	Slave	Set the **remote** station as a master
Config. via inband RM-Channel: yes/no	☑	Configuration of the device via RM **permitted** (except HF and System config)
	☐	Configuration of the device via RM prohibited
RM-2 Mode	Master	Set the **corresponding** RM-2 interface as a slave
	Slave	Set the **corresponding** RM-2 interface as a master
RM-2 Baud rate	9600 Bd	If there is a route connection to an SWT 3000 adjust **9600 Bd**
	19 200 Bd	For PowerLink connection
RM-1 Timeout	4 – 60 s	Check also the timeout for the serial interface in the menu <**Options-Connection**>

3.21.4 PowerLink Alarm Configuration - ALR Module

The ALR module is required for the output of alarms to the Alarm Interface connector and for the signal processing of the IRIG-B clock synchronization input. For more details of IRIG-B settings refer to Chapter *Setting options for the local clock synchronization of the iSWT 3000*.

Alarm Configuration in PowerLink

In the PowerLink100 max. 2 ALR alarm modules can be integrated.

In the PowerLink50 1 ALR alarm module can be integrated.

They have to be defined in the PowerLink system configuration.

The allocation of the system alarms to the relays of the ALR modules is user selectable. The default settings for the alarms are shown in the figure below

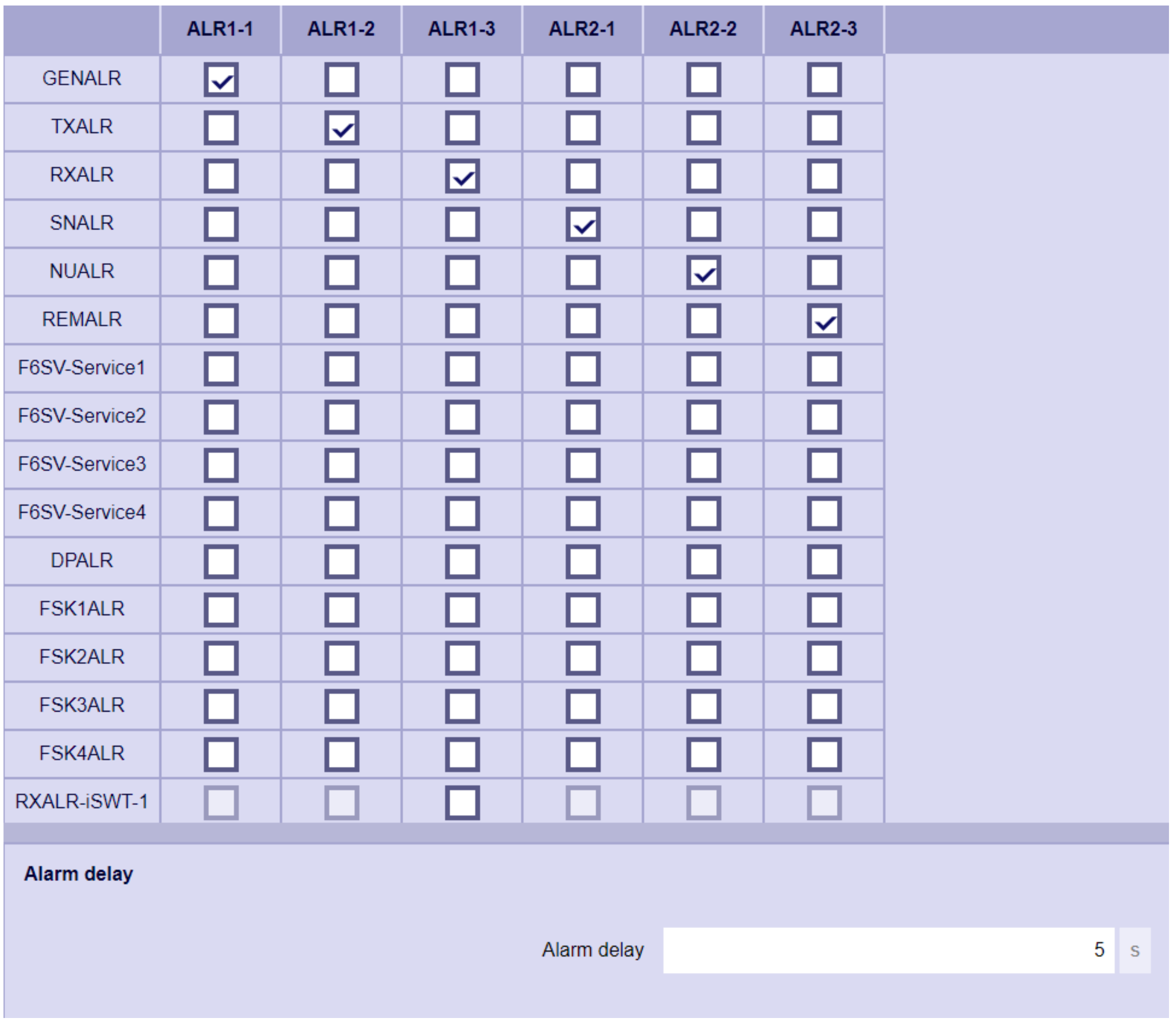


Figure 3-178 Default settings of the system alarms for 2 ALR modules

ALR1-1 up to ALR1-3 = ALR module 1 alarm output 1 up to 3

ALR2-1 up to ALR2-3 = ALR module 2 alarm output 1 up to 3

Adjustment of the ALR1-3 resp. ALR2-3

The output ALR1-3 can be allocated to the RXALR (former EALR) output of the iSWT1. The output ALR2-3 can be allocated to the RXALR output of the iSWT2 (see figure below). In this case **no additional alarm allocation** to these outputs is possible.

	ALR1-1	ALR1-2	ALR1-3	ALR2-1	ALR2-2	ALR2-3
GENALR	☑	☐	☐	☐	☐	☐
TXALR	☐	☑	☐	☐	☐	☐
RXALR	☐	☐	☐	☐	☐	☐
SNALR	☐	☐	☐	☑	☐	☐
NUALR	☐	☐	☐	☐	☑	☐
REMALR	☐	☐	☐	☐	☐	☐
F6SV-Service1	☐	☐	☐	☐	☐	☐
F6SV-Service2	☐	☐	☐	☐	☐	☐
F6SV-Service3	☐	☐	☐	☐	☐	☐
F6SV-Service4	☐	☐	☐	☐	☐	☐
DPALR	☐	☐	☐	☐	☐	☐
FSK1ALR	☐	☐	☐	☐	☐	☐
FSK2ALR	☐	☐	☐	☐	☐	☐
FSK3ALR	☐	☐	☐	☐	☐	☐
FSK4ALR	☐	☐	☐	☐	☐	☐
RXALR-iSWT-1	☐	☐	☑	☐	☐	☐
RXALR-iSWT-2	☐	☐	☐	☐	☐	☑

Alarm delay

Alarm delay 5 s

[sc_configuration_alr_rxalr_iswt, 1, --_--]

Figure 3-179 Allocation of the RXALR output from the iSWT 3000 to an alarm contact

It is possible to rank the alarm output RXALR of the integrated protection signaling device SWT 3000 to the receive alarm, unblocking impulse or to the input limitation alarm (refer to *3.18.5 Timer Setting Options for the iSWT 3000*).

F6SV Service 1 to 4 Alarm

The F6SV alarm (F6 Supervision alarm) is a supervision of the iSWT 3000 transmit level if it is working in the alternate multi purpose (AMP) operation mode with service 1 to 4. The alarm is activated if the level of the F6 transmit signal given from an external or iSWT 3000 is lower than allowed.

The supervisory is necessary, because during normal working conditions of a PLC link, the protection signal is only available inside the iSWT 3000 transmitter and not given to the far end.

In case of an iSWT 3000 this alarm can’t be tested. Only in case of a transmitter problem the alarm is given. In case of an external SWT 3000 the F6SV alarm can be tested by reducing the transmit level of the external SWT 3000 equipment.

Any F6SV alarm indicates a problem in the (i)SWT transmitter!

Additional Adjustments

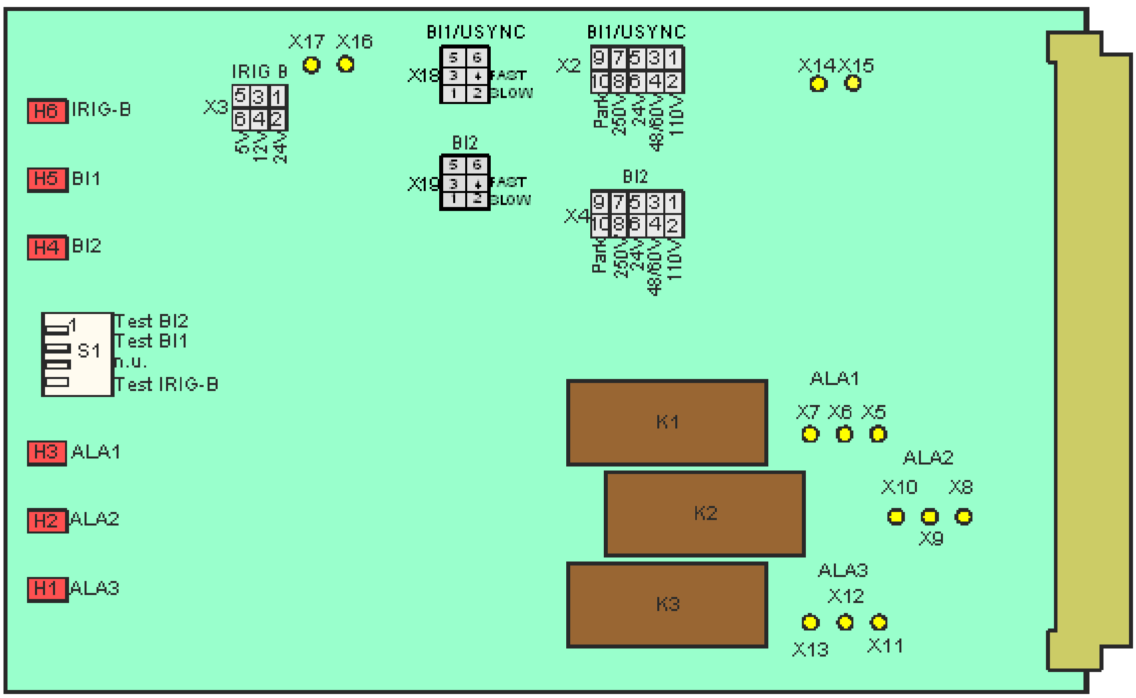
Additional a common delay time **for all relays** can be adjusted in the range from 1 up to 15 sec.

Binary Inputs

The module ALR provides 2 electrically isolated inputs BI1 and BI2 with selectable input voltage levels. As the circuits for the binary inputs comprise rectification, differential DC input signals of either polarity can be connected. The output signals of the circuits have TTL level. Binary input BI1 is alternatively configurable as an input for entering IRIG-B signals.

Relay Outputs

The alarm module comprises as well 3 alarm outputs, switched by relay (K1 – K3). The 3 relays provide change over contacts. In the standard setup the break contacts (NC) are used.



[tddsteam-120813-01.tif, 1, en_US]

Figure 3-180 Display and setting elements on the ALR module

Visual Indication

The module ALR provides a LED for visual indication of the state for each binary input and for each alarm output. They are visible after removal of the front panel. The significations are shown in the table below:

Table 3-106 ALR Indication

LED	Indication
H6	IRIG-B Input energized
H5	Binary Input 1 energized
H4	Binary input 2 energized
H3	Alarm output 1 activated
H2	Alarm output 2 activated
H1	Alarm output 3 activated

Test Switch S1

For test purposes the module ALR provides a switch for each of the binary input circuits and for the IRIG-B circuit. Closing a switch sets the output of the assigned circuit to the active state.

Switch	Function
S1.1	Binary Input 2 test
S1.2	Binary input 1 test
S1.3	n.u.
S1.4	IRIG-B test

ALR Jumper Settings

The function of the ALR jumpers is shown in the table below.

Table 3-107 ALR Jumper Settings

Jumpers					
	X2	**X3**	**X4**	**X5 – X13**	**X14 – X17**
Binary Input 1 – used with Sync Pulse					
250 V	X2 – 7/8 *)	open	---	---	X14 – X15 *)
110 V	X2 – 1/2	open	---	---	X14 – X15
48 V / 60 V	X2 – 3/4	open	---	---	X14 – X15
24 V	X2 – 5/6	open	---	---	X14 – X15
Debounce time		≈ 0.6 ms ≈ 1.0 ms	X18 – 3/4 X18 – 1/2		
24 V	open	X3 – 1/2		---	X16 – X17
12 V	open	X3 – 3/4		---	X16 – X17
5 V	open	X3 – 5/6		---	X16 – X17
Binary Input 2 – for future application					
250 V	---	---	X4 – 7/8 *)	---	---
110 V	---	---	X4 – 1/2	---	---
48 V / 60 V	---	---	X4 – 3/4	---	---
24 V	---	---	X4 – 5/6	---	---
Debounce time		≈ 0.6 ms ≈ 1.0 msX4 – 7/8 *)	X19 – 3/4 X19 – 1/2		
Alarm Output 1 Relay K1					
NC	---	---	---	X5 – X6 *)	---
NO	---	---	---	X6 – X7	---
Alarm Output 2 Relay K2					
NC	---	---	---	X8 – X9 *)	---
NO	---	---	---	X9 – X10	---
Alarm Output 3 Relay K3					
NC	---	---	---	X11 – X12 *)	---
NO	------	---	---	X12 – X13	---

NC Break contact

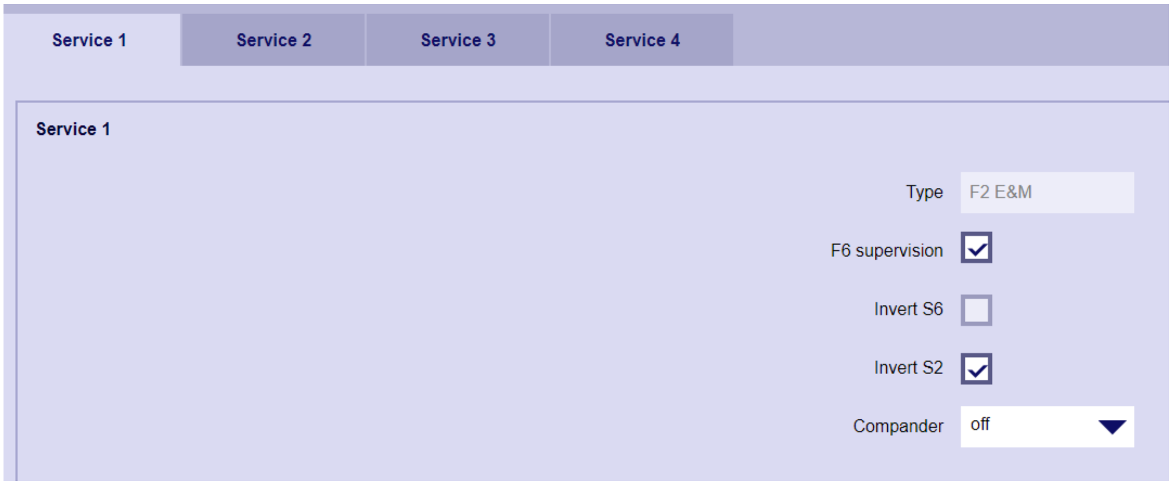
NO Make contact

*) Default setting

For the pin assignment of the Alarm Interface connector on the CFS-2 connector panel refer to the Chapter *Installation*.

3.21.5 Adjustment Options: F6 Supervision and compander

The form <**Adjustment – Service option**> offers the activation of the F6 supervision (only in case of alternate multi purpose operation with the corresponding service), the inverting of the S6 resp. S2 control wire and the activation of the compander.



[sc_adjustment_service_option, 1, --_--]

Figure 3-181 Adjustments options

Compander

The name is a combined word of compressing and expanding. The electronic circuit that does this is called a compander and works by compressing or expanding the dynamic range of an analog voice signal.

The objective is to raise low speech levels, which would make the transmission system most sensitive to noise disturbances, in the compressor of the transmitter so that these low speech signals are transmitted at an increased level over the line.

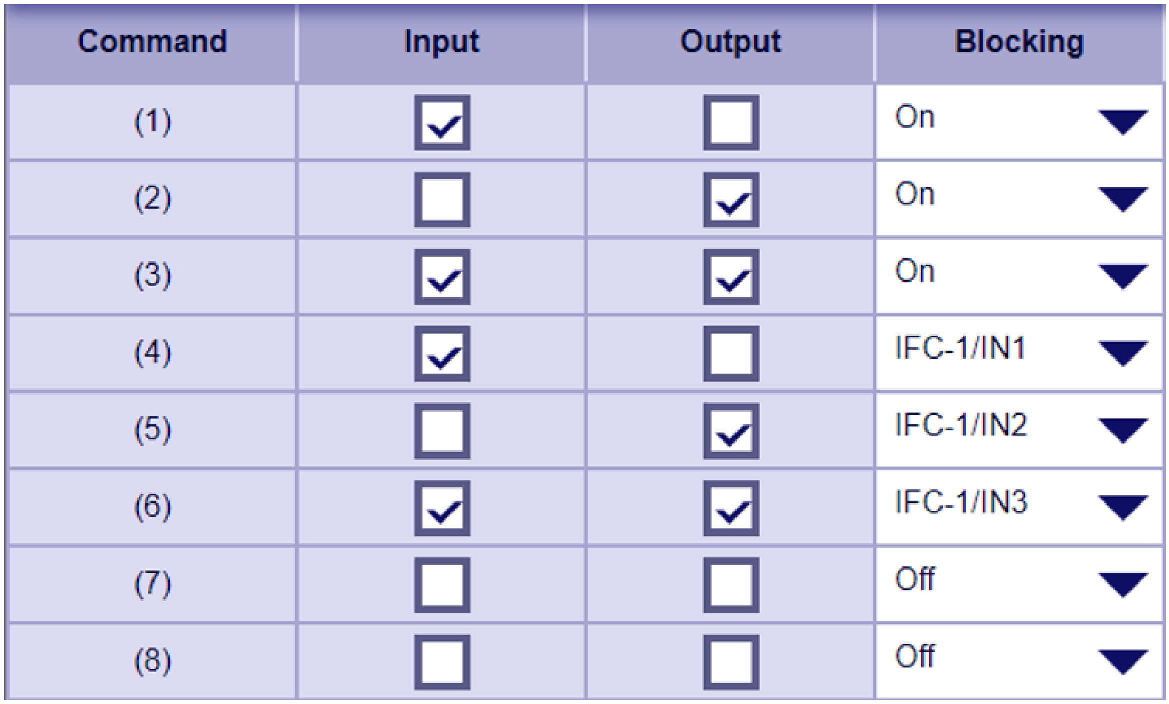
The dynamic expander in the receiving equipment serves to reduce the level raised in the compressor and, with it, the level of the noise signals picked up along the transmission route.

3.21.6 Command Blocking

Each command can be blocked independently for maintenance purpose. The control will be managed manually via software configuration (on / off) or any unused binary IFC input. Command input block is to cut off command transmission to remote side and command output block is to cut off command output on local side. The non-blocked commands are in normal operation.

If the command is activated during blocking on, the command will not be transmitted. If the command is already in transmission before blocking on, the transmitting command will not be blocked.

Block control is configurable for all protection mode under PowerSys > Adjustment > Maintenance mode. The changes are online parameter without device reset.



[sc_command_blocking, 1, --_--]

Figure 3-182 Command Blocking

Command	Blocking
(1)	Command input is blocked (On = blocked)
(2)	Command output is blocked
(3)	Command input and output are blocked
(4)	Command input is blocked by binary input IFC-1/IN 1 state (BI on = blocked, BI off = unblocked)
(5)	Command output is blocked by binary input IFC-1/IN 2 state
(6)	Command input and output are blocked by binary input IFC-1/IN 3 state
(7)..(24)	Remaining commands are in normal operation without blocking. (Off = unblocked)

Command block state is indicated by:

- PU4 LED_OK slow blinking (At least one command is blocking)
- Event log entry (command input/output block on/off for maintenance [xxx])
  Internal message for command during blocking.

4 PowerSys and Auxiliary Software Tools

4.1 Overview

The service program PowerSys is required for commissioning, maintenance, and diagnostics of the PowerLink or SWT 3000 units. This chapter gives a description of this program including the following points:

- System requirements of the service PC
- Installation of the service program
- Starting the service program
- Menu options and functions of the PowerSys buttons
- Description of the event recorder of the SWT 3000
- Firmware download or upgrade
- The program UDE MemTool
- Programming the PowerLink (CSPi and vMUX) resp. iSWT 3000 with MemTool
- Installation of the program PLPAStraps
- Description of the **PLPAStraps** program for PLPA adjustments

All **forms for system configuration and adjustments** are described with corresponding examples in the chapter *Commissioning* and **not** included in this chapter.

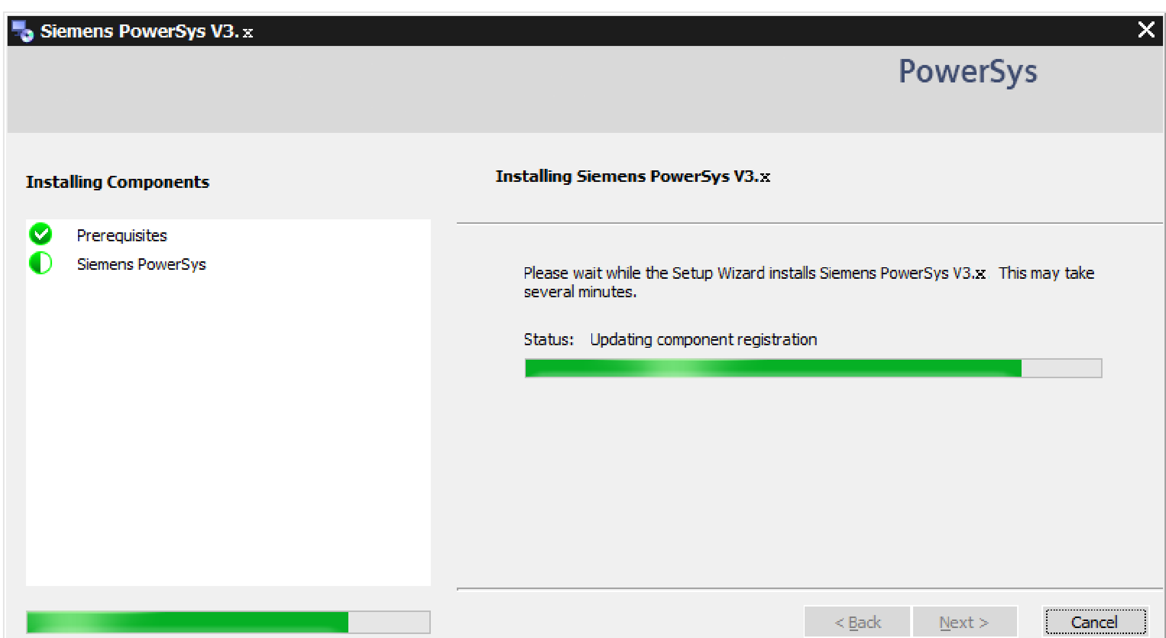
4.2 PowerSys Installation

4.2.1 Installation

The service program PowerSys is delivered as a zip file on our SIOS Internet platform for download. Run the setup.exe for the installation. The program leads you through the installation.

[sc_setup_splashscreen_powersys, 2, --_--]

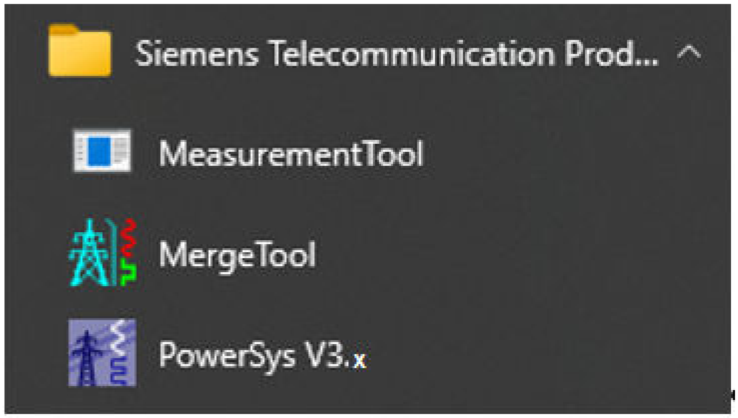
Figure 4-1 Setup Splash Screen of the Service Program PowerSys



[sc_installation_powersys, 2, --_--]

Figure 4-2 Installation of the Service Program PowerSys

New installed software PowerSys, MeasurementTool and MergeTool are located at Windows Startup Menu > Siemens Telecommunication Products.

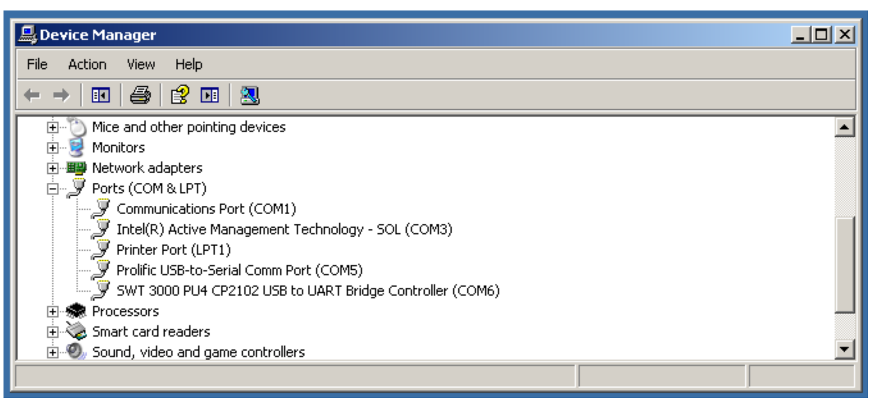


[sc_windows_startup_menu, 2, --_--]

Figure 4-3 Windows Startup Menu

With the installation setup of the PowerSys software a hardware PU4 USB driver is installed automatically. The driver is required for the connection of the service PC to the USB interface of the SWT 3000 on PU4 module.

The installation and activation of the driver is managed automatically by the Windows hardware installation wizard for Plug-and-Play devices with first connection of the PC to the SWT 3000. The COM-port number is assigned automatically to the next free serial port.



[scdeport-260313-01.tif, 1, en_US]

Figure 4-4 SWT 3000 PU4 USB to UART Bridge Controller

4.2.2 User Management

User Management

For access to device, 3 different user levels are available, each with an individual password. PowerSys does not require a password for operation. The offline configuration of a device is possible without a password.

- Control
  The configuration and settings of device can only be read. Changing of settings is not possible.
- Expert
  The user level Expert is allowed to configure the device. A reset of the device via the service PC is possible. Password change is not permitted.
- Admin
  The user level Admin enables full access to the device including password change and firmware update.

The device is delivered by factory without passwords. You can set a password for each user for the connection optionally.

To assign an initial password for the first time, leave the field current password blank and select one of the 3 different users. Each user can be assigned with an individual password.

If a password protects the device, perform the following instructions to change the password:

- Enter the current password.
- Enter the new password.
- Confirm the new password in the field Confirm password.

The password is requested from the device before the connection between the service PC and the device is established. Without entering the correct password, a connection to the device is not possible. PowerSys does not require a password for offline configuration.

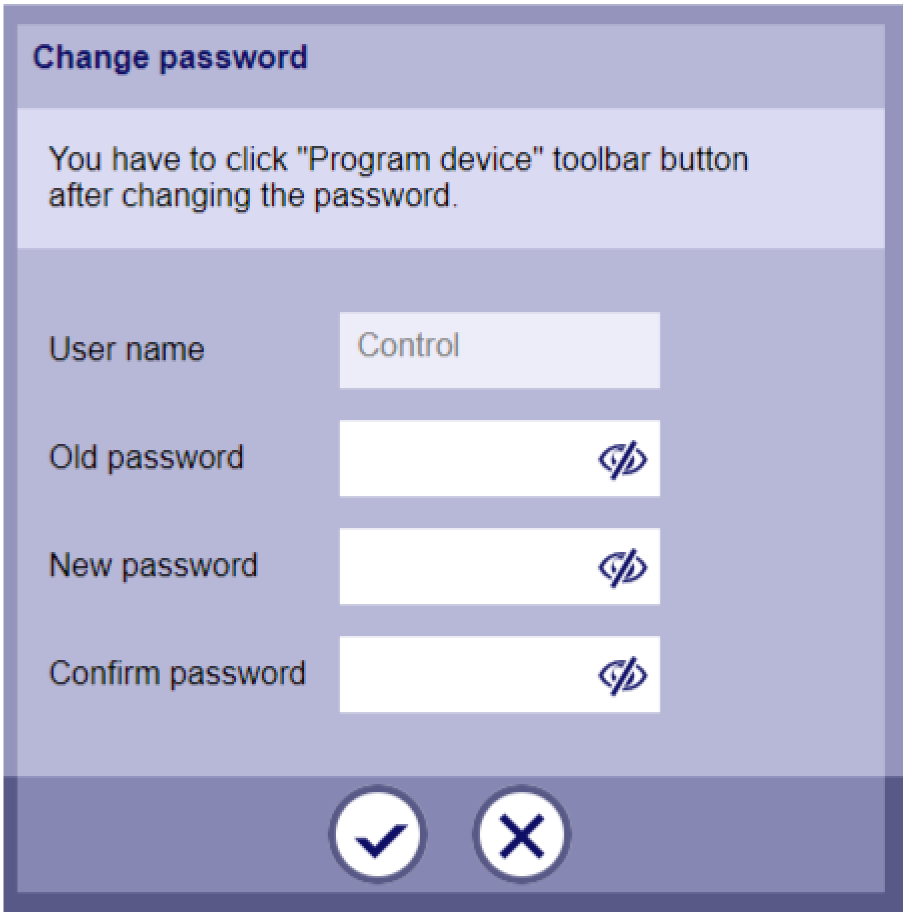
If the password is lost, send the CSPi or the PU4 module to the factory for resetting it to the default values.

Admin user can change all user passwords in menu user management.

[sc_user_management, 1, --_--]

Figure 4-5 User management

Each user can change their own password in the change password dialog. You must click “Program device” toolbar button after changing the password. Otherwise, the password is lost after the reset of device.

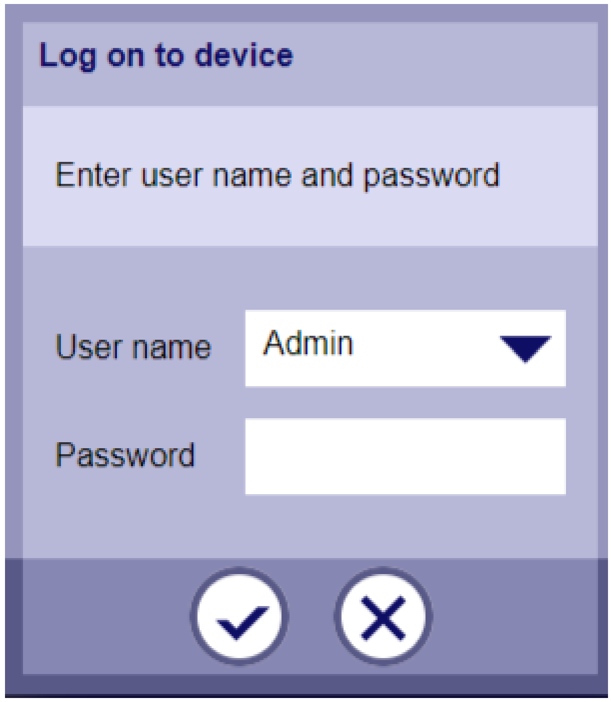


[sc_change_password, 1, --_--]

Figure 4-6 Change password dialog

Logon

If the password is set for the user, the logon dialog is prompted when connecting to the device. Enter the right username and password before logon to the device.



[sc_log_on_to_device, 1, --_--]

Figure 4-7 Log on to device dialog

Password complexity

Password complexity is not enforced by PowerSys. It is possible to access the device without password or with an unsecure password. When setting the new password, the password complexity indication (low / middle / high) is shown near the password entry field.

It is recommended to set the password according to the highest password complexity (high).

Password complexity and rules for indication check:

- a) Minimum password length of 8 characters
  (max. length 20 characters)
- b) At least one upper case letter
- c) At least one lower case letter
- d) At least one digit
- e) At least one special character (e.g. !@#$)

Password complexity indication	Comments
Low	2 or less of these rules matched
Medium	3 rules matched with mandatory rule a)
High	4 or more rules matched with mandatory rule a)

Device is delivered by factory without passwords. Optionally you can set a password for each user level for the connection. For assigning of an initial password for the first time, leave the field current password blank and select one of the 3 different user levels. Each user level can be assigned with an individual password.

If a password protects the device, perform the following instructions to change the password:

- Enter the current password.
- Enter the new password.
- Confirm the new password in the field Retype Password.

The password is requested from the device before the connection between the service PC and the device is established. Without entering the correct password, a connection to the device is not possible.

If the password is lost, send the CSPi or the PU4 module to the factory for resetting to the standard values.

4.2.3 Firmware Overview

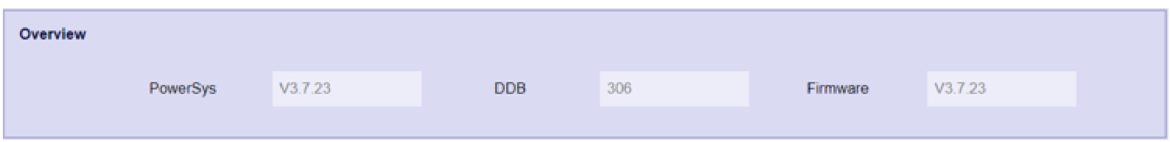
With the device information view, you can check if the firmware release of the device (Actual) corresponds with the firmware release of the connected service program PowerSys (Target).

When the firmware release of the device (Actual) or one of its firmware components does not correspond with the firmware release of the service program PowerSys (Target), the shown version is marked yellow and shows a target version in tooltips. That means, the firmware release of the device (Actual) has a newer or older version than the Target of the service program PowerSys (For example a firmware hotfix is programmed to the device.)

Device overview information shows three version numbers:

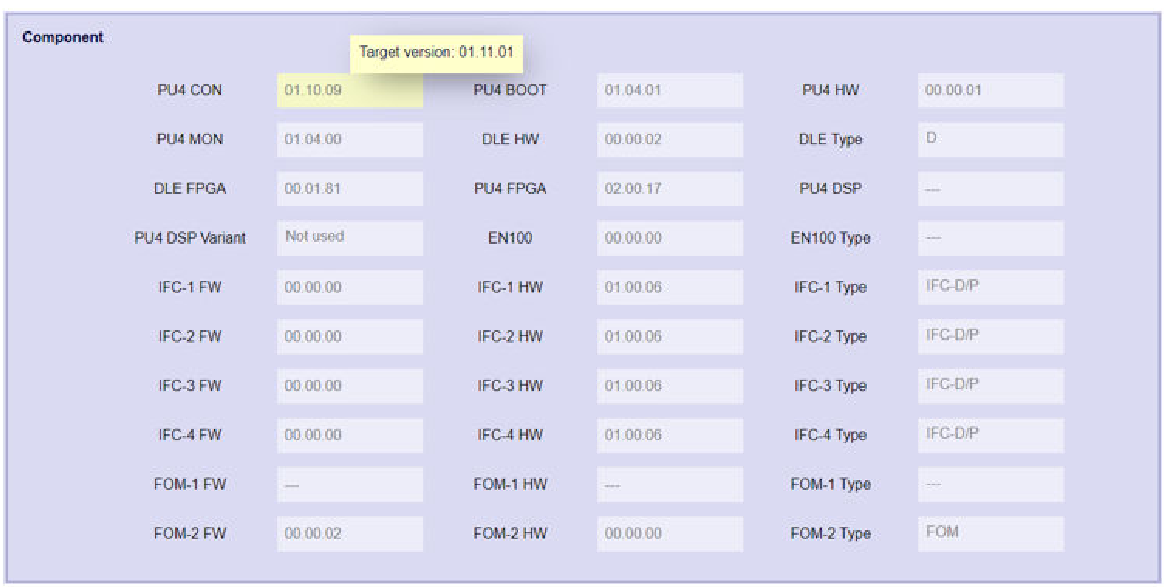
- PowerSys version
- Device parameter database (DDB) version (306 means V3.6)
- Firmware version

Verify the PowerSys current and new release and upgrade the device firmware to the matching version.



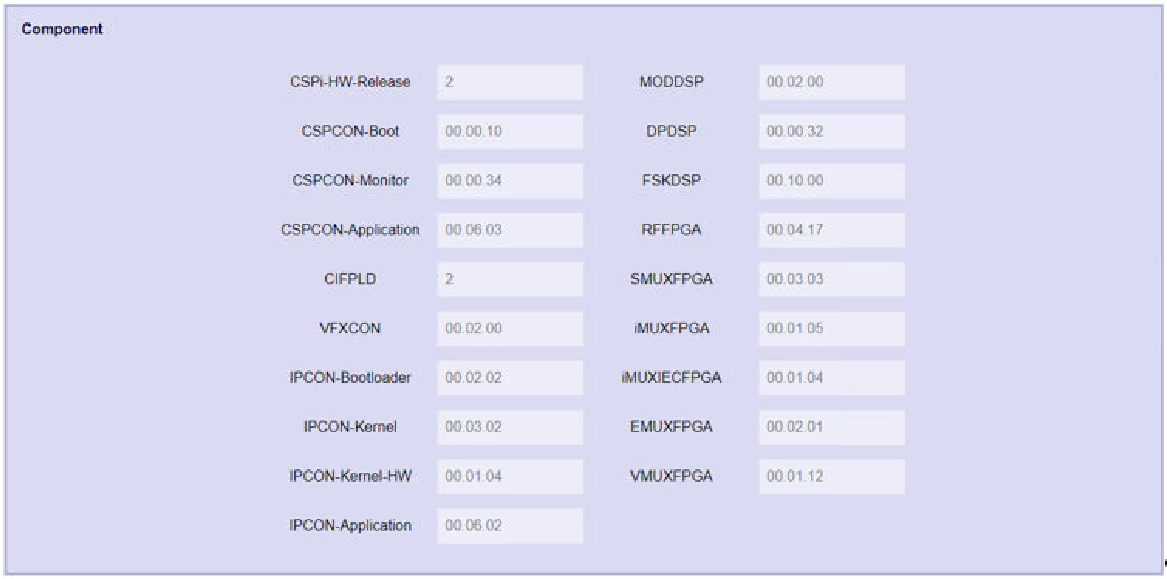
[sc_device_general_overview, 2, --_--]

Figure 4-8 Device > General > Overview



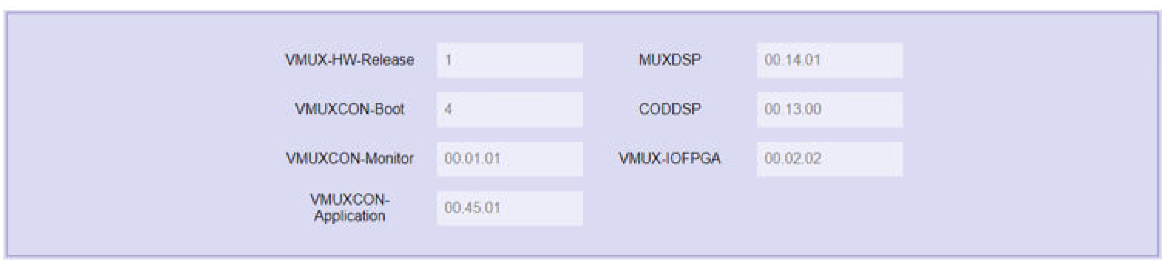
[sc_swt_device_general_component, 1, --_--]

Figure 4-9 SWT 3000 or iSWT > Device > General > Component



[sc_pl_device_general_component, 1, --_--]

Figure 4-10 PowerLink > Device > General > Component



[sc_pl_vmux_general, 1, --_--]

Figure 4-11 PowerLink > vMUX > General

4.2.4 Parameter Compatibility

With the service program PowerSys versions V3.6 and higher, multiple installation is not possible. Older versions shall be uninstalled via Start > Control Panel > Add or Remove Programs. Versions less than V3.6 (e.g., P3.5.188) can be installed in parallel.

One PowerSys supports full read only access to all P3.5.xxx firmware release and full read / write access since P3.5.185 firmware.

The device firmware is located under PowerSys installation path: ...\PowerSys\Firmware

File name	Description
AllInOne_PU4_Vx.y.z.jnk	All in one firmware image for SWT 3000 / PU4 board.
AllInOne_CSPi_Vx.y.z.jnk	All in one firmware image for PowerLink / CSPi board.
AllInOne_VMUX_Vx.y.zzz.jnk	All in one firmware image for PowerLink / vMUX board.
Package*.*	Firmware image for individual firmware component, e.g. DLE, SWT_TPOP

In normal case, the version number of PowerSys, firmware and parameter database shall be matching. If want to upgrade firmware release (e.g. V3.6), you need to follow these steps:

- Install PowerSys V3.6 on your PC (Setup.exe)
- Upgrade device firmware V3.6 (AllInOne_*.jnk) using Memtool
- Upgrade parameter database release

When creating a device parameter database file, the latest version is used by default. But it is possible to select a previous release.

PowerSys will check parameter compatibility as following procedure when sending offline configuration to device or online change the device configurations:

Check if programmed DDB file is matched with actual device parameter database release. In case of mismatch DDB version, a message dialog will prompt. Click "Yes" will update device parameter database to matched version.

```
PowerSys does not match with device parameter database V3.5.xxx. Do you want to update device parameter database to V3.7.xxx?
Please check if device firmware is already updated to same version as PowerSys.
If do not want to update parameter database version, you must use matched PowerSys release.
```

Check if PowerSys supports actual device parameter database release. In case of connecting to an unsupported old firmware release. A message dialog will prompt to switch to read-only access. Click "Yes" button disable all the configurations for editing.

```
PowerSys does not support the configuration of device parameter database V3.5.xxx. Do you want to continue with read-only access?
```

Check if configured parameters are supported in actual device firmware. PowerSys will check if the configurated parameters for new features are supported in actual device firmware. A message dialog will prompt in case of mismatch. Clicking "Yes" button will discard these unsupported parameters.

```
Some configured parameters do not support in actual device firmware V3.6.xxx. Do you want to ignore these parameters and continue the configuration?
```

4.2.5 Release Upgrade Check

After updating the firmware of the device with MemTool, connect the PowerSys to the PowerLink RM-1 interface or SWT 3000 USB interface.

If the firmware release is mismatched with device parameter database, PowerSys will activate the release update message dialog:

```
Firmware V3.7.xxx does not match with device parameter database V3.6.111. Do you want to update device parameter database to V3.7.xxx?
```

Verify the current firmware version and device parameter database release, click Yes for updating the release information in the device.

4.2.6 Multiple Language Support

From PowerSys main menu, you can select your preferred language.

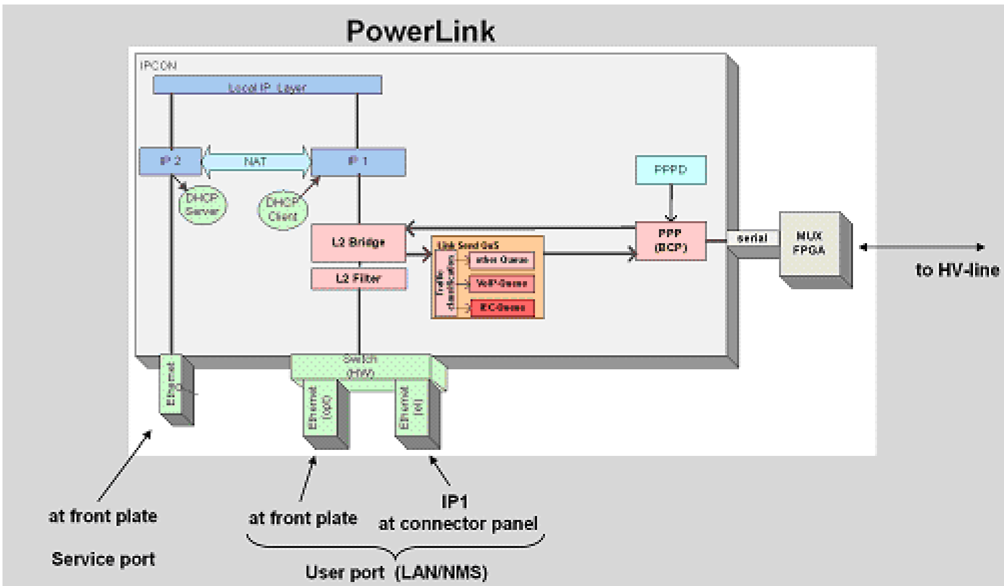
Currently supported languages: English / German / Russian / Spanish.

The UI text and event log in PowerSys is displayed in the selected language immediately.

[sc_multiple_language_support, 3, --_--]

4.3 PowerSys Connection via TCP/IP

4.3.1 Ethernet-Interface of PowerLink – Block Diagram



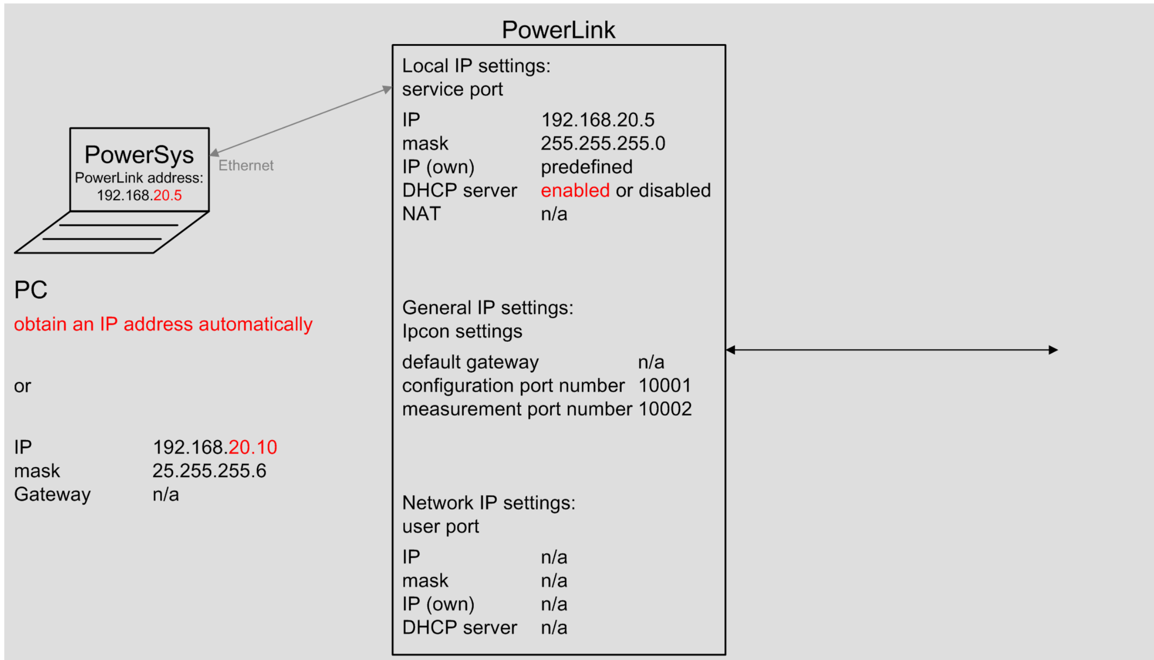
[scethint-120813-01.tif, 1, --_--]

Figure 4-12 Ethernet Interface Block Diagram

PowerLink default settings:

Service interface of PowerLink:	192.168.20.5
DHCP Server IP-Address Pool begin:	192.168.20.10

4.3.2 Settings for Access to Local PowerLink via Service Port



[dwlocacc-120813-01.tif, 1, --_--]

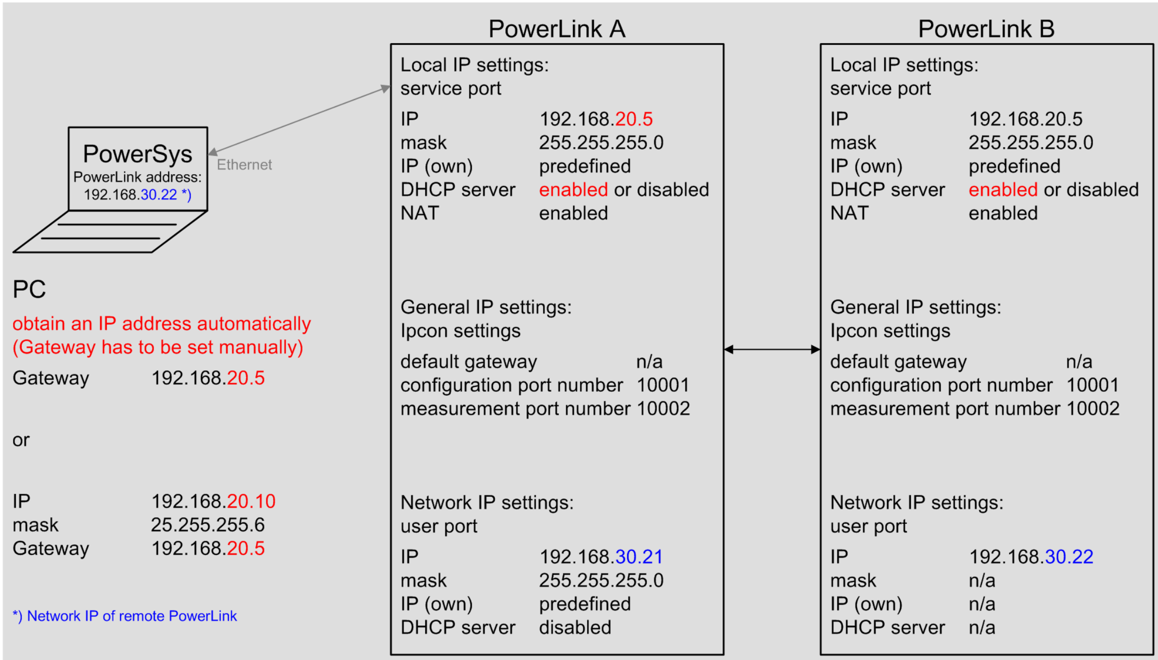
Figure 4-13 Local Access with PowerSys to PowerLink via Service Port

The PC is directly connected to the service port of the local PowerLink. The PC can obtain an IP address automatically from PowerLink, if the PowerLink DHCP server is enabled.

Also it is possible to apply the IP address to the PC manually. In this case the IP address settings in PowerLink and in the PC have to fit together.

To get access to the local PowerLink the IP address 192.168.20.5 has to be adjusted in the program PowerSys (Menu: Options – Connection)

4.3.3 Settings for Access to remote PowerLink via Service Port



[dwaccpsy-120813-01.tif, 1, --_--]

Figure 4-14 Access with PowerSys via Service Port to the Remote Equipment (B)

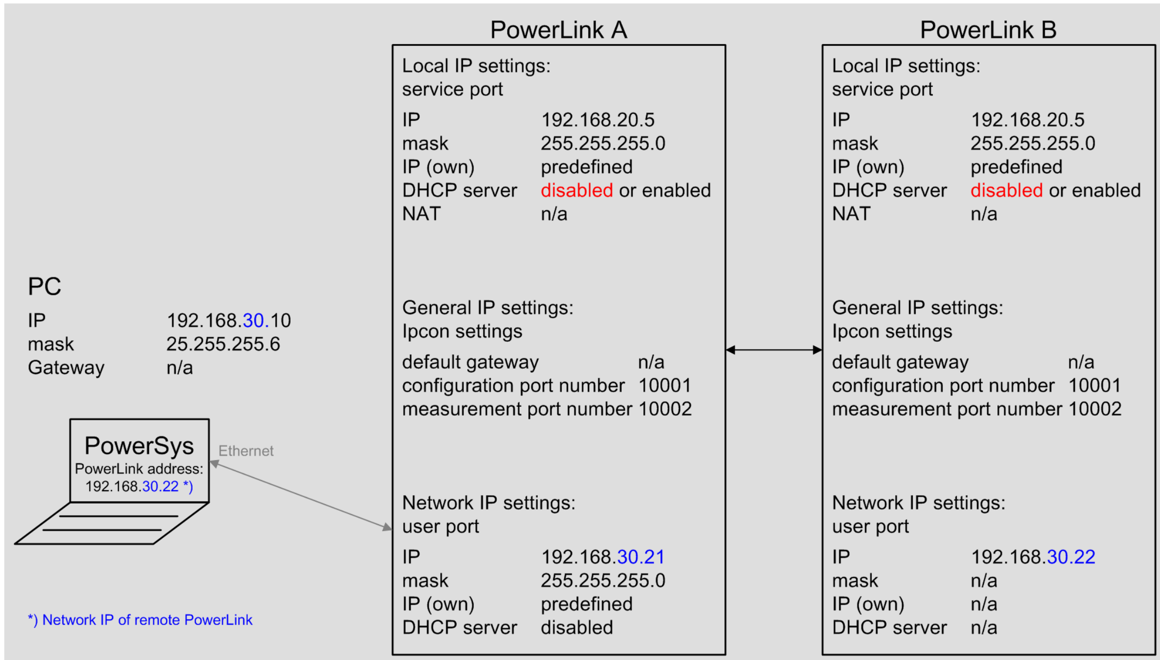
The PC is directly connected to the service port of the local PowerLink (PowerLink A). The PC can obtain an IP address automatically from PowerLink, if the PowerLink DHCP server is enabled.

Also it is possible to apply the IP address to the PC manually. In this case the IP address settings in PowerLink and in the PC have to fit together.

To get access with PowerSys to the remote PowerLink (PowerLink B), the IP- address setting in PowerSys has to be the network IP address of the remote PowerLink (PowerLink B). This is shown in the example above, where the IP address 192.168.30.22 (network IP address of PowerLink B) has to be given in PowerSys for getting connection to PowerLink B.

Also the Gateway in the local PowerLink has to be set correctly. In the example above, the Gateway is the IP address of the local PowerLink A, that means 192.168.20.5.

4.3.4 Settings for Access to any PowerLink via User Port



[dwaccps2-120813-01.tif, 1, --_--]

Figure 4-15 Access with PowerSys to PowerLink B via User Port

The PC is connected to the user port. The IP address has to be applied manually to the PC. The IP address settings of the network and of the PC have to fit together. This is shown in the example above, where the IP address 192.168.30.22 (network IP address of PowerLink B) has to be given in PowerSys to get in connection with PowerLink B.

To get access with PowerSys to the remote PowerLink (PowerLink B), the IP- address setting in PowerSys has to be the network IP address of the remote PowerLink (PowerLink B).

A special Gateway setting is not necessary for this connection, because the PC and the PowerLink B are in the same IP address range.

4.4 PowerSys Online Connection

4.4.1 The PowerLink Event Log

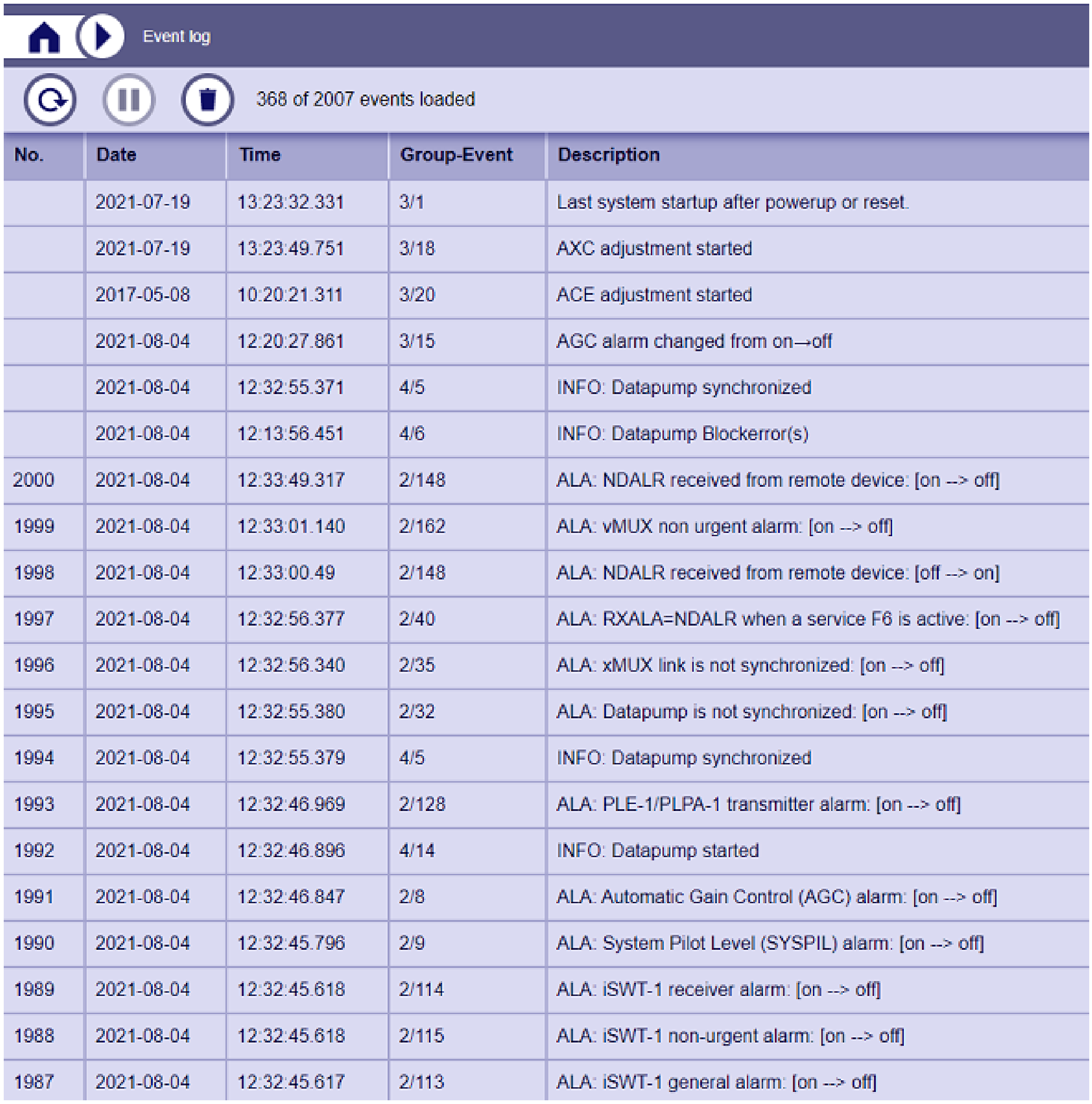
General Information

Alarms of the PowerLink (without iSWT alarms; iSWT alarms are recorded in the iSWT event memory) are provided with time and date and a registration number before they are entered in the event log. The following events are entered:

- Detected alarms
- Program restart
- Changing date and/or time
- Changing the configuration

Up to 4000 entries with a time resolution of 1 ms are possible. They are read out by the service PC and this is also possible from the remote station with Remote Monitoring. In case of an overflow the oldest entry in the event memory is overwritten.

To read the event log, press the button "Start event reading". The PowerSys program has to be connected to the device.



Event log

368 of 2007 events loaded

No.	Date	Time	Group-Event	Description
	2021-07-19	13:23:32.331	3/1	Last system startup after powerup or reset.
	2021-07-19	13:23:49.751	3/18	AXC adjustment started
	2017-05-08	10:20:21.311	3/20	ACE adjustment started
	2021-08-04	12:20:27.861	3/15	AGC alarm changed from on→off
	2021-08-04	12:32:55.371	4/5	INFO: Datapump synchronized
	2021-08-04	12:13:56.451	4/6	INFO: Datapump Blockerror(s)
2000	2021-08-04	12:33:49.317	2/148	ALA: NDALR received from remote device: [on --> off]
1999	2021-08-04	12:33:01.140	2/162	ALA: vMUX non urgent alarm: [on --> off]
1998	2021-08-04	12:33:00.49	2/148	ALA: NDALR received from remote device: [off --> on]
1997	2021-08-04	12:32:56.377	2/40	ALA: RXALA=NDALR when a service F6 is active: [on --> off]
1996	2021-08-04	12:32:56.340	2/35	ALA: xMUX link is not synchronized: [on --> off]
1995	2021-08-04	12:32:55.380	2/32	ALA: Datapump is not synchronized: [on --> off]
1994	2021-08-04	12:32:55.379	4/5	INFO: Datapump synchronized
1993	2021-08-04	12:32:46.969	2/128	ALA: PLE-1/PLPA-1 transmitter alarm: [on --> off]
1992	2021-08-04	12:32:46.896	4/14	INFO: Datapump started
1991	2021-08-04	12:32:46.847	2/8	ALA: Automatic Gain Control (AGC) alarm: [on --> off]
1990	2021-08-04	12:32:45.796	2/9	ALA: System Pilot Level (SYSPIL) alarm: [on --> off]
1989	2021-08-04	12:32:45.618	2/114	ALA: iSWT-1 receiver alarm: [on --> off]
1988	2021-08-04	12:32:45.618	2/115	ALA: iSWT-1 non-urgent alarm: [on --> off]
1987	2021-08-04	12:32:45.617	2/113	ALA: iSWT-1 general alarm: [on --> off]

[sc_event_log, 1, --_--]

Figure 4-16 The PowerLink event log in the PowerSys service program

Display of the Entries in the Event Log

For better understanding of the event recorder entries, time and date on the PowerLink RTC should be set with PowerSys before starting operation! During power off, time and date is saved on the CSPi for at least 5 hours. The information of the event log are saved in a non-volatile memory without limitation.

Table 4-1 Event log entries

Grp	Explanation
No	Event number Entered from the PU module from 0 to 9999. After 9999 the event-counter restarts with 0!
Date	year-month-day
Time	hour:minute:second.msecond

Grp	Explanation
Group-Event	group identifier, event identifier
Description	

In the first lines (up to 7, depending on the configuration of the PowerLink) are **fixed records** and displayed **without** event number:

Table 4-2 Fixed entries in the event log

	Grp	Evt	Explanation
1	3	1	Last system start-up
2	3	18	Last AXC sequence started
3	3	20	Last ACE sequence started
4	3	15	Last AGC alarm on/off
5	4	5	Last Data Pump synchronization
6	4	6	Last Data Pump block error(s)
7	5	1	Last successful RTC synchronization

Table 4-3 Group numbers

Grp	Explanation
1	Errors
2	Alarm
3	System
4	Datapump
5	RTC
6	RM
7	PowerSys

4.4.2 The iSWT 3000 Event Recorder

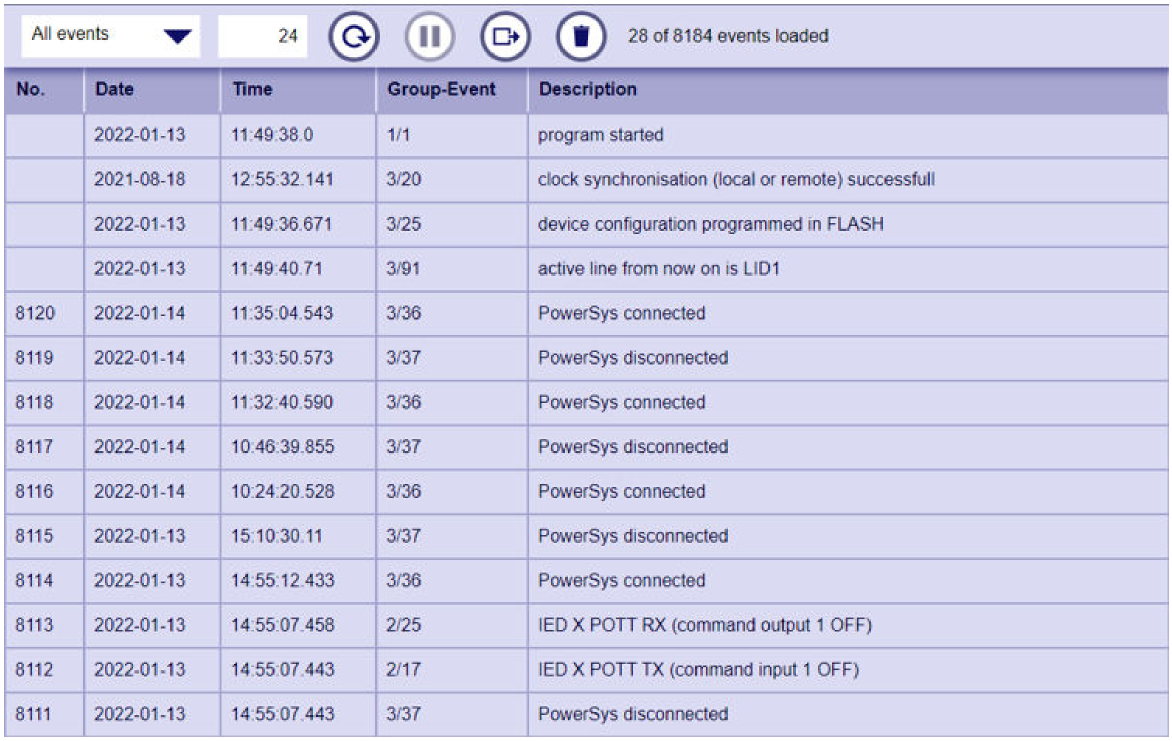
General Information

Protection commands and alarms of the iSWT are provided with time and date and a registration number before they are entered in the event memory. The following events are entered:

- Incoming protection commands from IFC-D/P
- Outgoing protection commands to the IFC-D/P
- Detected alarms
- Program restart
- Changing date and/or time
- Changing the configuration

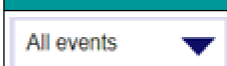
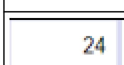
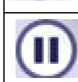
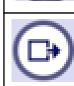
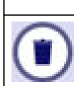
Up to 8192 non volatile event entries with a time resolution of 1 ms are possible. The service PC reads out the entries. The readout is also possible from the remote station with remote monitoring. If there is an overflow, the oldest entry in the event memory is overwritten.

To read the event log, press the button "Start event reading". The PowerSys program has to be connected to the device. It is available in <**iSWT-x / Event log**>.



No.	Date	Time	Group-Event	Description
	2022-01-13	11:49:38.0	1/1	program started
	2021-08-18	12:55:32.141	3/20	clock synchronisation (local or remote) successfull
	2022-01-13	11:49:36.671	3/25	device configuration programmed in FLASH
	2022-01-13	11:49:40.71	3/91	active line from now on is LID1
8120	2022-01-14	11:35:04.543	3/36	PowerSys connected
8119	2022-01-14	11:33:50.573	3/37	PowerSys disconnected
8118	2022-01-14	11:32:40.590	3/36	PowerSys connected
8117	2022-01-14	10:46:39.855	3/37	PowerSys disconnected
8116	2022-01-14	10:24:20.528	3/36	PowerSys connected
8115	2022-01-13	15:10:30.11	3/37	PowerSys disconnected
8114	2022-01-13	14:55:12.433	3/36	PowerSys connected
8113	2022-01-13	14:55:07.458	2/25	IED X POTT RX (command output 1 OFF)
8112	2022-01-13	14:55:07.443	2/17	IED X POTT TX (command input 1 OFF)
8111	2022-01-13	14:55:07.443	3/37	PowerSys disconnected

Figure 4-17 Event log

	Function
	Event log type filter for all events, command only or alarm only. Only supported for SWT event log.
	Select how many entries of event log you want to read out, default number is 24.
	Start or reload event log.
	Stop event log reading.
	Export loaded event log as offline PDF.
	Confirm and delete all entries in the event log.

Display of the Entries in the Event Recorder

For a better understanding of the event-recorder entries, set the time and date on the PU4 with PowerSys before starting operation. During power off, time and date are saved on the PU4 for about 96 hours. The recorded event entries are non volatile.

Table 4-4 Event log entries

Grp	Explanation
No	Event number Entered from the PU module from 0 to 9999. After 9999 the event-counter restarts with 0!
Date	year-month-day

Grp	Explanation
Time	hour:minute:second.msecond
Group-Event	group identifier, event identifier
Description	

In the first four lines, the **fixed records** are displayed **without** record number:

Table 4-5 Fixed entries in the event recorder

No.	Grp	Evt	Description
1	1	1	Last start-up of the PU4 firmware
2	3	20	Last successful clock synchronization (if activated)
3	3	25	Last change of the device data (not date or time change!)
		90	Last change of the line selection to LIA
4	3	91	Last change of the line selection to LID1
		92	Last change of the line selection to LID2

Table 4-6 Group numbers

Grp	Description
1	System control
2	Tele protection commands
3	Alarms
4	Alarms
128 - 255	Internal system messages

NOTE

The displayed comments have the same signification than the combination of group and event identifier.
In case of the comment : **Internal system message** contact the Siemens Customer Support!

4.4.3 Configuration of the PowerLink Ethernet Interface

The Ethernet interfaces of the PowerLink and their setting options are configured by the PowerLink (CSPi) Web interface. The Service PC is connected with the device via the Ethernet service interface on the CSPi module.

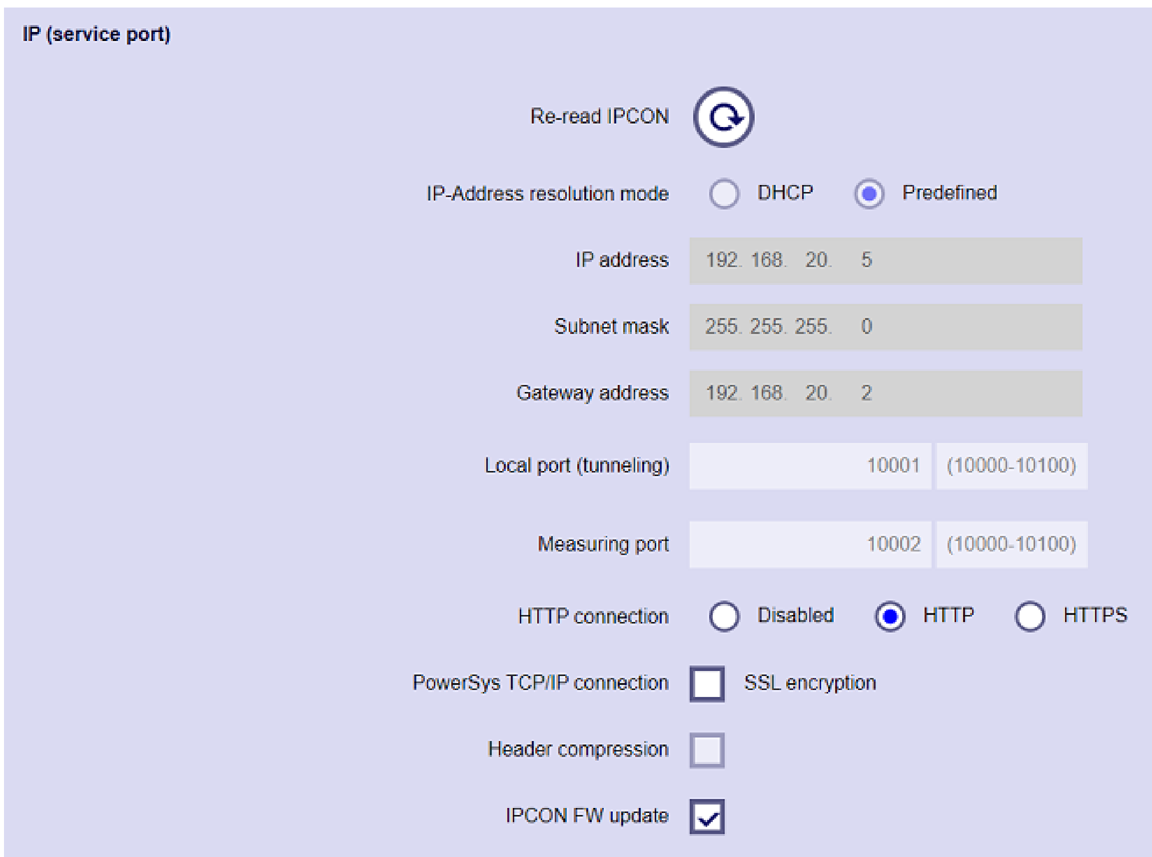
There are only a few Ethernet parameters configured in the PowerSys service program. The following tables and figures describe those Ethernet parameters, which are directly configured in PowerSys.

IP Service port

The IP Service port in PowerSys menu <**Configuration – Ethernet**> contains the read-only information for major parameters of the IP- Service port as configured by the web interface. The following parameters are directly configured in PowerSys.

Table 4-7 Menu <Configuration - Ethernet - IP Service port>

Selection	Setting Option	Comment
HTTP Connection	Disabled	HTTP and HTTPS are disabled (default option)
	HTTP	HTTP is enabled. You can access the web interface via HTTP protocol (e.g. http://192.168.20.5)
	HTTPS	HTTPS is enabled. You can access the web interface via HTTPS protocol (e.g. https://192.168.20.5) The installation of security certificates on the Service PC is required.
PowerSys TCP/IP Connection > SSL Encryption	☐	SSL Encryption for PowerSys connection to device disabled (default setting)
	☑	SSL Encryption for PowerSys access enabled in PowerLink. The setting requires a SSL encrypted PowerSys connection: Select SSL Encryption in PowerSys > Options > Connection

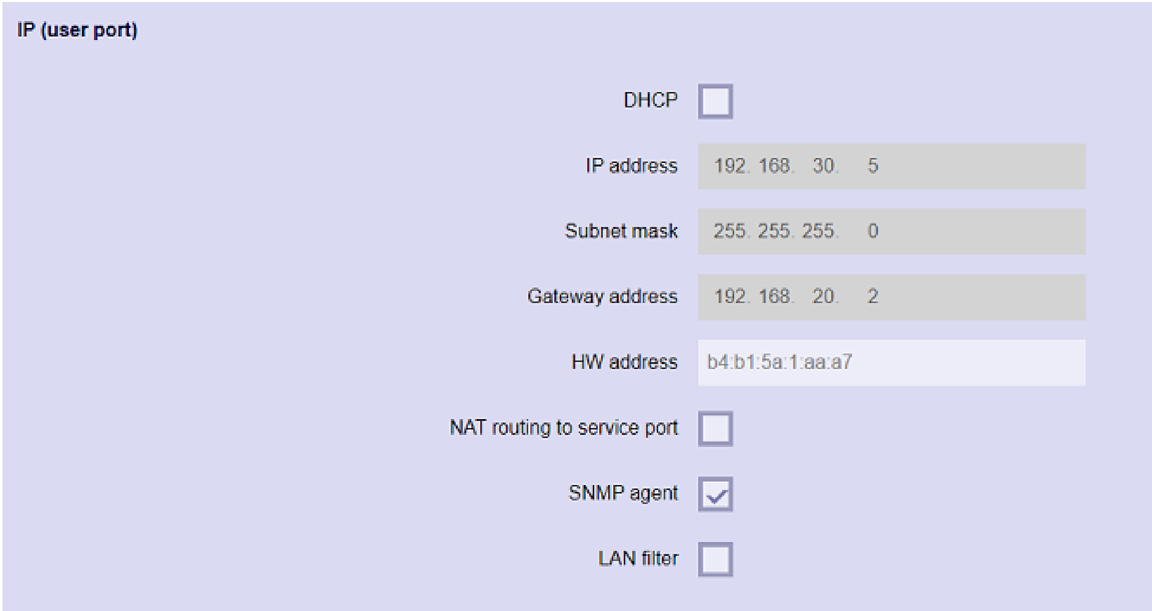


[sc_ip_service_port, 1, --_--]

Figure 4-18 Configuration - Ethernet - IP Service port

IP User port

The IP User port in PowerSys menu <**Configuration – Ethernet**> contains the information for major parameters of the IP- User port as configured by the web interface. All parameters are read-only.



[sc_ip_user_port, 1, --_--]

Figure 4-19 Configuration - Ethernet - User port

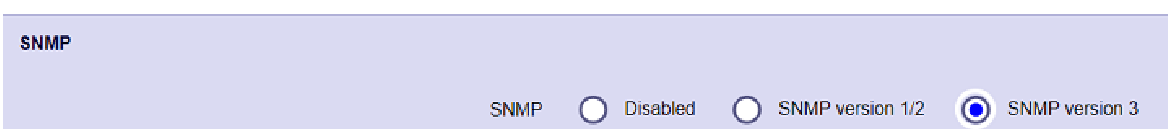
SNMP

The SNMP settings are configured via the Webinterface. The device access via SNMP v1/2 resp. SNMP v3 has to be enabled in PowerSys via the Ethernet configuration menu.

Table 4-8 Menu <PowerLink – Configuration – Ethernet>, Tab <SNMP agent>

Selection	Setting Option	Comment
SNMP	Disabled	SNMP access disabled (default setting)
	SNMP Version 1/2	SNMP access enabled, SNMP v1/2
	SNMP Version 3	SNMP access enabled, SNMP v3

For details, refer to Chapter *Simple Network Management Protocol Version 3 (SNMPv3)*.



[sc_ethernet_snmp, 1, --_--]

Figure 4-20 Configuration - Ethernet - SNMP

NTP

The NTP settings are configured via the web interface. The clock synchronization mode “NTP sync” or “NTP sync & USYNC output” has to be configured in PowerSys via <**Configuration – Clock synchronization**> to become enabled.

4.5 MemTool for Firmware Upgrade Tool

4.5.1 General Information

This description is the upgrade instruction for the controller cards of PowerLink and SWT 3000. For firmware download of PowerLink and SWT 3000, a dedicated Flash PROM programming tool can be used. The MemTool flash programming software is provided with the PowerSys software package and ensures easy and quick product upgrade if required.

The document describes the upgrade of PowerLink CSPi, PowerLink vMUX and SWT 3000 PU4 units. Target files are delivered as AllInOne*.jnk. Typically the files are part of the PowerSys software package. After the prerequisite installation of the service program PowerSys, the files are saved in the folder **Hard disk\Program Files\PowerSys\Px.y.z\Firmware**.

The firmware files of the CSPi-IPCon are not included in the AllInOne*.jnk file. The CSPi-IPCon firmware has to be upgraded seperately from the MemTool programming with a dedicated upgrade script.

System Requirements

To run MemTool at least the following minimum system configuration is required.

Table 4-9 System Requirements

	IBM compatible
Operating system	MS Windows 10 or higher / x64 version
Processor	i5 or better (or processor with equivalent performance)
Clock	min. 1 GHz
System memory	1 GB
Ethernet interface	10/100Base-T
Serial interface	RS 232 and USB
Printer interface	LPTx (optional)
Additional needed Software	Microsoft .NET Framework

Version of MemTool

MemTool release V3.0 or higher.

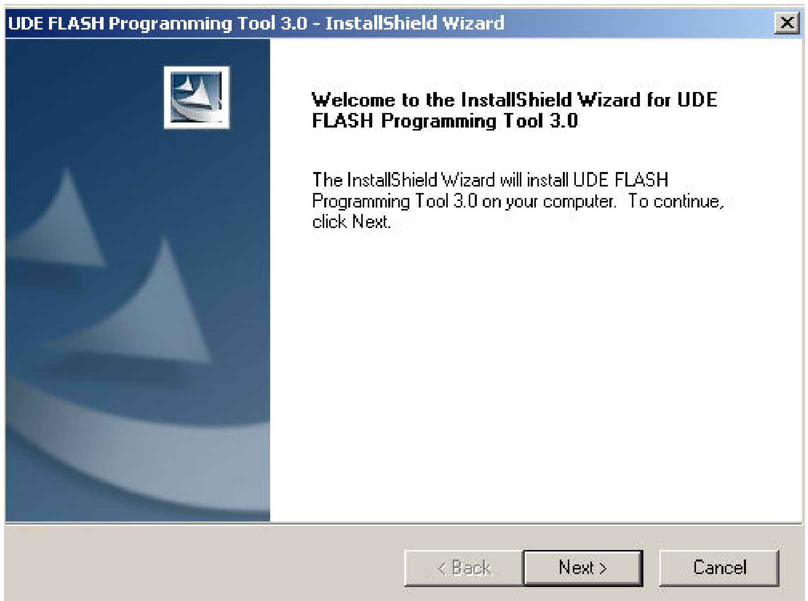
4.5.2 Installation of MemTool

NOTE

It is necessary to install MemTool under administrator rights. Furthermore, it is required to remove previous MemTool versions before installation.

In order to install MemTool, change to the PowerSys package \ MemTool directory and observe the following instructions:

- Start **setup.exe** from PowerSys\MemTool.
- Click **Next** to continue the installing process or click **Cancel** to abort.



[scmemtin-201113-01.tif, 1, en_US]

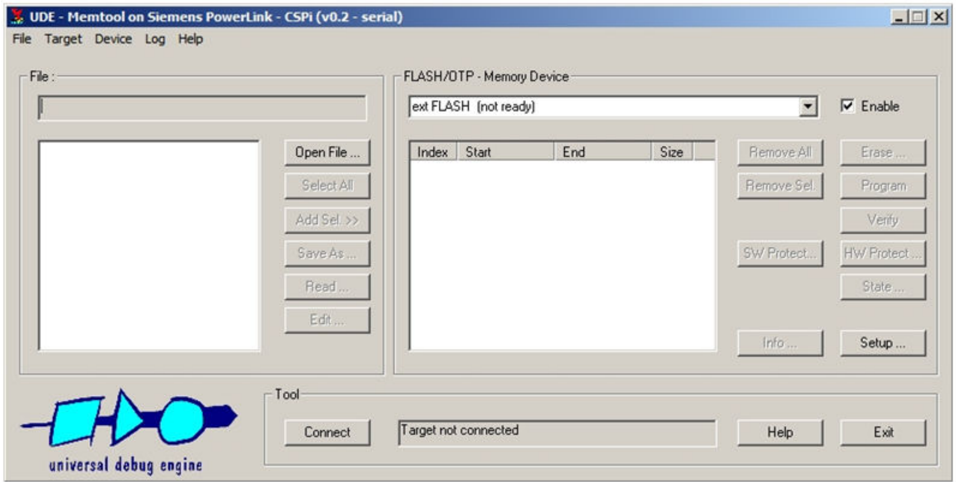
Figure 4-21 Starting the MemTool Installation

- Accept the terms of license agreement and click **Next** and once again **Next**.
- Select the destination folder via **Browse**. Select an empty or new directory for the MemTool software.
- Click **Next**.
- Select the program folder and click **Next** to continue.
- Click **Install** to begin the installation.
- Click **Finish** to continue and end the installation process.

4.5.3 Basic Settings

Starting MemTool

For launching MemTool as a stand-alone tool, execute Memtool.exe via the Windows Main menu **Start - Programs – UDE Memtool**.



[scstrtmt-091210-01.tif, 1, en_US]

Figure 4-22 Starting the MemTool program

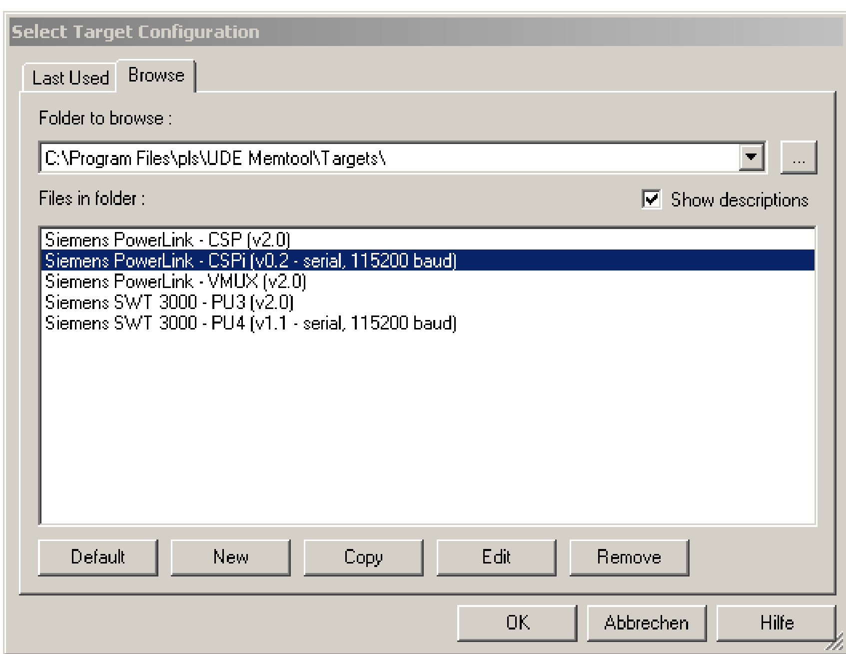
MemTool Settings

When starting MemTool for the first time, the **Select Target Configuration** dialog is displayed. Otherwise, this dialog can be reached via the menu

Target – Change.

The installation of MemTool provides target files for selection of Siemens CSP, CSPi, vMUX (PowerLink), as well as PU3 and PU4 (SWT 3000) systems.

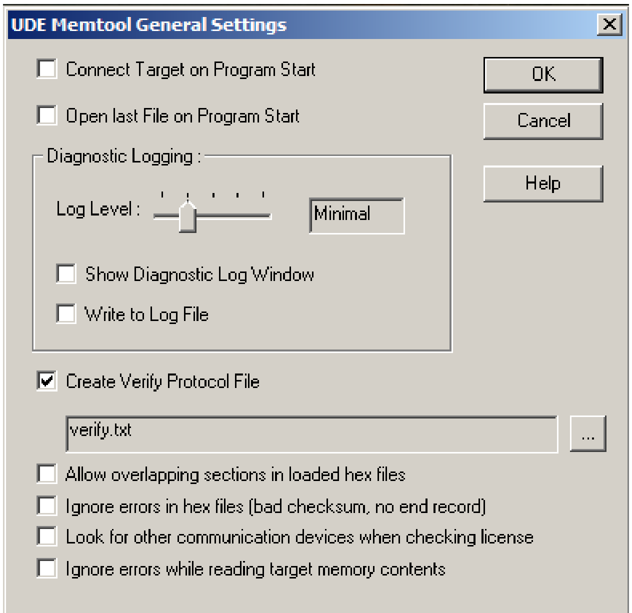
Select **Siemens PowerLink – CSPi** (v0.2 – serial, 115200 baud) and click **OK**.



[sctgtsel-250813-01.tif, 1, en_US]

Figure 4-23 Target selection

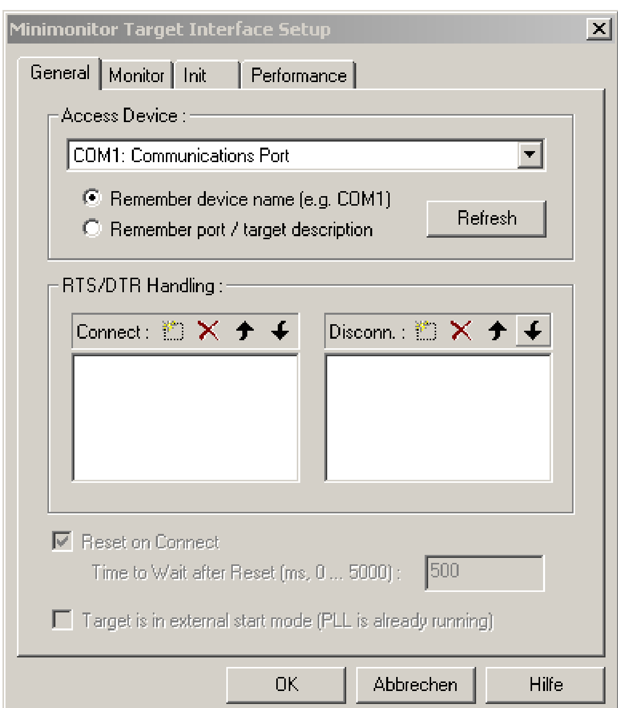
Select **File > Setup** in the menu bar and enable the **Create Verify Protocol File** check box. Afterwards, click **OK**.



[scmtgnsg-201113-01.tif, 1, en_US]

Figure 4-24 MemTool general settings

Select **Target > Setup > General** in the menu bar and set the COM-Port of the Access Device. For CSPi and vMUX it is usually **Serial Port COM1**. For target PU4 (connected via USB cable) select the COM-Port of the "SWT 3000 PU4 CP2102 USB to UART Bridge Controller" in the list box (for example **COM6**) in the **General** tab.



[scmtinsu-250813-01.tif, 1, en_US]

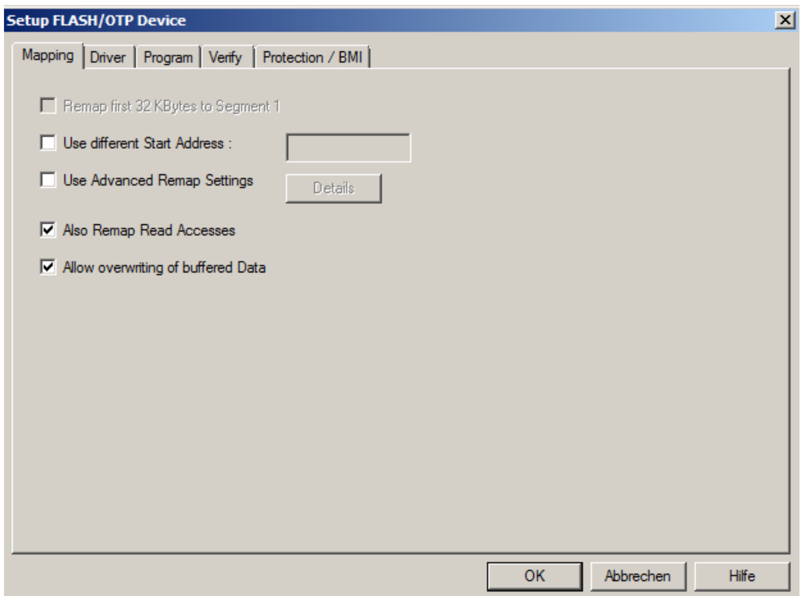
Figure 4-25 MemTool Target Interface Setup

Settings in the **Target > Setup > Monitor** and **Setup > Init** tabs are defaults and remain unchanged. Click **OK**.

NOTE

The baud rate in **Setup > Monitor** is set automatically according to the selected Target file (115 200 for CSPi, 57 600 for vMUX and CSP, and 115 200 for PU4).

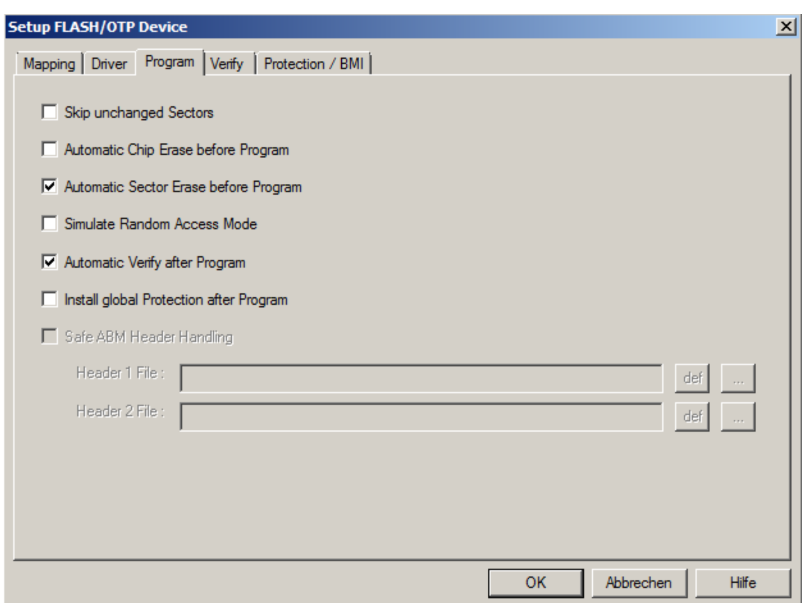
Manual changes are saved by clicking **OK**.
Select **Device > Setup > Mapping** and verify settings as shown.



[scpngsum-201113-02.tif, 1, en_US]

Figure 4-26 MemTool Device > Setup > Mapping

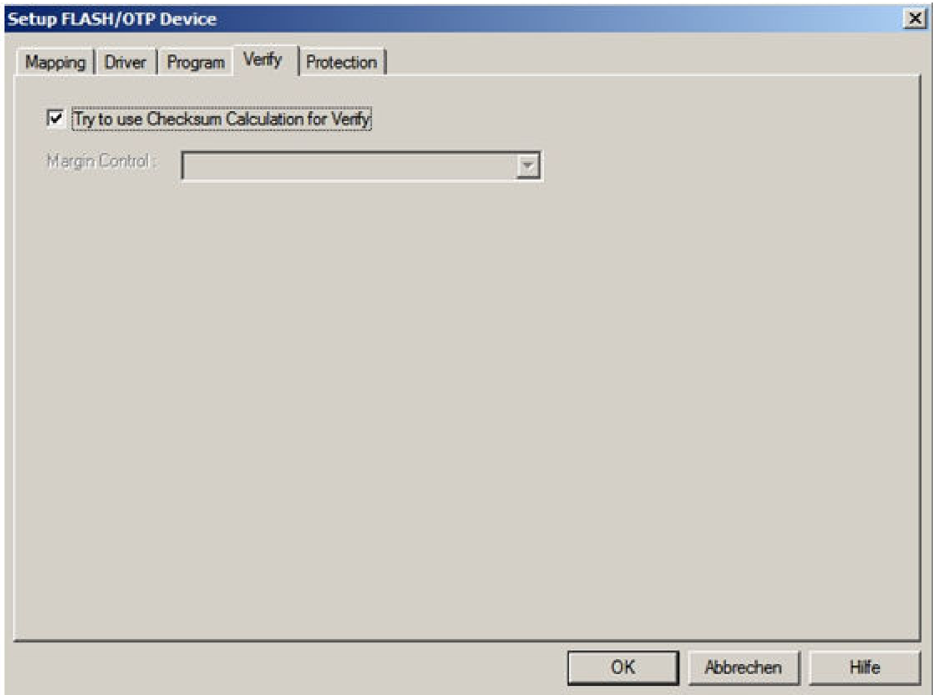
Select **Device > Setup > Program** and click **Automatic Sector Erase before Program** and **Automatic Verify after Program**.
Settings in the **Device > Setup > Driver** and **Setup > Protection** tabs are defaults and remain unchanged.



[scsumpng-201113-01.tif, 1, en_US]

Figure 4-27 MemTool Device > Setup > Program

Select **Setup > Verify** and click **Try to use Checksum Calculation for Verify** if not enabled.



[scsuvery-091210-01.tif, 1, en_US]

Figure 4-28 MemTool Device > Setup > Verify

Save all manual changes by clicking **OK**.

4.5.4 Getting Started

To perform the upgrade verify if necessary firmware type and version for upgrade are available. One or all of the following files shall be existing:

- AllInOne_CSPi_Px.y.z.jnk — Required for PowerLink upgrade (module CSPi)
- AllInOne_VMUX_Px.y.z.jnk — Required for PowerLink upgrade (module vMUX)
- AllInOne_PU4_Px.y.z.jnk — Required for SWT 3000 upgrade (module PU4)

The Firmware package (AllInOne*.jnk- file) is stored

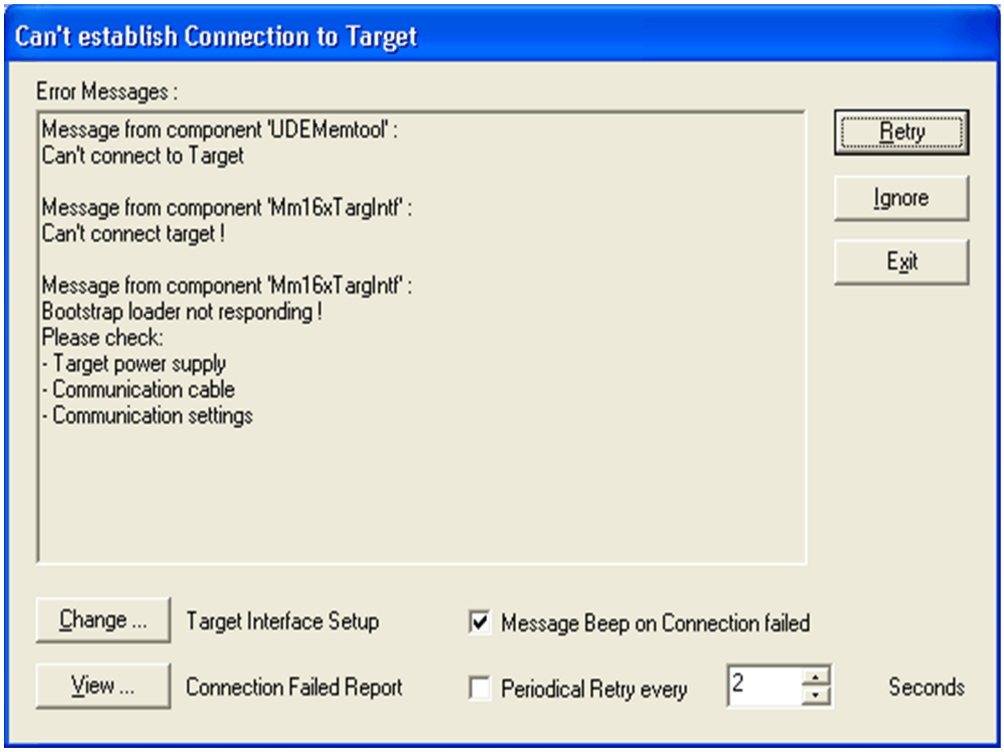
- as a part of the PowerSys software package)
- on the PC with PowerSys already upgraded to the new version (default destination folder C:\Program Files\PowerSys\Px.y.z\Firmware) or on a
- folder of own choice while receiving the upgrade version by email or download.

NOTE

The term Px.y.z is the PowerSys release version.

4.5.5 Trouble Shooting

If the connection to the target is not established, click **View** and verify the connection failed report.
Reset the device with **S1 on the PU4** or **S4 on the CSPi**.
Check if the USB cable (PU4) or RS232 cable (CSPi) is plugged in and if the serial port is selected correctly.
Press **Retry** for the connection to the device.



[scnoconn-271011-01.tif, 1, en_US]

Figure 4-29 Dialog of No Connection to the Target Device

NOTE

MemTool always **starts with the last used target selection**. If the upgrade fails, **check that the target** (in menu bar Target > Change) and the file selection (in menu bar File > Open) **correspond to the device physically connected**.. For **SWT 3000** is the target **SWT 3000-PU4** and the file **AllInOne_PU4_Px.y.z.jnk**.

Select the target and file of the devices as follows:

- For **PowerLink** is the target **PowerLink-CSPi** and the file **AllInOne_CSPi_Px.y.z.jnk**.
- For **PowerLink-vMUX** is the target **PowerLink-vMUX** and the file **AllInOne_VMUX_Px.y.z.jnk**.
- For **SWT 3000** is the target **SWT 3000-PU4** and the file **AllInOne_PU4_Px.y.z.jnk**.

If there is a wrong combination, **repeat** the download after correcting the selection.

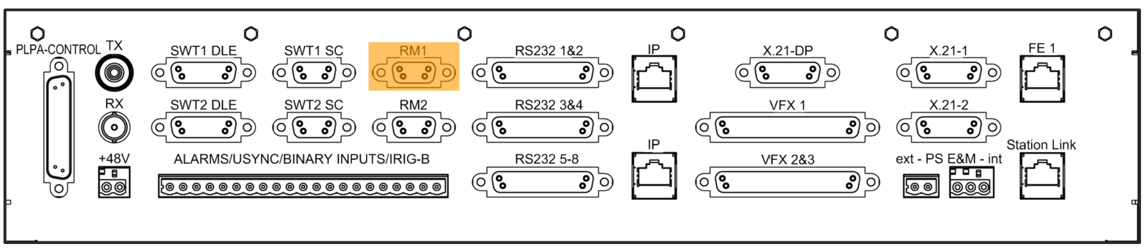
4.6 Programming of CSPi Flash Memory

4.6.1 Connecting the PC

For programming the CSPi module, the **RM1 connector** is used. The connection to the PC is established with the serial PC connection cable which is also used for the access to the PowerLink device with service program PowerSys.. To enable the programming with "MemTool" the switch **S5/1 on CSPi must be in "ON"** position.

- Switch OFF the device with S1
- To enable the programming with MemTool switch **S5/1** on CSPi board to **ON** position
- Switch ON the device
- Press the Reset button **S4** on CSPi to proceed the upgrade

For PowerLink 100, the RM1 connector is placed on the on the CFS-2 connector panel.



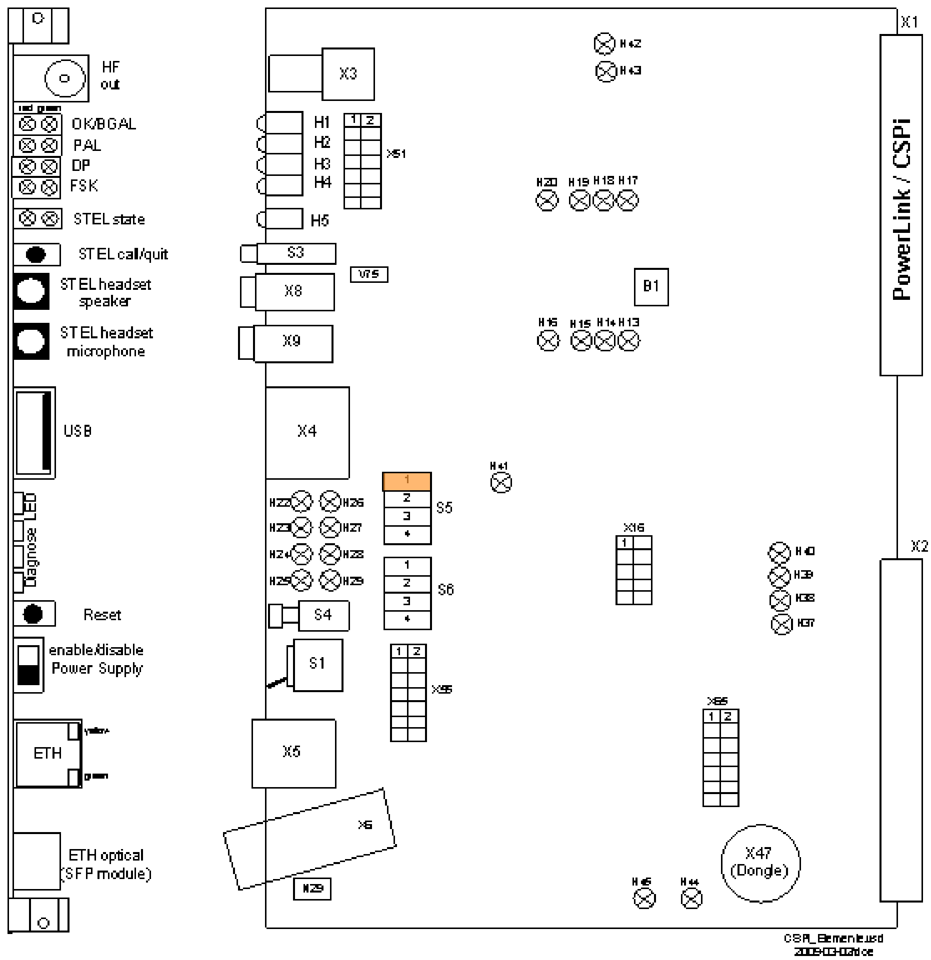
[tdcfs2cp-201113-01.tif, 1, en_US]

Figure 4-30 The CFS-2 connector panel

For PowerLink 50, the RM1 connector is placed on the rear side of the device.

CAUTION

✧ During the update operations with MemTool the PowerLink device will be out of regular service.



[tdcspibd-081210-01.tif, 1, en_US]

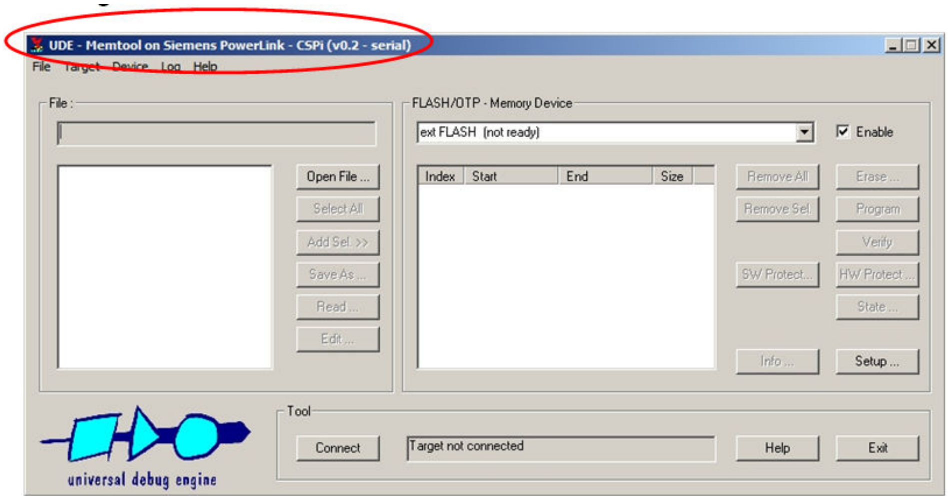
Figure 4-31 The CSPi board

NOTE

To enable the programming with MemTool switch S5/1 set to ON position.

4.6.2 Starting MemTool

For launching MemTool as a stand-alone tool, execute Memtool.exe via the Windows Main menu Start - Programs -UDE MemTool.

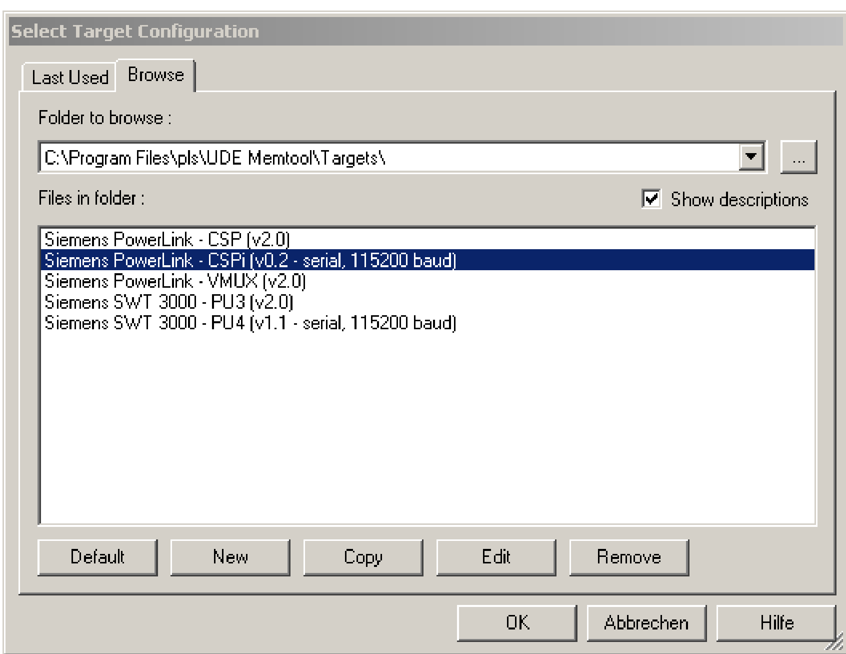


[scmtpltg-091210-01.tif, 1, en_US]

Figure 4-32 MemTool with the PowerLink CSPi target

When starting MemTool for the first time, the **Select Target Configuration** dialog is displayed. Otherwise, this dialog can be reached via menu Target – Change.

Select **Siemens PowerLink-CSPi** and click **OK**.



[sctgtsel-250813-01.tif, 1, en_US]

Figure 4-33 Selecting the CSPi target

NOTE

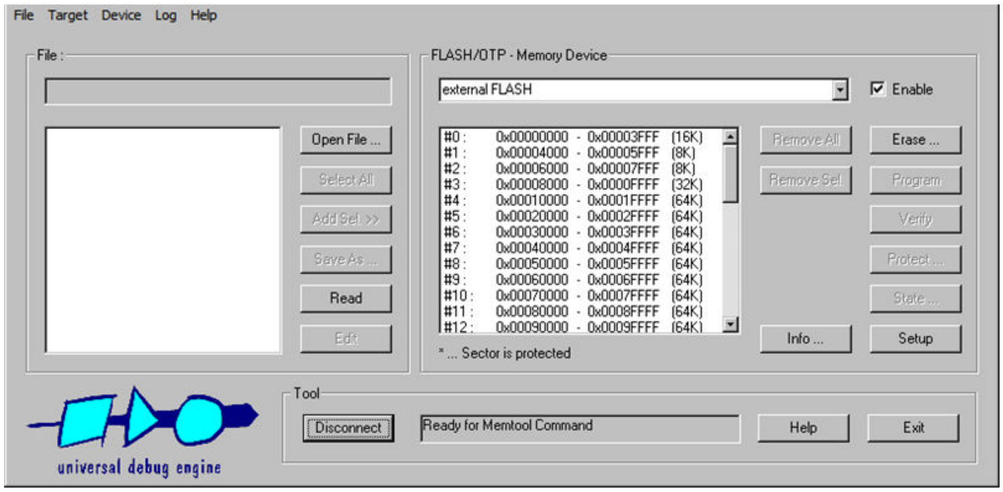
Wrong target selection will result in unsuccessful flash programming. Verify that the **target selected** is the **device physically connected**.

4.6.3 Connection to the PowerLink Target

For external FLASH modules the sector table is created on connect after determining the actual type of the FLASH. The Sector list box is empty at this time.

Click the **Connect** button to establish a connection to the target PowerLink system. Now the sector list box contains the sector table of the selected FLASH module and the connect button changes to disconnect.

If the connection fails, check the selected interface and the position of S5/1, reset the CSPi module and try again. For more detailed information, refer to chapter *4.5.5 Trouble Shooting*.



[scdspcnp-091210-01.tif, 1, en_US]

Figure 4-34 Display after the connection to the PowerLink has been established

NOTE

Make sure that the **external FLASH** is selected as FLASH memory device.

CAUTION

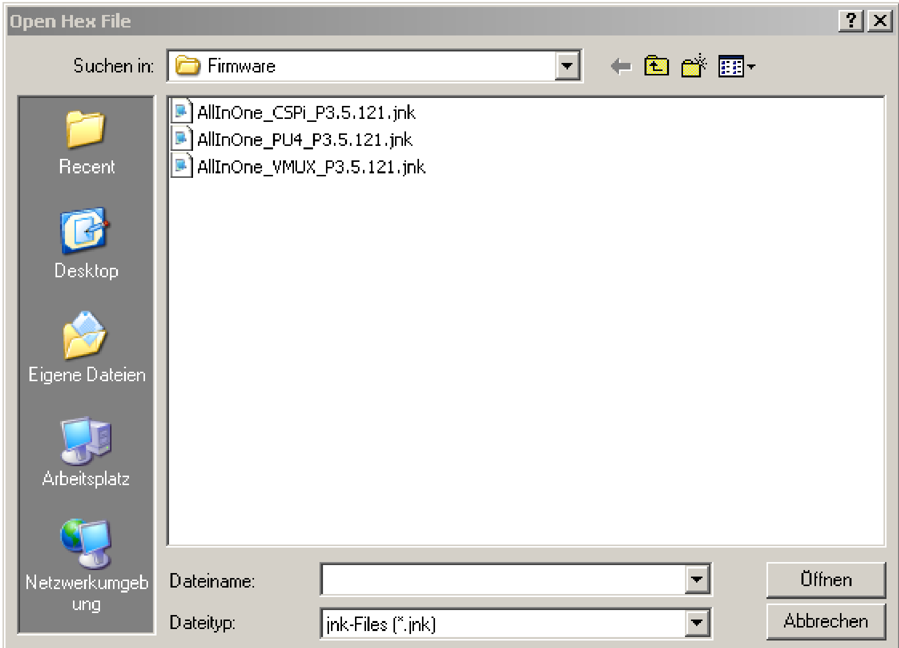
Erasing or programming of the 384 KB on-chip FLASH may result in the deletion of the CSPi boot sector and disabling of the CSPi module.

The connection to the PowerLink target will not work.

✧ Do not delete the on-chip FLASH.xxx

4.6.4 Programming the Application into the Flash Memory

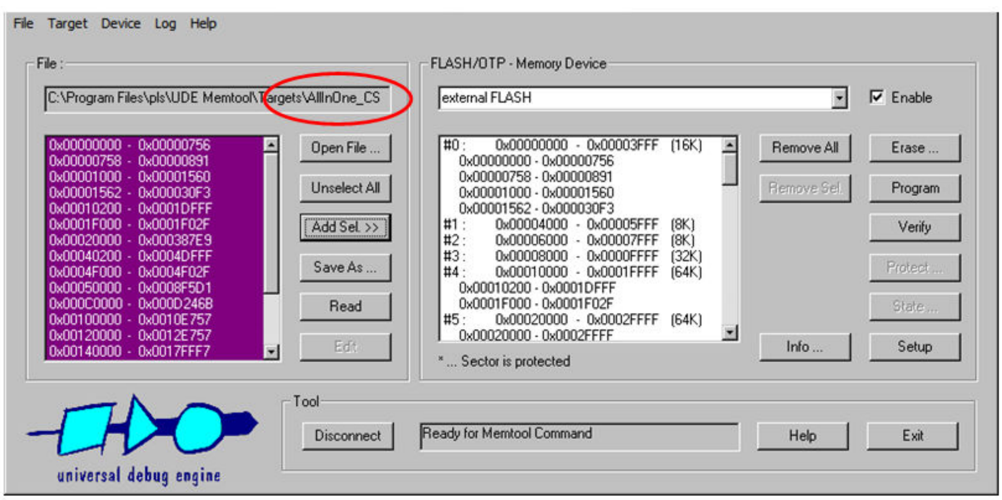
Click the **Open File** button and select the AllInOne_CSPi_Px.y.z.jnk (**on the first time you may have to select File type All Files or jnk Files and to navigate to the source folder according to** *4.5.4 Getting Started*). Click **Open**. After loading this file, in the left part of the MemTool window the file name and a list of sections of the application are displayed.



[scslaiof-260813-01.tif, 1, en_US]

Figure 4-35 Example for selection of the AllInOne files

Click Select All and then on Add Selection. The sections of the application are displayed (according to the sectors they belong to) in the list box on the right-hand side.



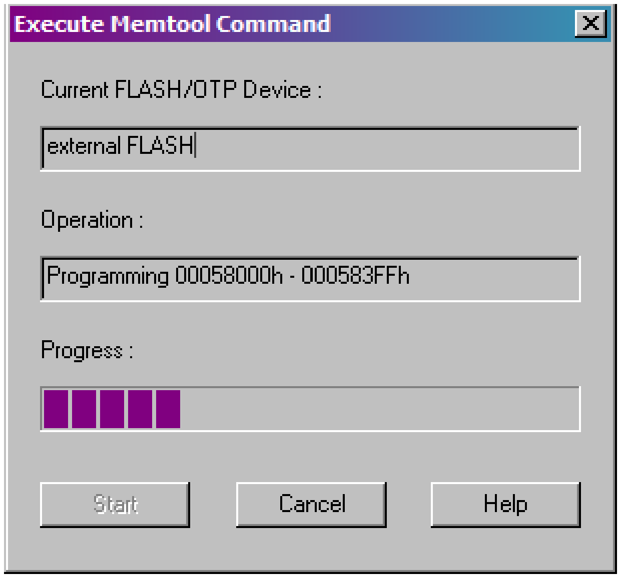
[scdssase-091210-01.tif, 1, en_US]

Figure 4-36 Display of the sections in the list box after the Add Select has been executed

NOTE

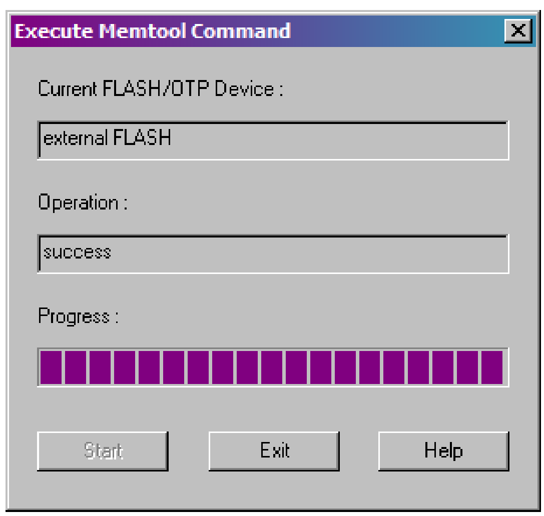
Wrong file selection will result in unsuccessful flash programming. Verify that the **file selected matches to the target** and device physically connected.

Click **Program** to start the programming cycle. The **Execute MemTool Command** dialog appears and shows the programming progress. The upgrade starts with programming and verification.



[scstprpr-081210-01.tif, 1, en_US]

Figure 4-37 Starting of the programming process



[scdspasp-081210-01.tif, 1, en_US]

Figure 4-38 Display after a successful programming

After successful upgrade **Exit** the command dialog, click **Disconnect** and **Exit** to close the MemTool in the main view.

NOTE

Switch OFF the Power on the CSPi module. **Move S5/2 on the CSPi and S2/1 on the vMUX back to the OFF** position.

In case SWT 3000 is integrated, continue with SWT 3000 flash programming otherwise **switch Power ON** (CSPi-Reset).

4.6.5 Programming IPCON via Web UI

4.6.5.1 Overview

The CSPi-IPCON firmware components are not included in the All-In-One firmware file of the CSPi (AllInOne_CSPi_P3.5.xyz.jnk) and cannot be upgraded via MemTool Flash programming.

The required firmware files for programming are included in the corresponding firmware package file Package_xyz.cab stored in \Firmware folder of the installed PowerSys version. After extracting Package_xyz.cab file using an Unzip tool (e.g. 7Zip), the following CSPi-IPCON firmware components can be found in \Firmware\Package_xyz:

- **CspiIpconKernel_vxx_yy_zz.bin** IPCON-Kernel image
- **CspiIpconFw_vxx.yy.zz.bin** IPCON-Application image

Firmware version requirements to update CSPi-IPCON firmware via web access:

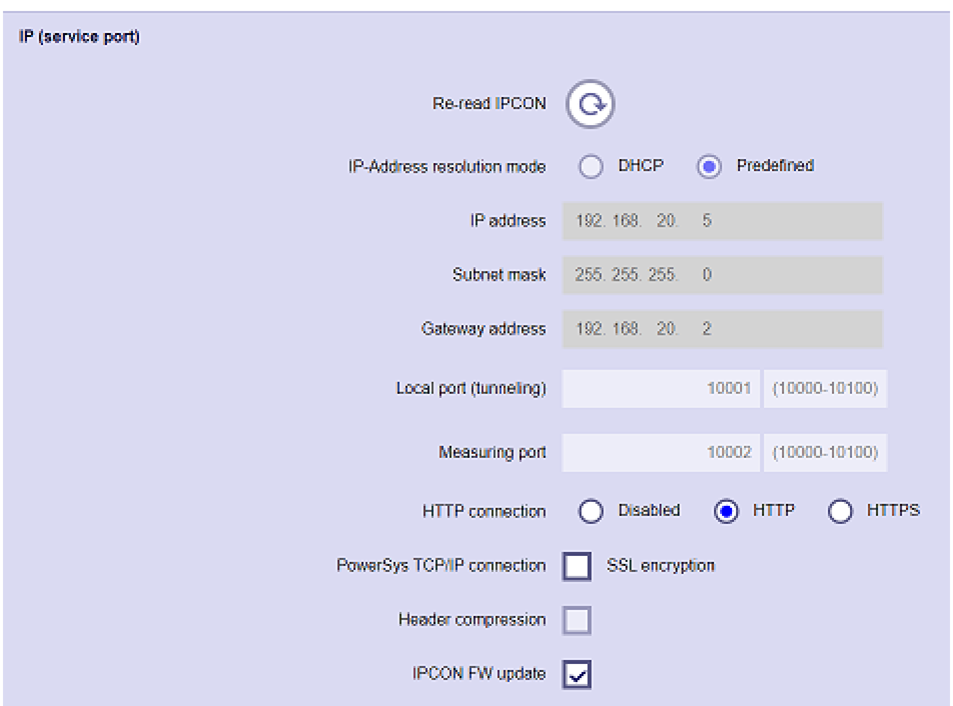
Component	Version
IPCON-Kernel	V00.02.00 or higher
IPCON-Application	V00.05.00 or higher

You can check the current firmware version in PowerSys: PowerLink > Firmware overview

If the current firmware version is lower than the required version, you have to update firmware using script tool as described in application notes "SI_PowerLink_CSPi-IPCON_Upgrade_v1_3.pdf"

4.6.5.2 Enable IPCON Firmware Update

By default the IPCON firmware update via web access is disabled. It can be enabled in PowerSys: PowerLink > Configuration > Ethernet.

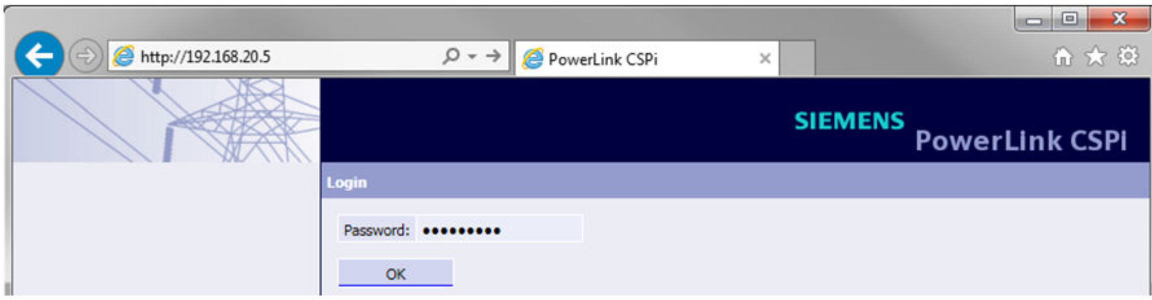


[sc_enable_IPCON_FW_update, 1, --_--]

Enable IPCON firmware update

4.6.5.3 Firmware Update

After entering the actual IP address of the connected PowerLink in the web browser, the following page is displayed. Default IP Address / password: 192.168.20.5 / cspiwrite

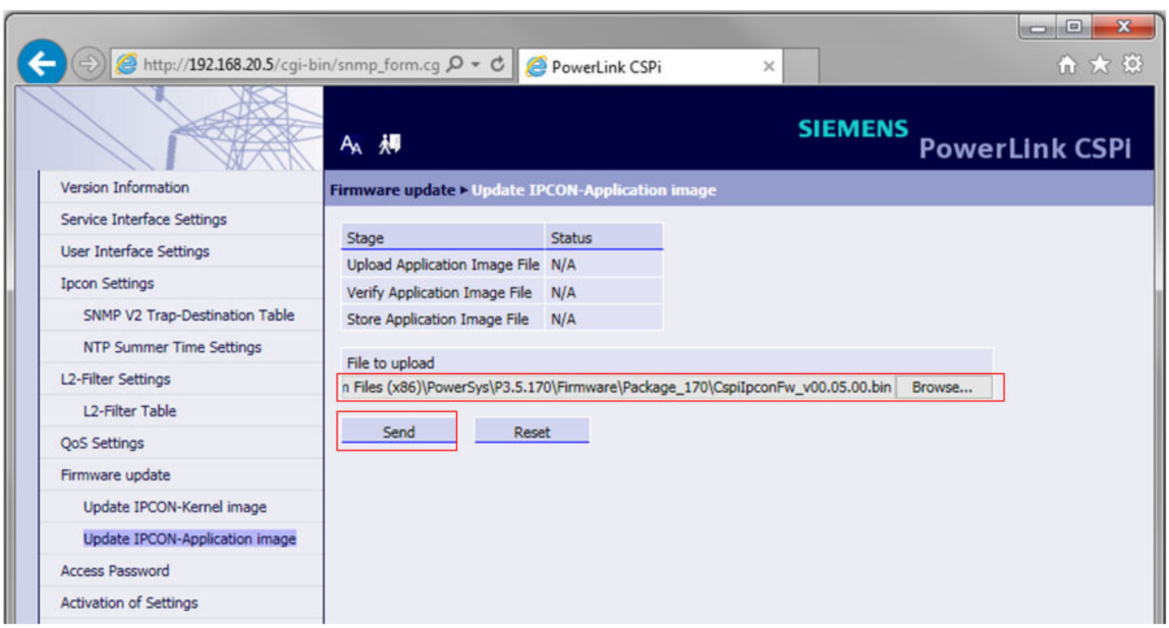


[sc_PowerLink Login, 1, --_--]

Navigate to “Firmware update” menu, select the IPCON firmware image you want to update:

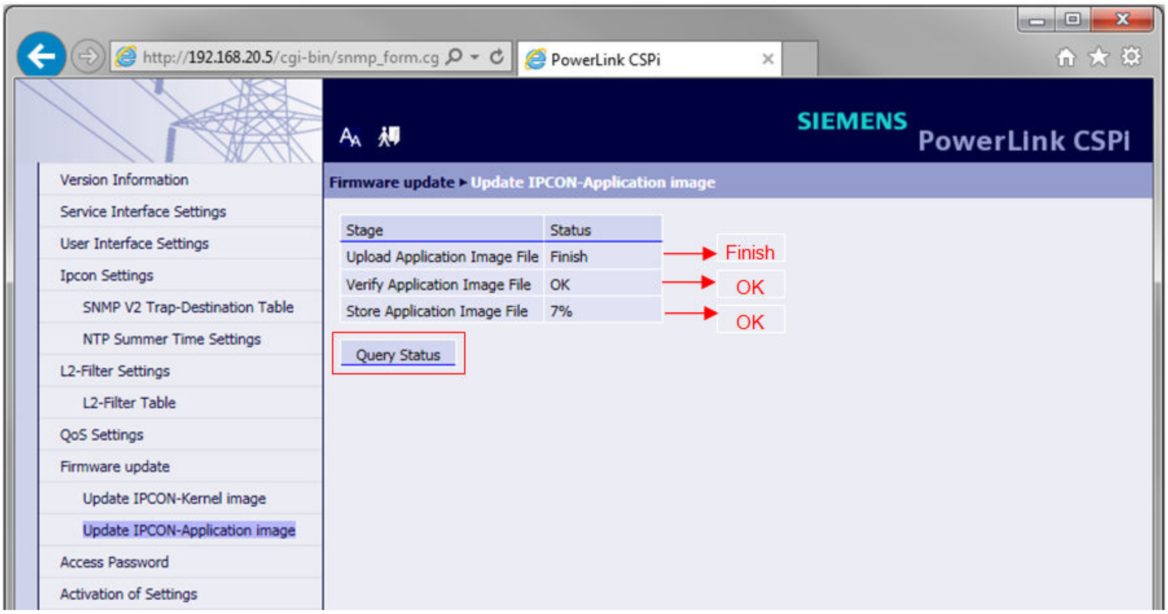
- For update IPCON-Kernel image, select image file “CspiIpconKernel_vxx_yy_zz.bin”
- For updating IPCON-Application image, select image file “CspiIpconFw_vxx.yy.zz.bin”

Do not power off the device or disconnect Ethernet cable while the firmware update is in progress.



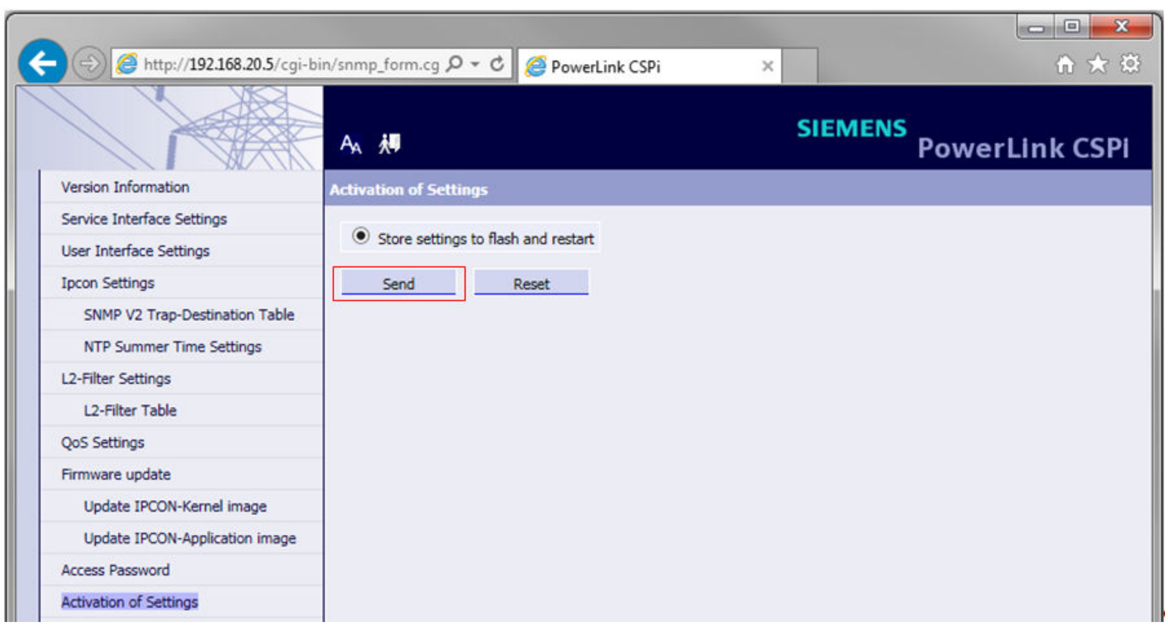
[sc_PowerLink Update IPCON-Application image, 1, --_--]

Refresh current update status via clicking “Query Status” button, wait until the store image file status is OK.



[sc_PowerLink Firmware update Query Status, 1, --_--]

After both, IPCON-Application image and IPCON-Kernel image, are updated, restart device via clicking “Send” button.



[sc_PowerLink Activation of Settings, 1, --_--]

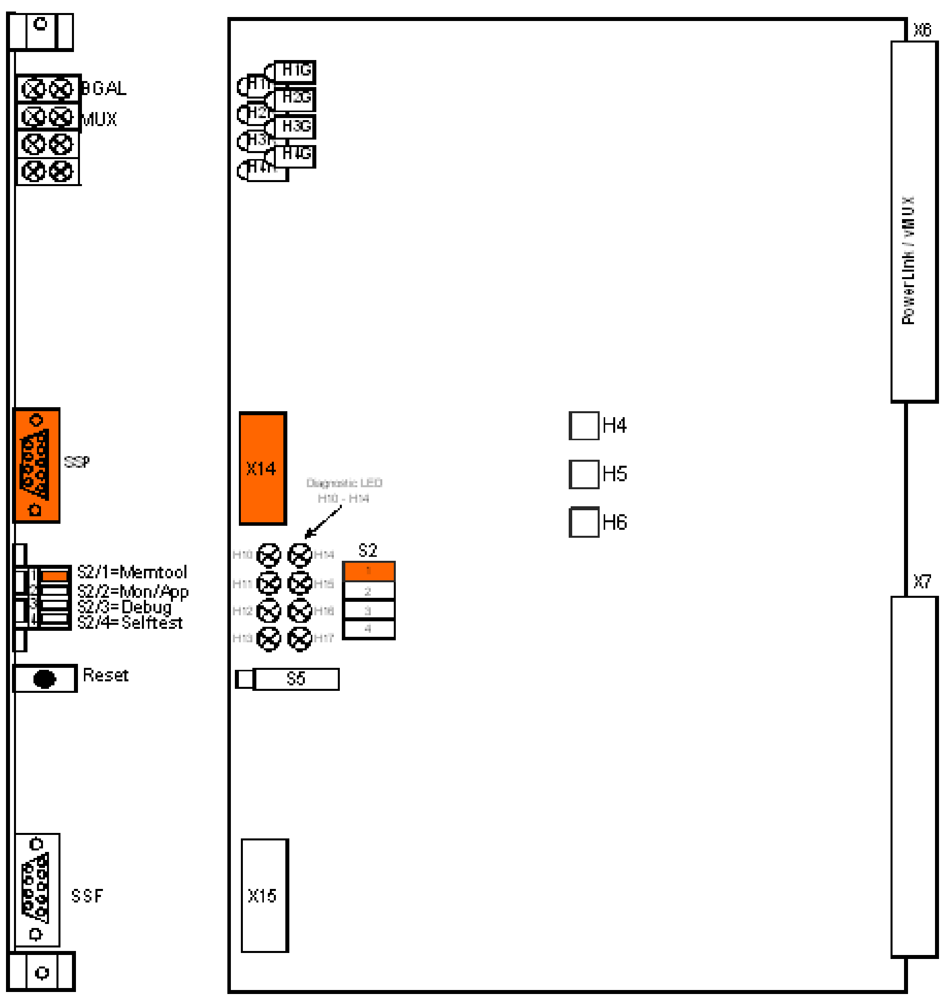
Re-connect PowerSys to the device and check the current firmware version in PowerSys: PowerLink > Firmware overview. The latest firmware versions shall be displayed correctly.

4.7 Programming of vMUX Flash Memory

4.7.1 Connecting the PC

For programming the vMUX module the SSP **connector (X14)** has to be used. The connection to the PC is established with the normal PC connection cable which is used for the PowerSys service program. To enable the programming with “MemTool” the switch **S2/1 on the vMUX** and **switch S5/2 on the CSPi module must be in “ON”** position.

- Switch OFF the device with S1 on the CSPi
- To enable the programming with MemTool switch **S2/1 on the vMUX and switch S5/2 on the CSPi to ON** position
- Switch ON the device
- Press Reset **S5** to proceed the upgrade



[tdvmuxbd-081210-01.tif, 1, en_US]

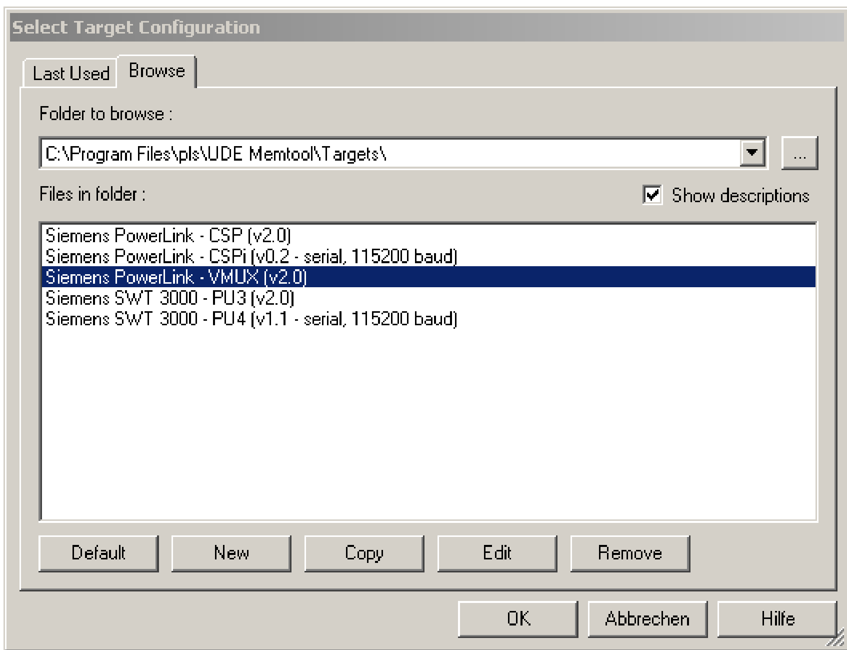
Figure 4-39 The vMUX board

CAUTION

- During the update operations with MemTool the PowerLink device will be out of regular service.

4.7.2 Starting MemTool

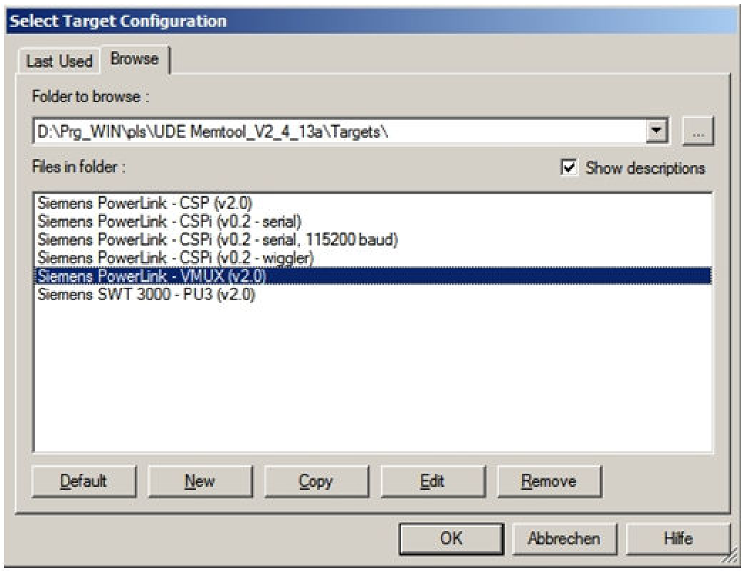
For launching MemTool as a stand-alone tool, execute Memtool.exe via the Windows Main menu **Start - Programs -UDE MemTool**.



[scmtvmux-260813-01.tif, 1, en_US]

Figure 4-40 MemTool with the vMUX target

When starting MemTool for the first time, the **Select Target Configuration** dialog is displayed. Otherwise, this dialog can be reached via menu **Target – Change**. Select **Siemens PowerLink-vMUX** and click **OK**.



[scslspvt-091210-01.tif, 1, en_US]

Figure 4-41 Selecting the Siemens PowerLink-vMUX target

NOTE

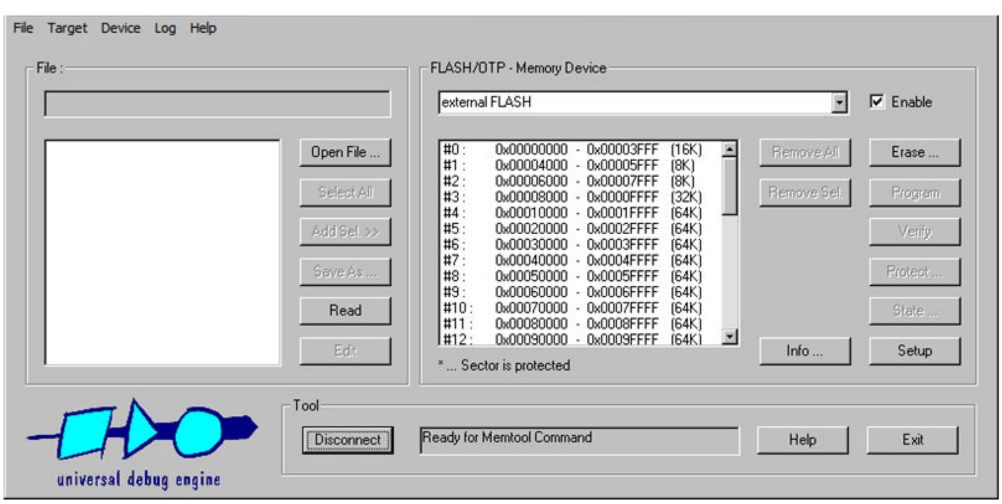
Wrong target selection will result in unsuccessful flash programming. Verify that the **target selected** is the **device physically connected**.

4.7.3 Connection to the vMUX Target

For external FLASH modules the sector table is created on connect after determining the actual type of the FLASH. The Sector list box is empty at this time.

Click the **Connect** button to establish connection to the target vMUX system. Now the sector list box contains the sector table of the selected FLASH module and the connect button changes to disconnect.

If the connection fails, check the selected interface and the position of the DIL switches, reset the **CSPi** module and try again. For more detailed information, refer to *Trouble Shooting*.

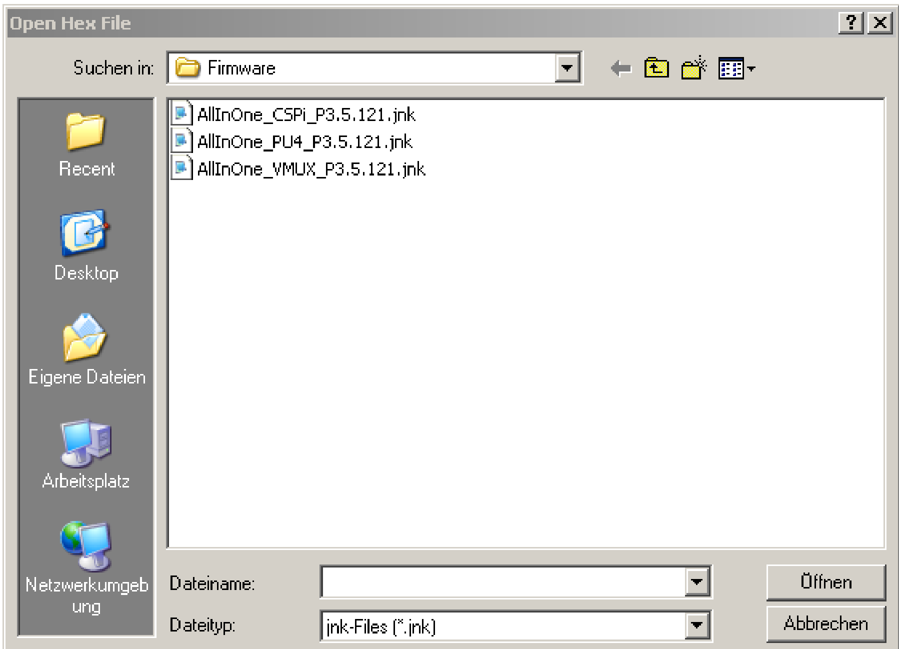


[scdsavce-091210-01.tif, 1, en_US]

Figure 4-42 Display after the connection to the vMUX has been established

4.7.4 Programming the Application into the Flash Memory

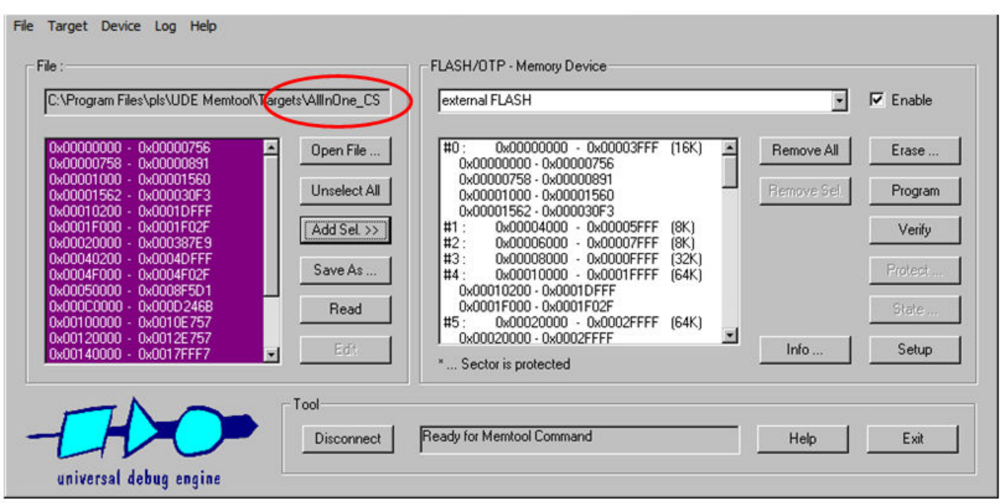
Click the **Open File** button and select the AllInOne_VMUX_Px.y.z.jnk (**on the first time you may have to select File type All Files or jnk Files and to navigate to the source folder according to** *4.5.4 Getting Started*). Click **Open**. After loading this file, in the left part of the MemTool window the file name and a list of sections of the application are displayed.



[scslaiof-260813-01.tif, 1, en_US]

Figure 4-43 Example for selection of the AllInOne files

Click Select All and then on Add Selection. The sections of the application are displayed (according to the sectors they belong to) in the list box on the right-hand side.



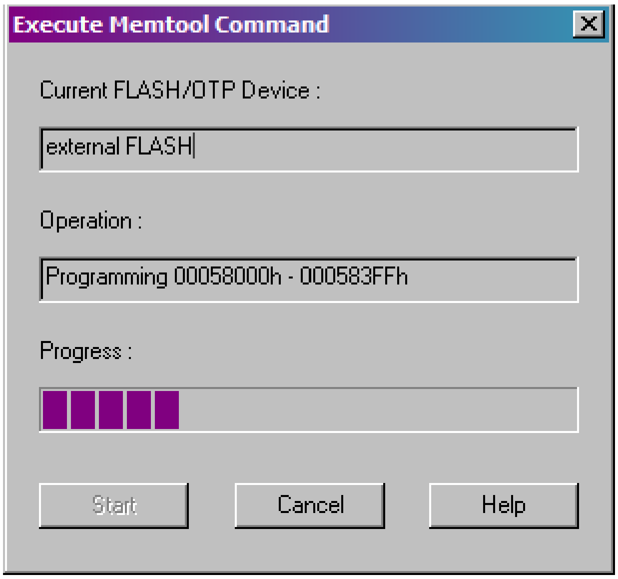
[scdssase-091210-01.tif, 1, en_US]

Figure 4-44 Display of the sections in the list box after the Add Select has been executed

NOTE

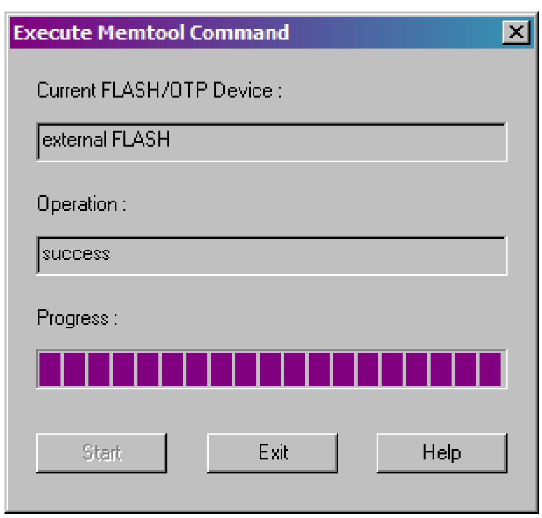
Wrong file selection will result in unsuccessful flash programming. Verify that the **file selected matches to the target** and device physically connected.

Click **Program** to start the programming cycle. The **Execute MemTool Command** dialog appears and shows the programming progress. The upgrade starts with programming and verification.



[scstprpr-081210-01.tif, 1, en_US]

Figure 4-45 Starting of the programming process



[scdspasp-081210-01.tif, 1, en_US]

Figure 4-46 Display after a successful programming

After successful upgrade **Exit** the command dialog, click **Disconnect** and **Exit** to close the MemTool in the main view.

NOTE

Switch OFF the Power on the CSPi module. **Move S5/2 on the CSPi and S2/1 on the vMUX back to the OFF** position.

In case SWT 3000 is integrated, continue with SWT 3000 flash programming otherwise **switch Power ON** (CSPi-Reset).

4.8 Programming of PU4 Flash Memory

4.8.1 Connecting the PC

In order to program the PU4 module of SWT 3000, use the **USB connector of the PU4 module**. The connection to the service PC is established with with the USB connecting cable supplied with the device. The SWT 3000 PU4 CP2102 USB to UART Bridge Controller must have been installed with installation of the service program PowerSys on the PC (refer to chapter *4.2 PowerSys Installation*).

In order to program the PU4 module, perform the following instructions:

- Turn off the device with the **S2** switch on the PU4 module.
- To enable the programming with MemTool, set the **S3.1 of S3 DIL switch on the PU4 module to ON position**.
- Turn on the device with the **S2** switch on the PU4 module.
- Press the **S1** reset button on the PU4 to proceed the upgrade.

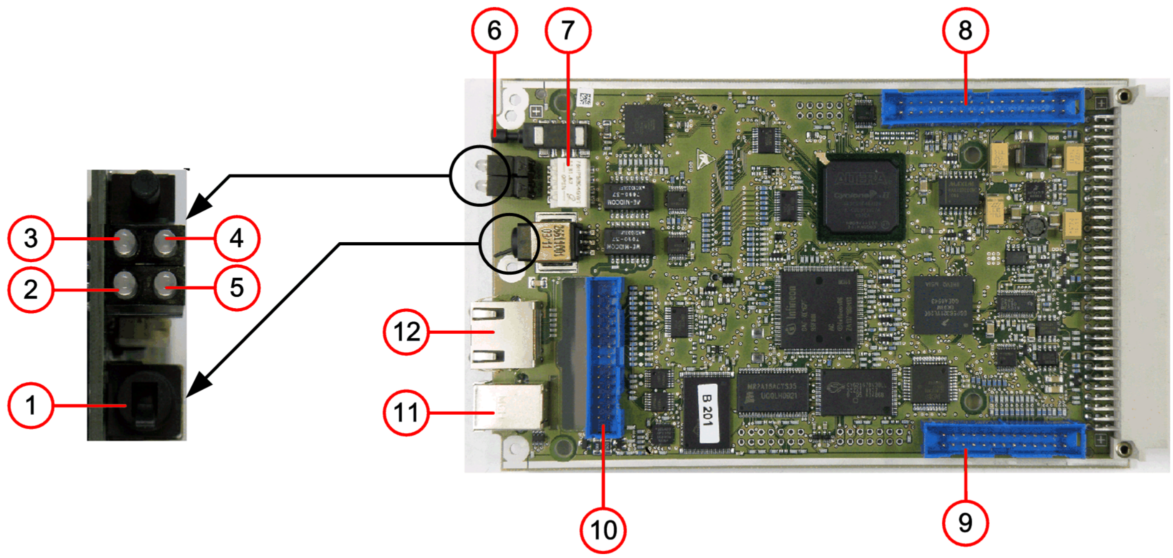
NOTE

If SWT 3000 is integrated into PowerLink (as iSWT), perform the following instructions:

- Turn off the device with the **S1** switch on the CSPi module.
- To enable the programming with MemTool, set the **S5.2 on the CSPi module to ON position**.
- To enable the programming with MemTool, set the **S3.1 of S3 DIL switch on the PU4 module to ON position**.
- Turn on the device with the **S1** switch on the CSPi module.
- Press the **S1** reset button on the PU4 to proceed the upgrade.

CAUTION

✧ During the update operations with MemTool the device (SWT 3000 or PowerLink with iSWT) will be out of regular service.



[le_pu4jum, 1, en_US]

Figure 4-47 Position of Jumpers, Input and Signaling Elements on the PU4 Module

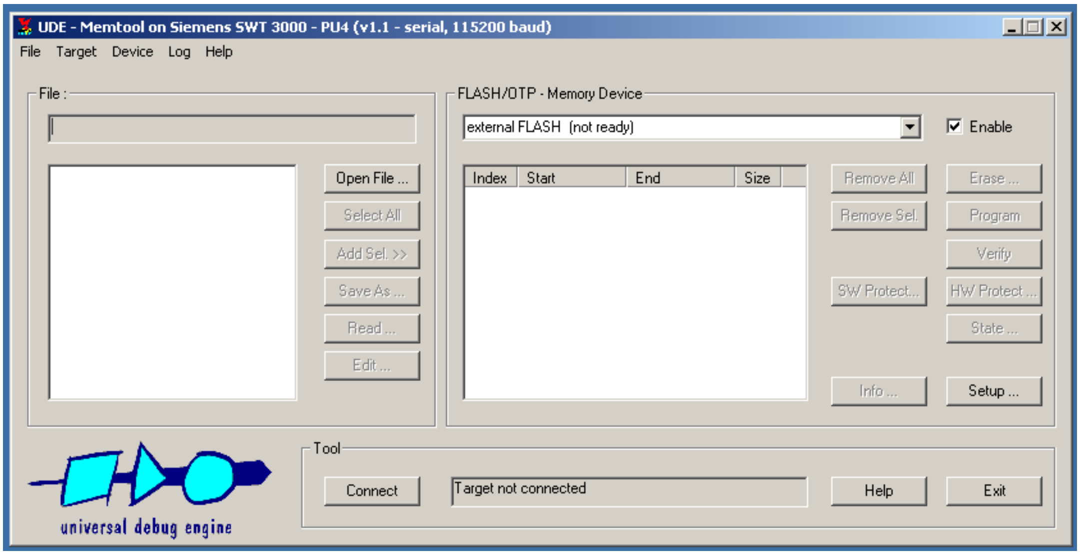
1	S2: Power ON/OFF
2	LED OK/GBAL
3	LED Status Interface LID-2
4	LED Status Interface LID-1
5	LED Status Interface LIA
6	S1: Reset button
7	S3 (3.1 to 3.4)
8	Connection on DLE
9	Connection on DLE
10	Connection of the IFC Modules
11	LCT: Service Interface (USB)
12	NMS: Ethernet Interface

NOTE

The Digital line equipment DLE is available only for PowerLink 100.

4.8.2 Starting MemTool

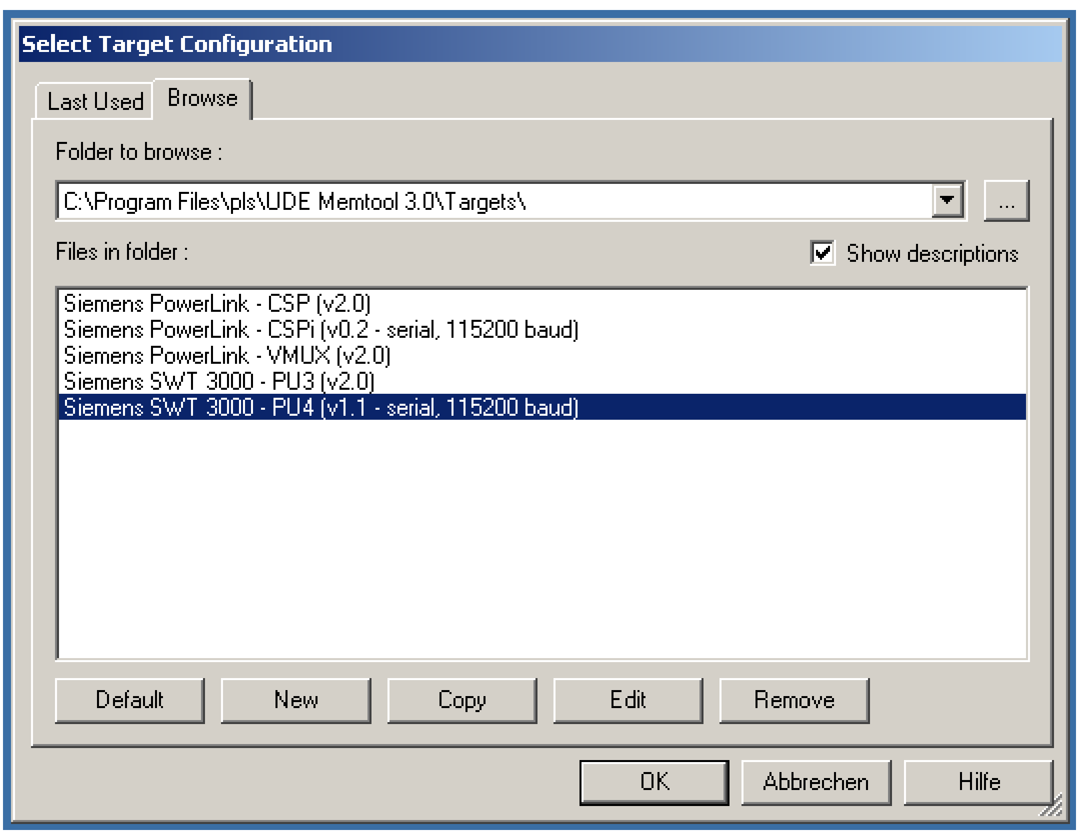
In order to launch MemTool as a stand-alone tool, execute Memtool.exe via the Windows main menu **Start > Programs > UDE MemTool**.



[scstrmem-020413-01.tif, 1, en_US]

Figure 4-48 MemTool with the PU4 Target

When starting MemTool for the first time, the **Select Target Configuration** dialog is displayed. Otherwise, you can reach this dialog via the menu bar **Target > Change**.



[sctarget-020413-01.tif, 1, en_US]

Figure 4-49 Selecting the Siemens SWT 3000 - PU4 (v0.1 - serial, 115200 baud)

Select **Siemens SWT 3000 - PU4 (v1.1 - serial, 115200 baud)** and click **OK**.

NOTE

Wrong target selection results in unsuccessful flash programming. Verify that the **selected target** is the **physically connected device**.

Refer to Chapter *4.5.3 Basic Settings*,*MemTool Settings* to get more detailed information.

4.8.3 Connection to the SWT 3000 Target

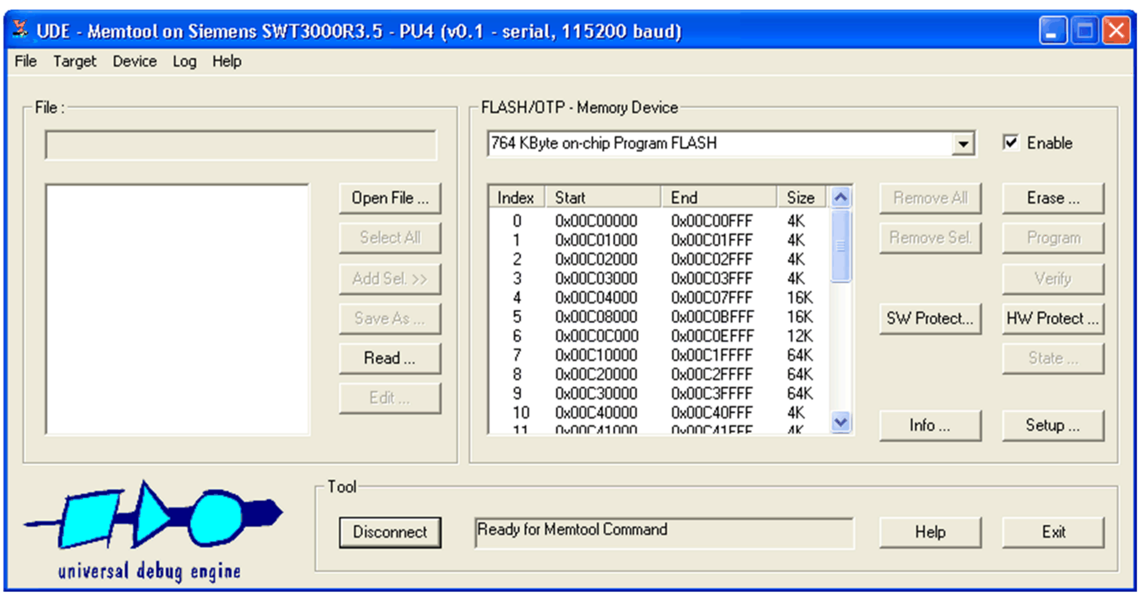
The PU4 memory consists of an internal FLASH (on-chip flash) and an external FLASH module. Both are programmed sequential with the same procedure.

For **764 KByte on-chip Program FLASH** module, the sector table is created after determining the actual type of the FLASH and clicking **Connect**.

Select **764 KByte on-chip Program FLASH (not ready)** in the **Flash/OTP - Memory Device** list box.

Click **Connect** to establish a connection to the target SWT 3000 system. The sector list box contains now the sector table of the selected FLASH module. The **Connect** button changes to **Disconnect**.

If the connection fails, reset the PU4 module and try again. For more detailed information, refer to *4.5.5 Trouble Shooting*.

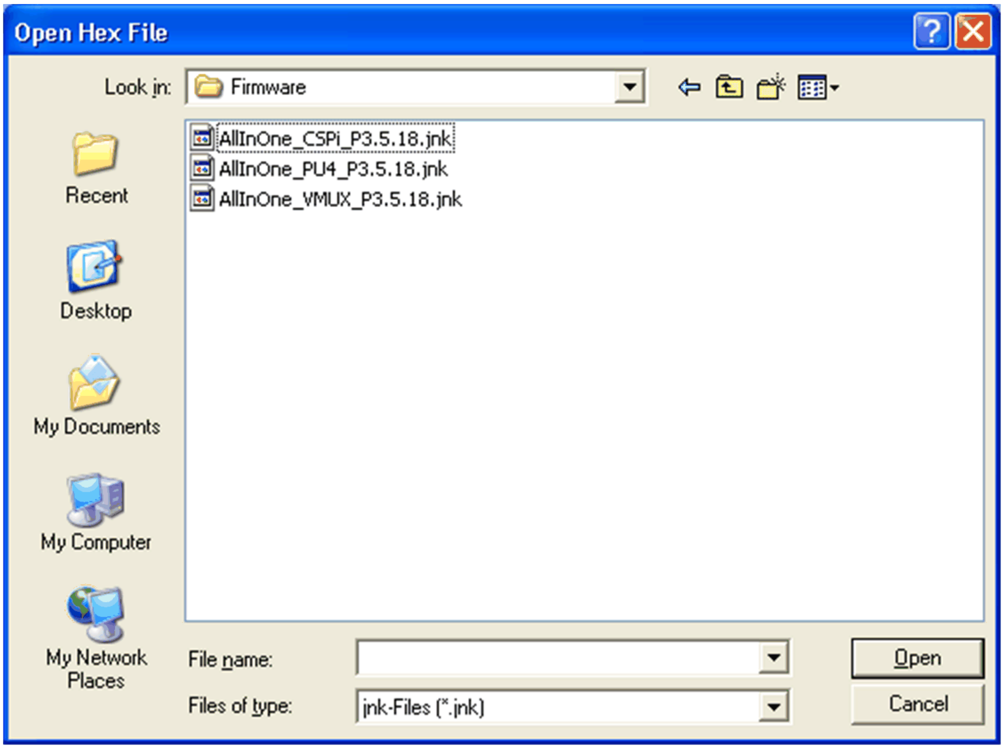


[scdicosw-171011-01.tif, 1, en_US]

Figure 4-50 Dialog of the Connection to SWT 3000 for 764 KByte On-Chip Program FLASH

4.8.4 Programming the Application into the Flash Memory

Click **Open File** and select the AllInOne_PU4_Px.y.z.jnk.



[scsealli-171011-01.tif, 1, en_US]

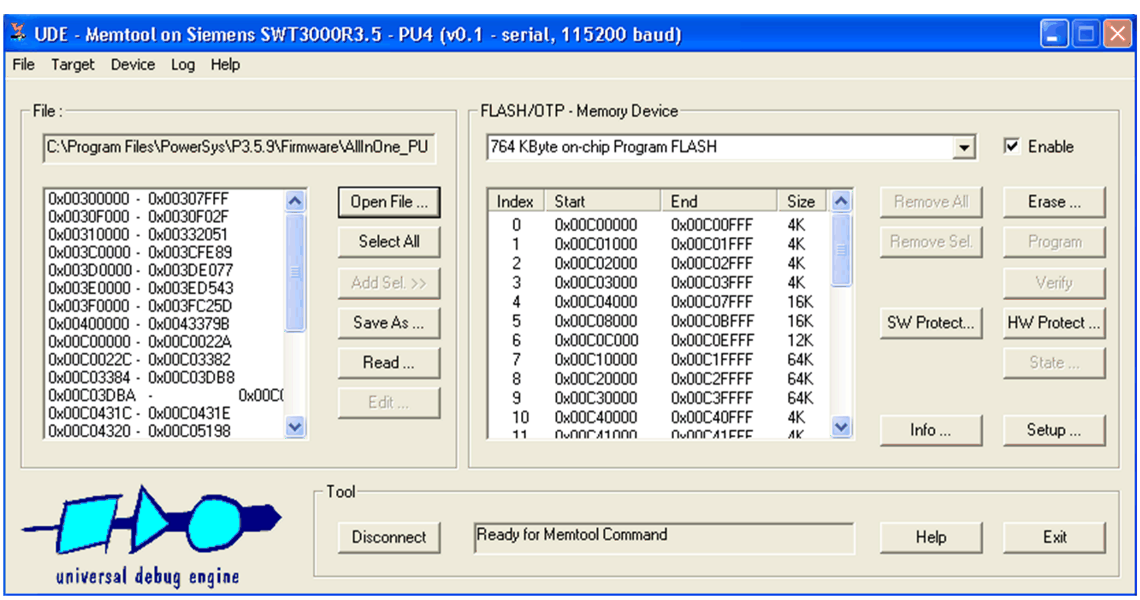
Figure 4-51 Selection of the AllInOne_PU4_Px.y.z.jnk File

NOTE

For the first time, it can be possible that you have to select **All Files** or **jnk Files** in the **Files of type** list box and navigate to the source folder. For more detailed information, refer to *4.5.4 Getting Started*.

Click **Open**.

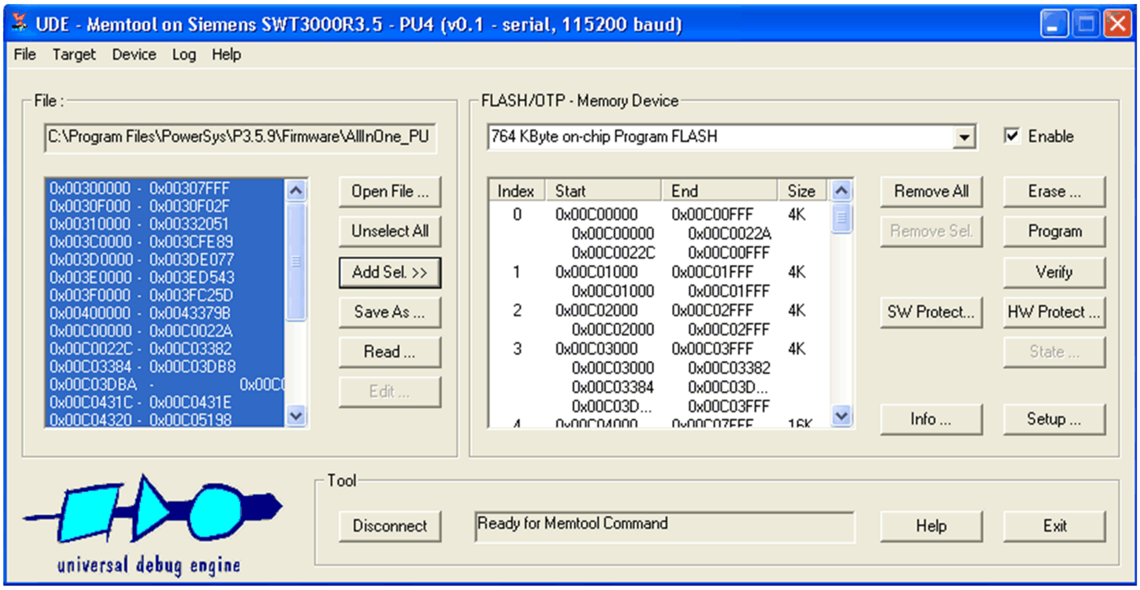
After loading this file in the left part of the MemTool main dialog, the file name and a list of sectors of the application are displayed.



[scfilena-171011-01.tif, 1, en_US]

Figure 4-52 After Selection of the AllInOne_PU4_Px.y.z.jnk File

Click **Select All** and then **Add Sel. >>**. The sectors of the application are displayed (according to the sectors they belong to) in the list box on the right-hand side.



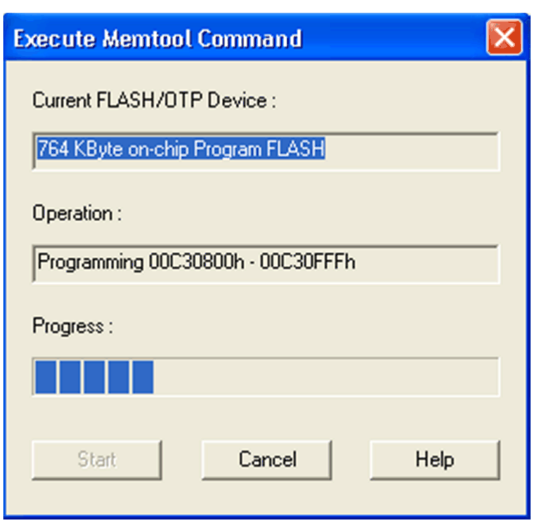
[scaddsel-171011-01.tif, 1, en_US]

Figure 4-53 Dialog of the Sectors in the List Box After clicking Add Selection

NOTE

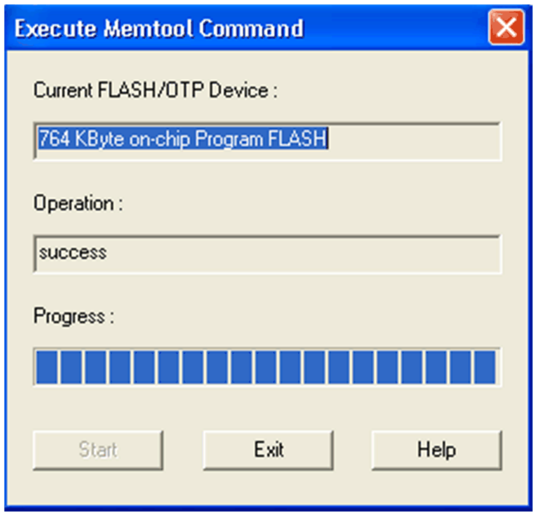
Wrong file selection results in unsuccessful flash programming. Verify that the **selected file matches to the target**, the correct FLASH memory device is selected and enabled and the device is physically connected.

Click **Program** to start the programming cycle. The **Execute MemTool Command** dialog appears and shows the programming progress. The upgrade starts with programming and verification.



[scstprog-250711-01.tif, 1, en_US]

Figure 4-54 Starting of the Programming Process



[scsucpro-250711-01.tif, 1, en_US]

Figure 4-55 Dialog After a Successful Programming

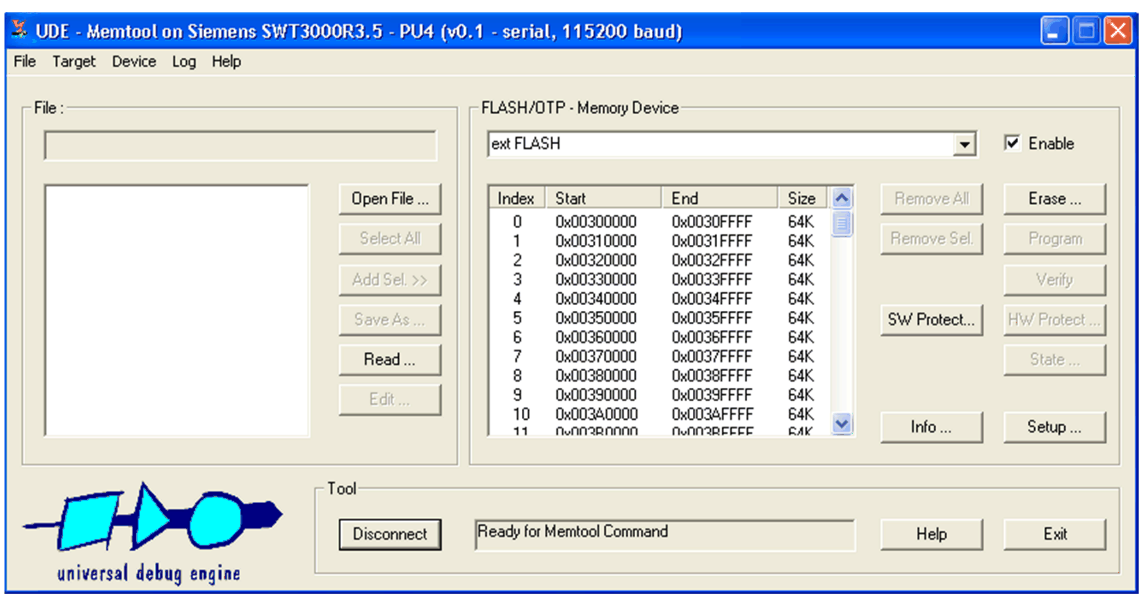
After successful upgrade, click **Exit**.

For **external FLASH** module, the sector table is created after determining the actual type of the FLASH.

Select **ext FLASH** in the **Flash/OTP - Memory Device** list box.

If the connection fails, reset the PU4 module and try again. For more detailed information, refer to *4.5.5 Trouble Shooting*.

Click **Erase ...** to erase the external FLASH.



[scdicose-150911-01.tif, 1, en_US]

Figure 4-56 Dialog of the Connection to SWT 3000 for External FLASH

Click **Program** to start the programming cycle. The **Execute MemTool Command** dialog appears and shows the programming progress. The upgrade starts with programming and verification.

After successful upgrade, click **Exit**.

Click **Disconnect** and then **Exit** to close the MemTool main dialog.

NOTE

Turn off the device with the **S2** switch on the PU4 module.
Set the **S3.1 of S3 DIL switch on the PU4 module to OFF position**.
Turn on the device with the **S2** switch on the PU4 module (PU4-Reset).

NOTE

If SWT 3000 is integrated into PowerLink (as iSWT), perform the following instructions:

- Turn off the device with the **S1** switch on the CSPi module.
- Set the **S3.1 of S3 DIL switch on the PU4 module to OFF position**.
- Set the **S5.2 on the CSPi module to OFF position**.
- Turn on the device with the **S1** switch on the CSPi module (CSPi-Reset).

4.9 PLPAStraps for Jumper Settings

4.9.1 Overview

This program is part of the PowerSys software package. Copy the program on your computer hard disk and run the <**PLPAStraps Setup**> file.

The program PLPAStraps calculates the necessary jumper settings for all modules in the PLPA section of the PowerLink

4.9.2 Installation

If older PLPAStraps program versions are installed on the PC, all program parts of the former versions need to be uninstalled prior to installation of the new PLPAStraps version.

Open the **Control Panel > Add / Remove software programs** and select the following software programs for uninstallation:

- PLPAStraps (e.g. PLPAStraps CSPi v1.4)
- MATLAB Component Runtime

After uninstallation and Restart of the PC the new PLPAStraps version (e.g. v01.50.00) can be installed by execution of the **PLPAStraps_Setup.exe** from folder **\PLPAStraps**.

The Setup Wizard leads you through the installation process which is divided in 2 parts:

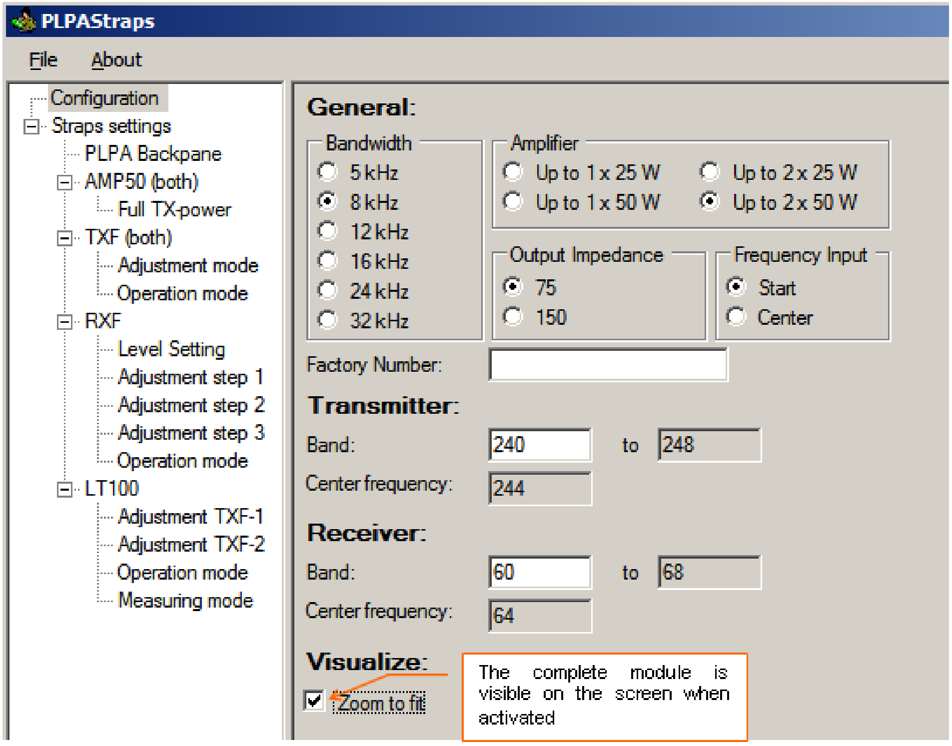
- 1. Setup of the PLPAStraps program
- 2. Installation of the MATLAB Compiler Runtime 8.0 (MCR)

The MCR is mandatory part of the installation, otherwise PLPAStraps will not work. Older MATLAB Runtime versions may be incompatible with new PLPAStraps versions. It's strongly recommended always to execute both installation steps. In case the MCR is not automatically installed automatically with the PLPAStraps_Setup.exe execute the **MCRInstaller.exe** separately from folder **\PLPAStraps\MCRInstaller**.

4.9.3 Input of PLPA configuration

After start of the program PLPAStraps the <**Configuration**> form is opened. Here the configuration parameters of the PLPA amplifier can be selected.

Fill the required parameters and activate the checkbox **Visualize > Zoom to fit**. The option enables the automatic zoom of the forms in the Straps settings submenus to the actual window size.



[scplpacf-081210-01.tif, 1, en_US]

Figure 4-57 The PLPA configuration form

First enter the general settings like bandwidth of the PowerLink the amplifier power and the output impedance. The frequency input is possible for the start frequency of the Transmitter resp. Receiver band or for the center frequency.

Strap Settings

By selecting the <**Strap settings**> submenus the program calculates the required settings for the PLPA modules.

When selecting <**Strap settings – TXF – Operation mode**> the necessary strap settings for the TXF in the normal operation mode are calculated from the program and displayed subsequently. For the filter adjustment a slightly different strap setting is necessary. It is displayed with click on <**TXF – Adjustment mode**>. In case of using a 100 W power amplifier two AMP50 and two TXF modules are necessary. The strap settings are the same in both modules.

The strap settings for the receiver module RXF in the normal mode is calculated when selecting <**Strap Settings – RXF – Operation mode**>. For the filter adjustment a slightly different setting is necessary. It is displayed with click on <**RXF – Adjustment step 1 to 3**>. Additional RX level setting is possible.

The strap setting for the LT 100 module in the normal mode is calculated when selecting Straps Settings - <**LT100 – Operation mode**>. For tuning the TXF in position 1 resp. 2 a slightly different setting is necessary. It is displayed with click <**LT100 – Adjustment TXF-1**>resp. **TXF-2**.

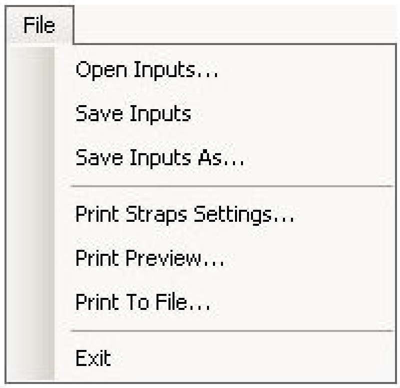
NOTE

For further information about filter adjustment refer to chapter *Commissioning*.

Configuration settings and the corresponding straps settings can be saved by the option Save Inputs in the menu <**File**>.

4.9.4 The Menu <File>

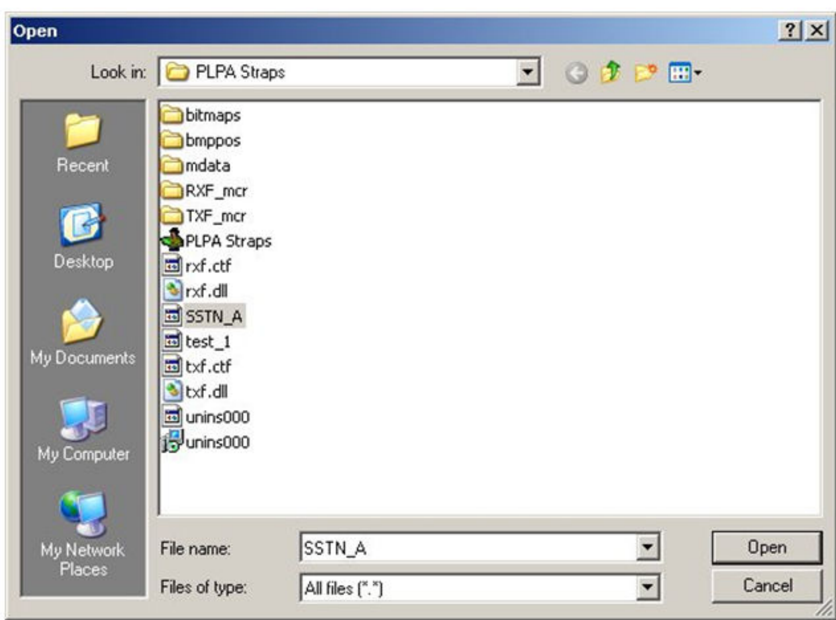
After the program has been started an existing file can be opened <**Open**>. Further the saving of the entries <**Save**> or print-out of an existing file <**Print**> is carried out. With <**Exit**> the program is aborted.



[scflmenu-081210-01.tif, 1, en_US]

Figure 4-58 The menu <File>

4.9.5 Selecting an Existing File



[scselexf-091210-01.tif, 1, en_US]

Figure 4-59 Selection of an existing file

4.10 SWTStraps for Jumper Settings

4.10.1 Overview

The program SWTStraps can be used as a graphical utility to find the correct jumper settings for the SWT 3000 modules. The program is supplied with the PowerSys package in folder \Utilities. The program has to be installed on the PC by execution of the setup file in folder : \Utilities\SWTStraps. The Setup Wizard leads you through the installation process. With installation of the SWTStraps program a shortcut in the Programs folder and a desktop icon are created.

4.10.2 SWTStraps Input Form

With program start the SWTStraps Start Window is opened. You can either chose to load a new Input Form by click on <**New Configuration**> or to open a earlier saved configuration by <**Load Configuration**>.

[scstrasw-010813-01.tif, 1, en_US]

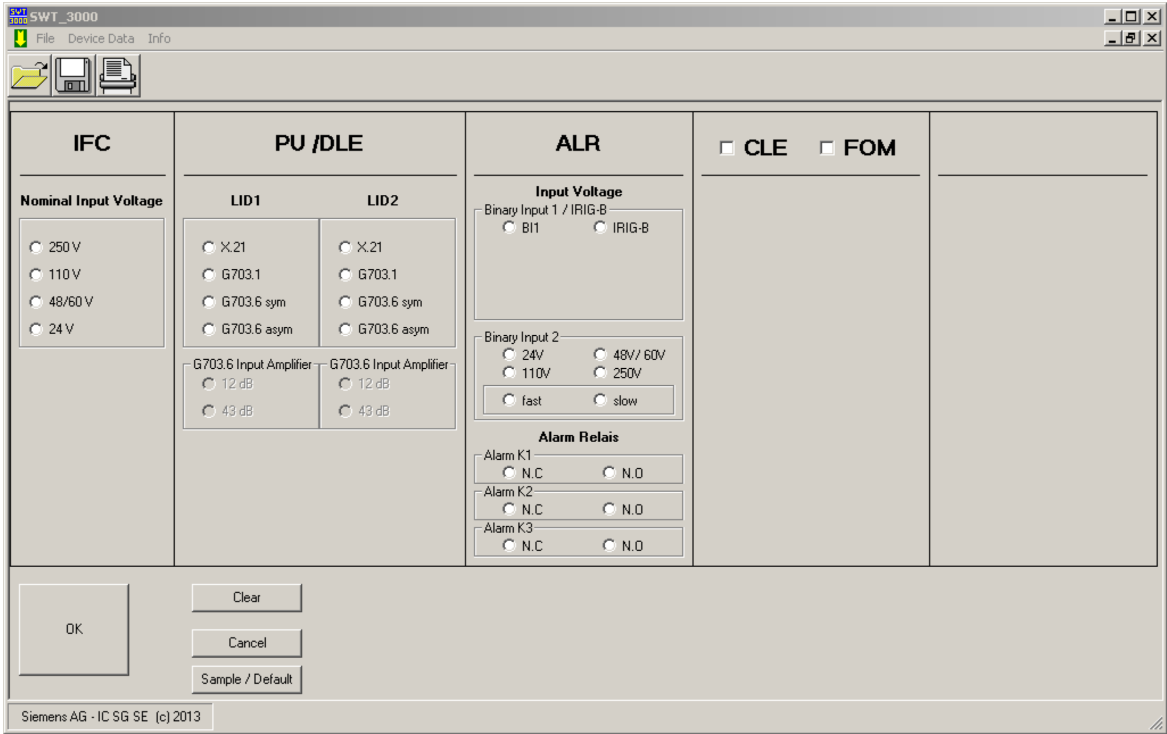
Figure 4-60 The SWTStraps start window

With selection of <**New Configuration**> a blank Input Form is opened. Earlier saved configuration inputs can be uploaded via the <**Load Configuration**> button.

With the blank input form the standard modules of an (i)SWT 3000 are displayed with their configurable parameters for the straps settings: IFC, PU4/DLE and ALR. Fill all parameters for the modules according to the requirements of your SWT 3000 system.

NOTE

Unsupported features or hardware of PowerLink 50 are not blocked in SWTStraps.

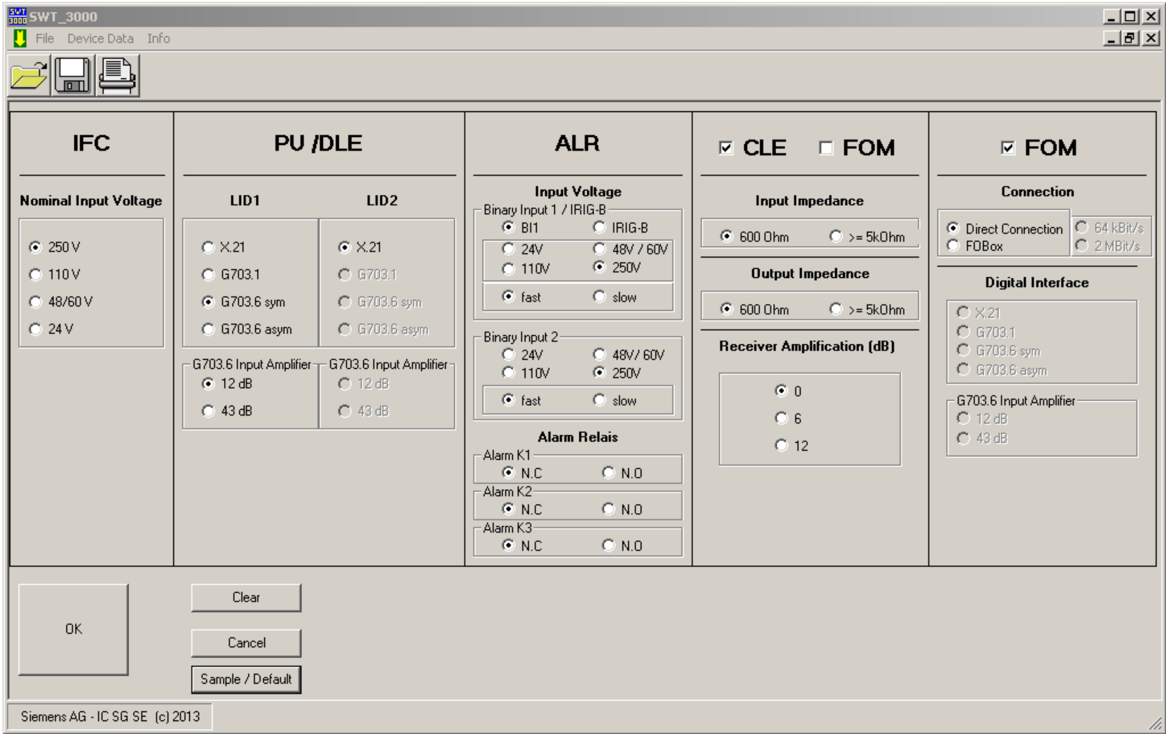


[scstripb-010813-01.tif, 1, en_US]

Figure 4-61 SWTStraps Input Form

When selecting the checkboxes of the optional SWT 3000 modules CLE and FOM the corresponding input forms become visible. Optionally then the parameters for CLE **or** FOM-1 can be entered. The inputs for an (optional) second FOM module can be made separately.

For exercise you can open a sample configuration by click on the button <**Sample/Default**>.



[scstrips-010813-01.tif, 1, en_US]

Figure 4-62 SWTStraps Input Form (Sample)

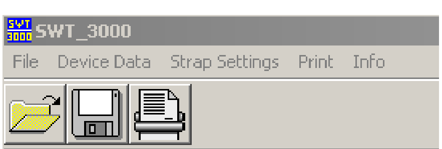
NOTE

For an iSWT 3000 integrated in PowerLink it is sufficient to enter the inputs for IFC, PU4/DLE and ALR module.

If the configuration of the device data is completed, click the <**OK**> button.

In the SWTStraps menu **>File** resp. **>Print** (or by click on the icons) you can **Save** or **Print** the device data inputs. From the **>File** menu it is also possible to **Open** saved input datafiles or to **Clear** the recent configuration.

You can edit the device data inputs of the recent configuration anytime via **>Device Data > Edit**.



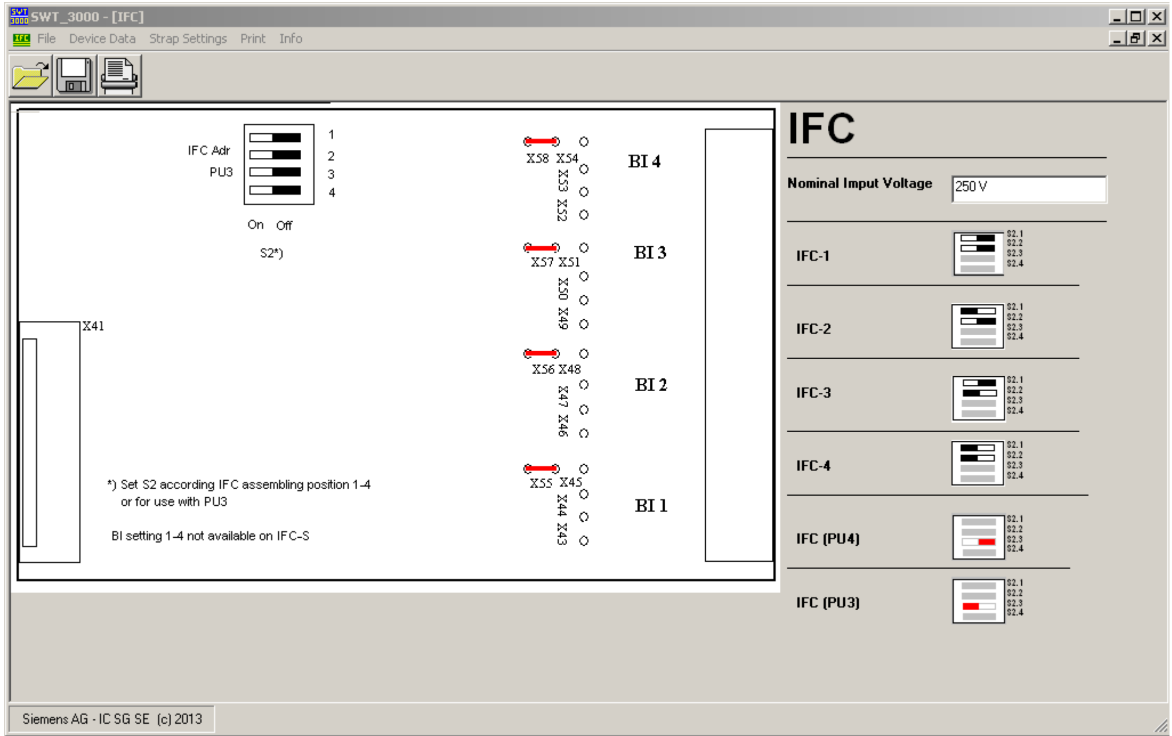
[scstrmen-010813-01.tif, 1, en_US]

Figure 4-63 The SWTStraps main menu

4.10.3 The Straps Settings windows

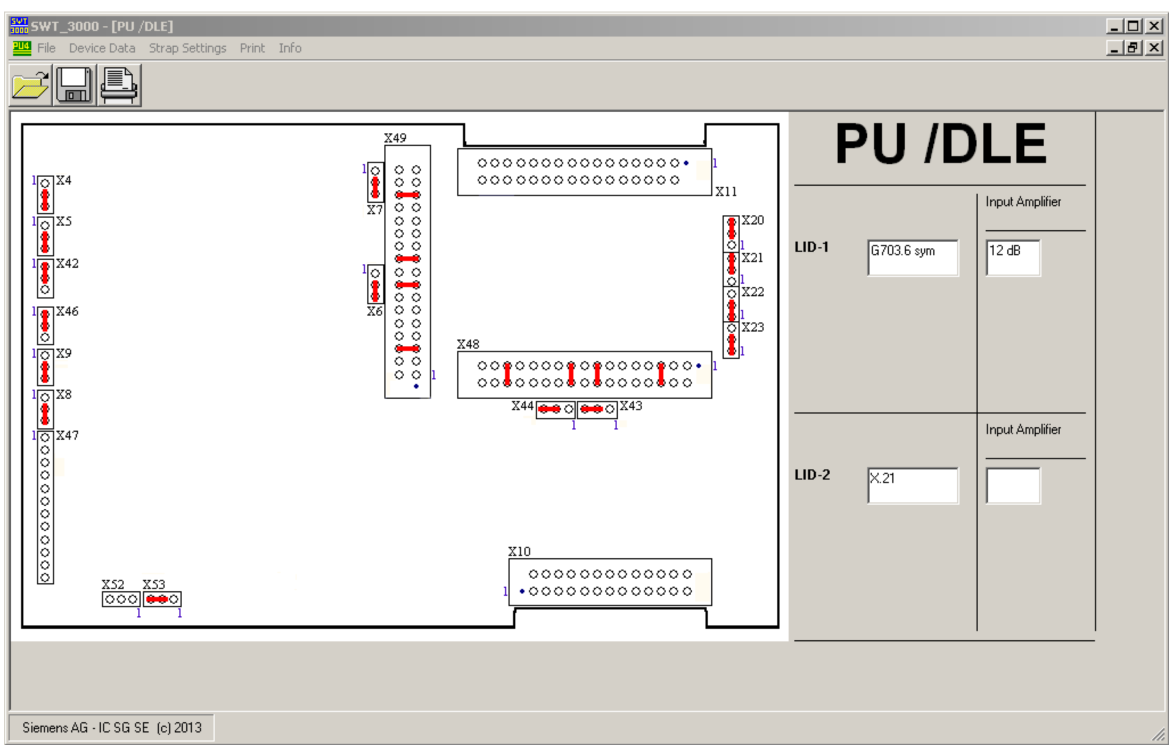
The straps setting windows for the configured (i)SWT 3000 modules can be selected via the main menu **>Straps Settings**. From here you can open the displays with the required straps settings for the modules IFC(-P/D/S), PU4/DLE, ALR and (if configured) CLE, FOBox-1 or -2.

The following figures show examples.



[scstrifc-010813-01.tif, 1, en_US]

Figure 4-64 Straps Settings for a IFC module (example)



[scstrdle-010813-01.tif, 1, en_US]

Figure 4-65 Straps Settings for the DLE (example)

You can print the straps settings of the configured (i)SWT 3000 modules to paper-print via menu **>Print** or the printer icon.

4.11 MergeTool for IEC61850 with (i)SWT 3000

4.11.1 Overview

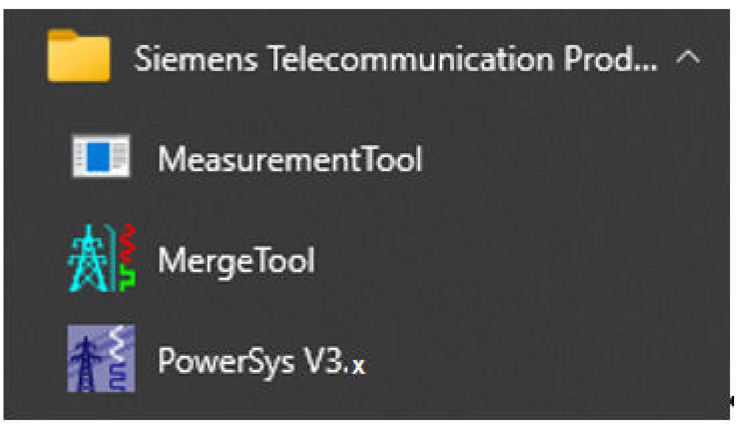
The IEC 61850 Intelligent Electronic Device (IED) configuration philosophy of SWT 3000 is to have a separate static IED Capability Description (ICD) file for each possible SWT 3000 I/O configuration. These ICD files are imported in the IEC 61850 system configurator (DIGSI®) for substation configuration.

When the substation configuration is finished, the **MergeTool**[3] reads the Station Configuration Description (SCD) file (of the substation configuration) and generates the following 2 files:

- EN100 parameter file (BIN file)
- PowerSys preconfiguration file (CFG file)

PowerSys imports these 2 files into PU4 board.

MergeTool is installed together with the PowerSys installation, it can be started from Windows Startup menu.



[sc_windows_startup_menu, 2, --_--]

Figure 4-66 MergeTool in Windows Startup menu

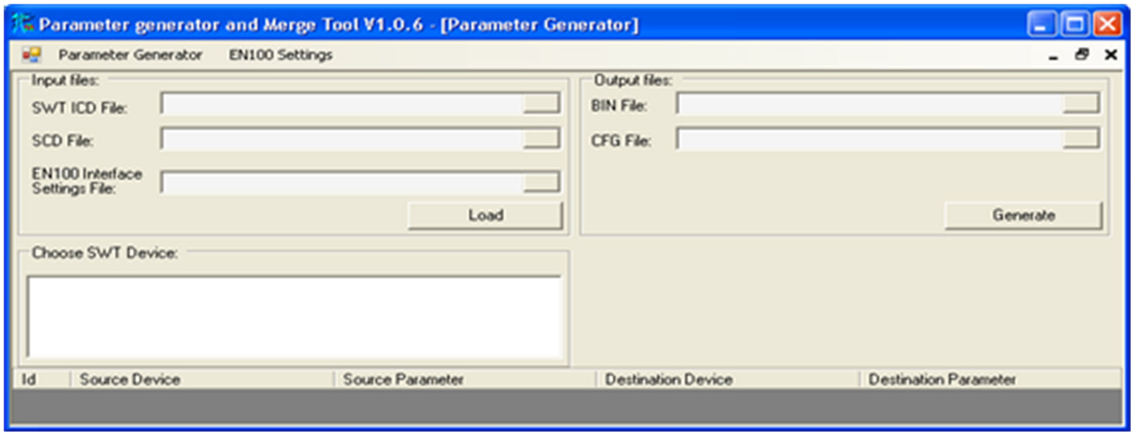
The **MergeTool** dialog contains the **Parameter Generator** and **EN100 Settings** buttons.

4.11.2 Parameter Generator

Select the **Parameter Generator** button in the **MergeTool** dialog.

The following **MergeTool > [Parameter Generator]** dialog appears:

3 MergeTool covers the offline configuration of the IEC 61850 related settings for SWT 3000.



[scpargen-141011-01.tif, 1, en_US]

Figure 4-67 MergeTool > [Parameter Generator] Dialog

Table 4-10 Parameter Generator Settings

Parameter	Description	Selection
Input files > **SWT ICD File**	The **SWT ICD File** (a mapping of the device in a standard compliant file) is the precondition for work in the system configurator (DIGSI), which is based on these files. The ICD files describe the communication properties of the device according to IEC 61850. The ICD file of the SWT 3000 device is used for station configuration.	One of maximum 9 different available ICD files. Each file describes maximum amount of transmittable and receivable commands.
Input files > **SCD File**	Several devices form a complete station. They can also include a master unit. These components have various communication connections between them that must be parameterized. The description of all devices, their settings, and interrelations are grouped together in the SCD file. The SCD file itself is created and processed using the system configurator (DIGSI).	SCD file of the station
Input files > **EN100 Interface Settings File**	The **EN100 Interface Settings File (IFD file)** contains the interface settings for the EN100 module.	IFD file for the EN100 module A default IFD file for the selection of input file is presented to the MergeTool user in the PowerSys installation folder **\Px.y.zzz\Util\Merge-Tool\v01.00.11**.
Choose SWT Device	The present SWT 3000 devices appear in this window. For the generation of output files, select one of the SWT 3000 devices. After selecting the desired SWT 3000 device, the source device, source parameter, destination device, and destination parameter are listed in the option table.	One of the SWT 3000 devices
Output files > **BIN File**	The configuration for the EN100 module is provided via EN100 parameter file (binary parameter file, **BIN file**) EN100par.bin.	Select a folder for storage of the BIN file.
Output files > **CFG File**	The configuration for PowerSys is provided via PowerSys preconfiguration file (**CFG file**).	Select a folder for storage of the CFG file.

NOTE

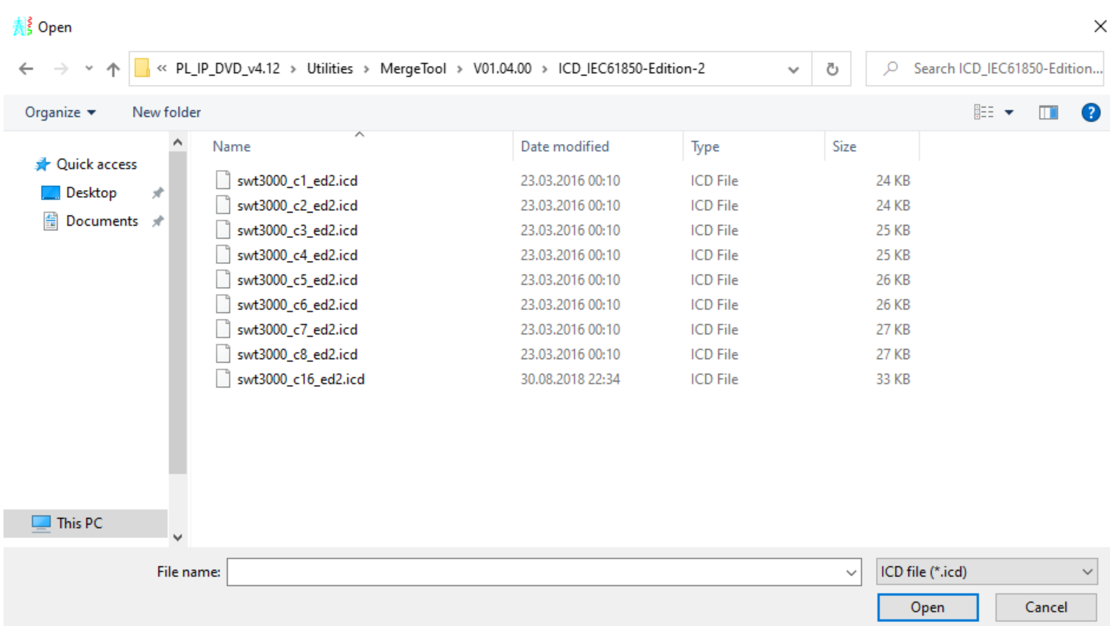
There are maximum 9 different ICD files available. Each file describes maximum amount of transmittable and receivable commands. The ICD files are available in the PowerSys installation folder **\Px.y.zzz\Util\MergeTool\v01.00.11** and on the PowerSys package in folder **\IEC61850\Config_files**.

Table 4-11 Selection of different ICD Files

Selection	Comment
SWT3000_c1_ed1/2.icd	Maximum 1 GGIO command is transmittable and receivable
SWT3000_c2_ed1/2.icd	Maximum 2 GGIO commands are transmittable and receivable
SWT3000_c3_ed1/2.icd	Maximum 3 GGIO commands are transmittable and receivable
SWT3000_c4_ed1/2.icd	Maximum 4 GGIO commands are transmittable and receivable
SWT3000_c5_ed1/2.icd	Maximum 5 GGIO commands are transmittable and receivable
SWT3000_c6_ed1/2.icd	Maximum 6 GGIO commands are transmittable and receivable
SWT3000_c7_ed1/2.icd	Maximum 7 GGIO commands are transmittable and receivable
SWT3000_c8_ed1/2.icd	Maximum 8 GGIO commands are transmittable and receivable
SWT3000_c16_ed1/2.icd	Maximum 16 GGIO commands are transmittable and receivable

Select the files in the **Input files** area **in the following order**:

- Click the **SWT ICD File** button.
  The following dialog appears:

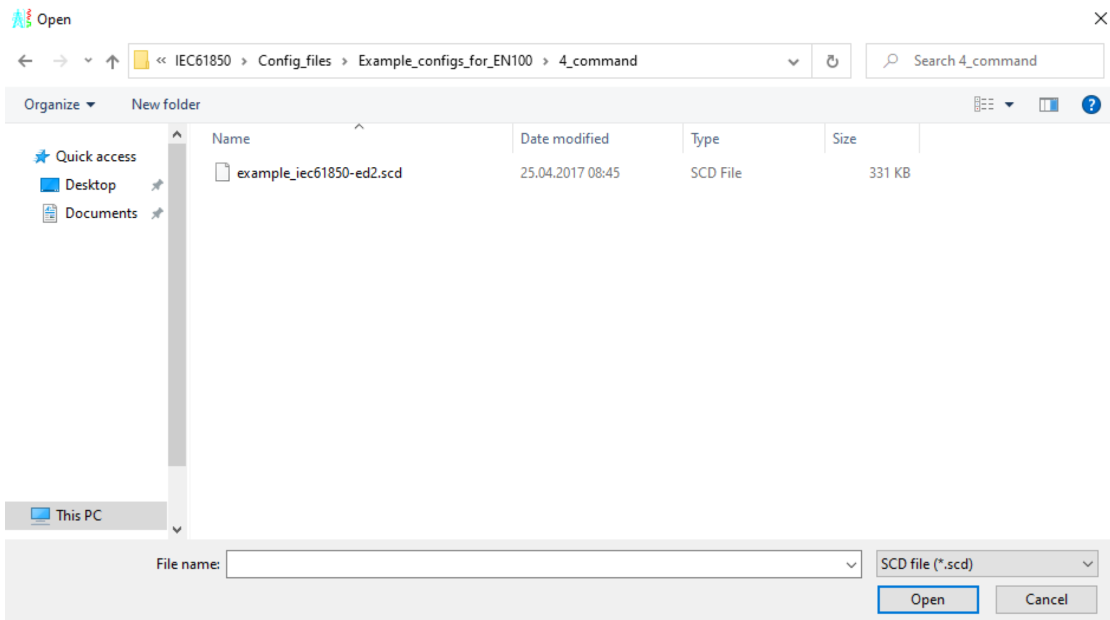


[sc_ICD_Fileselection, 1, --_--]

Figure 4-68 ICD File Selection of SWT 3000

Select the proper **SWT ICD File**, which was used in station configuration.
After selection of the **SWT ICD File**, click **Open**.

- Click the **SCD File** button.
  The following dialog appears:

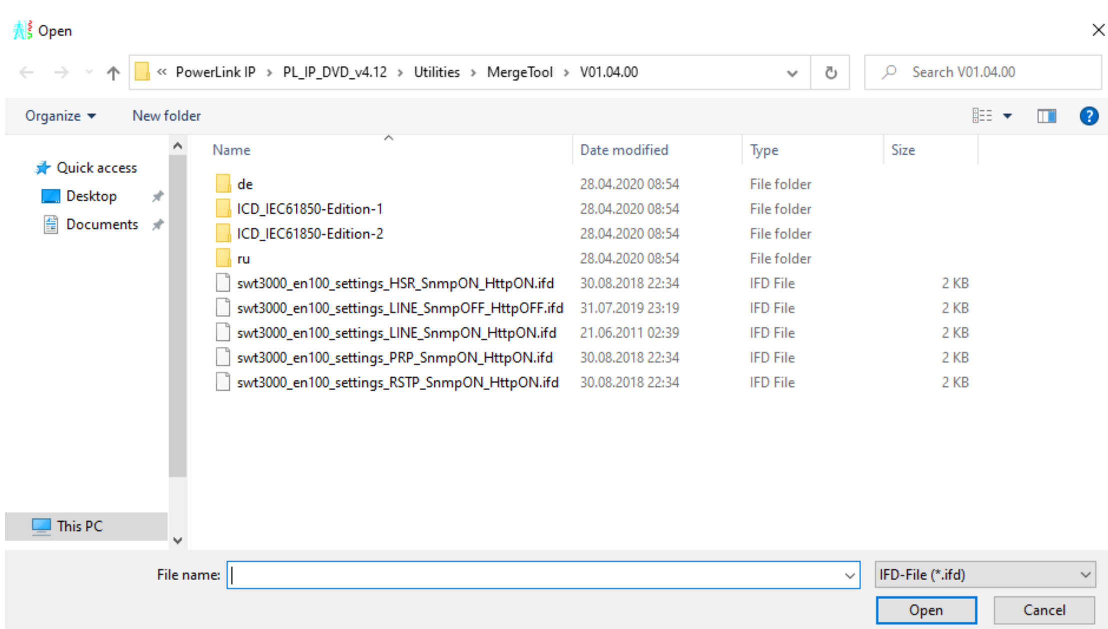


[sc_SCD_Fileselection, 1, --_--]

Figure 4-69 SCD File Selection of the Station

Select the proper **SCD File** of the station.
After selection of the **SCD File**, click **Open**.

- In the third step, click the EN100 **Interface Settings File (IFD file)** button.
  The following dialog appears:



[sc_EN100_Settingselection, 1, --_--]

Figure 4-70 IFD File Selection of the EN100 Module

Explanation for the default IFD files:

xxx_SnmpOFF_HttpOFF.ifd: EN100 SNMP and HTTP services are enabled

xxx_SnmpOn_HttpON.ifd: EN100 SNMP and HTTP services are disabled

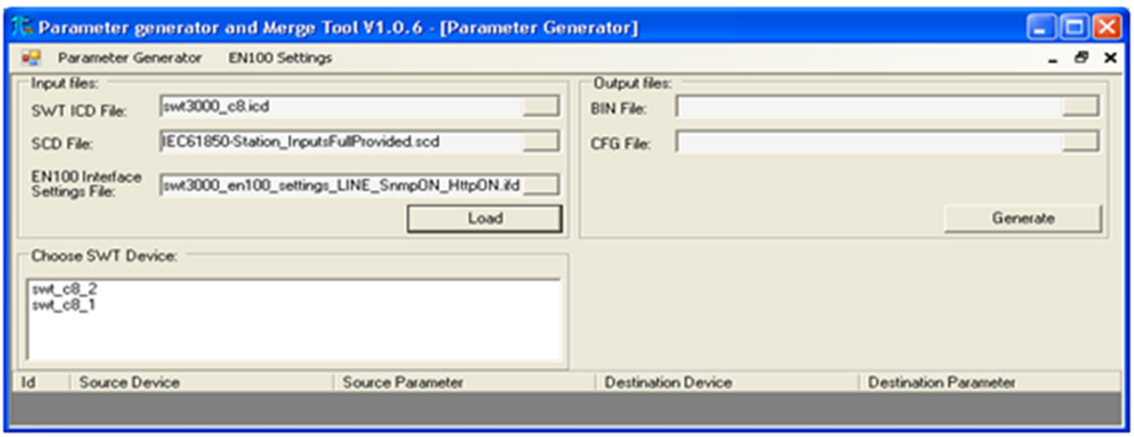
Select the proper **IFD file** of the EN100 module.

After selection of the **IFD file**, click **Open**.

NOTE

A default IFD file for the selection of input file is presented to the MergeTool user in the PowerSys installation folder **\Px.y.zzz\Util\MergeTool**.

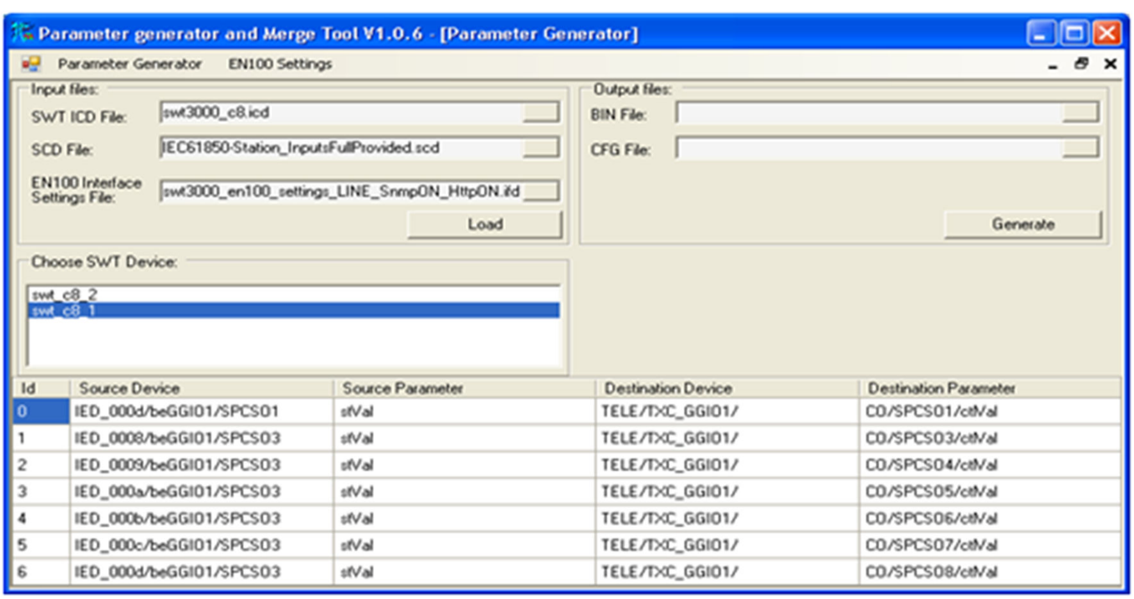
After selecting the **Input files**, click the **Load** button. If multiple matching SWT 3000 devices are found in the local station, they are listed in the **Choose SWT Device** area.



[scmtswtd-141011-01.tif, 1, en_US]

Figure 4-71 [Parameter Generator] Dialog with Choose SWT Device area

With clicking the desired device, the **Source Device, Source Parameter, Destination Device**, and **Destination Parameter** are listed in the option table.



[scmtopta-141011-01.tif, 1, en_US]

Figure 4-72 [Parameter Generator] Dialog with Option Table area

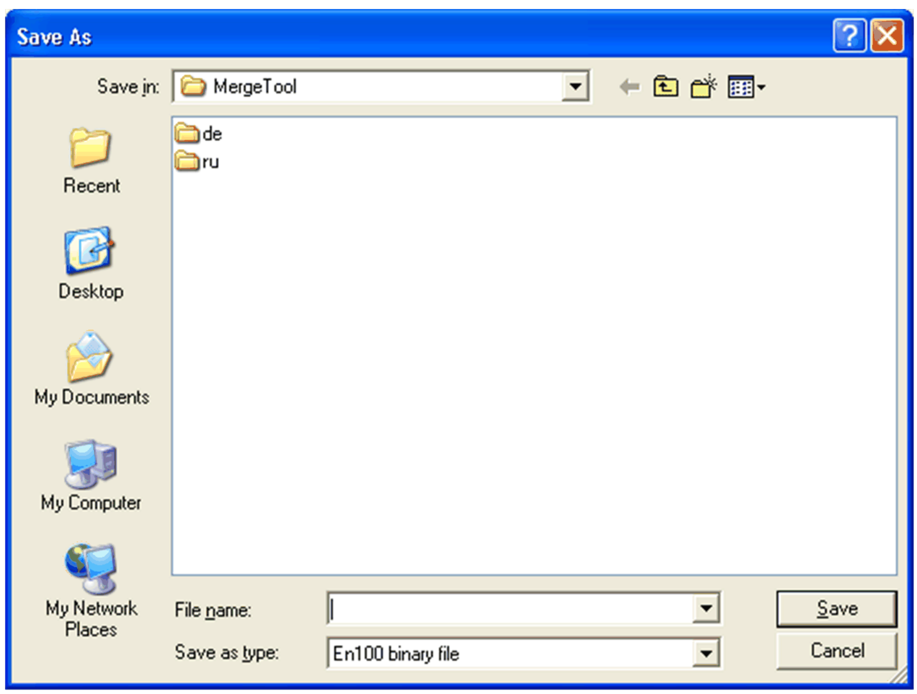
NOTE

If the SCD file does not contain the intAddr and daName tags for the inputs sections (so the substation configurator does not provide this information), manual selection of the source and destination parameters in the option table is necessary. Click the **Source Parameter** or **Destination Parameter** list box and select the specific parameters.

When using the EN100 module, it is necessary to generate the EN100 parameter file (BIN file) and PowerSys preconfiguration file (CFG file) and save them in a proper folder. The mentioned files can be uploaded to PowerSys in the SWT 3000 > Configuration > System-2 submenu. Store the content of the BIN file then in PU4 Flash. With each startup of SWT 3000, the BIN file is transferred to volatile memory of the EN100 module.

In order to generate the desired **Output files**, define the name and place of storage of the **Output files** area as follows:

- Click the **BIN File** button.
  The following dialog appears:

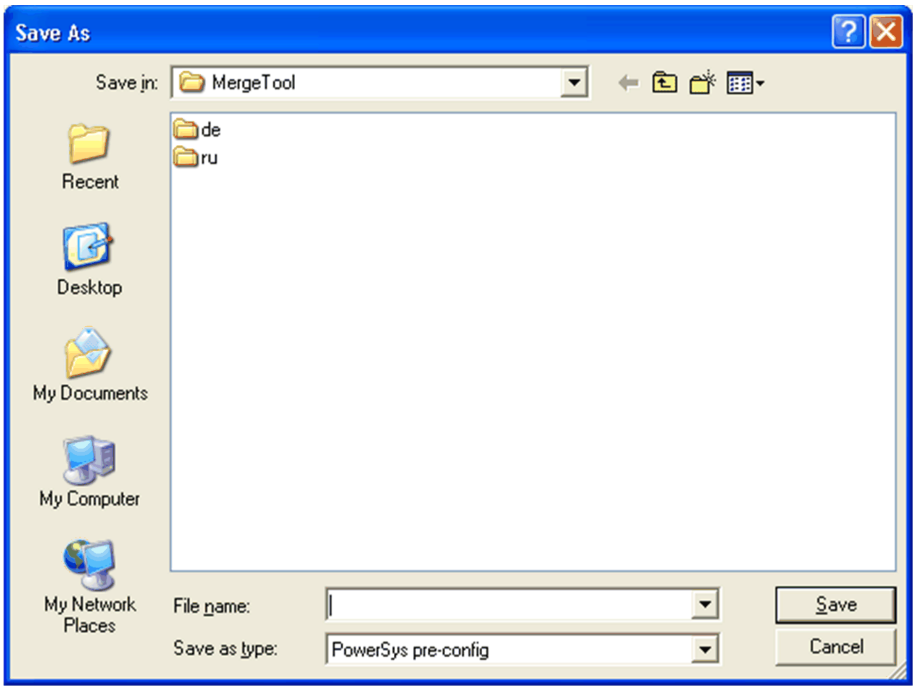


[scbinsel-080911-01.tif, 1, en_US]

Figure 4-73 Selection of Name and Place of the BIN File

Define the name and place of storage of the BIN file.
Afterwards, click **Save**.

- Click the **CFG File** button.
  The following dialog appears:



[sccfgsel-080911-01.tif, 1, en_US]

Figure 4-74 Selection of Name and Place of the CFG File

Define the name and place of storage of the CFG file.
Afterwards, click **Save**.

In order to generate the EN100 parameter file (BIN file) and PowerSys preconfiguration file (CFG file), click the **Generate** button.

NOTE

If SWT 3000 is equipped with an EN100 module, the BIN file and CFG file are configured in **PowerSys > SWT 3000 > Configuration > System-2 > EN100** area.

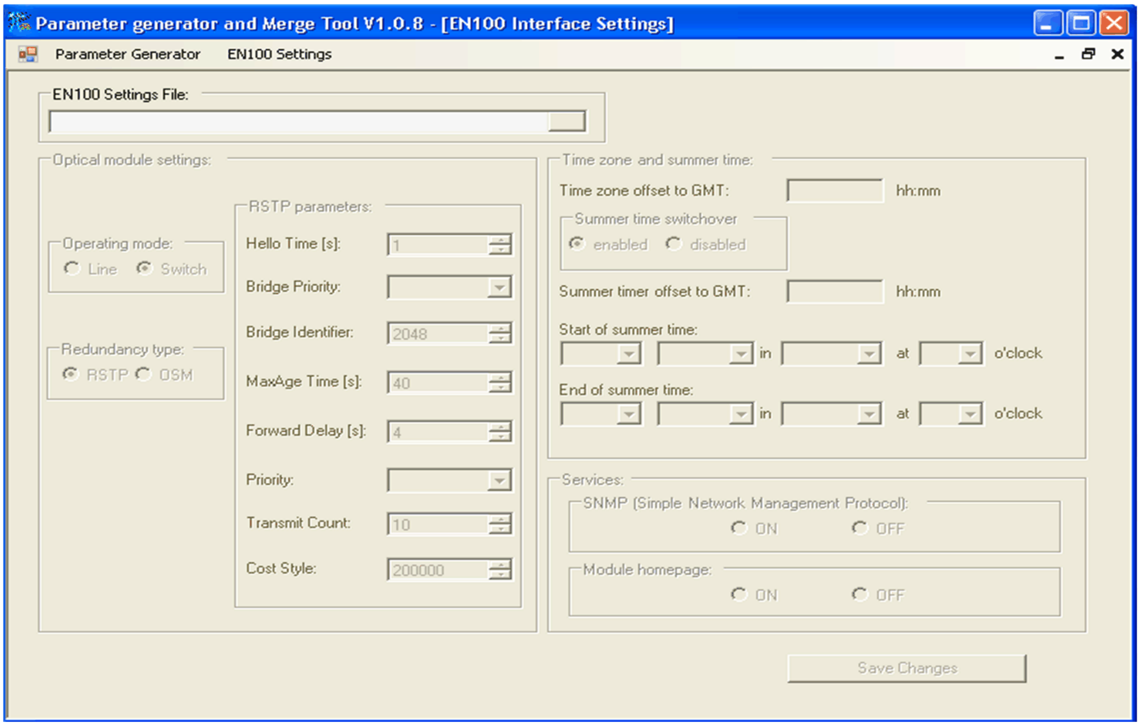
4.11.3 EN100 Settings

When using the EN100 module, there are some additional (none IEC 61850) configuration settings for the EN100 module. These settings have to be put in the parameter file downloaded to the EN100 module at startup.
Therefore, the MergeTool provides a Graphical User Interface (GUI) for the configuration of EN100 settings and stores these settings in a separate file. This option provides the implementation of the GUI elements processing the user interaction for the EN100 settings file manipulation.

NOTE

It is not necessary to create an EN100 settings file (IFD file). A default IFD file for the selection of the input file is presented to the MergeTool user.
If there is a new IFD file needed, proceed like described in the following.

Select the **EN100 Settings** button in the **MergeTool** dialog.
The following **MergeTool > [EN100 Interface Settings]** dialog appears:



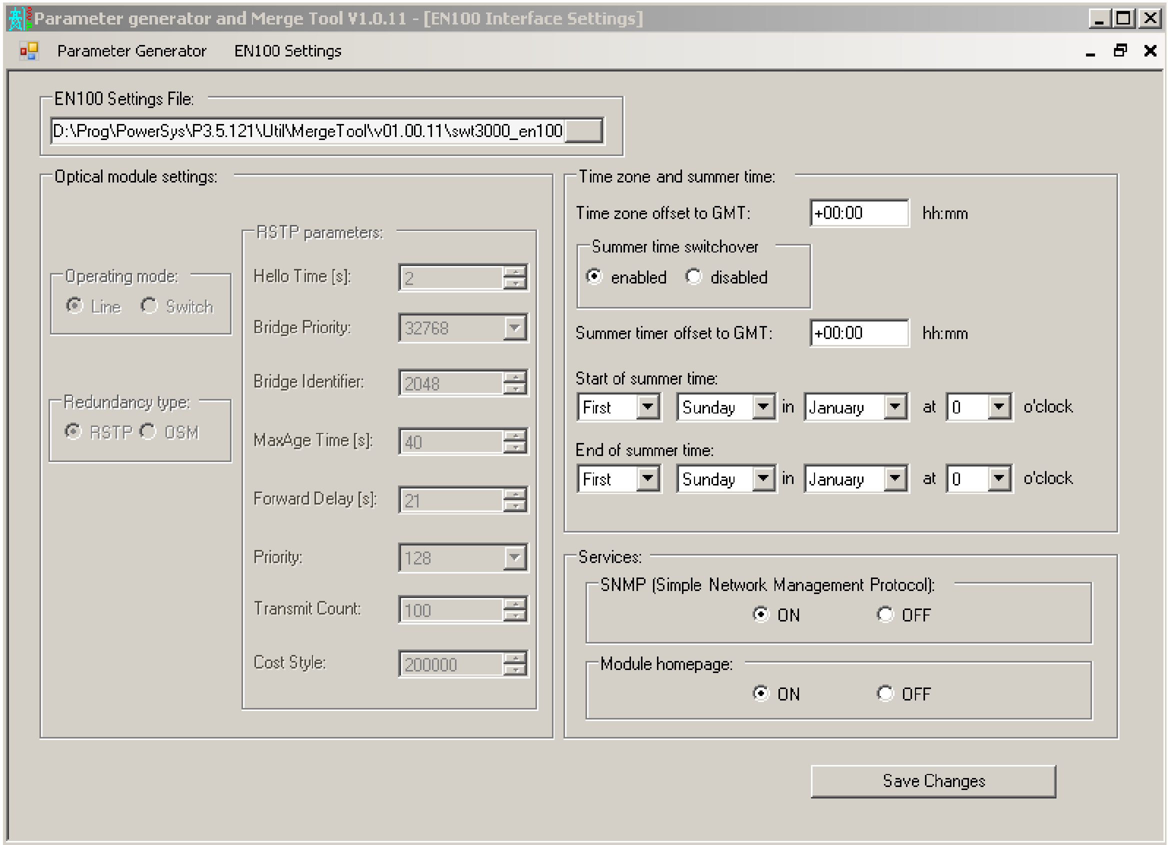
[scen100s-150911-01.tif, 1, en_US]

Figure 4-75 MergeTool > [EN100 Interface Settings] Dialog

Copy the presented default IFD file into a desired folder.

Rename this IFD file for creation of a new IFD file and save this file in the desired folder of database.

In order to select the new created IFD file, click the button in the **EN100 Settings File** area. Select the newly created IFD file from the folder in database. You can edit now the IFD file settings.



[scen100i-200513-01.tif, 1, en_US]

Figure 4-76 MergeTool > [EN100 Interface Settings] Dialog with Selected IFD File

Edit the **Optical module settings** as follows:

Table 4-12 Optical Module Settings of EN100 Settings

Parameter	Description	Setting Range or Selection
Operating mode	The operating mode for SWT 3000 is set to **Line** by default. The **Line** mode is equivalent to the functions of the EN100 module with electrical interface.	**Line**
Redundancy type	If the **Switch** mode has been selected, set the **Redundancy type** next. Available **Redundancy types** are **Rapid Spanning Tree Protocol (RSTP)** and **Optical Switch Module (OSM)**. The redundancy type depends on the ring structure. **Redundancy type OSM** is a proprietary procedure of the Siemens AG. The OSM type can only be used in combination with at least one external switch that can control this type of redundancy. Set one of the external switches as master. **Redundancy type RSTP** is used world-wide and supported by nearly all switches.	**RSTP** or **OSM**

Parameter	Description	Setting Range or Selection
RSTP parameter > **Hello Time [s]**	If no test message is received 3 times in a row during the specified monitoring time, the connection is considered faulty. The link status is also monitored. It leads to an immediate detection of an interruption with subsequent changeover. Permissible values are from 1 s to 10 s (the standard recommends a default setting of 2 s).	From 1 s to 10 s Change the RSTP parameter settings only if this change is necessary. In particular, use the settings recommended in this manual.
RSTP parameter > **Bridge Priority**	This value represents a priority for a switch. Every switch in the ring network has a specific priority that has been set equally for all switches by default. Furthermore, this priority is linked to the MAC address within the switch, which always yields different priorities. The lowest priority defines the logical separation of the ring network. Here, the messages are output from the ring network. The highest priority (identified by zero) marks the root switch. If messages are output or input there, both logical lines must have the same length. Permissible values are: 0, 4096, 8192, 12 288, 16 384, 20 480, 24 576, 28 672, 32 768, 36 864, 40 960, 45 056, 49 152, 53 248, 57 344, and 61 440 (the standard recommends a default setting of 32768 s).	From 0 s to 61 440 s (in increments of 4096)
RSTP parameter > **Bridge Identifier**	Enter a number from 0 to 4 294 967 295 as an identifier for the switch (default setting: 2048).	From 0 to 2^{32}
RSTP parameter > **MaxAge Time [s]**	Set a time from 6 s to 40 s. After this time has elapsed, older messages will be removed from the network (default setting: 40 s).	From 6 s to 40 s
RSTP parameter > **Forward Delay [s]**	The ports of the module remain in one of the conditions - discarding, learning, and forwarding - not longer than for the time set here. Permissible values are from 4 s to 30 s (the standard recommends a setting of 21 s).	From 4 s to 30 s
RSTP parameter > **Priority**	Every switch in the ring network has a specific priority that has been set equally for all switches by default. The priority is preset by the switch manufacturer. Furthermore, this priority is linked to the MAC address within the switch, which always yields different priorities. The lowest priority defines the logical separation of the ring network. Here, the messages are output from the ring network. The highest priority (identified by zero) marks the root switch. If messages are output or input there, both logical lines must have the same length (default setting: 128).	From 0 to 240 (in increments of 16)
RSTP parameter > **Transmit Count**	Maximum number of configuration messages sent for a specific event (structural reconfiguration). This number must exceed the number of existing switches in the ring network. Permissible values are from 3 to 128 (the standard recommends a setting of 10).	From 3 to 128
RSTP parameter > **Cost Style**	This value is a variable that depends on the speed of the link controlling the reconfiguration algorithm. A value of 200000 is fixed for 200 Mbits. Changes are necessary only in special cases and if Spanning Tree Protocol (STP) switches are used. The value -1 is the identifier for the automatic mode.	200000

Edit the **Time zone and summer time** as follows:

Table 4-13 Time Zone and Summer Time Settings of EN100 Settings

Parameter	Description	Setting Range or Selection
Time zone offset to GMT	The time offset of your time to the Greenwich Mean Time (GMT).	From -12 h to +12 h
Summer time switchover	Select the option **enabled** or **disabled** summer time switchover if you do or do not wish to change to daylight saving time.	enabled or disabled
Summer time offset to GMT	The time offset of your time to the GMT.	From 0 h to +23 h
Start of summer time	Date for the change to daylight saving time.	
End of summer time	Date for the change from daylight saving time.	

Edit the **Services** as follows:

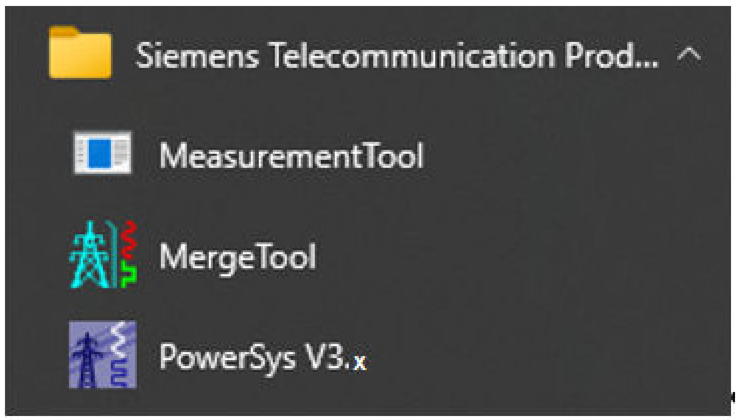
Table 4-14 Service Settings of EN100 Settings

Parameter	Description	Selection
SNMP	You can use this setting to activate or deactivate the SNMP protocol.	ON or OFF
Module homepage	You can use this setting to activate or deactivate the module homepage.	ON or OFF

4.12 Measurement Tool

4.12.1 Measurement Tool

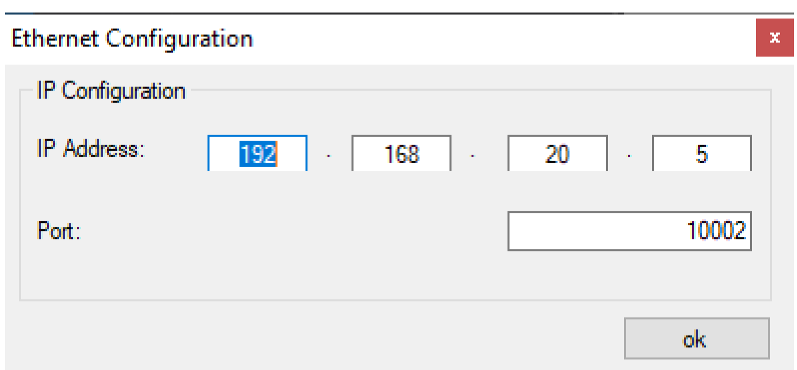
MeasurementTool is installed together with the PowerSys installation, it can be started from Windows Startup menu.



[sc_windows_startup_menu, 2, --_--]

Figure 4-77 MeasurementTool in Windows Startup menu

Enter device IP address before the connection to PowerLink.



[sc_measurement_tool_ethernet_config, 1, --_--]

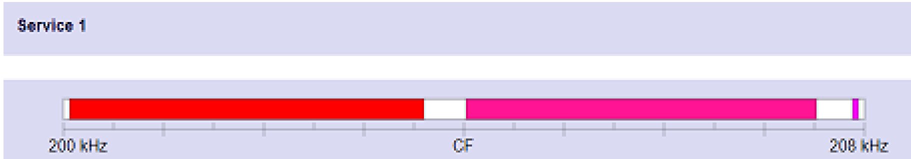
Figure 4-78 MeasurementTool Ethernet configuration

NOTE

Measurement Tool is only available if the connection to a PowerLink via TCP/IP is established. Microsoft .NET Framework 2.0 is requested.

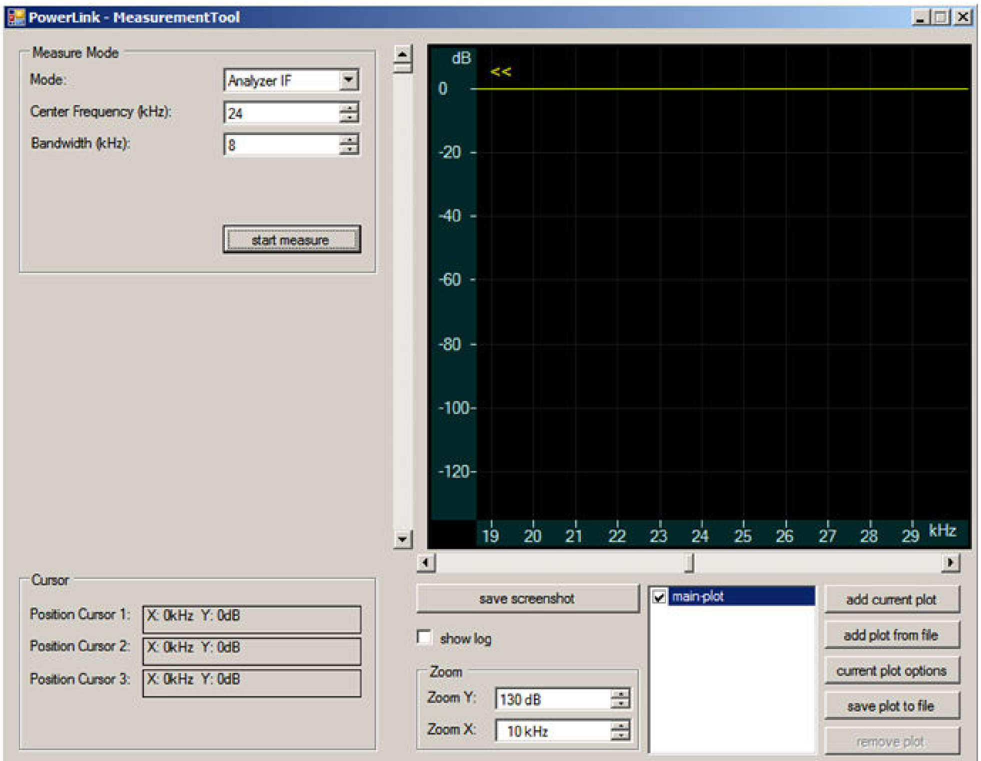
Mode Analyzer IF

The MeasurementTool is a helpful tool to display the received signal inside PowerLink during operation and also for providing a level generator, a level meter and a display for tuning the receive and transmit filter. The MeasurementTool displays corresponds with the display of the service allocation display shown in services.



[sc_service_allocation_display, 1, --_--]

Figure 4-79 Service allocation display



[scmtlaif-081210-01.tif, 1, en_US]

Figure 4-80 Measuring tool Analyzer IF

CF corresponds to the center frequency of the transmission band and has to be set to 24 kHz.

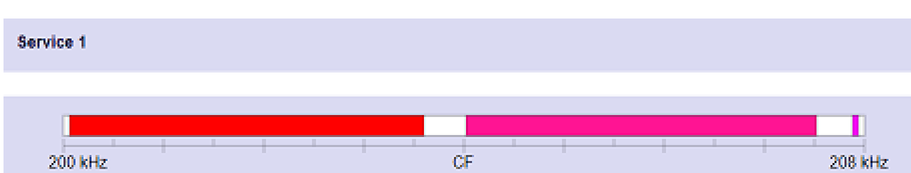
The screen of the Measurement Tool shows the services like a spectrum analyzer. With Changing the bandwidth or the center frequency the signal can be zoomed and moved.

Pushing the start measure button starts the measurement and changes the name of the button to stop measure. The display is refreshed after 1 to 2 seconds.

Pushing the stop measure button stops the measurement.

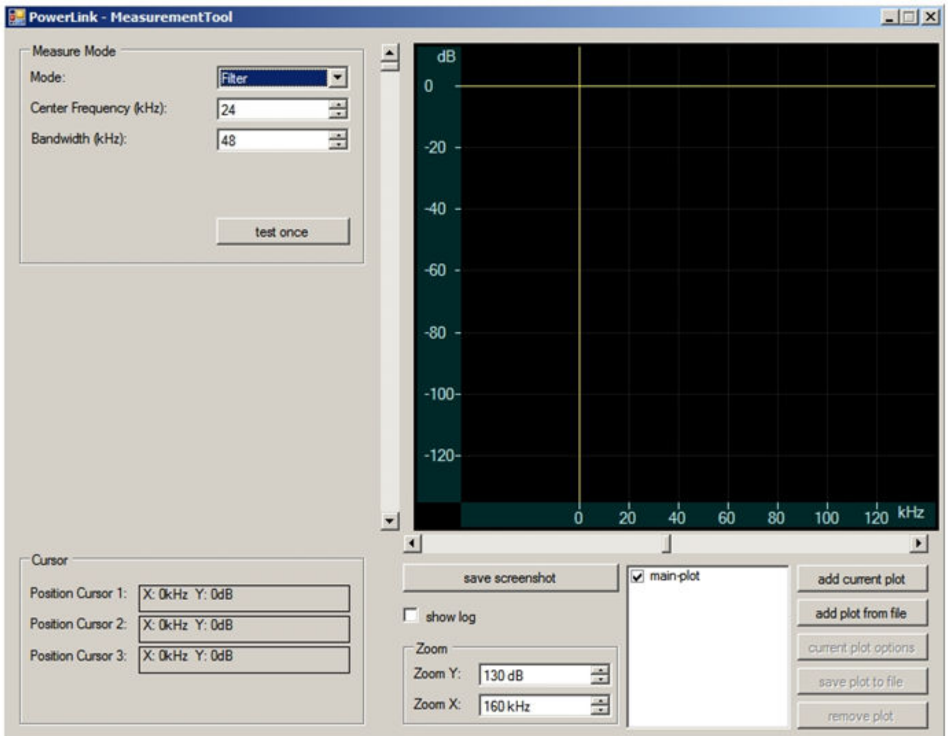
Mode Filter

The measuring tool is a helpful tool to display the received signal inside PowerLink during operation and also for providing a level generator, a level meter and a display for tuning the receive and transmit filter. The measuring tool display corresponds with the display of the service allocation display shown in services.



[sc_service_allocation_display, 1, --_--]

Figure 4-81 Service allocation display



[scmtlflt-091210-01.tif, 1, en_US]

Figure 4-82 Measuring tool Filter

CF corresponds to the center frequency of the transmission band and has to be set to 24 kHz.

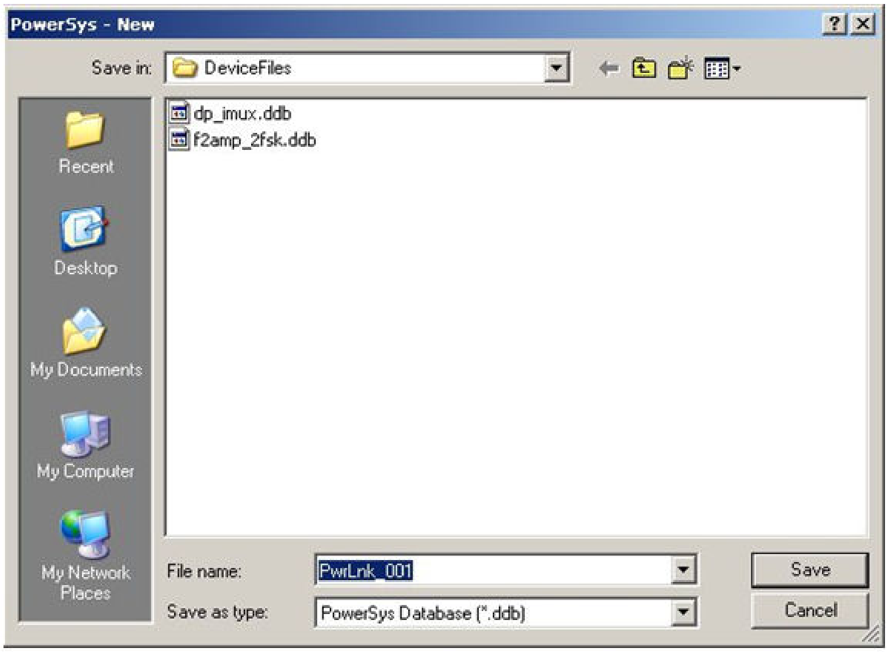
In the mode Filter, the measuring tool is used as level generator, level meter and display for tuning the receive and transmit filter. The signal from the level generator to the filter that should be tuned is given from PowerLink at the TX- connector at the CFS-2 panel. The received signal from the filter that should be tuned is given to PowerLink at the RX- connector at the CFS-2 panel.

The coarse tuning of the filter has to be carried out and the PowerLink transmit and receive frequency has to be adjusted to the correct values before beginning the filter tuning.

After this preparatory work, the filter tuning has to be done as described in Chapter *Commissioning*.

Pushing the test once button starts the measurement.

Saving the Screen



[scmestol-081210-01.tif, 1, en_US]

Figure 4-83 Measuring tool

Selection	Function
save screenshot:	The explorer opens for saving the measurement tool screen. (png- or jpeg- file)
show log:	Only for internal use
add current plot:	set the color of the marked plot
add plot from file	The explorer opens for adding a stored plot
current plot options:	Setting base color of plots and cursors
save plot to file:	The actual shown plot will be saved (csv- file)
remove plot:	remove a marked plot from screen

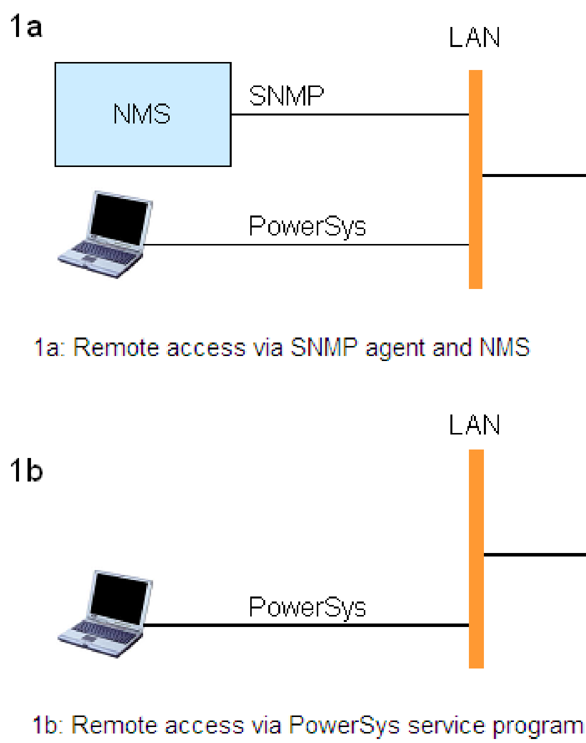
5 SNMP and Remote Access

5.1 Remote Access and Remote Monitoring

5.1.1 Overview

The following examples show the possibilities for remote access resp. remote monitoring of the PowerLink system.

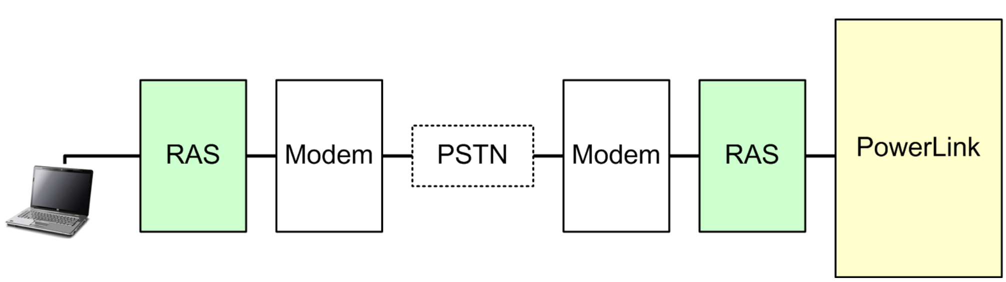
5.1.2 Remote Access via Intranet (TCP/IP)



[dwravint-091210-01.tif, 1, en_US]

Figure 5-1 Remote access via intranet

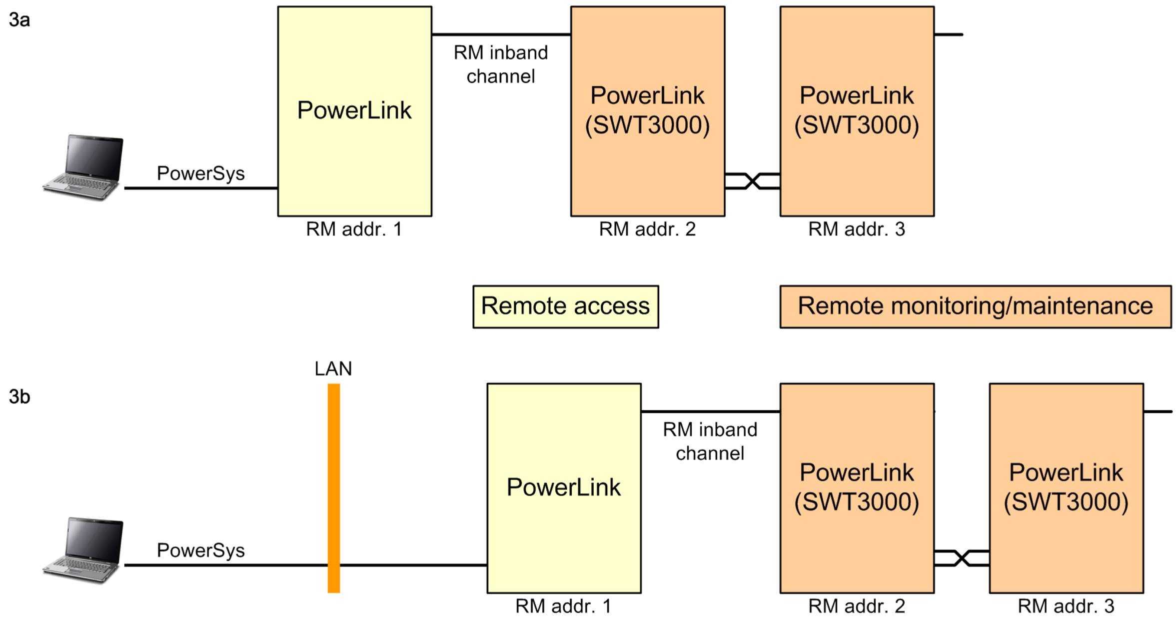
5.1.3 Remote Access via Modem



[dwravmdm-120813-01.tif, 1, en_US]

Figure 5-2 Remote access via RAS, modem and PowerSys service program

5.1.4 Remote Monitoring/Maintenance via In-band RM Channel



[dwrmmirc-120813-01.tif, 1, en_US]

Figure 5-3 Remote monitoring/maintenance via in-band RM channel and PowerSys service program

3a	Remote monitoring via inband RM-Channel and service program PowerSys
3b	Remote monitoring via inband RM-Channel and service program PowerSys with Intranet (LAN) remote access

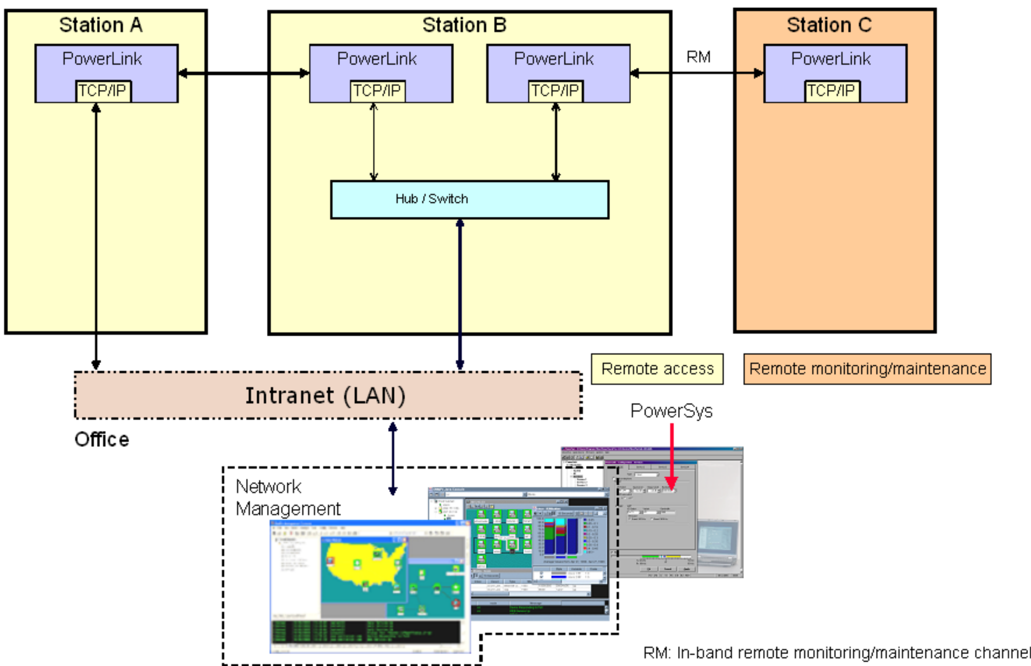
5.2 SNMP

5.2.1 General Information

PowerLink 50/100, equipped with the module CSPi, offers SNMP agent functionality without additional hardware

5.2.2 SNMP Function

The SNMP agent allows the request of system parameters and a limited control (commands) of the PowerLink from a central NMS (Network Management System) via TCP/IP. The SNMP agent provides the status of the PowerLink device. Spontaneous alarm indications (traps) are transmitted to the NMS.



[dwsravin-131210-01.tif, 1, en_US]

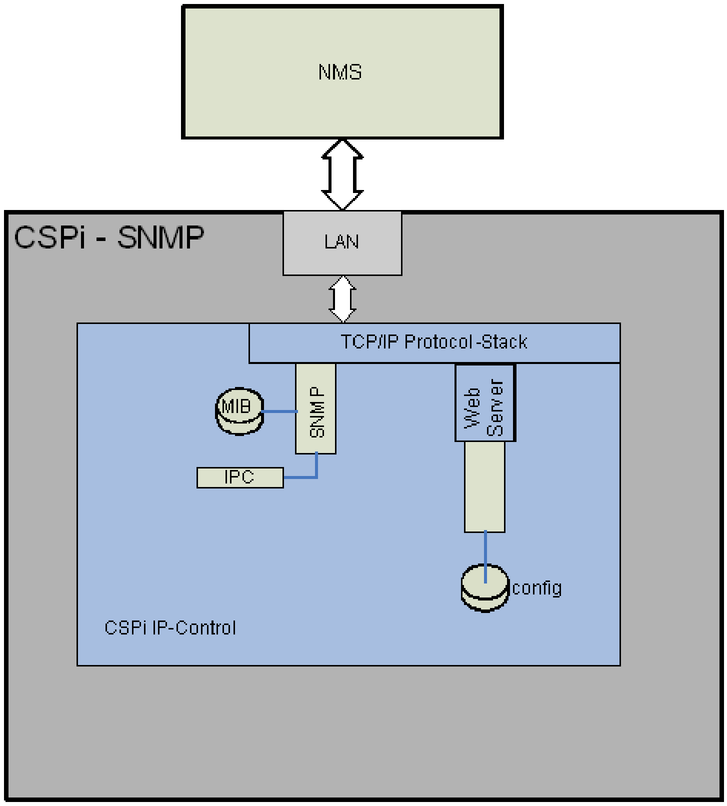
Figure 5-4 SNMP & Remote access via IP network

The minimum setting of the SNMP agent is:

- Local IP address
- Trap destination(s) IP address
- Trap delay and repetition suppression
- Community string
- Configuration via Web browser (password protected)

Functional Diagram

The figure below shows a functional diagram of the SNMP system:



[dwsnmpfd-131210-01.tif, 1, en_US]

Figure 5-5 SNMP Functional diagram

Components:

- TCP/IP protocol stack:
  The TCP/IP protocol stack handles the internet communication of the LAN.
- SNMP
  Handling of the SNMP access of the spontaneous indication (traps)
- MIB
  The management information base (MIB), contains the status information of the PowerLink system.
- IPC
  Inter process communication for communication and synchronization of the processes.
- Config.
  Configuration data base of PowerLink.

PowerLink Read General Information

The following parameter can be read:

- System information
  CSPi hardware release, dongle serial number, PowerSys release
- Update information
  User, device number, change date/time comment

- Dongle information
  - Basic features
    Voice channels (F2), data channels (F3), teleprotection (F6), Data Pump (DP), iFSK, iMUX
  - CSPi features
    max. HF- bandwidth, SNMP agent, Ethernet,
  - Add on features:
    service telephone, Remote Monitoring, dynamic data pump
  - vMUX features
    voice channels, rFSK channels, X.21 Channels, fE1 interface
  - Serial number.
- Data pump information
  SNR, number of restarts, executed data rate, block error rate
- iFSK information
  Mode of iFSK channel 1 up to 4
- VFx information
  VFx index, VFx type, VFx hardware release
- IPCON setting
  Ethernet service/user interface, DHCP, IPCON, L2 filter, QoS, NTP, summer time switchover

Read Integrated SWT 3000 (iSWT) Information

The following information can be read:

- iSWT hardware information
  PU4 hardware release, DLE hardware release (PowerLink 100), IFC1 hardware release, IFC2 hardware release
- iSWT counter (PowerLink 100: max. 24 inputs, max. 24 outputs, PowerLink 50: 4 inputs, 4 outputs)
  Input number and counter value, output number and counter value
- Event recorder
  Recorder sequence number, time stamp, event group, and event number, event description

PowerLink Read Hardware Configuration

The following hardware configuration can be read:

- System configuration
  PowerLink 100:
  VFx modules 1 up to 3, iSWT1, iSWT2, vMUX, ALR1, ALR2, PLPA 50 W / 100 W
  PowerLink 50:
  VFx modules 1 up to 2, iSWT1, vMUX, ALR1, PLPA
- HF configuration
  Bandwidth, frequency grid, Tx/Rx frequency Tx/Rx frequency order, AXC configuration
- Service configuration
  RM, service number (max. 4), service type, service bandwidth
- RM configuration
  RM address, master, slave
- ALR configuration
  alarm adjustment, alarm delay

- iSWT system configuration
  Operation mode, purpose, VF variant, analog interface, digital interface. primary path, secondary path, Tx/Rx address, coded transmission, permissive, or direct tripping, IFC1/2 type
- Adjustment Rx level
  Rx level, Rx input gain, Rx overflow

PowerLink Set Commands

The following commands can be set from the NMS:

- Force data pump synchronizing, Reset device, iSWT line select, iMUX loop enable/disable, local IF loop enable/disable
- IPCON setting (Ethernet service/user interface, DHCP, IPCON, L2 filter, QoS, NTP, summer time switch-over)

5.2.3 Spontaneous Indication SNMP Traps

Spontaneous indications from the PowerLink device are transmitted from the SNMP agent to the configured Network Management Systems. Up to 6 NMS can be configured for receiving this traps. Each trap is sent with a severity (1-5) with the following signification:

Table 5-1 Alarm severity

Alarm severity	Signification
1	Critical
2	Major
3	Minor
4	Warning
5	Normal

General Traps

- Authentication failure (severity 2)
  An authentication failure trap signifies that the SNMP has received a protocol message that is not properly authenticated

PowerLink Alarms

If there is a status change during a configured time range, 2 events (active or not active) are assigned to each alarm and transmitted to the programmed NMS. Cyclic repetitive alarms within an adjustable time period are transmitted once only. Each alarm contains the severity level and a short description of the event.

The following PowerLink alarms are transmitted from the SNMP agent:

- alarmHardware (severity 1)
  The PowerLink device reports hardware alarm. One or more configured hardware components are not available or faulty.
- alarmConfiguration (severity 1)
  The PowerLink reports configuration alarm. The adjusted device configuration is not valid.
- alarmGeneral (severity 1)
  The PowerLink reports general alarm
- alarmNonUrgent (severity 2)
  The PowerLink reports non urgent alarm
- alarmTx (severity 1)
  The PowerLink reports transmitter alarm

- alarmRx (severity 1)
  The PowerLink reports receiver alarm
- alarmS2N (severity 4)
  The PowerLink reports S/N alarm
- alarmRemGeneral (severity 1) *)
  The PowerLink of the remote station reports general alarm
- alarmRemNonUrgent (severity 2) *)
  The PowerLink of the remote station reports non urgent alarm
- alarmRemTx (severity 1) *)
  The PowerLink of the remote station reports transmitter alarm
- alarmRemRx (severity 1) *)
  The PowerLink of the remote station reports receiver alarm
- alarmRemS2N (severity 4) *)
  The PowerLink of the remote station reports S/N alarm

NOTE

REM alarms are only available with an existing RM connection at the local PowerLink device. REM alarms can be suppressed in the NMS if required.

NOTE

The polling cycle is configured in the Network Management System and should not be less than 30 seconds.

5.2.4 Simple Network Management Protocol Version 3 (SNMPv3)

5.2.4.1 SNMPv3 Overview

Authentication in SNMP version 1 and version 2 is nothing more than a password (community string) which is sent in plaintext between the network manager and the SNMP agent. It is simple to intercept the community string because the SNMPv2 is a kind of unprotected protocol. Once the community string is known read out and modification of the device configuration or even shutdown might be possible.

The Simple Network Management Protocol Version 3 (**SNMPv3**) addresses the cryptographic security weakness of SNMPv1 and SNMPv2 using following methods:

- **User-based Security Model** (USM):
  Each user has a name, authentication key and privacy key. **MD5** or **SHA-1** authentication protocol is used to authentication SNMPv3 message. SNMPv3 agent authenticates the incoming request message with authentication key, and rejects the access if the authentication has failed.
  The SNMPv3 message data is encrypted and decrypted with privacy key using DES protocol.
- **View-based Access Control Model**:
  It is used to control the access of USM user to the managed object of **MIB**.

SNMPv3 is supported in both **PowerLink** and **SWT 3000** (release **≥ P3.5.120**). Additionally, the notification can be sent out through both **SNMP Trap and Inform**.

The standard MIB modules are used for SNMPv3 and notification operation.

Table 5-2 Standard MIB Modules

MIB	Comments
SNMP-FRAMEWORK-MIB	SNMP Management Architecture MIB (RFC 3411).
SNMP-NOTIFICATION-MIB	This MIB module provides mechanisms to remotely configure the notification parameters (RFC 3413).
SNMP-TARGET-MIB	This MIB module provides mechanisms to remotely configure the target addresses and security parameters (RFC 3413).
SNMP-USER-BASED-SM-MIB	This MIB module provides mechanisms to remotely configure User-based Security Model (RFC 3414).
SNMP-VIEW-BASED-ACM-MIB	This MIB module provides mechanisms to remotely configure View-based Access Control Model (RFC 3415).

The private MIB modules are used to access **PowerLink** and **SWT 3000** device configurations.

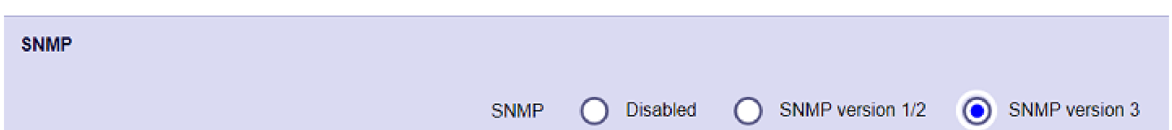
Table 5-3 Private MIB Modules of PowerLink and SWT 3000

MIB	Comments
SIEMENS-POWERLINK-CSPI-MIB	This MIB module provides mechanisms to access PowerLink CSPi settings.
SIEMENS-POWERLINK-CSPI-IPCON-MIB	This MIB module provides mechanisms to access PowerLink CSPi IP related settings.
SIEMENS-POWERLINK-CSPI-VMUX-MIB	This MIB module provides mechanisms to access PowerLink vMux settings.
SIEMENS-POWERLINK-CSPI-ISWT3000R3_5-MIB	This MIB module provides mechanisms to access integrated **SWT 3000** settings.
SIEMENS-SWT3000R35-MIB	This MIB module provides mechanisms to access standalone **SWT 3000** settings.

It is possible to configure PowerLink and SWT 3000 via PowerSys application whether with SNMPv2 or SNMPv3 (for more details, see chapter *5.2.4.2 SNMPv3 Configuration*). If SNMPv3 is configured, the USM users, VACM, and notification parameters are managed through SNMP GET/SET command instead of PowerSys or Web server.

5.2.4.2 SNMPv3 Configuration

The SNMP version is configured in **Configuration - Ethernet - SNMP**.



[sc_ethernet_snmp, 1, --_--]

Figure 5-6 SNMP Version Configuration

Table 5-4 SNMP Agent Configuration

MIB Parameter	Comments
SNMP version	Configure SNMP version. • Disabled: Disable SNMP function • Version 1/2: Enable SNMP version 1 and 2 • Version 3: Enable SNMP version 3
Engine ID	Unique identifier of SNMP engine. It contains following parts: • Start bit : 0x8000 • Enterprise OID: 0x586E • Indicator for identifier: 0x03 • Identifier <MAC address>
Community strings	Display read and write community string for SNMPv1/2.
Trap destination	Display trap destination address for SNMPv1/2.
Min. active time	Display minimum time that the alarm must be active before a rising trap is sent. It is used for both SNMP V1/2 and V3.
Falldown delay	Display minimum time that the alarm must be inactive before a falling trap is sent. It is used for both SNMP V1/2 and V3.

5.2.4.3 USM User Management

Using the USM

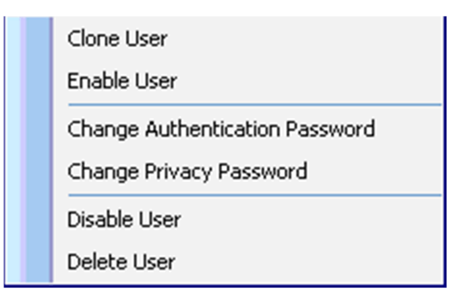
Network Management System (NMS) usually has a user management tool, which is used to easily manage SNMPv3 USM user configuration on remote SNMPv3 agents, e.g. clone a new user, change the password etc.

USM needs to be configured in a SNMPv3 NMS client and configuration is sent and stored in the SNMPv3 agent (PowerLink or SWT 3000) afterwards.

All these operations are accomplished through SNMP by setting **SNMP-USER-BASED-SMMIB::usmUserTable MIB object**.

3 initial users are provided in **SWT 3000** devices for connection to **SNMPv3 agent**.

User Name	Auth Protocol	Auth Password	Priv Protocol	Priv Password
initial	MD5	cssnmpv3auth	DES	cssnmpv3priv
templateMD5	MD5	cssnmpv3auth	DES	cssnmpv3priv
templateSHA	SHA	cssnmpv3auth	DES	cssnmpv3priv



[scuserop-140912-01.tif, 1, en_US]

Figure 5-7 USM User Operation

Table 5-5 USM User Table

Operation	Comments
Clone User	Create new SNMPv3 users from existing one.
Enable User	Enable a disabled SNMPv3 user.

Operation	Comments
Change Authentication Password	Change the authentication password to a new one.
Change Privacy Password	Change the privacy password to a new one.
Disable User	Disable the active SNMPv3 user and change the row status from "active(1)" to "notInService(2)".
Delete User	Delete the existing SNMPv3 user.

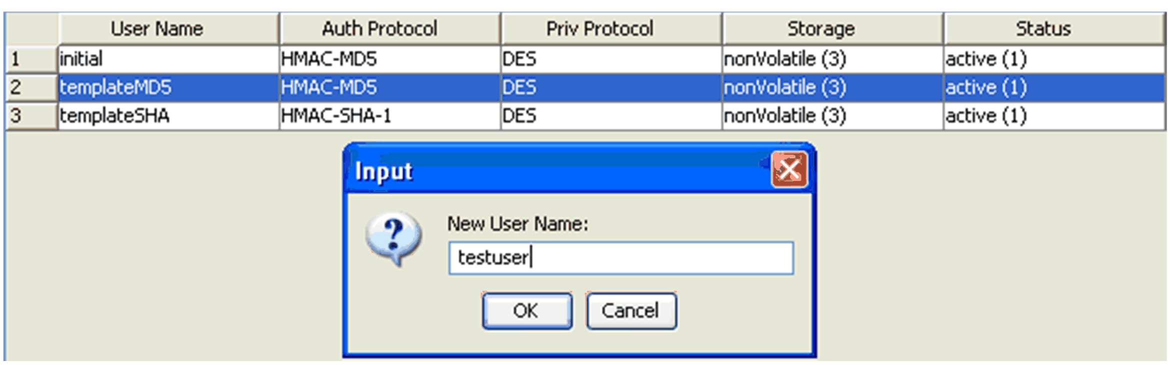
NOTE

Because the initial user name and password are printed on paper and are well known for other people, you must create at least one working user from the initial user template, change the default authentication, and the privacy password as soon as possible. After all needed working users are created, the initial and template users should be deleted.

Example: Create New User

This example shows the workflow of creating a new user "testuser" using iReasoning MIB Browser.

- 1 - Open the SNMPv3 user management tool from MIB Browser.
- 2 - All users of the remote agent are listed in the user management tool.
- 3 - Select the user template you want to clone from:
  templateMD5: user template with MD5 authentication protocol and DES privacy protocol
  templateSHA: user template with SHA authentication protocol and DES privacy protocol.
- 4 - Click on clone user operation and enter a new user name in the text box.

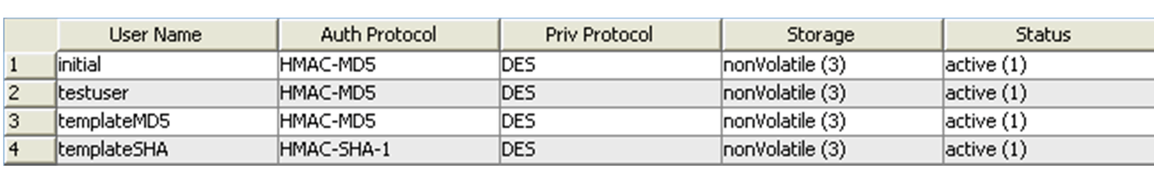


	User Name	Auth Protocol	Priv Protocol	Storage	Status
1	initial	HMAC-MD5	DES	nonVolatile (3)	active (1)
2	templateMD5	HMAC-MD5	DES	nonVolatile (3)	active (1)
3	templateSHA	HMAC-SHA-1	DES	nonVolatile (3)	active (1)

[sccloneu-140912-01.tif, 1, en_US]

Figure 5-8 Clone New User

- 5 - The new user "testuser" is cloned from templateMD5, whose authentication and privacy passwords are same as templateMD5.



	User Name	Auth Protocol	Priv Protocol	Storage	Status
1	initial	HMAC-MD5	DES	nonVolatile (3)	active (1)
2	testuser	HMAC-MD5	DES	nonVolatile (3)	active (1)
3	templateMD5	HMAC-MD5	DES	nonVolatile (3)	active (1)
4	templateSHA	HMAC-SHA-1	DES	nonVolatile (3)	active (1)

[scusmuse-140912-01.tif, 1, en_US]

Figure 5-9 USM User Table List

- 6 - Change the authentication password and the privacy password. For example:
  Auth password: "testuser_auth"
  Priv password: "testuser_priv"

NOTE

It is recommended to have at least 8 characters for the password.

- 7 - Assign access right for the new cloned user (see **Example: Assign Access Right**)

NOTE

This step is not needed for the **SWT 3000** standalone device. The new cloned user has full access right to complete MIB modules and it cannot be changed by the user via VACM.

- 8 - Check if new working user can connect to SNMP agent. Remove initial and template users as soon as all desired working users have been created.
- 9 - Store all the configurations to flash and restart SWT 3000 system through SNMP by setting following MIB object:
  SIEMENS-SWT3000R35-MIB::swtIpActivationReq.0 = storeToFlashAndRestart(1)

NOTE

For all detail operation steps, check the user manual of your MIB Browser.

5.2.4.4 VACM Management

Definition

VACM controls the access right of the user to the MIB object, which is accomplished through SNMP by setting MIB module SNMP-VIEW-BASED-ACM-MIB.

Configure the VACM in a SNMPv3 NMS client. The configuration is sent and stored in the SNMPv3 agent afterwards.

The initial user has the full access right to complete MIB modules by default.

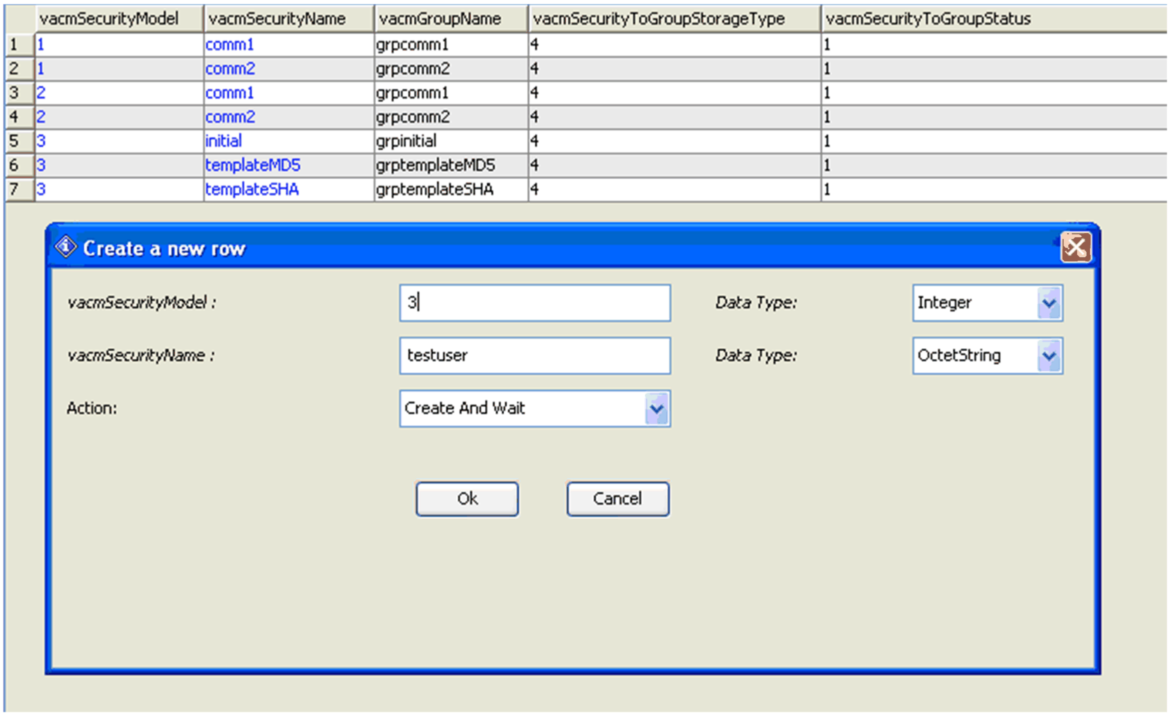
NOTE

VACM is not supported in the **SWT 3000** device. All SNMPv3 users in **SWT 3000** have the full access right to complete MIB modules by default.

Example: Assign Access Right

This example shows the workflow of assigning full access rights for a new user “testuser” using iReasoning MIB Browser.

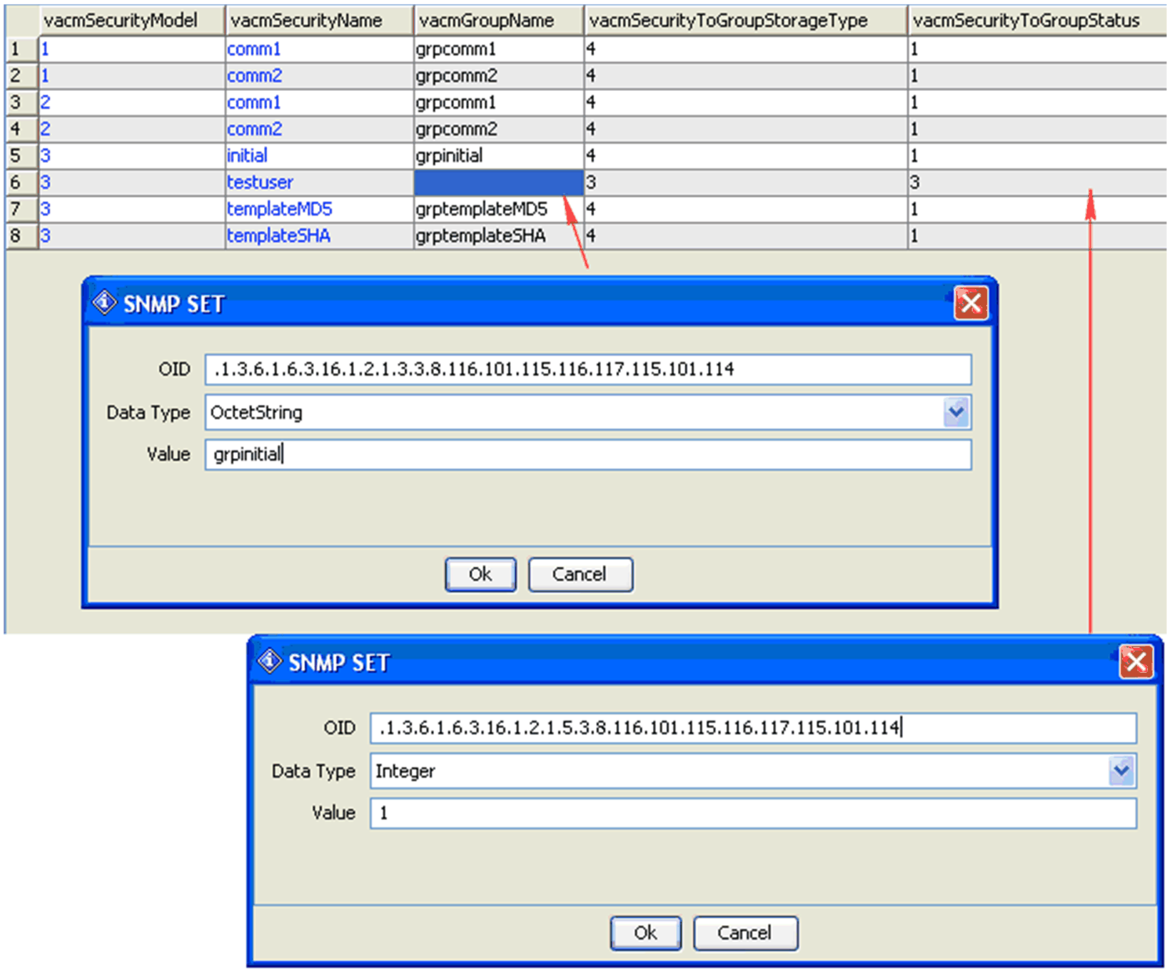
- 1 - Open SNMP-VIEW-BASED-ACM-MIB::vacmSecurityToGroupTable in MIB Browser table view
- 2 - Create a new row with the cloned user name “testuser”.



[sccreate-140912-01.tif, 1, en_US]

Figure 5-10 Create New Row in vacmSecurityToGroupTable

- 3 - Assign “testuser” to the existing group name “grpinitial”.



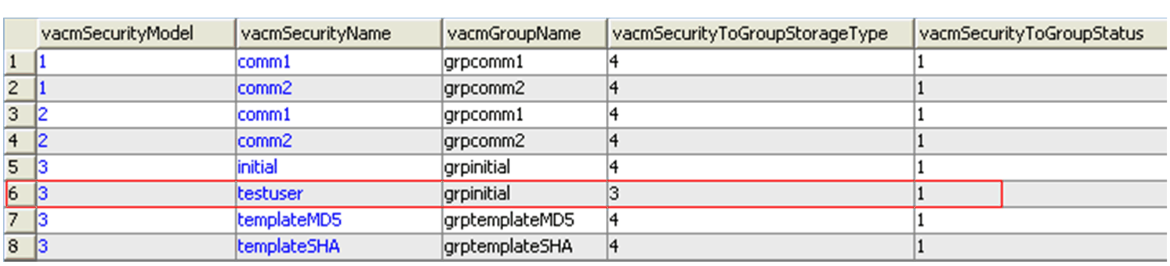
[scchange-140912-01.tif, 1, en_US]

Figure 5-11 Change Group Name and Row Status

Table 5-6 vacmSecurityToGroupTable Settings

Field	Value
vacmGroupName	grpinitial
vacmSecurityToGroupStatus	active(1)

- "testuser" is added into table vacmSecurityToGroupTable.



	vacmSecurityModel	vacmSecurityName	vacmGroupName	vacmSecurityToGroupStorageType	vacmSecurityToGroupStatus
1	1	comm1	grpcomm1	4	1
2	1	comm2	grpcomm2	4	1
3	2	comm1	grpcomm1	4	1
4	2	comm2	grpcomm2	4	1
5	3	initial	grpinitial	4	1
6	3	testuser	grpinitial	3	1
7	3	templateMD5	grptemplateMD5	4	1
8	3	templateSHA	grptemplateSHA	4	1

[scvacmse-140912-01.tif, 1, en_US]

Figure 5-12 vacmSecurityToGroupTable List

- 5 - Store all the configurations to flash and restart system through SNMP by setting following MIB object: SIEMENS-POWERLINK-CSPI-IPCON-MIB::ipSettingsActivationReq.0 = storeToFlashAndRestart(1)

- 6 - Connect SNMPv3 agent with new user "testuser", and check if the user has full access right for private and standard MIB modules.
  SIEMENS-POWERLINK-CSPI-IPCON-MIB::ipSettingsActivationReq.0 = storeToFlashAndRestart(1)

5.2.4.5 Key Reset

In case of any security incident which has affected the SNMPv3 communication, a key reset should be executed. With the key reset operation the initial users can be retrieved in PowerSys application.

NOTE

After key reset operation, all created SNMPv3 users will be deleted from SNMP-USER-BASED-SM-MIB::usmUserTable MIB object.

The new working users have to be cloned again from the initial user template after key reset operation (see **Example: Create new user**).

The key reset operation is as follow:

- 1 - Open **SWT 3000 > Commands**
- 2 - Click the **Reset SNMPv3 key** button.

5.2.4.6 Notification

Definition

A notification is a way for an agent to inform the SNMP Master Agent, e.g. Network Manager System (NMS) that some alarms occurred in the system.

Configure the notification in a SNMPv3 NMS client. The configuration is sent and stored in the SNMPv3 agent afterwards.

There are 2 types of notification:

- **SNMP Trap**
  Agent sends traps to NMS if an alarm event occurs. No acknowledgement is sent from NMS to the agent. So the agent has no possibility to know if the trap is received.
- **SNMP Inform**
  It is nothing more than an acknowledged trap. If the trap is not received and acknowledged by the NMS, the agent will retransmit it until timeout.

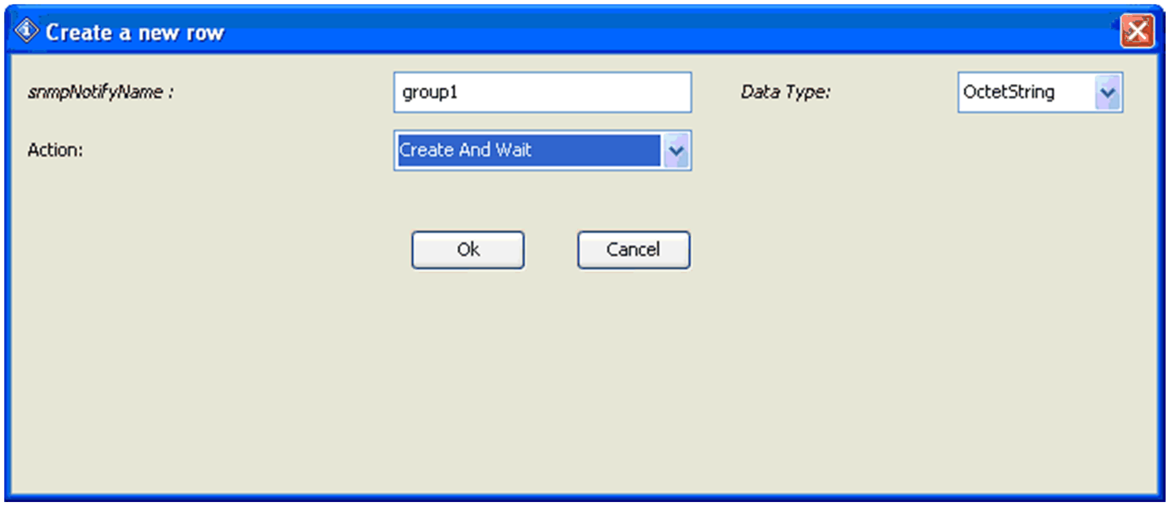
Depending on the configured SNMP version by PowerSys (see Chapter *5.2.4.2 SNMPv3 Configuration*), the notification is handled in different methods:

- **SNMPv1/2**
  Only SNMP Trap is supported, the function is the same as the former released version.
  Trap destination is configured through web pages or SNMP by setting private MIB object SIEMENS-SWT3000R35-MIB::swtIpSnmpTrapDestTable for **SWT 3000**.
- **SNMPv3**
  Both SNMP Trap and Inform are supported. The notification parameters including trap addresses are moved to standard MIB module SNMP-NOTIFICATION-MIB and SNMP-TARGET-MIB.
  All configurations must be done through SNMP set operation.

Example: Create Notification Entry through SNMP

This example shows the workflow of sending an SNMP Trap to 2 destinations through both SNMPv2c and SNMPv3 protocols using iReasoning MIB Browser.

- 1 - Create a new row in the table SNMP-NOTIFICATION-MIB::snmpNotifyTable.



[scnewrow-140912-01.tif, 1, en_US]

Figure 5-13 Create New Row in snmpNotifyTable

	snmpNotifyName	snmpNotifyTag	snmpNotifyType	snmpNotifyStorageType	snmpNotifyRowStatus
1	group1	group1	trap	3	1

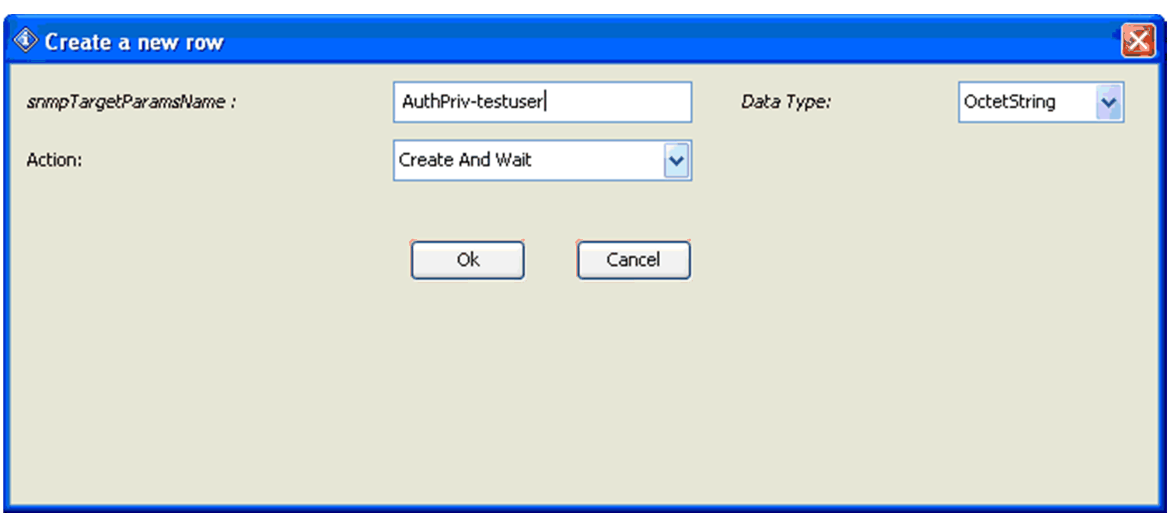
[scnotify-140912-01.tif, 1, en_US]

Figure 5-14 snmpNotifyTable List

Table 5-7 snmpNotifyTable Settings

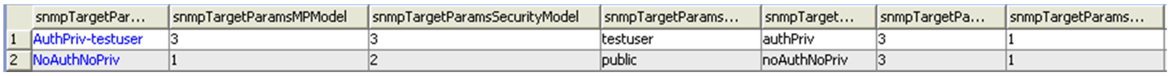
Field	Value
snmpNotifyName	group1
snmpNotifyTag	group1
snmpNotifyType	trap(1)
snmpNotifyRowStatus	active(1)

- 2 - Create a new row in table SNMP-TARGET-MIB::snmpTargetParamsTable



[scparame-140912-01.tif, 1, en_US]

Figure 5-15 Create New Row in snmpTargetParamsTable



	snmpTargetPar…	snmpTargetParamsMPModel	snmpTargetParamsSecurityModel	snmpTargetParams…	snmpTarget…	snmpTargetPa…	snmpTargetParams…
1	AuthPriv-testuser	3	3	testuser	authPriv	3	1
2	NoAuthNoPriv	1	2	public	noAuthNoPriv	3	1

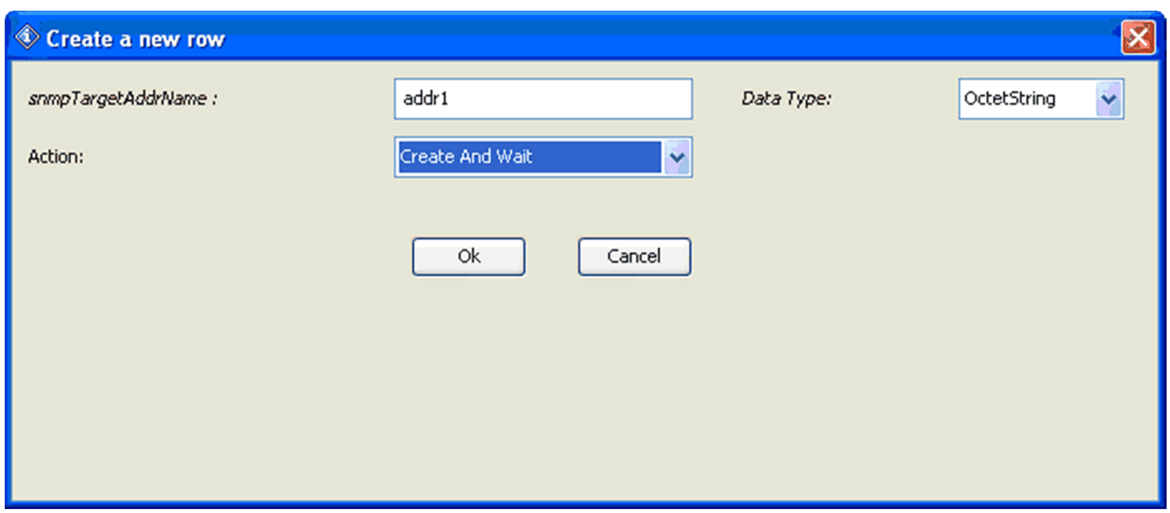
[scpartab-140912-01.tif, 1, en_US]

Figure 5-16 snmpTargetParamsTable Settings

Table 5-8 snmpTargetParamsTable Settings

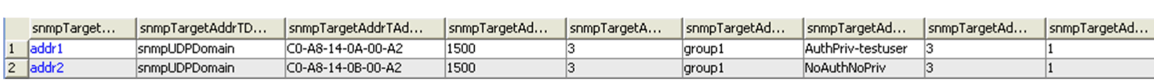
Field	Value
Target Paramter 1	
snmpTargetParamsMPModel	SNMPv3(3)
snmpTargetParamsSecurityModel	USM(3)
snmpTargetParamsSecurityName	testuser
snmpTargetParamsSecurityLevel	authPriv(3)
snmpTargetParamsRowStatus	active(1)
Target Parameter 2	
snmpTargetParamsMPModel	SNMPv2c(1)
snmpTargetParamsSecurityModel	SNMPv2c(2)
snmpTargetParamsSecurityName	public
snmpTargetParamsSecurityLevel	noAuthNoPriv(1)
snmpTargetParamsRowStatus	active(1)

- 3 - Create 2 new rows in table SNMP-TARGET-MIB::snmpTargetAddrTable



[scsnmpta-140912-01.tif, 1, en_US]

Figure 5-17 Create New Row in snmpTargetAddrTable



	snmpTarget…	snmpTargetAddrTD…	snmpTargetAddrTAd…	snmpTargetAd…	snmpTargetA…	snmpTargetAd…	snmpTargetAd…	snmpTargetAd…	snmpTargetAd…
1	addr1	snmpUDPDomain	C0-A8-14-0A-00-A2	1500	3	group1	AuthPriv-testuser	3	1
2	addr2	snmpUDPDomain	C0-A8-14-0B-00-A2	1500	3	group1	NoAuthNoPriv	3	1

[scsnmpad-140912-01.tif, 1, en_US]

Figure 5-18 snmpTargetAddrTable List

Table 5-9 snmpTargetAddrTable Settings

Field	Value
Target Address 1	
snmpTargetAddrName	addr1
snmpTargetAddrTDomain	snmpUDPDomain(.1.3.6.1.6.1.1)
snmpTargetAddrTAddress	192.168.20.10:162 (192.168.20.10:162)

Field	Value
snmpTargetAddrTagList	group1
snmpTargetAddrParams	AuthPriv-testuser
snmpTargetAddrRowStatus	active(1)
Target Address 2	
snmpTargetAddrName	addr2
snmpTargetAddrTDomain	snmpUDPDomain(.1.3.6.1.6.1.1)
snmpTargetAddrTAddress	192.168.20.11:162 (192.168.20.11:162)
snmpTargetAddrTagList	group1
snmpTargetAddrParams	NoAuthNoPriv
snmpTargetAddrRowStatus	active(1)

- 4 - Start trap receiver on target address “192.168.20.10” on port 162.
- 5 - Start trap receiver on target address “192.168.20.11” on port 162.
  Configure following security parameters on the receiver:

User Name	Auth Protocol	Auth Password	Priv Protocol	Priv Password
testuser	MD5	testuser_auth	DES	testuser_priv

5.2.5 NMS Commissioning

The necessary MIBs are part of the PowerSys software package. They have to be integrated in the NMS. After the NMS has been configured, traps from the SNMP agent are received. It is also possible to read PowerLink (ref. to *PowerLink Read General Information*) resp. iSWT information (ref. to *Read Integrated SWT 3000 (iSWT) Information*) or configuration (ref. to *PowerLink Read Hardware Configuration*). Commands can be set as well from the NMS (ref. to *PowerLink Set Commands*).

Import the provided MIB files to the MIB compiler of your NMS in the following sequence:

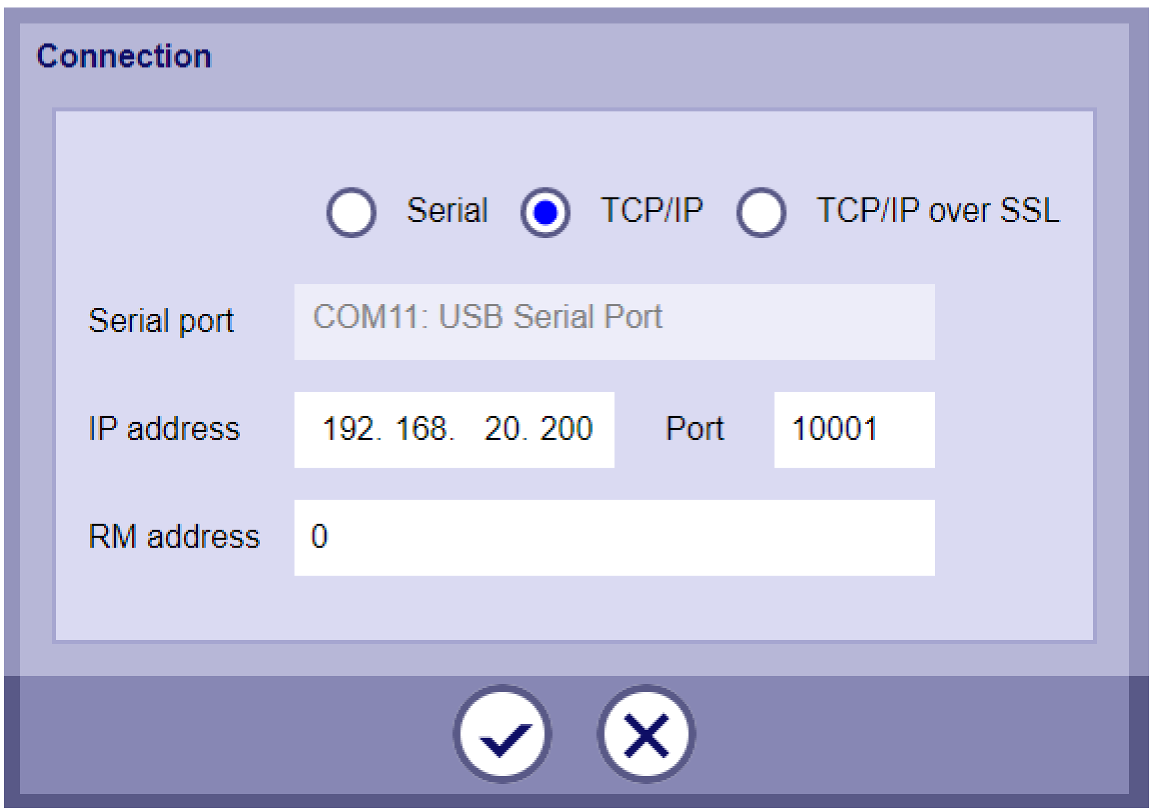
- 1. SIEMENS-POWERLINK-CSPI.MIB
- 2. SIEMENS-POWERLINK-CSPI-IPCON.MIB
- 3. SIEMENS-POWERLINK-CSPI-VMUX.MIB
- 4. SIEMENS-POWERLINK-CSPI-ISWT3000R3_5.MIB
- 5. SIEMENS-SWT3000R35.MIB

5.3 Remote Access

5.3.1 General Information

The TCP/IP connection via Intranet as well as a remote access server (RAS) connection serves complete system functionality administration identical to local on-site operation. Standard TCP/IP network protocols are used for easy access to each PowerLink from anywhere within a company Intranet. The system can interface with your own network security systems and firewalls, providing you with just the right security level your company requires.

The remote access to the PowerLink is possible with the service program PowerSys. With <**Menu – Connection setup**> the connection to the device via serial interface or TCP/IP has to be configured.



[sc_connection_rm, 1, --_--]

Figure 5-19 Configuration example for the TCP/IP connection

After the TCP/IP connection has been selected the IP address and port of the remote access server (RAS), or PowerLink has to be entered.

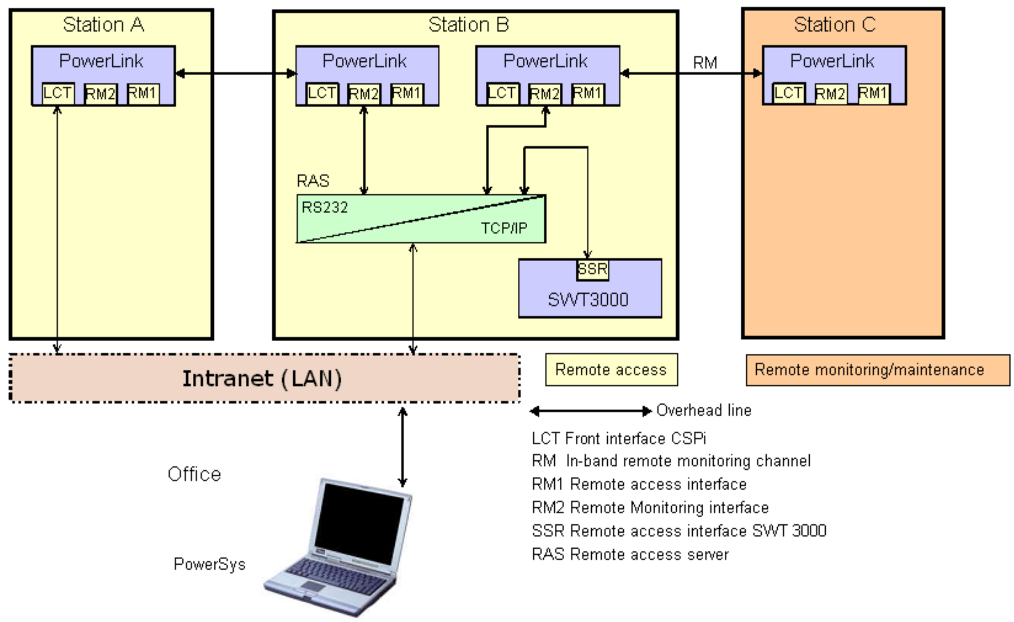
The service program is connected with <**Menu - Connect to device**> or the corresponding button.

5.3.2 Remote Access Examples

The following figures show examples for the connection on a PowerLink 100 device.

In PowerLink 50, the data interface RM2 is not available.

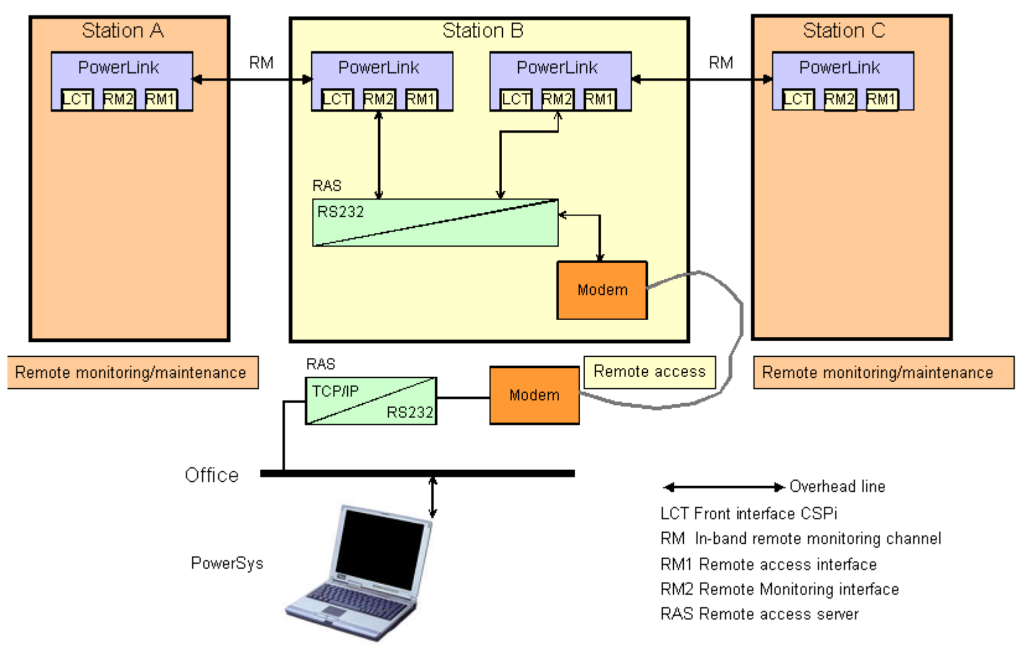
The figure below shows a RAS connection to the PowerLink resp. SWT 3000. Information from the PowerLink in station C can be read via in-band remote monitoring channel if the RM function is activated.



[dwtrcnpl-131210-01.tif, 1, en_US]

Figure 5-20 TCP/IP and RAS connection to the PowerLink devices in the station A and B

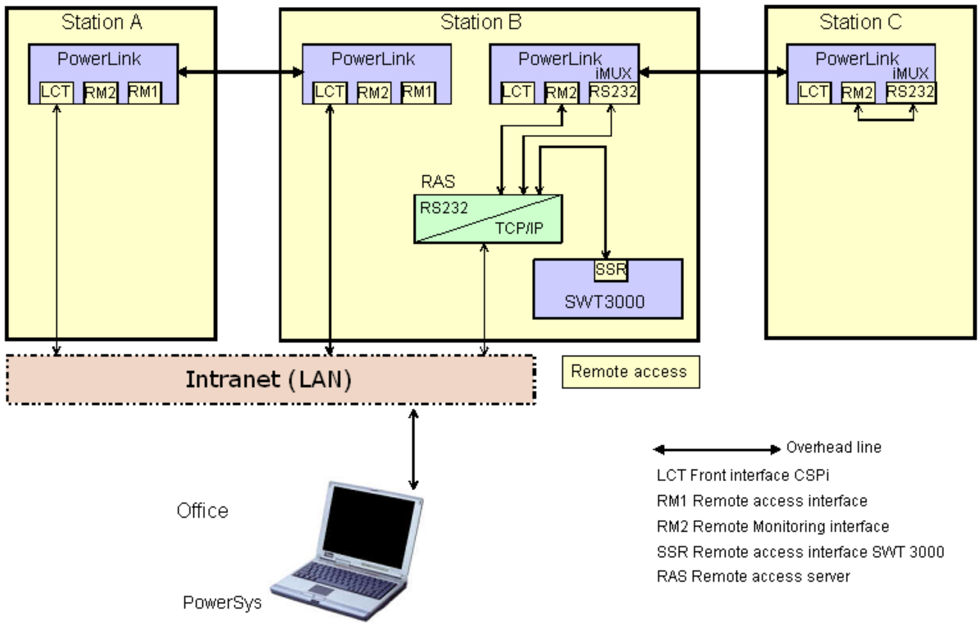
The next example shows a RAS connection via modem. The stations A and C are accessible via in-band remote monitoring channel and the service RM.



[dwrcnvmm-131210-01.tif, 1, en_US]

Figure 5-21 RAS connection via modem

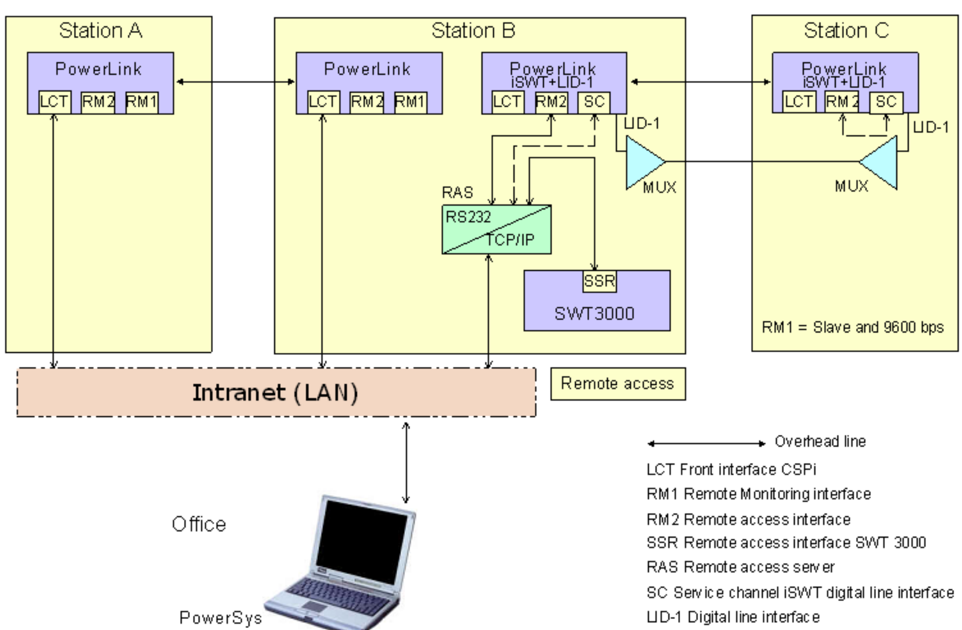
The example in figure below shows a remote access to the PowerLink in station A and B via intranet and remote access server (RAS). Access to the PowerLink in station C is performed by using an iMUX channel. The bit rate for this channel is 19 200 bps and the UART mode 8N1. For the connection between the RAS and the iMUX resp. iMUX and RM-2 interface a one-to-one cable is necessary.



[dwrasvrc-131210-01.tif, 1, en_US]

Figure 5-22 Remote access to station C via iMUX channel

With an integrated SWT 3000 using additional a digital transmission line via the interface LID-1 a service channel (SC) is available. This is a transparent data channel with 9600 bps. For remote access from station B, the output of this channel is connected in station C to the RM-2 interface of the PowerLink. This interface has to be adjusted to “Slave” mode and 9600 bps.



[dwraplsc-131210-01.tif, 1, en_US]

Figure 5-23 The remote access to the PowerLink in station C is performed via SC of the iSWT

NOTE

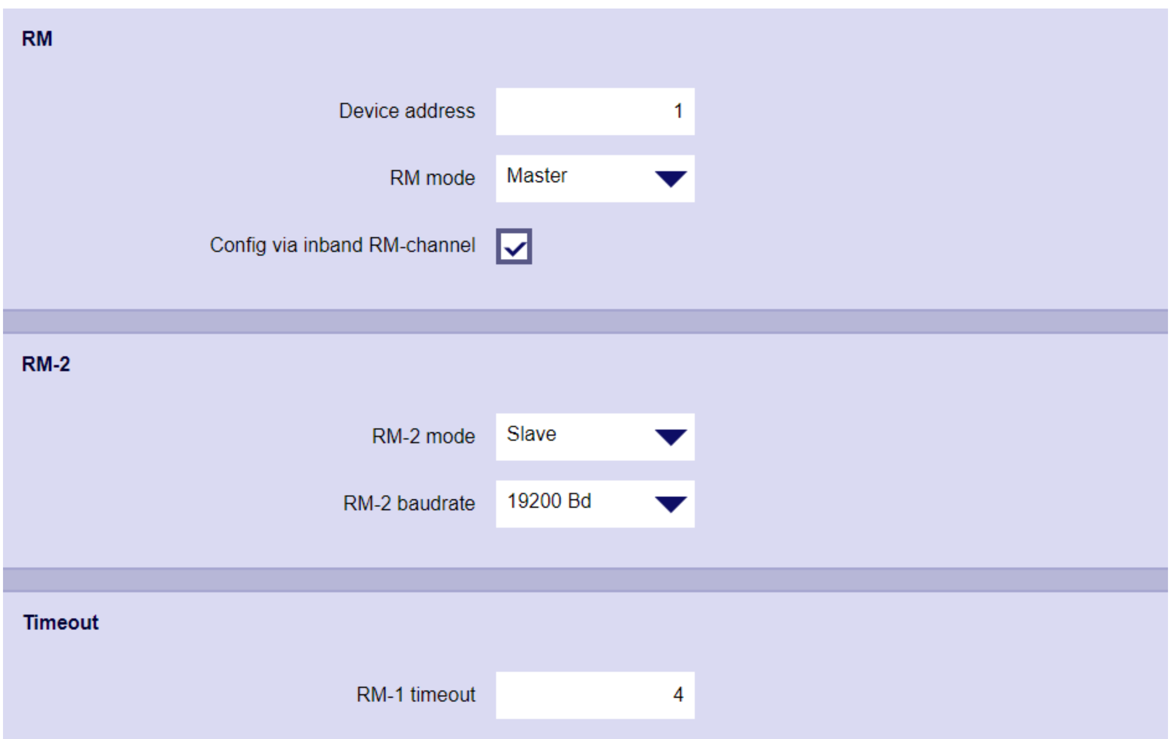
The LAN connection to PowerLink in the examples (see *Figure 5-20*, *Figure 5-21*, *Figure 5-22*, *Figure 5-23*) is for instance connected to the LCT interface. It is also possible to make this connection to another TCP/IP interface of PowerLink.

5.3.3 RM Inband Channel

In the event that no intranet or modems are available, you can still monitor or configure remote terminals using the inband RM channel. With the optional service “Remote Monitoring” (RM), data can be transmitted between the devices of one or more PowerLink routes. The RM function enables the user to have access via a serial interface with the service program to the following function:

- query of the device data (configuration, parameter, status) of the remote device
- temporary adjustments (for example, test loops)
- producing a reset

Changing of the configuration and parameters in the remote device is possible if the configuration via inband RM-Channel is activated.



[sc_configuration_rm, 1, --_--]

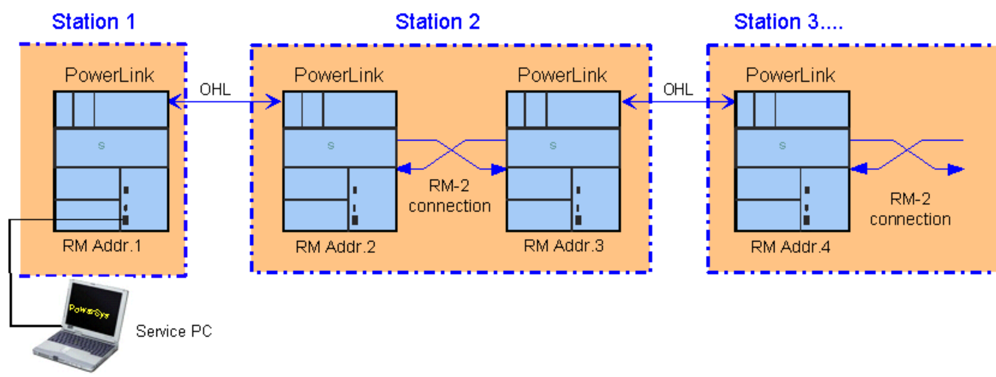
Figure 5-24 Configuration via in-band RM Channel has to be enabled in the RM configuration

NOTE

Also with enabled RM configuration it is still **not permitted** to change the HF and the System configuration via RM!

5.3.4 Route Coupling via RM-2 for PowerLink 100

Via an additional interface RM-2 up to 5 transmission routes can be coupled. It is possible to couple PowerLink transmission links with SWT 3000 links in arbitrary sequence.
When using transmission links with SWT 3000 the correct baud rate (9600 Bd) must be adjusted.



[dwexrcrm-131210-01.tif, 1, en_US]

Figure 5-25 Example of a route coupling via the RM-2 interface

Service PC connected to PowerLink:

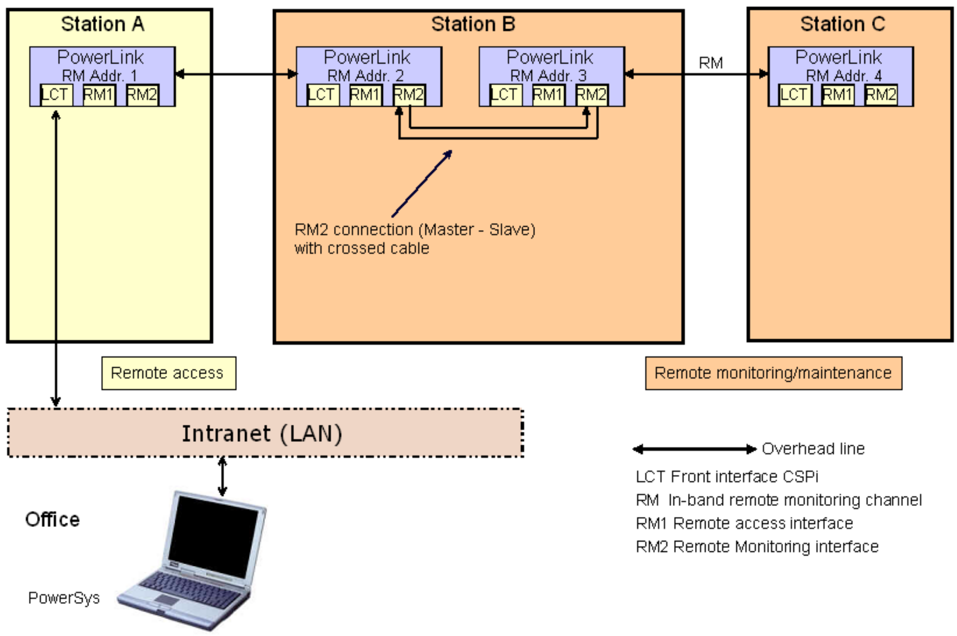
Activation of a RM-2 data transmission from another PowerLink is possible without influencing the Service PC connection at the front interface LCT. Because the RM-2 connection is the second one, only read permission is available, while the first connection (Service PC) has read/write access.

Active data transfer via RM-2:

Connection of the Service PC to the front interface LCT does not block the RM-2 transmission. Because the connection is the second one, only read permission is available, while the first connection (RM-2) has read/write access (if configured).

The RM-2 interface of the PowerLink system has the same characteristics as the SSB interface of the SWT 3000 systems.

The figure below shows the remote connection to the PowerLink in station A via TCP/IP connection. The access to the PowerLink devices in station B and C is possible when the RM in-band channel is activated. For the RM2 – RM2 connection in station B a crossed cable has to be used. 1 RM2 interface must be configured as “Slave” the other one as “Master”.



[dwrplirm-131210-01.tif, 1, en_US]

Figure 5-26 Reading the PowerLink information in station B and C with the RM function

The PowerSys program is connected with <**Menu - Connect to device using RM**>.

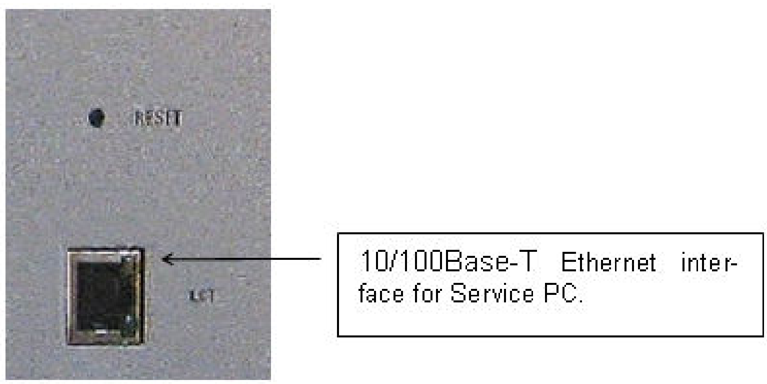
5.4 Web Interface

5.4.1 Connection PowerLink – Service PC

The connection between the service PC and PowerLink is done via the 10/100Base-T Ethernet service interface LCT. The LCT connector is located at the front of the CSPi module. The connection is realized by using a standard CAT5e (shielded) patch-cable.

NOTE

The use of a shielded patch-cable is recommended.



[tdethcon-071210-93.tif, 2, en_US]

Figure 5-27 Ethernet connector for Service PC

After connecting the service PC to PowerLink, start a standard browser (for example Microsoft Internet Explorer or Firefox) on the service PC.

PowerLink – Default IP- Address

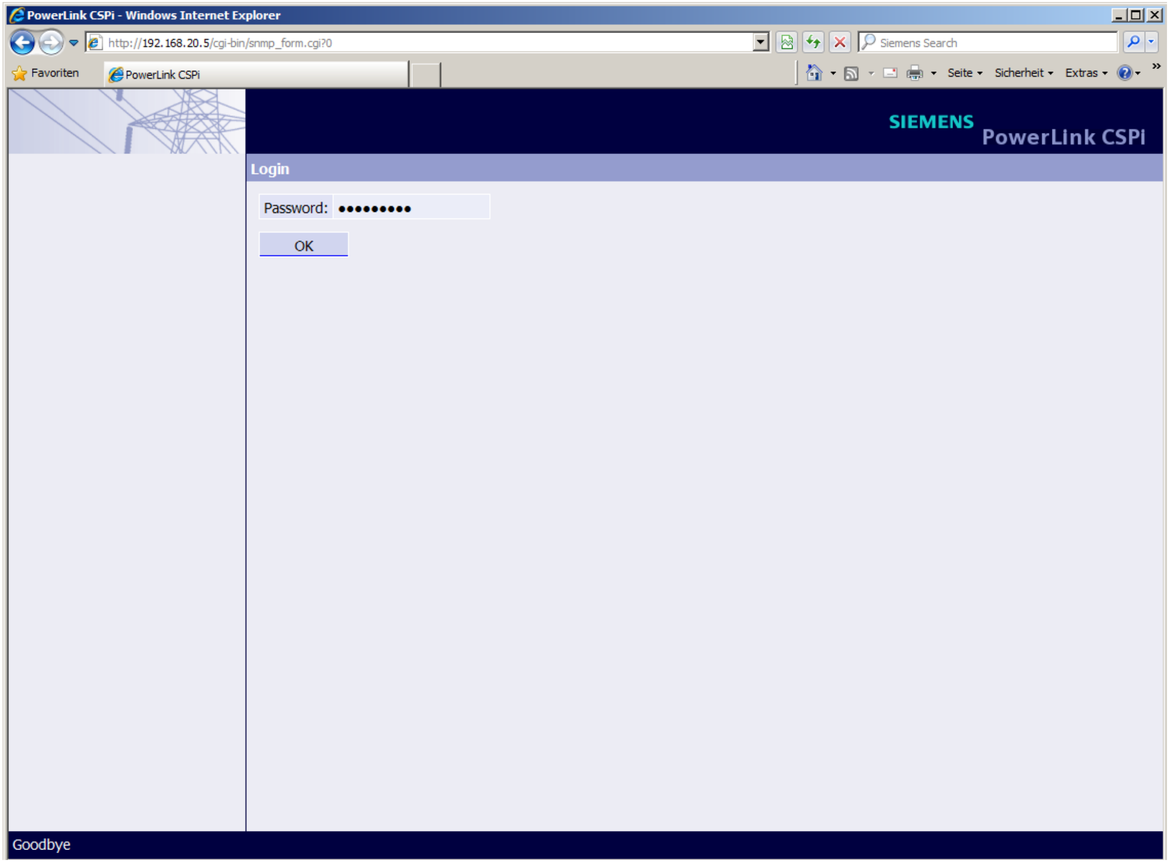
Default IP address of PowerLink	192.168.20.5
IP address range of the DHCP server	192.168.20.10-14

In the default configuration of PowerLink the DHCP Server functionality is set to on. Therefore the Service PC has to be set to “Obtain an IP address automatically” (for further details refer to chapter *Commissioning*).

The IP-Controller start-up time to establish a connection with the PC after a Reset of PowerLink is approximately 50 s.

5.4.2 Start Page before Login

After entering the actual IP address of the connected PowerLink in the browser (default IP- address: 192.168.20.5) the following screen is displayed.



[scstrtpg-201113-94.tif, 1, en_US]

Figure 5-28 Start page of PowerLink Web interface

For working with the Web interface of CSPi, enter the password.

Continue with clicking "OK"

NOTE

Default password for full access: cspiwrite

For security reasons the access to the Web interface is **disabled by default** settings (release ≥ **P3.5.130**). You have to enable the access by **http** or **https** via the service program PowerSys in configuration menu: **PowerLink > Configuration > Ethernet >IP (Service port)**

For details, please refer to Chapter *Configuration of the PowerLink Ethernet Interface* and Chapter *Cyber Security*.

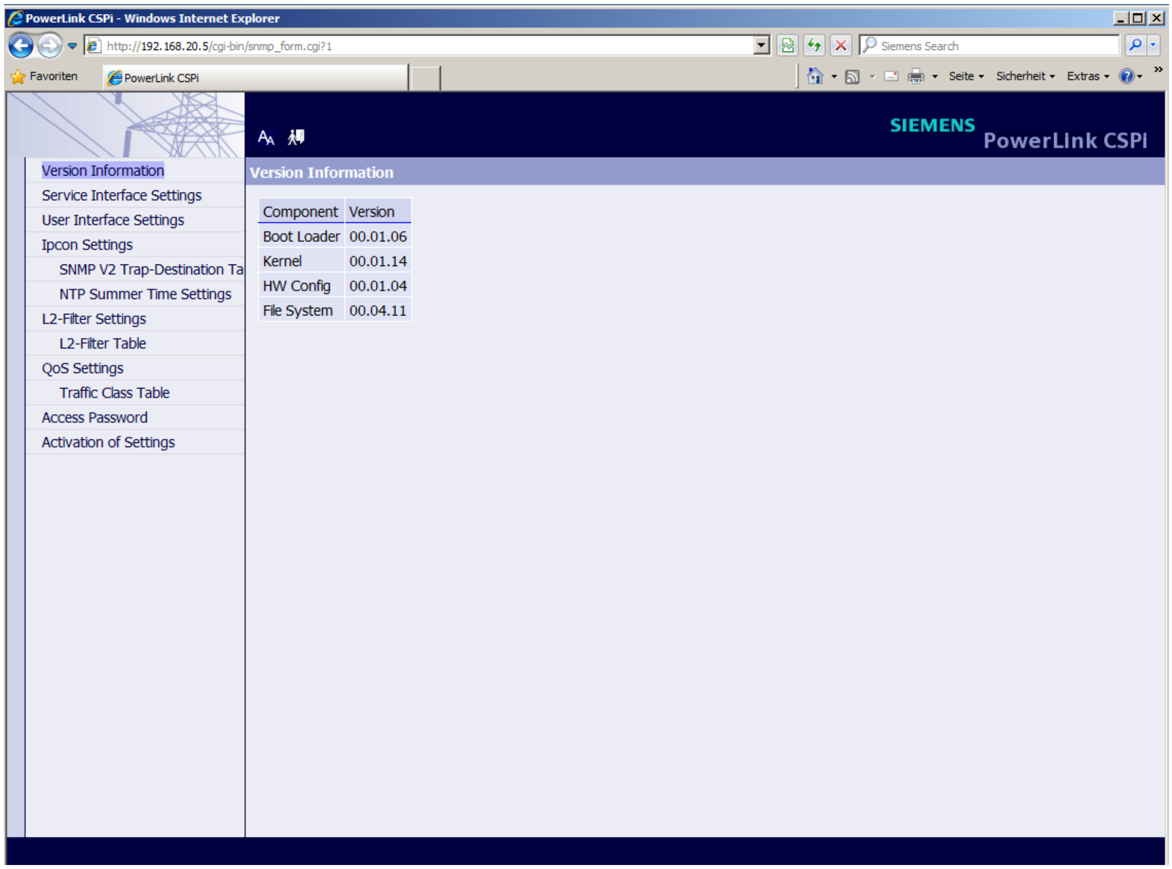
NOTE

Without knowing the password, access to the PowerLink Web interface is not possible!

If the password is lost, the CSPi module must be send to the factory for resetting to the default values.

All changed values are written temporary to the equipment by clicking the Send button. To fix these settings in the equipment the Activation of Settings (*Ipcon Settings – Change Access Password*) is necessary.

5.4.3 Start Page after Login



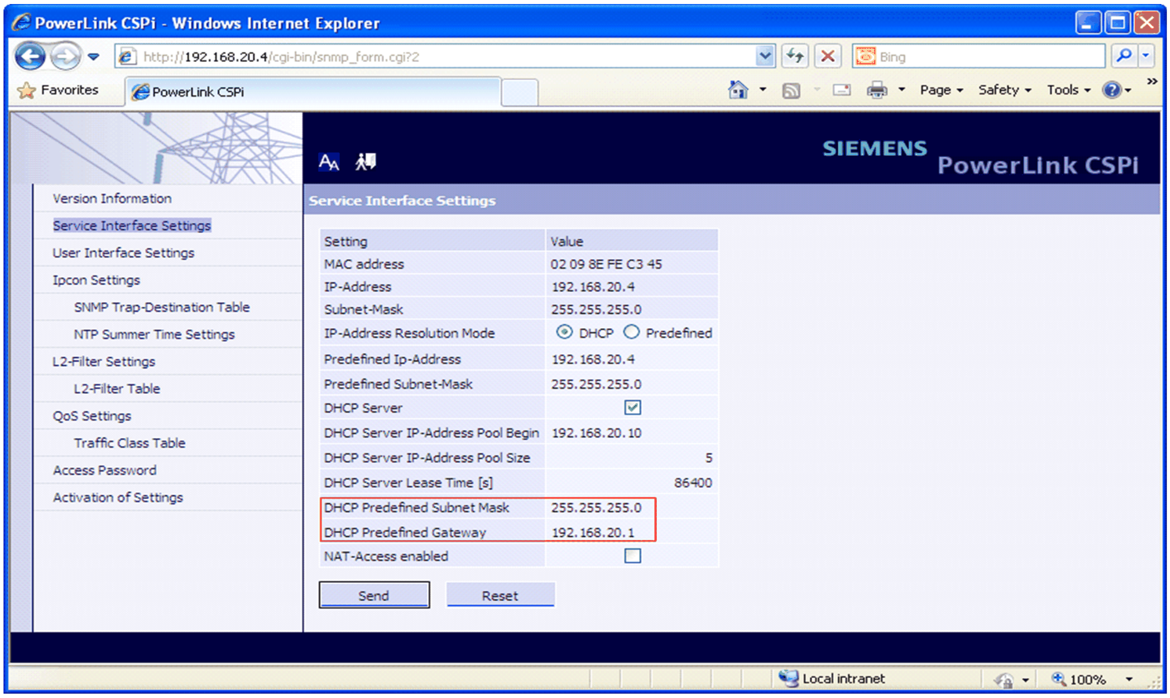
[scstrpga-201113-96.tif, 1, en_US]

Figure 5-29 Version Information of CSPi Web interface (Example)

After entering the PowerLink Web interface the screen with the version numbers is displayed.

5.4.4 Service Interface Settings

The service interface is used for the communication between the service PC and PowerLink. It is located at the front of the CSPi (LCT).



[scdhcpse-060712-01.tif, 1, en_US]

Figure 5-30 Service Interface Settings

Table 5-10 Service Interface Settings

Settings	Comments
MAC address	Actual MAC address of CSPi Service Interface
IP-Address	Actual IP-address of CSPi Service Interface
Subnet-Mask	Actual Subnet Mask
Predefined IP-Address	User defined IP-address
Predefined Subnet-Mask	User defined Subnet Mask
IP-Address Resolution Mode	
DHCP	Service interface is connected to a DHCP Server and expect an IP-address. May not be combined with DHCP Server on!
Predefined	IP address and subnet mask for the service interface defined by the user. The values, given in the fields “Predefined”, are written to the CSPi with SEND. After restart of PowerLink this user given values are valid as actual IP-address and subnet mask.
DHCP Server	DHCP Server of the service interface on(☑)/off (☐) (Default: DHCP Server of the service interface on(☑))
DHCP Server IP-Address Pool Begin	Start address of DHCP Server given addresses
DHCP Server IP-Address Pool Size	Number of Addresses given by DHCP Server
DHCP Server Lease Time	Validation of given IP-Address before automatic update
DHCP Predefined Subnet Mask	Predefined subnet mask address for connected DHCP client
DHCP Predefined Gateway	Predefined gateway address for connected DHCP client

Settings	Comments
NAT-Access enabled	Network Address Translation enabled
HTTP Connection	Read-only field, displays the connection option to the Web interface as **configured by PowerSys program**:http /https or disabled
PowerSys TCP/IP Connection	Read-only field, displays the TCP/IP connection option for PowerSys as **configured by PowerSys program**: ssl encryption or no ssl encryption
Create Certificate	Option to create a Trusted Certificate for Secure Connection. For details, refer to chapter *Cyber Security*
Send	Send the values to the CSPi
Reset	Reject the changes

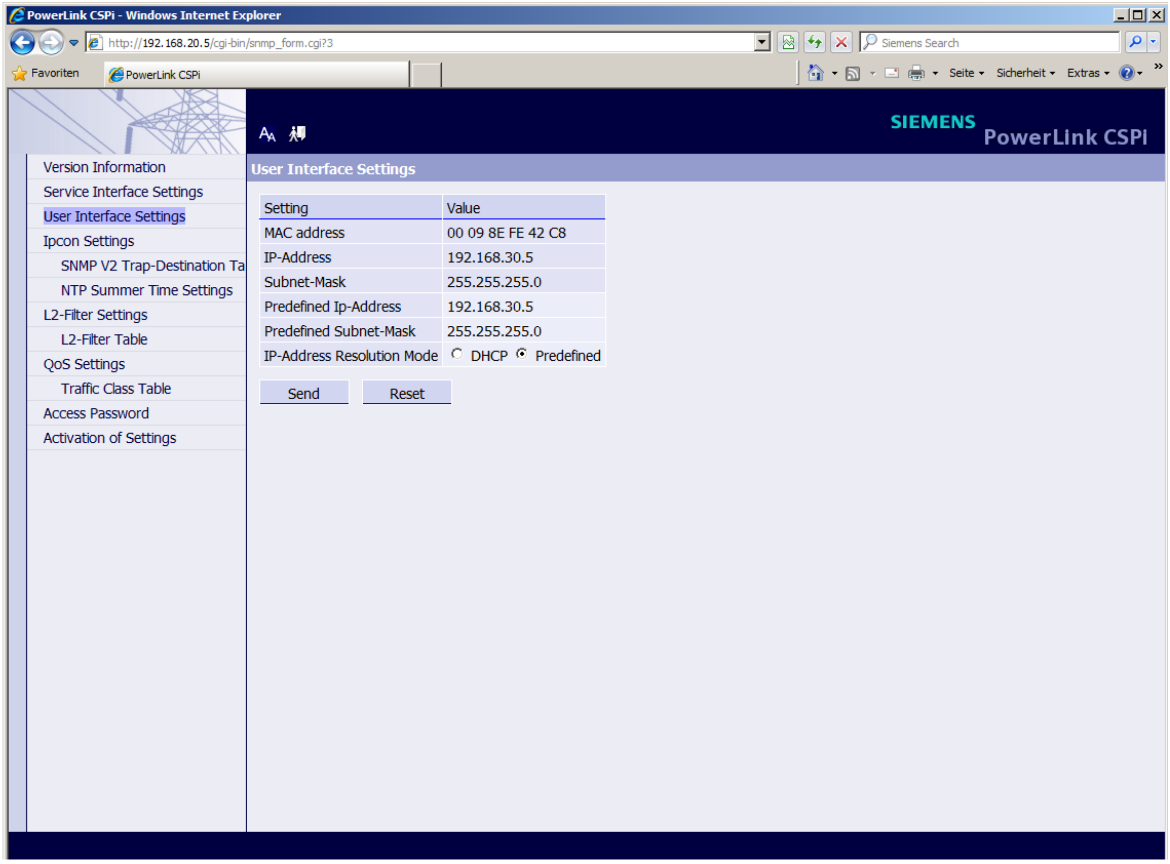
Adaption to the user requirements

NOTE

If the IP-Address of the interface is changed, make sure, that the actual values are known later. If the user does not know the IP-Address of the CSPi service interface it is not possible to communicate with the equipment.

5.4.5 User Interface Settings

The electrical user interface is located at the CFS2 connector panel (IP-1). The optical service interface is located at the front of the CSPi (ETH).



[scusrint-201113-96.tif, 1, en_US]

Figure 5-31 User Interface Settings

Table 5-11 User Interface Settings

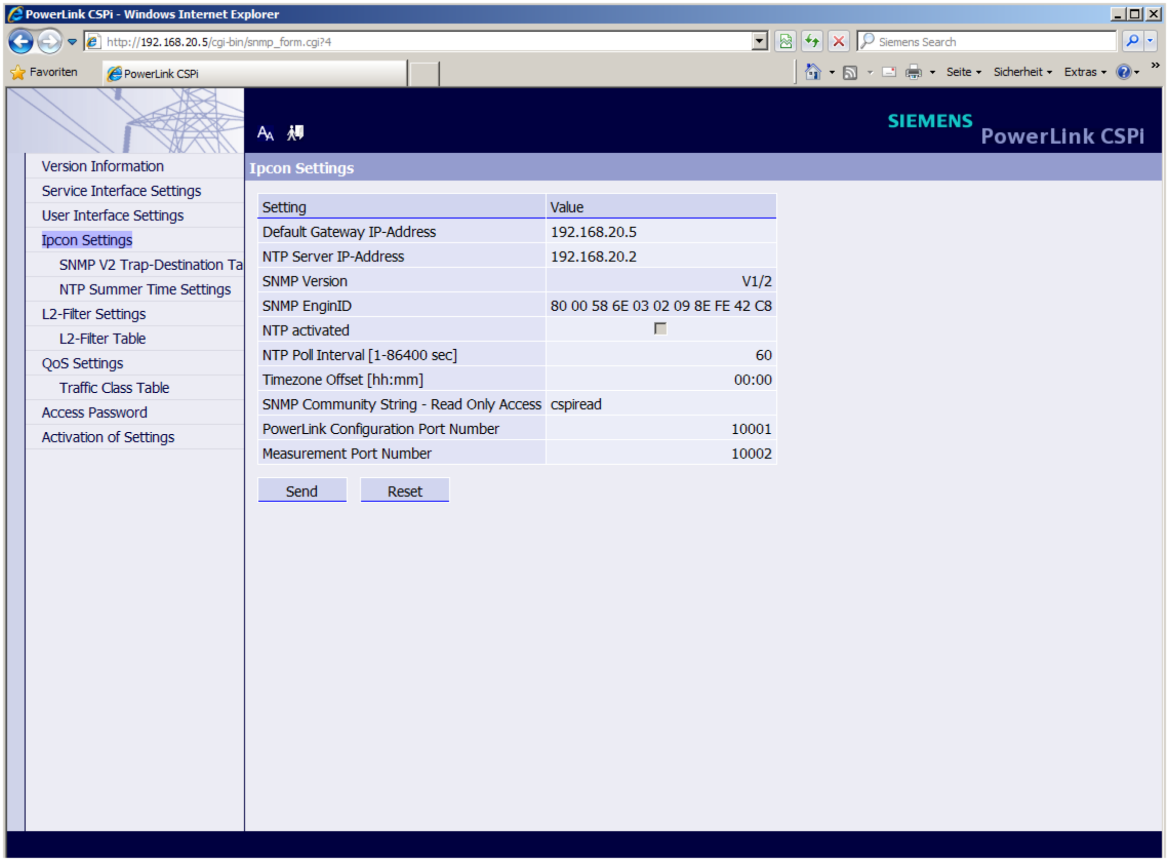
Settings	Comments
MAC address	Actual MAC address of CSPi User Interface
IP-Address	Actual IP-address of CSPi User Interface
Subnet-Mask	Actual Subnet Mask
Predefined IP-Address	User defined IP-address
Predefined Subnet-Mask	User defined Subnet Mask
IP-Address Resolution Mode	DHCP User interface is connected to a DHCP Server and expect an IP-address.
	Predefined IP address and subnet mask for the user interface defined by the user. The values, given in the fields “Predefined”, are written to the CSPi with SEND. After restart of PowerLink this user given values are valid as actual IP-address and subnet mask.
Send	Send the values to the CSPi
Reset	Reject the changes

NOTE

If the IP- Address of the interface is changed, make sure, that the actual values are known later. If the user does not know the IP- Address of the CSPi user interface it is not possible to communicate with the equipment.

5.4.6 Ipcon Settings

With the IPCON settings the values for the gateway, the NTP- server and the trap destination are defined.



[scipcons-201113-97.tif, 1, en_US]

Figure 5-32 Ipcon (PowerLink IP Controller) Settings

Table 5-12 Ipcon (PowerLink IP Controller) Settings

Settings	Comments
Default Gateway IP-Address	Gateway for Ethernet user port
NTP Server IP-Address	NTP (Network Time Protocol) server address
NTP activated	off (☐) NTP not used for time synchronization on(☑) NTP used for time synchronization Default: NTP Server off (☐)
NTP Poll Interval	1 - 86400 sec It is recommended to use a polling cycle not less than 60 seconds.
Timezone Offset (hh:mm)	The Time zone is always the GMT. Select the local deviation (up to ±12h).
SNMP Community String – Read Only Access	Text string, max. 10 characters, cspiread (default) Must be identically with the community string in the NMS

Settings	Comments
PowerLink Configuration Port Number	1024 to 65 535 (Adjust the same value in PowerSys – Options – Connection, Communication: TCP/IP, TCP/IP Configuration Port.) Default: 10001
Measurement Port Number	1024 to 65 535 (Adjust the same value in PowerSys – Options – Connection, Communication: TCP/IP, TCP/IP Measurement Port.) Default: 10002
Send	Send the values to the CSPi
Reset	Reject the changes
1)Range for PowerLink Configuration Port: 0 to 65 535, but well known ports up to 1023 should not be used. 2)Range for PowerLink Measurement Port: 0 to 65 535, but well known ports up to 1023 should not be used	

NOTE

For the clock synchronization via NTP only the related parameters are configured in the PowerLink Web interface. The local clock synchronization type of the PowerLink device is configured and activated with the PowerSys service program (refer to *3.18.8 Clock Synchronization*).

It is not possible to activate the NTP via the Web Interface. The Checkbox “NTP activated” in the IPCon settings of the Web interface shows the status, whether NTP synchronization was activated in the PowerSys configuration or not.

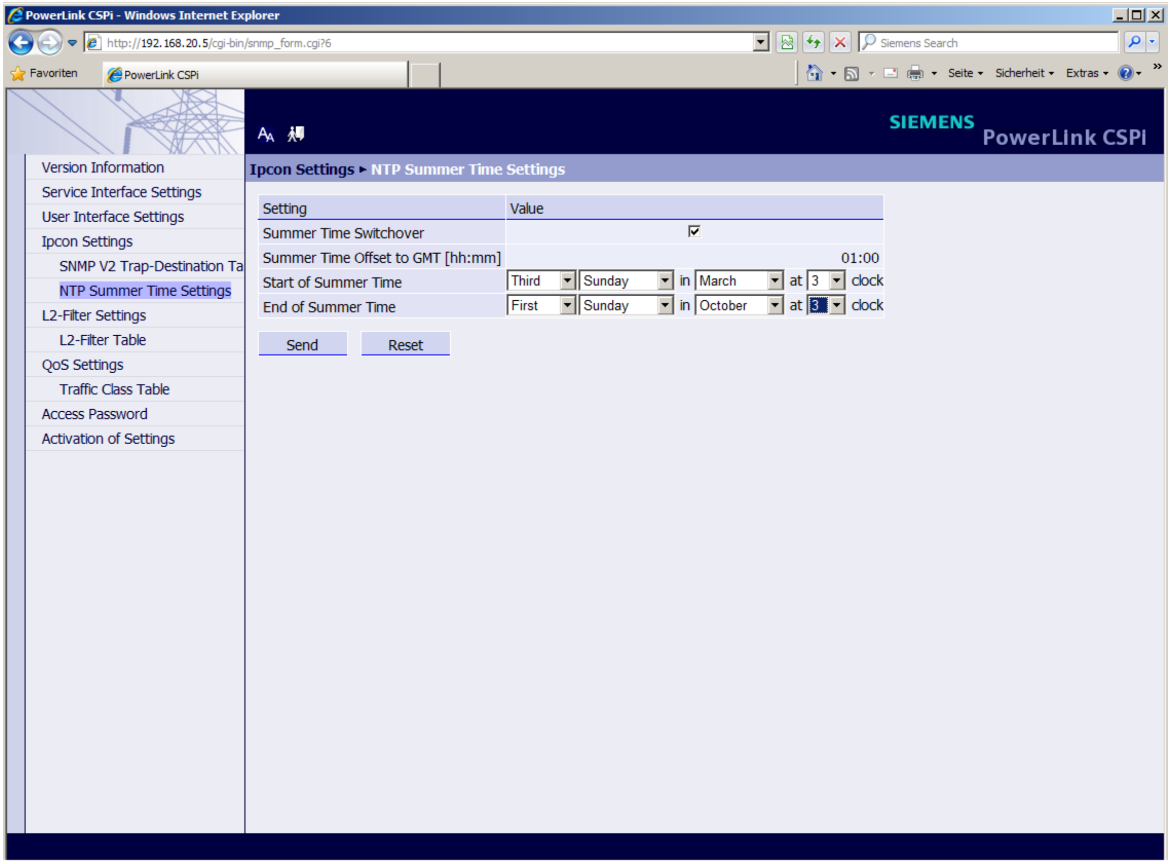
NTP Daylight Saving Time

Network Time Protocol (NTP) is a networking protocol to synchronize the clock between an NTP server and a PowerLink or SWT 3000 device. No information of time zone or daylight saving time (summer time) is provided by NTP, which has to be configured manually using the Web server (see *Figure 5-32*) or SNMP SET command.

The Universal Time Coordinated (UTC) received from the NTP server will be adjusted with the setting of local time zone or daylight saving time.

NOTE

The same content can also be displayed as read-only in PowerSys.



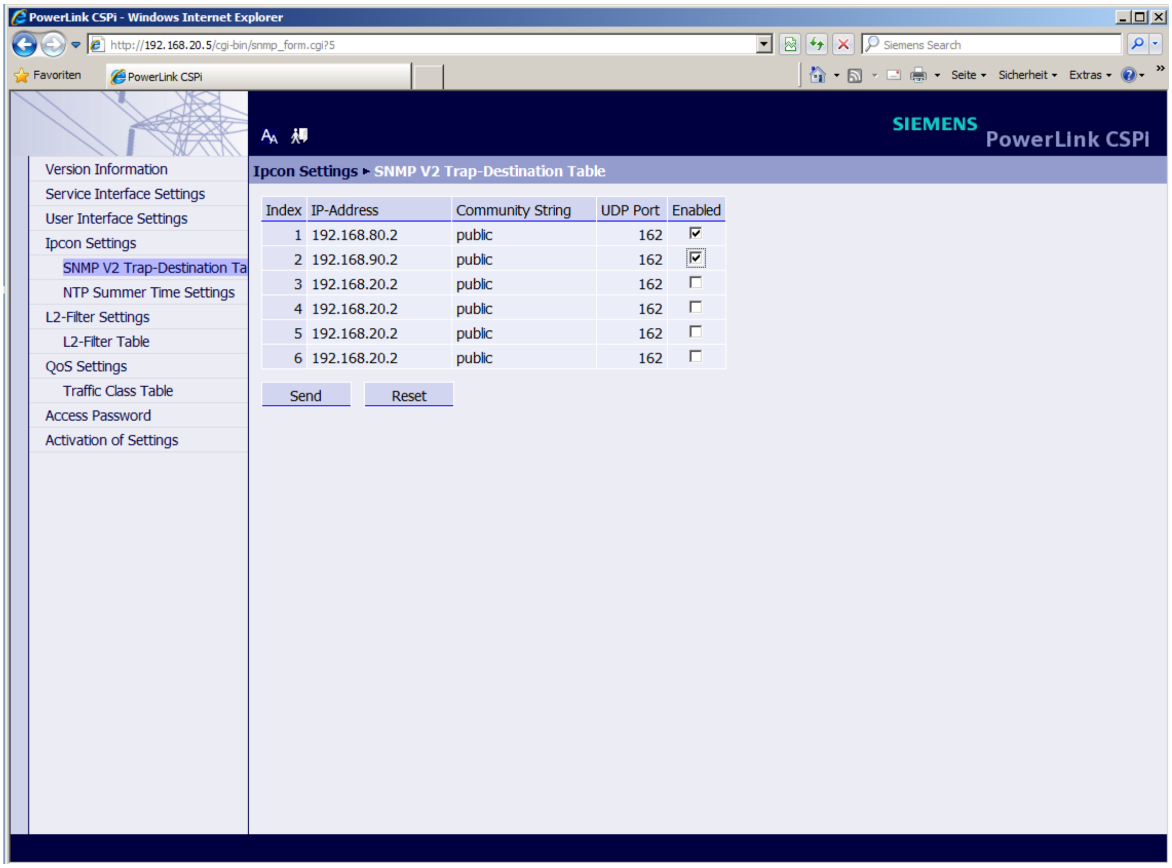
[scdaypow-201113-01.tif, 1, en_US]

Figure 5-33 PowerLink NTP Daylight Saving Time Setting using the Web Server

Settings	Comments
Summer Time Switchover	This enables daylight saving time switchover, it is only relevant for NTP. If it is enabled, you have to configure the summer time offset, the begin and the end of summer time also.
Summer Time Offset to GMT [hh:mm]	Daylight saving time offset to GMT (Greenwich Mean Time). The possible range of value: -12:00 to 12:00
Start of Summer Time	Define daylight saving start time
End of Summer Time	Define daylight saving end time

Ipcon Settings – Trap Destination

Up to 6 destinations can be set. The SNMPv2 traps are send automatically to these addresses.



[sctrpdst-201113-98.tif, 1, en_US]

Figure 5-34   Ipcon Settings – Trap Destination

Settings	Comments
Index	1 to 6
IP-Address	IP-Address of Trap destination (NMS)
Community String	Text string, max. 10 characters, Must be identically with the community string, expected by the NMS when receiving a trap
UDP Port	Range: 1024 to 65 535 default: 162 (well known port for traps) Must be identically with the number in the NMS
Enabled	on (☑) / off (☐) Default: off (☐)
Send	Send the values to the CSPi
Reset	Reject the changes
[1)]Range for UDP Port: 0 to 65 535, but well known ports up to 1023 should not be used. Exception for SNMP: Port 161: put and get, Port 162: traps	

Adaption to the user requirements.

The **NMS addresses** as well as the **community string** for set/get has to be adjusted via web login and must match between the SNMP agent and the NMS.

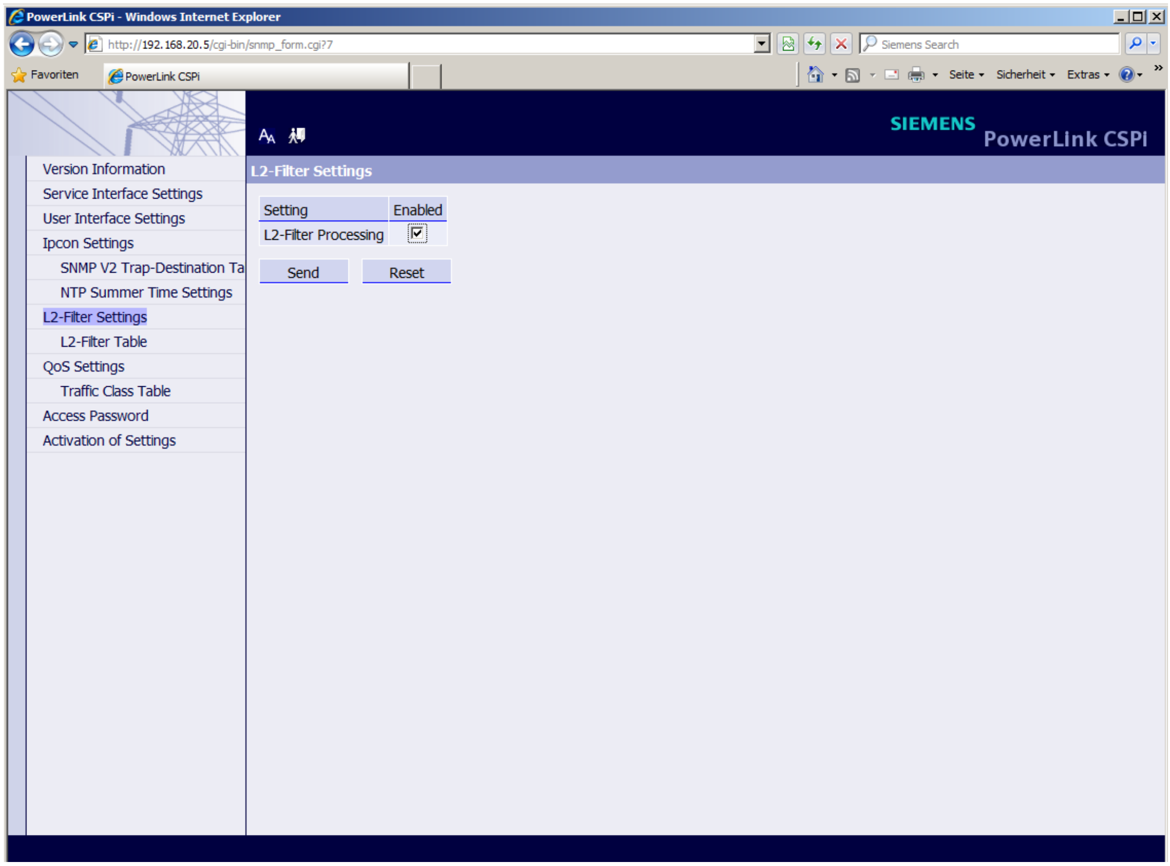
NOTE

For further information about the configuration of SNMP (v2/v3) please refer to chapter *SNMP*.

5.4.7 L2 Filter Settings

With L2 (Level 2) filter settings it is possible to lower the transmitted Ethernet traffic via PowerLink by blocking defined types of traffic. Within this form the function is activated or deactivated.

Default: Filter settings are switched off.



[scl2fltr-201113-99.tif, 1, en_US]

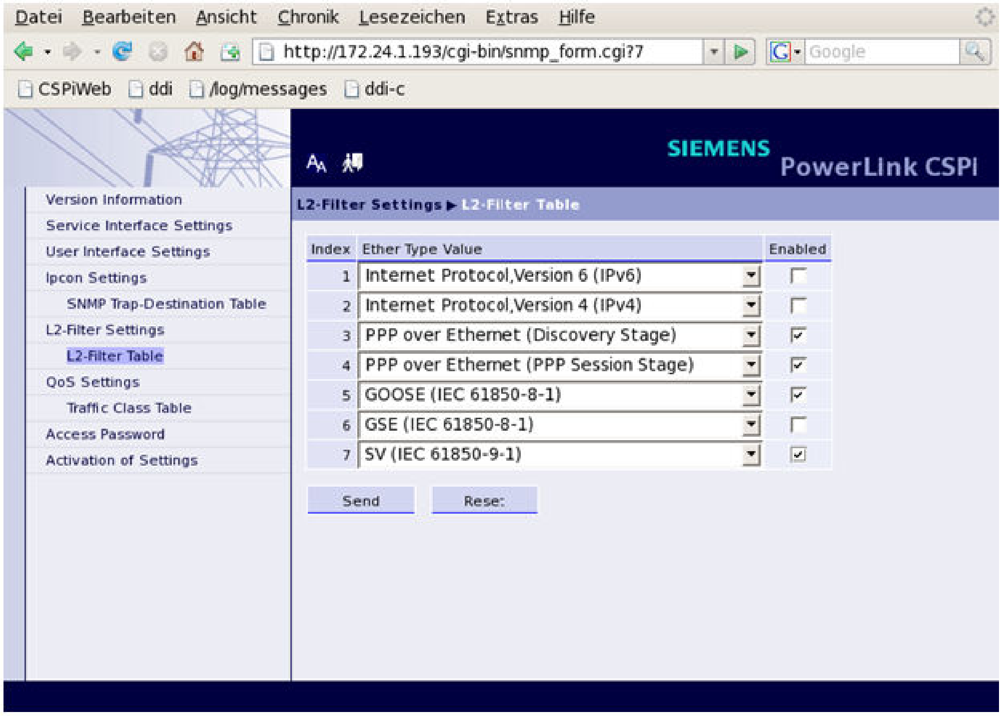
Figure 5-35 Level 2 Filter Settings

Table 5-13 Level 2 Filter Settings

Settings	Comments
L2-Filter Processing ☐	L2-Filter Processing off
L2-Filter Processing ☑	L2-Filter Processing on
Send	Send the values to the CSPi
Reset	Reject the changes

L2 Filter Settings – L2 Filter Table

With L2 (Level 2) filter settings it is possible to lower the transmitted Ethernet traffic via PowerLink by blocking defined types of traffic. Within this form the type of data is chosen.



[scl2fltb-081210-01.tif, 1, en_US]

Figure 5-36 Level 2 Filter Settings – Filter Table

Table 5-14 Level 2 Filter Settings – Filter Table

Settings	Comments
Internet Protocol, Version 6 (IPv6)	(☐) transmitted (☑) not transmitted
Internet Protocol, Version 4 (IPv4)	(☐) transmitted (☑) not transmitted
PPP over Ethernet (Discovery Stage)	(☐) transmitted (☑) not transmitted
PPP over Ethernet (PPP Session Stage)	(☐) transmitted (☑) not transmitted
Address Resolution Protocol (ARP)	(☐) transmitted (☑) not transmitted
Reverse Address Resolution Protocol (RARP)	(☐) transmitted (☑) not transmitted
VLAN Tag	(☐) transmitted (☑) not transmitted
GOOSE (IEC 61850-8-1)	(☐) transmitted (☑) not transmitted
GSE (IEC 61850-8-1)	(☐) transmitted (☑) not transmitted

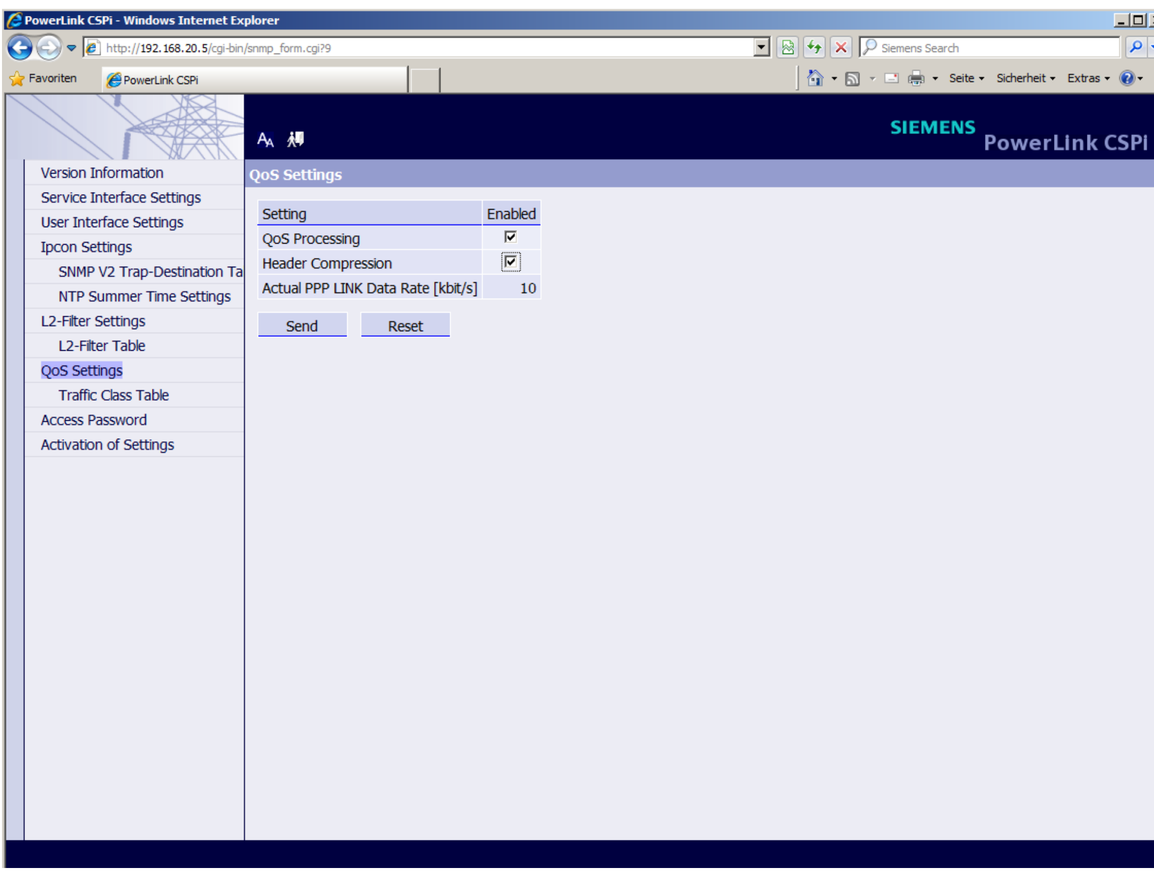
Settings	Comments
SV (IEC 61850-9-1)	(☐) transmitted (☑) not transmitted
Send	Send the values to the CSPi
Reset	Reject the changes

Goose	Generic object oriented substation events is a control model mechanism in which any format of data (status, value) is grouped into a data set an transmitted.
GSE	Generic substation events are defined as fast transfer of event data for a peer-to-peer communication mode.
SV	Sampled values

5.4.8 QoS Settings

Enabling the QoS processing, PowerLink reserves the given data rate for VoIP (voice over IP) traffic and/or IEC 60850-5-104 protocol. Adjustments for the data rates have to be done in the menu traffic class table.

Default: QoS settings are switched off



[scqosstg-201113-01.tif, 1, en_US]

Figure 5-37 QoS Settings

Table 5-15 QoS Settings

Settings	Comments
QoS Processing ☐	QoS Processing off
QoS Processing ☑	QoS Processing on
Actual PPP LINK Data Rate [Kbps]	Actual value, PowerLink is working with
Send	Send the values to the CSPi
Reset	Reject the changes

The Header Compression is configured in the web page through **PowerLink > QoS settings**.

[dwtcpiph-170513-01.tif, 1, en_US]

Figure 5-38 Parameter: Header Compression

Checked **Header Compression** enables the ROHC (RFC3095) and the header compression for low-speed serial links (RFC1144).

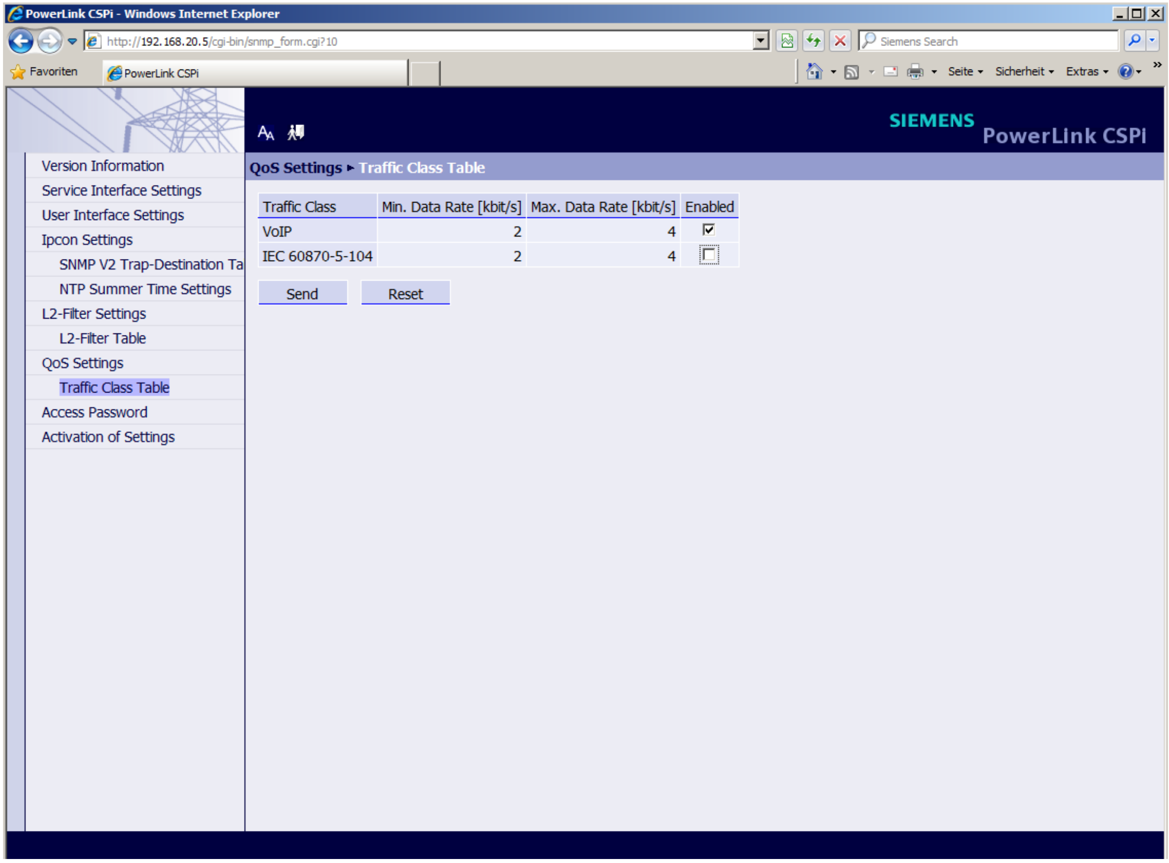
NOTE

Both local and remote PowerLink must have the same configuration for ROHC.

5.4.9 QoS Settings – Traffic Class Table

Within this menu a min. resp. max. data rate (Kbps) for traffic class VoIP (voice over IP) and/or IEC 60870-5-104 protocol can be set. The range between the min. and the max. value is guaranteed for the enabled service. This reservation is only active, if those traffic class is transmitted. Otherwise the reserved data rate can be used by other Ethernet data.

If the data rate of a traffic class exceeds the given max. value, than the exceeding data will be transmitted within the normal data stream.



[sctrfclt-201113-01.tif, 1, en_US]

Figure 5-39 QoS Settings – Traffic Class Table

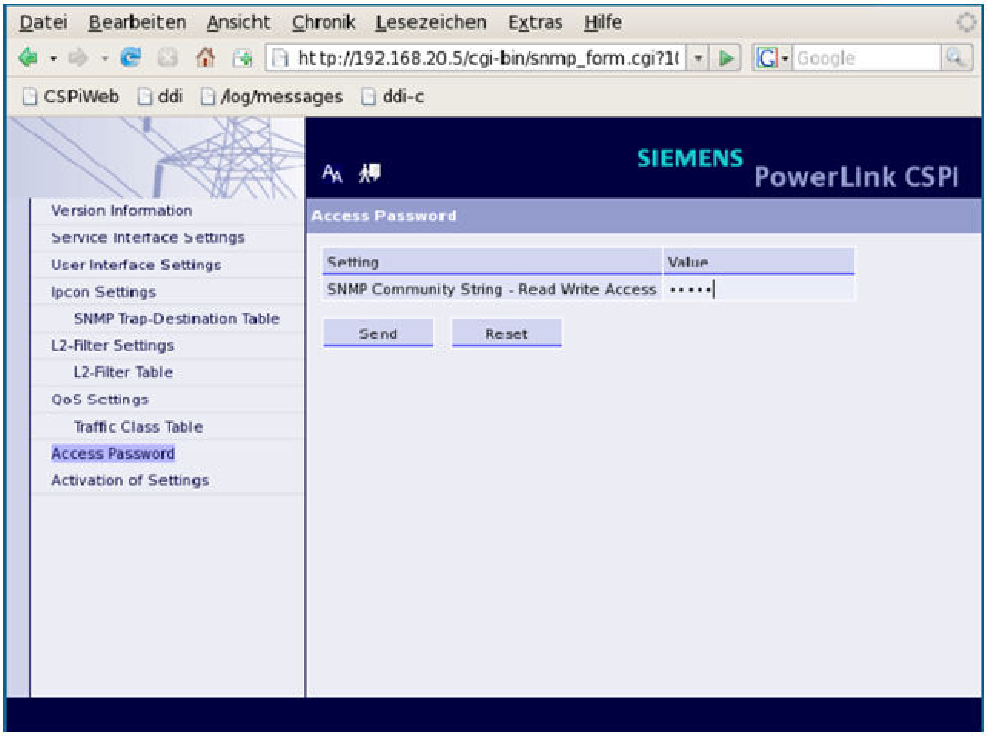
Table 5-16 QoS Settings – Traffic Class Table

Settings	Comments
VoIP ☐	QoS for VoIP off
VoIP ☑	QoS for VoIP on
IEC 60870-5-104 ☐	QoS for IEC 60870-5-104 off
IEC 60870-5-104 ☑	QoS for IEC 60870-5-104 on
Min. Data Rate	Reserved data rate [Kbps]
Max. Data Rate[4]	Reserved data rate [Kbps]
Send	Send the values to the CSPi
Reset	Reject the changes

5.4.10 Change Access Password

Within this menu the password for the access to the Web interface and the SNMP community string can be set.

4 Must be less than datarate of the Data Pump



[sccngapd-081210-01.tif, 1, en_US]

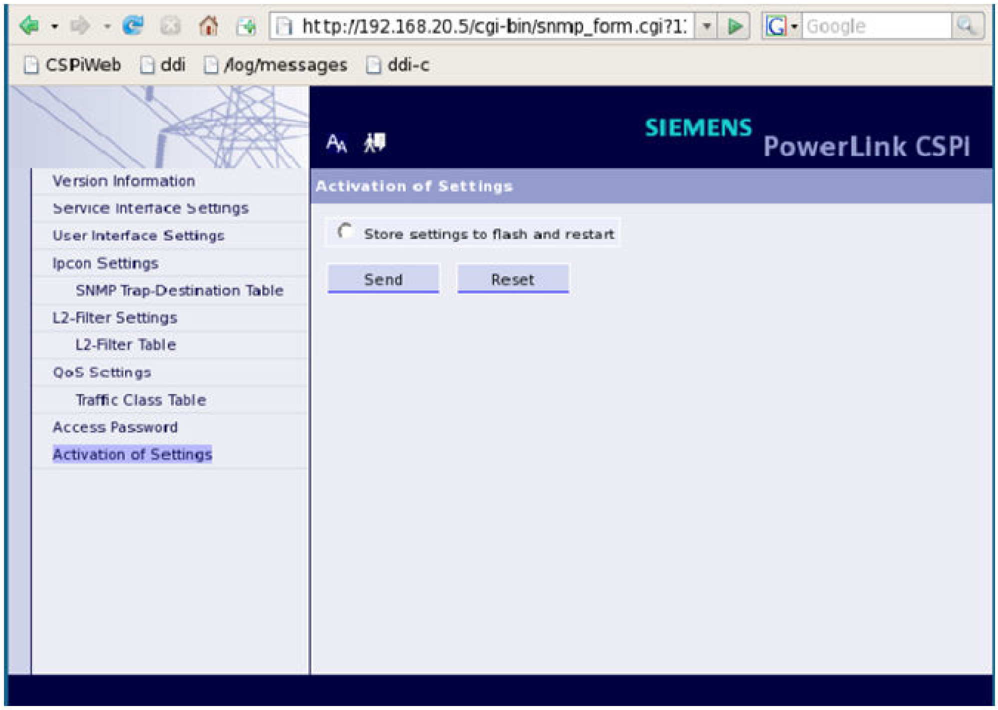
Figure 5-40 Ipcon Settings – Change Access Password

Table 5-17 Ipcon Settings – Change Access Password

Settings	Comments
SNMP Community String – Read Write Access	Text string, max. 10 characters, cspiwrite (default) Must be identically with the community string in the NMS
Send	Send the values to the CSPi
Reset	Reject the changes

5.4.11 Activation of Settings

Within this menu all the settings can be saved in PowerLink. Saving the values in PowerLink causes a reset in PowerLink.



[scactvst-081210-01.tif, 1, en_US]

Figure 5-41 Activation of Settings

Table 5-18 Activation of Settings

Settings	Comments
Store settings to flash and restart	Save all actual settings in the CSPi and restart the CSPi IP controller
Send	Send the values to the CSPi
Reset	Reject the changes

NOTE

Restart of the CSPi interrupts all services.

6 MCM Function

6.1 Overview

The function MCM (Multi Command Mode) extends the transmission of the integrated SWT 3000 via the **analog** interface from actual 4 to maximum 24 commands.

If only 20 commands have to be transmitted in the MCM mode, a second SWT 3000 can be integrated in the mounting position B of the PowerLink.

The SWT 3000 with the MCM function is integrated in the PowerLink. The transmission is always carried out in the **alternate multi purpose operation** (AMP) in combination with analog voice channel (F2) or with the Data Pump.

Due to the number of inputs and outputs in the MCM operating mode, the functionality of the interface module IFC-x from the SWT 3000 is divided in the modules IFC-24 and IFC-MCM.

The module IFC-24 only exists once per equipment, and is connected via a front cable to the PU4. The connecting cables to the IFC-MCM modules are plugged at the rear side of the module.

The MCM module consists of a basis and a sub module which are connected with each other via a ribbon cable. The basis module has 2 binary inputs and 4 relay outputs. The sub module also has 2 binary inputs, however here 4 semi-conductor outputs are available.

This chapter provides detailed instructions for commissioning the PowerLink system using the MCM function including jumper settings for the MCM resp. IFC-24 modules and explanation of the corresponding forms in the PowerSys service program.

6.2 Functional Description

6.2.1 Introduction

The general function of the SWT 3000 has been already described in the system description chapter *System Description*. The additional features for the MCM function are described below.

NOTE

The MCM function is only available for PowerLink 100.

6.2.2 Structure and Requirements

The function MCM (Multi Command Mode) extends the command transmission of the (i)SWT 3000 via the **analog** interface from actual max. 4 to max. 24.

NOTE

If up to 20 commands (max. 5 IFC-MCM units inserted in PowerLink) have to be transmitted in the MCM mode, a second SWT 3000 can be integrated in the mounting position B of the PowerLink. This has the capability to transmit up to four independent protection signaling commands.

For MCM the existing operation modes are expanded with the **mode 6**. The commands are transmitted serial and according to the programmed priority. They are divided into two categories:

- Relay Protection (RP) commands and
- Emergency automation (EA) signals

The classification only serves for a linguistically distinction of the priority. There is no functional difference between these two items.

Relay Protection Commands (RP)

Up to 4 relay protection (RP) commands have to be transmitted serially and according to the programmed priority.

Emergency Automation Signals (EA)

Up to 20 emergency automation (EA) signals have to be transmitted serial and according to the programmed priority.
While transmitting these two command categories the line protection equipments have the possibility to take action, e.g. with trip commands, in order to minimize the malfunction effect in case of disturbance. The normal operation mode is thus recovered as fast as possible.

Input Allocation/Input Treatment

The RP or EA commands can be connected to the inputs and outputs of the SWT 3000 equipment in an arbitrary sequence, because it is possible, to define the transmission priority by software. For the impulse suppression, two different input debounce times can be selected by means of jumper. They exist additional to the debounce time adjustable with the software. When selecting the longer debounce time, the signal transmission time is also corresponding longer.

Priority Assignment

The assignment of the inputs to the individual priority steps is carried out with the service program. For each priority step only one input can be assigned. This prioritization can also be carried out via the RM function.

Output Allocation

In the MCM operating mode a binary input (BI1 to BI24) can be assigned to any command output (CO1 to CO24). Combinatory operations are not possible.

Priority Control

For all 24 commands a different priority has to be adjusted. A command with higher priority interrupts the transmission of a command with lower priority. The interrupted command (which wasn't transmitted for the defined duration) will be transmitted again after all commands with higher priority have been send.

Transmit Memory

In general a send flag is set from an input command. This is only deleted after the command has been send for the complete transmission time. If the transmission of a command is delayed due to commands of higher priority, and the waiting command occurs again or several times at the input, it will nevertheless be transmitted only **once**.

6.2.3 Alternate Multi Purpose Operation

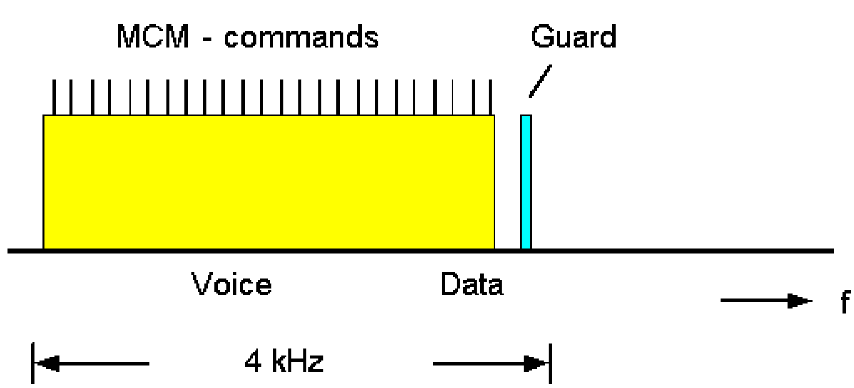
The SWT 3000 with the MCM functions is integrated in the PowerLink. The transmission is always carried out in the **alternate multi purpose operation** (AMP) in combination with analog voice channel (F2) or with the Data Pump. Using the F6-modulation ensures the reliable and secure transmission via very long HV-lines. Only one single signal is necessary to transmit the relay protection or the emergency automation signal.

NOTE

Further information about the alternate multi purpose operation mode can be found in the chapter *System Description*.

MCM with an Analog Voice Channel F2

The guard of the voice channel has to be adjusted to 3.81 kHz. The MCM trip frequencies are transmitted in the range from 0.3 up to 3.6 kHz. The voice band is adjustable from 0.3 up to 2.04 kHz (min.) and, in steps of 120 Hz, up to 3.6 kHz.

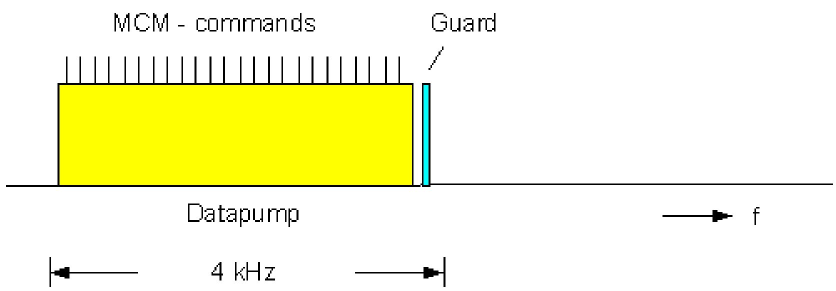


[lomcmvoc-061210-59.tif, 1, en_US]

Figure 6-1 MCM Alternate multi purpose operation with voice

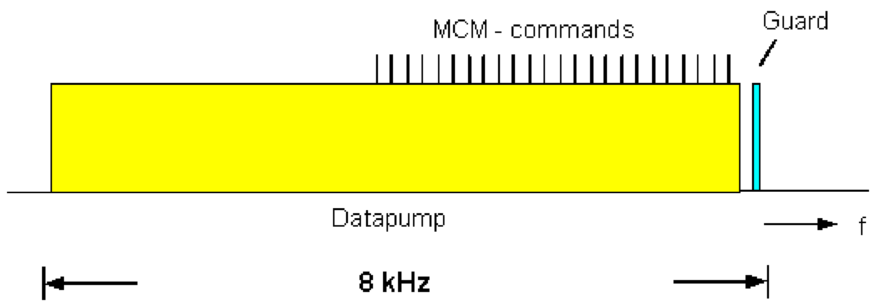
MCM with Data Pump

In the alternate multi purpose operation with the Data Pump (DP) the guard for the protection signaling system is the DP pilot. The MCM trip frequencies are transmitted within the DP-bandwidth. The DP bandwidth is adjustable between 3.5 to 7.5 kHz



[lomcmdpm-061210-60.tif, 1, en_US]

Figure 6-2 MCM Alternate multi purpose operation with Data Pump bandwidth 3.5 kHz



[lomcmdp2-061210-61.tif, 1, en_US]

Figure 6-3 MCM alternate multi purpose operation with Data Pump bandwidth 7.5 kHz

Transmission Period

The transmission period of a command is per default fixed to 50 ms. A longer upcoming command will also be transmitted only once for 50 ms. This value is adjustable via the service program in the range 50 to 100 ms in steps of 5 ms.

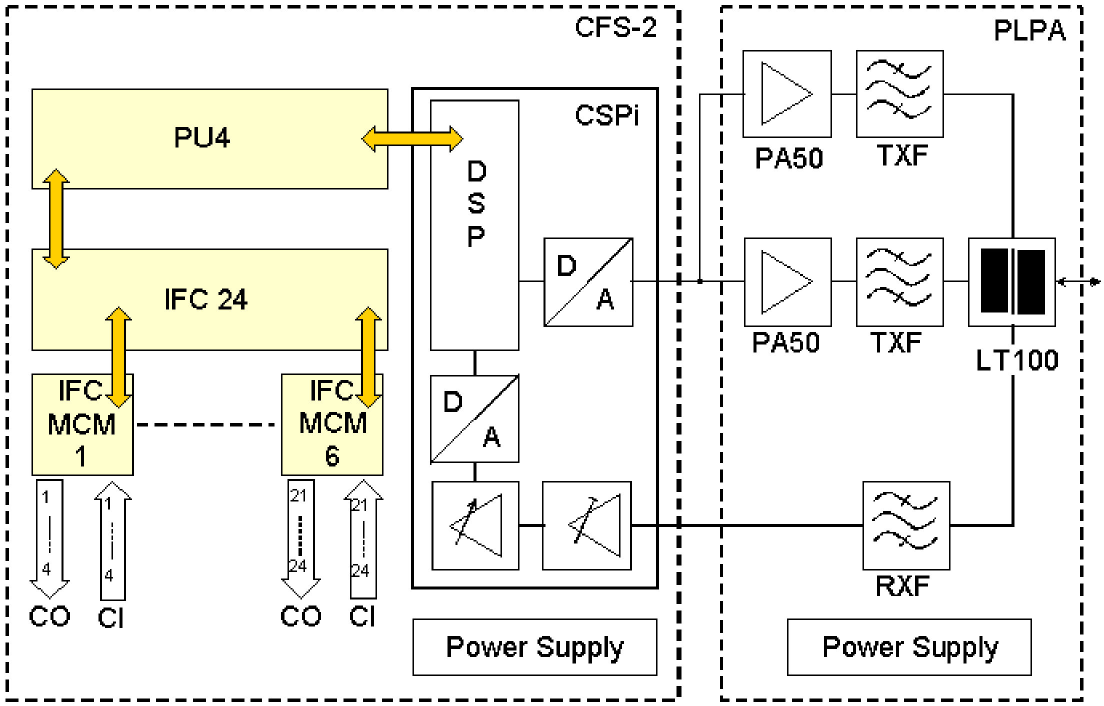
Transmit Power

Because of the transmission range the commands are coded in such a way, that for each tone the full transmit power is available. This means a coding which uses two or more tones at the same time on the line is not necessary.

Interface Modules

Due to the number of inputs and outputs in the MCM operating mode 6 (max. 24) the functionality of the interface module IFC from the SWT 3000 is divided in the modules IFC-24 and IFC-MCM.

The module IFC-24 only exists once per equipment, and is connected via a front cable to the PU4. The connection cables to the IFC-MCM modules are plugged at the rear side of the module.



[cdplmcmf-120813-62.tif, 1, en_US]

Figure 6-4 Block diagram of the PowerLink 100 system with MCM function

The MCM module consists of a basis and a sub module which are interconnected via a ribbon cable. The basis module has 2 binary inputs and 4 relay outputs. The sub module also has 2 binary inputs, however here 4 semi-conductor outputs are available.

Event Memory

The event memory is taken over from the system SWT 3000 without changes. Display possibilities (alarm only, commands only, all events) are available. Also for the other operating modes.

When reading out the user has the possibility to get all events, all commands or only other events chronologically displayed.

Output Extension

The extension of the command output can be adjusted from 0 up to 500 ms (2000 ms for Supervision Command) in steps of 5 ms. The default setting for MCM commands must be 50 ms.

Fall Back Mode to the Normal Operation

If the transmitter remains in the command transmission mode due to a fault it will be forced to switch back into the normal mode after 10 s (default value; adjustable from 5 to 30 s). In this case an alarm output is activated. The remaining services are available again after this fall back mode.

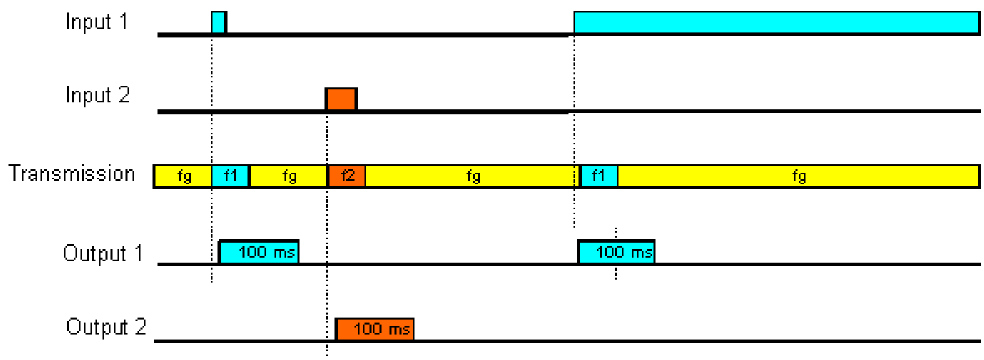
The alarm condition will only be cleared after all inputs are de-energized (no RP or EA input signal present).

6.2.4 Transmission Scheme

Example 1

The relay protection or emergency automation signal at the transmitter input x causes the transmission of the corresponding frequency fx for a certain time (Ttrans = 50 ms).

The receiver Output x sends the output impulse to the relay protection or emergency automation equipment (Tout = 100 ms).



[lottmcmc-061210-63.tif, 1, en_US]

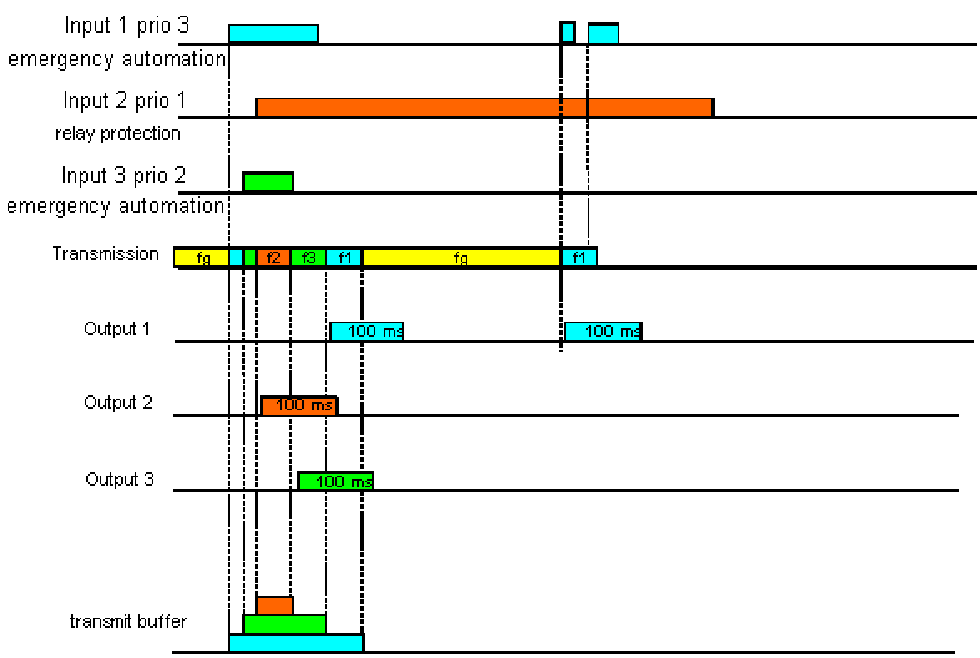
Figure 6-5 Transmission time of the MCM commands

Explanation:

In the example above the input 1 is energized for a very short time (< 50 ms) and later for a long time (approx. 1 sec). The transmission time in both cases is 50 ms and the command output time is the transmission period plus the extension time = 100 ms.

Example 2

The relay protection signals (input 2) and the emergency automation signals (input 1 and input 3) are transmitted with different priority.



[lotpinsg-061210-64.tif, 1, en_US]

Figure 6-6 Transmission priority for the different input signals

Explanation:

The inputs 1, 2 and 3 are energized nearly in the same time. Due to the different priorities the relay protection signal from input 2 is transmitted first. The input 1 and 3 signals are stored according to their priority in the transmit buffer, and sent subsequent to the signal from input 2.

6.2.5 Guard Alarm

If there is no valid command frequency present a guard alarm is triggered after about 10 ms. The Guard alarm is cancelled in the MCM operating mode as soon as a valid trip frequency resp. the Guard is received.

6.2.6 Supervision Command

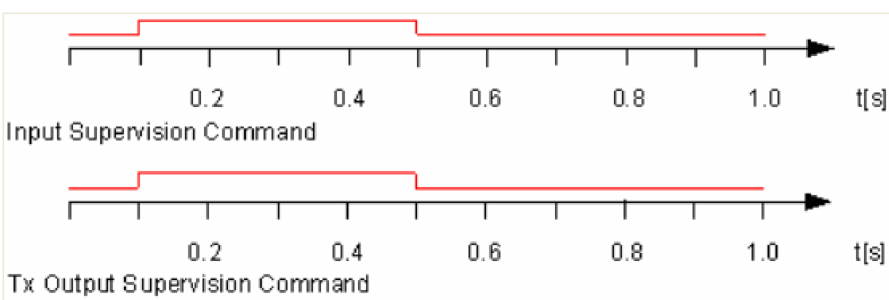
The command with the lowest priority can be used as "Supervision Command". For a Supervision Command, where the priority is fixed automatically to 24, special features are available.

Table 6-1 Where is the Supervision Command

IFC-MCM	Supervision command	Priority
1 module	4th command	24
2 modules	8th command	24
3 modules	12th command	24
4 modules	16th command	24
5 modules	20th command	24
6 modules	24th command	24

Continuous Signal Transmission

The Supervision Command is transmitted as long as the Supervision Command input is activated.

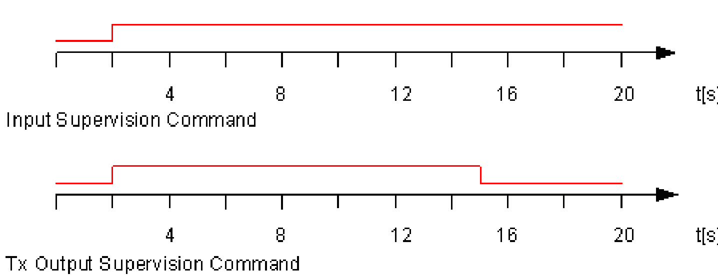


[scsupcom-120813-01.tif, 1, --_--]

Figure 6-7 Supervision Command Continuously

Input Limitation Alarm

If the activation time of the Supervision Command is longer than the adjusted input limitation time, a non urgent alarm is generated. Depending on this alarm the Supervision Command transmission can be stopped.



[scsupcm2-110711-01.tif, 1, --_--]

Figure 6-8 Supervision Command with input limitation

NOTE

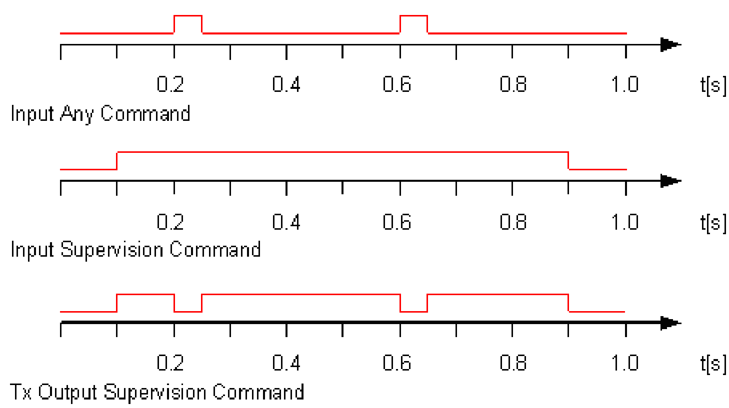
Result of exceeding the adjusted "Limit of Supervision Command"

- Anon urgent alarm is generated
- In case of activated: "Blocking outputs on Limit of Supervision Command", the transmission of the Supervision Command is stopped and PowerLink switches back to normal working conditions

Interruption of Supervision Command

As known, the Supervision Command has the lowest priority, therefore every other command has a higher priority.

If, during the transmission of a Supervision Command, any other command has to be transmitted, the Supervision Command is interrupted and the command with the higher priority is transmitted to the remote equipment. After finishing the transmission of the command with the higher priority, the transmission of the Supervision Command is restored, if the input contact of the Supervision Command is still active and the input limitation time setting has not been exceeded.



[dwsupcm3-110711-01.tif, 1, --_--]

Figure 6-9 Supervision Command Interrupted from command with higher priority

NOTE

All MCM signal transmission are done in Alternate Multipurpose Mode. Therefore the transmission of a MCM signal (including Supervision Command) interrupts the normal working condition of PowerLink.

6.2.7 Signaling Allocation

The signaling allocation is used to configure free output ports of IFC-MCM boards as command signaling for any command input, command output or alarm event. All free output ports can be configured as signaling ports, but the total transmitted command number is reduced.

By default, all IFC-MCM output ports are allocated for command outputs. These output ports must be deactivated in output allocation view at first before signaling allocation. Multiple command input and output can be signaling to the same port.

Table 6-2 PowerLink > Configuration > iSWT-1 > Signaling Allocation

Idx	IFC-1/ OUT1	IFC-1/ OUT2	IFC-1/ OUT3	IFC-1/ OUT4	...	IFC-6/ OUT1	IFC-6/ OUT2	IFC-6/ OUT3	IFC-6/ OUT4
IN1	X								
IN2		X							
...			X						

Idx	IFC-1/ OUT1	IFC-1/ OUT2	IFC-1/ OUT3	IFC-1/ OUT4	...	IFC-6/ OUT1	IFC-6/ OUT2	IFC-6/ OUT3	IFC-6/ OUT4
IN24				X					
OUT1						X			
OUT2							X		
...								X	
OUT24									X
ALR									

IN1...24 Signal transmitted input commands

OUT1...24 Signal received output commands

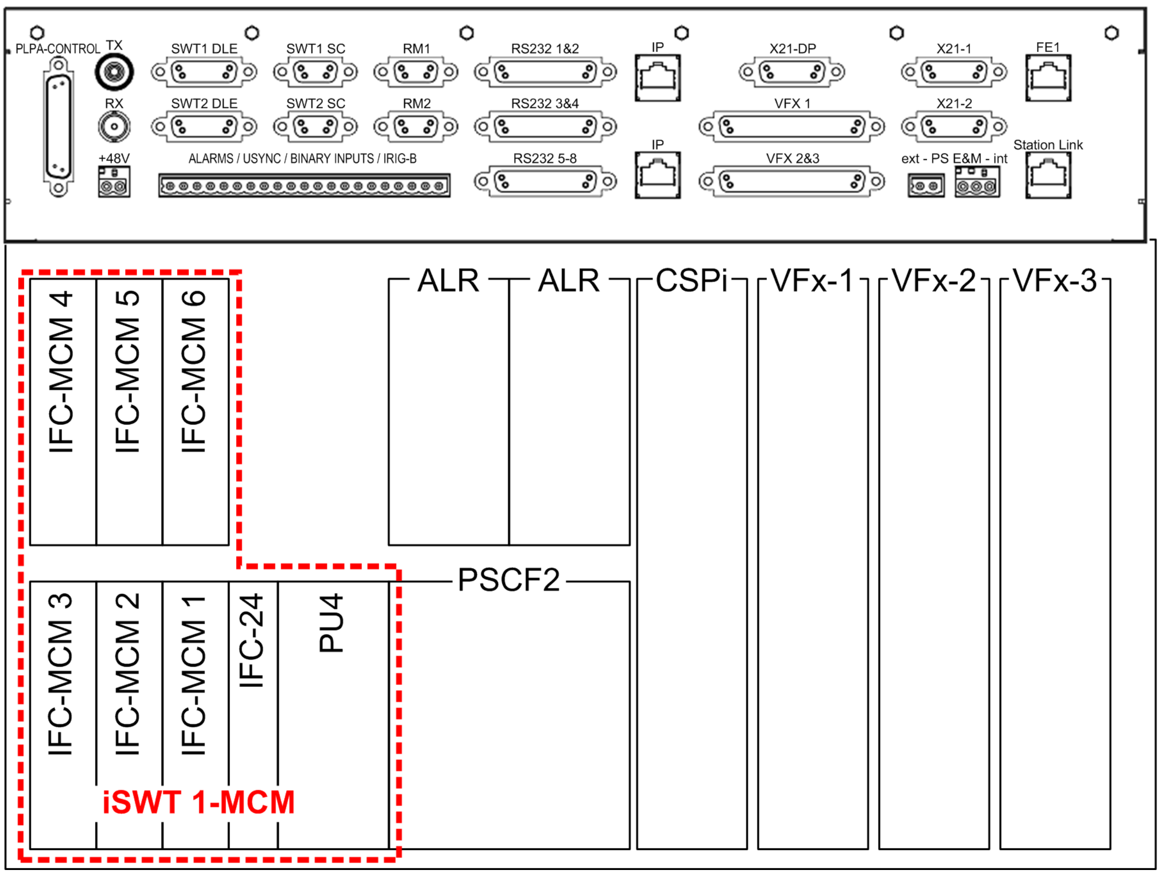
ALR Signal occurred alarm events

The MCM-Basis-Module has 4 relay outputs and the MCM-Sub-Module has 4 semi-conductor outputs. The 4 command outputs in basis module are mirrored to sub module. So, it can be used as contact doubling purpose.

6.3 Commissioning

6.3.1 Overview

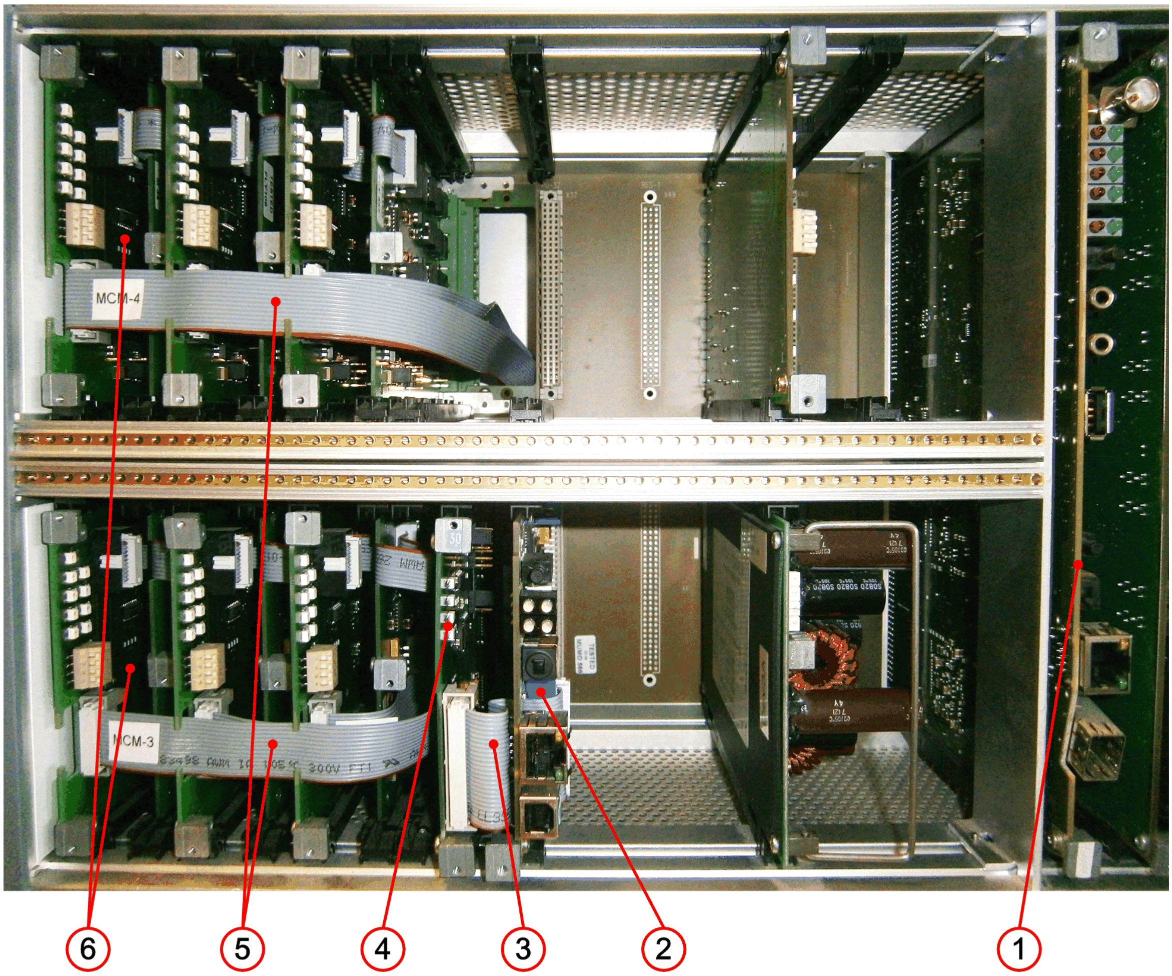
The PU4 module of the iSWT-MCM is located in the iSWT mounting position 1 of the PowerLink equipment.



[tdpliswt-180913-65.tif, 1, en_US]

Figure 6-10 iSWT 3000 with the MCM functionality and 6 interface modules

iSWT 1: integrated SWT 3000 in mounting position 1



[dwuccfs2-270813-01.tif, 1, --_--]

Figure 6-11 View into an uncovered CFS-2 part containing iSWT 3000 with MCM function

(1) CSPi

(2) PU4

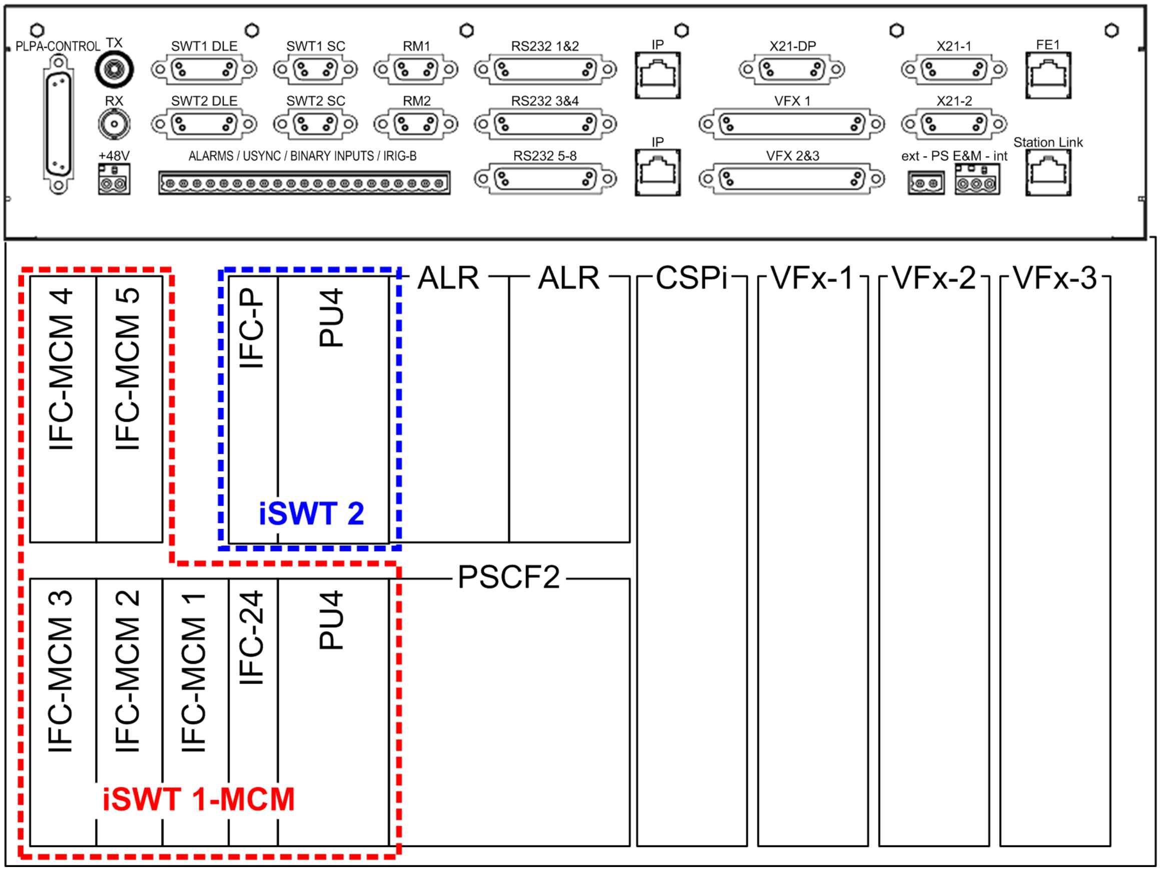
(3) TPi-Bus cable between PU4 and IFC-24

(4) IFC-24

(5) From / To Transfer connector IFC-24 module (rear side of CFS-2)

(6) IFC-MCM

If the number of MCM modules is not more than 5, a second iSWT 3000 (in the mounting position 2) can be used in the PowerLink system.

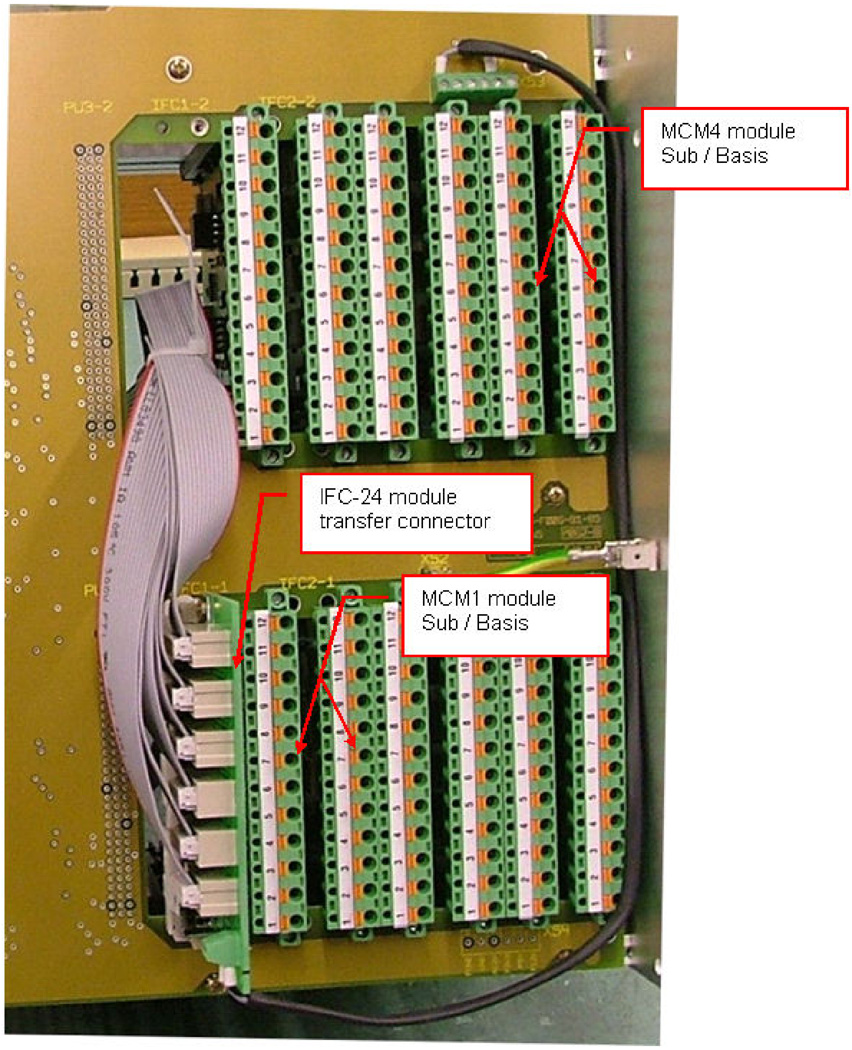


[tdiswttw-180913-67.tif, 1, en_US]

Figure 6-12 iSWT 3000 with the MCM functionality and an additional iSWT 3000 in mounting position 2

iSWT 1: integrated SWT 3000 in mounting position 1

iSWT 2: integrated SWT 3000 in mounting position 2

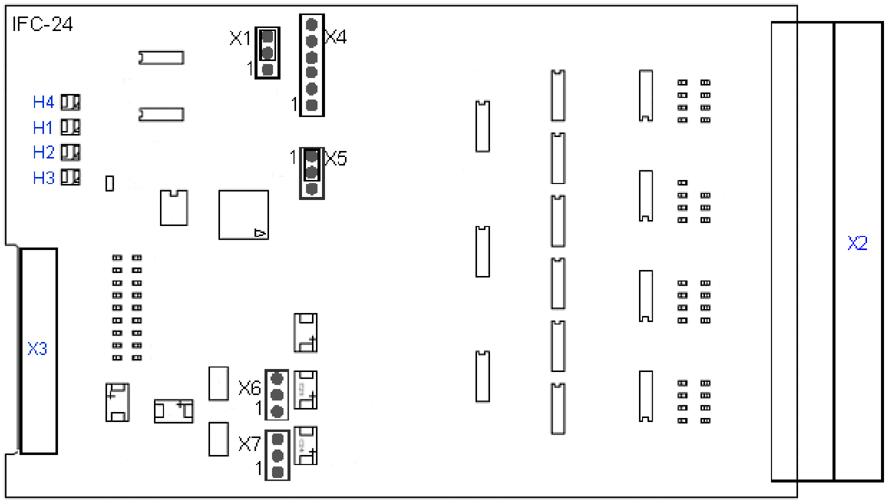


[scifc24m-071210-68.tif, 1, en_US]

Figure 6-13 Position of the IFC-24 and MCM modules in the PowerLink system rear view

6.3.2 IFC-24 Module

Displays



[tdifc24m-071210-69.tif, 1, en_US]

Figure 6-14 The IFC-24 module

The four LED (H1 to H4) on the IFC-24 module have the following signification

Table 6-3 Signification of the LED on the IFC-24 module

LED	Signification
H1	P12 Relay voltage ON
H2	P12 Relay voltage for module 3-4 ON
H3	P12 Relay voltage for module 5-6 ON
H4	Test mode

Jumper Settings

Table 6-4 Jumper settings on the IFC-24 module

Jumper	Position	Signification
X6	2-3*)	The 12 V supply for the MCM modules 1 to 6 is carried out from the power supply (PS) PowerLink via the switched signal P12_R.
X6	2-Jan	The 12 V supply for the MCM modules 1 to 2 is carried out from the power supply (PS) PowerLink via the switched signal P12_R. The supply for the MCM modules 3 to 4 is carried out from the power supply PS-MCM via the switched signal P12_M34.
X7	2-3*)	The 12 V supply for the MCM modules 1 to 6 is carried out from the power supply (PS) PowerLink via the switched signal P12_R.
X7	2-Jan	The 12 V supply for the MCM modules 1 to 2 is carried out from the power supply (PS) PowerLink via the switched signal P12_R. The supply for the MCM modules 5 to 6 is carried out from the power supply PS-MCM via the switched signal P12_M56.

*) default setting

NOTE

X1 (Pos 2-3) and X5 (Pos 1-2), are only given for **test purpose** and may not be modified!
X4 is used for programming purpose only

The connection of the IFC-24 module to the PU4 occurs via the 26 pin connector X3. The power supply of the IFC-24 with 5 V resp. 12 V is also conducted via this connector.

Pin Assignment of the X2 Connector

Table 6-5 Pin assignment of the IFC-24 connector X2

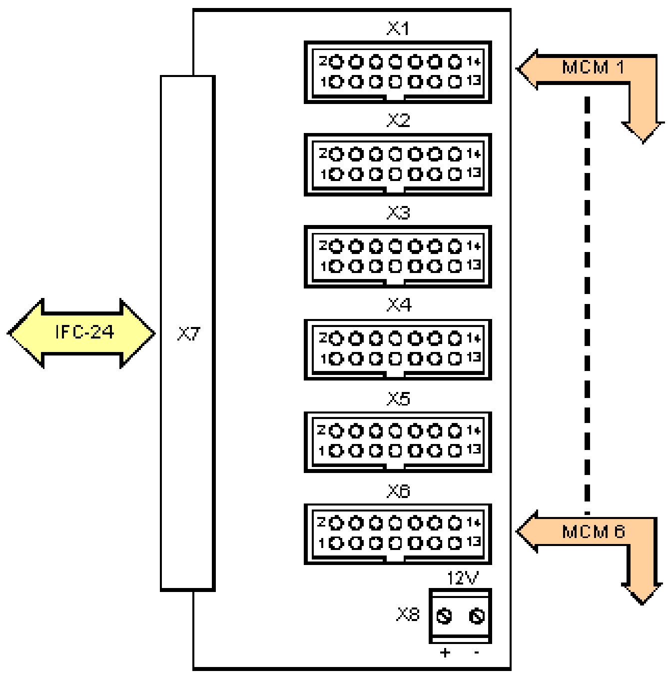
Pin	a	b	c
1	BA11	BA12	BA13
2	BA14	BE11	BE12
3	BE13	BE14	PD1
4	P12_R	VCC	GND
5	Test_N		
6	BA21	BA22	BA23
7	BA24	BE21	BE22
8	BE23	BE24	PD2
9	P12_R	VCC	GND
10	Test_N		
11	BA31	BA32	BA33
12	BA34	BE31	BE32
13	BE33	BE34	PD3
14	P12_R	VCC	GND
15	Test_N		
16	BA41	BA42	BA43
17	BA44	BE41	BE42
18	BE43	BE44	PD4
19	P12_R	VCC	GND
20	Test_N		
21	BA51	BA52	BA53
22	BA54	BE51	BE52
23	BE53	BE54	PD5
24	P12_R	VCC	GND
25	Test_N		
26	BA61	BA62	BA63
27	BA64	BE61	BE62
28	BE63	BE64	PD6
29	P12_R	VCC	GND
30	Test_N		
31	P12_MCM	GND	
32	P12_MCM	GND	

BExy	BE	Binary input	x = MCM module (1 to 6)	y = No. Binary input (1 to 4)
BAxy	BA	Command output	x = MCM module (1 to 6)	y = No. Command output (1 to 4)
PD	Present detect signal (MCM existing)			

P12_R	12 V Relay voltage
VCC	5 V Power supply
Test_N	Test mode

Transfer Connector

The connections from the IFC-24 to the MCM modules 1 to 6 are established by means of a transfer connector and 14 conductor ribbon cables.



[cdifcmcm-071210-70.tif, 1, en_US]

Figure 6-15 connector from the IFC-24 module to the MCM modules

Table 6-6 Assignment of the transfer connector, in brackets the 14 pin plug connectors X1 to 6

Pin	a	b	c
32	BA1_N (X1:1)	BA2_N (X1:2)	BA3_N (X1:3)
31	BA4_N (X1:4)	**BE1** (X1:5)	**BE2** (X1:6)
30	**BE3** (X1:7)	**BE4** (X1:8)	**PD1_N** (X1:9)
29	**P12_R** (X1:10)	**P5** (X1:11)	**GND** (X1:12)
28	**TEST_N** (X1:13)		
27	BA5_N (X2:1)	BA6_N (X2:2)	BA7_N (X2:3)
26	BA8_N (X2:4)	**BE5** (X2:5)	**BE6** (X2:6)
25	**BE7** (X2:7)	**BE8** (X2:8)	**PD2_N** (X2:9)
24	**P12_R** (X2:10)	**P5** (X2:11)	**GND** (X2:12)
23	**TEST_N** (X2:13)		
22	BA9_N (X3:1)	BA10_N (X3:2)	BA11_N (X3:3)
21	BA12_N (X3:4)	**BE9** (X3:5)	**BE10** (X3:6)
20	**BE11** (X3:7)	**BE12** (X3:8)	**PD3_N** (X3:9)
19	**P12_M34** (X3:10)	**P5** (X3:11)	**GND** (X3:12)
18	**TEST_N** (X3:13)		
17	BA13_N (X4:1)	BA14_N (X4:2)	BA15_N (X4:3)
16	BA16_N (X4:4)	BE13 (X4:5)	**BE14** (X4:6)

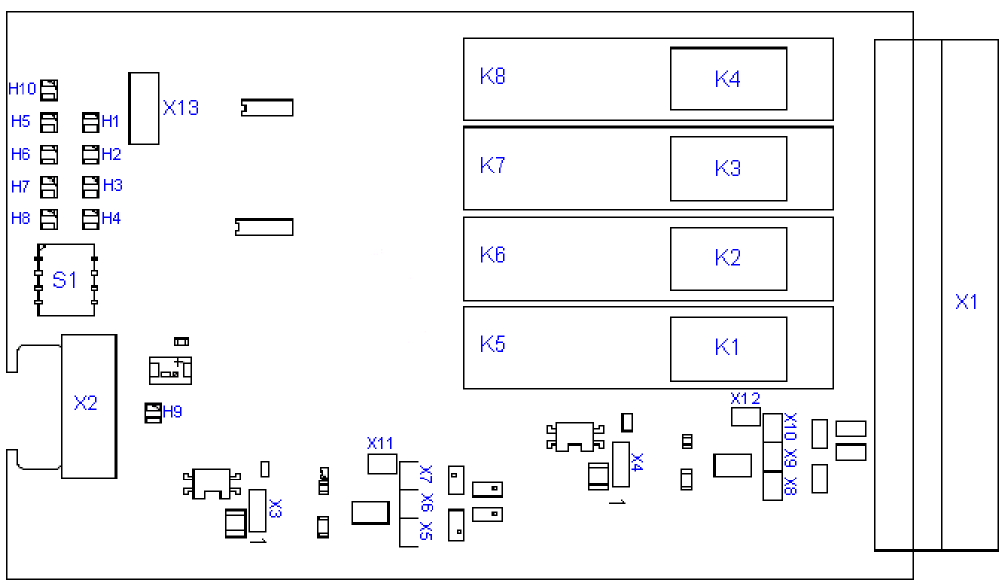
Pin	a	b	c
15	**BE15** (X4:7)	BE16 (X4:8)	**PD4_N** (X4:9)
14	**P12_M34** (X4:10)	P5 (X4:11)	**GND** (X4:12)
13	**TEST_N** (X4:13)		
12	BA17_N (X5:1)	BA18_N (X5:2)	BA19_N (X5:3)
11	BA20_N (X5:4)	**BE17** (X5:5)	**BE18** (X5:6)
10	**BE19** (X5:7)	**BE20** (X5:8)	**PD5_N** (X5:9)
9	**P12_M56** (X5:10)	**P5** (X5:11)	**GND** (X5:12)
8	**TEST_N** (X5:13)		
7	BA21_N (X6:1)	BA22_N (X6:2)	BA23_N (X6:3)
6	BA24_N (X6:4)	**BE21** (X6:5)	**BE22** (X6:6)
5	**BE23** (X6:7)	**BE24** (X6:8)	**PD6_N** (X6:9)
4	**P12_M56** (X6:10)	**P5** (X6:11)	**GND** (X6:12)
3	**TEST_N** (X6:13)		
2	**P12_MCM** (X8:1)	**GND_MCM** (X8:2)	
1	**P12_MCM** (X8:1)	**GND_MCM** (X8:2)	

6.4 IFC-MCM

6.4.1 Overview

The MCM module consists of a basis and a sub module which are connected with each other via a ribbon cable. The basis module has 2 binary inputs and 4 relay outputs. The sub module also has 2 binary inputs, however here 4 semi-conductor outputs are available.

6.4.2 MCM-Basis-Module



[tddspjmp-071210-71.tif, 1, en_US]

Figure 6-16 Displays and jumper of the MCM - basis module

The input circuit for the protection commands was taken over from the IFC-D/P modules of the SWT 3000 without any modification. Therefore the same nominal input voltages selectable with jumpers are available. The setting options are shown in the table below.

Table 6-7 Selection of the nominal input voltage for the MCM - basis module

Binary input	220 V	110 V	48/60 V	24 V
BE1	**X11 = inserted** X5 = open X6 = open X7 = open	X11 = open **X5 = inserted** X6 = open X7 = open	X11 = open X5 = open **X6 = inserted** X7 = open	X11 = open X5 = open X6 = open **X7 = inserted**
BE2	**X12 = inserted** X8 = open X9 = open X10 = open	X12 = open **X8 = inserted** X9 = open X10 = open	X12 = open X8 = open **X9 = inserted** X10 = open	X12 = open X8 = open X9 = open **X10 = inserted**

Additionally a hardware debounce time can be adjusted for each binary input. The jumper settings are shown in the table below.

Table 6-8 Selection of the HW debounce time

Binary input	HW debounce time 0.6 ms	HW debounce time 1 ms
BE1	X3 Pos. 1-2 *)	X3 Pos. 2-3
BE2	X4 Pos. 1-2 *)	X4 Pos. 2-3

*) default setting

Displays

The LED H1 up to H10 have the following signification:

Table 6-9 Signification of the LED H1 up to H10 on the MCM basis module

LED	Color	Signification
H1	Green	Binary input 1 activated
H2	Green	Binary input 2 activated
H3	Green	Binary input 3 activated
H4	Green	Binary input 4 activated
H5	Red	Binary output 1 activated
H6	Red	Binary output 2 activated
H7	Red	Binary output 3 activated
H8	Red	Binary output 4 activated
H9	Green	P12 V existing
H10	Red	Test mode

Test Mode

With the adjustment Test mode <IFC-Test> in the service program, it is possible to switch over into the test mode. In this operating mode commands can be activated on the MCM module by means of the DIL switches S1.1 up to S1.4 for each binary input. The activated test mode is indicated with the LED H10 "red".

NOTE

For security reasons all inputs are reported from the controller as „Off" independent from the actual switch position after switching over into the test mode. The „On" condition can be achieved only by turning all switches into the „**Open**" position and after that into the „Close" position.

Connector Assignment of the MCM Basis Module

The assignment of the 12-pol power connector X1 is shown in the table below:

Table 6-10 Connector assignment of the MCM - basis module

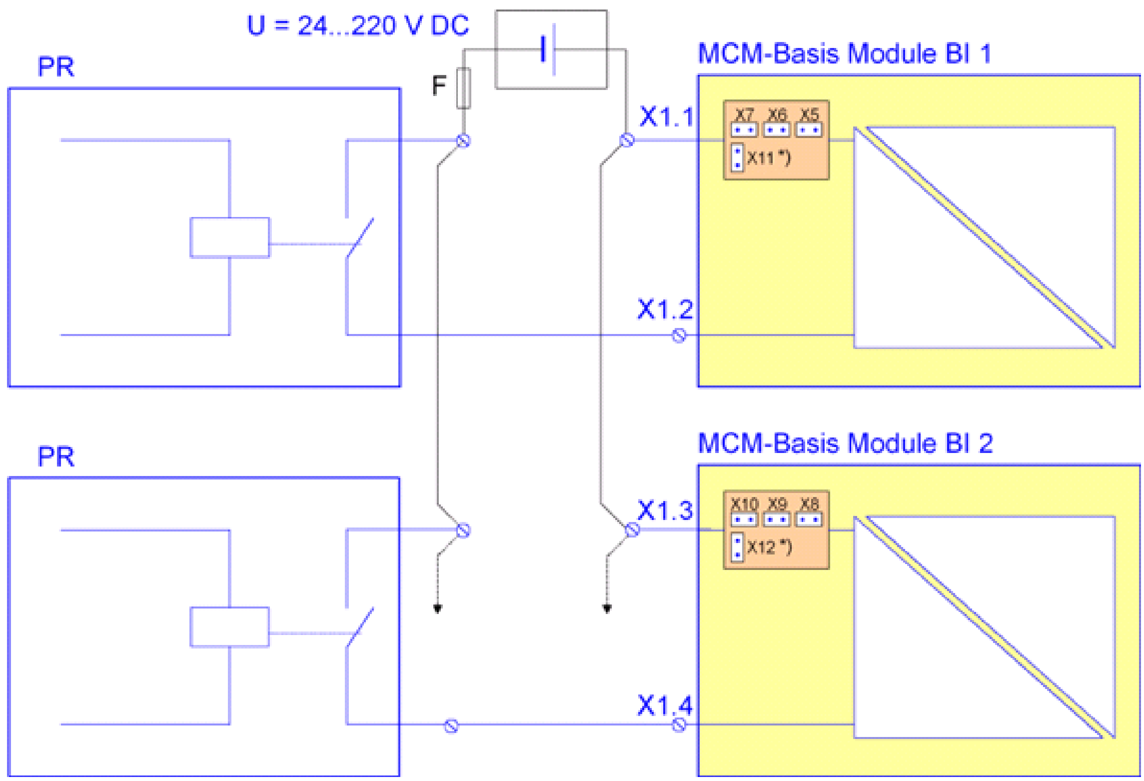
Pin	Signal name	Signification
1	BEX1_A *)	Binary input 1
2	BEX1_B	
3	BEX2_A	Binary input 2
4	BEX2_B	
5	BAX1_A	Relay output 1
6	BAX1_B	
7	BAX2_A	Relay output 2
8	BAX2_B	
9	BAX3_A	Relay output 3

Pin	Signal name	Signification
10	BAX3_B	
11	BAX4_A	Relay output 4
12	BAX4_B	

*) X = 1 to 6

Connection of the Protection Relay

The connection principle of the protection relay to the MCM basis module is shown in the figure below:



[cdconprc-071210-72.tif, 1, en_US]

Figure 6-17 Connection principle of the MCM - basis module

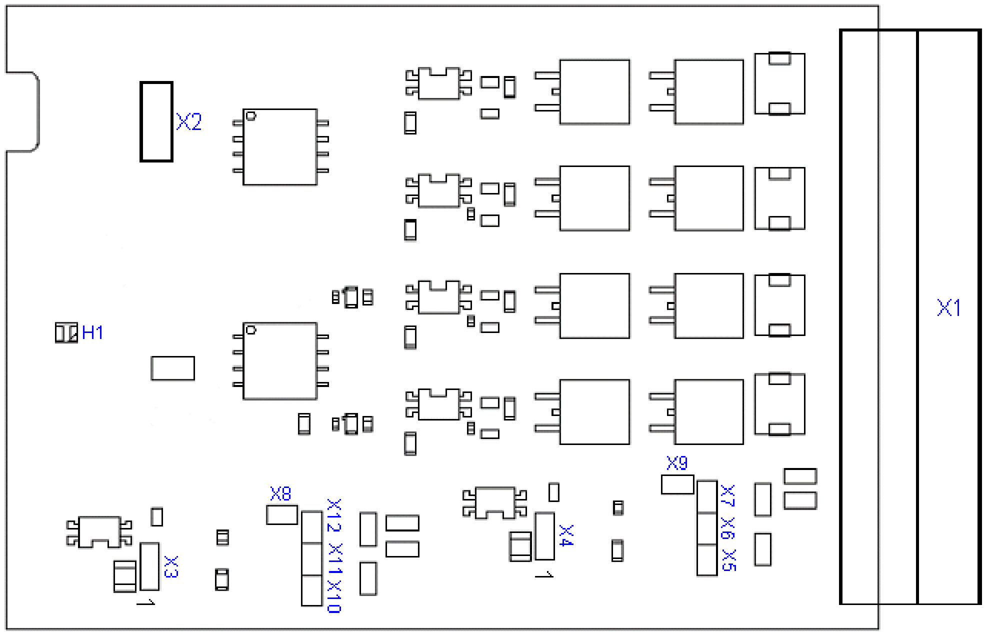
PR	protection relay contact
F	fuse
*)	default setting of the MCM jumper

In order to avoid interference on the cables between the protection relays and the interface cards we strongly recommend the following measures:

- Use shielded cables. Usually the cable shield should be grounded on both ends. However if the cables are very long and the ground potentials at both ends of the cable are different, it is advisable to ground the shield only on one cable end (preferably at the PLC side) to avoid high transients in case of short circuit currents.
- Use twisted pair wires.
- Avoid parallel laying with power cables in the same duct.
- Cable shall be min. 2 kV proved screen/wire/ and wire/wire.

We recommend the distance between the protection relay and the SWT 3000 as short as possible. The typical distance is about 30 m. However also distances of up to 300 m are in service without problems.

6.4.3 MCM-Sub-Module



[tddspjps-071210-73.tif, 1, en_US]

Figure 6-18 Displays and jumper of the MCM - Sub Module

The nominal voltage for the binary inputs can be adjusted with jumpers. The setting options are shown in the table below.

Table 6-11 Selection of the nominal input voltage for the MCM - Sub Module

Binary input	220 V	110 V	48/60 V	24 V
BE3	**X8 =inserted** X10 = open X11 = open X12 = open	X8 = open **X10 = inserted** X11 = open X12 = open	X8 = open X10 = open **X11 = inserted** X12 = open	X8 = open X10 = open X11 = open **X12 = inserted**
BE4	**X9 = inserted** X5 = open X6 = open X7 = open	X9 = open **X5 = inserted** X6 = open X7 = open	X9 = open X5 = open **X6 = inserted** X7 = open	X9 = open X5 = open X6 = open **X7 = inserted**

Additionally a hardware debounce time can be adjusted for each binary input. The jumper settings are shown in the table below.

Table 6-12 Selection of the HW debounce time

Binary input	HW debounce time 0.6 ms	HW debounce time 1 ms
BE3	X3 Pos. 1-2 *)	X3 Pos. 2-3
BE4	X4 Pos. 1-2 *)	X4 Pos. 2-3

*) default setting

Displays

The LED H1 has the following signification

Table 6-13 Signification of the LED H1 on the MCM - Sub Module

LED	Color	Signification
H1	Green	P12 V existing

Connector Assignment of the MCM Sub-Module

The assignment of the 12-pol power connector X1 is shown in the table below

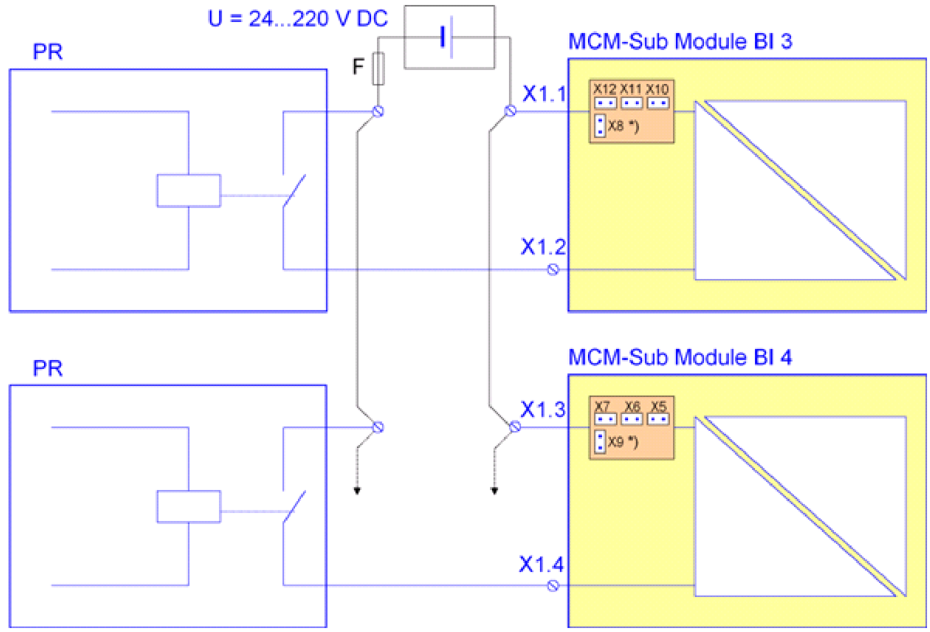
Table 6-14 Connector assignment of the MCM - Sub Module

Pin	Signal name	Signification
1	BEX3_A *)	Binary input 3
2	BEX3_B	
3	BEX4_A	Binary input 4
4	BEX4_B	
5	BAX1_A	Semi-conductor output 1
6	BAX1_B	
7	BAX2_A	Semi-conductor output 2
8	BAX2_B	
9	BAX3_A	Semi-conductor output 3
10	BAX3_B	
11	BAX4_A	Semi-conductor output 4
12	BAX4_B	

*) X = 1 to 6

Connection of the Protection Relay

The connection principle of the protection relay to the MCM sub module is shown in the figure below. Please refer also to the recommended measures in the section*Connection of the Protection Relay*



[cdcprmsm-071210-74.tif, 1, en_US]

Figure 6-19 Connection principle of the MCM - Sub Module

PR	protection relay contact
F	fuse
*)	default setting of the MCM jumper

6.5 Equipment Configuration

6.5.1 MCM Transmission with Voice

System configuration

The module for connecting the voice channel is selected with VFx-1. For the iSWT the connection via CSPi has to be selected.

NOTE

For detailed information concerning the VFx modules and settings for the voice transmission refer to Chapter *Commissioning* in this manual.

HF configuration

In the HF configuration form the HF-bandwidth, the frequency grid, the transmit resp. receive frequency and the frequency order has to be defined.

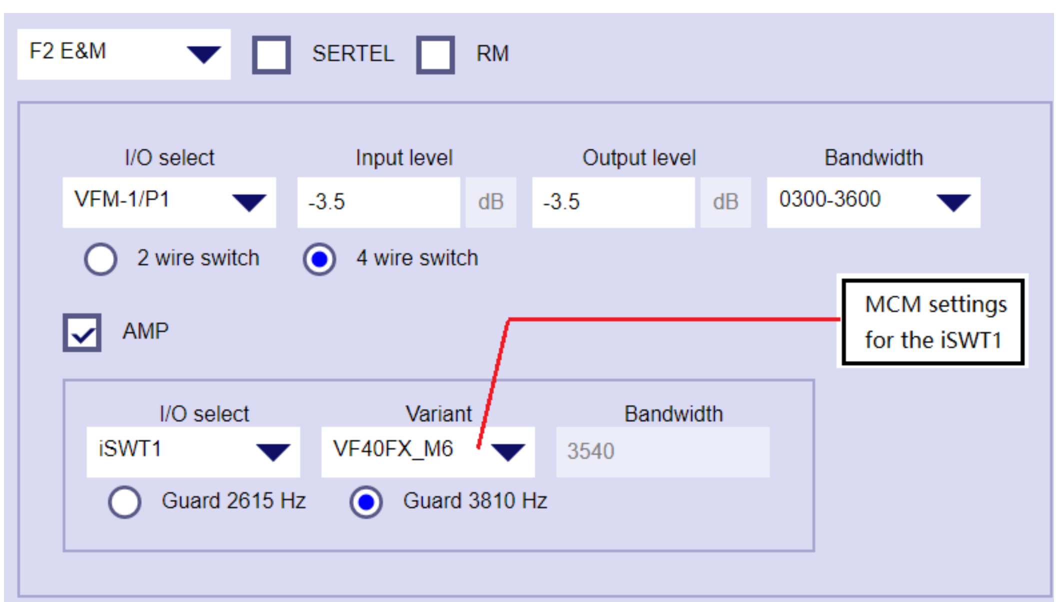
NOTE

For detailed information refer to Chapter *Commissioning* in this manual.

MCM service configuration

In the PowerLink service configuration form first the type of the voice channel E&M, subscriber resp. office (depending on the VFx module) has to be defined in service 1.

Then the AMP mode with the integrated iSWT 3000 in position A (iSWT1) has to be selected. For the MCM transmission the **F6 guard must be 3810 Hz**. After that the frequency variant for the MCM transmission mode VF40FX_M6 is available and has to be configured.



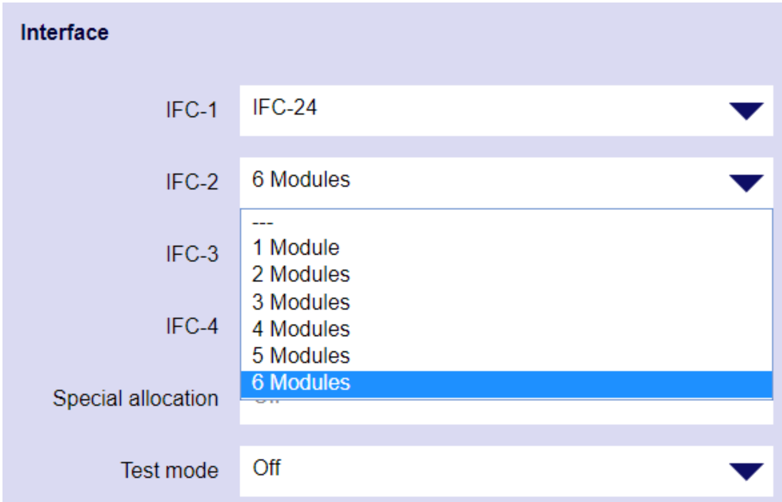
[sc_example_mcm_voice, 1, --_--]

Figure 6-20 Service configuration for the MCM transmission with voice (example)

System configuration of the iSWT 3000

For the MCM function the operation mode 6 has to be adjusted. Using an analog equipment the frequency variant VF40FX_M6 must be used.

iSWT 30000 configuration interface



[sc_example_iswt_mcm_interface, 1, --_--]

Figure 6-21 Interface configuration for the iSWT 3000 with MCM-Function

In this form the interface modules have to be configured. For the MCM function the IFC1 type must be IFC-24. The number of IFC-MCM modules depends on the number of commands which have to be transmitted. Max. 6 modules can be set.

Also the enabling of the function Supervision Command is done within this form.

NOTE

Inputs of additional configured MCM modules are not automatically enabled and must be enabled manually because the priority has to be selected!

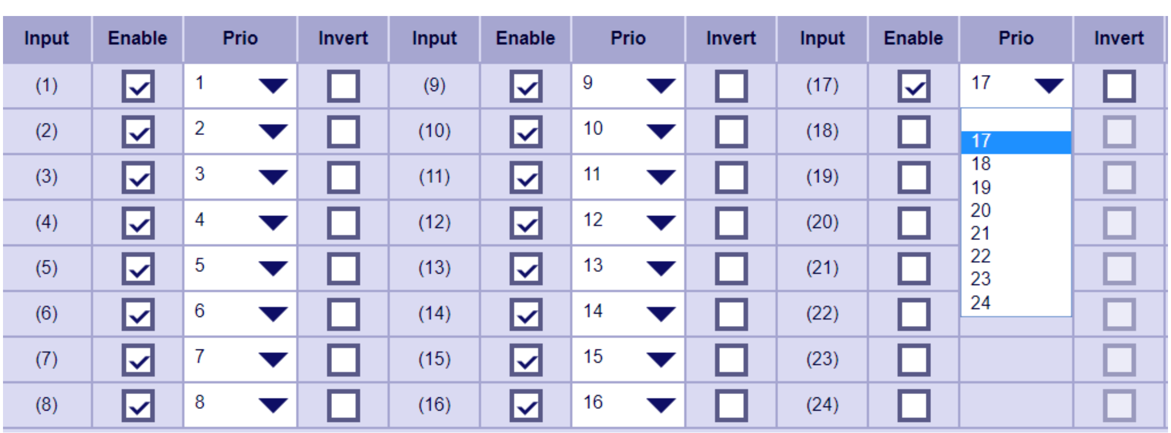
In case of enabling Supervision Command the last available command is automatically fixed to priority 24.

Input configuration

In the input configuration form the available inputs have to be enabled and the assignment of the inputs to the individual priority stage is carried out. For each priority stage **only one** input can be assigned. With selecting the default button an one-to-one assignment is set.

With selecting the dear button all assigned priority stages are cleared.

In case of using Supervision Command, the fixed priority of the Supervision Command is not cleared.



[sc_priority_command_input, 1, --_--]

Figure 6-22 Priority selection for the command inputs

Timer configuration for command input

In the MCM mode the adjustment for the limitation of input commands as well as the adjustment for the input command extension is not adjustable because the duration of the command transmission is fixed to 50 ms.

Pulse Suppression

With Command Input-2 a pulse suppression in the range 0 to 100 ms in steps of 1 ms can be adjusted for each released binary input.

Output Allocation

In the **operation mode 6 MCM** it is possible to assign each trip frequency to **one** command output (Output 1 up to Output 24 depending on the number of MCM modules) on the receive side. A **predefined** assignment can be loaded with **<Default>**. All settings are deleted with **<Clear>**.

Cmd	Connect	Output	Cmd	Connect	Output	Cmd	Connect	Output
(1)	☑	1 ▼	(9)	☑	9 ▼	(17)	☑	17 ▼
(2)	☑	2 ▼	(10)	☑	10 ▼	(18)	☑	18 ▼
(3)	☑	3 ▼	(11)	☑	11 ▼	(19)	☑	19 ▼
(4)	☑	4 ▼	(12)	☑	12 ▼	(20)	☑	20 ▼
(5)	☑	5 ▼	(13)	☑	13 ▼	(21)	☑	21 ▼
(6)	☑	6 ▼	(14)	☑	14 ▼	(22)	☑	22 ▼
(7)	☑	7 ▼	(15)	☑	15 ▼	(23)	☑	23 ▼
(8)	☑	8 ▼	(16)	☑	16 ▼	(24)	☑	24 ▼

[sc_iswt_output_selection_mcm, 1, --_--]

Figure 6-23 iSWT 3000 output selection for the MCM function

Limitation of Command Output

The limitation of command output is in the MCM function not available.

Output Command Extension

At receive side:

- Each MCM command output time can be extended individually in the range from 0 up to 500 ms in steps of 5 ms
- The Supervision Command output time can be extended in the range from 0 up to 2000 ms, also in steps of 5 ms.

The output duration for a command at the receive side is equal to the transmission time plus the output extension time.
Each command output time can be extended in the range from 0 up to 500 ms in steps of 5 ms.

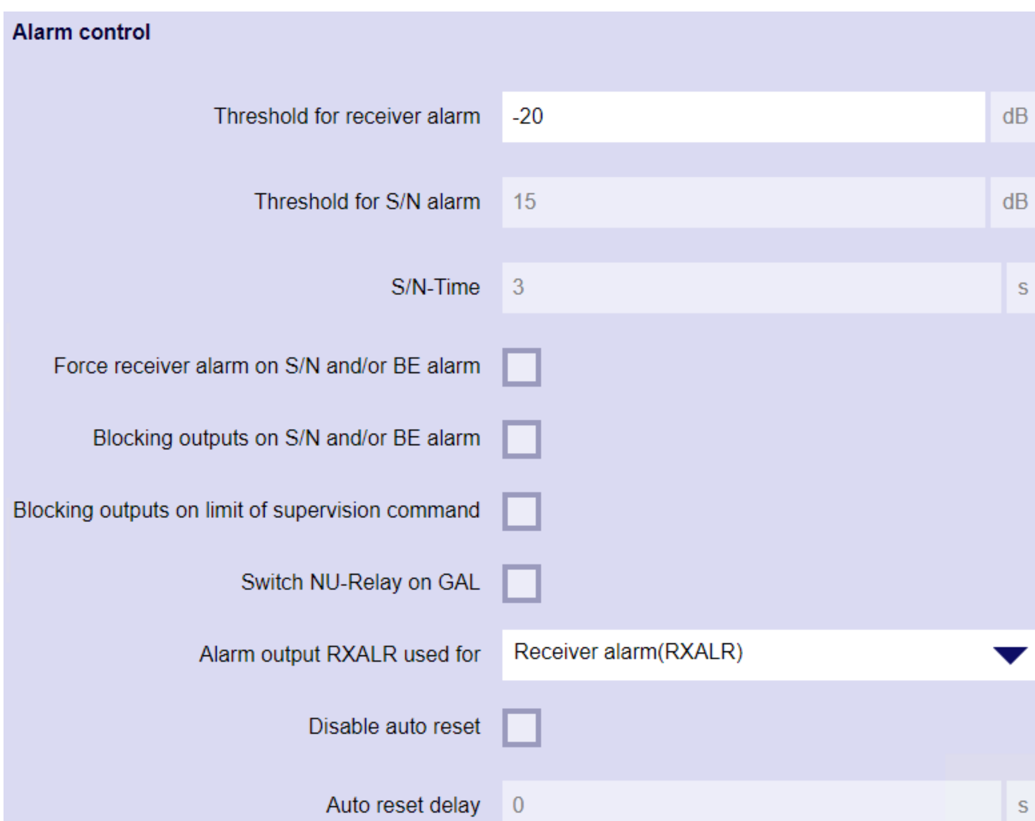
Setting Options for the iSWT 3000 <Timer Configuration>

Table 6-15 Settings of the SWT 3000 timer configuration

Selection	Settings	Remarks
Duration of unblocking impulse	30 to 300 ms in steps of 10 ms	Note: This function is not adjustable for the MCM mode!
Delay of unblocking impulse	10 to 100 ms in steps of 1 ms	Note: This function is not adjustable for the MCM mode!

Selection	Settings	Remarks
Delay of receiver alarm	0 to 2000 ms in steps of 50 ms	Delay time before output of the receiver alarm via relay.
Delay of S/N alarm	0 to 2000 ms in steps of 50 ms	Delay time before output of the S/N alarm via relay.
Transmit Duration (Only when switching functions in the system configuration or MCM is parameterized.)	50 to 100 ms in steps of 5 ms	Transmission time of each activated single command.
Supervision duration of transmission	5 to 30 s in steps of 1 s	Supervision time for the transmission of all MCM commands in the transmit buffer. Exceeding the adjusted value is causing Tx alarm and switches the transmission back from command transmission to normal operation. The Supervision Command transmission time is not included in this evaluation.
Limit of Supervision command	0 to 15 s in steps of 1 s	Supervision time for the transmission of the Supervision Command. Exceeding the adjusted value is causing an non-urgent alarm. If the option “Blocking Outputs on Limit of Supervision Command” is active, the transmission of the Supervision Command is also stopped. 0 means no limitation.

Setting Options for the iSWT 3000 <Alarms>



[sc_iswt_alarm_settings, 1, --_--]

Figure 6-24 The iSWT 3000 alarm settings

Table 6-16 Setting options for the iSWT 3000 alarm settings

Selection	Setting options	Comments
Threshold for receive level alarm	-30 to -10 dB in steps of 5 dB	When the PU4 input level drops about the adjusted value, this is causing receive alarm
Threshold for S/N alarm	-20 to -10 dB in steps of 5 dB	Note: This function is not adjustable for the MCM mode!
S/N Time	1 up to 30 sec in steps of 1 sec	Note: This function is not adjustable for the MCM mode!
Force receiver alarm on S/N and/or BE alarm	☑	Note: This function is not adjustable for the MCM mode!
	☐	
Blocking outputs on S/N and/or BE alarm		Note: This function is not adjustable for the MCM mode!
Blocking outputs on Limit of Super-vision Command	☑	In addition to the non urgent alarm caused by exceeding the adjusted value of Supervi-sion Command the transmission of the of the Supervision Command is stopped.
	☐	Supervision Command transmission not influenced by the Limit of Supervision Command.
Switch NU-Relays on GAL		Note: This function is not adjustable for the MCM mode!
Alarm output EALR used for	Receive Alarm (EALR)	Default setting
The output EALR can be allo-cated to an alarm output in the alarm configuration (refer to chapter *Commissioning, Alarm Relays*).	unblocking (UNBL)	Note: This function is not adjustable for the MCM mode!
		Note: This function is not adjustable for the MCM mode!
	input limitation alarm (INPLIM)	Limit of Supervision Command alarm given to the alarm relay

6.5.2 MCM Transmission with Data Pump

System Configuration

MCM transmission with the Data Pump doesn’t require a VFx module. Therefore only the iSWT 3000, the ALR module(s) and the PLPA have to be adjusted in the system configuration.

HF Configuration

In the HF configuration form the HF-bandwidth, the frequency grid, the transmit resp. receive frequency and the frequency order has to be defined.

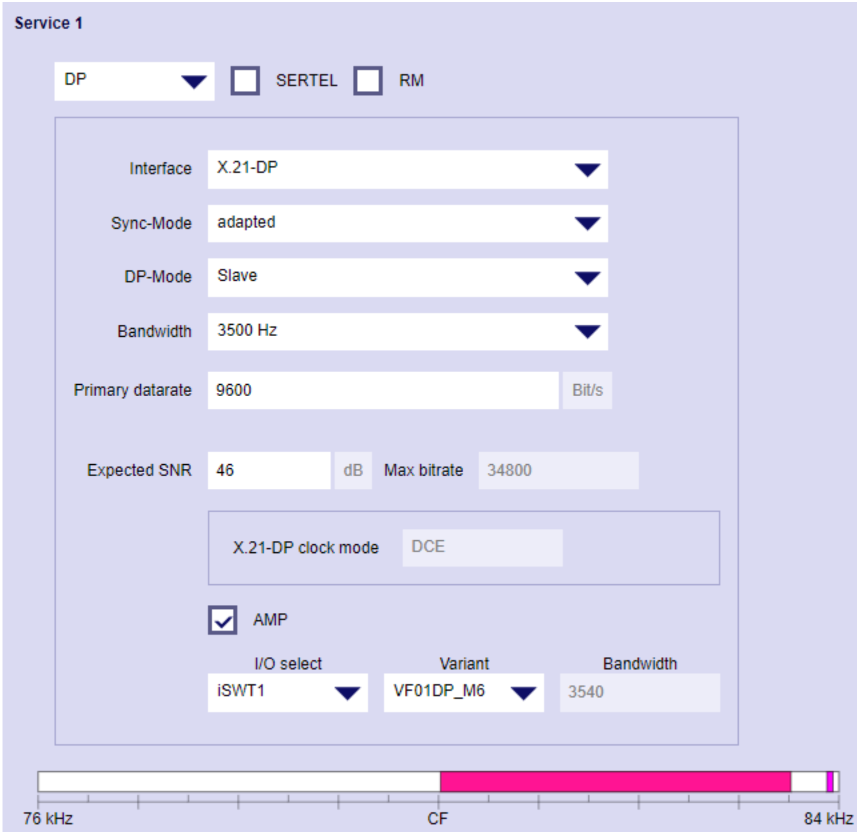
NOTE

For detailed information refer to Chapter *Commissioning*.

Service Configuration MCM with Data Pump

In the PowerLink service configuration form the Data Pump (DP) has to be defined in service 1. MCM is available for the Data Pump bandwidth 3.5 kHz and 7.5 kHz.

The AMP mode with the integrated iSWT 3000 in position A (iSWT 3000-1) has to be selected. For the MCM transmission the VF01DP_M6 variant has to be configured for the DP bandwidths 3.5 kHz resp. VF02DP_M6 for the DP bandwidth 7.5 kHz.



[sc_example_mcm_amp_dp, 1, --_--]

Figure 6-25 MCM transmission with AMP operation and Data Pump (example)

NOTE

The further settings for the Data Pump are described in chapter *Commissioning*.

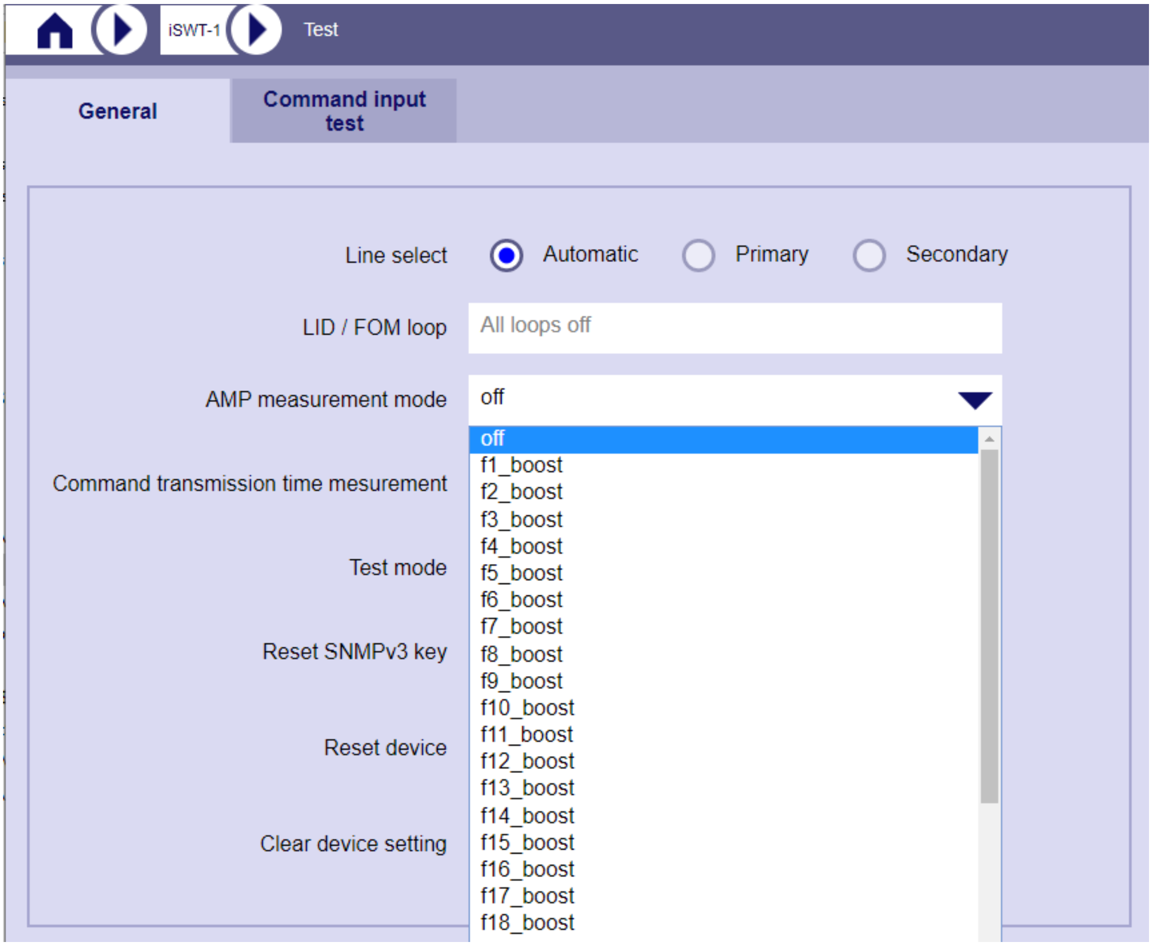
System Configuration of the iSWT 3000

The settings for the iSWT 3000 configuration are the same like described for the transmission with a voice channel (refer to *System Configuration of the iSWT*) except for the frequency variant which has to be adjusted to VF01DP_M6 for the DP bandwidths 3.5 kHz resp. VF02DP_M6 for the DP bandwidth 7.5 kHz.

6.5.3 Measuring Mode M6 Meas

Using the VF40X_M6 resp. VF0xDP_M6 frequency variant, the guard of the iSWT 3000 is not transmitted. A trip frequency is only transmitted for 50 ms when a binary input is energized.

For the purpose of level measurement it is possible to switch the guard resp. each trip frequency of the iSWT 3000 to boost operation by selecting the corresponding M6 measuring mode (M6 Meas) in the PowerLink For the purpose of level measurement it is possible to switch the guard resp. each trip frequency of the iSWT to boost operation by selecting the corresponding M6 measuring mode (M6 Meas) in <**iSWT-x - Test**> form shown in the figure below.



[sc_mm_trip_frequencies, 1, --_--]

Figure 6-26   Selecting the trip frequencies for the measuring mode

NOTE

To prevent an unintended command output at the remote station, the PowerLink equipment must be connected to the dummy load when operating the measuring mode of the **trip** frequencies.

The corresponding trip frequencies and its transmit levels are displayed in <**Service**>.

NOTE

The frequencies can be measured **only** in the HF range at the CSPi resp. PLPA output!

System pilot (-) 79510 Hz -23.0 dB System pilot(+) 79570 Hz -23.0 dB

Service 1 | Service 2 | Service 3 | Service 4

F2 E&M	VF-Input	VF-Level	HF (Tx)	HF-Level CSPi	HF-Level Out
	800 Hz	-3.5 dB	76560 Hz	-23.0 dB	27.5 dB
PILOT -			79510 Hz	-23.0 dB	27.5 dB
PILOT +			79570 Hz	-23.0 dB	27.5 dB
int.F6	VF40FX_M6				
Guard:	3789 Hz		79570 Hz	-23.0 dB	27.5 dB
Fs:	475 Hz		76256 Hz	-17.0 dB	33.5 dB
F1:	3506 Hz		79287 Hz	-17.0 dB	33.5 dB
F2:	3380 Hz		79161 Hz	-17.0 dB	33.5 dB
F3:	3254 Hz		79035 Hz	-17.0 dB	33.5 dB
F4:	3127 Hz		78908 Hz	-17.0 dB	33.5 dB
F5:	3001 Hz		78782 Hz	-17.0 dB	33.5 dB
F6:	2875 Hz		78656 Hz	-17.0 dB	33.5 dB
F7:	2748 Hz		78529 Hz	-17.0 dB	33.5 dB

[sc_example_mcm_trip_amp_voice, 1, --_--]

Figure 6-27 Example of the MCM trip frequencies in the AMP operation with voice

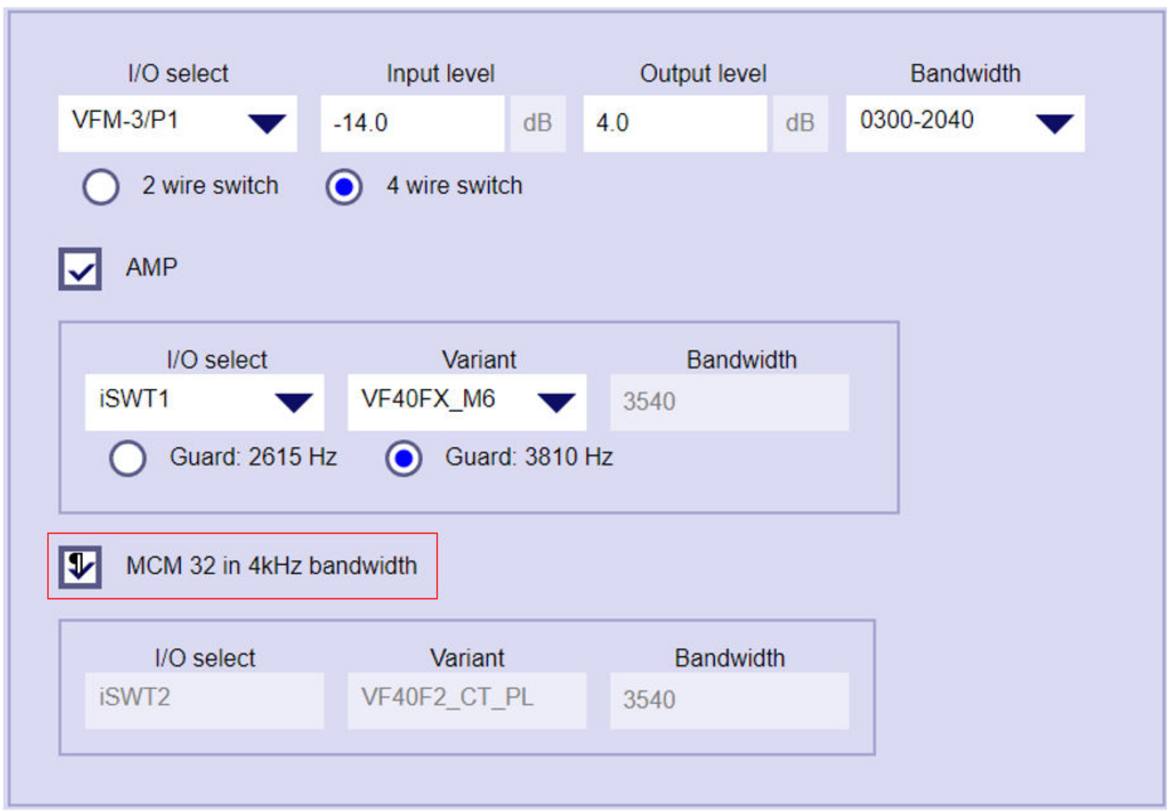
6.6 MCM 32

6.6.1 MCM 32 in 4 kHz bandwidth

The MCM multi command mode supports up to 32 tele-protection commands via 2 iSWT units operating in alternative multi purpose of same F2 or DP service. The major features if MCM 32 enabled:

- 24 Emergency automation signals from iSWT-1 with Mode 6
- 8 Relay protection commands from iSWT-2 with Mode 7a
- Mode 7a uses coded tripping frequency for up to 8 independent commands
- Mode 6 uses un-coded tripping frequency for up to 24 priority commands
- Both iSWT units share the same HF bandwidth, and Mode 7a has higher priority to interrupt the transmission of Mode 6
  The guard signal will be transmitted for at least 50 ms after a mode 7a command transmission.
- F2 or DP service data are interrupted for a short period of command transmission

Example configurations for MCM 32 in F2 or DP service:



[sc_mcm32_example, 1, --_--]

	MCM 32 in F2	MCM 32 in DP
System		
iSWT-1	via CSPi	
iSWT-2	via CSPi or FOM	
HF		
HF bandwidth	4 kHz	

	MCM 32 in F2	MCM 32 in DP
Service		
Service type 1	F2	DP
AMP	Checked	
I/O select	iSWT-1	
Guard	3810 Hz	
Variant	VF40FX_M6	VF01DP_M6
MCM in 32 kHz bandwidth	Checked	
I/O select	iSWT-2	
Variant	VF40F2_CT_PL	VF40_CT_PL
Service type 4	Occupied to store iSWT-2 unit data	
iSWT-1		
Operation mode	Mode 6 (MCM)	
IFC-1	IFC-24	
IFC-2	6 Modules	
iSWT-2		
Operation mode	Mode 7a (8iC)	
IFC-1	IFC-D/P	
IFC-2	IFC-D/P	

The service type 4 is occupied to store iSWT-2 unit data and cannot be configured for other service. In the service information view, Mode 7a command frequency and leveling are displayed in service 4.

7 Planning Guide

7.1 Overview

The instruction provides information for the sales department planning PowerLink connections with the following topics:

- Frequency planning
- Transmission range
- HF bandwidth
- Services transmitted in the PowerLink
- Noise level and calculation of the signal to noise ratio (SNR)

2 examples for a PowerLink with digital resp. analog interfaces show step by step the power calculation and the calculation of the SNR.

In a final step the program **PowerCalc_xx_xx.xls**, part of the PowerSys software package, is introduced including an operating instruction and calculating examples.

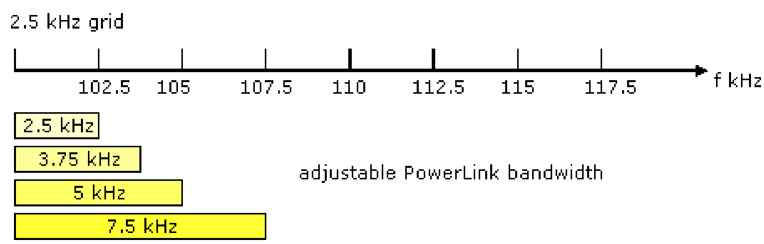
7.2 Frequency Planning

7.2.1 General Information

The utilizable frequency range for the carrier transmission over high voltage lines (PLC) is from 24 kHz to 1000 kHz. In many countries due to various conditions, certain frequency ranges are reserved for air traffic control, shipping radio service etc.

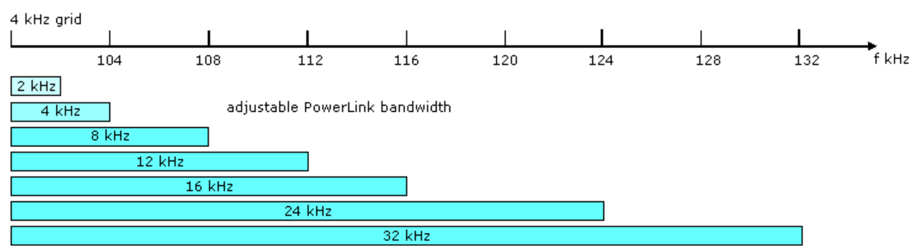
The frequency range is subdivided in frequency spaces with gross bandwidth B of 2.5 kHz or 4 kHz. At the occupancy of frequency spaces only gross bandwidth of 2.5 resp. 4 kHz or multiple of that may be used.

HF Bandwidth



[dwadjb2k-031210-01.tif, 1, en_US]

Figure 7-1 Adjustable bandwidth for the 2.5-kHz grid



[dwadjb4g-031210-01.tif, 1, en_US]

Figure 7-2 Adjustable bandwidth for the 4-kHz grid

Adjacent or Non-Adjacent Bands

Depending on the frequency gap between the Tx and Rx frequency band, this is considered as an adjacent or non-adjacent transmission.

[dwnadjfb-061210-01.tif, 1, en_US]

Figure 7-3 Non-adjacent frequency bands

[dwadjfrb-061210-01.tif, 1, en_US]

Figure 7-4 Adjacent frequency bands

7.2.2 Frequency Plan

The frequency plan determines the proper frequency allocation for each PLC link in the frequency scheme to avoid cross talk between any PLC links installed in the network. Cross talk affects speech, data, and protection signaling signals.

7.2.3 Planning Rules

Minimum Space Within the Same Terminal

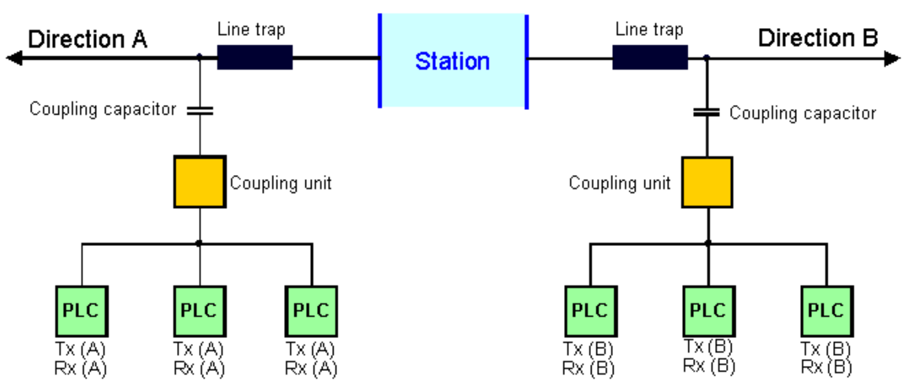
In principle the space between the Tx and Rx band is free selectable. However it is recommended to select non adjacent. If this is not possible, use adjacent mode without any space. For more details about adjacent and non- adjacent mode refer to chapter *Commissioning*.

Table 7-1 Min. space between Tx and Rx bands within the same terminal

PowerLink		
	analog	digital
Tx-Rx within the same terminal		
adjacent band	0	0
spaced band	≥1 x B	≥1 x B

B = HF Bandwidth

Minimum Space Between Terminals on the Same Line



[cdplcsys-061210-01.tif, 1, en_US]

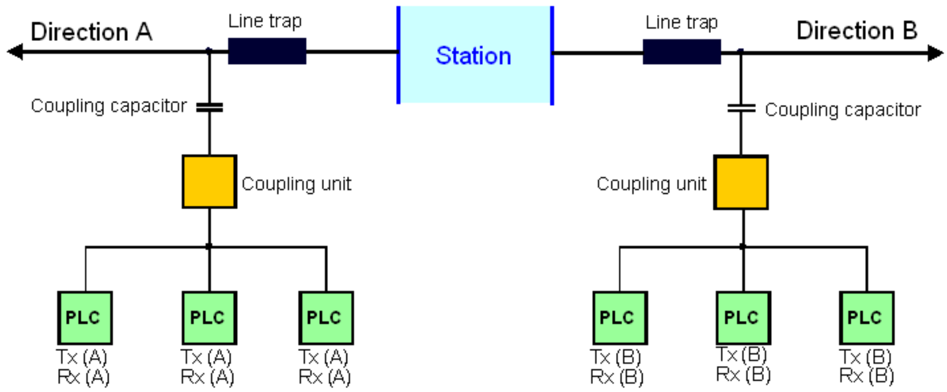
Figure 7-5 PLC systems using the same or different directions

Tx(A) / Rx(A) = PLC Transmitter / Receiver in direction A
Tx(B) / Rx(B) = PLC Transmitter / Receiver in direction B

Table 7-2 Min. space between Tx and Tx bands for PLC systems using the same line

	PowerLink	
	analog	digital
Parallel terminals on the same line		
Tx (A) - Tx (A)	8 kHz	8 kHz
Tx (A) – Rx (A)	8 kHz	8 kHz
Rx (A) – Rx (A)	8 kHz	8 kHz

Minimum Space Between Terminals Using Lines in Different Directions



[cdplcsy2-061210-01.tif, 1, en_US]

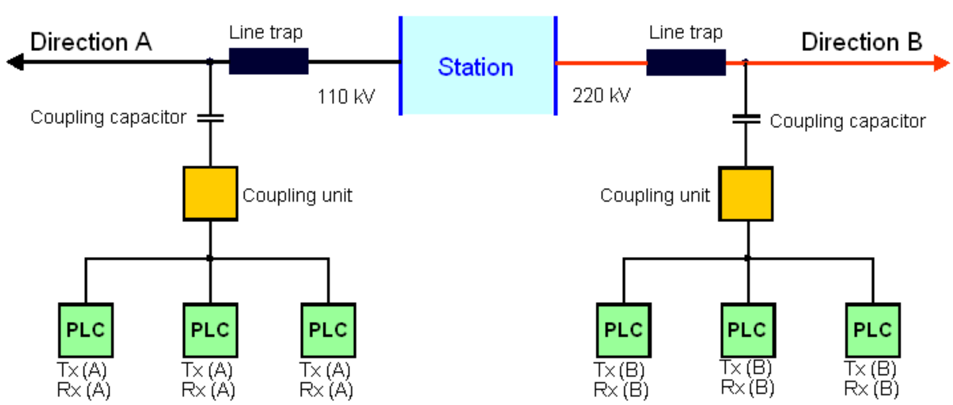
Figure 7-6 PLC systems using the same or different directions

Digital PLC requires special attention for frequency planning, because it utilizes the bandwidth closer to the band limits

Table 7-3 Min. gap between Tx and Tx bands for PLC systems using lines in different directions

PowerLink		
	analog	digital
Same stations line in different directions		
Tx (A) – Tx (B)	0 kHz	4 kHz
Tx (A) – Rx (B)	0 kHz	4 kHz
Rx (A) – Rx (B)	0 kHz	4 kHz
When analog and digital PLC's are mixed, the rules for digital PLC supersede		

Minimum Space Between Terminals Using Lines in Different Directions and Different Voltage Levels



[cdplcsy3-061210-01.tif, 1, en_US]

Figure 7-7 PLC systems using the same or different directions and voltage levels

Table 7-4 Min. space between Tx and Rx bands for PLC systems using different voltage levels

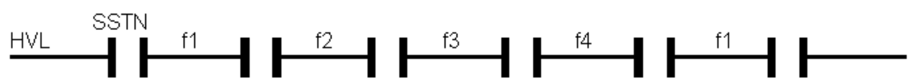
	PowerLink	
	analog	digital
Same station different voltage levels		

	PowerLink	
Lines in different directions		
Tx (A) – Tx (B)	0 kHz	0 kHz
Tx (A) – Rx (B)	0 kHz	0 kHz
Rx (A) – Rx (B)	0 kHz	0 kHz

Re-use of Frequencies

Digital PLC requires special attention for frequency planning, because it utilizes the bandwidth closer to the band limits. Therefore interference from neighboring PLC's have direct impact in the SNR which consequently reduces the transmission capacity.

Due to the same reason for digital PLC links not only 2 adjacent line sections - as in most cases sufficient for analog PLC links (except for very short lines) - but also the 3rd line section has to be considered when re-using a carrier frequency. Very short line sections do not count in full.

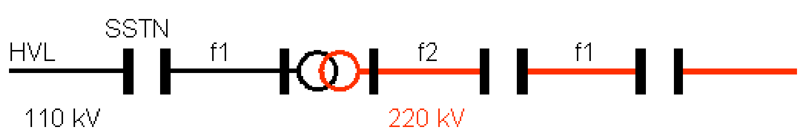


[dwrucf3l-061210-01.tif, 1, en_US]

Figure 7-8 Re-use of the carrier frequency f1 after three line sections

HVL	High voltage line
SSTN	Sub station
f1 to f4	carrier frequencies

In terms of frequency planning a change of the voltage level, for example from 110 kV to 220 kV, is considered like 2 line sections (see figure below). In this case the same frequency can be re-used after 1 line section.



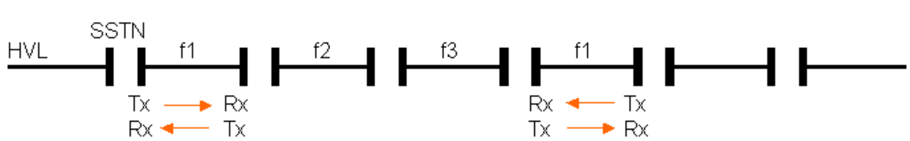
[dwruf1lv-061210-01.tif, 1, en_US]

Figure 7-9 Re-use of the frequency f1 after 1 line section when changing the voltage level

HVL	High voltage line
SSTN	Sub station
f1 to f2	carrier frequencies

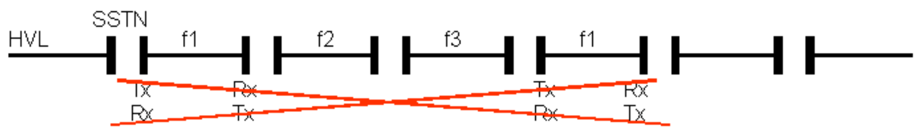
With the following restriction the same frequency can be used again after 2 line sections on the same voltage level:

The **location of Tx and Rx** from the PLC systems shown in the figure below must be observed!



[dwtdrtr2-061210-01.tif, 1, en_US]

Figure 7-10 Transmit direction of Tx and Rx when using the same frequency after 2 line sections



[dwlctrna-061210-01.tif, 1, en_US]

Figure 7-11 This location of Tx and Rx is not allowed when using the same frequency after 2 line sections

Summary Re-use of the Same Frequency

Table 7-5 Summary for repetition of the same frequency

	Siemens		IEC 60663	IEEE 643
	Re-use of the same frequency after			
	analog PLC	digital PLC		
Standard	3 sections	3 sections	2 sections	2 sections
Location of Tx and Rx to be considered	2 sections			
Only if very long line sections are in between and location of Tx, Rx has to be considered		2 sections		
Different voltage level counts as	2 sections	2 sections	2 sections	no info.
Same frequency within a station	no	no	not mentioned	Yes, if cross-station attenua-tion >40 dB

7.2.4 Line Traps

Line traps are connected in series with HV transmission lines. The main function of the line trap is to present a high impedance at the carrier frequency band while introducing negligible impedance at the power frequency. The high impedance limits the attenuation of the carrier signal within the power system by preventing the carrier signal from being:

- Dissipated in the substation
- Grounded in the event of a fault outside the carrier transmission path
- Dissipated in a tap line or a branch of the main transmission path.

Blocking Range of Line Traps

The blocking range of the existing line traps has to be considered when planning new frequencies for an existing line. The PLC channels have to be placed within the blocked bandwidth of the line trap.

The bandwidth of a line trap is that frequency range over which the line trap provides a certain specified minimum blocking impedance or resistance. Minimum blocking resistance should be specified if the potential exists for the reactive component of the line trap impedance to resonate with the substation impedance.

Different types of tuning may be supplied:

Single Frequency Tuning:

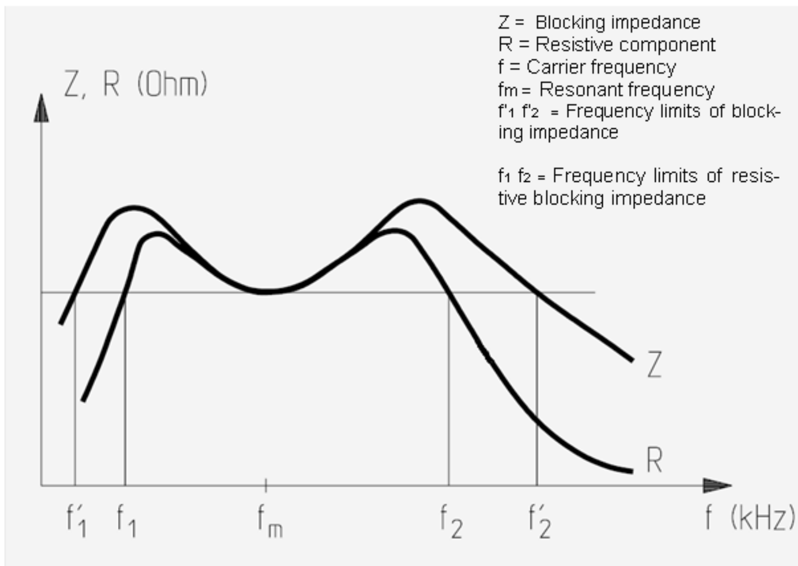
- If narrow blocking bands are required single frequency tuning is the simplest and most economical type of tuning available

Double Frequency Tuning:

- The double frequency tuning arrangement blocks 2 relatively narrow bands of fre-quencies. Otherwise, the blocking characteristic is similar to single frequency tuning.

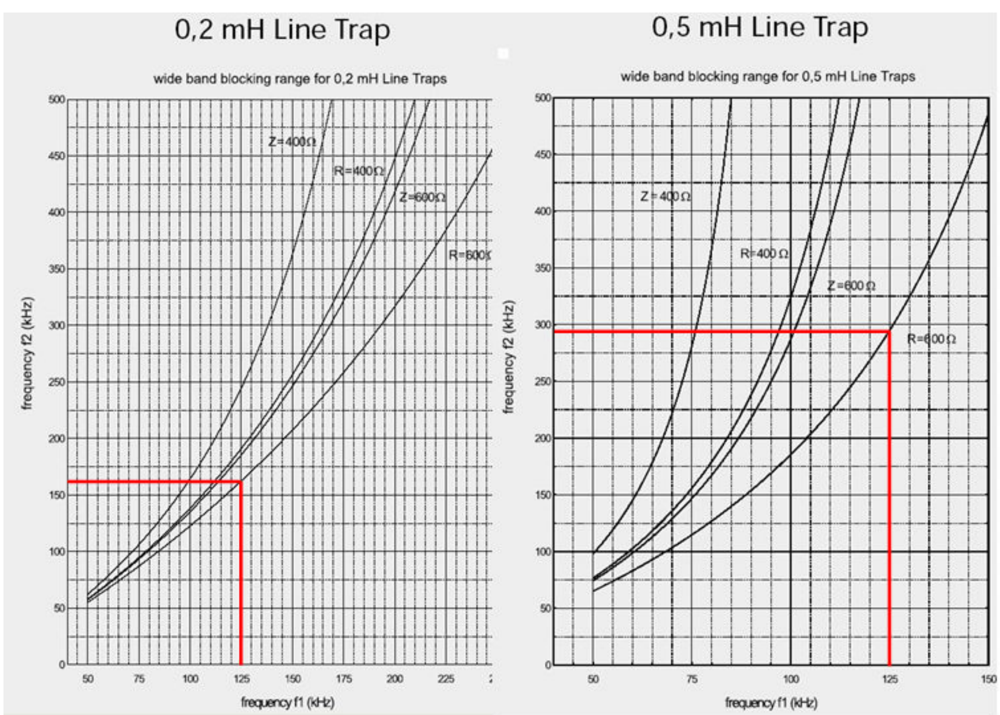
Wideband Tuning:

- Wideband tuning is the most common type of tuning as it efficiently utilizes the main coil inductance. Wideband tuned line traps are suitable for multi-channel applications, since relatively constant impedance is obtained over a broad frequency range. This type of tuning provides high-bandwidth flexibility for future changes or expansion of PLC frequencies. PLC channels can be placed anywhere within the blocked band-width.



[dwwfltbc-061210-01.tif, 1, en_US]

Figure 7-12 Typical wideband frequency line trap blocking characteristic



[dwblrdlt-061210-01.tif, 1, en_US]

Figure 7-13 Blocking range of different line traps (example f1 = 125 kHz)

7.2.5 Summary of the Necessary Information for Frequency Planning:

- Overview of the high voltage network (drawing)
- Frequency grid 2.5 kHz resp. 4 kHz
- Tx frequencies of all existing PLC links
- Through connections of frequencies
- Blocking range of the line traps
- Frequency ranges reserved for air traffic control, shipping radio service etc.
- Bandwidth of the PLC devices

Station Layouts

First of all, station layouts have to be drawn containing the following information:

- All overhead lines connected to this station with voltage level and coupling type
- Entry of the blocking range from the line traps and the existing PLC Tx resp. Rx frequencies for each line.
- Entry of possibly frequency blocking zone reserved for air traffic control, shipping radio service etc.

Line Layouts

For the high voltage lines getting additional resp. new frequencies, line layouts have to be prepared containing the following information:

- Blocking range of the line traps
- Tx frequencies of existing PLC's on this line
- Through connections of frequencies
- Line sections 1 up to 3 from the view of this line with all existing frequencies
- Display of the occupied frequencies

7.2.6 Planning New Frequencies

When planning new frequencies, the min. gap to the existing frequencies on the used line and in line section 1 has to be observed.

The gap and position to the frequencies used in the line sections 2 and 3 is not important. If an analog device is replaced by a digital device the gap to existing PLC's on the same line and in section 1 has to be checked (refer to table *Table 7-3*).

The new frequency may not be used in the line section 1 to 3 drawn in the line layouts. Frequencies which are no longer used have to be canceled.

The new planned frequencies have to be added also to all line layouts containing this line in section 1 to 3 and in to all station layouts.

7.3 Transmission Range

7.3.1 General Information

The maximum transmission range of the PowerLink is the difference between the transmit level PTX and the lowest possible receive level PR_{Xmin}. The attenuation of the transmission path must be lower than this difference.

[dwplctrp-061210-01.tif, 1, en_US]

Figure 7-14 The PLC transmission path

Output Power-Power Line attenuation = Receive Power

The lowest possible receive level PR_{Xmin} depends on the noise level P_{Noise} of the high voltage line and the required signal to noise ratio SNR for the transmitted services. For determining the transmission range, the following information has to be taken into consideration:

- The used HF bandwidth and frequencies of the PowerLink
- The power amplifier (25 W, 50 W, or 100 W)
- The services which have to be transmitted
- The attenuation of the high voltage line
- The expected noise level

7.3.2 Power Amplifier

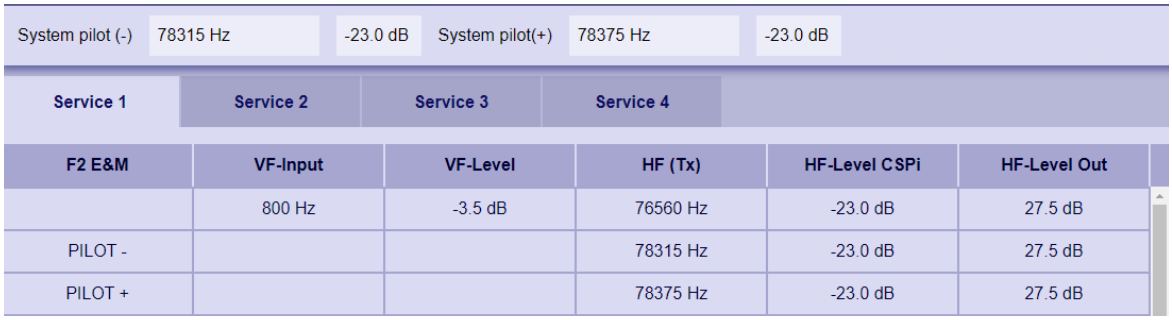
For the PowerLink equipment, transmit amplifiers with 25/50 W and 100 W peak power ratings are available.

The necessary power rate depends on the number and type of services and the min. required receive level. This again depends on the noise level P_{Noise} and the required signal to noise ratio SNR for the transmitted services.

Each additional service which is transmitted, reduces the output power of the PLC system. At the end of this chapter, you'll find the description of the tool "PowerCalc_xx_xx.xls", available on the manual CD. This tool calculates the max. acceptable line attenuation, after entering the services to be transmitted, the power amplifier and the expected noise level.

7.3.3 Services Transmitted in the PowerLink

The max. number of services which can be transmitted in the PowerLink is 4. The available transmitter power is automatically allocated to the different types of signal. The allocation is determined by the noise-bandwidth and the required signal-to-noise ratio of the services. The output level of the CSPi module and the system for each service is shown in <**Service**>.



[sc_example_voice_pilot_level, 1, --_--]

Figure 7-15 Example for the display of the voice and pilot level from a PowerLink system

7.3.4 Power Line Attenuation

For planning PowerLink connections, a careful calculation of the line attenuation is essential. For a correct calculation of the power line, a number of different values are necessary:

- Data of the high voltage line like: Tower, voltage range, length of the line, type of conductors, sag of the line, transpositions etc.
- The PLC frequencies used for transmission and receiving
- The type of the coupling unit: Phase-to-ground, Phase-to-Phase, or Inter-System coupling.
- The conductors used for coupling

Using a computer program is as accurately as possible. The program also helps to determine the useful conductor(s) for connecting the coupling unit(s).

7.3.5 Coupling Units

A phase-to-ground coupling is often used for reasons of cost. This is generally adequate from an engineering viewpoint unless extra-high-voltage lines with a high noise level or long distances are involved. In most line protection applications, however, it is recommended to use a phase-to-phase coupling or intersystem coupling regardless of the higher cost.

Table 7-6 Comparison of the different coupling types

	Coupling type	Financial outlay	Attenuation	Transmission
1	Phase-to-ground coupling	minimal	greater than for 2	not guaranteed if a coupled conductor breaks
2	Phase-to-phase coupling	twice as high as 1	smaller than for 1	possible if a coupled conductor breaks
3	Inter-system coupling	twice as high as 1	smaller than for 1	also possible in case of short circuit or grounding of a system on the line

7.3.6 Noise Level

The noise level should be taken according IEC resp IEEE recommendations for adverse weather, because the transmission line has to be available throughout the whole year.

The noise level depends on the voltage level, the construction of the overhead line and the used frequency. Typical corona noise power levels on 220 kV transmission lines as in IEC 60663 referring to a 4 kHz bandwidth is:

-20 dBm to -10 dBm

The values are given for a 4 kHz bandwidth. For a different bandwidth (BW) of the service a correction P_{cor} has to be added to this level.

$$P_{cor} = 10 * \log (BW [kHz] / 4[kHz])$$

[fo4khzbw-061210-01.tif, 1, en_US]

In case of transmitting via Data Pump the service program PowerSys offers a bit rate estimation which shows the max. bit rate for a given bandwidth and noise level.

7.3.7 Signal-to-Noise Ratio

The signal-to-noise ratio (SNR) is calculated with

$$SNR = \text{Receive level} - \text{noise level}$$

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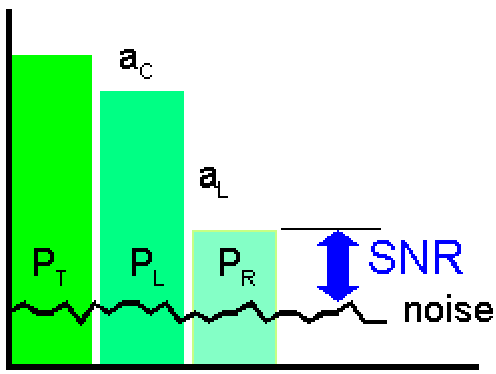


[dwgrsnrc-061210-01.tif, 1, en_US]

Figure 7-16 The calculation of the SNR

PT = Transmit level at the output of the PLC

PL = Transmit level at the coupling point of the line

PR = Receive level

ac = Coupling loss

aL = Line attenuation

7.3.8 Formulas for the Calculation of the Transmission Range and the SNR

Receive level:	$P_R = P_T - a_C - a_L$
Signal to noise ratio:	$SNR = P_R - P_{Noise}$
Minimum receive level:	$P_{Rmin} = P_{Noise} + SNR_{required}$

[foctrsnr-061210-01.tif, 1, en_US]

Subsequently you'll find calculation examples for using the Data Pump resp. for voice and data transmission in the PowerLink.

7.4 Planning Examples

7.4.1 PowerLink with Data Pump

In the following example the PowerLink configuration is a Data Pump with 7.5 kHz bandwidth, and 100 W power amplifier.

The figure below shows the output level of the DP signal generator at the CSPi module

System pilot (-) 83940 Hz -41.9 dB System pilot(+) 83940 Hz -41.9 dB

Service 1 | Service 2 | Service 3 | Service 4

Signalgenerator	VF-Input	VF-Level	HF (Tx)	HF-Level CSPi	HF-Level Out
DP-	510 Hz		80083 Hz		
DP mid	2232 Hz		81805 Hz	-17.5 dB	33.0 dB
DP+	3954 Hz		83527 Hz		

[sc_example_hf-dp, 1, --_--]

Figure 7-17 HF output for a PowerLink system with Data Pump

When using a PLC line equipment (PLE) with a 100 W power amplifier, it results in a transmit volt-age-level at the HF output (75 Ohm) from:

HF-Level Out = 33.0 dB

The QAM signal of the Data Pump has to be calculated 10 dB less and results in 23.0 dB.

The maximum obtainable transmission rate of a Data Pump connection depends on the available bandwidth and the signal-to-noise-ratio (SNR). For SNR calculation, the voltage level must be converted into a power level because the noise levels are also given in power levels.

Power Level

Conversion of the voltage level to a power level:

The power level (reference to 1 mW at 600 Ohm) results from

- Voltage level at 75 Ohm: +9 dB
- Voltage level at 150 Ohm: +6 dB

This results in a power level for the:

- QAM-signal: +39.6 dBm

Coupling Loss

According IEC 60663 an overall loss of 5 dB can be calculated. This results in a power level for the QAM signal at the coupling point of the overhead line from 34.6 dBm.

Max. Possible Transmission Rate

To determine the max. possible transmission rate the signal-to-noise ratio (SNR) must be known. Subsequently the calculation for this example: QAM signal level at the coupling point: 34.6 dBm.

In the next step, an exact calculation of the line attenuation is necessary! In this example, a line attenuation of 12 dB is assumed. This results in a receive level from:

Transmit level minus line attenuation = 34.6 dBm – 12 dB = 22.6 dBm for the DP

[fotlmlat-061210-01.tif, 1, en_US]

In the following table noise levels for different DP bandwidth, voltage levels and carrier frequencies (CF) with adverse weather conditions are shown.

Table 7-7 Noise levels (adverse weather acc. IEEE 643) for different DP Bandwidth part 1

High voltage	CF	DP Bandwidth in kHz adjustable in the PowerLink									
in kV	kHz										
		7.5	7	6.5	5.5	5	4.7	4.5	4	3.7	3.5
110	75	-14.3	-14.6	-14.9	-15.6	-16	-16.3	-16.5	-17	-17.3	-17.6
110	250	-20.3	-20.6	-20.9	-21.6	-22	-22.3	-22.5	-23	-23.3	-23.6
110	500	-22.3	-22.6	-22.9	-23.6	-24	-24.3	-24.5	-25	-25.3	-25.6
230	75	-10.3	-10.6	-10.9	-11.6	-12	-12.3	-12.5	-13	-13.3	-13.6
230	250	-15.3	-15.6	-15.9	-16.6	-17	-17.3	-17.5	-18	-18.3	-18.6
230	500	-17.3	-17.6	-17.9	-18.6	-19	-19.3	-19.5	-20	-20.3	-20.6
400	75	-5.3	-5.6	-5.9	-6.6	-7	-7.3	-7.5	-8	-8.3	-8.6
400	250	-10.3	-10.6	-10.9	-11.6	-12	-12.3	-12.5	-13	-13.3	-13.6
400	500	-12.3	-12.6	-12.9	-13.6	-14	-14.3	-14.5	-15	-15.3	-15.6

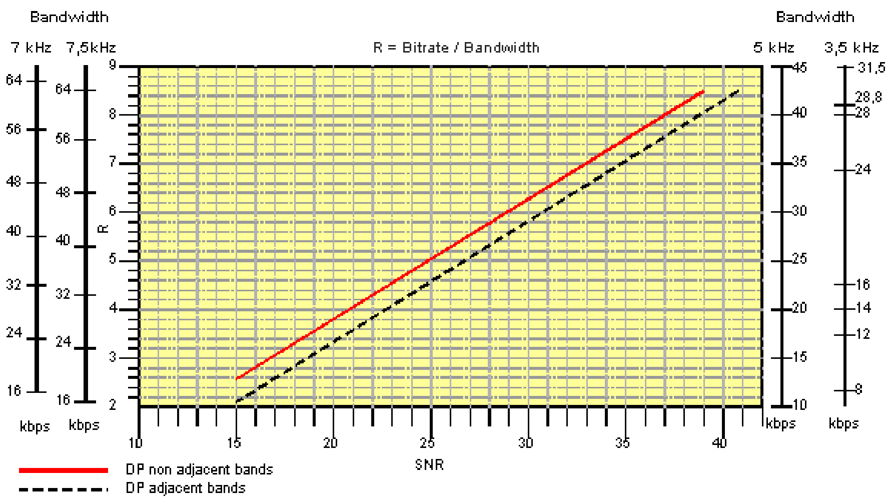
Table 7-8 Noise levels (adverse weather acc. IEEE 643) for different DP Bandwidth part 2

High voltage	CF	DP Bandwidth in kHz adjustable in the PowerLink									
in kV	kHz										
								31.5	23.5	15.5	11.5
110	75							-8.9	-9.3	-11.2	-12.4
110	250							-14	-15.3	-17.4	-18.4
110	500							-16	-17.3	-19.1	-20.4
230	75							-4	-5.3	-7.1	-8.4
230	250							-9	-10.3	-12.1	-13.4
230	500							-11	-12.3	-14.1	-15.4
400	75							-0.9	-0.3	-2.1	-3.4
400	250							-4	-5.3	-7.1	-8.4
400	500							-6	-7.3	-9.1	-10.4

The signal-to-noise ratio (SNR) is calculated with: SNR = receive level minus noise level. In this example, a noise level of -10.3 dBm is assumed. This results in an SNR from:

22.6 dBm – (-10.3 dBm) = 32.9 dBm

The max. possible transmission rate for an SNR from 33 dBm is shown in the drawing below. The required bit rate of 42 000 bps needs an SNR of approx. 27 dB when using **non-adjacent** Tx and Rx bands resp. 29 dB when using adjacent Tx and Rx bands.



[dwdrdpbr-061210-01.tif, 1, en_US]

Figure 7-18 Derivation of the DP bit rate from the bandwidth and the information density

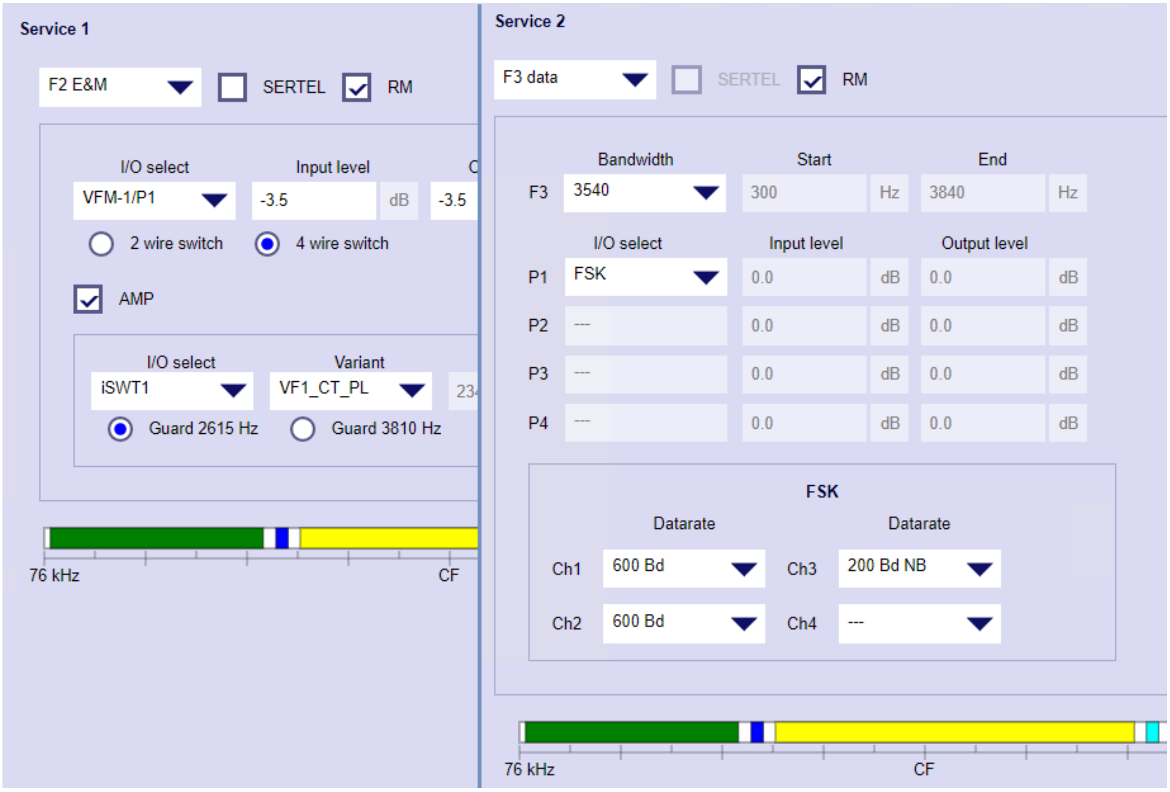
Conclusion: The transmission with the required bit rate can be performed.

7.4.2 PowerLink with Analog Services

The next example shows a PowerLink with the service voice (F2), data transmission (F3) using FSK channels, RM channel and protection signaling in the AMP mode with the service F2. The system has a 50 W amplifier, the line impedance is 75 Ohm.

Service Configuration

The service configuration of the PowerLink is shown in the figure below:



[sc_example_f2_amp_3fsk, 1, --_--]

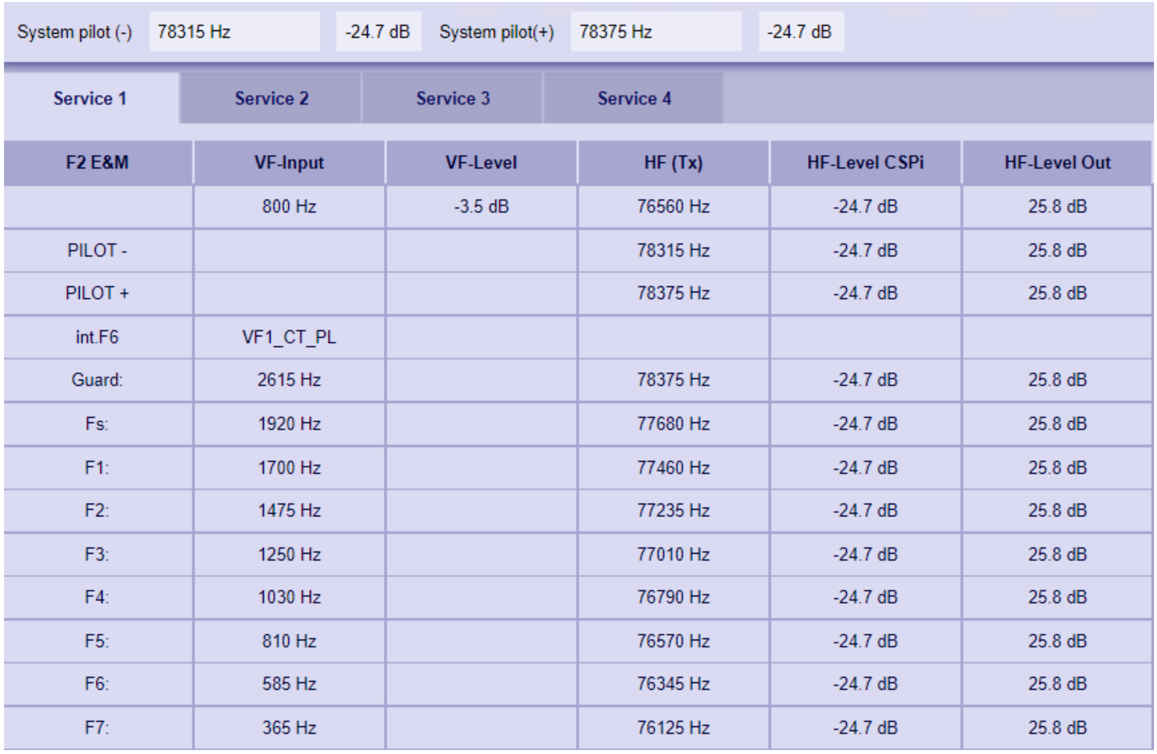
Figure 7-19 Example PowerLink with F2, protection AMP, and 3 FSK data channels

Further particulars:

The required SNR is:	25 dB for voice and 15 dB for data
The total line attenuation including the coupling loss:	17 dB
Noise level for 4 kHz bandwidth:	-20 dBm

Output Level

The transmit levels of voice, pilot, and protection are shown in the figure below



System pilot (-) 78315 Hz -24.7 dB System pilot(+) 78375 Hz -24.7 dB

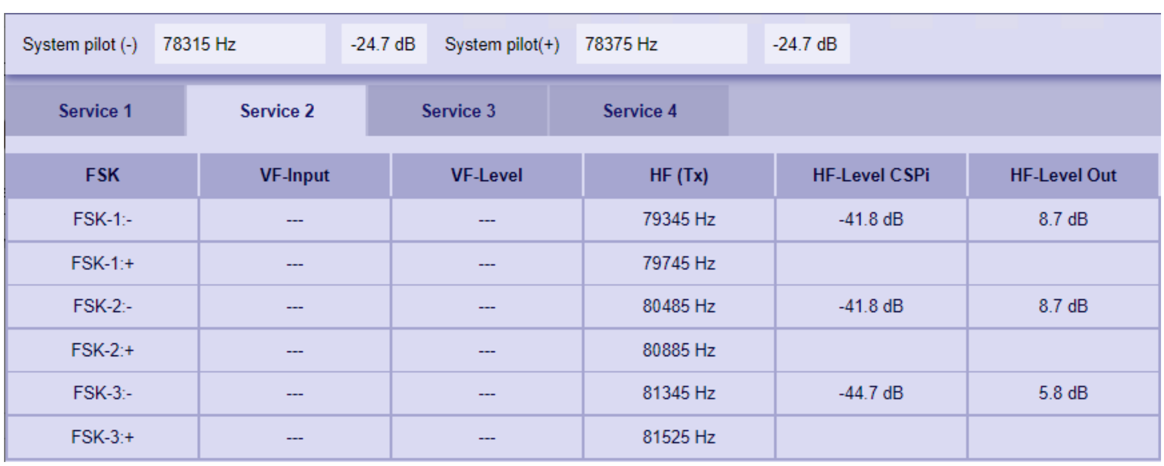
Service 1 | Service 2 | Service 3 | Service 4

F2 E&M	VF-Input	VF-Level	HF (Tx)	HF-Level CSPi	HF-Level Out
	800 Hz	-3.5 dB	76560 Hz	-24.7 dB	25.8 dB
PILOT -			78315 Hz	-24.7 dB	25.8 dB
PILOT +			78375 Hz	-24.7 dB	25.8 dB
int.F6	VF1_CT_PL				
Guard:	2615 Hz		78375 Hz	-24.7 dB	25.8 dB
Fs:	1920 Hz		77680 Hz	-24.7 dB	25.8 dB
F1:	1700 Hz		77460 Hz	-24.7 dB	25.8 dB
F2:	1475 Hz		77235 Hz	-24.7 dB	25.8 dB
F3:	1250 Hz		77010 Hz	-24.7 dB	25.8 dB
F4:	1030 Hz		76790 Hz	-24.7 dB	25.8 dB
F5:	810 Hz		76570 Hz	-24.7 dB	25.8 dB
F6:	585 Hz		76345 Hz	-24.7 dB	25.8 dB
F7:	365 Hz		76125 Hz	-24.7 dB	25.8 dB

[sc_example_hf_voice_pilot_protection, 1, --_--]

Figure 7-20 The HF level CSPi for voice, pilot, and protection

Due to the coded tripping variant the trip frequencies have the same level as voice and pilot
The transmit levels of the FSK channels are shown in the figure below:



System pilot (-) 78315 Hz -24.7 dB System pilot(+) 78375 Hz -24.7 dB

Service 1 | Service 2 | Service 3 | Service 4

FSK	VF-Input	VF-Level	HF (Tx)	HF-Level CSPi	HF-Level Out
FSK-1:-	---	---	79345 Hz	-41.8 dB	8.7 dB
FSK-1:+	---	---	79745 Hz		
FSK-2:-	---	---	80485 Hz	-41.8 dB	8.7 dB
FSK-2:+	---	---	80885 Hz		
FSK-3:-	---	---	81345 Hz	-44.7 dB	5.8 dB
FSK-3:+	---	---	81525 Hz		

[sc_example_hf_fsk, 1, --_--]

Figure 7-21 The HF level CSPi for the FSK channels 600 Bd resp. 200 Bd

For the conversion from voltage to power level 9 dB have to be added. The HF output levels are shown in the table below.

Table 7-9 HF output levels

Service	HF output voltage level dB	HF output power level dBm
F2	30.3	39.3
Sys Pilot	30.3	39.3
Protection trip tone	30.3	39.3

Service	HF output voltage level dB	HF output power level dBm
FSK 600 Bd	13.2	22.2
FSK 200 Bd	10.2	19.2
RM (50 Bd)	4.3	13.3

Receive Level

For calculating the receive level for the services a total line attenuation of 17 dB is assumed. The receive levels are shown in the table below.

Table 7-10 Receive levels

Service	Receive level in dBm
F2	22.3
Sys Pilot	22.3
Protection trip tone	22.3
FSK 600 Bd	5.2
FSK 200 Bd	2.2
RM (50 Bd)	-3.7

Calculating the SNR

The noise level of -20 dBm is given for a bandwidth of 4 kHz. For a different bandwidth (BW) of the service a correction P_{cor} has to be added to this level.

$$Pcor = 10^* \log (BW[kHz] / 4[kHz])$$

[foclpcor-061210-01.tif, 1, en_US]

SNR voice:

Correction for the voice BW = 2.1 kHz:

Pcor = 10*log (2.1/4) = -2.8 dB

Noise level for voice = -20 dBm + (-2.8) = -22.8 dBm

SNR $_{voice}$ = Rx level – noise level = 22.3 dB – (-22.8 dB) = 45.1 dB

When calculating the SNR for the FSK channels the following bandwidths have to be considered:

Table 7-11 Definition of the FSK channel bandwidth

No.	System	Nominal	max. Bit rate	Grid distance Hz	Bandwidth Hz	FM	Nominal channel level dBr
		Bit rate				deviation Hz	
1	FM 120	50	85	120	100	±30	-22.5
2	FM 240	100	170	240	200	±60	-19.5
3	FM 480	200	340	480	400	±120	-16.5
4	50 Bd NB	50	60	90	75	±22.5	-24.5
5	100 Bd NB	100	120	180	150	±45	-21.5
6	200 Bd NB	200	240	360	300	±90	-18.5
7	600 Bd	600	880	1140	1000	±200	-13.5
8	1200 Bd	1200	1300	1710	1440	±400	-10.5
9	2400 Bd	2400	2500	3400	2720	±800	-7.5

SNR data 600 Bd:

Correction for the 600 Bd data BW =1 kHz:

P_{cor} = 10*log (1/4) = -6 dB

Noise level for data = -20 dBm + (-6) = -26 dBm

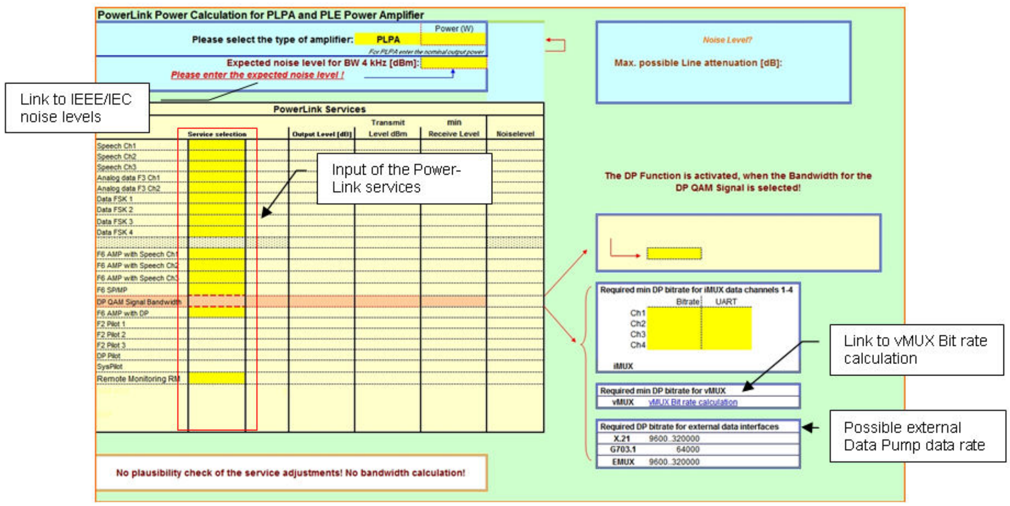
SNR $_{data\ 600}$ = Rx level – noise level = 5.2 dB – (-26 dB) = 31.2 dB

Conclusion: The transmission with the required SNR can be performed.

7.5 PowerCalc_xx_xx.xls

7.5.1 Introduction

When the expected noise level is known, the tool PowerCalc.xls is calculating the max. line attenuation for the desired PowerLink connection. The tool is available on the CD-ROM in the PowerLink manual and described subsequently.



[scpctool-061210-01.tif, 1, en_US]

Figure 7-22 The tool PowerCalc_xx_xx.xls

PowerCalc_xx_xx.xls should be used when the equipment configuration is already completed with the Power-Conf program. This ensures, that the system is working and can be ordered.

NOTE

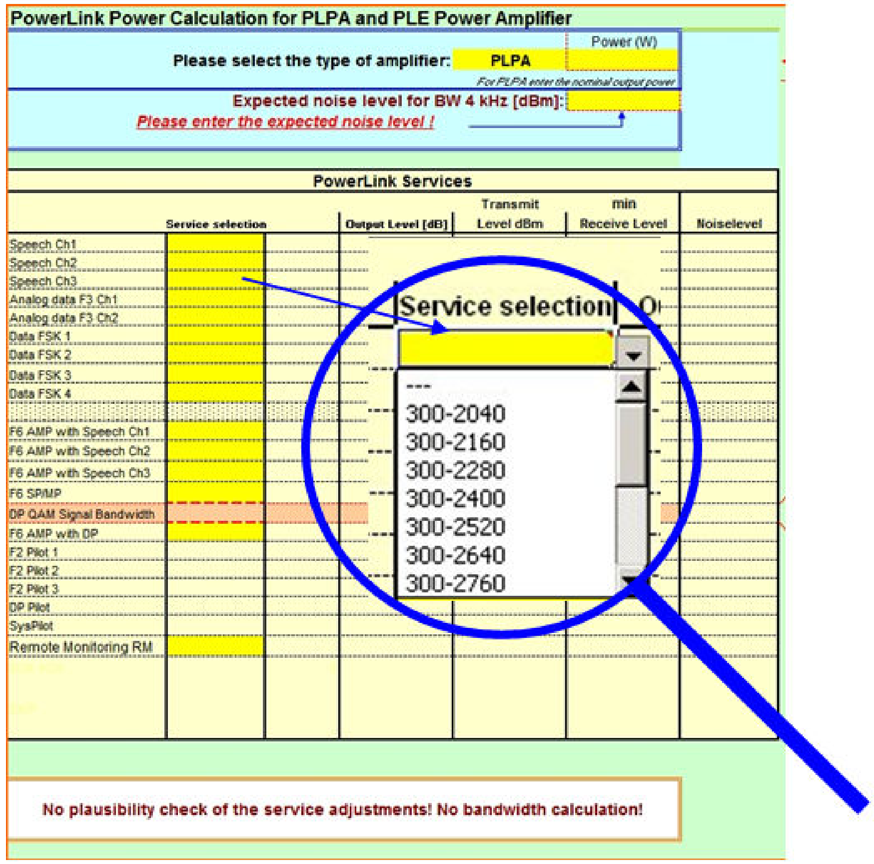
In the PowerCalc_xx_xx.xls, **no plausibility check** of the service adjustments and **no bandwidth calculation** is performed!

The tool calculates the max. permissible line attenuation for this equipment configuration. This must be more than the attenuation calculated for the customer's high voltage line.

If it is less, either the PowerLink amplifier must be increased, or if not possible the services have to be reduced since the noise level and the transmission line cannot be changed.

7.5.2 Input of the PowerLink Services

The figure below shows the section for selecting the required PowerLink services. For the input only the **dark yellow fields** can be used. The **other fields** i.e. for the F2 or DP Pilot are completed automatically.



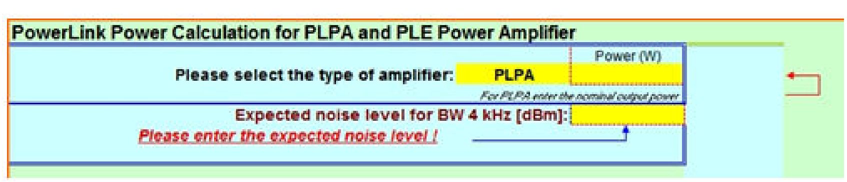
[scslsvyl-061210-01.tif, 1, en_US]

Figure 7-23 Selecting the services with the yellow marked fields

With click on a service an arrow appears for selecting the available input. For speech and analog data (F3) the bandwidth has to be selected. In case of using FSK channels the baud rate (50 up to 2400 Bd) appears.

Protection signaling (F6) is possible in the single purpose (SP), multi purpose (MP) resp. in the al-ternate multi purpose (AMP) mode. The AMP mode is possible with a speech channel or Data Pump (DP). If both services are activated in the configuration, the AMP should be used with the speech channel because an interrupt of the DP is causing always the loss of several services. The service **DP is activated** with the **selection** of the used **bandwidth** (3500 Hz to 31 500 Hz).

After selecting the type of power amplifier PLPA or PLE and the output power the expected **noise level for a bandwidth of 4 kHz** has to be entered.

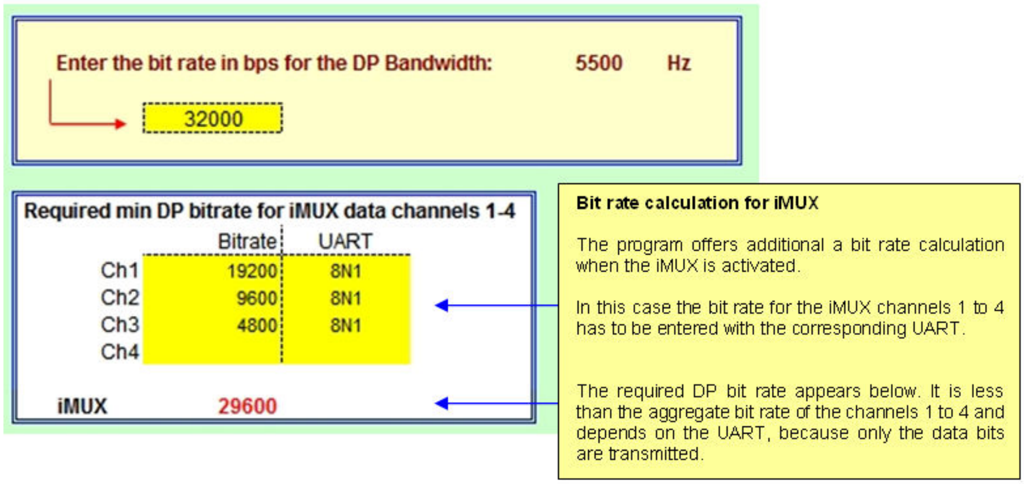


[scinexnl-061210-01.tif, 1, en_US]

Figure 7-24 Input of the expected noise level

Using the Data Pump and iMUX

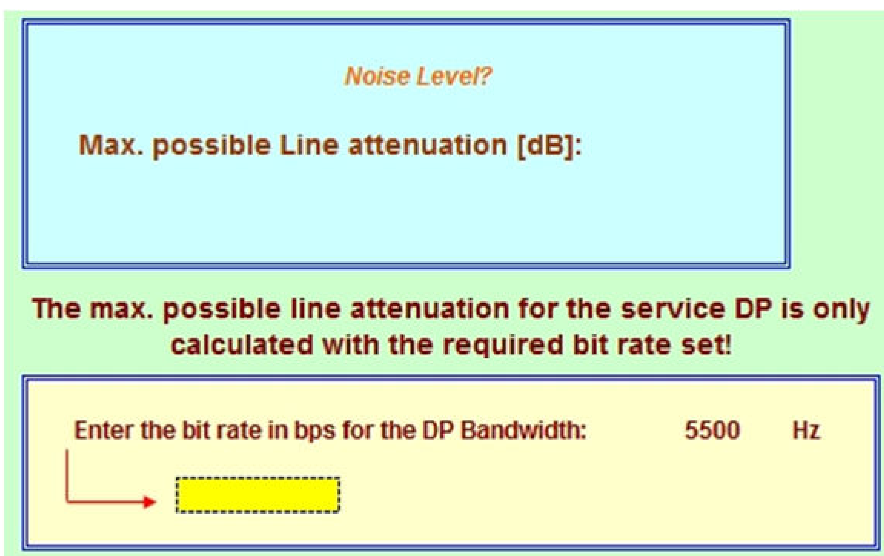
When using the service Data Pump, the necessary SNR depends on the **required bit rate**. This is requested from the program as soon as a DP bandwidth is adjusted:



[scadindp-061210-01.tif, 1, en_US]

Figure 7-25 Additional inputs for the DP

Max. possible line attenuation can’t be calculated without noise level and in case of Data Pump without the required bit rate

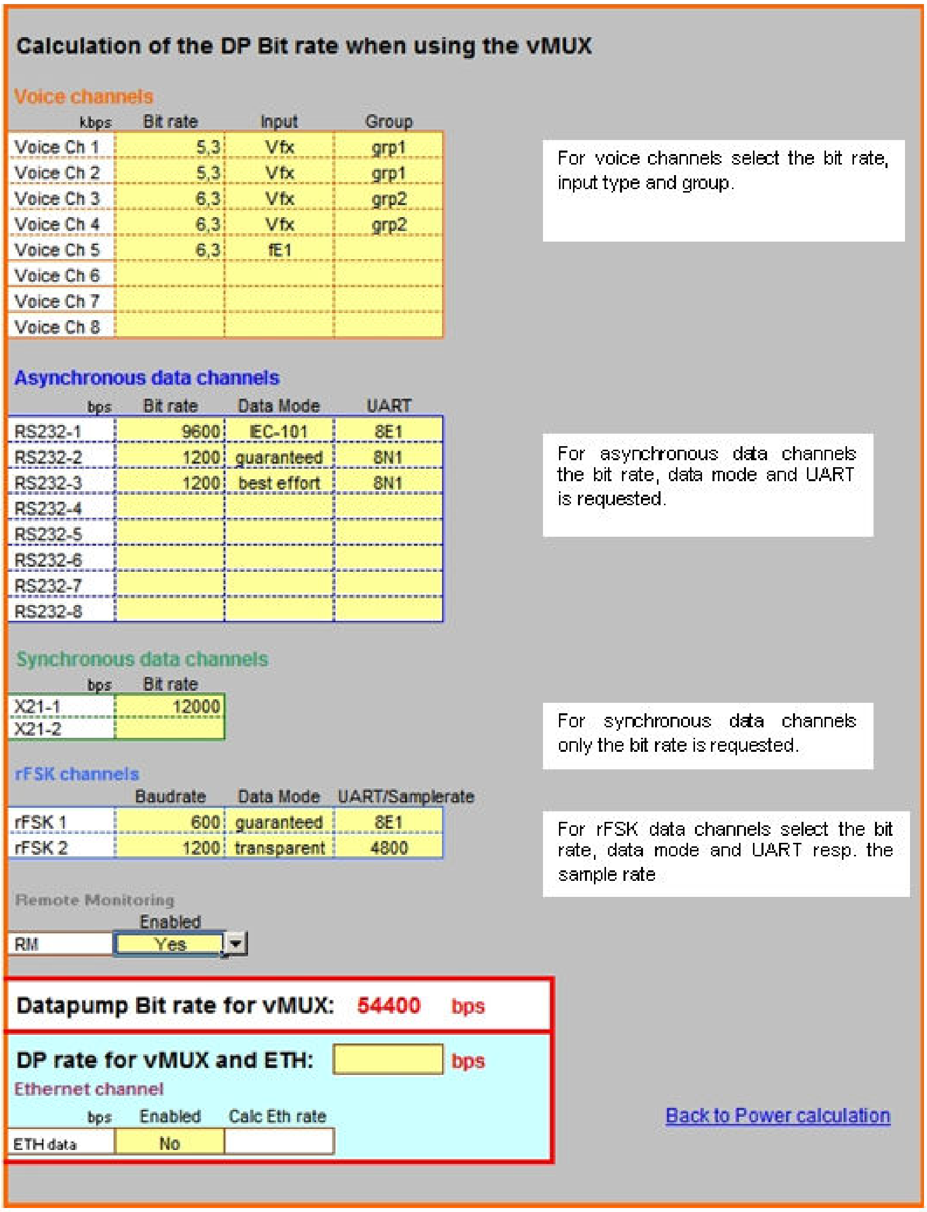


[scmsrqcl-061210-01.tif, 1, en_US]

Figure 7-26 The tool shows missing requirements for calculation

Using the Data Pump and vMUX without ETH

When using the vMUX a separate Excel sheet is available for calculating the necessary Data Pump bit rat. Click the hyperlink “vMUX Bit rate calculation” (refer to *Figure 7-22*) resp. the corresponding Excel sheet in PowerCalc_xx_xx.xls.



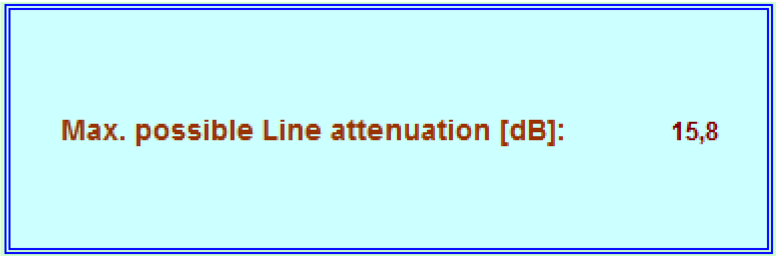
[scclrqdp-061210-01.tif, 1, en_US]

Figure 7-27 The Excel sheet for calculating the required DP bit rate for the vMUX

Max. Possible Line Attenuation

The tool calculates the max. possible line attenuation observing that the required SNR for the service with the lowest receive level is obtained. According IEC 60663 the required SNR for speech channels is 25 dB and for data channels 15 dB.

Under assumption of an expected noise level of -10 dB for 4 kHz bandwidth:

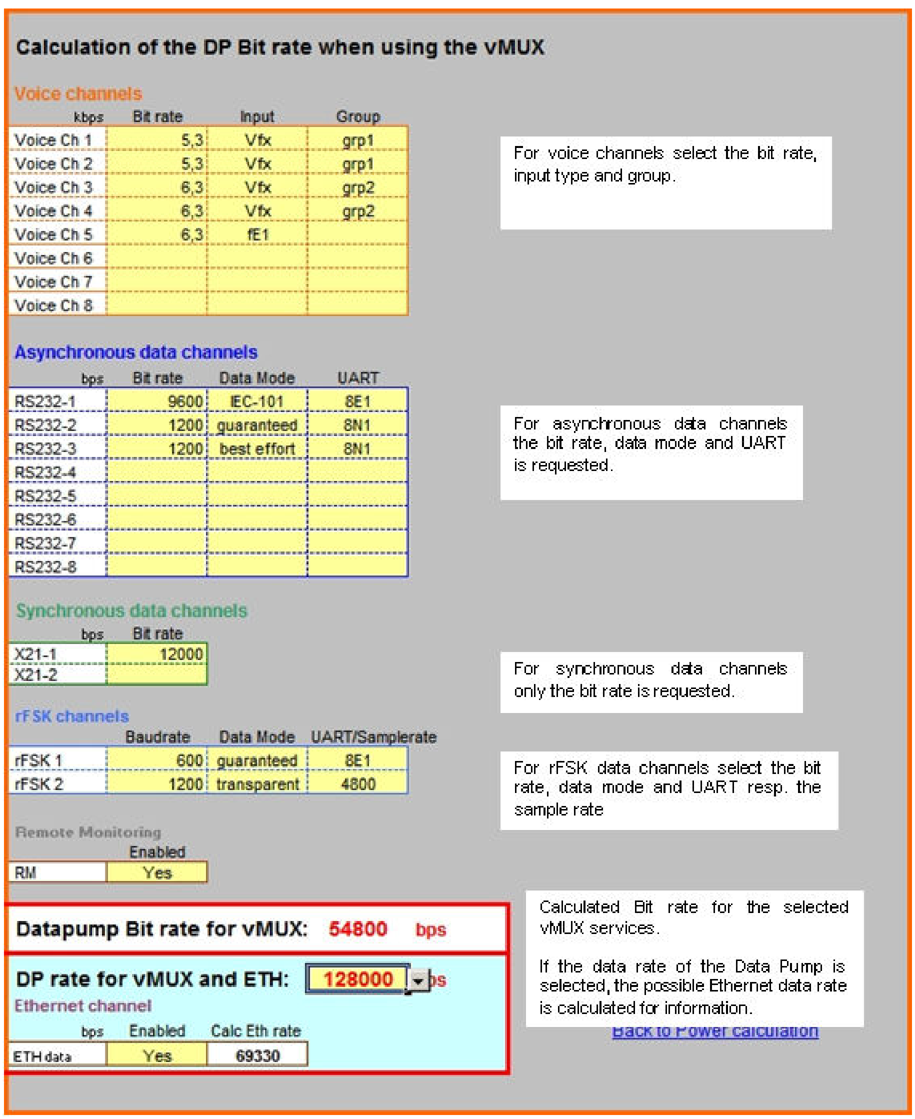


[scdsmpla-061210-01.tif, 1, en_US]

Figure 7-28 Display of the max possible line attenuation

Using the Data Pump and vMUX with ETH

When using the vMUX a separate Excel sheet is available for calculating the necessary Data Pump bit rat. Click the hyperlink “vMUX Bit rate calculation” (refer to *Figure 7-22*) resp. the corresponding Excel sheet in PowerCalc_xx_xx.xls.



[sccrqdp2-061210-01.tif, 1, en_US]

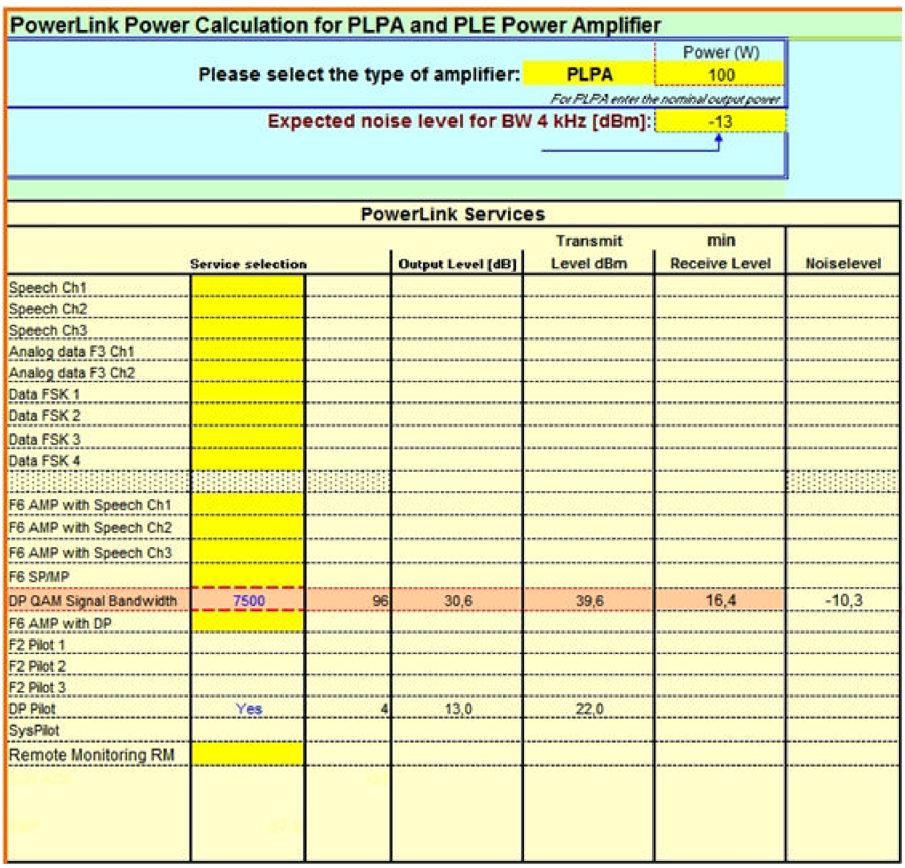
Figure 7-29 Calculating the required DP bit rate for vMUX and possible Ethernet data rate

7.5.3 Planning Examples with PowerCalc_xx_xx.xls

Subsequently the previous planning examples will be shown using the tool PowerCalc_xx_xx.xls.

Example 1 Data Pump

The PowerLink configuration (refer to *7.4.1 PowerLink with Data Pump*) was a Data Pump with 7.5 kHz bandwidth, and 100 W power amplifier. The required bit rate was 42 000 bps. For the line attenuation 12 dB and for the coupling loss 5 dB were assumed. The noise level for the DP bandwidth 7.5 kHz was assumed with -10,3 dB. The figure below shows the inputs for the tool PowerCalc_xx_xx.xls:



PowerLink Power Calculation for PLPA and PLE Power Amplifier

Please select the type of amplifier: PLPA — Power (W): 100

For PLPA enter the nominal output power

Expected noise level for BW 4 kHz [dBm]: -13

PowerLink Services

	Service selection		Output Level [dB]	Transmit Level dBm	min Receive Level	Noiselevel
Speech Ch1						
Speech Ch2						
Speech Ch3						
Analog data F3 Ch1						
Analog data F3 Ch2						
Data FSK 1						
Data FSK 2						
Data FSK 3						
Data FSK 4						
F6 AMP with Speech Ch1						
F6 AMP with Speech Ch2						
F6 AMP with Speech Ch3						
F6 SP/MP						
DP QAM Signal Bandwidth	7500	96	30,6	39,6	16,4	-10,3
F6 AMP with DP						
F2 Pilot 1						
F2 Pilot 2						
F2 Pilot 3						
DP Pilot	Yes	4	13,0	22,0		
SysPilot						
Remote Monitoring RM						

[scinexpc-061210-01.tif, 1, en_US]

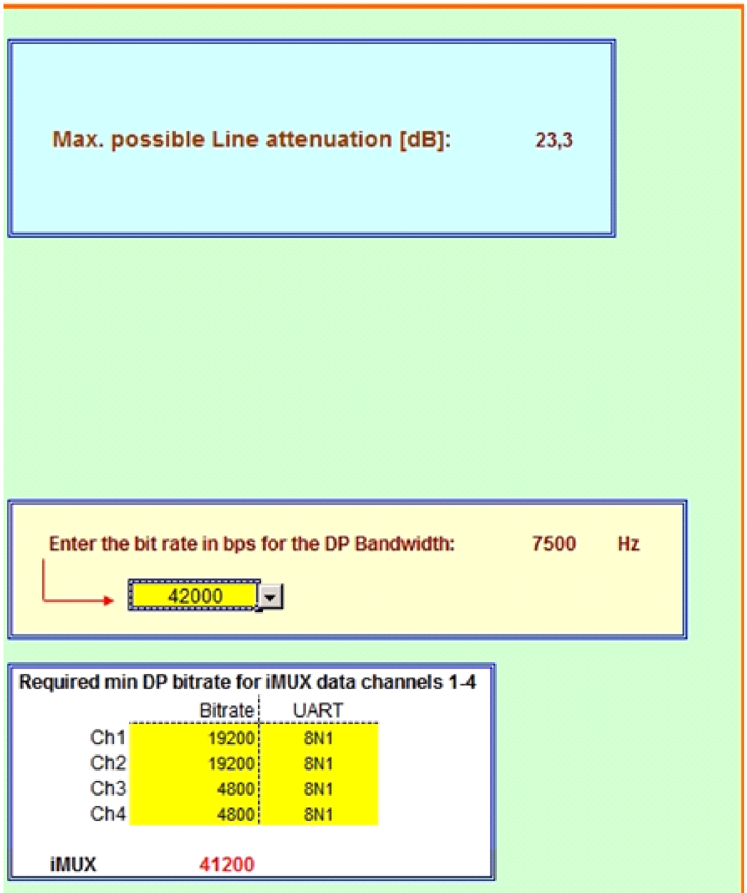
Figure 7-30 Inputs from example 1 in PowerCalc_xx_xx.xls

NOTE

The input of the expected noise level must be entered now for the **bandwidth 4 kHz**! The corre-sponding conversion into the noise level of the used DP bandwidth is executed automatically from the tool.

The output of the tool PowerCalc_xx_xx.xls for the example 1 is shown in the next figure:

The maximum line attenuation for the bit rate 42 000 bps is calculated with 23.3 dB



[scoutpcb-061210-01.tif, 1, en_US]

Figure 7-31 Output of PowerCalc_xx_xx.xls for the bit rate 42 000 bps

The result of example 1 was an SNR from 32.9 dBm for a total line attenuation of 17 dB. The required bit rate of 42 000 bps needs an SNR of approx 27 dB (6 dB spare).

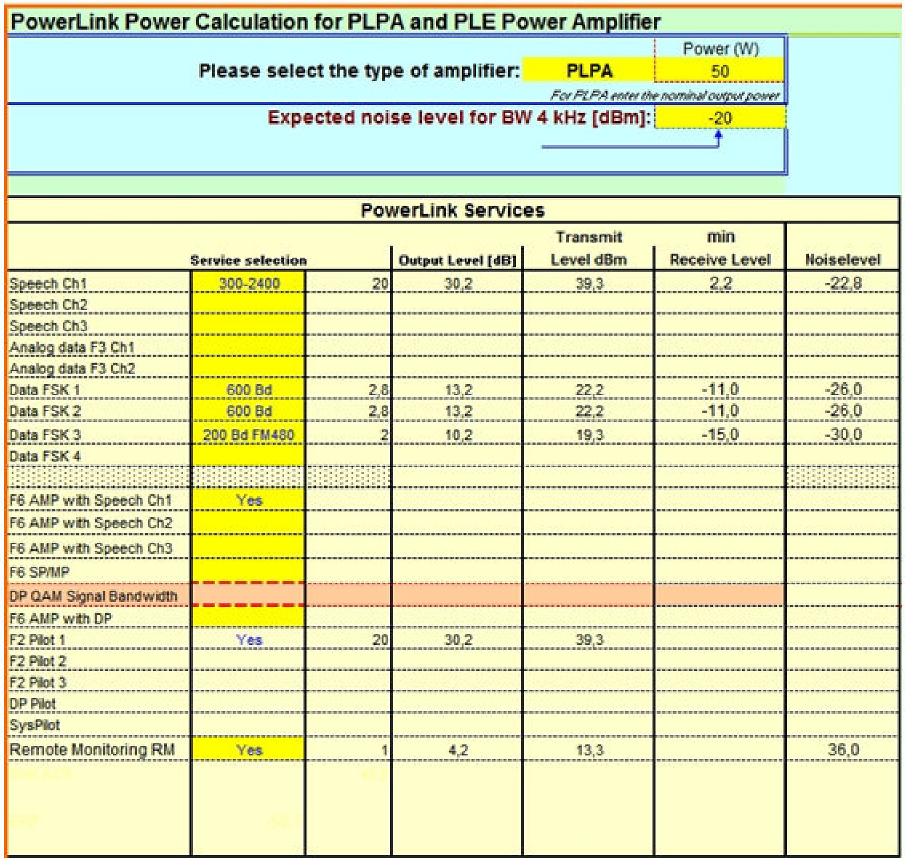
The tool PowerCalc_xx_xx.xls calculates the maximum line attenuation always for the desired bit rate. Related to the example 1 the tool shows the 6 dB spare plus the 17 dB line attenuation. The result is a maximum line attenuation of 23.3 dB.

Example 2 PowerLink with Analog Services

The configuration of the PowerLink was set with the service voice (F2), data transmission (F3) using FSK channels, RM channel and protection signaling in the AMP mode with the service F2. The system had a 50 W amplifier, the line impedance was 75 Ohm.

The assumed line attenuation including the coupling loss was 17 dB. The noise level for a band-width of 4 kHz was assumed with -20 dB.

The figure below shows the inputs from the configuration in example 2 (ref. to *Example PowerLink with F2, protection AMP, and 3 FSK data channels*).



PowerLink Power Calculation for PLPA and PLE Power Amplifier

Please select the type of amplifier: PLPA | Power (W): 50

For PLPA enter the nominal output power

Expected noise level for BW 4 kHz [dBm]: -20

PowerLink Services

	Service selection		Output Level [dB]	Transmit Level dBm	min Receive Level	Noiselevel
Speech Ch1	300-2400	20	30,2	39,3	2,2	-22,8
Speech Ch2						
Speech Ch3						
Analog data F3 Ch1						
Analog data F3 Ch2						
Data FSK 1	600 Bd	2,8	13,2	22,2	-11,0	-26,0
Data FSK 2	600 Bd	2,8	13,2	22,2	-11,0	-26,0
Data FSK 3	200 Bd FM480	2	10,2	19,3	-15,0	-30,0
Data FSK 4						
F6 AMP with Speech Ch1	Yes					
F6 AMP with Speech Ch2						
F6 AMP with Speech Ch3						
F6 SP/MP						
DP QAM Signal Bandwidth						
F6 AMP with DP						
F2 Pilot 1	Yes	20	30,2	39,3		
F2 Pilot 2						
F2 Pilot 3						
DP Pilot						
SysPilot						
Remote Monitoring RM	Yes	1	4,2	13,3		36,0

[scincne2-061210-01.tif, 1, en_US]

Figure 7-32 Input of the configuration from example 2

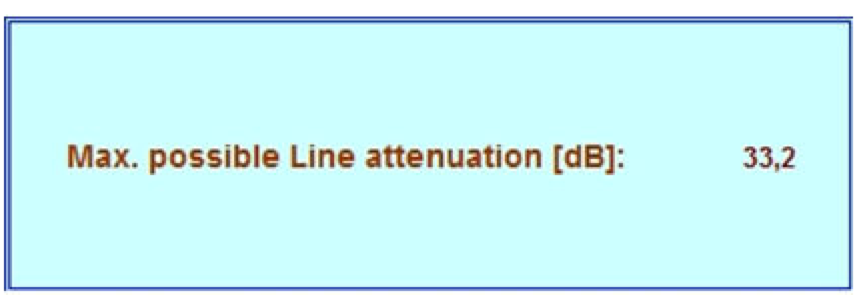
The result from example 2 assuming a line attenuation of 17 dB was an SNR for the voice chan-nel of:

SNR $_{voice}$ = 45.1 dB (considering the required SNR of 25 dB this is 20.1 dB spare)

The SNR for the 600 Bd data channel was:

SNR $_{data\ 600}$ = 31.2 dB (considering the required SNR of 15 dB this is 16.2 dB spare)

As described before the tool PowerCalc_xx_xx.xls calculates the max. possible line attenuation observing that the required SNR for the service with the lowest receive level is obtained. The result is shown in the figure below.



[scrse2pc-061210-01.tif, 1, en_US]

Figure 7-33 The result of example 2 displayed in PowerCalc_xx_xx.xls

Related to the example 2 the tool shows the 17 dB line attenuation plus the 16.2 dB spare from the data channel.

7.6 Examples of Using the vMUX and StationLink

7.6.1 In General

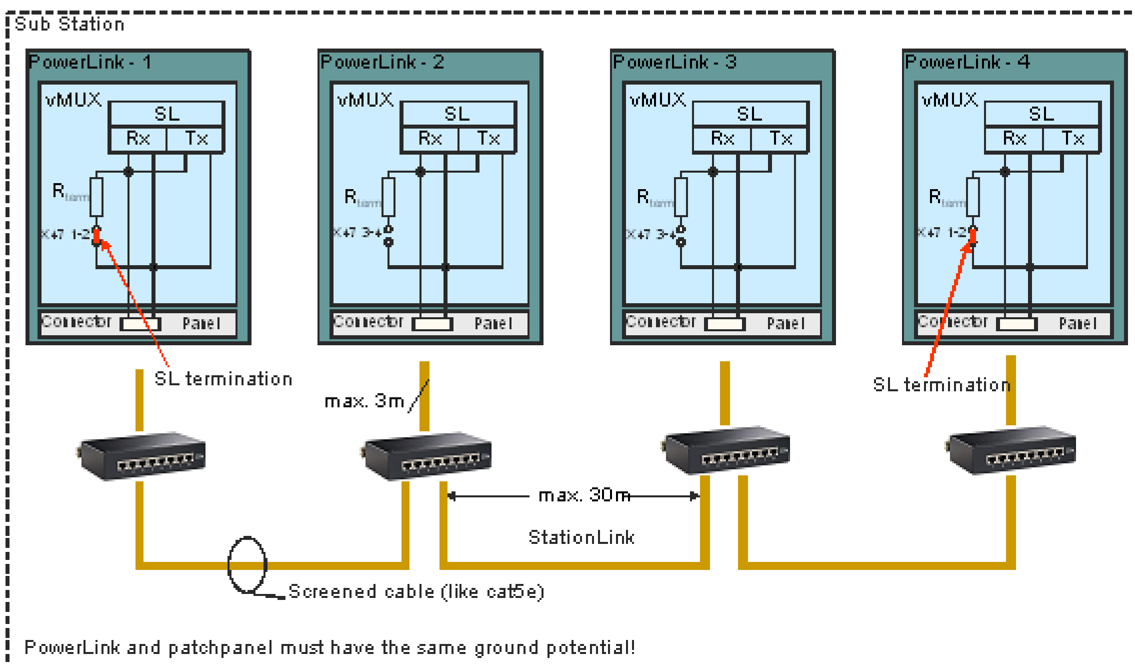
The StationLink (SL) offers the routing of channels between up to 4 different PowerLink equipment in 1 substation. The port mapping is carried out in the receiver. Local ports of the PowerLinks cannot be routed.

The station link RJ45 connector is located on the PowerLink connector panel.

NOTE

For more details of the PowerLink connector panel and the pinout of the connectors, we refer you to the chapter *Installation* in this manual.

The station link bus must be terminated on both ends (in 2 PowerLink equipment). For this purpose. a termination resistance R_{term} is available which is located on the vMUX board.



[dwslm4pl-120813-01.tif, 1, en_US]

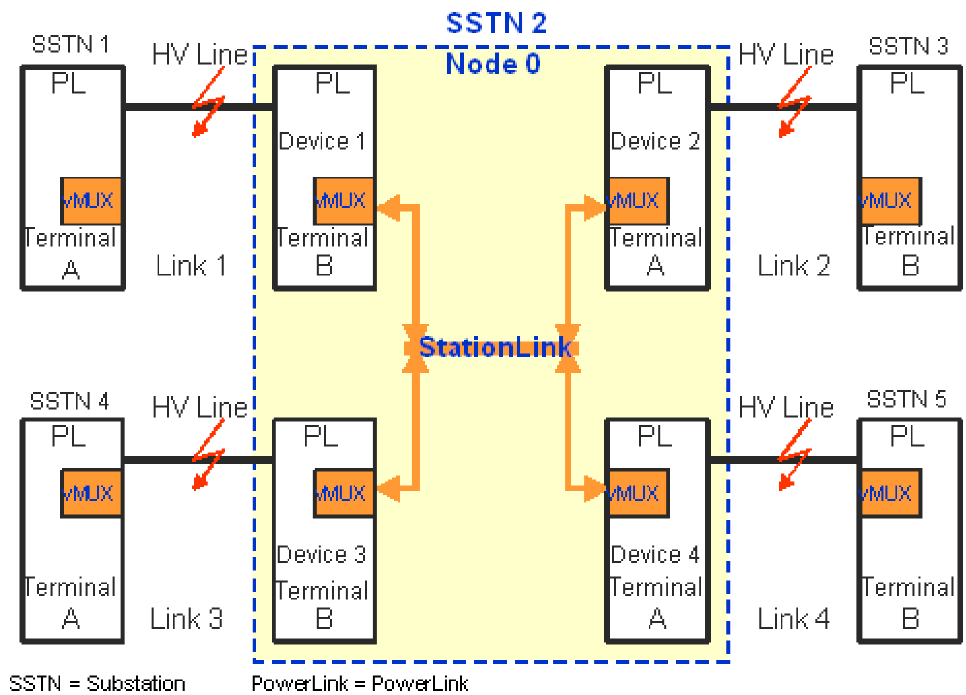
Figure 7-34 StationLink with (max) 4 PowerLink

NOTE

For more details of the StationLink termination and the pinout of the connectors, we refer you to the chapter *Installation* in this manual.

7.6.2 The vMUX Node

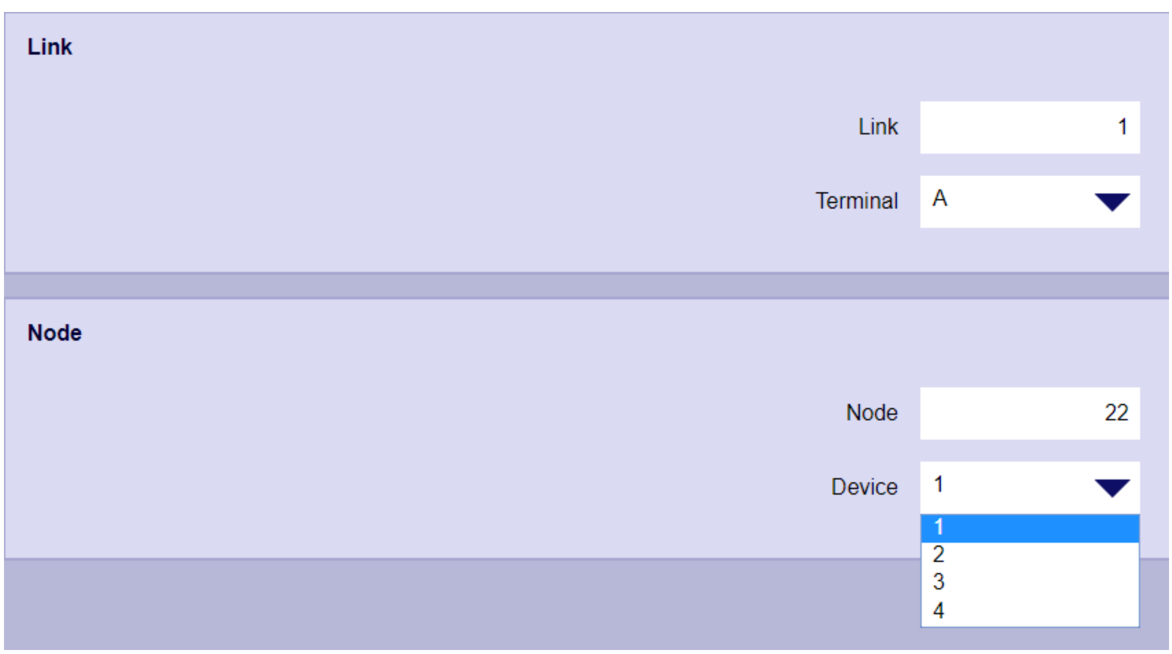
The PowerLink terminals which are connected to a StationLink in a substation represent a "Node" which is defined in the he PowerLink terminals which are connected to a StationLink in a substation represent a "Node" which is defined in <**Configuration - vMUX - Station address**>.



[dwvmuxn4-061210-01.tif, 1, en_US]

Figure 7-35 vMUX node with 4 PowerLinks

For **each** PowerLink 50/100 which is connected to a StationLink the **Link settings** (Link 0 to 2047), Terminal (A resp. B) and the **Node settings** (Node number 0 to 1023; Device 1 to 4) have to be defined in this form:



[sc_vmux_station_address, 1, --_--]

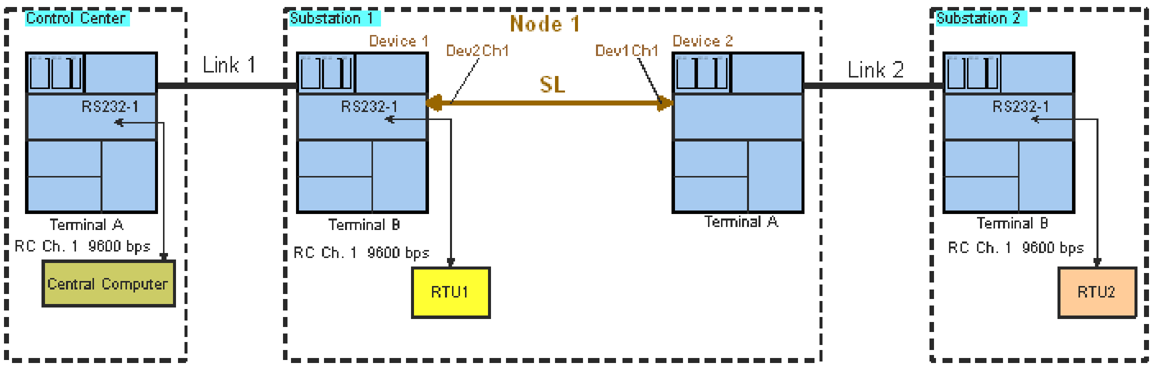
Figure 7-36 Configuration of the vMUX Station Address

7.6.3 Example 1 Point-to-Multipoint Connection

The figure below shows a connection of two RTU's to a control center using the same data channel (RC Ch1). This is a point-to-multipoint connection. The channel is transmitted via Power-Link 50/100 and the vMUX with 9600 bps. The routing of the data channel between the 2 transmission links is carried out via StationLink.

Further data for this example:

- data mode = IEC-101
- UART mode = 8E1
- PowerLine Ch 1



[cdptmcdc-120813-01.tif, 1, en_US]

Figure 7-37 Point-to-multipoint connection of a data channel

The interface for this data channel is the RS 232-1 connector at the PowerLink connector panel. Link 1 is the connection between the control center and the substation 1. The RC Ch1 in Terminal B from this link is direct connected to the RTU1 and additional to the StationLink (SL) for routing to the Terminal A from Link 2.

Via Link 2 the data channel is connected to the RTU2 in substation 2.

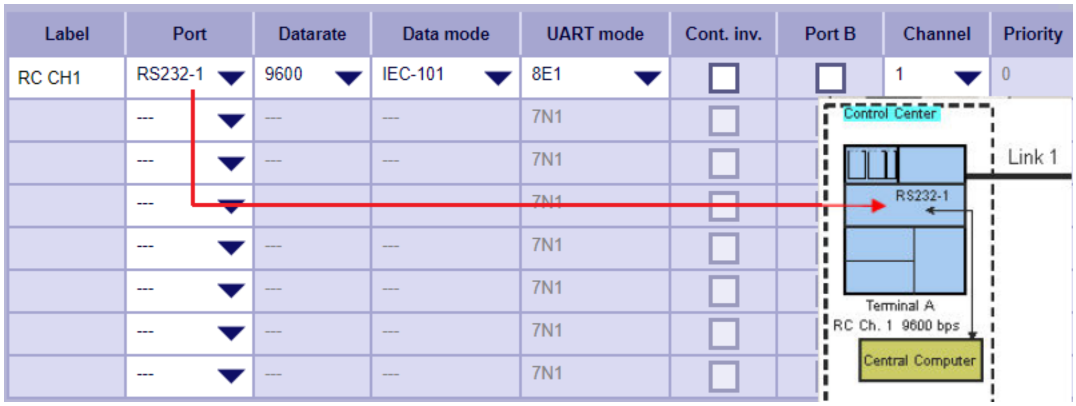
NOTE

For more details of the PowerLink system resp service configuration, we refer you to the chapter *3 Installation and Commissioning* in this manual.

Subsequent you'll find the **vMUX resp. SL configuration** for the 4 PowerLink terminals which is different for each device.

vMUX Configuration for Link 1 Terminal A

Terminal A from Link 1 is connected to the central computer. In the figure below the vMUX con-figuration is shown:



Label	Port	Datarate	Data mode	UART mode	Cont. inv.	Port B	Channel	Priority
RC CH1	RS232-1	9600	IEC-101	8E1	☐	☐	1	0
	---	---	---	7N1	☐			
	---	---	---	7N1	☐			
	---			7N1	☐			
	---	---	---	7N1	☐			
	---	---	---	7N1	☐			
	---	---	---	7N1	☐			
	---	---	---	7N1	☐			

[sc_example_vmux_rc_ch1, 1, --_--]

Figure 7-38 vMUX settings for the RC Ch1 in Terminal A from Link 1

In Terminal A from Link 1 only the local port needs to be configured. Enter the Label, Port, Data rate, Data-Mode, UART Mode and the used channel for the transmission via the Power Line. The Prio setting is only available in case of the Data Pump mode dynamic.

NOTE

For more details of the vMUX configuration, we refer you to the chapter *3 Installation and Commissioning* in this manual.

vMUX Configuration for Link 1 Terminal B

Terminal B from Link 1 is connected on the one hand to the local RTU and on the other hand to the StationLink in substation 1.

The vMUX configuration is given below. First of all the <**vMUX Station Address**> has to be completed:

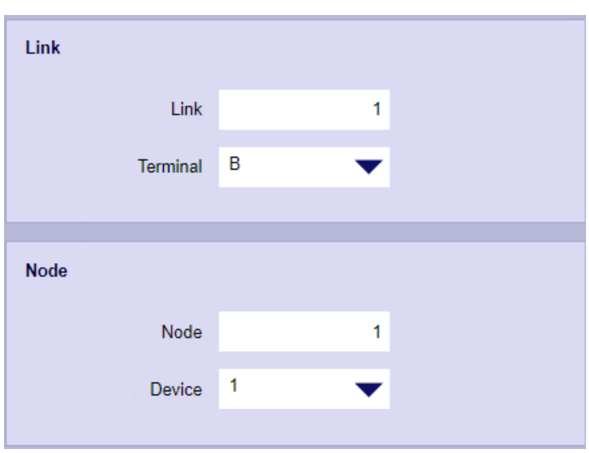
For **each** PowerLink 50/100 which is connected to a StationLink the

Link settings (Link 0...2047), Terminal (A resp. B)

and the

Node settings (Node number 0...1023; Device 1 to 4)

have to be defined in this form:

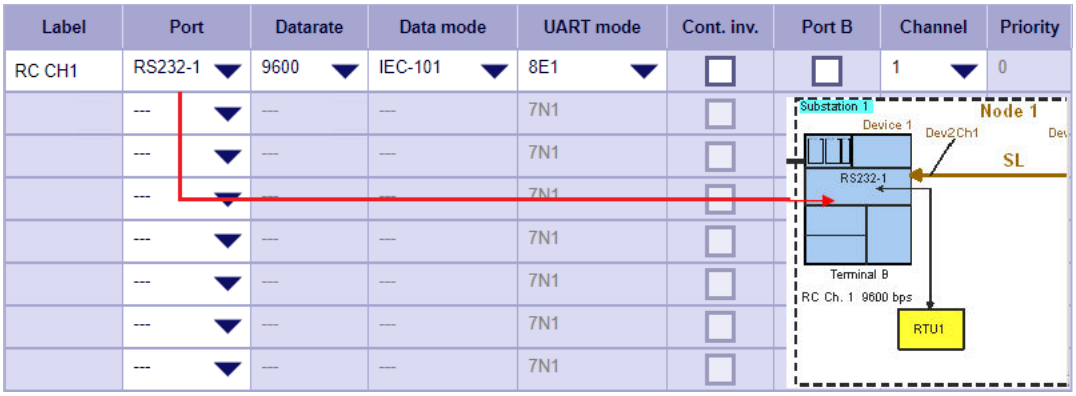


[sc_example_link1_terminalb, 1, --_--]

Figure 7-39 vMUX Station address settings for Terminal B from Link 1

After the vMUX station address has been completed (refer also to *7.6.2 The vMUX Node*) continue with the vMUX configuration for the data channel.

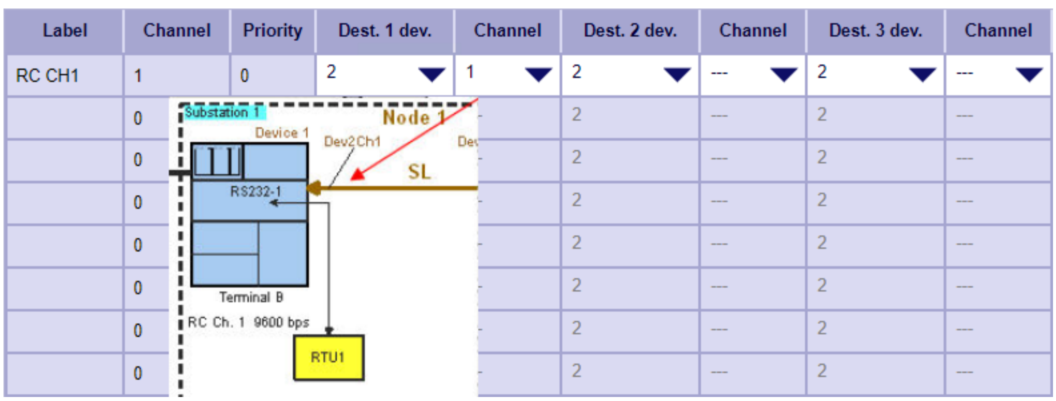
In our example the Terminal B from Link 1 needs the settings shown in the figure below:



[sc_example_vmux_rc_ch1_terminalb, 1, --_--]

Figure 7-40 vMUX settings for the RC Ch1 in Terminal B from Link 1

Here the local port for the connection to the local RTU1, as well as the StationLink (SL) is configured.



[sc_example_vmux_sl_rc_ch1, 1, --_--]

Figure 7-41 vMUX StationLink settings for the RC Ch1 in Terminal B from Link 1

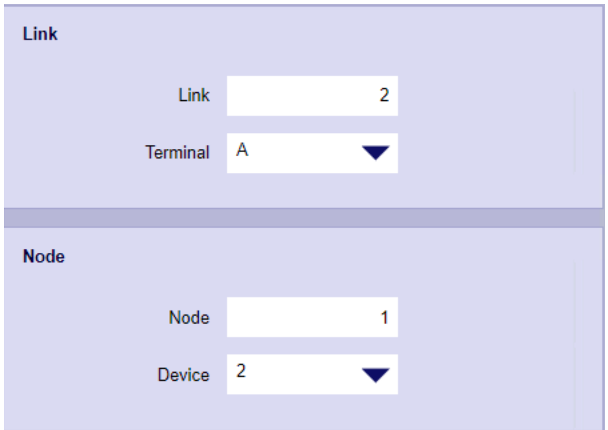
The SL data describe the destination 1 (device 2 and channel 1). For the further transmission of this data channel via Link 2 the Power Line channel 1 has to be used as well. This has to be observed in the configuration of Terminal A and B in Link 2.

NOTE

For more details of the vMUX configuration, refer to the chapter *3 Installation and Commissioning* in this manual.

vMUX Configuration for Link 2 Terminal A

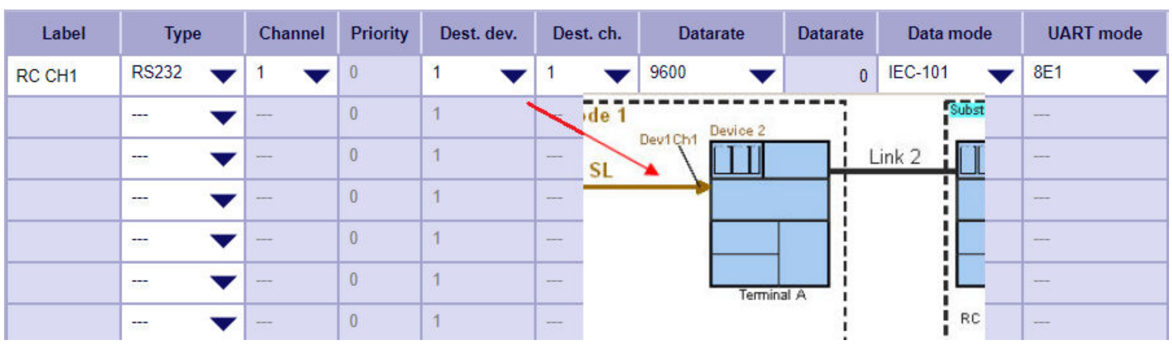
Terminal A from Link 2 is connected to the StationLink. Also here we have to start with the vMUX station address settings like described before for Terminal B from Link 1.



[sc_example_vmux_stationaddress_link2, 1, --_--]

Figure 7-42 vMUX Station address for Terminal A Link 2

The further configuration is shown in the figure below:



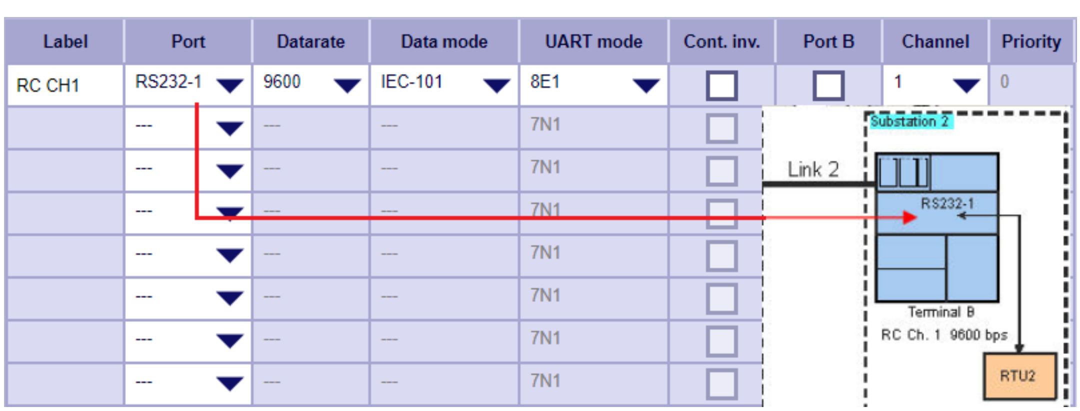
[sc_example_stationlink_terminala, 1, --_--]

Figure 7-43 StationLink configuration of Terminal A

For Link 2 Terminal A only the StationLink configuration is necessary. The StationLink destination in this device is Terminal B from Link 1 using the Power Line channel 1.

vMUX Configuration for Link 2 Terminal B

In the example, the Terminal B from Link 2 is connected to the RTU2 in substation 2 without any StationLink ref. to *Figure 7-37*. Consequently the vMUX configuration is only concerning the local port for the data channel RC CH1.



[sc_example_vmux_rc_ch1_terminalb_link2, 1, --_--]

Figure 7-44 vMUX settings for the RC Ch1 in Terminal B from Link 2

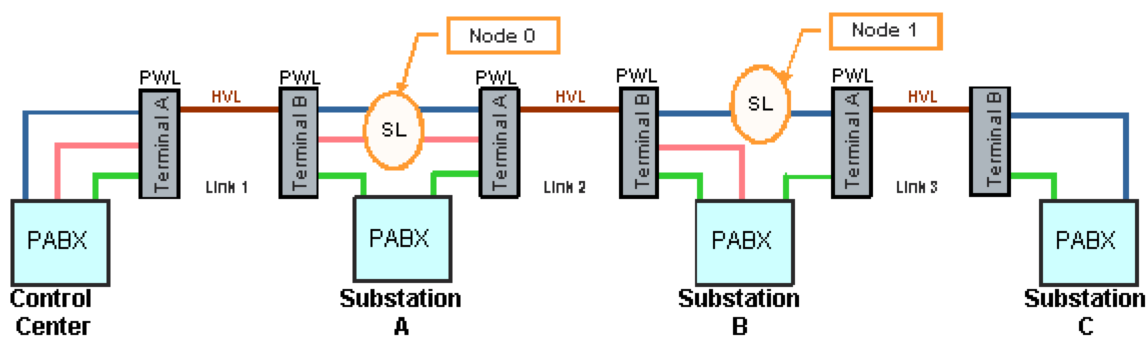
NOTE

For more details of the vMUX configuration, we refer you to the chapter *3 Installation and Commissioning* in this manual.

7.6.4 Example 2 Routing of Voice Channels

The figure below shows the voice transmission between a control center and 3 substations via vMUX. In the substations A (Node 0) and B (Node 1) the voice channels are routed (in compressed mode) to the next PLC Link via StationLink.

In this example, we assume a voice data rate from 6.3 Kbps.



[dwrvcdss-120813-01.tif, 1, en_US]

Figure 7-45 Routing of voice channels between different substations

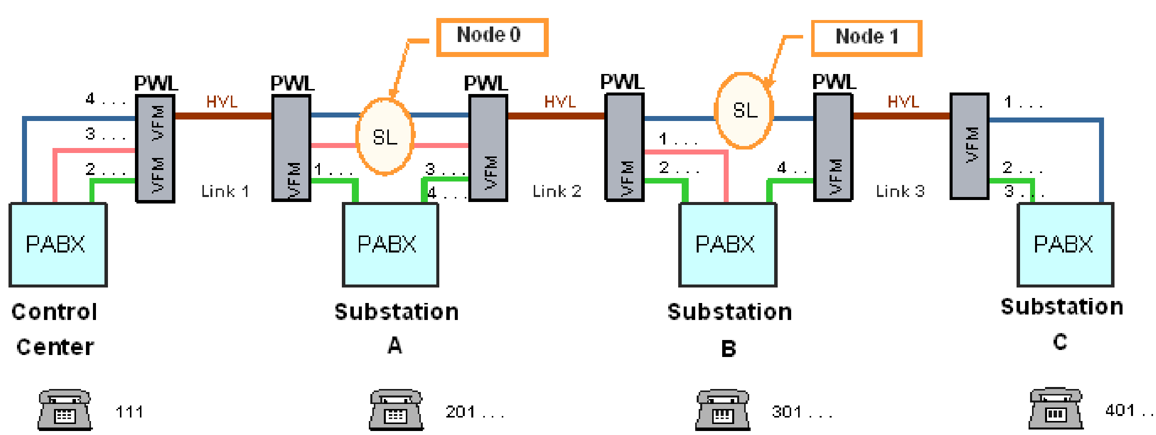
HVL High voltage line

PWL PowerLink

SL StationLink

In the substations, the voice channels are connected to PABX. Therefore the PowerLinks must be equipped with VFM modules. The PowerLink in the control center needs 2 VFM modules because 3 voice channels are connected.

The other PowerLinks need only one VFM module because of the channel routing in substation A resp. B. Details are shown in the figure below.

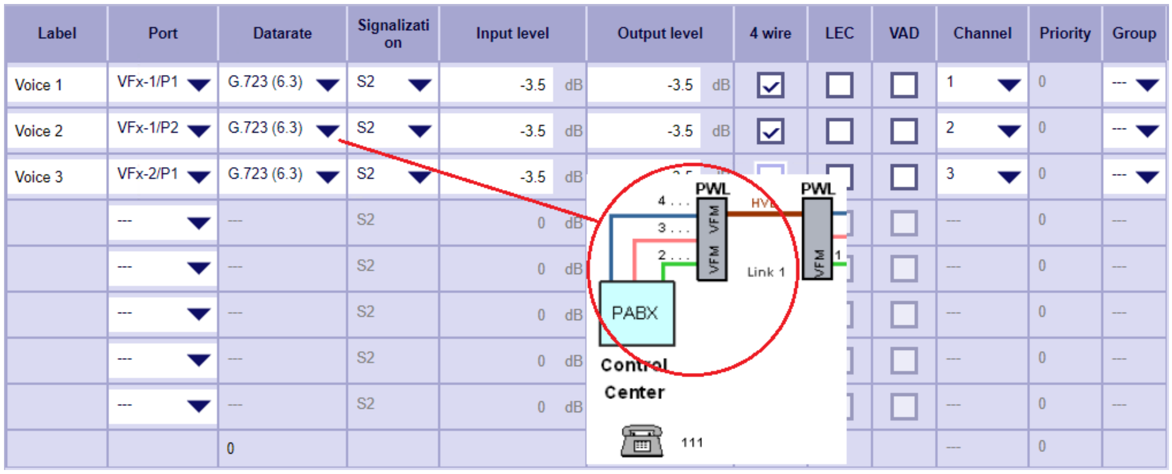


[dwvcalpx-120813-01.tif, 1, en_US]

Figure 7-46 Voice channel allocation in the PABX

vMUX Configuration for Link 1 Terminal A

In this PowerLink, only the configuration of the vMUX for the 3 voice channels using the local ports is necessary.

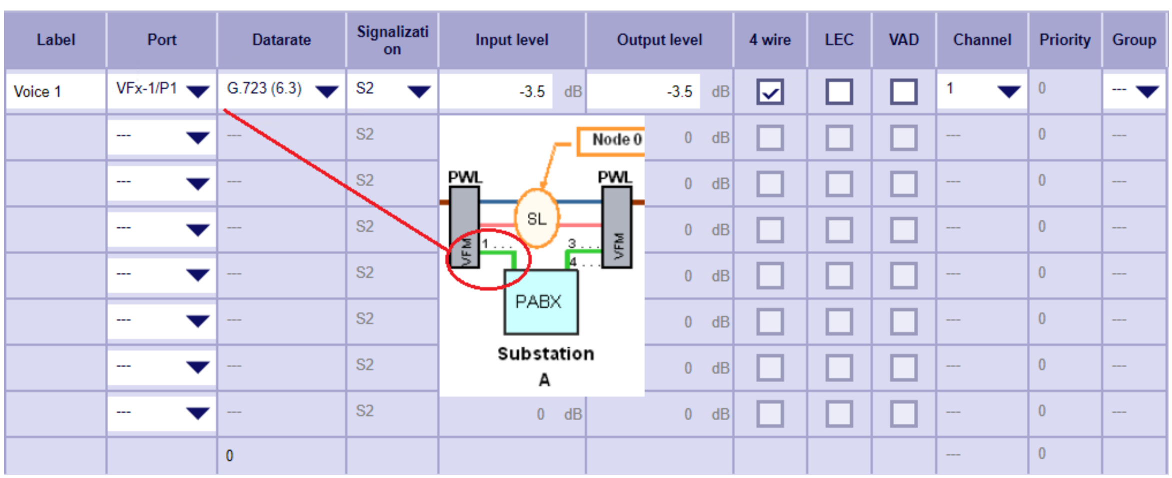


Label	Port	Datarate	Signalization	Input level	Output level	4 wire	LEC	VAD	Channel	Priority	Group
Voice 1	VFx-1/P1	G.723 (6.3)	S2	-3.5 dB	-3.5 dB	☑	☐	☐	1	0	---
Voice 2	VFx-1/P2	G.723 (6.3)	S2	-3.5 dB	-3.5 dB	☑	☐	☐	2	0	---
Voice 3	VFx-2/P1	G.723 (6.3)	S2	-3.5 dB			☐	☐	3	0	---
	---	---	S2	0 dB				☐	---	0	---
	---	---	S2	0 dB				☐	---	0	---
	---	---	S2	0 dB				☐	---	0	---
	---	---	S2	0 dB				☐	---	0	---
	---	---	S2	0 dB				☐	---	0	---
		0							---	0	

Figure 7-47   vMUX configuration for the 3 voice channels in Terminal A from Link 1

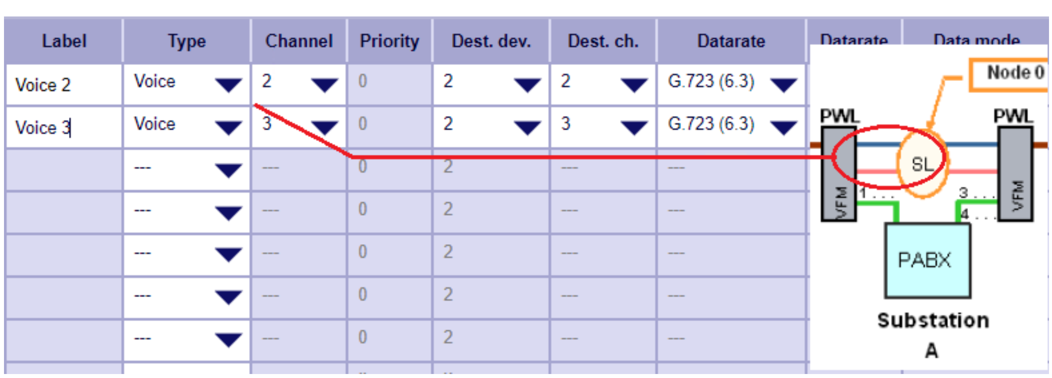
vMUX Configuration for Link 1 Terminal B

In Terminal B from Link 1, we find the voice channel 1 connected to the PABX and the voice channels 2 and 3 routed to the StationLink in Node 0. For the vMUX Station Address settings refer to the description, *7.6.2 The vMUX Node*. The other settings are given below:



Label	Port	Datarate	Signalization	Input level	Output level	4 wire	LEC	VAD	Channel	Priority	Group
Voice 1	VFx-1/P1	G.723 (6.3)	S2	-3.5 dB	-3.5 dB	☑	☐	☐	1	0	---
	---	---	S2		0 dB	☐	☐	☐	---	0	---
	---	---	S2		0 dB	☐	☐	☐	---	0	---
	---	---	S2		0 dB	☐	☐	☐	---	0	---
	---	---	S2		0 dB	☐	☐	☐	---	0	---
	---	---	S2		0 dB	☐	☐	☐	---	0	---
	---	---	S2		0 dB	☐	☐	☐	---	0	---
	---	---	S2	0 dB	0 dB	☐	☐	☐	---	0	---
		0							---	0	

Figure 7-48   vMUX configuration for the voice channel 1 for Link1 Terminal B

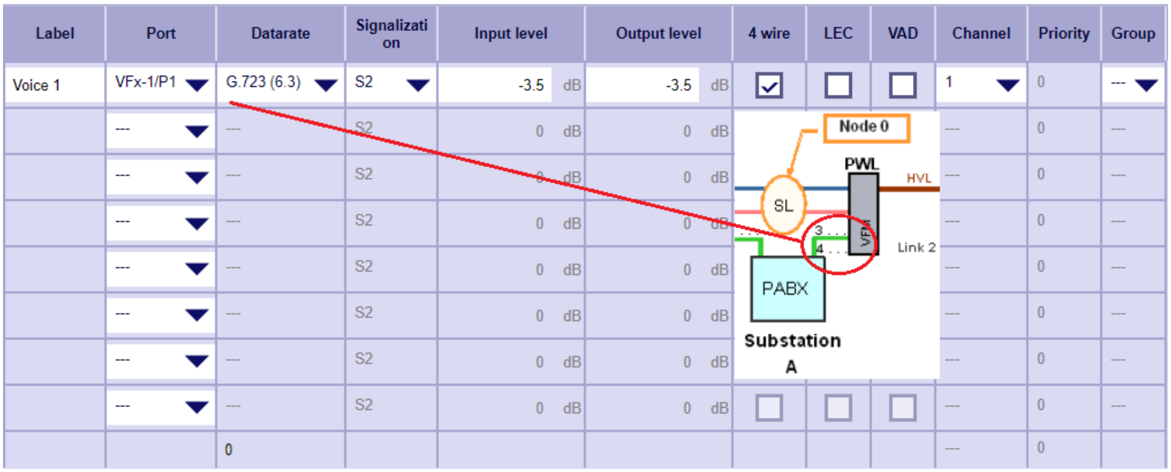


Label	Type	Channel	Priority	Dest. dev.	Dest. ch.	Datarate	Datarate	Data mode
Voice 2	Voice	2	0	2	2	G.723 (6.3)		
Voice 3	Voice	3	0	2	3	G.723 (6.3)		
	---	---	0	2	---	---		
	---	---	0	2	---	---		
	---	---	0	2	---	---		
	---	---	0	2	---	---		
	---	---	0	2	---	---		

Figure 7-49   vMUX StationLink configuration for the voice channels 2 and 3 from Link 1 Terminal B

vMUX Configuration for Link 2 Terminal A

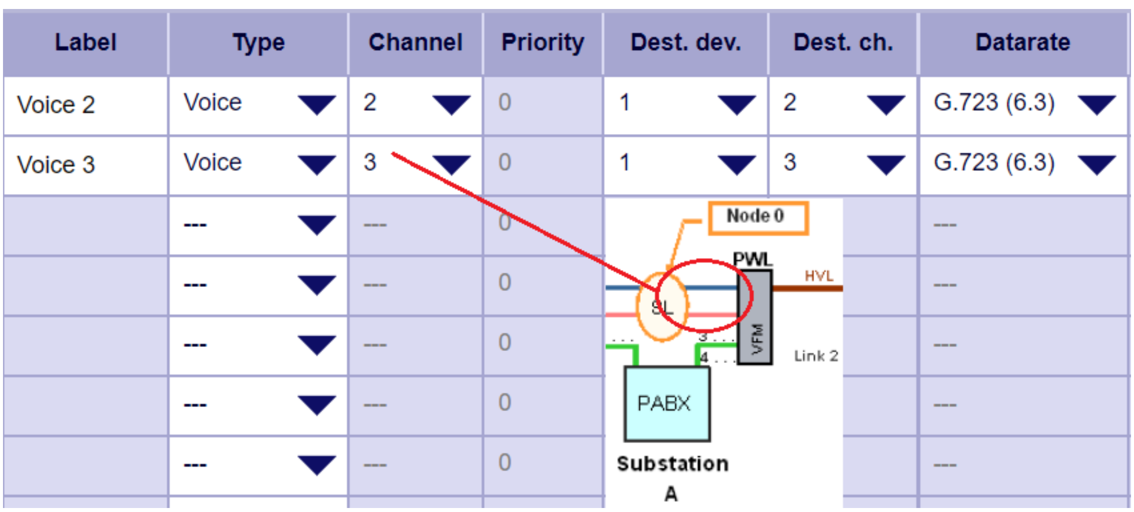
In Terminal A from Link 2, we find the voice channel 1 connected to the PABX and the voice channels 2 and 3 routed to the StationLink in Node 0. For the vMUX Station Address settings refer to the description, *7.6.2 The vMUX Node*. The other settings are given below:



Label	Port	Datarate	Signalization	Input level	Output level	4 wire	LEC	VAD	Channel	Priority	Group
Voice 1	VFx-1/P1	G.723 (6.3)	S2	-3.5 dB	-3.5 dB	☑	☐	☐	1	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB	☐	☐	☐	---	0	---
		0							---	0	

[sc_example_vmux_voice1_link2, 1, --_--]

Figure 7-50 vMUX configuration for the voice channel 1 for Link 2 Terminal A



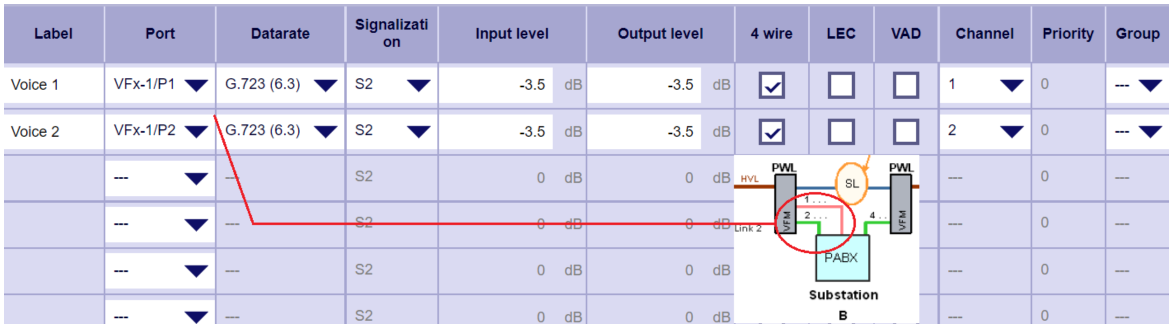
Label	Type	Channel	Priority	Dest. dev.	Dest. ch.	Datarate
Voice 2	Voice	2	0	1	2	G.723 (6.3)
Voice 3	Voice	3	0	1	3	G.723 (6.3)
	---	---	0			---
	---	---	0			---
	---	---	0			---
	---	---	0			---
	---	---	0			---

[sc_example_vmux_voice23_link2, 1, --_--]

Figure 7-51 vMUX StationLink configuration for the voice channels 2 and 3 for Link 2 Terminal A

vMUX Configuration for Link 2 Terminal B

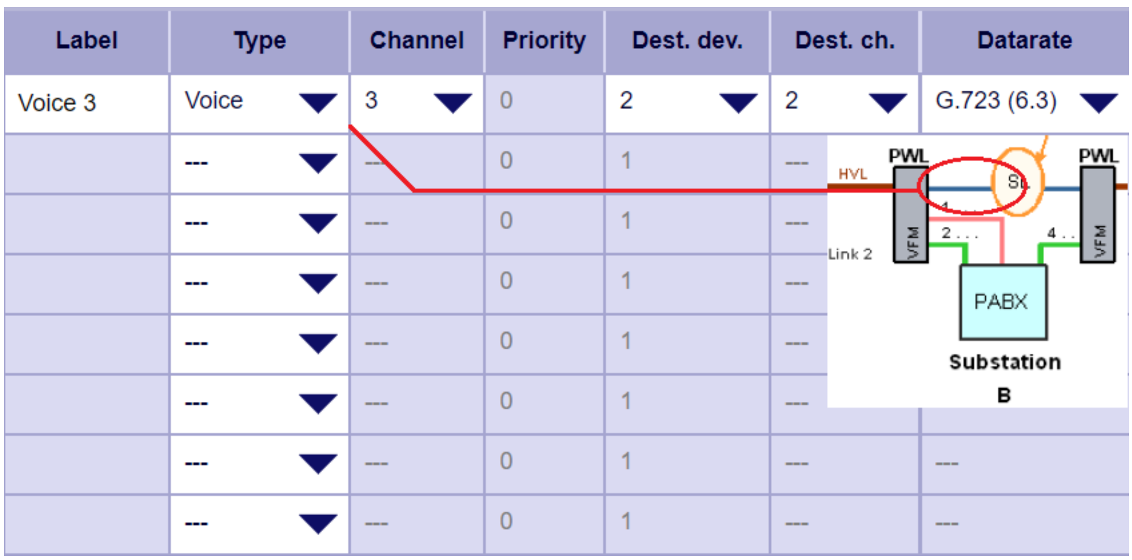
In Terminal B from Link 2, the voice channel 1 and 2 are connected to the PABX and the voice channel 3 is routed to the StationLink in Node 1. For the vMUX Station Address settings refer to the description, *7.6.2 The vMUX Node*. The other settings are given below:



Label	Port	Datarate	Signalization	Input level	Output level	4 wire	LEC	VAD	Channel	Priority	Group
Voice 1	VFx-1/P1	G.723 (6.3)	S2	-3.5 dB	-3.5 dB	☑	☐	☐	1	0	---
Voice 2	VFx-1/P2	G.723 (6.3)	S2	-3.5 dB	-3.5 dB	☑	☐	☐	2	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---

[sc_example_vmux_vc12_link2, 1, --_--]

Figure 7-52 vMUX configuration for the voice channels 1and 2 for Link 2 Terminal B



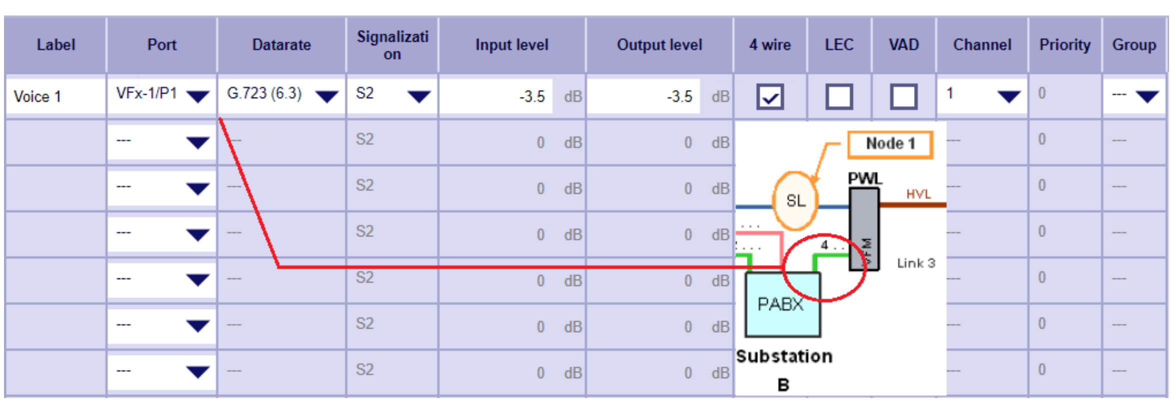
Label	Type	Channel	Priority	Dest. dev.	Dest. ch.	Datarate
Voice 3	Voice	3	0	2	2	G.723 (6.3)
	---	---	0	1	---	
	---	---	0	1	---	
	---	---	0	1	---	
	---	---	0	1	---	
	---	---	0	1	---	
	---	---	0	1	---	---
	---	---	0	1	---	---

[sc_example_vmux_v3_link2, 1, --_--]

Figure 7-53 vMUX StationLink configuration for the voice channel 3 from Link 2 Terminal B

vMUX Configuration for Link 3 Terminal A

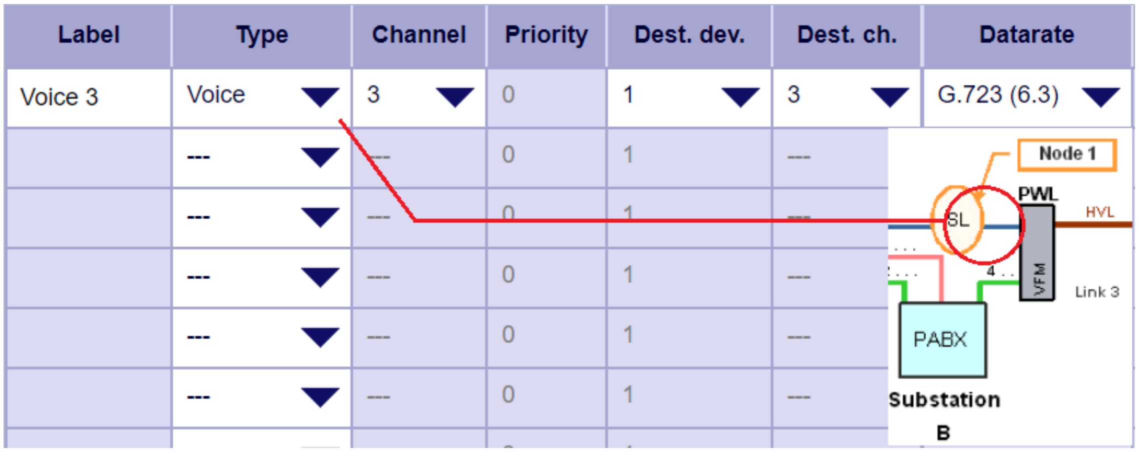
In Terminal A from Link 3, the voice channel 1 is connected to the PABX and the voice channel 2 routed to the StationLink in Node 1. For the vMUX Station Address settings refer to the description, *7.6.2 The vMUX Node*. The other settings are given below:



Label	Port	Datarate	Signalization	Input level	Output level	4 wire	LEC	VAD	Channel	Priority	Group
Voice 1	VFx-1/P1	G.723 (6.3)	S2	-3.5 dB	-3.5 dB	☑	☐	☐	1	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---
	---	---	S2	0 dB	0 dB				---	0	---

[sc_example_vmux_v1_link3, 1, --_--]

Figure 7-54 vMUX configuration for the voice channel 1 for Link3 Terminal A



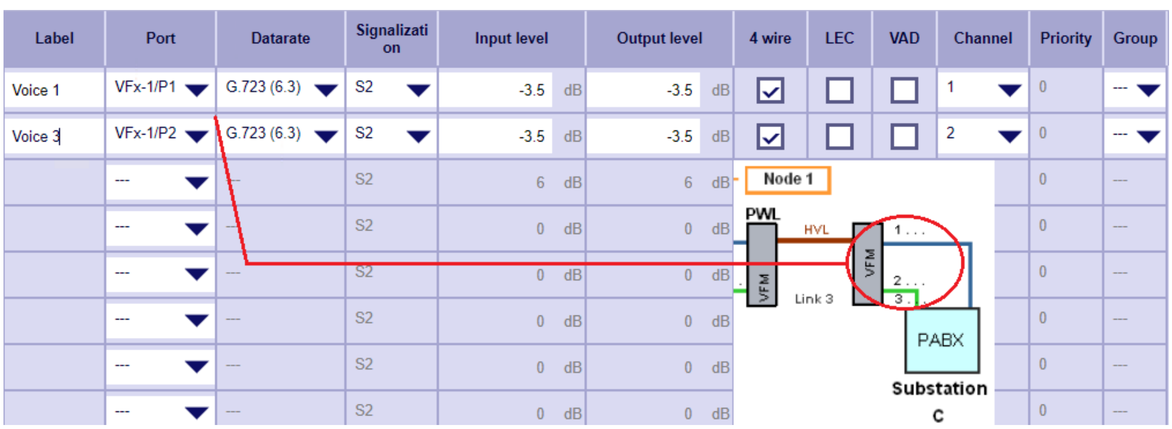
Label	Type	Channel	Priority	Dest. dev.	Dest. ch.	Datarate
Voice 3	Voice	3	0	1	3	G.723 (6.3)
	---	---	0	1	---	
	---	---	0	1	---	
	---	---	0	1	---	
	---	---	0	1	---	
	---	---	0	1	---	

[sc_example_vmux_v1_sl_link3, 1, --_--]

Figure 7-55 vMUX StationLink configuration for the voice channel 3 from Link 3 Terminal A

vMUX Configuration for Link 3 Terminal B

Both voice channels from the PowerLink in substation C are connected to the PABX. Therefore only the local port configuration in the vMUX is necessary. The settings are given below:



Label	Port	Datarate	Signalization	Input level	Output level	4 wire	LEC	VAD	Channel	Priority	Group
Voice 1	VFx-1/P1	G.723 (6.3)	S2	-3.5 dB	-3.5 dB	☑	☐	☐	1	0	---
Voice 3	VFx-1/P2	G.723 (6.3)	S2	-3.5 dB	-3.5 dB	☑	☐	☐	2	0	---
	---	---	S2	6 dB	6 dB					0	---
	---	---	S2	0 dB	0 dB					0	---
	---	---	S2	0 dB	0 dB					0	---
	---	---	S2	0 dB	0 dB					0	---
	---	---	S2	0 dB	0 dB					0	---
	---	---	S2	0 dB	0 dB					0	---

[sc_example_vmux_terminalb_link3, 1, --_--]

Figure 7-56 vMUX configuration for the Terminal B from Link 3

8 Diagnostics and Error Handling

8.1 Overview

At the beginning of this chapter, you'll find a figure showing the **control and signaling elements** of the CSPi module. Subsequently the function of the buttons and LED significations are described.

The PowerLink system provides a diagnostic function displayed on 8 LED at the CSPi and vMUX module. They can be activated in the service program PowerSys with selecting various diagnostic modes. The significance of the LED in the corresponding modes is described in the section **Diagnostic LED H10 – H17 (CSPi) and H1 – H8 (vMUX)**.

For the SWT 3000 integrated in PowerLink the **control and signaling elements** of the PU4 module and diagnosis functions of the EN100 module are described.

Alarms occurring in PowerLink are displayed in the PowerSys form <**Information / Alarms / Errors**>. The corresponding system reaction is shown in the section **System Alarm Display**.

Additional to the diagnostic LED also test modes can be selected in the service program. A corresponding description is available in the section **Test modes**.

The section **Data Pump block error** provides information about the display of block errors and useful adjustments for Data Pump block error supervision, in case of using the service Data Pump in the PowerLink.

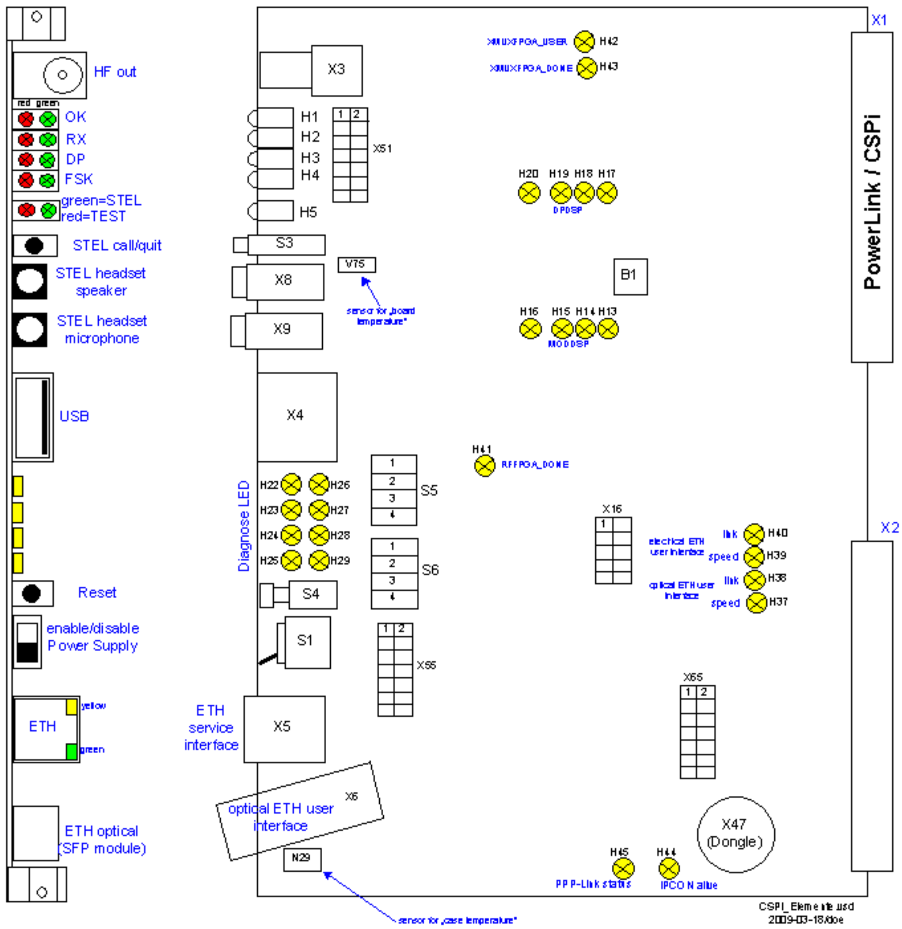
In the section **Quality Data (QD)** information for the Quality Data records can be found.

The section **Problem Tracking** answers frequently asked questions (FAQ) about the PowerLink and the integrated protection signaling equipment iSWT 3000 and provides operating instructions for possible system reactions in case of disturbances resp. operating errors.

The function and contents of PowerLink Eventlog and iSWT 3000 Eventrecorders are described in chapter *Service Program PowerSys and MemTool*.

8.2 Control and Signaling Elements on the CSPi Module

8.2.1 General



[tdplcspi-031210-45.tif, 1, en_US]

Figure 8-1 Jumpers, Connectors, Control, and Signaling Elements on the CSPi module

Dongle (X47)

The dongle contains the information about enabled resp. possible services. An operation of the system without dongle is not possible.

NOTE

Removing and inserting the dongle is only allowed, when the power is off!

The dongle can be (re)programmed on-board with the service program PowerSys. Therefore an applicable “dongle file” is needed. For further information see chapter *Commissioning* of this manual.

8.2.2 CSPi Input Elements in the Front Cover

Service Telephone Button (S3)

S3 is used to control the function “Service Telephone” (STEL, EOW). You find further information about the service telephone function in chapter *Commissioning*

Service Telephone – Connectors for Headset (X8, X9)

At these two 3.5-mm stereo jacks, the upper one (X8) for the earpieces and the lower one (X9) for the microphone, a headset can be connected.

Reset Button (S4)

Pushing the reset button restarts the PowerLink, the integrated SWT 3000 and all functions.
The reset button is located behind the front cover and cannot be pushed purposeless.

NOTE

ATTENTION:
Reset interrupts also tele-protection operation! In case of integrated SWT 3000, a reset for SWT 3000 has to be only generated from CSPi module!

Service Interface Connector (X5)

Ethernet connector for the Service PC. This interface can be switched between DHCP Server on (default setting) or DHCP Server off.

Slot for SFP Module (X6)

Slot for an SFP module for the optical Ethernet user interface.

8.2.3 Input Elements Behind the Front Cover

8.2.3.1 Power Inhibit (Switch S1)

Table 8-1 CSPi-Switch S1

Position	
Down	Power supply disabled
Up	Power supply is enabled

8.2.3.2 DIL-Switches

DIL-Switch S5

Table 8-2 DIL-Switches S5/1 to 4

S5	Pos	Explanation	
1	On	MemTool operation (read/write CSPiFPROM)	
	Off	No MemTool operation	
2	On	Monitor active (for programming iSWT 3000 with MemTool)	
	Off	Monitor inactive	
3	On	Enable Debugger (Auto Reset is prevented, even if Auto Reset activated with PowerSys)	
	Off	Disable Debugger	
4	On	S5/2 = off (monitor mode inactive)	S5/2 = on (monitor mode active)
	Off	Diagnose mode after reset	CSPi initialization and self test only for use in the factory
		Normal operation after reset	CSPi initialization only for use in the factory

Note-1: Changes are only recognized after Reset

In normal operation of the PowerLink, all switches have to be in "OFF" position!

DIL-Switch S6

Table 8-3 DIL-Switches S6/1 to 4

S6	Pos	Explanation
1	On	Interface RM-1/SSM is used for IPCON terminal connection (needed for programming the IPCON FPROM).
	Off	Interface RM-1/SSM is used for CSPCON terminal (for CSPCON Monitor) or PowerSys (Application)
2	On	CSPCON-Boot-Loader does not load CSPCON-Monitor resp. CSPCON-Application. Only for test purposes in the factory
	Off	normal mode
3	On	n.u.
	Off	n.u.
4	On	n.u.
	Off	n.u.

In normal operation of the PowerLink, all switches have to be in "OFF" position!

8.2.3.3 CSPi Connector X3 (BNC)

This connector is used for measuring the HF transmit level of the configured services at the CSPi output. The level as well as the HF frequency is shown in the PowerSys service program in the form <**Information – Services**>.

8.2.3.4 CSPi Connector X4 (USB)

The USB connector X4 is for future use.

8.2.4 CSPi Operation Signaling LED in the Front Cover

The CSPi LED OK, RX, DP, FSK and STEL consist of 2 LED, a red one (Hx-1) and a green one (Hx-2), to inform the user about the actual state of PowerLink.

The LED "OK"

Table 8-4 The LED "OK" (H1-1, H1-2)

State	Reasons
Off	a) Power off or b) System failure!
green	System is OK and no test mode or temporary setting is active
green slow blinking	System is OK but a test mode or temporary setting is active.
green fast blinking	System is OK but IPCON is not yet ready for operation
red	Board alarm (BGAL) and no test mode or temporary setting is active
red slow blinking	Board alarm (BGAL) but any test mode or temporary setting is active
red fast blinking	Board alarm (BGAL) and IPCON is not yet ready for operation

The LED RX

Table 8-5 The LED “RX” (H2-1, H2-2)

State	Reasons
Off	a) Power off or b) System failure
green	Receiver OK. Pilot alarm is off. AGC alarm is off, Signal to Noise alarm is off
green slow blinking	AGC limit reached (AGC alarm is on alarm relay NU) or AGC not locked Overload in receive path – input level to high
green fast blinking	Signal to Noise alarm
red	Error service 1 to 4
red slow blinking	Pilot level to low
red fast blinking	Receive level to high. ADC overflow, see also display overflow in the form <**Adjust-ment-RX leveling**>. For further adjustment from the ADC ref. to chapter *Commis-sioning*.

The LED DP

Table 8-6 The LED “DP” (H3-1, H3-2)

State	Reasons
Off	a) Power off or b) Service DP inactive (not configured) or c) Error occurred before starting service DP
green	Data Pump has synchronized; xMUX has synchronized
green slow blinking	Data Pump has synchronized; xMUX has not synchronized
green fast blinking	DP Configuration Alarm (Master-Master warning), xMUX Alarm
red	Data Pump error (causes Auto Reset)
red slow blinking	Data Pump not synchronized
red fast blinking	Signal Generator ON resp. Test configuration (e.g. xMUX Loop back

xMUX = iMUX or SMUX

The LED FSK

Table 8-7 The LED “FSK” (H4-1, H4-2)

State	Reasons
Off	a) Power off or b) Service inactive (not configured) or c) Error occurred before starting service iFSK
green	iFSK 1 to 4 OK
green slow blinking	“RX supervision alarm” or “signal quality alarm” or “TX signal overflow” in iFSK-1 and/or iFSK-2 and/or iFSK-3 and or iFSK-4
green fast blinking	At least one iFSK channel not in normal operation (test mode)
red	Service iFSK error
red slow blinking	iFSK Level alarm (PAL)
red fast blinking	iFSK Configuration alarm (at least 1 parameter in a iFSK channel out of range)

The LED STEL

Table 8-8 The LED "STEL" (H5-1)

State	Reasons
Off	Service telephone inactive
green	STEL active
green slow blinking	--
green fast blinking	Signaling (Service telephone call request)

The LED TEST

Table 8-9 The LED "TEST" (H5-2)

State	Reasons
Off	Service telephone inactive
red	not used
red slow blinking	Any Test mode is active (GENALR active with Test mode)
red fast blinking	Diagnose mode is active

The LED in ETH RJ45 Connector C5

Table 8-10 The LED in the ETH RJ45 connector

LED	State/Explanation
yellow (top)	• off: Ethernet Service Interface is not connected • on: Ethernet Service Interface is connected
green (bottom)	• off: Ethernet Service Interface with 10 Mbps • on: Ethernet Service Interface with 100 Mbps

Signaling during Firmware Download

During firmware download with PowerSys the 4 LED "OK", "RX", "DP" and "FSK" are used for signaling download activities. Firmware download means that data are loaded into FPROM on board CSPi. During download the LED "OK", "RX", "DP" and "FSK" are flashing "crosswise", what means that LED are flashing alternating:

- OK = **red** and RX = off and DP = off and FSK = **red** or
- OK = off and RX = **red** and DP = **red** and FSK = off

Signaling during VFx Programming

The firmware for the controllers of the VFX boards are stored in the CSPi FPROM. During system startup CSPi compares the version and the revision of the VFX controllers with the version and revision stored in the CSPi.
Disparity between the version causes:

- In the case of normal operation:
  PowerLink is generating an error which causes auto reset
- In the case that a test mode is active:
  PowerLink is generating a warning (non urgent alarm)
- In the case of diagnose mode is active:
  Those VFX boards that needs a firmware update are programmed

During programming firmware for VFx controllers the 4 LED "OK", "RX", "DP" and "FSK" are used for signaling programming activities.
The Firmware for the controller on boards VFx-1 to 3 is loaded from CSPi_FPROM to VFXCON_FPROM only in the diagnostic mode. To switch into this mode DIL switch S5/4 is set to "On" before the restart of the

system. Before a VFx programming sequence is started, the LED “OK”, “RX”, “DP” and “FSK” are flashing 5 times “parallel”. During download the LED “OK”, “RX”, “DP” and “FSK” are flashing “crosswise”, what means that LED are flashing alternating.

- OK = **red** and DP = **red** and RX = off and FSK = off or
- OK = off and DP = off and RX = **red** and FSK = **red**

The firmware download is finished with a reset. This causes PowerLink to restart in the diagnostic mode (LED “OK” is green fast blinking).
Then the diagnostic mode is finished manually as described in *Diagnostic Mode*.

Signaling Auto Reset

Auto-Reset is executed by internal watchdog. Before the watchdog timer expires LED “OK”, “RX”, “DP” and “FSK” are flashing 5 times between states “red” and “off”.

8.2.5 CSPi LED Behind the Front Cover

8.2.5.1 MODDSP LED H13 to H16

Only for factory use

8.2.5.2 Data Pump LED H17 to H20

Only for factory use

8.2.5.3 ETH User Interfaces LED H37 to H40

Table 8-11 The ETH User Interface LED

LED	State	Explanation
H37	off	Electrical Ethernet User Interface is not connected
	on	Electrical Ethernet User Interface is connected
H38	off	Electrical Ethernet User Interface with 10 Mbps
	on	Electrical Ethernet User Interface with 100 Mbps
H39	off	Optical Ethernet User Interface is not connected
	on	Optical Ethernet User Interface is connected
H40	off	Optical Ethernet User Interface with 10 Mbps
	on	Optical Ethernet User Interface with 100 Mbps

8.2.5.4 RFFPGA_DONE LED H41

Table 8-12 The RFFPGA_DONE LED

LED	State	Explanation
H41	off	RFFPGA initialized
	on	RFFPGA not initialized

8.2.5.5 MUXFPGA_USER LED H42

Only for factory use

8.2.5.6 MUXFPGA_Done LED H43

Table 8-13 The MUXFPGA_Done LED

LED	State	Explanation
H43	off	MUXFPGA initialized
	on	MUXFPGA not initialized

8.2.5.7 IPCON LED H44 to H45

Table 8-14 The RFFPGA LED

LED	States	Explanation
H44	off	power off
	blinking < 1 s cycle	Boot loader active
	blinking 1 s cycle	Linux alive
H45	off	PPP not active
	on	PPP active

8.2.5.8 Diagnostic LED H22 to H29

For diagnostics purposes, 8 LED (H22 to H29) are available on the CSPi module. The LED are located behind the front cover. The significance depends on the diagnostic mode which is selected in the service program PowerSys in the form: <**Configuration – Option**>.

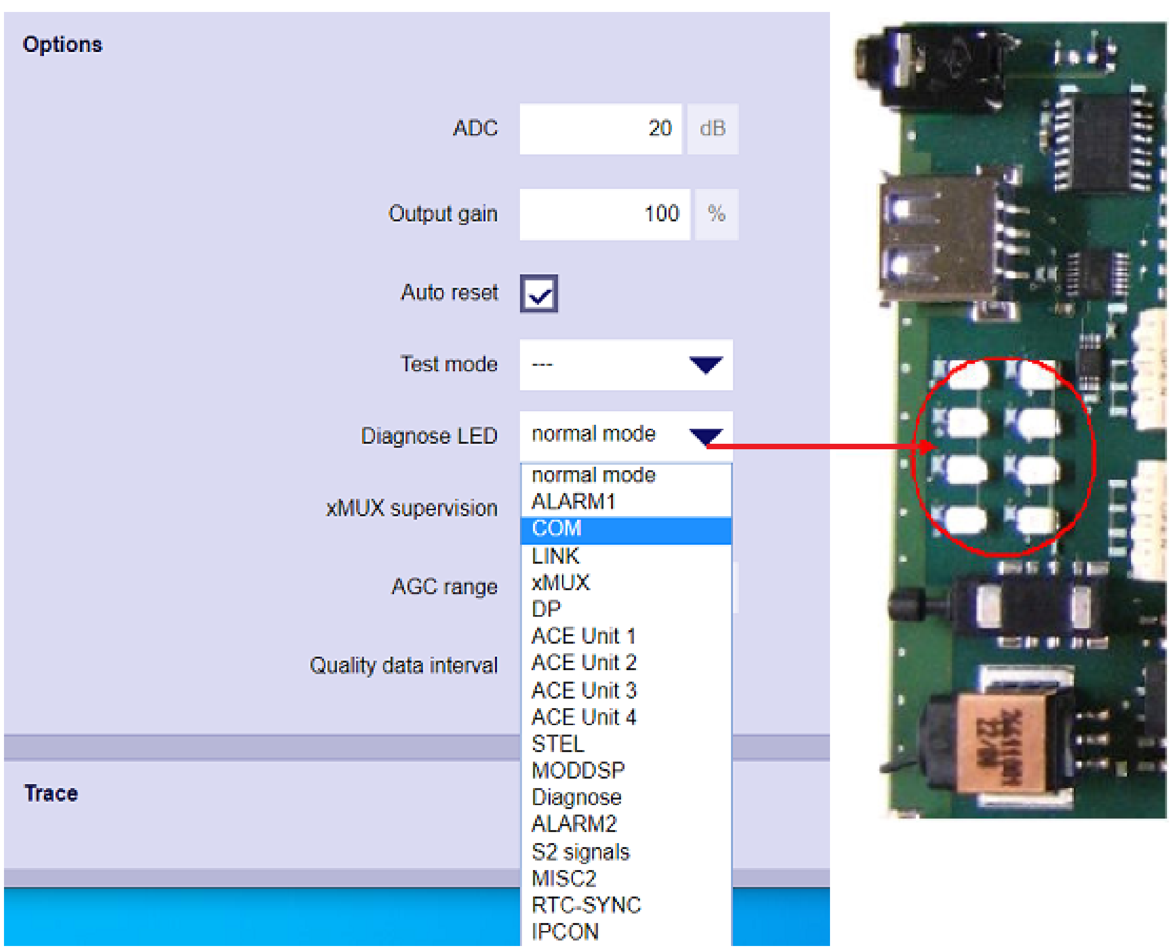


Figure 8-2 The adjustment of the diagnostic LED display

Normal Operating Mode (Status of Equalizer)

The significance of the LED H22 to H29 in the normal operating mode is shown in the following table.

Table 8-15 Diagnostic LED in the “normal mode”

Status	LED	Explanation	LED	Explanation
off	DIAG1	ACE for **Service-1** is disabled	DIAG5	ACE for **Service-1** is disabled
yellow	(H22)	ACE TX state is “ready”	(H26)	ACE RX state is “ready”
yellow slow blinking		ACE TX is “busy” or “locked”		ACE RX is “busy”
yellow fast blinking		**ACE TX failed** (TO or S6)		**ACE RX failed** (TO or FAILED)
off	DIAG2	ACE for **Service-2** is disabled	DIAG6	ACE for **Service-2** is disabled
yellow	(H23)	ACE TX state is “ready”	(H27)	ACE RX state is “ready”
yellow slow blinking		ACE TX is “busy” or “locked”		ACE RX is “busy”
yellow fast blinking		**ACE TX failed** (TO or S6)		**ACE RX failed** (TO or FAILED)
off	DIAG3	ACE for **Service-3** is disabled	DIAG7	ACE for **Service-3** is disabled
yellow	(H24)	ACE TX state is “ready”	(H28)	ACE RX state is “ready”
yellow slow blinking		ACE TX is “busy” or “locked”		ACE RX is “busy”
yellow fast blinking		**ACE TX failed** (TO or S6)		**ACE RX failed** (TO or FAILED)
off	DIAG4	ACE for **Service-4** is disabled	DIAG8	ACE for **Service-4** is disabled
yellow	(H25)	ACE TX state is “ready”	(H29)	ACE RX state is “ready”
yellow slow blinking		ACE TX is “busy” or “locked”		ACE RX is “busy”
yellow fast blinking		**ACE TX failed** (TO or S6)		**ACE RX failed** (TO or FAILED)

ACE RX state is set to “failed” after start-up

TO = timeout

ALARM 1 Mode (Status of Alarm Relays)

The significance of the LED H22 to H29 in the alarm 1 mode is shown in the following table.

Table 8-16 Diagnostic LED in the “ALARM1” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	Alarm GENALR off	DIAG5	Alarm NDALR off
yellow	(H22)	**Alarm GENALR on**	(H26)	**Alarm NDALR on**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG2	Alarm SALR off	DIAG6	Alarm REMALR off
yellow	(H23)	**Alarm SALR on**	(H27)	**Alarm REMALR on**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG3	Alarm EALR off	DIAG7	Alarm DPALR off
yellow	(H24)	**Alarm EALR on**	(H28)	**Alarm DPALR on**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG4	Alarm SNALR off	DIAG8	FSK1, 2, 3, 4 ALR off
yellow	(H25)	**Alarm SNALR on**	(H29)	**FSK1, 2, 3, 4 ALR on**
yellow slow blinking		---		---
yellow fast blinking		---		---

COM Mode

The significance of the LED H22 to H29 in the com mode is shown in the following table.

Table 8-17 Diagnostic LED in the “COM” mode

Status	LED	Explanation	LED	Explanation
Off	DIAG1	**Rx: iLAN (toggle)**	DIAG5	**Tx: iLAN (toggle)**
Yellow	(H22)	**Rx: iLAN (toggle)**	(H26)	**Tx: iLAN (toggle)**
yellow slow blinking		---		---
yellow fast blinking		---		---
Off	DIAG2	**Rx: RM- (toggle)**	DIAG6	**Tx: RM (toggle)**
Yellow	(H23)	**Rx: RM (toggle)**	(H27)	**Tx: RM (toggle)**
yellow slow blinking		---		---
yellow fast blinking		---		---
Off	DIAG3	**Rx: RM-2 (toggle)**	DIAG7	**Tx: RM-2 (toggle)**
Yellow	(H24)	**Rx: RM-2 (toggle)**	(H28)	**Tx: RM-2 (toggle)**
yellow slow blinking		---		---
yellow fast blinking		---		---
Off	DIAG4	**Rx: SSM/RM-1 (toggle)**	DIAG8	**Tx: SSM/RM-1 (toggle)**
Yellow	(H25	**Rx: SSM/RM-1 (toggle)**	(H29)	**Tx: SSM/RM-1 (toggle)**
yellow slow blinking		---		---
yellow fast blinking		---		---

iLAN = internal connection between CSPi, iSWT, and VFx. Must toggle if iSWT or VFx is used

RM = Remote Monitoring channel communication via line

RM-1 = PowerSys communication or IPCON console via connector panel

RM-2 = RM channel communication via RM-2 interface (route communication

LINK Mode (Status of RM Channel

The significance of the LED H22 to H29 in the link mode is shown in the following table.

Table 8-18 Diagnostic LED in the “LINK” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	DDI Layer2 disconnected	DIAG5	---
yellow	(H22)	**DDI Layer2 connected**	(H26)	---
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG2	RM-Layer2 disconnected	DIAG6	---
yellow	(H23)	**RM-Layer2 connected**	(H27)	---
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG3	SSB/RM-2 Layer2 discon-nected	DIAG7	---
yellow	(H24)	**SSB/RM-2 Layer2 connected**	(H28)	---
yellow slow blinking		---		---
yellow fast blinking		---		---

Status	LED	Explanation	LED	Explanation
off	DIAG4	SSM/RM-1 Layer2 discon-nected	DIAG8	---
yellow	(H25)	**SSM/RM-1 Layer2 connected**	(H29)	---
yellow slow blinking		---		---
yellow fast blinking		---		---

DDI: Interface between IPCON and CSPCON

RM-Layer2 = RM connection via the line

RM-1-Layer2 = RM connection via the RM-1 interface

RM-2-Layer2 = RM connection via the RM-2 interface

xMUX Mode (xMUX is working as vMUX)

The significance of the LED H22 to H29 in the vMUX mode is shown in the following table.

Table 8-19 Diagnostic LED in the “vMUX” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	Alarm VMUXGENALR off	DIAG5	Alarm VMUXFLSYNC off
yellow	(H22)	**Alarm VMUXGENALR on**	(H26)	**Alarm VMUXFLSYNC on**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG2	Alarm VMUXEALR off	DIAG6	Alarm VMUXBLSYNC off
yellow	(H23)	**Alarm VMUXEALR on**	(H27)	**Alarm VMUXBLSYNC on**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG3	Alarm VMUXNDALR off	DIAG7	Alarm VMUXRDY2GO off
yellow	(H24)	**Alarm VMUXNDALR on**	(H28)	**Alarm VMUXRDY2GO on**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG4	vMUX not synchronized	DIAG8	Alarm VMUXRMFOVR and VMUXRMFOVT off
yellow	(H25)	**vMUX synchronized**	(H29)	**Alarm VMUXRMFOVR and/or VMUXRMFOVT on**
yellow slow blinking		---		---
yellow fast blinking		---		---

xMUX Mode (xMUX is working as SMUX)

The significance of the LED H22 to H29 in the SMUX mode is shown in the following table.

Table 8-20 Diagnostic LED in the “vMUX” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	SMUX not synchronized	DIAG5	RESYNC off
yellow	(H22)	SMUX synchronized, SYNC supervision off	(H26)	**RESYNC on**
yellow slow blinking		**SMUX synchronized, SYNC supervision started**		---
yellow fast blinking		---		---
off	DIAG2	Alarm SMUXALA off	DIAG6	Bit Error Rate = 0

Status	LED	Explanation	LED	Explanation
yellow	(H23)	**Alarm SMUXALA on**	(H27)	**Bit Error Rate > 0 *)**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG3	Alarm RX FIFO Overflow off	DIAG7	STOPRX and STOPTX off
yellow	(H24)	**Alarm RX FIFO Overflow on**	(H28)	**STOPRX and STOPTX on**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG4	Alarm TX FIFO Overflow off	DIAG8	PLL locked
yellow	(H25)	**Alarm TX FIFO Overflow on**	(H29)	**PLL unlocked**
yellow slow blinking		---		---
yellow fast blinking		---		---

*) is on when a Bit Error is detected during the 5 second integration interval

xMUX Mode (xMUX is working as EMUX)

The significance of the LED H22 to H29 in the EMUX mode is shown in the following table.

Table 8-21 Diagnostic LED in the “EMUX” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	EMUX not synchronized	DIAG5	DP Local Loop off
yellow	(H22)	**EMUX synchronized**	(H26)	---
yellow slow blinking		---		---
yellow fast blinking		EMUX Sync Timeout		**DP Local Loop on**
off	DIAG2	Alarm EMUXALA off	DIAG6	PPP UART Loop off
yellow	(H23)	**Alarm EMUXALA on**	(H27)	---
yellow slow blinking		---		---
yellow fast blinking		---		**PPP UART Loop on**
off	DIAG3	Alarm RX FIFO Overflow off	DIAG7	EMUX supervision off
yellow	(H24)	**Alarm RX FIFO Overflow on**	(H28)	EMUX supervision finished
yellow slow blinking		---		EMUX supervision running
yellow fast blinking		---		Sync Lost during EMUX supervision interval
off	DIAG4	Alarm TX FIFO Overflow off	DIAG8	---
yellow	(H25)	**Alarm TX FIFO Overflow on**	(H29)	**IPCON ready and DP synchronized**
yellow slow blinking		---		Wait for DP synchronization
yellow fast blinking		---		Wait for IPCON ready

Data Pump Mode

The significance of the LED H22 to H29 in the Data Pump mode is shown in the following table.

Table 8-22 Diagnostic LED in the “DP” Data Pump mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	DP Measurement data not ready	DIAG5	Data Pump not synchronized
yellow	(H22)	**DP Measurement data ready**	(H26)	**DP synchronized with primary bit rate**
yellow slow blinking		---		**DP synchronized with secon-dary bit rate**
yellow fast blinking		**DP Measurement data readout**		---
off	DIAG2	---	DIAG6	Not ready to up switch local
yellow	(H23)	**Block error** (display time at least 1 second)	(H27)	**Ready to up switch local**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG3	xMUX not synchronized	DIAG7	Not ready to up switch remote
yellow	(H24)	**xMUX synchronized**	(H28)	**Ready to up switch remote**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG4	Alarm xMUX off	DIAG8	Bit Error Rate < 10-3
yellow	(H25)	---	(H29)	**Bit Error Rate ≥ 10-3**
yellow slow blinking		---		---
yellow fast blinking		**Alarm xMUX on**		---

xMUX = EMUX, iMUX, iMUXIEC, SMUX (G703.1), SMUX (X.21) or vMUX

ACE Unit (Automatic Channel Equalizer)

The significance of the LED H22 to H29 in the automatic channel equalization mode (ACE) is shown in the following table.

Table 8-23 Diagnostic LED in the “ACE Unit 1 to 4” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	ACE disabled	DIAG5	Unidirectional
yellow	(H22)	**ACE enabled**	(H26)	Bidirectional (always set)
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG2	Not ready to start cyclic ACE	DIAG6	F2 level < threshold and S2IN and S2OUT signal unchanged
yellow	(H23)	**Ready to start cyclic ACE**	(H27)	**F2 level > threshold and/or S2IN and/or S2OUT signal changed**
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG3	ACE Tx not started	DIAG7	No ACE start sequence received
yellow	(H24)	**ACE Tx started**	(H28)	**ACE start sequence received**
yellow slow blinking		---		---
yellow fast blinking		---		---

Status	LED	Explanation	LED	Explanation
off	DIAG4	ACE inactive	DIAG8	
yellow	(H25)	ACE Tx successful	(H29)	ACE Rx successful
yellow slow blinking		**ACE Tx start failed (timeout)**		---
yellow fast blinking		**ACE Tx start failed (S6 break)**		**ACE Rx failed**

Service Telephone Mode STEL

The significance of the LED H22 to H29 in the service telephone mode (STEL) is shown in the following table.

Table 8-24 Diagnostic LED in the “STEL” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	Button STEL not pressed	DIAG5	Not used
yellow	(H22)	**Button STEL pressed**	(H26)	
yellow slow blinking				
yellow fast blinking				
off	DIAG2	Not used	DIAG6	Not used
yellow	(H23)		(H27)	
yellow slow blinking				
yellow fast blinking				
off	DIAG3	Buttons unlocked	DIAG7	Not used
yellow	(H24)	**Buttons locked**	(H28)	
yellow slow blinking				
yellow fast blinking				
off	DIAG4	STEL signaling disabled	DIAG8	Not used
yellow	(H25)	**STEL signaling enabled**	(H29)	
yellow slow blinking				
yellow fast blinking				

MODDSP Mode

The significance of the LED H22 to H29 in the MODDSP mode is shown in the following table.

Table 8-25 Diagnostic LED in the “MODDSP” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	AGC not locked	DIAG5	
yellow	(H22)	**AGC locked**	(H26)	
yellow slow blinking				
yellow fast blinking				
off	DIAG2	RF loop open	DIAG6	
yellow	(H23)	**RF loop closed**	(H27)	
yellow slow blinking				
yellow fast blinking				
off	DIAG3	No RF clipping	DIAG7	
yellow	(H24)	**RF clipping *)**	(H28)	
yellow slow blinking				
yellow fast blinking				
off	DIAG4	S2 signaling disabled	DIAG8	
yellow	(H25)	**S2 signaling enabled**	(H29)	

Status	LED	Explanation	LED	Explanation
yellow slow blinking				
yellow fast blinking				

*) LED on is extended for 2 seconds

Diagnose Mode

The significance of the LED H22 to H29 in the Diagnose mode is shown in the following table.

Table 8-26 Diagnostic LED in the Diagnose mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	---	DIAG5	---
yellow	(H22)	Test VFX Port-0	(H26)	Test VFX Port-4
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG2	---	DIAG6	---
yellow	(H23)	Test VFX Port-1	(H27)	Test VFX Port-5
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG3	---	DIAG7	---
yellow	(H24)	Test VFX Port-2	(H28)	Test VFX Port-6
yellow slow blinking		---		---
yellow fast blinking		---		---
off	DIAG4	---	DIAG8	---
yellow	(H25)	Test VFX Port-3	(H29)	Test VFX Port-7
yellow slow blinking		---		---
yellow fast blinking		---		---

Alarm2 Mode (ALA2 Alarm Amplifier and F6 Supervision)

The significance of the LED H22 to H29 in the ALARM2 mode is shown in the following table.

Table 8-27 Diagnostic LED in the “ALARM2” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	Tx Alarm PLPA-1 off	DIAG5	Alarm F6 superv. Serv.-1 off
yellow	(H22)	---	(H26)	**Alarm F6 superv. Serv.-1 on**
yellow slow blinking		**Tx Alarm PLPA-1 on**		
yellow fast blinking		---		
off	DIAG2	Tx Alarm PLPA-2 off	DIAG6	Alarm F6 superv. Serv.-2 off
yellow	(H23)	---	(H27)	**Alarm F6 superv. Serv.-2 on**
yellow slow blinking		**Tx Alarm PLPA-2 on**		
yellow fast blinking		---		
off	DIAG3	PLPA dynamic control alarm off	DIAG7	Alarm F6 superv. Serv.-3 off
yellow	(H24)	---	(H28)	**Alarm F6 superv. Serv.-3 on**
yellow slow blinking		**PLPA dynamic control alarm on**		
yellow fast blinking		---		
off	DIAG4		DIAG8	Alarm F6 superv. Serv.-4 off

Status	LED	Explanation	LED	Explanation
yellow	(H25)		(H29)	**Alarm F6 superv. Serv.-4 on**
yellow slow blinking				
yellow fast blinking				

S2 Signals Mode

The significance of the LED H22 to H29 in the S2 signals mode is shown in the following table.

Table 8-28 Diagnostic LED in the “S2 Signals” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	Signal S2IN (unit-1) inactive	DIAG5	Signal S2OUT (unit-1) inactive
yellow	(H22)	**Signal S2IN (unit-1) active**	(H26)	**Signal S2OUT (unit-1) active**
yellow slow blinking		---		
yellow fast blinking		---		
off	DIAG2	Signal S2IN (unit-2) inactive	DIAG6	Signal S2OUT (unit-2) inactive
yellow	(H23)	**Signal S2IN (unit-2) active**	(H27)	**Signal S2OUT (unit-2) active**
yellow slow blinking		---		
yellow fast blinking		---		
off	DIAG3	Signal S2IN (unit-3) inactive	DIAG7	Signal S2OUT (unit-3) inactive
yellow	(H24)	**Signal S2IN (unit-3) active**	(H28)	**Signal S2OUT (unit-3) active**
yellow slow blinking		---		
yellow fast blinking		---		
off	DIAG4	Signal S2IN (unit-4) inactive	DIAG8	Signal S2OUT (unit-4) inactive
yellow	(H25)	**Signal S2IN (unit-4) active**	(H29)	**Signal S2OUT (unit-4) active**
yellow slow blinking				
yellow fast blinking				

Indicated S2 signal state is not influenced by setting “PowerLink/Adjustment/Options/Service-x/invert S2”. The refresh cycle of the display is 1 second, therefore fast changes of S2 signal cannot be displayed.

MISC2 Mode (Status of Connection)

The significance of the LED H22 to H29 in the MISC2 mode is shown in the following table.

Table 8-29 Diagnostic LED in the “MISC2” mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	Local iLAN communication Receiver ready	DIAG5	Remote iLAN communication Receiver ready
yellow	(H22)	**Local iLAN communication** **Receiver not ready**	(H26)	**Remote iLAN communication** **Receiver not ready**
yellow slow blinking		---		
yellow fast blinking		---		
off	DIAG2	Local RM communication Receiver ready	DIAG6	Remote RM communication Receiver ready
yellow	(H23)	Local RM communication Receiver not ready	(H27)	Remote RM communication Receiver not ready
yellow slow blinking		---		
yellow fast blinking		---		

Status	LED	Explanation	LED	Explanation
off	DIAG3	Local SSB/RM-2 communica-tion	DIAG7	Remote SSB/RM-2 com.
		Receiver ready		Receiver ready
yellow	(H24)	**Local SSB/RM-2 com.**	(H28)	**Remote SSB/RM-2 com.**
		Receiver not ready		**Receiver not ready**
yellow slow blinking		---		
yellow fast blinking		---		
off	DIAG4	Local SSM/RM-1 communica-tion	DIAG8	Remote SSM/RM-1 com.
		Receiver ready		Receiver ready
yellow	(H25)	**Local SSM/RM-1 com.**	(H29)	**Remote SSM/RM-1 com.**
		Receiver not ready		**Receiver not ready**
yellow slow blinking				
yellow fast blinking				

RTCSYN Mode

The significance of the LED H22 to H29 in the RTCSYNC mode is shown in the following table.

Table 8-30 Diagnostic LED in the "RTCSYN" mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	Without RTC synchronization	DIAG5	IRIG-B not used
yellow	(H22)	**With RTC synchronization**	(H26)	**IRIG-B synchronized**
yellow slow blinking		---		**IRIG-B not synchronized**
yellow fast blinking		---		**IRIG-B no signal**
off	DIAG2		DIAG6	
yellow	(H23)	NTP time and date valid	(H27)	**USYNC missing**
yellow slow blinking		**NTP time and date not valid**		
yellow fast blinking		**NTP server missing**		
off	DIAG3	Without iUSYNC	DIAG7	USYNC successful
yellow	(H24)	**With iUSYNC**	(H28)	**USYNC failed**
yellow slow blinking		---		
yellow fast blinking		---		
off	DIAG4		DIAG8	USYNC alarm off
yellow	(H25)	**USYNC Done (duration ~1 s)**	(H29)	**USYNC alarm on**
yellow slow blinking				
yellow fast blinking				

NTP: Network Time Protocol
iUSYNC: internal clock synchronization between CSPi and iSWT
(NTP sync in CSPi and USYNC in iSWT has to be configured)
USYNC: Clock synchronization general

IPCON Mode

The significance of the LED H22 to H29 in the IPCON mode is shown in the following table

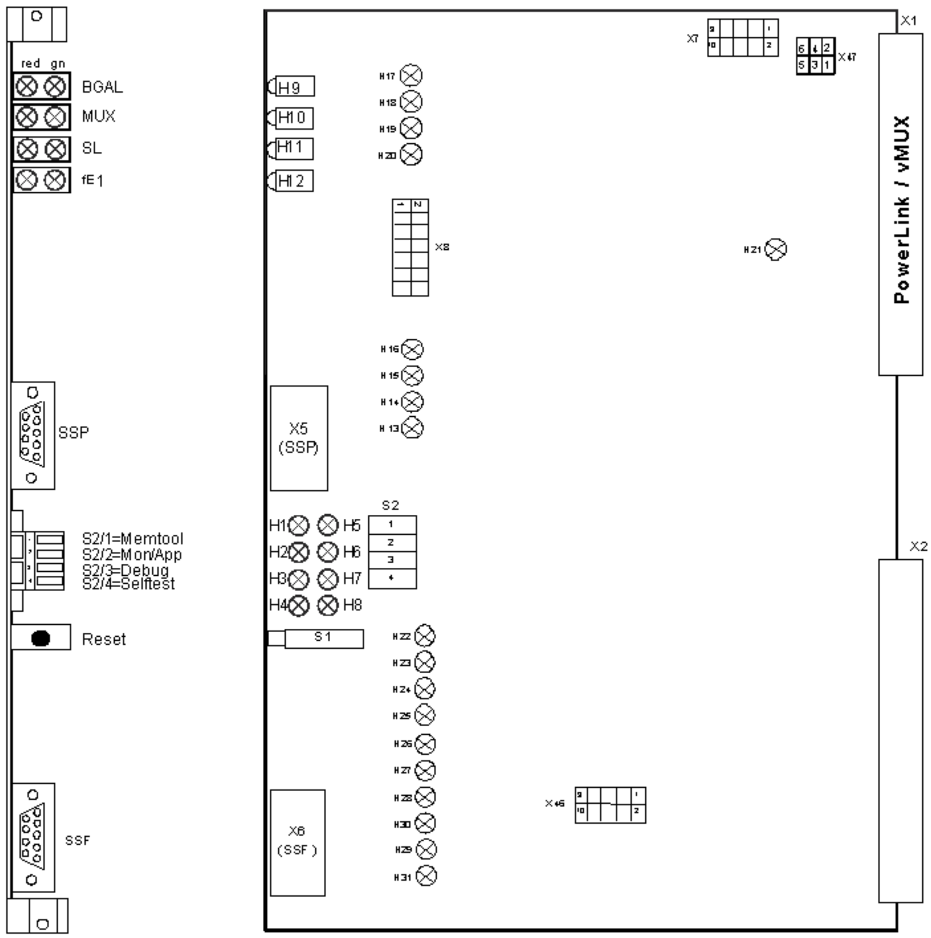
Table 8-31 Diagnostic LED in the "IPCON" mode

Status	LED	Explanation	LED	Explanation
off	DIAG1	ICC from IPCON not yet detected	DIAG5	IPCON not ready
yellow	(H22)	**ICC from IPCON detected**	(H26)	**IPCON ready detected**
yellow slow blinking		**ICC from IPCON timeout**		**IPCON ready timeout**
yellow fast blinking		**ICC from IPCON lost**		**IPCON ready lost**
off	DIAG2	**IPCON alive = 0**	DIAG6	ETH service interface inactive
yellow	(H23)	**IPCON alive = 1**	(H27)	**ETH service interface active**
yellow slow blinking		---		
yellow fast blinking		**IPCON alive counter timeout** (error)		
off	DIAG3	No PowerSys session	DIAG7	at least one ETH user interface active
yellow	(H24)	**PowerSys session active**	(H28)	**ETH user interfaces down**
yellow slow blinking		---		
yellow fast blinking		---		
off	DIAG4	no IPCON error and PPP not active	DIAG8	
yellow	(H25)	**PPP active, primary data rate**	(H29)	
yellow slow blinking		**PPP active, secondary data rate**		
yellow fast blinking		**IPCON error**		**NTP server cannot be connected**

ICC: Internal Communication Control between IPCON and CSPiCON

8.3 Control and Signaling Elements on the vMUX

8.3.1 Overview



[tdvmuxel-031210-47.tif, 1, en_US]

Figure 8-3 Jumpers, Connectors, Control, and Signaling-Elements on the vMUX

8.3.2 LED during Operation

The vMUX LED OK/BGAL, MUX, SL and fE1 consist of 2 LED, a red one (Hx-1) and a green one (Hx-2), to inform the user about the actual state of vMUX.

Table 8-32 LED “OK/BGAL” (H9-1, H9-2)

State	Reason(s)
Off	a) Power off or b) System failure
green	System is OK and no test mode or temporary settings are active
green slow blinking	System is OK but any test mode or temporary setting is active.
	Note: at least GENALR is also active in this case!
green fast blinking	---
red	a) Board vMUX is in reset state or b) Board alarm (BGAL) and no test mode or temporary settings are active

State	Reason(s)
red slow blinking	Board alarm (BGAL) and test mode or temporary settings are active
red fast blinking	---

Table 8-33 LED ”MUX” (H10-1, H10-2)

State	Reason(s)
Off	a) Power off or
	b) System failure or
	c) Error occurred before starting MUX.
green	vMUX-Link is synchronized, all configured services are available.
green slow blinking	vMUX-Link is synchronized with secondary data rate, only the prioritized services are available (DP is synchronized with secondary data rate).
green fast blinking	One ore more configured CV’s (compressed voice) are not locked
red	a) Board vMUX is in reset state or b) vMUX-Link not synchronized
red slow blinking	vMUX-Link is disturbed
red fast blinking	Overflow on VL-Input/Output buffer

Table 8-34 LED ”SL” (H11-1, H11-2)

State	Reason(s)
Off	a) Power off or
	b) StationLink (SL) is inactive or
	c) Error occurred before starting StationLink.
green	SL is OK (communication without errors with all configured stations)
green slow blinking	SL loop active
green fast blinking	Device is configured but not detected (no communication with more than one configured station)
red	a) Board vMUX is in reset state or b) Own Node-index detected on SL
red slow blinking	Failures detected on SL
red fast blinking	Collision detected on SL

Table 8-35 LED ”fE1” (H12-1, H12-2)

State	Reason(s)
Off	a) Power off or
	b) fE1 inactive or
	c) Error occurred before starting fE1
green	fE1-interface is enabled and locked
green slow blinking	Transmit current limit exceeded in the E1 Interface
green fast blinking	E1-Remote alarm present (being generated by the system connected to PowerLink)
red	a) Board vMUX is in reset state or
	b) fE1-interface is enabled and unlocked
red slow blinking	‚Loss of transmit clock' or 'Receive carrier loss' or 'Receive all ones' detected on the E1 interface
red fast blinking	Transmit open circuit detected on the E1 interface

8.3.3 vMUX Input Elements and Connectors

8.3.3.1 vMUX Connectors

Table 8-36 vMUX connectors

Nr	Name	Connector	Interface	Explanation
X5	SSP	9-pin sub-D female	RS232	Programming the vMUX with MemTool. For this the switch **S2/1 on vMUX and S2/2 on the CSPi** must be in **ON** position (see chapter *PowerLink Web Interface Service Program PowerSys and MemTool Flash Programming*.
X6	SSF	9-pin sub-D female	RS232	vMUX-Monitor: Terminal resp. Terminal emulation (for test department only)

8.3.3.2 StationLink Termination

Table 8-37 Jumper position X47

Jumper position X47	Function
1-2	StationLink terminated
3-4	StationLink not terminated Park position (default setting)
5-6	Not used

8.3.3.3 Reset Button S1

When S1 is pressed and released the vMUX restarts

NOTE

ATTENTION:

In the PowerLink system only the reset button of board CSPi should be used!

8.3.3.4 vMUX DIL Switch S2/1 to.4

Table 8-38 DIL-Switches S2/1 to 4

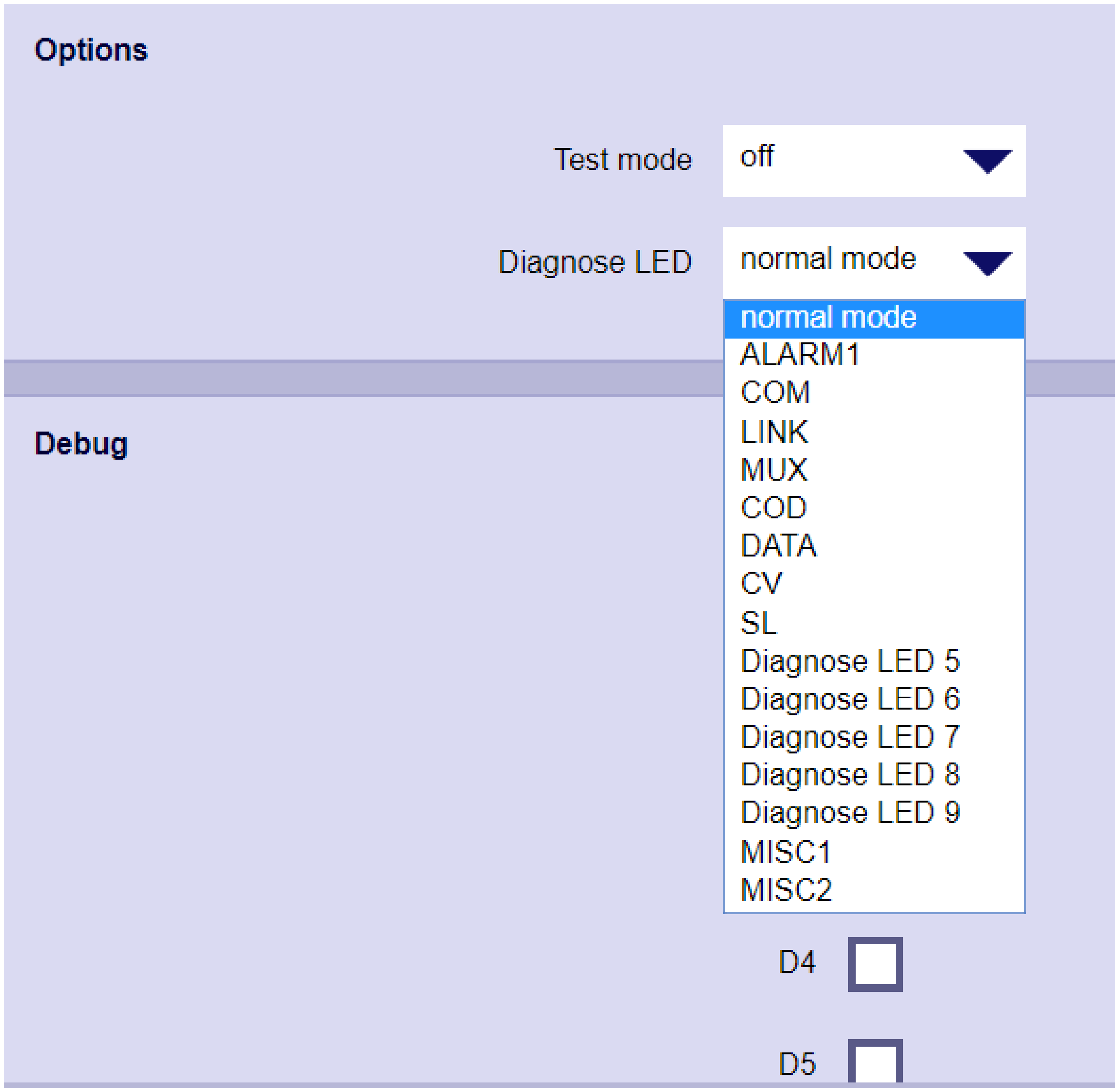
S2	Pos.	Explanation
1	On	MemTool operation (read/write VMUXFPROM, see chapter *PowerLink Web Interface Service Program PowerSys and MemTool Flash Programming*)
	Off	No MemTool operation
2	On	VMUXCON-Monitor after reset (monitor mode)
	Off	Normal mode after reset
3	On	VMUXCON Debugger is enabled after reset
	Off	Normal mode after reset
4	On	vMUX initialization and self test
	Off	Normal mode after Reset

Note: Changes are only recognized after Reset

In normal operation of the PowerLink, all switches have to be in “OFF” position!

8.3.4 vMUX Diagnostic LED H1 to H8

For diagnostics purposes 8 LED (H1 to H8) are available on the vMUX module. The LED are located behind the front cover. The significance depends on the diagnostic mode which is selected in the service program PowerSys form: <**PowerLink – Configuration – vMUX - Options**>.



[sc_vmux_diagnostic_led, 1, --_--]

Figure 8-4 Selecting the diagnostic mode for the vMUX

Table 8-39 Diagnostic LED in the “normal” mode

state	LED	explanation	LED	explanation
off	DIAG1	VL not synchronized	DIAG5	
on	(H1)	**VL synchronized**	(H5)	
slow				
fast				
off	DIAG2	SL inactive	DIAG6	
on	(H2)	**SL OK**	(H6)	
slow				

state	LED	explanation	LED	explanation
fast				
off	DIAG3		DIAG7	
on	(H3)		(H7)	
slow				
fast				
off	DIAG4		DIAG8	
on	(H4)		(H8)	
slow				
fast				

Table 8-40 Diagnostic LED in the “Alarm1” mode

State	LED	explanation	LED	Explanation
off	DIAG1	Alarm GENALR off	DIAG5	
on	(H1)	**Alarm GENALR on**	(H5)	
slow		---		---
fast		---		---
off	DIAG2	Alarm EALR off	DIAG6	
on	(H2)	**Alarm EALR on**	(H6)	
slow		---		
fast		---		
off	DIAG3	Alarm NDALR off	DIAG7	
on	(H3)	**Alarm NDALR on**	(H7)	
slow		---		
fast		---		
off	DIAG4	---	DIAG8	
on	(H4)	---	(H8)	
slow		---		---
fast		---		---

Table 8-41 Diagnostic LED in the “COM” mode

State	LED	explanation	LED	explanation
off	DIAG1	**Rx: iLAN-Telegram (toggle)**	DIAG5	**Tx: iLAN-Telegram (toggle)**
on	(H10)	**Rx: iLAN-Telegram (toggle)**	(H14)	**Tx: iLAN-Telegram (toggle)**
slow		---		---
fast		---		---
off	DIAG2	---	DIAG6	---
on	(H11)	---	(H15)	---
slow		---		---
fast		---		---
off	DIAG3	---	DIAG7	---
on	(H12)	---	(H16)	---
slow		---		---
fast		---		---
off	DIAG4	---	DIAG8	---
on	(H13)	---	(H17)	---

State	LED	explanation	LED	explanation
slow		---		---
fast		---		---

Table 8-42 Diagnostic LED in the “LINK” mode

State	LED	explanation	LED	explanation
off	DIAG1	---	DIAG5	---
on	(H10)	---	(H5)	---
slow		---		---
fast		---		---
off	DIAG2	---	DIAG6	---
on	(H11)	---	(H6)	---
slow		---		---
fast		---		---
off	DIAG3	---	DIAG7	---
on	(H12)	---	(H7)	---
slow		---		---
fast		---		---
off	DIAG4	---	DIAG8	---
on	(H13)	---	(H8)	---
slow		---		---
fast		---		---

The LINK mode is for future use and not yet activated.

Table 8-43 Diagnostic LED in the “MUX” mode

State	LED	explanation	LED	explanation
off	DIAG1	---	DIAG5	unexpected MUXDSP state
on	(H10)	---	(H5)	**MUXDSP state is “ERROR”**
slow		---		**MUXDSP state is “IDLE”**
fast		---		**MUXDSP state is “RUN”**
off	DIAG2	---	DIAG6	DP not ready for uplink
on	(H11)	---	(H6)	**DP ready for uplink**
slow		---		---
fast		---		---
off	DIAG3	---	DIAG7	DP has secondary data rate
on	(H12)	---	(H7)	**DP has primary data rate**
slow		---		---
fast		---		---
off	DIAG4	BL is not synchronized	DIAG8	DP is not synchronized
on	(H13)	**BL is synchronized**	(H8)	**DP is synchronized**
slow		---		---
fast		---		---

Table 8-44 Diagnostic LED in the “COD” mode

State	LED	explanation	LED	explanation
off	DIAG1	---	DIAG5	unexpected CODDSP state
on	(H10)	---	(H5)	**CODDSP state is “ERROR”**
slow		---		**CODDSP state is “IDLE”**
fast		---		**CODDSP state is “RUN”**
off	DIAG2	---	DIAG6	---
on	(H11)	---	(H6)	---
slow		---		---
fast		---		---
off	DIAG3	---	DIAG7	---
on	(H12)	---	(H7)	---
slow		---		---
fast		---		---
off	DIAG4	---	DIAG8	---
on	(H13)	---	(H8)	---
slow		---		---
fast		---		---

Table 8-45 Diagnostic LED in the “DATA” mode

State	LED	explanation	LED	explanation
off	DIAG1	RS232 channel 1 not enabled	DIAG5	RS232 channel 5 not enabled
on	(H10)	**RS232 channel 1 enabled**	(H5)	**RS232 channel 5 enabled**
slow		---		---
fast		---		---
off	DIAG2	RS232 channel 2 not enabled	DIAG6	RS232 channel 6 not enabled
on	(H11)	**RS232 channel 2 enabled**	(H6)	**RS232 channel 6 enabled**
slow		---		---
fast		---		---
off	DIAG3	RS232 channel 3 not enabled	DIAG7	RS232 channel 7 not enabled
on	(H12)	**RS232 channel 3 enabled**	(H7)	**RS232 channel 7 enabled**
slow		---		---
fast		---		---
off	DIAG4	RS232 channel 4 not enabled	DIAG8	RS232 channel 8 not enabled
on	(H13)	**RS232 channel 4 enabled**	(H8)	**RS232 channel 8 enabled**
slow		---		---
fast		---		---

Table 8-46 Diagnostic LED in the “CV” mode

State	LED	explanation	LED	explanation
off	DIAG1	CV channel 1 not enabled	DIAG5	CV channel 5 not enabled
on	(H10)	**CV channel 1 enabled**	(H5)	**CV channel 5 enabled**
slow		---		---
fast		---		---

State	LED	explanation	LED	explanation
off	DIAG2	CV channel 2 not enabled	DIAG6	CV channel 6 not enabled
on	(H11)	**CV channel 2 enabled**	(H6)	**CV channel 6 enabled**
slow		---		---
fast		---		---
off	DIAG3	CV channel 3 not enabled	DIAG7	CV channel 7 not enabled
on	(H12)	**CV channel 3 enabled**	(H7)	**CV channel 7 enabled**
slow		---		---
fast		---		---
off	DIAG4	CV channel 4 not enabled	DIAG8	CV channel 8 not enabled
on	(H13)	**CV channel 4 enabled**	(H8)	**CV channel 8 enabled**
slow		---		---
fast		---		---

CV: Coded voice

Table 8-47 Diagnostic LED in the “SL” mode

State	LED	explanation	LED	explanation
off	DIAG1	SL Node #0 not present	DIAG5	SL Node #0 not disturbed
on	(H10)	**SL Node #0 present**	(H5)	**SL Node #0 disturbed**
slow		---		---
fast		**SL Node #0 configured and not present**		**SL Node #0 has collision**
off	DIAG2	SL Node #1 not present	DIAG6	SL Node #1 not disturbed
on	(H11)	**SL Node #1 present**	(H6)	**SL Node #1 disturbed**
slow		---		---
fast		**SL Node #1 configured and not present**		**SL Node #1 has collision**
off	DIAG3	SL Node #2 not present	DIAG7	SL Node #2 not disturbed
on	(H12)	**SL Node #2 present**	(H7)	**SL Node #2 disturbed**
slow		---		---
fast		**SL Node #2 configured and not present**		**SL Node #2 has collision**
off	DIAG4	SL Node #3 not present	DIAG8	SL Node #3 not disturbed
on	(H13)	**SL Node #3 present**	(H8)	**SL Node #3 disturbed**
slow		---		---
fast		**SL Node #3 configured and not present**		**SL Node #3 has collision**

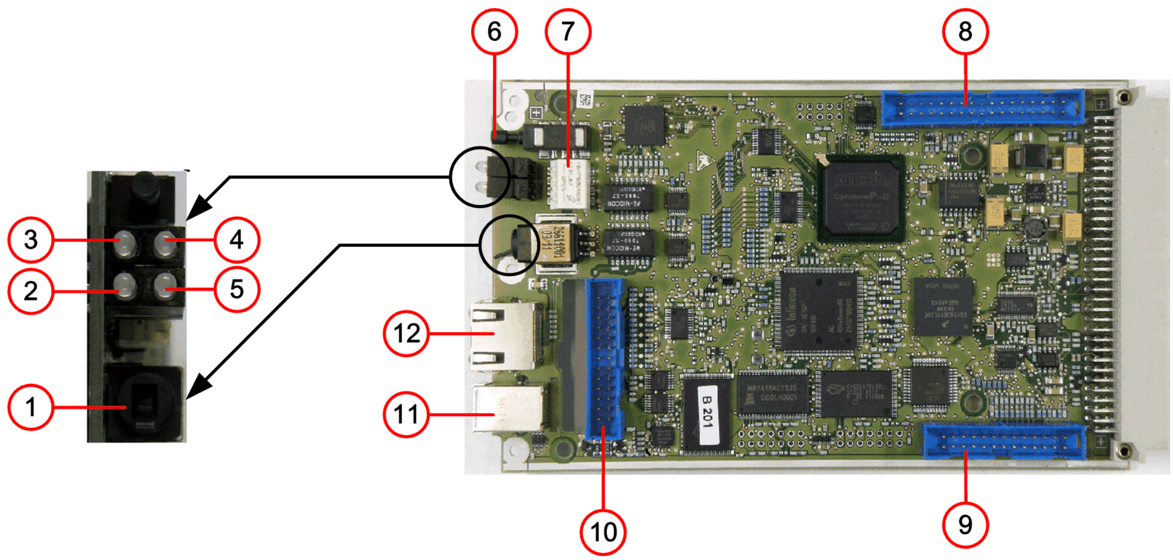
SL: StationLink

NOTE

The other diagnostic modes are for future use and not yet activated. The LED 22 to 31 are used only for development purposes.

8.4 Control and Signaling Elements on the PU4 module (iSWT 3000)

8.4.1 Overview PU4, LED and Input Elements



[le_pu4jum, 1, en_US]

Figure 8-5 Position of Jumpers, Input and Signaling Elements on the PU4 Module

1	S2: Power ON/OFF
2	LED OK/GBAL
3	LED Status Interface LID-2
4	LED Status Interface LID-1
5	LED Status Interface LIA
6	S1: Reset button
7	S3 (3.1 to 3.4)
8	Connection on DLE
9	Connection on DLE
10	Connection of the IFC Modules
11	LCT: Service Interface (USB)
12	NMS: Ethernet Interface

The Digital line equipment is not applicable for PowerLink 50.

Table 8-48 Function of the S3 DIP Switch on the PU4 Module

Switch Number	Position	Function
S3.1	OFF ON	Normal operation Programming with Memtool
S3.2	OFF ON	Monitor inactive Monitor active
S3.3	OFF ON	Disable debugger Enable debugger
S3.4	OFF ON	Disable initialization in monitor Enable initialization in monitor

NOTE

For normal operation all switches must be in the **OFF**-position.

8.4.2 Significance of LEDs on the PU4 Module

- The 2-color LIA LED is needed for displaying the status of the LIA. The following states can be displayed:

Table 8-49 Significance of the LIA LED Displays

State	Significance
Off	LIA is not configured
Red static	LIA is not ready for operation (for example, primary path receiver alarm)
Red flashing	LIA is only operational to a limited extent (for example, secondary path receiver alarm)
Green static	LIA is working correctly and used as main path.
Green flashing	LIA is working correctly and used as secondary path.

NOTE

Red flashing always means that the secondary path is not working correctly.

- The 2-color LID-1 LED is used for displaying the status of the LID-1. The following states can be displayed:

Table 8-50 Significance of the LED LID-1 Displays

State	Significance
Off	LID-1 is not configured
Red static	LID-1 is not ready for operation
Red flashing	LID-1 is only operational to a limited extent (for example, receiver alarm)
Green static	LID-1 is functioning correctly
Green flashing	Secondary path

- The 2-color LID-2 LED is used for displaying the status of the LID-2. The following states can be displayed:

Table 8-51 Significance of the LID-2 LED Displays

State	Significance
Off	LID-2 is not configured
Red static	LID-2 is not ready for operation
Red flashing	LID-2 is only operational to a limited extent (for example, receiver alarm)
Green static	LID-2 is functioning correctly
Green flashing	Secondary path

- The 2-color OK/BGAL LED is needed for displaying the PU4 module status. The following states can be displayed:

Table 8-52 Significance of the OK/BGAL LED Displays

State	Significance
Off	Power supply is disconnected or faulty
Red static	Module is not ready for operation
Red flashing	General alarm module is only operational to a limited extent

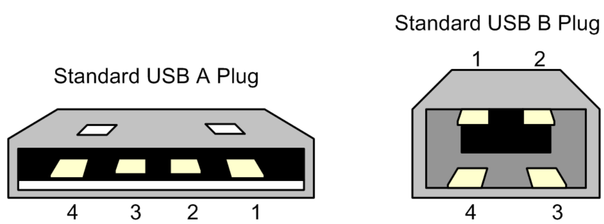
State	Significance
Green static	Normal operation
Green slow flashing	Test operation or remote alarm active
Green fast flashing	Ethernet port of PU4 is not ready for operation

8.4.3 PU4 Connectors

The IP (Ethernet) interface of the PU4 module is used for:

- The communication between the NMS and SWT 3000
- Remote PowerSys session

The Ethernet interface (as RJ45 socket) can also be used for local Web login. It is located at the front of the PU4 module.
A USB local (service) interface in form of a standard USB B plug is fitted at the PU4 for the communication between the service PC and SWT 3000. The service PC is connected to the USB socket on the front panel of the PU4 module with a USB A/B plug cable.



[dwpinout-300811-01.tif, 1, en_US]

Figure 8-6 USB A/B Plug Cable

(1) Pin 1 is V_{CC} (+5 V)
(2) Pin 2 is Data- (D-)
(3) Pin 3 is Data+ (D+)
(4) Pin 4 is ground (-)

NOTE

An SWT 3000 integrated in PowerLink is accessed via the service interfaces of the PowerLink device. The USB interface of the PU4 in iSWT 3000 is used only for the firmware upgrade via MemTool.

8.5 Control and Signaling Element on the Power Supply

8.5.1 Displays

LEDs on Power Supply Unit, visible after removal of the front panel.

[ph_power_supply_leds, 1, --_--]

Figure 8-7 Front view of the power supply (stand alone device, power supply connected via FOM to PowerLink)

Table 8-53 Significance of the LEDs on the Power Supply Unit

LED	Conditions	Significance
Operate	$U_{i\,min} \leq U_i \leq U_{i\,max}$ $I_o \leq I_{o\,nom}$ $T_C \leq T_{cmax}$ $U_{inh} \leq 0.8$ V	Unit in normal operation
Operate and overload 1, 2, or 3	$U_{i\,min} \leq U_i \leq U_{i\,max}$ $TC \leq T_{cmax}$ $U_{inh} \leq 0.8$ V	Current at output Uout1, Uout2, or Uout3 too high
Disable	$U_{i\,min} \leq U_i \leq U_{i\,max}$ $I_o \leq I_{o\,nom}$ $T_C \leq T_{cmax}$	$U_{inh} > 0.8$ V Unit switched off or PU4 or CLE not inserted

LED	Conditions	Significance
Disable	$U_{i\ min} \leq U_i \leq U_{i\ max}$ $I_o \leq I_{o\ nom}$ $U_{inh} \leq 0.8$ V	Temperature monitoring has operated
Disable	$I_o \leq I_{o\ nom}$ $T_C \leq T_{cmax}$ $U_{inh} \leq 0.8$ V	Undervoltage or overvoltage monitoring has operated

U_i = Input voltage

8.6 System Information

8.6.1 System Alarm Display

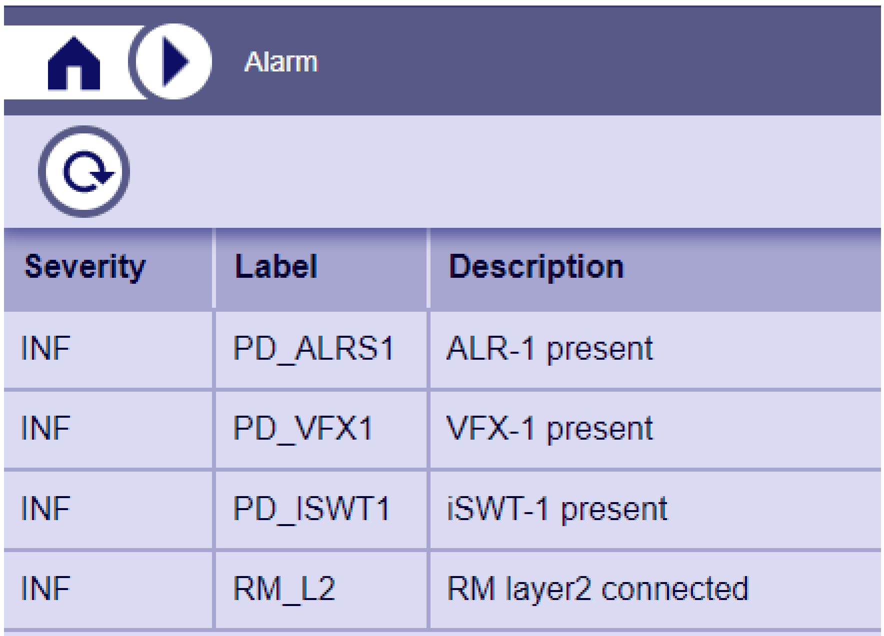
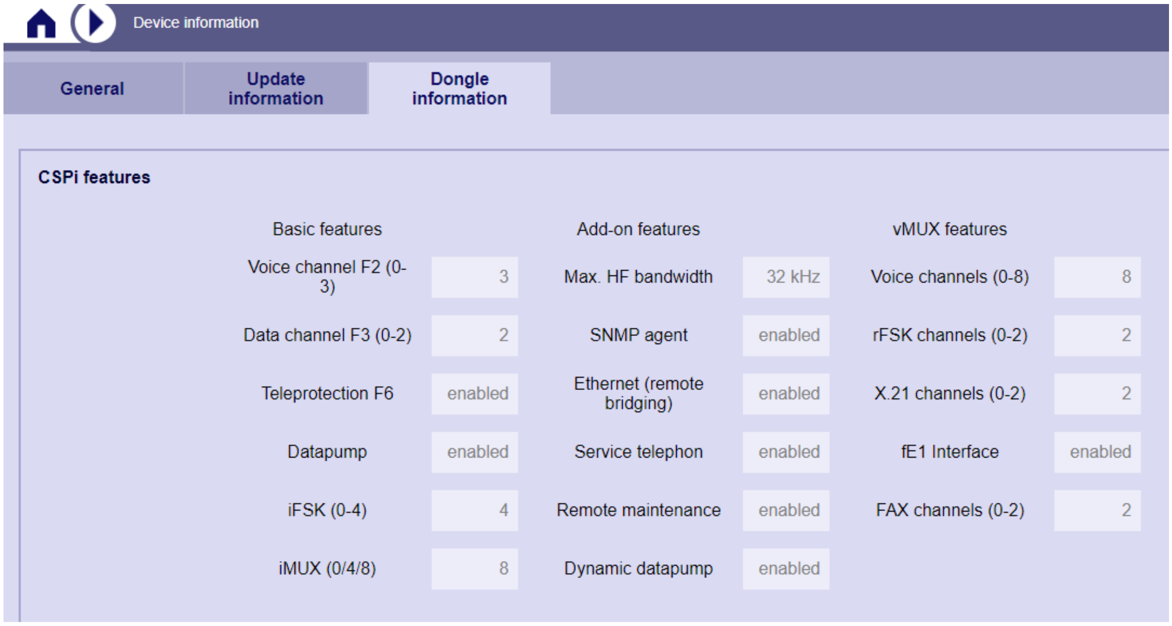


Figure 8-8 Alarm/Errors display in the PowerSys service program (example)

Faults, that have an impact to the normal system operation, are displayed in <**Alarm**> . The display is refreshed with the button <**Read**>.

8.6.2 Dongle Info

<**Device information – Dongle Information**> shows the number of services released in the systems dongle. The figure below shows the max. of released services. This form appears when the dongle default values are loaded.



[sc_dongle_information, 1, --_--]

Figure 8-9 Dongle information

NOTE

The configuration of services is only possible when they are released in the dongle.

8.7 Test Modes

Test modes can be selected in <**Configuration – Options**>.

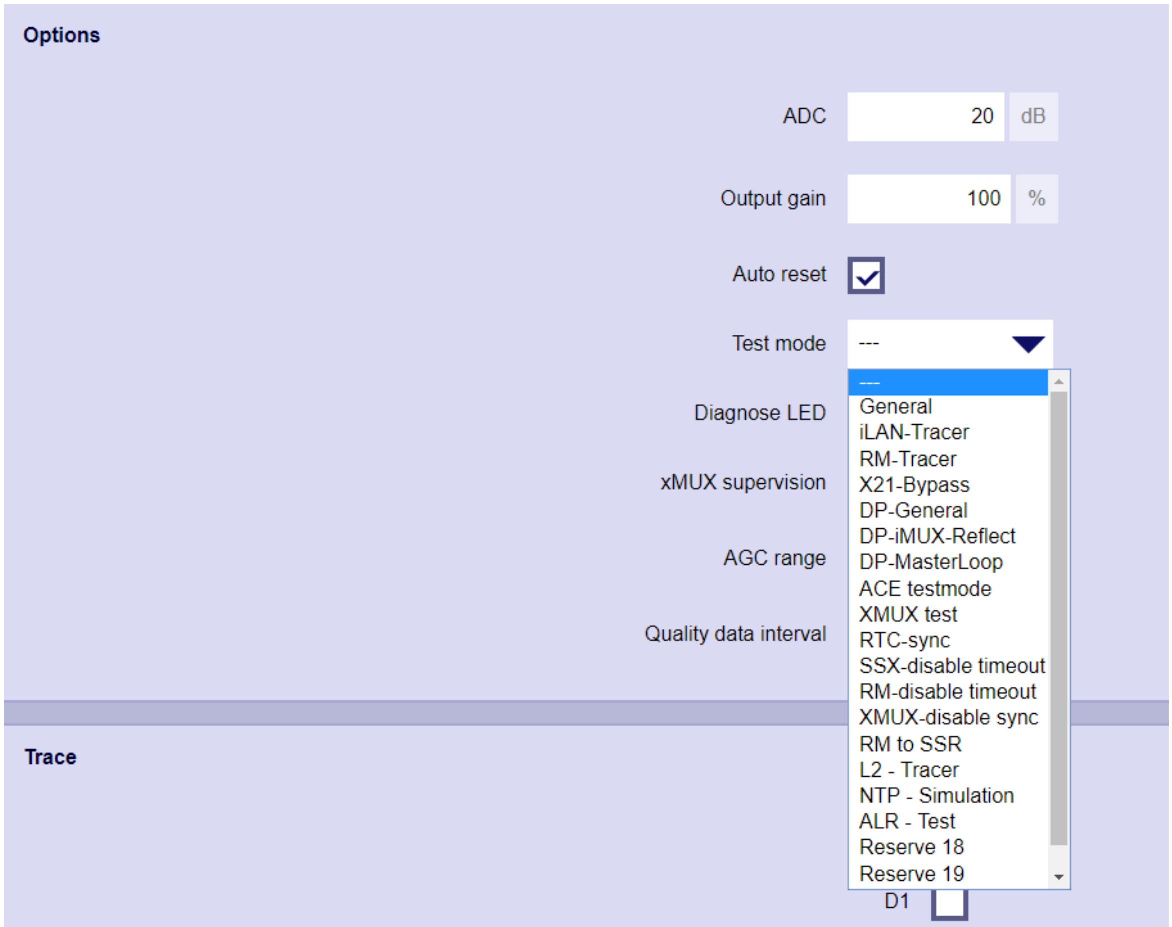


Figure 8-10 Test mode selection in the form PowerLink Configuration Options

NOTE

Test modes are for internal use only!

8.8 CSPi Diagnostic Mode

NOTE

Diagnostic mode interrupts normal operation and causes General Alarm

Diagnostic mode can be started with DIL switch S5/4 on and S5/2 off (see also *Table 8-2*) followed by a reset or switching on of PowerLink. As long as diagnostic mode is active the LED “OK” is in state “green fast flashing”, the configured functions of the PowerLink are tested and supervised. Diagnostic mode is used for:

- Checking of CFS
- To update VFX firmware (refer to chapter *Signaling during VFx Programming , Page 539*
- Testing PowerLink after replacing hardware components
- For problem fixing

For diagnose mode, the PowerLink configuration data are changed temporary

- HF Loop (see *Figure 8-12*) stays closed after start-up so that no signal is transmitted via the amplifier!
- HF receive and transmit frequencies are set with the same frequency
- VFx signal outputs are muted
- Data Pump is operating as “loop master"

NOTE

To quit the diagnostic mode, switch off PowerLink and the set DIL switch S5/4 to off. After switching on the PowerLink, the user configuration is restored automatically. Alternatively S5/4 is set to off during diagnostic mode is active and push the reset button.

8.9 Commands and Test Loops

8.9.1 Overview

In <**Test**>, it is possible to activate the Data Pump signal generator or to switch test loops.

General

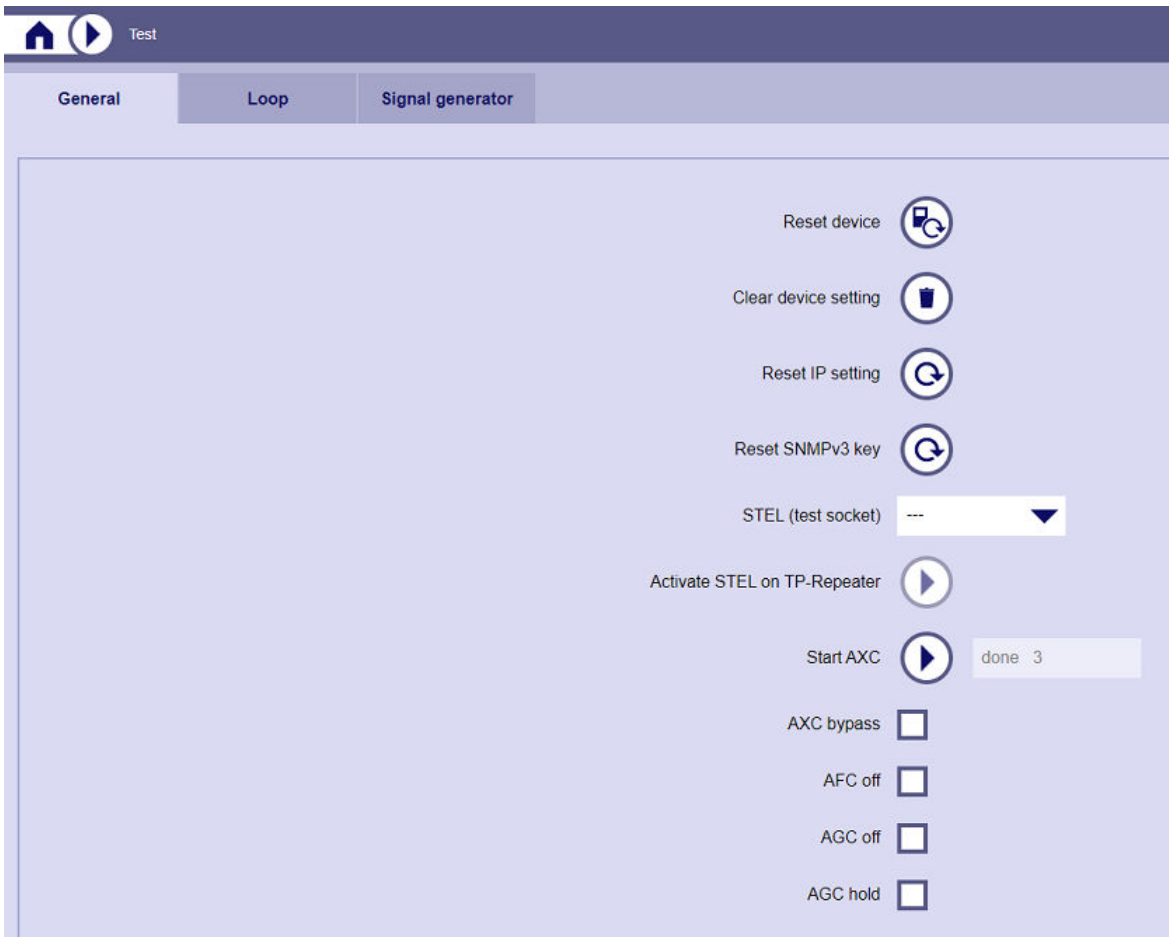
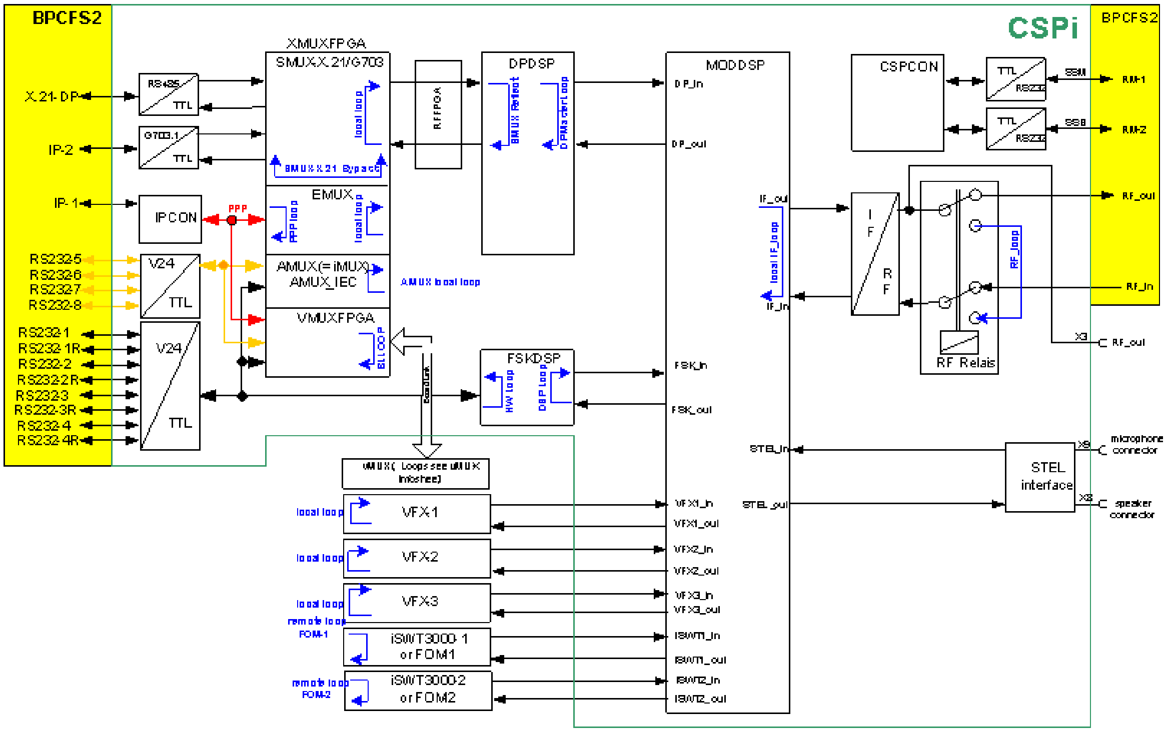


Figure 8-11 Test - General

- **Local HF loop**: Transmitter and receiver have to be adjusted to the same frequency and are looped with this command (see figure below). The transmission via the PLE (and via the line) is interrupted.
- **Clear device setting**: The command **clears the complete configuration (!)** stored in the CSPi resp. PU4 module (in a stand alone SWT 3000).
- **Reset IP setting**: Reset of the PowerLink via the service PC. After the reset the service program is automatically connected back to the PowerLink.
- **Start AXC** start of the AXC function (if enabled). This may cause an interrupt of the PowerLink receive signal. The AXC is adjusted automatically after restart of the PowerLink.
- Possibility to switch a local IF loop. AGC resp. AFC switch OFF for test purposes only! Activation of the AGC hold for switching the AGC to a fixed value.



[cdtestlp-120813-53.tif, 1, en_US]

Figure 8-12 Test loop overview in the PowerLink 100 system

Loop

Remote test loops VFx, FOM, resp. EMUX if the service is enabled:

[sc_test_local_loop, 1, --_--]

Figure 8-13 Test - Loop

- Reflection of the received signals from the corresponding service to the transmission line.

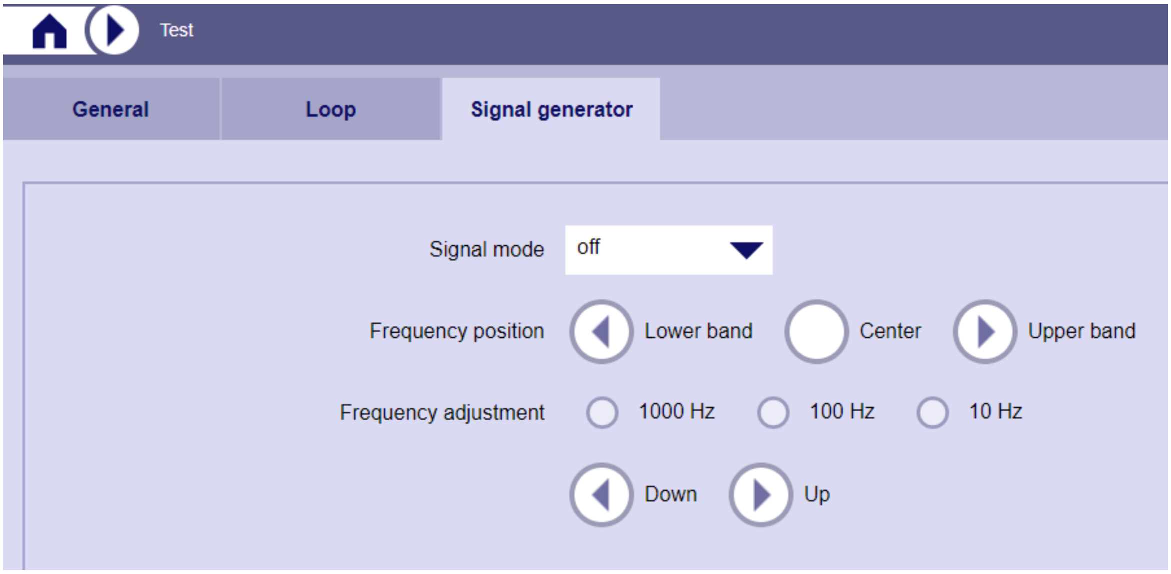
DP commands xMUX:

[sc_test_stationlink_loop, 1, --_--]

Figure 8-14 DP loop

- Setting a local test loop for the iMUX
- SL Loops, setting StationLink loops (off, local loop, remote loop) ref. also to chapter *Commissioning*.

Signal generator

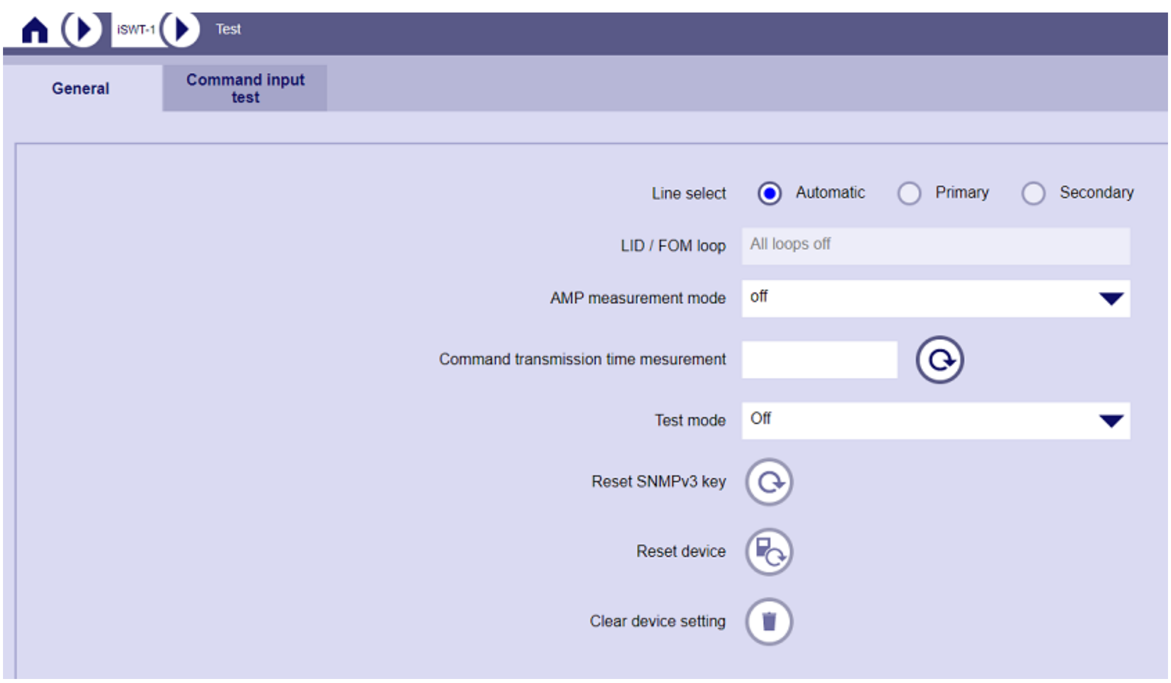


[sc_test_signal_generator, 1, --_--]

Figure 8-15 Test - Signal generator

- Activation of the DP signal generator when selecting “on[sine]" and pushing the button “center”. The corresponding HF frequency is displayed in the PowerSys form <**Information/Services**>. For more details refer to chapter *Commissioning*. With the button “Upper band” resp. “Lower band”, the signal generator is adjusted to the upper resp. lower band limit of the DP. With the buttons <**Up**> resp. <**Down**>, the signal generator can be adjusted upwards resp. downwards in steps of 10 Hz, 100 Hz, or 1000 Hz.

SWT 3000 Commands



[sc_iswt_test_general, 1, --_--]

Figure 8-16 iSWT-x - General

- Line selection automatic (only if 2 transmission links are activated): Automatic selection of the (primary) transmission line. If there is a fault, switchover to the alternative (secondary) line.
- Primary (only if 2 transmission links are activated): The SWT 3000 receiver is fixed to the primary transmission line. No switchover in case of line interrupt.
  This **setting is causing general alarm!**
- Secondary (only if 2 transmission links are activated): The SWT 3000 receiver is fixed to the secondary transmission line. No switchover in case of line interrupt.
  This **setting is causing general alarm**!
- **AMP Meas Off/On**: Disables the input limitation from the binary inputs (which is automatically activated in the AMP mode of the (i)SWT 3000) when adjusted to On. It is now possible to send continuous commands for measuring the trip frequencies.
  The **general alarm is activated** in case of **AMP Meas On**!
- **Command transmission time measurement**: Single test provides a method to measure command transmission time over the current active line. It is available for both analog and digital transmission lines, but not for Ethernet transmission line (TPoP).

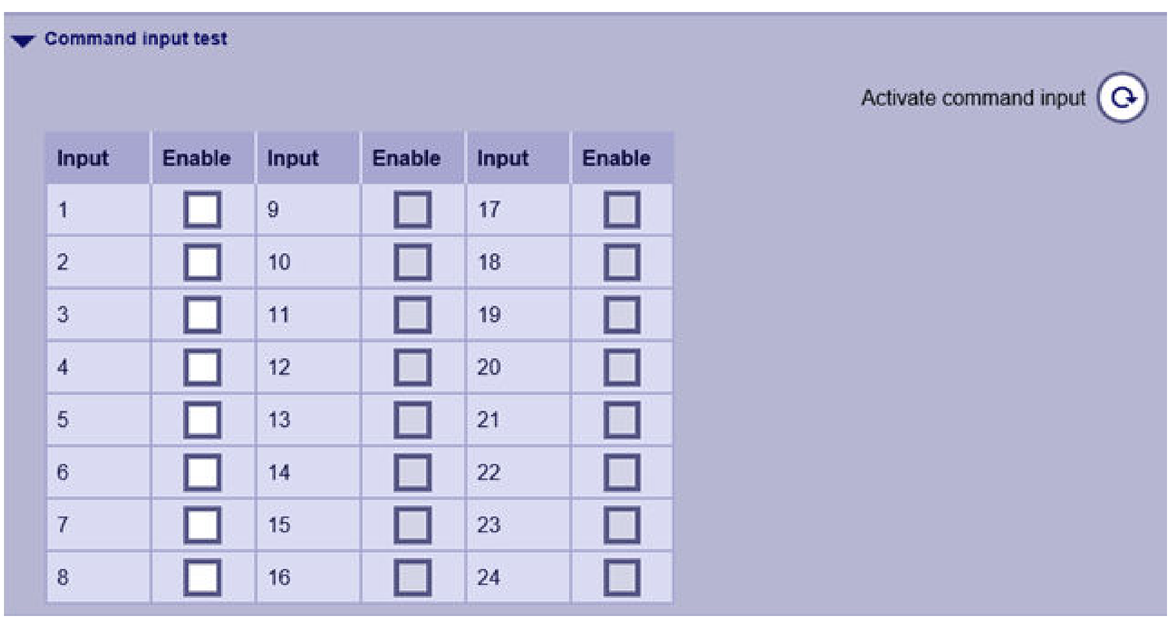
Command Input Test

Command input test is a test function to verify command input / output during the commissioning phase. It must be switched off in normal operation. To avoid unwanted command by incident, the command input test can only be enabled when:

- IFC-Test mode configured (GEN alarm activated)
- PU4 switch S3.4 is enabled for test purpose

If the command input test is enabled, command input from IFC or EN100 port is ignored. Instead, the input from the test page is assigned to a protection frequency and transmitted as in normal operation.

The command input test page is only available when iSWT is active. Any command input combinations can be triggered on by enabling the corresponding inputs and then clicking ‘Activate command input’ button. Disable all command inputs and click ‘Activate command input’ button will trigger all commands off.



[sc_command_input_test, 1, --_--]

NOTE

Any test command input should work according to the actual configuration. For example, if mode 3a is selected, only input 1 to 4 can be transmitted.

Another example, if command 1 is not assigned to a valid input port in input command allocation, command 1 will never be sent.

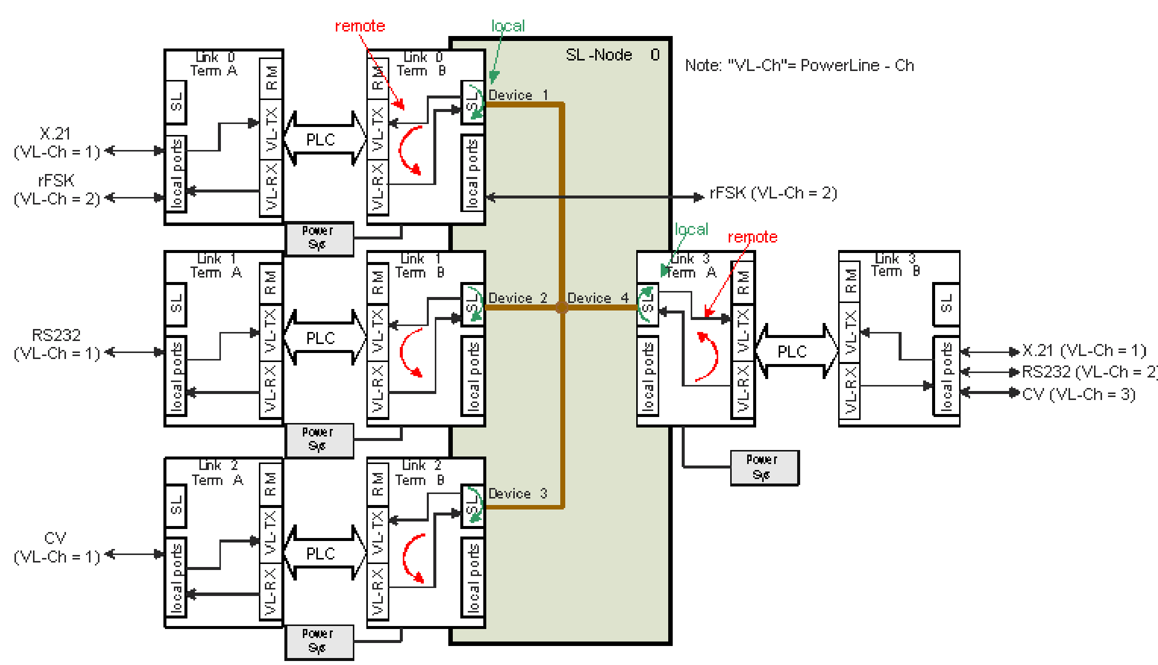
8.9.2 Periodic transmission time test configuration

The periodic command transmission time test works for the digital transmission line only. It triggers command transmission time tests at a configurable interval. The actual command transmission is not affected. The test result (OK/fail) is recorded in event log.

SWT3000 > Configuration > System > Line interface	
Connection: digital 1/2	At least one digital is selected
Address	Transmitter/Receiver < 128
SWT3000 > Configuration > Clock Synchronisation	
Command periodic transmission time test mode	One side is master, the other side is slave
Command periodic transmission time test interval	Not OFF at the master side (If interval is off, no automatically loop test is triggered)

8.9.3 StationLink Test Loops

It is possible to switch StationLink test loops (local loop resp. remote loop). The data traffic via StationLink is interrupted in this case.



[cdstllps-120813:54.tif, 1, en_US]

Figure 8-17 StationLink Loops

The test loops are activated in <**Test - Loop - DP loop**>. The adjustments are taken over online.

[sc_test_stationlink_loop, 1, --_--]

Figure 8-18 Test - Loop - DP loop

If “StationLink **local loop**” is selected the data are not sent to the StationLink but back.

Example from *Figure 8-17*: If **local loop**is selected in Device 1 the data of the X.21 channel are sent back to Terminal A Link 0.

If “StationLink **remote loop**” is selected the received data are sent back with its own device address. In this case the corresponding device can receive the data and it is proved that the StationLink is working properly.

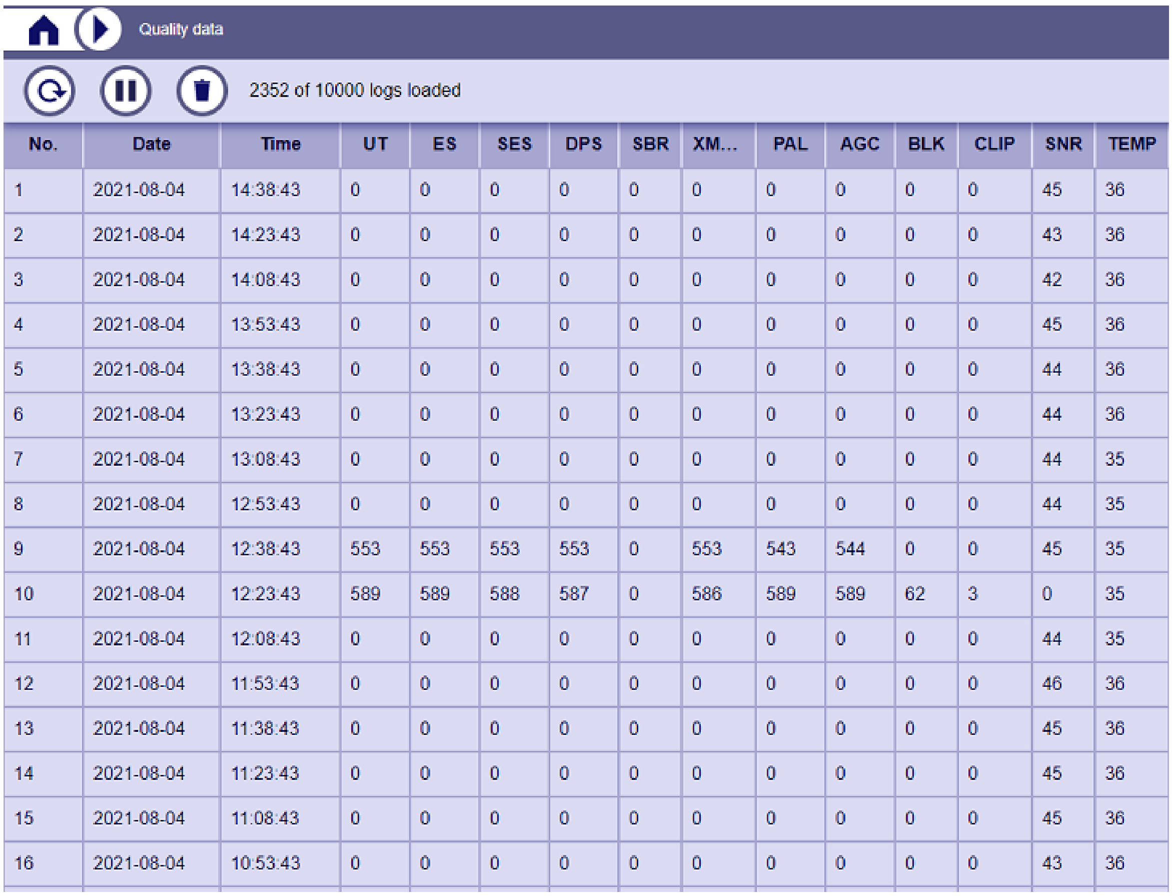
Example from *Figure 8-17*: If **remote loop** is selected in Device 1 the data of the X.21 channel are sent back via the StationLink to Device 4 Terminal A.

To test several connections at the same time, the test loops are **not automatically canceled** after the connection to the service PC is interrupted.

8.10 Quality Data QD

8.10.1 Overview

With <**Quality Data**> the quality of a Data Pump connection can be recorded for a defined time interval.



No.	Date	Time	UT	ES	SES	DPS	SBR	XM...	PAL	AGC	BLK	CLIP	SNR	TEMP
1	2021-08-04	14:38:43	0	0	0	0	0	0	0	0	0	0	45	36
2	2021-08-04	14:23:43	0	0	0	0	0	0	0	0	0	0	43	36
3	2021-08-04	14:08:43	0	0	0	0	0	0	0	0	0	0	42	36
4	2021-08-04	13:53:43	0	0	0	0	0	0	0	0	0	0	45	36
5	2021-08-04	13:38:43	0	0	0	0	0	0	0	0	0	0	44	36
6	2021-08-04	13:23:43	0	0	0	0	0	0	0	0	0	0	44	36
7	2021-08-04	13:08:43	0	0	0	0	0	0	0	0	0	0	44	35
8	2021-08-04	12:53:43	0	0	0	0	0	0	0	0	0	0	44	35
9	2021-08-04	12:38:43	553	553	553	553	0	553	543	544	0	0	45	35
10	2021-08-04	12:23:43	589	589	588	587	0	586	589	589	62	3	0	35
11	2021-08-04	12:08:43	0	0	0	0	0	0	0	0	0	0	44	35
12	2021-08-04	11:53:43	0	0	0	0	0	0	0	0	0	0	46	36
13	2021-08-04	11:38:43	0	0	0	0	0	0	0	0	0	0	45	36
14	2021-08-04	11:23:43	0	0	0	0	0	0	0	0	0	0	45	36
15	2021-08-04	11:08:43	0	0	0	0	0	0	0	0	0	0	45	36
16	2021-08-04	10:53:43	0	0	0	0	0	0	0	0	0	0	43	36

[sc_quality_data, 1, --_--]

Figure 8-19 Quality Data

- **Button "Read"/"Stop":**
  Starts reading QD records. Reading begins at Start time stamp and ends at Stop time stamp. During reading of QD records, "Read" button is changed to "Stop" button. Clicking this button causes end of reading QD records (Attention: Readout of maximum number of QD records can take several minutes!)
- **Button "Delete":**
  All QD records are deleted.

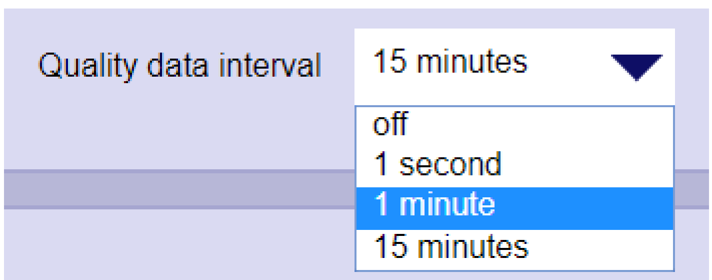
Table 8-54 Explanation of a Quality Data QD record

Row text	Explanation	Format
Date Time	Time Stamp of QD record	Year, Month, Day of Month, Hour, Minute, Second
UT	Unavailable time in the last QD interval	0 to 900 seconds [decimal]
ES	Number of errored seconds in the last QD interval	0 to 900 seconds [decimal]
SES	Number of severely errored seconds in the last QD interval	0 to 900 seconds [decimal]

Row text	Explanation	Format
DPS	Number of non-synchronized seconds of DP link in the last QD interval	0 to 900 seconds [decimal]
SBR	Number of seconds with secondary data rate of DP in the last QD interval	0 to 900 seconds [decimal]
XMUX	Number of non-synchronized seconds of xMUX link in the last QD interval	0 to 900 seconds [decimal]
PAL	Duration of PAL (level alarm) in the last QD interval	0 to 900 seconds [decimal]
AGC	Duration of AGC (automatic gain control) alarm in the last QD interval	0 to 900 seconds [decimal]
BLK	Number of block errors in the last QD interval	0 to 255 BLKERR [decimal]
CLIP	Number of RF100CLIPs in the last QD interval	0 to 255 clips [decimal]
SNR	Minimum SNR value in the last QD interval	0 dB to 127 dB [decimal]
TEMP	Temperature measured on the CSPi	Degree celsius

Adjustment of the QD interval in <**Configuration – Option**>.

Changes in the adjustment of the QD interval will be effective immediately. You do not have to reset the PowerLink device.



[sc_option_quality_data_interval, 1, --_--]

Figure 8-20 Configuration Quality data interval

Table 8-55 Quality Data Interval

Settings	Comments
Quality Data Interval	When the setting interval time is elapsed, a new entry will be added in the quality data table. The possible internal values are: • off • 1 second • 1 minute • 15 minutes The default value is **15 minutes**.

8.11 Data Pump Block Error

8.11.1 Information

The Content of Data Pump Block Error FIFO is displayed as an 240-byte array, arranged in 15 lines (numbered 1 to 15) and 16 columns (numbered A to P). The newest entry is displayed in line 15/row P, the oldest entry is displayed in line 1/row A.

Table 8-56 Display of Data Pump block error

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	oldest	-239	-238	-237	-236	-235	-234	-233	-231	-230	-229	-228	-227	-226	-225	-224
2	-223															-208
3	-207															-192
4	-191															-176
5	-175															-160
6	-159															-144
7	-143															-128
8	-127															-112
9	-111															-96
10	-95															-80
11	-79															-64
12	-63															-48
13	-47															-32
14	-31															-16
15	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	newest

Block errors are displayed as hex values from 0 to 0xEF (0 to 239), 2-character-combinations as described in table below are used to mark events.

The "Block Error Rate" is calculated from all visible block error numbers (0 to 239) in the Block Error display.

Table 8-57 List of block error entries

Entry	Explanation
Space	Entry not yet used
RB	Restart caused by "block error threshold" BLKANZ
RF	Restart caused by "block error sequence" BLKFOL
RE	Restart caused by error from Data Pump DSP
RA	Restart requested by Data Pump DSP
RS	Restart requested by PowerSys command
RR	Restart because synchronized with false data rate
RP	Restart caused by PAL (too many block errors)

Entry	Explanation
DW	Restart to switchover to secondary bit rate (“down switch”)
TO	Timeout while waiting for sync
ST	Data Pump DSP started
SY	Synchronized
LO	Sync lost
UP	Restart to switchover to primary bit rate (“up switch”)
PB	Data Pump synchronized with primary bit rate
SB	Data Pump synchronized with secondary bit rate
0 to 0xEF	Hexadecimal number of block errors in this window

8.11.2 Supervision

To ensure Data Pump operation re-synchronization after line disturbance block error supervision functions are implemented. All Data Pump supervision features (<**Configuration - DP**>) depend on analyzing block errors. The following supervision functions can be used:

- Block error sequence
- Block error threshold
- disturbed blocks (hold function)

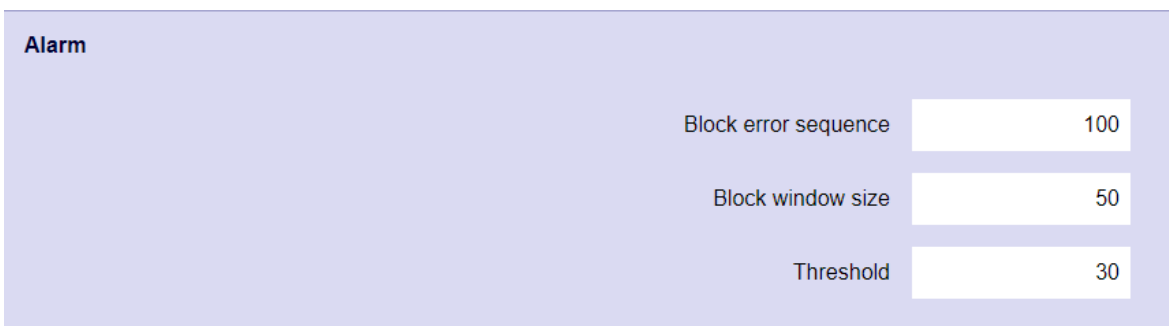


Figure 8-21 Configuration of the DP block error supervisory

Supervision of the “Block Error Sequence” (Configuration)

When the Data Pump recognizes more disturbed blocks in sequence as defined by “Block error sequence”, the Data Pump will be restarted automatically.

NOTE

This supervision does not use “Block window size”!

NOTE

When “Block error sequence” is set to 0 supervision is disabled!

Block Window Size (Configuration)

Defines the number of blocks (10 to 239) needed for supervision block error threshold and disturbed windows in sequence.

Supervision "Block Error Threshold" (Configuration):

When Data Pump recognizes more disturbed blocks within a "Block window" as defined by **Block error threshold**, the Data Pump will be restarted automatically after 3 consecutive errored win-dows.

NOTE

When "Block error threshold" is set to 0 supervision is disabled!

Supervision DPHOLD:

Depending on the standard function "DPHOLD" the DP tries to hold the connection during "block error bursts" caused by switching procedures on the transmission line. Under worst case conditions (= all blocks disturbed), DP is waiting 1800 ms.

NOTE

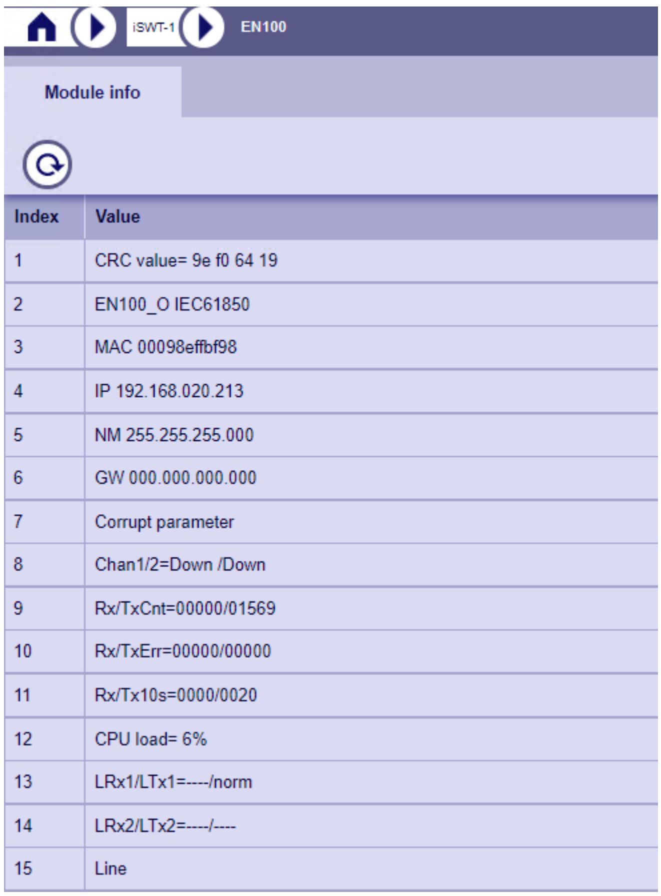
It is recommended not to change the standard values.

8.12 Diagnosis of Ethernet EN100 Module

EN100 Information in PowerSys

If an Ethernet module EN100 for IEC 61850 is configured with the iSWT, the PowerSys menu **iSWT-x > EN100 > Module info** displays the most important information about addresses and connection status of the module.

The EN100 information can only be read when the PowerSys program is connected to the device (stand-alone SWT 3000 or iSWT in PowerLink).



[sc_diagnosis_EN100, 1, --_--]

Figure 8-22 iSWT-x > EN100 > Module info

The following EN100 information is displayed:

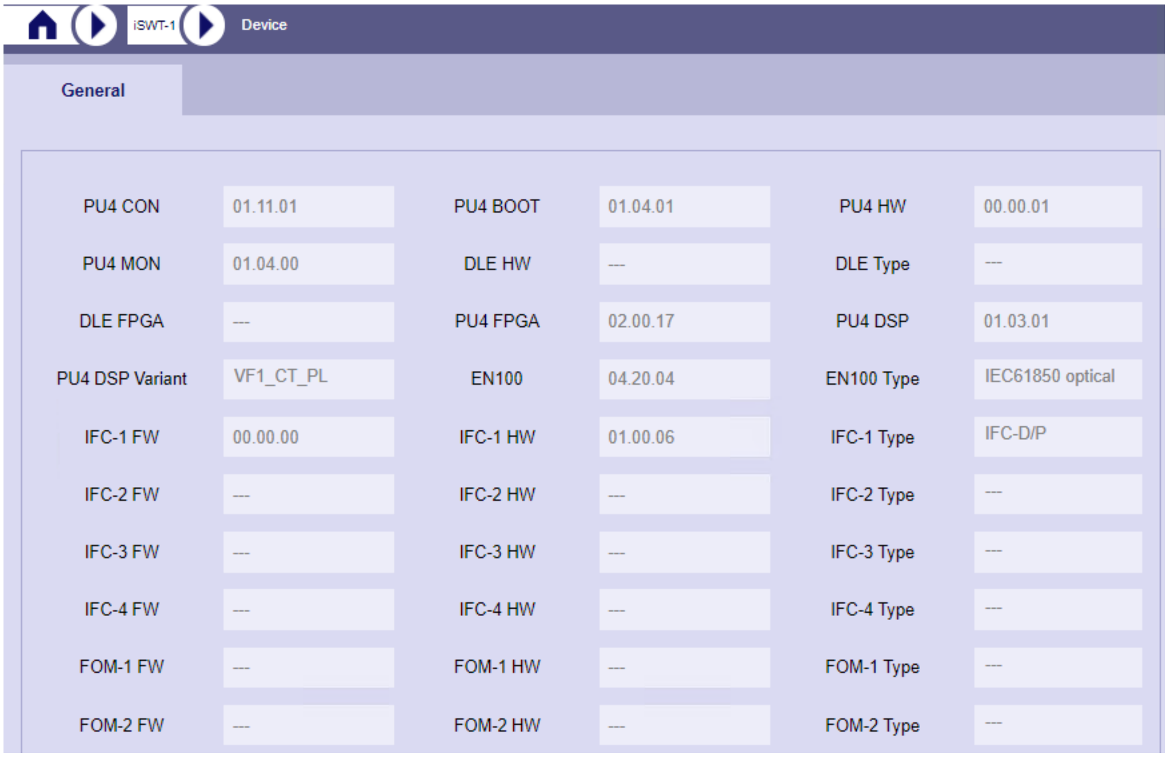
Table 8-58 EN100 Information

Line/IDX	Information
IDX 1	CRC value (EN100 BIN parameter file checksum)
IDX 2	Module type
IDX 3	Hardware address (MAC)
IDX 4, IDX 5, IDX 6	Ethernet channel adresses: IP address, Network mask, Gateway address
IDX 7	EN100 clock synchronisation status (NTP1/2)
IDX 8	Physical link status and data rate of connected Ethernet channel (Phy1/ Phy2)
IDX 9, IDX 10, IDX 11	Communication status: Statistics and error counters
IDX 12	CPU load rate

The status information is updated by pressing the Read button.

EN100 Firmware Version Information

You can check the firmware version of the Ethernet module EN100 in the PowerSys menus **iSWT-x - Device - General**.

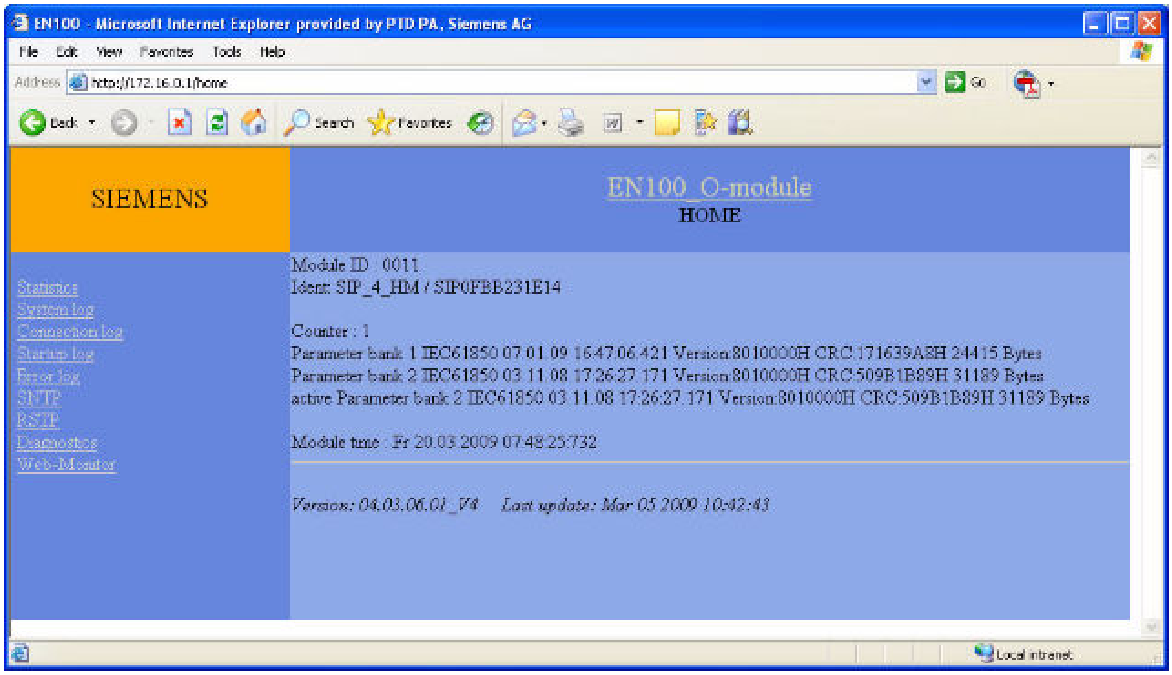


[sc_EN100_firmwarversion_info, 1, --_--]

Figure 8-23 EN100 FW version information in iSWT-x > Device > General

EN100 Module Homepage

The EN100 modules are provided with a homepage, which can be invoked on all devices using the respective IP address. Fig. 9-2 shows an example of a homepage. The homepage is invoked by entering the IP address of the device combined with home in the address line of the browser on the PC (e.g.: **`https://192.168.0.55/home`** for the EN100 default IP address)



[scen100h, 1, --_--]

Figure 8-24 Homepage of the EN100 modules

NOTE

With a factory pre-configuration of EN100 in SWT 3000 devices the following generic IP addresses are programmed to the module: 192.168.100.11 and 192.168.100.12.

You can check the actual IP address of the EN100 module in PowerSys menu **SWT 3000 > Information > EN100 Info** (refer to **EN100 Information in PowerSys**).

The EN100 module homepage always shows at its end the version and creation date of the software version loaded on the module. With the links on the left area of the EN100 homepage you can browse to following subpages, which contain information for commissioning, operational information and internal error messages.

Table 8-59 Linked pages of the EN100 module homepage

Page	Description
Statistics-page	shows relevant information of Ethernet
System log-page	shows information of system behavior, being produced from operation time
Connection log-page	contains information about Client-Server-Connection and DIGSI-Accesses
Startup-page	contains information about run-up behavior and configuration settings respecting network- and GOOSE-Parameters
Error log-page	contains internal error messages

Refer to **SIPROTEC 4 EN100-Module - Manual IEC 61850** for description of the pages.

You may find a copy of the manual on the PowerSys package in folder /IEC61850/Manual.

Check the SIPROTEC webpage for the latest manual version:

Internet: *www.siprotec.com*

8.13 Problem Tracking

This chapter answers frequently asked questions (FAQ) about the PowerLink and the integrated protection signaling equipment iSWT 3000 and provides operating instructions for possible system reactions in case of disturbances resp. operating errors.

Problem concerning:	Reason/Solution
PowerLink without Function	
The system has no function, the red **LED "i" on the PSPA2** is **OFF**	Check the external supply voltage.
The system has no function, the red **LED "i"** on the **PSPA2** is **ON** all other LED are OFF.	The switch S1 for the power supply enable/disable is in the lower position. S1 is behind the front cover on the module CSPi above the Service Interface connector.
PowerSys	
Not possible to establish a **connection** between PowerLink and PowerSys	Wrong IP address selected? Adjustment with <**Connection setup**>.
	Check cable configuration (for more information ref. to chapter *Commissioning*).
	Check the PowerSys release
No further **service can be added** in the system configuration	The services must be **enabled in the dongle**. It can be checked in the menu <**Device - Dongle information**>. Note: For reading the dongle information of the equipment, the connection to PowerSys has to be established. For upgrade contact your responsible SIEMENS department.
Create System Log	
Create system log	The function may be used in case of problems occurring in a PowerLink resp. SWT 3000 connection.
	It creates an **encoded** zip file containing important system information including the whole database of the equipment and the event memory of the equipment.
	Send the zip file to your responsible SIEMENS department for evaluation.
Clear CDB Command	
Clear CDB The command is available in **Test - General**	The command "Clear device setting" (Configuration Database) **clears the complete configuration (!)**, stored in any active module (CSPi, vMUX, PU4). It is **recommended** to store a **safety copy** from the device **before** executing this command.
	After the command has been executed, **you may receive hardware and/or configuration fault alarm** because the CSPi has no valid database.
	The function has to be executed after firmware upgrade/downgrade, or in case of a **new configuration** of an existing PowerLink resp. if problems occur after changing an PowerLink configuration.
Connecting Cables	
Service PC to PowerLink	Standard CAT5e patch cable. A shielded cable is recommended. Refer to chapter *Commissioning: Configuration with the Service PC*
	Cable for Software download with MemTool refer to chapter *Commissioning: RS232 Connection Cable for the Service PC*.
SWT 3000 to PowerLink via VFx modules	Refer to chapter *Installation: Connection of an external SWT 3000 to the VFx modules*.
PMX 3000 resp. PMX 2100 MUX to PowerLink	Refer to chapter *Installation* and chapter *Commissioning: Synchronous interface X.21.*.

Problem concerning:	Reason/Solution
ACE	
ACE for Service F3 is selected but is never executed	ACE can only work properly when the bandwidth of the service is equal or bigger than 600 Hz.
ACE after start-up	ACE for services F2x and F3x is started automatically. To prevent a concurrence of ACE when both devices of a line are started at the same time, different start-up delays are used in "ACE-Master" and "ACE-Slave" device.
	A device is "**ACE-Slave**" when the HF-TX-Frequency is less than HF-RX-Frequency, otherwise the device is "ACE-Master"
ACE start-up delay	The Start-up delay used by "ACE-Master" is 12 seconds. The Start-up delay used by "ACE-Slave" is the delay of "**ACE-Master**" + 60 seconds
HF Configuration	
Definition of "Frequency order" for receive and transmit frequency	Refer to chapter *Commissioning": Frequency pattern using adjacent Tx- and Rx-bands*
Frequency adjustment	The frequency adjustment is depending on the setting of the frequency grid. In case of 4-kHz grid the smallest possible frequency step is 2 kHz. In case of 2.5-kHz grid the smallest possible step is 1.25 kHz.
HF Frequencies from 24 up to 500 kHz	For using these frequencies LB versions of the AMP50, LT100, TXF1, TXF2 resp. RXF modules in the PLPA are required.
HF Frequencies from 500 up to 1000 kHz	For using these frequencies HB versions of the AMP50, LT100, TXF1, TXF2 resp. RXF modules in the PLPA are required.
AXC activation	The AXC function must be activated when using adjacent Tx and Rx bands or if the gap between the Tx and Rx bands is less a defined value. For more details refer to chapter *Commissioning: Definition of the adjacent mode*.
Receive Alarm	
Receive alarm and general alarm is activated. The LED RX is red slow blinking.	Check the complete cable connection between the HF output PLPA and the HF connection board.
	Adjustment of the RXF? HF configuration?
Receive Alarm in case of adjacent Tx and Rx bands	
The PowerLink receive level cannot be properly adjusted with adjacent Tx and Rx bands	Check the setting for the ADC in the <**Configuration – Option**>. The default setting is 12 dB. If the line attenuation (from Tx output to Rx input) is more than 15 dB this value has to be changed. Refer to chapter *Commissioning: ADC Adjustments*.
iSWT Module Type	
Type of PU4 module for iSWT	In the PowerLink system the module type **PU4** is required for the integrated SWT 3000. In case of connecting an external SWT 3000 via fiber optic module **FOM**, the module type for the PU4 in the external SWT 3000 and PowerLink must be **PU4**.
iSWT	
PU4 is equipped and configured but all LED are staying red after power up	PU4x power supply enable switch is in position OFF! Check jumper X17 on the PU4 module it must be in position 1-2. Refer to chapter *Commissioning: Integrated SWT 3000*.
PU4 LED **OK** is green **flashing** and general alarm is activated.	The test mode of the iSWT is activated. Deactivation with PowerSys <**iSWT-x - Test**>
PU4 LED **LIA** is red (flashing)	The module shows guard alarm. The guard frequency must be received at least for 150 ms to unlock the LIA receiver. No connection via PowerLink. Check the receive level of the PowerLink. PowerLink connected to dummy load?

Problem concerning:	Reason/Solution
No trip signal is transmitted from the connected protection device	Check the jumper on the IFC-D/P module for the rated voltage of the binary inputs. The settings are shown in chapter *Commissioning*: Jumper settings for the IFC modules.
	Make sure that the "Test mode IFC" is not activated.
	Check the input configuration of the iSWT 3000(<**Configuration–iSWT-x–Input allocation** >). The inputs must be enabled.
IFC-Test inputs do not work although IFC-test mode is enabled	After enabling „Test mode-IFC" by configuration, all test-switches must be once in **off**-position before on-position of any switch is accepted (warning: switch-off-position depends on IFC-hardware-release!)
	During IFC-Test mode, the signals via binary inputs are disabled! Binary inputs activated with the test-switch in the test mode, are causing command outputs in the remote station
Command transmission time via Line- Interface-Analog (LIA) is longer than expected	Adjustment „Application" in the PowerSys-Form <**Configuration – iSWT-x – System-Line interface**> is set to „direct tripping"
iSWT with LID (for PowerLink 100)	
Line-Interface-Digital (LID) does not **synchronize** (respective LED is indicated red)	Check if all jumpers on board DLE are set to the right position for the desired interface. The settings are shown in chapter *Commissioning*. The jumper settings are shown also in the SWTStraps program installed with the PowerSys.
	Check if LID-configuration is OK, especially **DCE/DTE**-settings. False connection(s) in the cables?
	Check if "Address settings for Transmitter and Receiver in <**Configuration – iSWT-x – System**> corresponds within the SWT 3000 link.
	More information can be found in chapter *Commissioning*.
Test loops for the Line-Interface-Digital (**LID**) are not working	Check the address settings for the transmitter and receiver in the iSWT 3000 system configuration. For switching remote or local loop, it must be the same address.
iSWT Event Recorder PowerLink Event Log	
Saving the event log	Open the event recorder and read the number of events. Then select the <**save**> button.
Clock Adjustment	
Time and date is not taken over from the service PC	Check the regional settings of the service PC. It must be set to "German" or "English (UK)"
RS232 Splitter	
Interfaces for the RS232 splitter	The RS 232 splitter is available for the interfaces RS232-1 up to 4. For using the splitter function connect the RTU to the port B. In this case the RTS signal is needed for the data transmission. For detailed information refer to chapter *System description*.
iFSK Channels	
Interfaces for the iFSK channels	Up to 4 iFSK channels are available in the PowerLink. They have to be connected at the RS232-1 up to 4 interfaces. For using the splitter function connect the RTU to the port **B**. In this case the **RTS** signal is needed for the **data transmission**.
VFx Firmware Update	
Updating Firmware of **VFx** module	For updating the firmware of the VFx modules, the PowerLink must be switched to the diagnostic mode (refer to chapter *Diagnostic and error handlings*.

Problem concerning:	Reason/Solution
Measuring Voice Frequencies via VFx Modules in the HF Range	
The HF level of the fed data frequency is less than the HF level CSPi displayed in the PowerLink information services form	The feeding data channel is working with the **nominal** level. The displayed HF CSPi level is the **peak** level. The difference between the VF peak level and the channel level is also measured in the HF range. You find more information in chapter Commissioning *Considerations About Level Adjustment*.
VFM Module	
No S2 Signals from/to VFx	No supply voltage for S2 receiver/transmitter, check **connection** of the **PS E&M** terminal. For detailed information refer to chapter *Installation*.
State of S2/S6 Signal	
State of control signals **S2** and/or **S6** of user interface must be changed	To adapt PowerLink interfaces to user demands the states of all S2 and S6 input signals can be used "normal" or "inverse". The states of S2 and S6 signals can be changed in the PowerSys form <**Adjustment – Service option - Service x**>.
DP Data Rate	
Primary data rate adjustment	The primary data rate cannot be higher adjusted than the max bit rate calculated with the **bit rate estimation**.
Secondary data rate	The secondary data rate is only adjustable in the **synch. mode dynamic**. **The synch. mode dynamic must be enabled in the dongle!**
DP is not synchronizing	Check the ADC adjustment of the <**Configuration – Option**>. It must be 20 dB when the line attenuation is 25 dB. Refer also to the chapter *Commissioning: ADC adjustments*.
DP and X.21-DP Interface	
The connected PMX3000 is not working properly	Check the setting DCE/DTE for the MUX and DP.
	Check the connecting cable. For detailed information refer to chapter *Commissioning: Synchronous Interface X.21-DP*: .
X.21 clock mode is not adjustable	The X.21 clock mode is fixed to DCE for the **DP-Mode** "Slave". Only the "**Master**" can be adjusted to **DTE**.
The connected MUX is not working properly in the synch. mode **dynamic**	Only the PMX3000 can be connected in this synch. mode.
	Make sure that the connected **PMX3000** is set to the clock mode **DTE** and the **DP** to **DCE**.
DP and iMUX	
Setting the bit rate of the channels 1 to 4 in the synch. mode **dynamic**	The bit rate adjusted for the channels 1 to 4 has to be transmitted with the primary **and** secondary bit rate of the DP.
iMUX data channels 1 up to 4 are not transmitted.	Make sure that the channels are connected to the RS232-**1A to 4A** interfaces. If connected to the **1B to 4B** interfaces the **RTS** signal is needed for the transmission.
	In case of connection to the 1A to 4A interfaces make sure, that the contact polarity inversion (**Cont inv** in the PowerSys service configuration) is not activated.
	Check the connecting cable to the RTU! **Do not use crossed wires**.
iMUX data channels 5 up to 8 are not transmitted.	The data channels are exceeding the aggregate bit rate of the Data Pump.
DP and vMUX	
vMUX Board Link error	15-pin Sub-D-Connecter "X.21-DP" on PowerLink 50/100 connector panel is wired!
Transmission errors on non guaranteed ("best effort") RS232 channels of vMUX	Hardware handshake must be used to stop transmission when the transmission channel is not available. Handshake signals at the RS232-1 up to 4 interfaces are available on the B ports.

Problem concerning:	Reason/Solution
File transfer via RS232 channel with **HyperTerminal** .	For file transfer, always UART-Format 8N1 is used!
DP and adjacent Tx/Rx Bands	
HF configuration of the frequency order	In case of using DP only, the lower frequency band must be adjusted regular and the upper frequency band inversed.
	If using DP and voice transmission the lower frequency band must be adjusted inversed and the upper frequency band regular. Refer also to chapter *Commissioning*.
DP is not synchronizing and RX-AL LED is green flashing	The receive level is to high! Correct it with PowerSys program <**Adjustments – Leveling - RX-Leveling**>
PLPA	
The transmit line filter cannot be adjusted	Check the straps on the TXF module according the PLPA program. Refer also to chapter *Commissioning: Tuning of the transmit line filter*. If all jumpers are correct, and there are still problems change the module.
No output power after filter adjustment	Make sure that the straps on the TXF and LT100 modules are in normal operating position.
	Refer also to chapter *Commissioning: Tuning of the transmit line filter, or to the PLPA program*.
Service Telephone STEL	
Activation	For activating the service telephone, the SERVICE- button on the CSPi has to be pressed for at least 5 seconds. At the local station, this is indicated by slow blinking of the LED SERVICE-TEL. The remote station receives a call signal. The STEL is working, if the STEL button is pressed in the remote station within 1 minute.
	The corresponding service is interrupted and general alarm is activated during the STEL activation.
Calling the remote station during the STEL operation	To call the remote station during the STEL operation, press the SERVICE-TEL button for min 1 second. In the remote station, the STEL button has to be pressed within 1 minute in order to switch off the buzzer.
Exit the STEL	To exit the SERVICE-TEL operation, press the SERVICE-TEL button for min 5 seconds.
Service telephone activation is working but no voice is transmitted	Check the head set of the service telephone. Both jacks must be stereo type.
RM Service	
The RM service is configured but a connection to the remote station is not possible	Check that no service PC is connected in the remote station.
	For the remote channel, a Master – Slave connection is necessary. Check the corresponding settings in the RM Configuration.
	The remote station is connected via route communication and RM-1 interface. RM-1 is blocked if a Service PC is connected to the device. Connect the service PC to the other PowerLink.
The RM service is configured a connection to the remote station is established but a configuration of the remote device is not permitted	Additional the configuration of the device has to be enabled in the RM configuration form. For more details refer to chapter *Commissioning* in this manual.
Remote Access to the PowerLink	
Description about remote access	For detailed information refer to chapter *SNMP and Remote Access*.
Firmware upgrade of PowerLink	
The Firmware of the PowerLink system has to be upgraded	For firmware upgrade the **MemTool program** is used which is part of the **PowerSys Package**. It is used for upgrading SWT 3000 and/or the PowerLink system.
	For detailed information refer to chapter *Service Program PowerSys*.

Problem concerning:	Reason/Solution
No connection of the MemTool program to the PowerLink possible	Verify, whether the service PC is connected to the RM-1 connector on the CFS-2 and switch S5/1 on the CSPi is in “ON” position. Refer to chapter *Control and Signaling Elements on the CSPi Module*. Make sure that the **target** file is **Siemens PowerLink CSPi**
No display of “AllInOne.jnk” files in the Open File form of MemTool	Make sure that the ”Files of type” selection in the Open file form is adjusted to **jnk-Files (*.jnk)**
Firmware upgrade of iSWT	
No connection of the MemTool program to the iSWT possible	Verify, whether the service PC is connected to the PU3f connector the jumper X17 on the PU3f is in position 2-3 and switch S5/2 on the CSPi is in “ON” position. Make sure that the **target** file is **Siemens SWT 3000 PU4**. If although no connection is possible, push the reset button at the PU3x and try again.
Firmware upgrade of vMUX	
The Firmware of the vMUX has to be upgraded	For firmware upgrade the **MemTool program** is used which is part of the **PowerSys Package**. It is used for upgrading SWT 3000, vMUX and/or the PowerLink system. For detailed information refer to chapter *Firmware Upgrade with MemTool* .
No connection of the MemTool program to the PowerLink vMUX possible	Make sure the service PC is connected to the upper connector (SSP) of the vMUX, the target file is Siemens PowerLink – vMUX, the S2.1 on the vMUX is in “ON” position and the S5.2 on the CSPi is in “ON” position. Ref. also to*Control and Signaling Elements on the vMUX* . For detailed information refer to chapter *Service Program PowerSys*.

8.14 Recommended Handling of Power Cycle

In order to ensure optimum performance of the system, applying standard procedures as for the operation of any electric equipment is recommended. These standard procedures include, but are not limited to:

- If a reset of the CSPi board has to be performed, it shall be executed via the RESET button S4 as described in the Equipment Manual chapter 8.2. Control and Signaling Elements on the CSPi Module.
- If a manual Power OFF has to be performed, it shall be executed via the Power Inhibit switch S1 as described in the Equipment Manual chapter 8.2. Control and Signaling Elements on the CSPi Module.
- If a manual Power OFF is performed, a subsequent power ON action shall be started not earlier than 10 sec after power down.

9 Technical Data

9.1 Transmission Method

Modulation	Amplitude modulation with single sideband transmission Single step frequency conversion Multicarrier modulation (OFDM)
HF-frequency range	24 kHz to 1000 kHz
HF-bandwidth	2.5, 3.75, 4, 5, 7.5, 8, 12, 16, 24, 32 kHz in each operating direction
Tx/Rx band	Adjacent Non adjacent

9.2 HF- Interface

Output power	**PowerLink 100**: 50 W-amplifier, up to +47 dBm PEP Adjustable 20 W to 50 W 100 W-amplifier, up to +50 dBm PEP Adjustable 40 W to 100 W **PowerLink 50**: 50 W-amplifier, up to +47 dBm PEP Adjustable 20 W to 50 W
Rated output impedance	75 Ohm unbalanced or 150 Ohm balanced
Spurious emission	In accordance with IEC 60495
At a distance of:	At transmitted power of:
	> 40 W < 40 W
1 x BN from the transmission Band	≥ 60 dB -14 dBm
2 x BN from the transmission Band	≥ 70 dB -24 dBm
>2 x BN from the transmission Band	≥ 80 dB -34 dBm
	BN = rated bandwidth of the transmission channel
Return loss	> 10 dB (according IEC 60495)
Tapping loss	≤ 1.5 dB (according IEC 60495)
Balance to ground 50 Hz Balance to ground 60 Hz	> 40 dB (according IEC 60495) > 40 dB (according IEC 60495)

9.3 Transmission Characteristics

Receiver sensitivity	Minimum receive level of pilot tone: -32 dBm (minimum receive level can vary depending on the operating mode)
Receiver selectivity	At a distance of 1 x BN from the band limits: ≥ 65 dB At a distance of 2 x BN from the band limits: ≥ 75 dB (BN = rated bandwidth of transmission channel)
Selectivity	< -55 dBm0 (according IEC 60495)
AGC (automatic gain control)	Range 40 dB (AGC-range can vary depending on the operating mode) stabilization of vf-output level: < ±0.5 dB
AFC (automatic frequency control)	VF-frequency deviation between transmitter and receiver » 0 Hz
AXC (autom. crosstalk cancellation)	Dynamic adjustments to changes in the line conditions

9.4 Analog Interface

VF- Interface (General)

Number of interfaces	**PowerLink 100**: Up to 8 **PowerLink 50**: Up to 7
Telephone signaling channel	Pulse distortion < 1.5 ms at 50 Bd
Compander	Compression/expansion ratio k = 2
Bandwidth	0.3 kHz to 3.84 kHz (range depends on configuration)
Return loss	> 14 dB (according IEC 60495)
Control wire in	Optocoupler DC 7 V < Vin < DC 72 V I_{max} = 7 mA due to limiter at input circuit
Control wire out	Optocoupler DC 12 V < Vout < DC 72 V I_{max} = 100 mA depending on Vout

VF- Telephone Channel E&M (2/4 Wire)

Number of channels	**PowerLink 100**: Up to 5 (5 with dPLC and vMUX, 3 with aPLC) **PowerLink 50**: Up to 4 (4 with dPLC, 2 with aPLC)
Impedance input/output	600 Ohm balanced
Input level	4 wire: -26 dBm to +1 dBm 2 wire: -22 dBm to +5 dBm
Output level	4 wire: -7 dBm to +14 dBm 2 wire: -11 dBm to +10 dBm
Control wires	Telephone signaling channel (S2) Compander control

VF- Telephone Channel FXS (2 Wire)

Number of channels	**PowerLink 100**: Up to 3 **PowerLink 50**: Up to 2
Impedance	600 Ohm
Infeed current	48 V, max. 40 mA
Max. loop resistance	1500 Ohm
Ringing voltage	96 Vpp, 25 Hz, 50 Hz, 60 Hz, selectable
Input level	-26 dBm to +5 dBm
Output level	-11 dBm to +14 dBm

VF- Telephone Channel FXO (2 Wire)

Number of channels	**PowerLink 100**: Up to 3 **PowerLink 50**: Up to 2
Impedance	600 Ohm
Ringing detection	25 Hz, 50 Hz, 60 Hz (> 24 Vrms)
Loop resistance	< 560 Ohm
Max. loop current	70 mA
Input level	-26 dBm to +5 dBm
Output level	-11 dBm to +14 dBm

VF-Data Channel F3 (4 Wire)

Number of channels	Up to 2
Impedance input/output	600 Ohm balanced
Input level	-26 dBm to +1 dBm
Output level	-7 dBm to +14 dBm

VF-Distance Protection Channel F6 (4 Wire) for aPLC

Number of channels	Up to 2
Impedance input/output	600 Ohm balanced
Input level	-26 dBm to +1 dBm
Output level	-7 dBm to +14 dBm
Control wire	Boosting of protection signal (S6)
Transmission time	≤ 10 ms

TP-Repeater Channel (4 Wire, VF)

Number of channels	Up to 4
Bandwidth	0.3 kHz to 2.64 kHz or 0.3 kHz to 3.84 kHz
Impedance input/output	600 Ohm balanced
Input level	0 dBm
Output level	0 dBm
Wiring	4 Wire Crossover Cable

9.5 Digital Interface

Transparent Narrowband Data for a PLC

Number of channels	Up to 4, asynchronous
Interface	RS232 (TxD, RxD)
Modulation scheme	FSK (Frequency Shift Keying)
Nominal baud rate	50 bps, 100 bps, 200 bps, 600 bps, 1200 bps, 2400 bps
Min. bandwidth	100 Hz, 200 Hz, 400 Hz, 1000 Hz, 1440 Hz, 2720 Hz

Broadband Data (General) for dPLC

Number of channels	Up to 8 asynchronous, 2 synchronous, 8 voice, 2 VF data, 2 ETH
Modulation scheme	Multicarrier
Data Pump data rate	Max. 320 Kbps
Data Pump bandwidth	3.5 kHz, 3.7 kHz, 4 kHz, 4.5 kHz, 4.7 kHz, 5 kHz, 5.5 kHz, 6.5 kHz, 7 kHz, 7.5 kHz, 11.5 kHz, 15.5 kHz, 23.5 kHz, 31.5 kHz
Versatile multiplexer	For the multiplex transmission of digitized voice and data channels. Transfer of data channels as well as digitized voice in the repeater station via StationLink. Voice transferred via StationLink without decompression/compression.
Fallback mode	Dynamic matching of the transmission rate in 2 steps with priority matching
Required minimum signal-noise ratio	39 dB for 8.5 bit/s/Hz (for example, 64 Kbps up to 7.5 kHz) 20 dB for 4 bit/s/Hz (for example, 32 Kbps up to 7.5 kHz)

Asynchronous Data Interface (iMUX- Data Pump)

Number of channels	Up to 8
Interface	RS232 (TxD, RxD, RTS, CTS)
Bit rate	1.2 Kbps, 2.4 Kbps, 4.8 Kbps, 9.6 Kbps, 19.2 Kbps
UART-mode	8N1, 8N2, 8E1, 8E2, 8O1, 8O2 7N1, 7N2, 7E1, 7E2, 7O1, 7O2
Multiplexer scheme	Statistical, with priority
Transmission capacity	Bandwidth 8 kHz with 64 Kbps Data Pump rate is suitable for up to 8 channels 9.6 Kbps or 4 channels 19.2 Kbps (= 76.8 Kbps). Bit rate of Data Pump is settable in 0.4 Kbps steps.

Synchronous Data Transmission via Data Pump and External Multiplexer

Number of channels	1
Interface Bit rate	X.21-DP 9.6 Kbps to 64 Kbps (adjustable in steps of 0.4 Kbps) 64 Kbps, 80 Kbps, 96 Kbps, 128 Kbps, 144 Kbps, 160 Kbps, 192 Kbps, 224 Kbps, 256 Kbps, 288 Kbps, 320 Kbps
Interface Bit rate	G703.1 (only PowerLink 100) 64 Kbps

IP User Interfaces

IP user interface	Ethernet 10/100 Base T SFP- Module
IP address PowerLink Default address Subnet mask	192.168.30.5 255.255.255.0

Versatile Multiplexer/Voice Compression for dPLC

Number of voice channels	**PowerLink 100**: Up to 5 via analog VF telephone interface **PowerLink 50**: Up to 4 via analog VF telephone interface Up to 8 via fractional E1 interface
Voice transmission	Compression rate: 5.3 Kbps/6.3 Kbps according G.723 8.0 Kbps according G.729
	Signaling: S2, DTMF, MFC (on request)
Synchronous data X.21	Up to 2 channels Bit rate: 9.6 Kbps to 64 Kbps (settable in 0.4-Kbps steps) 64, 80, 96, 128, 144, 160, 192 Kbps
Asynchronous data RS232	Up to 8 channels Bit rate: 1.2 Kbps, 2.4 Kbps, 4.8 Kbps, 9.6 Kbps, 19.2 Kbps, 38.4 Kbps, 57.6 Kbps, 115.2 Kbps UART-mode: 8N1, 8N2, 8E1, 8E2, 8O1, 8O2 7N1, 7N2, 7E1, 7E2, 7O1, 7O2 Multiplex method statistical, with priority
Analog FSK data	Up to 2 analog FSK channels for transmission in digital mode (Reverse FSK) Data rate: 50 bps, 100 bps, 200 bps, 300 bps, 600 bps, 1200 bps, 2400 bps UART-mode: 8N1, 8N2, 8E1, 8E2, 8O1, 8O2 7N1, 7N2, 7E1, 7E2, 7O1, 7O2 Transparent mode: oversampling with: 1200 Hz, 2400 Hz, 4800 Hz, 9600 Hz, 19 200 Hz
Transmission capacity via Data Pump	Up to 256 Kbps at 32-kHz bandwidth
Fallback mode	Dynamic transmission rate with 2 steps and priority adjustment

Data Pump

Modulation scheme	Multicarrier
Bandwidth	3.5 kHz, 3.7 kHz, 4.0 kHz, 4.5 kHz, 4.7 kHz, 5.0 kHz, 5.5 kHz, 6.5 kHz, 7.0 kHz, 7.2 kHz, 7.5 kHz,11.5 kHz, 15.5 kHz, 23.5 kHz, 31.5 kHz
Bit rate	9.6 Kbps to 64 Kbps (adjustable in steps of 0.4 Kbps) 64 Kbps, 80 Kbps, 96 Kbps, 128 Kbps, 144 Kbps, 160 Kbps, 192 Kbps, 224 Kbps, 256 Kbps, 288 Kbps, 320 Kbps

Required min. SNR	39 dB for 8.5 bit/s/Hz (for example, 64 Kbit/s within 7.5 kHz) 20 dB for 4 bit/s/Hz (for example, 32 Kbit/s within 8.0 kHz)
Latency	
(Bandwidth – Latency)	11 500 Hz, 15 500 Hz, 23 500 Hz, 31 500 Hz: 40 ms*) 6500 Hz, 7000 Hz, 7200 Hz, 7500 Hz: 80 ms*) 4500 Hz, 4700 Hz, 5000 Hz, 5500 Hz: 120 ms*) 3500 Hz, 3700 Hz, 4000 Hz: 160 ms*)

*) Latency in Sync-Mode adapted or dynamic

9.6 Integrated Teleprotection System SWT 3000

9.6.1 Overview

Number of systems	**PowerLink 100**: Up to 2 SWT 3000 integrated in the PowerLink rack or connected via fiber-optic cable (FOM) **PowerLink 50**: 1 SWT 3000 integrated in the PowerLink rack
Operation modes	Single purpose (SP) Alternate multi-Purpose (AMP) Simultaneous multi-Purpose
Number of commands	Up to 4 per system (SP, MP, AMP) **PowerLink 100**: Up to 24 in MCM mode
Modulation	F6 or Coded
Broadband frequencies	0.3 kHz to 2.03 kHz Guard 2.61 kHz or 3.81 kHz
Narrow band frequencies	0.63 kHz to 1.26 kHz (incl. Guard)
Transmission on alternative path (1+1)	**PowerLink 100**: Digital: 64 Kbps: X.21, G703.1 2 Mbps: G703.6 **PowerLink 50**: none

9.6.2 Command Input/Output

Binary Command Input IFC-P/IFC-D

Input voltage range[5]	DC 24 V to 250 V (tolerance -20 % to +20 %)	
Input per module	4	
Nominal Input Voltage	**Typical Threshold Voltage**	**Tolerance**
24 V	17.0 V	+/- 10 %
48 V or 60 V	33.0 V	+/- 10 %
110 V	75.0 V	+/- 10 %
220 V or 250 V	155.0 V	+/- 10 %
Polarity	Independent	
Pulse suppression	1 ms to 100 ms (programmable in steps of 1 ms)	
Input current	Max. 2 mA	

Binary Command Output IFC-P for normal contact load

Contact type	Relay NO, normally open
Contacts per module	4
Contact material	Ruthenium
Switching power	250 W/250 VA
Switching voltage	AC/DC 250 V

5 Regardless of the configured nominal input voltage, the maximum voltage of DC 287.5 V can be connected.

Switching current	AC/DC 1.5 A
Carry current < 2.5 ms	AC/DC 5 A
Carry current	AC/DC 1.5 A
Insulation withstand voltage	AC 3 kV
Contact configuration	Single pole, normally open
Connection cable	≤ 2.5 mm^2 (modular terminal block)
Pickup time including contact-chatter time maximum	2 ms
Electric strength of contacts/coil	AC 3000 V

Binary Command Output IFC-D for high contact load

Contact type	Relay NO, normally open
Contacts per module	4
Contact material	Silver Tin Oxide
Switching power	150 W/1250 VA
Switching voltage	AC/DC 250 V
Switching current	AC/DC 5 A (30 A ≤ 0.5 ms)
Carry current	AC/DC 5 A
Insulation withstand voltage	AC 3 kV
Contact configuration	Single pole, normally open
Connection cable	≤ 2.5 mm^2 (modular terminal block)
Electric strength of contacts/coil	AC 3000 V

Binary Command Output IFC-S for Signaling

Contact type	Relay CO, changeover with common root
Contacts per module	8
Contact material	Silver Tin Oxide
Switching power	150 W/1250 VA
Switching voltage	AC/DC 250 V
Switching current per contact	AC/DC 5 A (30 A ≤ 0.5 ms)
Carry current	AC/DC 1 A
Switching current per IFC-S module	8 A
Insulation withstand voltage	AC 3 kV
Contact configuration	Single pole, configurable: normally open or normally closed Common reference voltage
Connection cable	≤ 2.5 mm^2 (modular terminal block)
Electric strength of contacts/coil	AC 3000 V

Binary Input IFC-MCM Basis and Sub Module for PowerLink 100

Rated input voltage *)	DC 24 V to DC 250 V (tolerance: -20 % to +20 %)
Threshold	70 % of rated DC input voltage (24 V, 48/60 V, 110 V, 220 V)
Polarity independence	Yes
Pulse suppression	1 ms
	additionally up to 100 ms programmable in steps of 1 ms
Hardware debounce time	0.6 ms or 1 ms adjustable with jumpers

*) Regardless of the adjusted input voltage the max. voltage of DC 287.5 V can be connected

Command Output IFC-MCM (Relay) for PowerLink 100

Contact type	Relay, make contact
Switching power	150 W (DC) 1250 VA (AC)
Switching voltage	220 V (DC)
Switching current	5 A (DC or peak AC)
Carry current	5 A (DC or peak AC)

Command Output IFC-MCM (Solid State Relay) for PowerLink 100

Contact type	Semi-conductor electrically isolated, make contact
Switching power	50 VA
Switching voltage	250 V (DC or peak AC)
Switching current	2 A (DC or peak AC)
Carry current	2 A (DC or peak AC)

IEC 61850 Command Input/Output EN100

Electrical interface	RJ45, 100BaseT, max. range 20 m
Optical interface	1300 nm, LC connector, max. range 1.5 km, Multimode
Transmission rate	100 Mbps (Fast Ethernet)

9.6.3 Terminals of IFC Modules

Screwed connection

Wire cross section	< 1.5 mm^2 (> AWG 16)
Bare Wire without conductor sleeve Stripping Length L	12 mm (0.47 inch)
Stranded Wire with conductor sleeve Stripping Length L	10 mm (0.39 inch)
Terminal screw tightening torque	0.8 Nm (7.1 lb. inch)
Sleeve length (wire range) / Type	> 10 mm (0.39 inch) e.g. DIN 46228-E1,5-10
Sleeve Type	Acc. EN 60947-7 class 1

Crimped connection

0.5 to 1.0 mm^2 (AWG 20 to 18) Recommended Contact Type	Weidmueller Order. No. 162552 (Tape), 162556 (single contact)
1.5 to 2.5 mm^2 (AWG 15, 14) Recommended Contact Type	Weidmueller Order. No. 162550 (Tape), 162551 (single contact)
Recommended Crimp Tool	Weidmueller Order. No. 9014140000
Recommended Unlocking Tool	Weidmueller Order. No. 1359000000

9.6.4 Command Transmission Via Analog Path

Transmission Time ^{T0} (SWT 3000 Integrated into PowerLink)*

Broad band equipment	
Single purpose	≤ 10 ms (F6, CT)
Alternate multi purpose F2 + AMP DP + AMP	≤ 15 ms (F6, CT) ≤ 19 ms (F6, CT)
Simultaneous multipurpose	≤ 10 ms (F6, CT)
Narrow band equipment	≤ 15 ms (configured as service F6)

* All values are given for the IFC-P module and permissive tripping. Direct tripping will prolong transmission time 5 ms.

** In DP + AMP application with HF-bandwidth > 8 kHz, the transmission time is prolonged ~ 2 ms.

If the IFC-D module is used all specified transmission times are prolonged by ~ 4 ms.

Optical connection between SWT 3000 and PowerLink will prolong the transmission time 1 ms.

Command Transmission MCM for PowerLink 100

Transmission period	50 ms (range 50 ms to 100 ms in steps of 5 ms)
Transmission time T0	≤ 20 ms
Bandwidth	4 kHz

SWT 3000 Connection to PowerLink via Fiber Optic Module FOM for PowerLink 100

Module Type		FOS1 Short range SM	FOS2 Short range MM
Optical module		SFP-Transceiver	
Connector		Industry standard duplex LC connector	
Wavelength class [nm]		1310	850
Average output power [dBm]	max:	-8	-3
	min:	-15	-10
Maximum input power [dBm]		-8	0
Minimum input power [dBm]		-28	-17
Optical budget [dB]		13	7
Range [km] depending on the fiber	1310 nm: 0.38 dB/km 850 nm: 3.5 dB/km	34	2

Security (Analog Transmission Path)

P_{UC} Probability of unwanted commands	$< 10^{-6}$

Dependability (Analog Transmission Path)

P_{MC} (F6) P_{MC} (MCM) Probability of missing commands	$< 10^{-4}$ at SNR of +6 dB $< 10^{-3}$ at SNR of +4 dB

9.6.5 Command Transmission Via Digital Networks (Alternative Path) - PowerLink 100

Digital Interface

64 Kbps	X.21 G703.1
2 Mbps	G703.6 sym. 120 Ohm G703.6 asym. 75 Ohm

Transmission Time T0 *

64 Kbps	≤ 5 ms
2 Mbps	≤ 3 ms

* All values are given for the IFC-P module.
If the IFC-D module is used all specified transmission times are prolonged by about 4 ms

Security (Digital Transmission Path)

P_{UC} Probability of unwanted commands	$< 10^{-8}$

Dependability (Digital Transmission Path)

P_{MC} Probability of missing commands	$< 10^{-4}$ at BER of 10^{-6}

9.7 Miscellaneous

9.7.1 Maintenance Interfaces

Service-PC Interface 1 Interface 2	Ethernet 10/100Base T (LCT) RS232, 19 200 bps (RM-1)
IP address PowerLink	
Default address DHCP address range	192.168.20.5 192.168.20.10 to 15
Manual address range Subnet mask	192.168.20.16 to 254 255.255.255.0
DHCP	Server (default) Client
Service telephone	Headset (2 x 3.5-mm phone jack)

9.7.2 Network Management

Element Manager	For local and remote access with user account (MS Windows 10 or higher / x64 version); configuration, maintenance, and power management by PowerLink and SWT 3000 (integrated or connected via fiber-optic cable)
Integration with NMS at higher level	Via SNMP v2/3, Alarm Management (up to 6 destinations for alarm traps), inventory and performance management

9.7.3 Event Memory

Recording capacity	CSPi: 4000 events (i)SWT: 8192 events
Real-time clock	1-ms resolution, Synchronization per sync. pulse, IRIG-B, NTP

9.7.4 Alarm Modules Input/Output

Binary Input ALR Module

Binary Input 1 *) Nominal voltage used for Synchronization with:	
Sync pulse Polarity independence	DC 24 V to DC 250 V (tolerance: -20 % to +15 %) Yes
IRIG-B **) Polarity independence	DC 5 V, DC 12 V, DC 24 V (tolerance: ±15%) No, defined polarity required
Binary Input 2 *) ***) Nominal voltage Polarity independence	DC 24 V to DC 250 V (tolerance: -20 % to +15 %) Yes

*) Regardless of the adjusted input voltage the max. voltage of DC 287.5 V can be connected

**) IRIG-B input available only with ALR module

***) Binary Input 2 for future application

Output ALR Module (Relay)

Number of alarm outputs	3 or 6 relay contacts (6 relay with 2 modules for PowerLink 100)
Contact type	Change over contact
Switching power	300 W (DC) 1000 VA
Switching voltage	250 V (DC or peak AC)
Switching current	5 A (DC or peak AC)
Carry current	1 A (DC or peak AC)

9.7.5 Power Supply

Input voltage range	
PSPA2-DC	DC 38 V to DC 72 V
PSPA2-AC	AC 93 V to AC 264 V (47 Hz to 63 Hz) DC 85 V to DC 264 V
PowerLink 100: Power consumption	
50 W Amplifier (AC/DC)	Normal operation: 250 VA/140 W Max *): 340 VA/200 W
100 W Amplifier (AC/DC)	Normal operation: 390 VA/250 W Max *): 520 VA/360 W
PowerLink 50: Power consumption	
50 W Amplifier (AC/DC)	Normal operation: 250 VA/140 W Max *): 320 VA/180 W

*) Single tone operation

9.7.6 Climatic Conditions

Operation	0 °C to +55 °C -5 °C to +55 °C (hot boot)
Storage and transport	-40 °C to +70 °C
Relative humidity	5 % to 95 %
Absolute max. humidity	29 g/m^3 (no condensation)

9.7.7 EMC Immunity

RF disturbance Immunity	IEC 61000-4-6 0.15 MHz to 80 MHz 10 Vrms
	IEC 61000-4-3, EN 61000-6-2 (Industrial area) 80 MHz to 1,000 MHz 10 V/m 1.4 GHz to 2.0 GHz 3 V/m 2.0 GHz to 2.7 GHz 1 V/m

Electrostatic discharge	IEC 61000-4-2 4 kV (direct/indirect contact discharge) 8 kV (direct air discharge)
Bursts	IEC 61000-4-4
Power supply HF input/output VF input/output	2 kV 2 kV 1 kV
Surges	IEC 61000-4-5
Common mode (line-to-line)	2 kV
Differential mode (line-to-ground)	1 kV
Direct coupling into shields	1 kV

9.7.8 EMC Emission

RF disturbance Emission	IEC 61000-6-4 (Industrial area) Limit class A, 20 MHz to 1.000 MHz

9.7.9 Insulation Withstand Voltage

VF input/output	AC 500 V
Alarm outputs	AC 2.500 V
Carrier frequency input/output	AC 2.500 V
Power supply	AC 2.500 V
SWT: Command input/output	AC 2.500 V
SWT: G703.6 sym. (PowerLink 100)	AC 500 V

9.7.10 Impulse Withstand Level 1.2/50 µs, 0.5 J

VF input/output	1 kV
Alarm outputs	5 kV
Carrier frequency input/output	5 kV
Power supply	5 kV
SWT Command input/output	5 kV

9.7.11 International Standards

Single side band power-line carrier terminals	IEC 60495 *)
Product safety	IEC 60950-1

EMC	IEC 61000-6-4 (Industrial area) IEC 61000-6-2 (Industrial area) IEC 61000-4-2 Electrostatic discharge IEC 61000-4-3 RF disturbance Immunity IEC 61000-4-4 Bursts IEC 61000-4-5 Surges IEC 61000-4-6 RF disturbance Immunity IEC 61000-6-4 RF disturbance Emission (industrial area)
Climatic conditions	IEC 60870-2-2

*) IEC 60495 valid for analog transmission with bandwidth up to 8 kHz

9.7.12 Mechanical Conditions

Degree of protection	IP 20
Vibration stationary use	Class 3M3 2 Hz to 9 Hz: 1.5 mm amplitude 9 Hz to 200 Hz: 0.5 g acceleration
Shock	Resistance, class 2M1 11 ms pulse duration 10-g acceleration

9.7.13 Mechanical Design

PowerLink 100

19” frame	
Dimensions *)	482 mm x 578 mm x 270 mm (W x H x D)
Weight *)	
with 50-W amplifier with 100-W amplifier	21 kg 26 kg

*) Values including carrier frequency as well as amplifier section

PowerLink 50

19” frame	
Dimensions *)	482 mm x 266 mm x 270 mm (W x H x D)
Weight *)	18 kg

*) Values including carrier frequency as well as amplifier section

10 Appendix

10.1 Abbreviations

Subsequently you find a list with abbreviations which are used in the PowerLink 50/100 equipment manual:

Abbreviation	Signification
A	
AAA	AXC Automatic Activation
ACE	Automatic Channel Equalization
ACN	Allocated Channel Number
ADC	Analog Digital Converter
ADJ	Adjacent
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
AL	Alarm wire
AL-1HB	Adjustable coil of tx-filter 1st order high band 500 kHz up to 1000 kHz
AL-1LB	Adjustable coil of tx-filter 1st order low band 24 kHz up to 500 kHz
AL-1XB	Adjustable coil of tx-filter 1st order high or low band
ALA	Alarm output
ALR	Alarm Module PowerLink with binary input for IRIG-B synchronization
ALRS	Alarm module PowerLink
AMP	Tele protection mode: Alternate Multi Purpose operation
AMP50-HB	Amplifier 50 Watt (module) High Band for the frequency range 500 kHz to 1000 kHz
AMP50-LB	Amplifier 50 Watt (module) Low Band for the frequency range 24 kHz to 500 kHz
AMP50-XB	Amplifier 50 Watt (module) Low or High frequency band
aPLC	Analog PLC
ARP	Address Resolution Protocol
aSWT	Stand Alone SWT
ATT	Attenuator
AXC	Automatic Crosstalk Canceller
B	
BI	Binary Input
BER	Bit Error Rate
BL	Board Link (connection between vMUX and CSPi)
BP	Backplane
bps	bit per second
C	
CB-1	Capacitor bank
CC	Control Center
CDB	Configuration Data Base
CF	Carrier Frequency
CFG	Configuration alarm in the PowerSys service program
CFS-2	Carrier Frequency Section for connection with PLPA and vMUX
CI	Command Input
CO	Command Output
CSP	Central Signal Processing unit
CT	Coded tripping (transmission mode in SWT 3000)
CTS	Clear to send
CV	Compressed Voice
D	

Abbreviation	Signification
D/A	Digital Analog Converter
DCE	Data Communication Equipment
DDFC	Data Driven Frequency Control
DDS	Direct Digital Synthesizer
DHCP	Dynamic Host Configuration Protocol
DIAG	Diagnostic
DLE	Digital Line Equipment
DP	Data Pump
dPLC	Digital PLC
DSP	Digital Signal Processor
DTE	Data Terminal Equipment
DTMF	Dual Tone Multiple Frequency (signaling) telephone dialing procedure
DTR	Data Terminal Ready
DTT	Direct Transfer Trip
DV	Digital Voice
E	
E&M	Ear and Mouth
EALR	Receive alarm of the iSWT from version **≥ P3.2.216: RXALR-iSWTx** is used
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETC	External Transmit Clock
ETH	Ethernet
EOW	Engineering Order Wire (Service Telephone)
F	
F2	Speech signal at PLC terminals resp. service speech
F3/F4	Data signal at PLC terminals resp. service data
F6	Protection signal at PLC terminals resp. service protection signaling
F6SV	F6 supervisory from PowerSys version ≥ P3.2.216 (former F6UE)
FE1	Fractional E1 interface for connecting a digital exchange
FGND	Frame Ground
FIFO	First in First out
FM	Frequency Modulation
FO	Fiber Optic
FOBox	Fiber Optic Modem Box
FOL	Fiber Optic Modem Long distance
FOM	Fiber Optic Modem
FOS	Fiber Optic Modem Short distance
FPGA	Field Programmable Gate Array
FSK	Frequency Shift Keying
FTP	File Transfer Protocol
FW	Firmware
FXO	Telephone interface Foreign exchange office
FXS	Telephone interface Foreign exchange station
G	
GAL	Guard Alarm (i)SWT 3000
GENALR	General Alarm
GND	Ground

Abbreviation	Signification
GOOSE	Generic Object Oriented
GSE	Generic Substation Events
G703.1	Interface 64 Kbps of the iSWT digital line equipment
G703.6	Interface 2 Mbps of the iSWT digital line equipment
H	
HDB3	High Density Bipolar of order 3 code
HF	High Frequency
HV	High Voltage
HVL	High Voltage Line
HW	Hardware
I	
ICC	Internal Communication Control
IFC-D	Interface module for protection signaling system SWT 3000 (Direct tripping)
IFC-MCM	Interface module for protection signaling system SWT 3000 with MCM function
IFC-P	Interface module for protection signaling system SWT 3000 (Permissive tripping)
IFC-S	Interface module for protection signaling system SWT 3000 (Signaling only)
IFC-24	Interface module for protection signaling system SWT 3000 with MCM function
iFSK	integrated FSK-channel
iLAN	internal Local Area Network
iMUX	integrated Multiplexer for asynchronous data transmission
INC	Impulse Noise Compression
INPLM	Input Limitation Alarm
IRIG	Inter Range Instrumentation Group
IRIG-B00x	Message for clock synchronization of the CSPi, iSWT
ISDN	Integrated Services Digital Network
iSWT	integrated protection signaling system
iSWT3	integrated protection signaling system SWT 3000
K	
Kbps	Kilobit per second
L	
LAN	Local Area Network
LCT	Service interface at the front cover of CSPi (Local Craft Terminal)
LEC	Line Echo Canceller, processing echo cancellation of the incoming data (vMUX voice).
LED	Light Emitting Diode
LIA	Line Interface Analog – analog line interface from (i)SWT
LID	Line Interface Digital – digital line interface from (i)SWT
LT100-HB	Line Transformer module 100 Watt high frequency band 500 kHz up to 1000 kHz
LT100-LB	Line Transformer module 100 Watt low frequency band 24 kHz up to 500 kHz
LT100-XB	Line Transformer module 100 Watt low or high frequency band
M	
Mbps	Megabit per second
MCM	Multi Command Mode
MCM SV	Multi Command Mode Super Vision
MFC	Multi Frequency Code (multi frequency signaling)
MIB	Management Information Base
MLFB	Siemens ordering number
MMI	Man-machine interface

Abbreviation	Signification
MMU	Memory Management Unit
MP	Tele protection mode: Multi Purpose operation
MUX	Multiplexer
N	
NADJ	Non Adjacent
NAT	Network Address Translation
NC	Normally Closed contact, brake contact (alarm relay)
NE	Network Element
NMS	Network Management System
NO	Normally Open contact, make contact (alarm relay)
NTP	Network Time Protocol (clock synchronization of the iSWT resp. PowerLink via internet in case of SNMP)
NU	Non-Urgent alarm, pre-alarm
O	
OFDM	Orthogonal Frequency Division Multiplexing
OID	Object Identifier
OSA	Optimized Sub channel Allocation
P	
PABX	Private Automatic Branch Exchange
PAL	Pilot Alarm / Receive level alarm
PCB	Printed Circuit Board
PD	Present Detect
PDH	Plesiochronous Digital Hierarchy
PEP	Peak Envelope Power
PLC	Power Line Carrier
PLE	PLC line equipment
PLL	Phase Locked Loop
PLPA 50	PowerLink Power amplifier 50 Watt
PLPA 100	PowerLink Power amplifier 100 Watt
PLPAStraps	Program for determining the jumper and straps in the PowerLink PLPA part
PowerSys	Service program for PowerLink and SWT 3000
PPP	Point to Point Protocol
PPPOE	PPP Over Ethernet
PS	Power supply
PSCF2	Power Supply Carrier Frequency Section
PS E&M	Power Supply E&M interface (for signaling) on the PowerLink connector panel
PSCFS-2	Power Supply CFS-2
PSE	Protection Signaling Equipment
PSPLE	Power Supply PLE
PSPA2	Power Supply Power-Amplifier
PSTN	Public Switched Telephone Network
PU3e	Processing Unit SWT 3000 enhanced necessary for integration in PowerLink
PU3f	Processing Unit SWT 3000 enhanced for operation with FOM
PU3g	Processing Unit SWT 3000 enhanced for operation with FOM
PWL	PowerLink
Q	
QAM	Quadrature Amplitude Modulation

Abbreviation	Signification
QoS	Quality of Service
R	
RARP	Reverse Address Resolution Protocol
RAS	Remote Access Server
REM	Alarm from the remote station displayed in the PowerSys if RM function activated
RF	Radio Frequency (High Frequency)
rFSK	reversed FSK channel
RM	Remote Monitoring
RM-1	Serial interface Programming (CSPi), used for flash programming with MemTool
RM-2	Remote access interface on the PowerLink connector panel for route communication
ROHC	Robust Header Compression
RS232	Asynchronous digital interface
RTC	Real Time Clock (on iSWT)
RTS/CTS	HW handshake signals Request To Send / Clear To Send
RTU	Remote Terminal Unit
RX	Receiver
RXALR	Receiver Alarm
RxC	Receive Clock
RxD	Receive Data signal
RXF-HB	Receive Filter high frequency band 500 kHz up to 1000 kHz
RXF-LB	Receive Filter low frequency band 24 kHz up to 500 kHz
RXF-XB	Receive Filter low or high frequency band
S	
S/N, SNR	Signal to Noise Ratio
S2	Signaling wire from telephone exchange E&M interface
S6	Control wire for AMP, switch over to protection signal transmission
SC	Service Channel SWT 3000 via digital communication links
SDH	Synchronous Digital Hierarchy
SFP	Small Form-factor Pluggable (Opt module from the fiber optic modem FOM)
SL	StationLink
SMI	Structure of Management Information
SMUX	Synchronous Multiplexer
SNALR	Signal/Noise Alarm
SNMP	Simple Network Management Protocol
SP	Tele protection mode: Single Purpose operation
SSB	Service interface Backplane SWT 3000 for RM connection of 2 links
SSF	Service interface front panel PU3 module
SSI	Serial Synchronous Interface on the PU3e module
SSP	Serial interface Programming (vMUX), used for flash programming with MemTool
SSR	Service interface Remote Access on the backplane SWT 3000
SSTN	Substation
SERTEL	Service Telephone
STEL	Service Telephone
SV	Sampled Values
SWT	Protection voice frequency transmission
SysPil	System Pilot in the PowerLink
T	

Abbreviation	Signification
TCP/IP	Transmission Control Protocol/Internet Protocol
TP	Teleprotection
TPS	Teleprotection Signal (trip frequency)
Tunbl	Duration of the unblocking impulse of the (i)SWT 3000
TXALR	Transmitter Alarm
TxC	Transmit Clock
TxD	Transmit Data signal
TXF-1HB	Transmit filter 1st order high frequency band 500 kHz up to 1000 kHz
TXF-1LB	Transmit filter 1st order low frequency band 24 kHz up to 500 kHz
TXF-1XB	Transmit filter 1st order low or high frequency band
TXF-2HB	Transmit filter 2nd order high frequency band 500 kHz up to 1000 kHz
TXF-2LB	Transmit filter 2nd order low frequency band 24 kHz up to 500 kHz
TXF-2XB	Transmit filter 2nd order low or high frequency band
U	
UART	Universal Asynchronous Receiver Transmitter (RS232 chip)
UDP	User Datagram Protocol
UNBL	Unblocking
Usync	Clock synchronization for CSPi resp. integrated SWT 3000
V	
VAD	Voice Activity Detection
VCA	Voltage Controlled Amplifier
VF	Voice Frequency
VFM	Voice Frequency interface module with E&M interface
VFO	Voice Frequency interface module with FXO interface
VFS	Voice Frequency interface module with FXS interface
VFx	VF interface module (VFM, VFS, VFO)
VFx-y	VF interface module (VFM, VFS, VFO) in slot position y
VL	vMUX link
VLAN	Virtual Local Area Network
VoIP	Voice over IP
vMUX	Versatile Multiplexer in PowerLink 50/100
X	
X.21-DP	Synchronous digital interface for connection of external MUX to the DP
X.21-x	Synchronous user interface x for connection of synchr. data channels to the vMUX
xMUX	Collective term for iMUX or vMUX
2	
2plus2	Operation Mode 3b for the iSWT3 transmission of 2 uncoded and 2 coded commands
3	
3iC	Operation Mode M5A for the iSWT3 transmission of 3 independent commands
4	
4iC	Operation Mode 3a for the iSWT3 transmission of 4 independent commands

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