About this document

This document is a supplement to the TXT DM PL7 AXS V4● manual. It describes the installation and use of PL7-AXE V5 software installed under the X-TEL or MINI X-TEL V5 Software Workshop.

PL7-AXE V5 software can be used to create applications on TSX/PMX PLCs, versions V3, V4 or V5.

PL7-AXE software takes account of the model of the TSX/PMX "target" station and displays :

- V5 screens and menus if the TSX/PMX selected is V5
- V4 screens and menus if the TSX/PMX is V4.

V3 or V4 station selected : in this case, this supplement is not relevant; refer to the TXT DM PL7 AXS V4● manual.

V5 station selected : in this case, this supplement replaces sections 1 to 4 in divider C2 of the TXT DM PL7 AXS V4● manual.

Developments to PL7-AXE version V5 compared to previous versions

The main developments to the TXT L PL7 AXS V5E software compared to TXT L PL7 AXS V42E are as follows :

Data exchanges between PL7-AXE and XTEL-CONF

PL7-AXE uses certain objects generated by the XTEL-CONF tool. These objects are :
- the type of processor
- the rack module configuration
- the cartridge memory size
- the memory size reserved by XTEL-CONF.

The application structure must be generated by XTEL-CONF before using PL7-AXE software (see section 1.7 in divider C2).

Uniqueness of file names

Only one application file is generated by PL7-AXE, which contains the entire TSX/PMX configuration.
The application file name is AXIS.BIN.

Simplifying the generation phase of the application structure (.APP)

In version V5 it is no longer necessary to regenerate the ".APP" file after modifying a "BIN" file.

Terminology used

The names of certain function keys have been modified between version V4 and version V5. These modifications are :

- In connected mode

  [STORE] (V4) is now **[STA → DSK]**, used to transfer the axis control application from the TSX/PMX PLC memory to the AXIS.BIN file on disk. This transfer is executed using the TRANSFER tool.

  [RETRIEVE] (V4) is now **[DSK → STA]**, used to transfer the AXIS.BIN file on disk to the TSX/PMX PLC memory. This transfer is executed using the XTEL-TRANSFER tool.

- In local mode

  [•BIN] (V4) is now **[RETRIEVE]**, used to transfer any application file name from the hard disk to the AXIS.BIN file in the X-TEL database (thus erasing the previous contents of the AXIS.BIN file).

  [STORE] (V4) remains as **[STORE]** and is used to transfer the AXIS.BIN file to any application file name on the hard disk or on a backup diskette.

It is also possible to modify the configuration of the application I/O. To do this, the XTEL-CONF tool must be used by pressing the **[XTELCONF]** soft key (this key is only offered if there is a discrepancy between the directory and the configuration generated under XTEL-CONF).

Connection to the FIPIO fieldbus

PL7-AXE software can be used on an FTX 417/507 workstation connected to the FIPIO distributed I/O bus. In this case, the workstation uses the reserved connection point 63.

Upgrading a PL7-AXE V4 application to V5

Any V4 application can be converted to a V5 application, provided the following operations are performed :

① Retrieve the V4 application under X-TEL V5, using **Save/Restore** or **Copy/Paste**.

② Create the initial window for a V5 station.

③ Start the **Import** function from the AXIS icon in the V5 station initial window, and import the following files :

V4 station\AXIS\APPLI\xxx.BIN (essential) : binary application file

into the V5 station directory \AXIS\APPLI

then

V4 station\AXIS\MOD\xxx.162, xxx.172 or xxx.182 (optional)

into the V5 station directory \AXIS\MOD.

④ Run PL7-AXE in the V5 station and perform the following operations :

- Select the **TSX/PMX file** under the item **local/working memory** (depending on type of operation) to display the RETRIEVE command
- Activate the **[RETRIEVE]** command which provides access to the list of xxx.BIN station files
- Activate the **[DIR BIN]** command and select the previously imported xxx.BIN file
- **<ENTER><ENTER>** restores the xxx.BIN file under the V5 station with the file name AXIS.BIN.

⑤ Quit PL7-AXE.

⑥ Start XTEL-CONF

- From the **Generation** menu, activate the **with entry of application parameters** command
- Quit XTEL-CONF.

⑦ Start PL7-3 and activate the **[V5 CONF]** command to assign the new configuration defined under XTEL-CONF to the application program.

C
2

1.1 General

1.1-1 Functions available with PL7-AXE

PL7-AXE software, reference TXT L PL7 AXS V5E, is a help program for programming and installing axis control applications.

PL7-AXE software comprises :

- A software function for entering the configuration and program of TSX AXM 162/172/182 modules
- Optional function blocks
  - program loading OFB
  - diagnostic OFB
  - automatic mode management OFB.

- **Functions associated with the axis control modules**
  - assistance with entering configuration and program parameters using menus and on-line documentation,
  - assistance with diagnostics and debugging,
  - transferring the configuration and the program between the PLC memory, the module memory and the disk,
  - documenting the configuration and the program,
  - archiving the configuration and the program to disk,
  - printing the configuration and the program.

1.2 Configuration required for PL7-AXE

To install PL7-AXE requires an FTX 417/507 terminal or an IBM PS/2 microcomputer or compatible PC with :

- OS/2 operating system, version 1.3 or 2.1.
- The MINI X-TEL or X-TEL Software Workshop, reference TXT L BASE V5● or TXT L BJR V5●.
- PL7-3 software, reference TXT L PL7 3 V5●, TXT L PL7 3D V5● or TXT L PL7 3T V5●.
- A minimum of 4 Mb of RAM memory and a 40 Mb hard disk.

Important

> Telemecanique cannot guarantee correct operation of this software on all microcomputers or compatible PCs on the market with the above-mentioned characteristics.

1.3 Checking the hardware

The TXT L PL7 AXS V5 software package comprises :

- A 3" 1/2 diskette, reference TXT LF PL7 AXS V5,
- A 3" 1/2 diskette, reference TXT LF FB AXS V42,
- A software protection key,
- A licence agreement,
- This manual, reference TXT DM PL7 AXS V5.

To use PL7-AXE, the following hardware should be used :

- An FTX 417/507 terminal or an IBM PS/2 microcomputer or compatible PC (see required configuration section 1.2).
- A terminal/PLC connection cable for an FTX 417/507 terminal.
- A terminal/PLC connection kit for an IBM PS/2 microcomputer or compatible PC, comprising :
  - an RS 232C/current loop converter,
  - converter/microcomputer connection cable with a 9-pin connector,
  - converter/microcomputer connection cable with a 25-pin connector,
  - converter/PLC connection cable,
  - a TSX SCC 02 software key support.

1.4 Connections

All connections specific to the terminal (monitor, keyboard, mouse, printer, software key support, etc) are assumed to be in place, this section only describes fitting the software key. To do this, place the key in the empty slot in the key support.

This operation must be carried out with the equipment switched off.

Note
This software key contains the access rights needed to access PL7-AXE. The Key Manager tool, supplied with each Software Workshop, allows these rights to be transferred to the working key so that all rights are grouped on one key (the working key) so as to free a slot on the key support.

For further details about this tool, refer to the X-TEL or MINI X-TEL database manual.

The PL7-AXE V5 software key is identical to that of PL7-AXE V4.

1.5 Installing the software

1.5-1 Preliminary operations

Before installing PL7-AXE on the hard disk it is advisable to :

- Read the licence agreement and guarantee concerning copying restrictions and installation of the software.
- Make a duplicate of the diskette required for installation to avoid any accidental damage to the original diskette and work only with the copy.

Important

The PL7-AXE program disks are supplied in the write-locked position. Do not alter the position of the locking tabs.

1.5-2 Installation procedure

The following operations must be performed prior to installing PL7-AXE :

- Check that the MINI X-TEL or X-TEL V5 Software Workshop is already installed :
  - if so, install PL7-AXE according to the procedure described below,
  - otherwise, first install the MINI X-TEL or X-TEL Software Workshop (refer to the manual for the database concerned).
- Close all the current sessions. To do this :
  - open the Electronic Office Manager window,
  - pull down the Electronic Office menu and select the "Close all..." item,
  - confirm by pressing the Close all button.

Installing PL7-AXE software

- Open an OS/2 full-screen session. To do this :
  - open the Start Programs window,
  - pull down the Group menu and select the Main Group item,
  - select the OS/2 full-screen session item. The [C:\] prompt is displayed on the screen.
- Insert the TXT LF PL7 AXS V5 diskette in the drive.
- Enter the drive identifier (a: or b:), then confirm with <Enter>.
- From the new prompt (for example [A:\] or [B:\]), type **Install** then confirm with <Enter>.
- Follow the procedure displayed on the screen.
- When installation is complete, replace the diskette with the second diskette (reference TXT LF FB AXS V42).
- Type the **Install** command then confirm with <Enter>.
- Follow the procedure displayed on the screen.
- When the installation is complete and if it is the last one, check the configuration. Confirm with <Enter>.
- Remove the diskette from the drive and return to the Software Workshop using the <Ctrl><Esc> command.

1.6 Using the keyboard and the mouse

Using the keyboard

To use PL7-AXE , Telemecanique recommends a 102-key QWERTY keyboard.

Certain PL7-3 function keys (CLEAR, ZOOM, QUIT, etc), which are also used by PL7-AXE, are not printed as standard on the keyboard, but are accessed by another key or combination of keys.

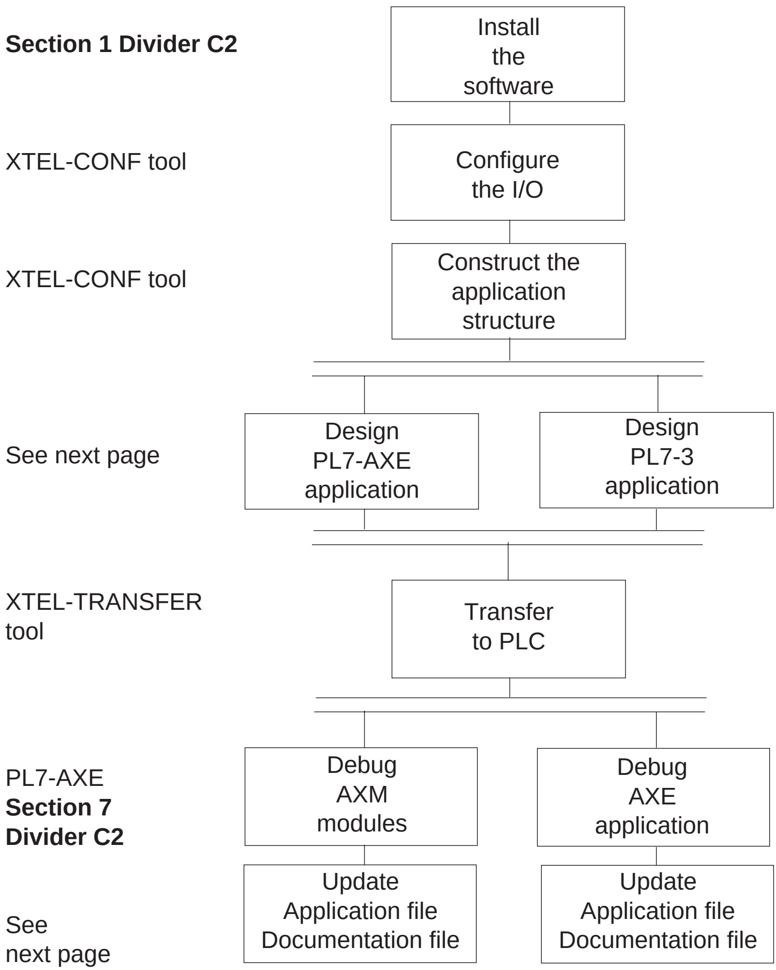
These keys, common to several programs, are described in the PL7-3 Operating modes manual, section 3.1 in divider A.

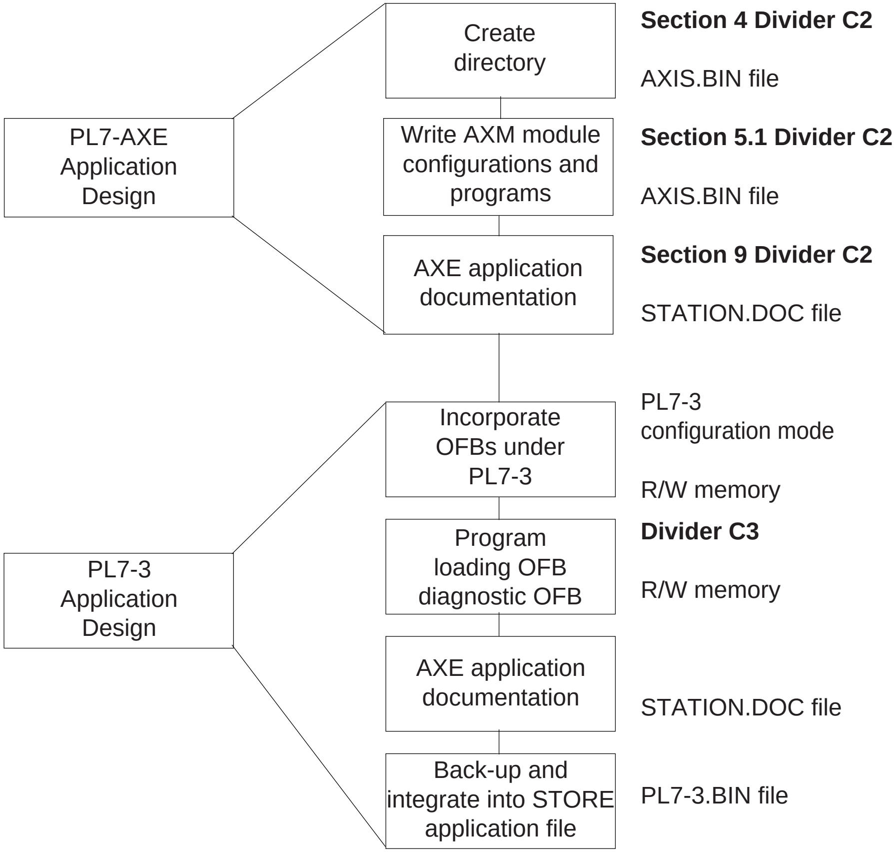
Using the mouse

As for the keyboard, detailed use of the mouse is described in the PL7-3 Operating modes manual, section 3.2 in divider A.

1.7 Methodology for installing an axis control application on a TSX/PMX V5 programmable controller

The following methodology is intended as a guide to the user when creating, debugging, archiving and documenting a communication application. This methodology refers to each operation without going into detail about the operations required.




PL7-AXE Application Design
Create directory
Section 4 Divider C2
AXIS.BIN file
Write AXM module configurations and programs
Section 5.1 Divider C2
AXIS.BIN file
AXE application documentation
Section 9 Divider C2
STATION.DOC file
PL7-3 Application Design
Incorporate OFBs under PL7-3
PL7-3 configuration mode
R/W memory
Program loading OFB diagnostic OFB
Divider C3
R/W memory
AXE application documentation
STATION.DOC file
Back-up and integrate into STORE application file
PL7-3.BIN file

2.1 Accessing the configuration and programming software

Configuration and programming software for TSX AXM xxx axis control modules is accessed by opening the main PL7-AXE function window. To do this :

① Open the Start programs window by double clicking on the corresponding item

② Pull down the Group menu and activate the Telemecanique item

③ Open the User window by double clicking on the X-TEL item

④ Enter the user parameters (name and password) and then confirm to open the Volumes window

⑤ Open a volume by double clicking on the icon of the volume to be opened

⑥ Open a project by double clicking on the icon of the project to be opened

⑦ Open a station by double clicking on the icon of the station to be opened

⑧ Open the PL7-AXE function by double clicking on the corresponding AXIS icon. If this icon is not displayed in the secondary Functions window even though the software has been installed, this indicates that the function has not yet been defined. To do this :
- pull down the Define menu and activate the New item
- click on AXIS then on OK.

⑨ For greater ease, open the AXIS full screen window by clicking on the "arrow up" button of the window.

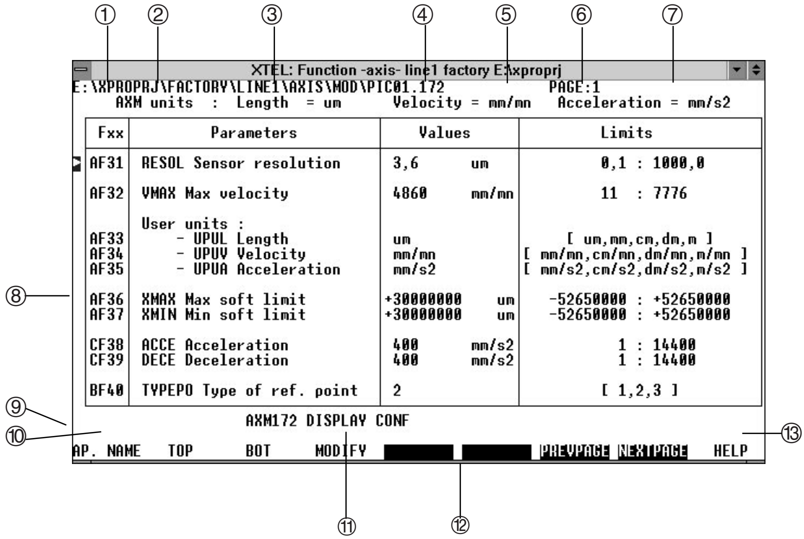
Notes

- If a PL7-AXE session is already open (the corresponding icon appears on the screen outside the secondary Functions window), double click on this icon to open the corresponding window.
- To close a session, click on the corresponding icon to pull down a menu. Then click on the Shutdown/Close command.

2.2 Introduction to the display screen

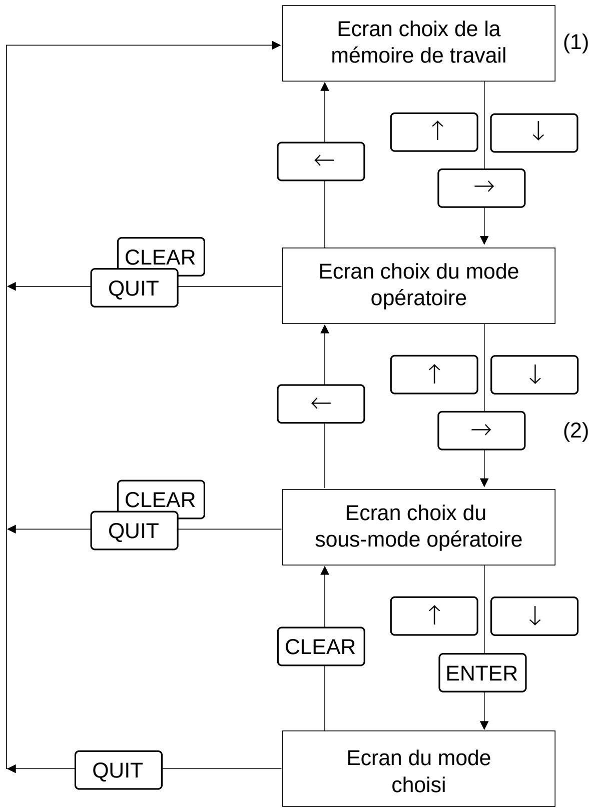
The window which displays the PL7-AXE screens is known as the display screen. All items specific to the X-TEL Software Workshop (icons, window title, window commands, etc) are described in the Software Workshop manual.

Information displayed



① Working memory,
② Network address for the terminal,
③ Working memory and its address if AXM MEM or TSX/PMX MEM,
④ Axis number or file name if AXM file or TSX/PMX file working memory,
⑤ Application number,
⑥ Current page number,
⑦ Name of application (only in TSX/PMX MEM, TSX/PMX file or AXM file),
⑧ Display zone available for the application (configuration, program, etc),
⑨ Real-time event zone, indicating PLC status (connected),
⑩ Parameter entry line,
⑪ Zone indicating current operation (DISPLAY, MODIF, etc),
⑫ F1 to F9 soft key display line,
⑬ Message zone for syntax or entry errors, or confirmation request.

Screen sequences



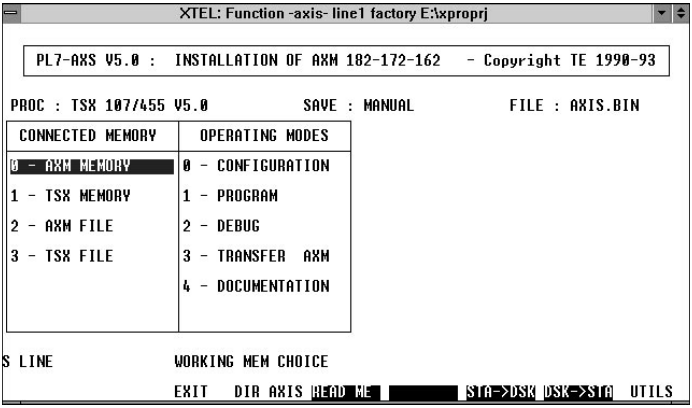
(1) To access AXM MEMORY or TSX/PMX MEMORY in connected mode, ensure that :

- a configuration memory file has previously been transferred to the PLC memory,
- at least one TSX AXM module is declared in the XTEL-CONF I/O configuration.

(2) In DEBUG, TRANSFER and DOCUMENT modes.

2.3 Selecting modes

The choice of modes screen, the basic PL7-AXE screen, provides access to all the functions available with this software.



This screen has two parts :

- a menu zone for selecting :
  - the working memory (module, PLC or disk),
  - the operating mode (configuration, programming, debug, transfer and documentation),
  - an operating sub-mode for the debug mode or transfer mode.
- an information zone which indicates (in connected operation) :
  - the type of processor and its version,
  - the associated file name and type of store.

Role of the function keys

< ↑ > < ↓ >	used to move the cursor in the active column : working memory, operating modes or operating sub-modes. An item in a column can also be selected by entering its number.
< → > < ← >	used to move from one column to another.
<Enter>	confirms the selections made.

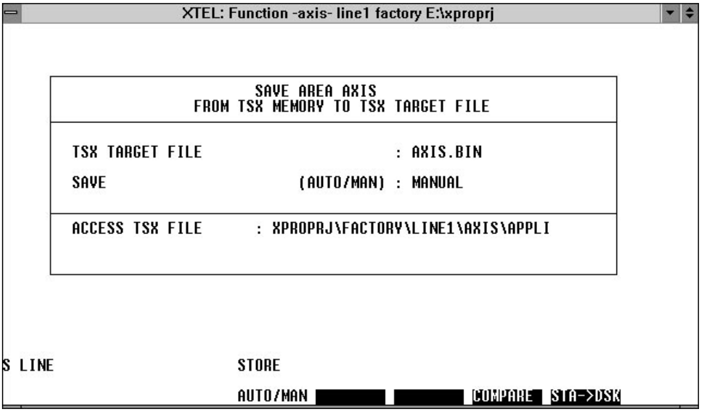
Role of the soft keys

[EXIT] causes PL7-AXE to quit with the possibility of saving and comparing.

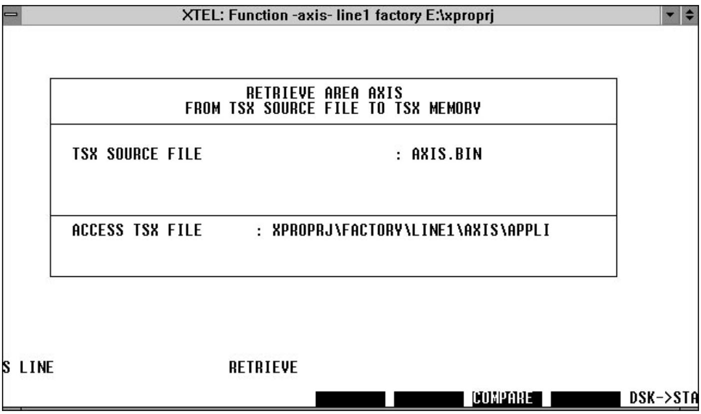
[READ ME] provides access to on-line documentation.

The following 2 keys are offered when the working memory selected is the TSX/PMX PLC memory.

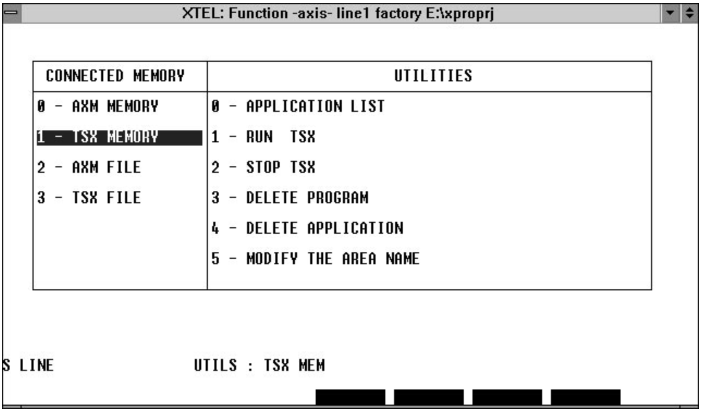
[STA→DSK] accesses a store function in the AXE zone of the TSX/PMX memory in the AXIS.BIN file on disk.



[DSK→STA] enables the AXIS.BIN file on disk to be retrieved from the AXE zone to the TSX/PMX memory.



[UTILS] accesses the utilities functions.

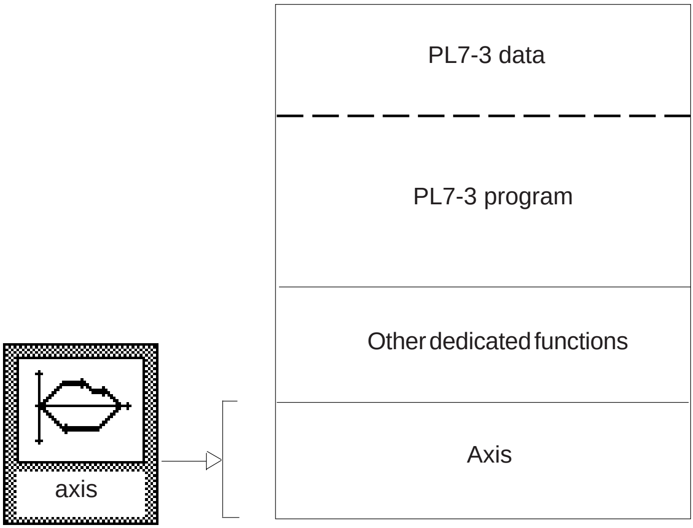


Other soft keys, specific to the selected mode, are described in section 2, selecting working memory.

2.4 Relationship with PLC memory

2.4-1 Dedicated axis zone in the PLC memory

If the PL7-AXE function is declared for a station, a dedicated axis zone is automatically created by the XTEL-CONF tool when the STATION.APP file is generated. The size of this zone is set by the XTEL-CONF tool by default, and may be modified by the user. The position of this zone is determined by the size of the PL7-3 and other dedicated zones which it follows.



Contents of the axis zone

When the PLC memory image is created, the XTEL-CONF tool creates an empty zone. This can then be filled by PL7-AXE (1). It comprises :

- the directory, consisting of :
  - a correspondence table between the logic numbers (0 to 63) and the physical positions of the modules in the racks. The program offers default assignments (2) which may be modified,
  - a table which gives the start address and the size of the applications stored in the dedicated zone,
- the applications, in ascending logic number order.

(1) *Providing the PLC memory image or the PL7-3 application contains the I/O configuration and the slots are occupied by TSX AXM modules.*

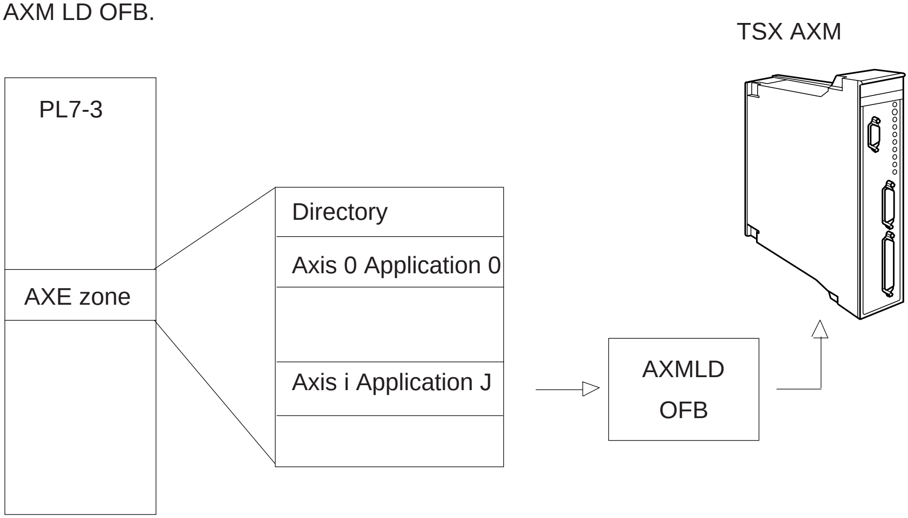
(2) *Ascending numbering from 0 to 63 in the order of the modules in the XTEL-CONF configuration.*

Dedicated AXE zone

Correspondence table between axis n° and module location	Directory
Address and size of stored configurations	
AXIS 0 APPLICATION 0	
AXIS 0 APPLICATION 1	
AXIS 1 APPLICATION 0	
AXIS n APPLICATION 0	
AXIS n APPLICATION 1	

This zone contains the information which can be accessed by the PL7-AXE functions concerned with its organization and by the axis control OFBs. A compacting function is used to optimize the contents. A copy of this dedicated AXE zone is stored in the AXIS.BIN file under the AXIS\APPLI directory on the hard disk (or diskette).

An application stored in this zone can be transferred to the TSX AXM xxx module by the AXM LD OFB.



The AXMLD OFB is described in section 2, divider C2.

2.4-2 Reservation while operating in connected mode

Any FTX 417/507 terminal or microcomputer can be physically connected to any TSX/PMX PLC station on the same MAPWAY/ETHWAY/FIPWAY/ETHERNET network. Because of this, several terminals can request to be logically connected to the same PLC station.

In order to avoid access or procedural conflicts, each terminal must request reservation of the entire dedicated AXE zone. This reservation can only take place while reading from or writing to the directory or to an axis control application.

If the dedicated AXE zone is not already reserved, the requester can access this zone. From this moment, any attempt by another terminal to access is refused and the message TSX ALREADY RESERVED appears. This reservation is cancelled when work has been completed.

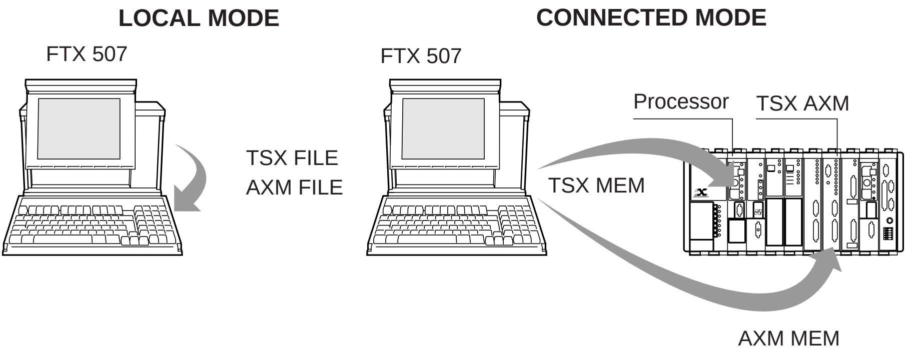
Caution

PL7-AXE cannot be used to set up a remote station over a TELWAY network.

2.5 Methodology

The AXM configuration software can be used :

- in local mode, working on the disk,
- in connected mode, working on the module memory (AXM MEM) or the PLC memory (TSX/PMX MEM).



The use of local mode is recommended when creating AXE applications and the dedicated AXE zone. Although there is nothing to stop a complete application being created in connected mode, it is really designed for modification, correction and debugging.

Implementation is in three phases :

	Program mode (local)	**Debug mode (connected)**
1st phase	Create directory	
2nd phase	Write the AXM applications	Modify the AXM applications
3rd phase	Document the AXM	Update Documentation

1st phase : Creating the directory

- Open the main PL7-AXE window.
- Select the TSX/PMX File memory.
- Select AXIS DIR (the software automatically recognizes STATION.APP files).
  Quit by pressing ENTER.

2nd phase : Creating the application

- In Program mode : select the TSX/PMX File (Local) and for each axis :
  - select the axis number and the application number
  - create the configuration (CONFIGURATION)
  - create the PIC program (PROGRAM)
- In Debug mode : select AXM-MEM (connected)
  - modify the configuration and the program
  - update TSX/PMX MEM using the Transfer function
    (AXM.MEM TRANSFER TSX/PMX MEM)

3rd phase : Documentation

- In Program mode : select the TSX/PMX File
  - document each application
    (output to printer or to STATION.DOC file (XTEL-DOC))
- In Debug mode : select TSX/PMX MEM

Note

In TSX/PMX File mode, PL7-AXE works directly on the AXIS.BIN file. It is not necessary to perform saves.

3.1 Introduction

The choice of working memory defines the PL7-AXE operating mode : local or connected.

Local mode operation

In this case, the hard disk is selected as the working memory.
In local mode the user can :

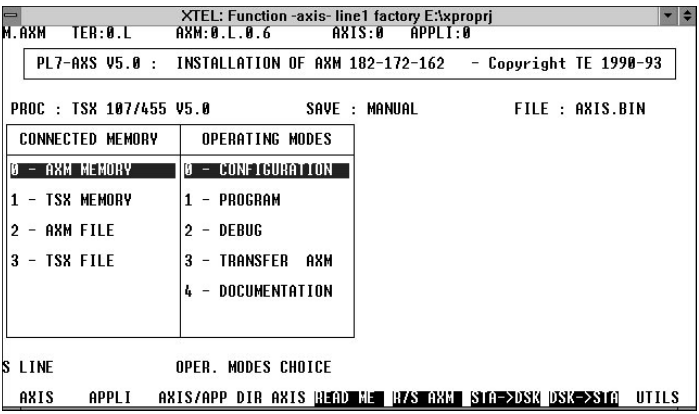
- define the configurations and the programs for each module application (AXM file). Applications created in this way are not associated with any module.
- generate the AXIS.BIN file, image of the dedicated AXE zone (TSX/PMX file).

Connected mode operation

In this case the AXM memory (module memory) or TSX/PMX memory (PLC dedicated zone) is chosen as the working memory. In connected mode the user can :

- generate or modify a configuration,
- generate the dedicated AXE zone,
- transfer configurations from the disk to the modules or to the dedicated zone in the PLC memory.

When the terminal is connected to an AXM MEM module, PL7-AXE can also be used for debugging.



3.1-1 Role of the common soft keys

Details of the soft keys common to the different modes are given below :

[AXIS] selects the number of the working module. In documentation mode, the "*" character confirms all the AXM modules which are configured.

[APPLI] selects the number of the application. In documentation mode, the "*" character confirms all the applications of the selected module. AXIS = * and APPLI = * enable documentation of all the channels stored in the TSX/PMX memory or in the TSX/PMX file.

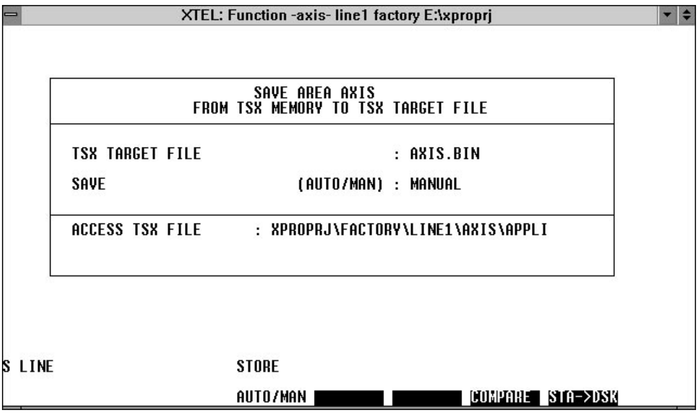
[AXIS/APP] selects the number of the module and of the working application.

[DIR AXIS] provides access to the AXE directory screen (see section 4.2 in divider C).

[READ ME] provides access to the PL7-AXE help screens.

[R/S TSX] or **[R/S PMX]**
sets the PLC to RUN or to STOP.

[STA→DSK] displays a screen which allows the contents of the dedicated AXE zone to be stored to disk, as an AXIS.BIN file in the AXIS\APPLI sub-directory :

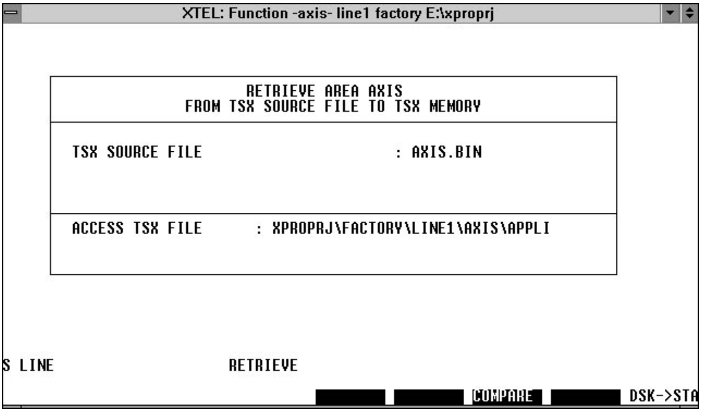


[AUTO/MAN] allows the type of store operation to be selected in connected mode. In automatic mode, all modifications are systematically stored. In manual mode, modifications are not stored unless the [STA→DSK] key is pressed.

[COMPARE] starts the comparison between the source files and the target files.

[STA→DSK] stores a file and starts up after confirmation.

[DSK→STA] displays a screen which allows the contents of an AXIS.BIN file, previously stored to disk, to be transferred to the dedicated AXE zone of the PLC memory :



[COMPARE] starts the comparison between the source file and the dedicated AXE zone of the PLC.

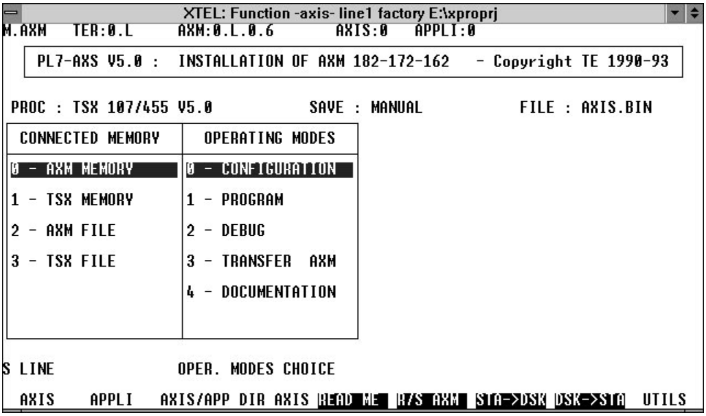
[DSK→STA] retrieves the selected AXIS.BIN files to the dedicated AXE zone in the PLC memory.

3.2 Selecting AXM MEMORY

The AXM memory is the only one which can be used for debugging and operating modules.

The application is stored directly in the module memory on each confirmation.

The AXM memory can only be used if a STATION.APP configuration file, containing at least the I/O configuration performed under XTEL-CONF, has previously been transferred to the PLC memory. The PLC can be in STOP or in RUN.



[UTILS] accesses the utilities functions associated with the AXM memory :

0 - APPLICATION CHARACTERISTICS : displays a table of the application characteristics contained in the module selected : axis number, application number, geographic address in the PLC, application name, module type and version.

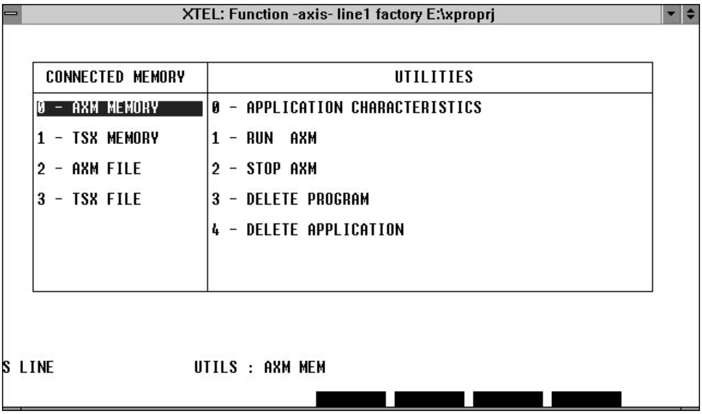
1 - RUN AXM : RUN the AXM TSX module.

2 - **STOP AXM** : STOP the AXM TSX module.

3 - **DELETE THE PROGRAM** : allows the PIC program to be deleted while maintaining the configuration and the internal WNi variables.

4 - DELETE THE APPLICATION : deletes the entire module memory (PIC, configuration and internal variables).

Each of these functions is confirmed by the (ENTER) key. The (CLEAR) key returns the user to the selection screen.



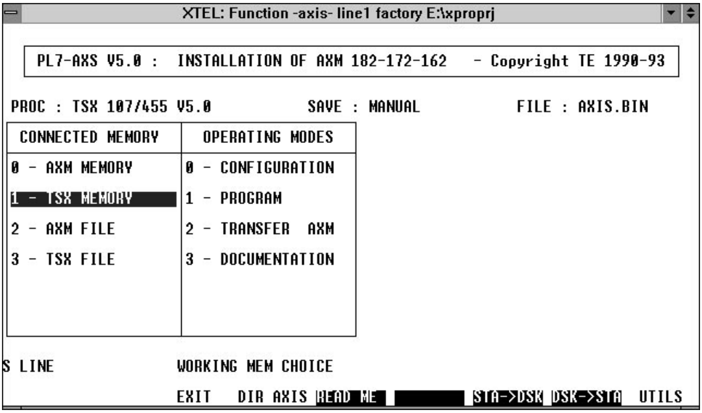
Note : In CONFIGURATION and PROGRAM modes, the following message is displayed if the application number selected does not correspond to the application number of the module :
APPLI AXE < > APPLI EXPECTED
but the application can still be accessed. However, when ENTER is pressed to store the application, another message requests confirmation from the user :
N.APPLI AXM UNEXPECTED, WRITE APPLI?
The <YES> soft key stores the application with the specified number.
The <NO> soft key retains the initial application with its original number.

3.3 Selecting TSX/PMX MEMORY

The PLC memory is essentially for archiving. It allows the various configurations to be stored in the dedicated AXE zone of the PLC memory.

This store operation allows the PLC program to reload the applications into the modules, via the AXMLD optional function block, if required. (The AXMLD OFB is described in section 2 in divider C3).

The TSX/PMX MEMORY can only be used if the I/O configuration performed under XTEL-CONF has previously been transferred to the PLC memory. The PLC can be in STOP or in RUN.



[UTILS] accesses the utilities functions associated with the TSX/PMX MEMORY :

0 - LIST THE APPLICATIONS : displays the list of applications associated with a module :
• the upper box indicates the number, the geographic address and the type of module,
• the lower box indicates the application number, the name, the date and time of creation or last modification, as well as the size of all the applications stored in the PLC memory.

1 - RUN TSX or RUN PMX : sets the PLC to RUN,

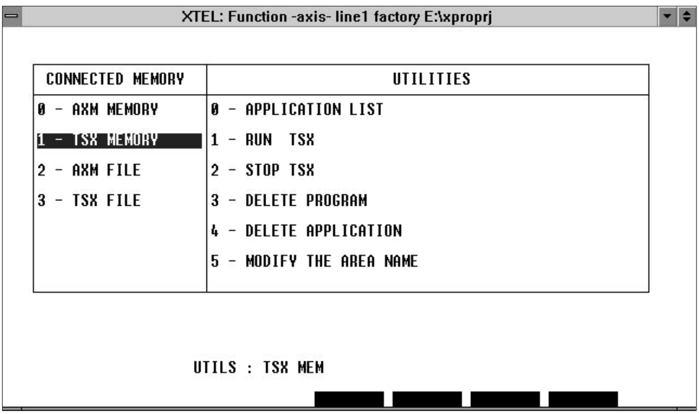
2 - STOP TSX or STOP PMX : sets the PLC to STOP,

3 - DELETE THE PROGRAM : clears the PIC program of the selected application, after confirmation.

4 - DELETE THE APPLICATION : deletes the entire selected application, after confirmation.

<AXIS>	selects the axis number
<APPLI>	provides access to the application n°
<AXIS/APP>	displays the directory.

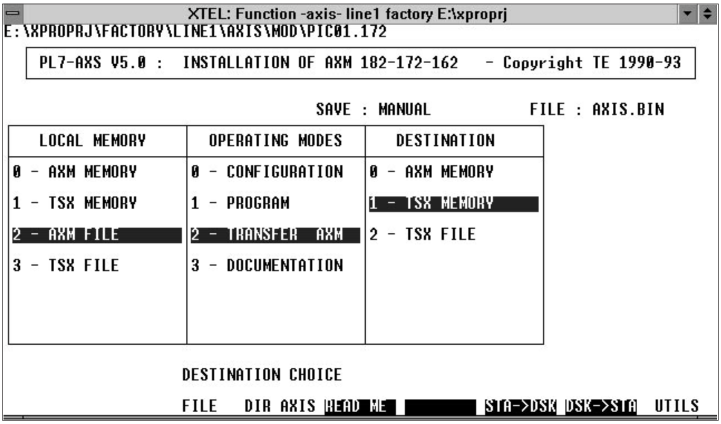
5 - MODIFY THE AREA NAME : assigns a name of up to 24 characters to the dedicated AXE zone in the TSX/PMX memory.



3.4 Selecting an AXM file

This is recommended for creating AXM configurations in the design office, or as a means of archiving. It does not require the PLC, the module, nor the X-TEL CONF configuration.

The applications are stored on the hard disk or diskette (defined in the VOLUMES of the X-TEL Software Workshop) as they are entered.
The applications created are "anonymous" : they are not associated with any module and are not dependent on any PL7-3 application (library function).



[UTILS]	accesses the utilities functions associated with the DISK memory :

0 - MOD DIRECTORY

Displays the list of files contained in the AXIS\MOD directory, the module type (162, 172 or 182) and the size of the application.

1 - LIST OF APPLICATIONS (162)

Table of the list of TSX AXM 162 application files stored in the AXIS/MOD directory with the creation date and the size of the application alongside.
The (CLEAR) key returns the user to the selection screen.

2 - LIST OF APPLICATIONS (172)

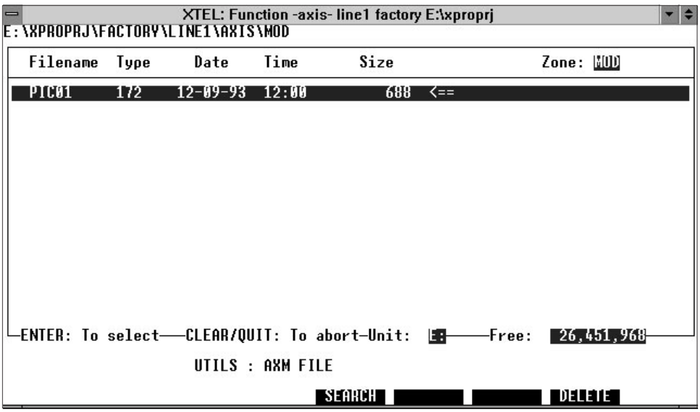
The same as the preceding function but for TSX AXM 172 application files.

3 - LIST OF APPLICATIONS (182)

The same as function 2 but for TSX AXM 182 application files.

4 - DELETE THE PROGRAM

Destroys the PIC program of the file specified using the <FILE> soft key. The file retains the configuration. To completely destroy an application file, the <DELETE> soft key must be used.



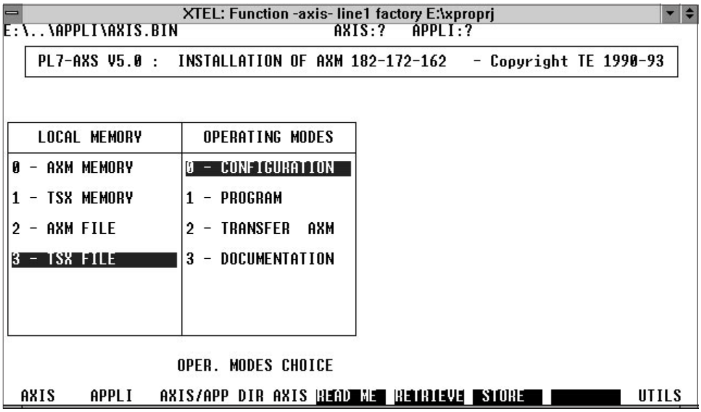
Two soft keys are common to the disk utilities.

[SEARCH]	searches for a file in a list.
[DELETE]	deletes, after confirmation (YES), the file indicated by the cursor.

3.5 Selecting a TSX/PMX file

This mode allows an image of the PLC memory to be created in Local mode.

To use the TSX/PMX file, the station configuration must have previously been created using XTEL-CONF.

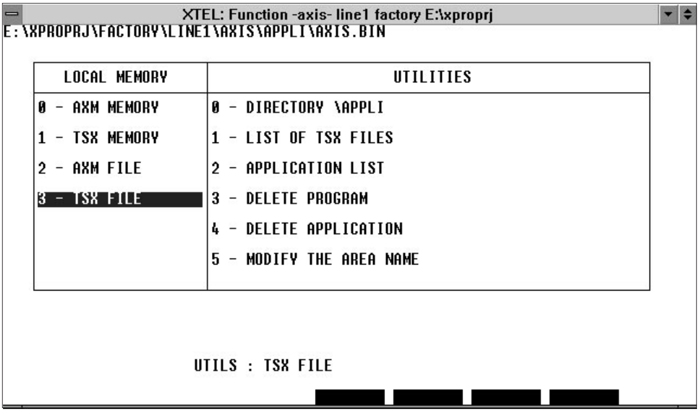


[STORE] Stores the configuration in an xxx .BIN file. By default, the store name is AXIS.BIN. The screen displays two keys :

- **[FILE]** enables selection of another name for the store file : xxx.BIN
- **[STORE]** executes the store function.

[RETRIEVE] Enables an xxx.BIN file, previously stored using the STORE function, to be retrieved.
The file is restored in the X-TEL zone under the name : AXIS.BIN.

[UTILS] accesses the utilities functions associated with the TSX/PMX file :



0 - DIRECTORY\APPLI : displays the list of files contained in the directory :
AXIS\APPLI (xxx.BIN, xxx.DOC files etc).

1 - LIST OF TSX/PMX FILES : displays the list of configuration files (xxx.BIN files).

2 - LIST OF APPLICATIONS : displays the list of all the applications linked to an AXM module in the current xxx.BIN file.

3 - DELETE THE PROGRAM : deletes the program specified by an axis number and an application number in the current xxx.BIN file.

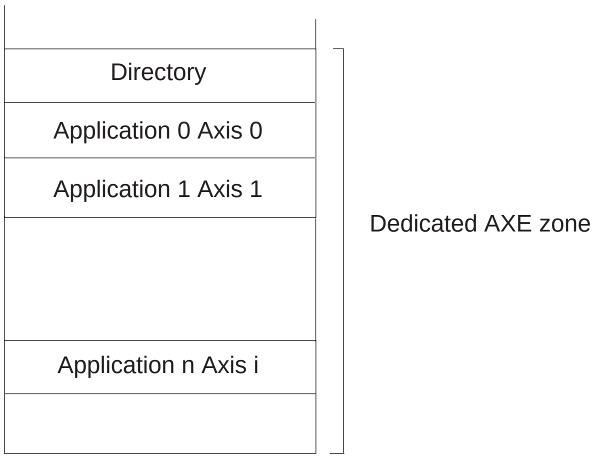
4 - DELETE THE APPLICATION : deletes the application specified by an axis number and an application number in the current xxx.BIN file.

5 - MODIFY AREA NAME : assigns a comment of up to 24 characters to the current xxx.BIN file.

4.1 Dedicated AXE zone

This PLC memory zone is used for storing the directory and the various applications which may be loaded into the AXM modules. This zone is managed entirely by PL7-AXE :

- The directory is created by PL7-AXM.
- The configurations are entered :
  - either by direct entry to the TSX/PMX memory, from PL7-AXE,
  - or by transferring an AXM FILE to the TSX/PMX MEMORY,
  - or by transferring an AXM MEMORY to the TSX/PMX MEMORY.



Any attempt to transfer a application to the PLC memory or to modify an existing application may be preceded by one of the following two messages :

- **Area full :** The size of the dedicated AXE zone is insufficient to receive the new application. The size of the zone can be modified using the XTEL-CONF tool.
- **Area to be compacted :** The size of the dedicated AXE zone is sufficient, provided that it is compacted. Optimizing the dedicated zone in this way removes the "holes" created during transfer operations or when applications are deleted. Compacting is performed by the [PACK] key accessible from the directory screen (see section 4.2).

4.2 Directory

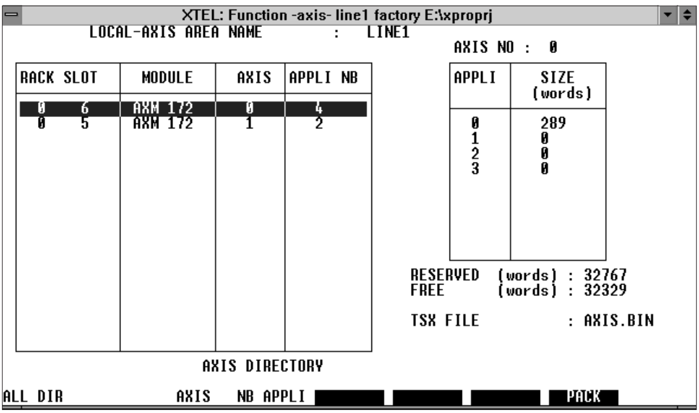
An axis control application is defined by :

- an axis (or module) number from 0 to 63,
- an application number from 0 to 8.

It is the directory which defines the correspondence between the geographic position of the modules in the I/O configuration and the logic numbers.

Created by PL7-AXE, the directory is stored initially in the dedicated AXE zone of the PLC memory. The first 64 AXM modules in the I/O configuration are allocated an axis number from 0 to 63 in ascending order.
The allocation of these numbers may be modified by the user.

If PL7-AXE is operating in connected mode (AXM MEMORY or TSX/PMX MEMORY), the [DIR AXIS] soft key will display the AXIS DIRECTORY screen (or enable this directory to be created).



TSX/PMX-AXM space

RESERVED The number of reserved words is fixed by XTEL-CONF. This number cannot be modified by PL7-AXE.

FREE The number of free words represents the memory area not used.

TSX FILE AXIS.BIN is the name under which the dedicated AXE zone is stored on disk using the [STORE] command.

Soft keys

[ALL DIR] provides a detailed view of the AXIS directory, specifying for each logic number :

- its geographic location : rack, module,
- its type (TSX AXM 162, TSX AXM 172, TSX AXM 182, etc),
- the number of the associated AXM,
- the size assigned to each application.

[TOP]	displays the start of the directory,
[BOT]	displays the end of the directory,
[PREVPAGE]	displays the previous page,
[NEXTPAGE]	displays the next page.

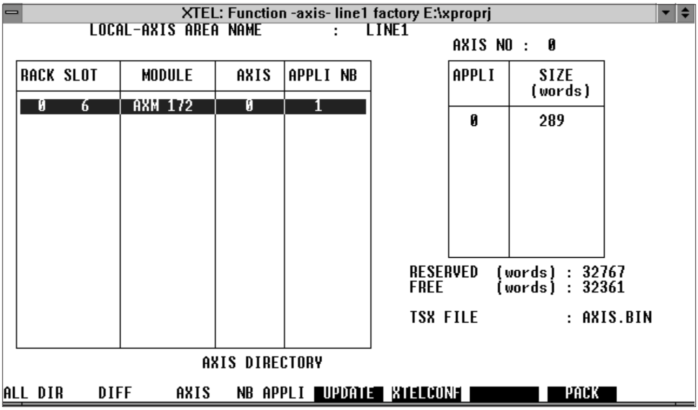
This is the view of the directory which will be provided in the documentation.

[AXIS] is used to modify the default assignment of the axis numbers. A number can only be assigned to one slot.

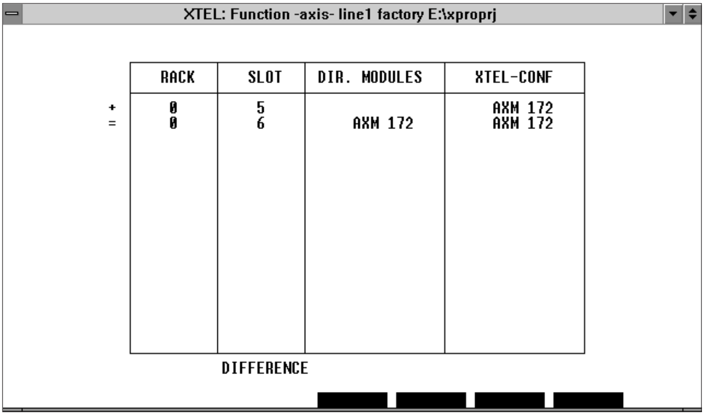
[PACK] compresses the dedicated AXE zone. It is also used to recover empty spaces which have been created, for example, when applications have been deleted.

[.../...] only displayed if the configuration is made up of more than 16 TSX AXM modules. It enables movement from one group to another.

[UPDATE] Modification of a slot, or the addition or removal of an AXM module affecting an I/O configuration using XTEL-CONF, is indicated in the AXIS directory by an asterisk which precedes each module concerned. Displayed only in this case, the [UPDATE] key causes the directory to be updated following each new I/O configuration defined by XTEL-CONF.



[DIFF] displays the differences between the configuration of the AXM modules stored in the AXIS directory and the current I/O configuration of the AXM modules in X-TEL.
In connected mode, the current I/O configuration of the AXM modules corresponds to the I/O configuration stored in the PLC.
In local mode, the current I/O configuration of the AXM modules corresponds to the I/O configuration defined under XTEL-CONF.
This key is not displayed unless a difference is detected (addition, removal or modification of a module).



Meaning of the characters in the margin :
= no change
+ module added
- module removed
different type of module

If a configuration is made up of more than 16 modules, the following soft keys are displayed :

[TOP] accesses the first module on the first page of the directory,

[BOT] accesses the first module on the last page of the directory,

[PREVPAGE] accesses the first module on the previous page of the directory,

[NEXTPAGE] accesses the first module on the next page of the directory.

[XTEL-CONF] displayed if there is a discrepancy between the directory and the I/O configuration defined under XTEL-CONF. This key enables XTEL-CONF to be launched directly from PL7-AXE.

General Contents

General Contents

Contents

Axis Control System Presentation

1 Presentation 1

1.1 Documentation Presentation

This manual describes the installation, setting-up and operation of TSX AXM 172, TSX AXM 182 and TSX AXM 162 axis control modules with the TXT L PL7 AXS V4 axis control software pack and the TSX XBT 182 operator terminal.

The manual is in four main parts:

Part 1 (Divider A) : Axis Control Presentation

A presentation of the main components of the axis control system.
It describes the interactions between the various devices and the overall set-up of an axis control application.

Part 2 (Divider B) : TSX AXM 172/182/162 Axis Control Modules

This part of the manual describes:

- Application parameters,
- Operating modes,
- Programming language syntax,
- Interaction between the axis control module and the PLC processor,
- Axis control module hardware installation.

Part 3 (Dividers C1, C2 and C3) : TXT L PL7 AXS V4 Axis Control Software

This part of the manual describes the axis control software for use with TSX AXM 172/182/162 modules on FTX 507 workstations or IBM PS/2 or compatible microcomputers.

Only the entry and modification of axis parameters and the AXM program are covered here. The parameters and instructions are described in the axis control module sections.

Part 4 (Divider D) : TSX XBT 182 Operator Terminal

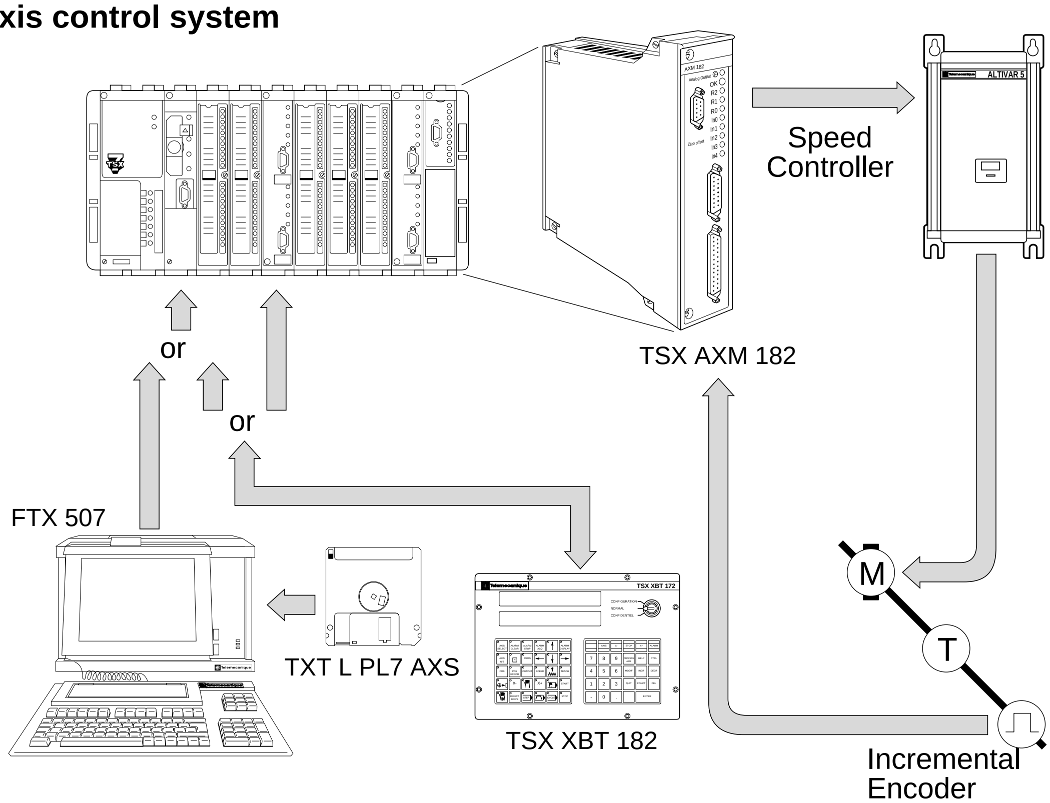
A full description of the TSX XBT 182 operator terminal and its operating modes.

Divider F contains the TSX AXM 172/182/162 module and TSX XBT 182 terminal Quick Reference Guides that summarize all essential information on programming and operating TSX AXM 172/182/162 modules and their terminals.

Divider G, **Additional Information** includes a procedure for updating applications. This only applies to users with an installed base of axis control applications running on V3 level PLCs (TSX 47-30/67-20/87-30) who wish to upgrade their system to use V4 level Model 40 PLCs.

1.2 Axis Control System Presentation

TSX Series 7 axis control system



The TSX Series 7 axis control system comprises:

- TSX AXM 172, TSX AXM 182 and TSX AXM 162 axis control modules for use with TSX 47-40, TSX 67-40, TSX 87-40 and TSX 107-40 PLCs. These programmable axis control modules run a user developed program and are designed to control a speed controller used to move a moving part along a linear axis with servo loop feedback control of its position.
- The TXT L PL7 AXS V4 software pack for FTX 507 workstations. This software is used to program TSX AXM 172, TSX AXM 182 and TSX AXM 162 modules. It also provides the user with ready to use Optional Function Blocks (OFBs) that simplify the module set-up procedure.
- The TSX XBT 182 terminal for operating and adjusting the modules.

The TSX AXM 172 and TSX AXM 182 modules can be programmed and can operate independently of the CPU as compared with the TSX AXM 162 which cannot be programmed. All movements are executed under the control of the CPU.

The TXT L PL7 AXS V4 software is used in the application programming and debug phases.

Axis Control System Presentation

The TSX XBT 182 terminal provides all of the services required for normal operation. It lets the user access all axes in a configuration. When required by the user, it will also monitor motion, modify parameters, control manual mode motion, etc.

There are two versions of the terminal:
- The TSX XBT 182.1 dedicated axis control operator terminal,
- The TSX XBT 182.2 multi-purpose terminal that provides a standard operator dialog terminal function in addition to the specialized axis control terminal features.

Companion products

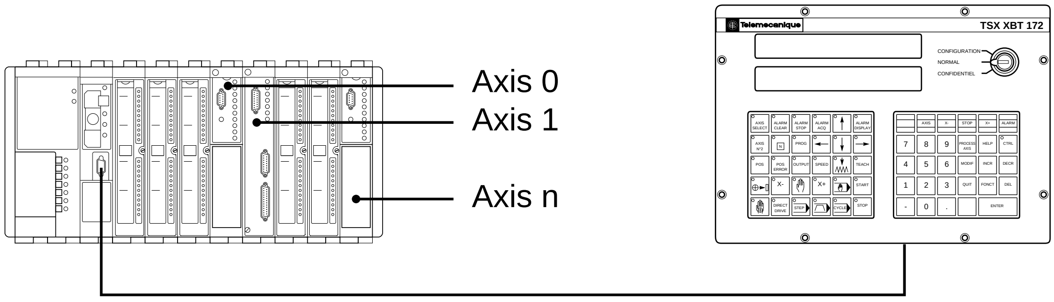
In addition to TSX Series 7 products that are used for servo loop control and processing, Telemecanique can also supply all of the other component parts required in an axis control application (operating part) :

- The XCC range of incremental rotational encoders (with an open collector, Totem Pole or line transmitter output).
  Refer to the general catalog or specialized catalog,
- The Rectivar range of speed controllers for DC motors,
- The MASAP range of servo drives, comprising :
  - An auto-synchronous permanent magnet (brushless) motor fitted with a resolver,
  - A dedicated speed controller.

When used with TSX AXM 172/182/162 modules, these components let the user develop high performance servo loop systems. Connection cables between the TSX AXM modules and the MASAP servo drives are also available. Refer to the general catalog or specialized catalog for more information.

Axis Control System Presentation

Multiple axis layout



The TXT L PL7 AXS V4 (version 4.5) software allows up to 64 axis control modules to be handled. The maximum number of modules physically present in a configuration depends on the PLC used.

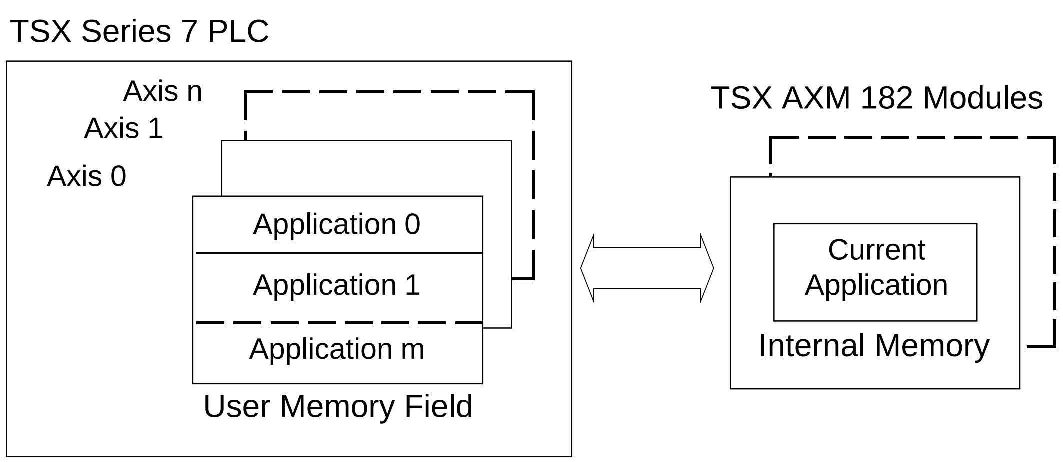
These modules can operate independently or can be synchronized by a PLC program.

The TXT L PL7-AXS V4 software pack lets the user program all of the axis control modules in a configuration.

Each module in a PLC rack slot is assigned an axis number from 0 to 63.

The TSX XBT 182 can access 16 modules and simultaneously display positions on two axes.

Multiple application layout



For each axis, the user can generate up to nine applications.

Once generated, the applications stored in the PLC memory can be transferred cycle by cycle to the internal memory of the axis control module via a TSX XBT 182 terminal, the TXT L PL7 AXS V4 software or the user program via the AXM LD OFB.

1.3 Terminology Conventions

To simplify the descriptions in this manual, the following conventions are used :

- The term TSX AXM module refers to TSX AXM 172, TSX AXM 182 or TSX AXM 162 modules, except in those sub-sections where their detailed specifications are described.
  (TSX AXM 172 and TSX AXM 182 modules have identical functions, only their user interface and performance differ. The TSX AXM 162 has a user interface identical to the TSX AXM 182 but cannot be programmed).

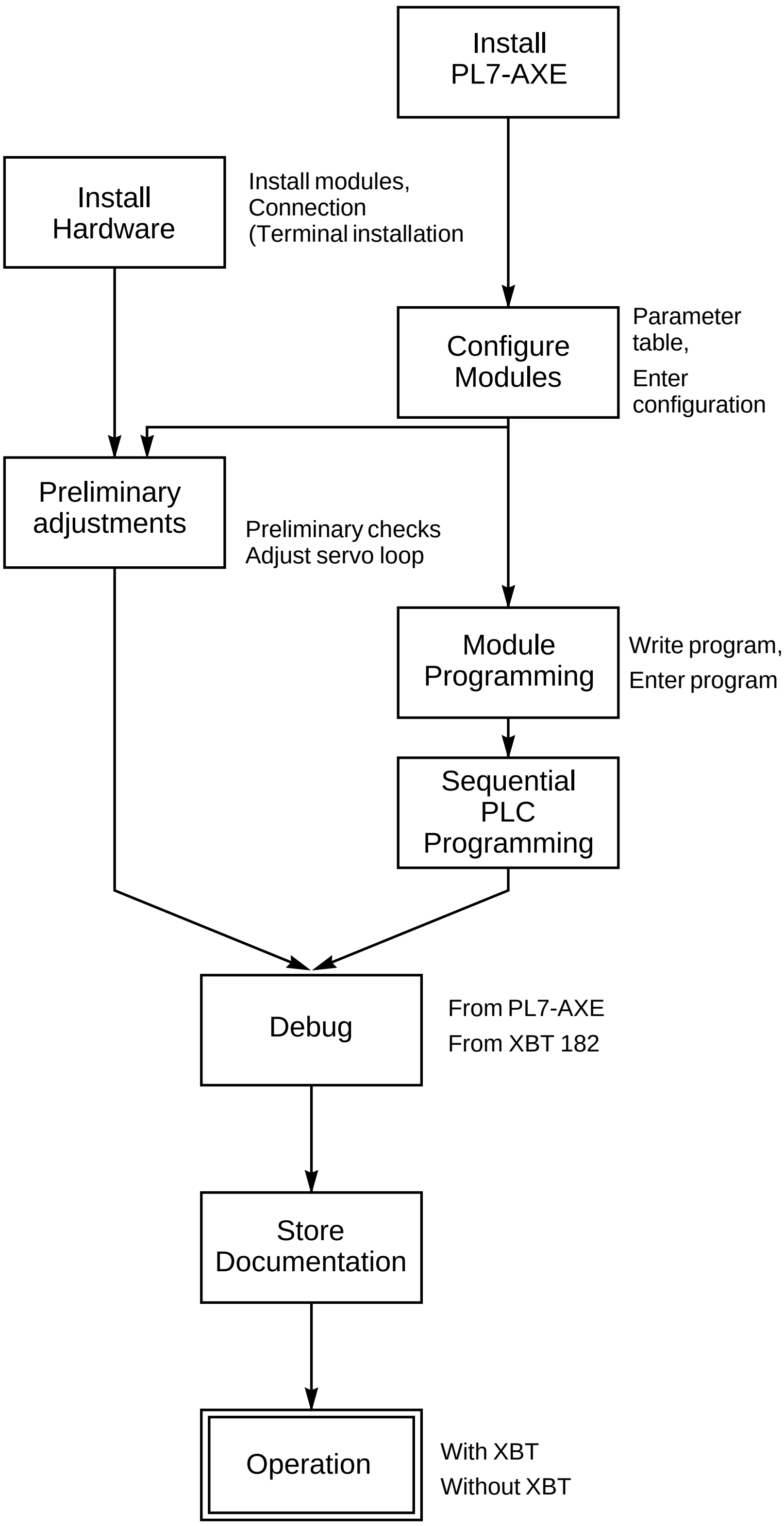
- The term TSX XBT 182 refers to the operator terminal in either its dedicated axis control version (TSX XBT 182.1) or its multi-function version (TSX XBT 182.2).

- The term PL7-AXE program or software refers to the program used to set-up axis control applications on the FTX 507 workstation or an IBM PS/2 or compatible microcomputer.

- The term PLC Processor refers to Telemecanique TSX Series 7 Model 40 PLCs that accept axis control modules, i.e. (TSX 47-410/411/420, TSX 67-410/420, TSX 87-410/420, TSX 107-410/420 PLCs).

The diagram below is intended to illustrate to the user the various steps that are required when setting-up an axis control application and the order in which it is recommended that these steps be performed.
By each step is listed the corresponding Sections or Sub-sections in this manual and where necessary the type of form that should be used.

Assumption : PLC I/O already configured (using PL7-3)



Divider	Section	Form
C2	1.1	
B	7.1/7.2	
B	7.3	A5-3
D	1	
B	2	A5-1
C2	5	
B	7.4	
or C2	7.4	
B	5	A5-2
C2	6	
B	6	
C3	1 to 4	
C2	7	
D	3 to 7	
C2	8 and 9	
B	6	
D	3 and 4	

TSX AXM 172 / 182 / 162 Axis Control Modules

Contents

TSX AXM 172/182 Axis Control Modules

1 Module Presentation

1.1 Axis Control Presentation

Purpose

TSX AXM 172, TSX AXM 182 and TSX AXM 162 Axis Control Modules are part of the TSX Series 7 range of intelligent I/O modules.

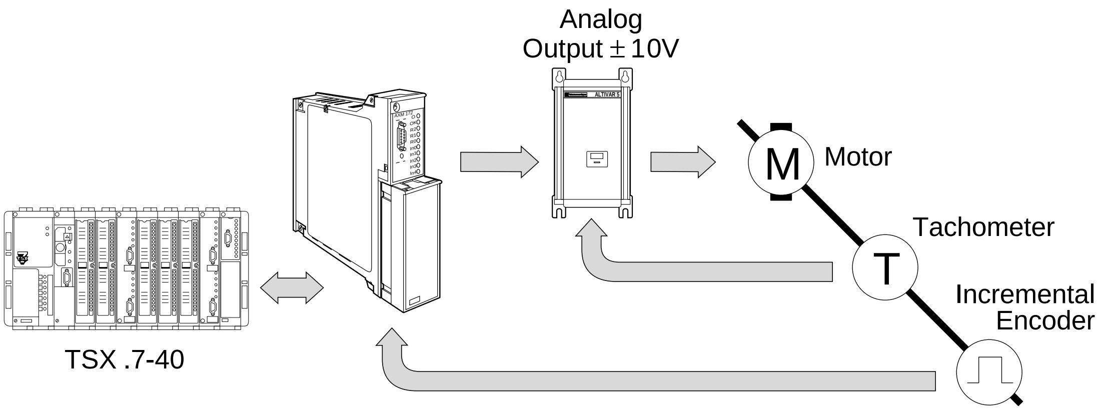
These modules can operate independently and have their own microprocessor and operating software providing high level performance and the ability to control specialized applications.

These modules can control the motion of a moving part along a linear axis with servo loop position control.

Inputs/Outputs

The module receives as an input an incremental position signal and signals for reference point set-up (axis calibration) or event detection.

The output from the module is an analog signal used to control a servodrive.



The module also provides four auxiliary relay outputs.

Programming

TSX AXM 172 and TSX AXM182 modules have their own programming language.
This language comprises a motion control instruction set and another instruction set for structuring programs with jump and subroutine call instructions.

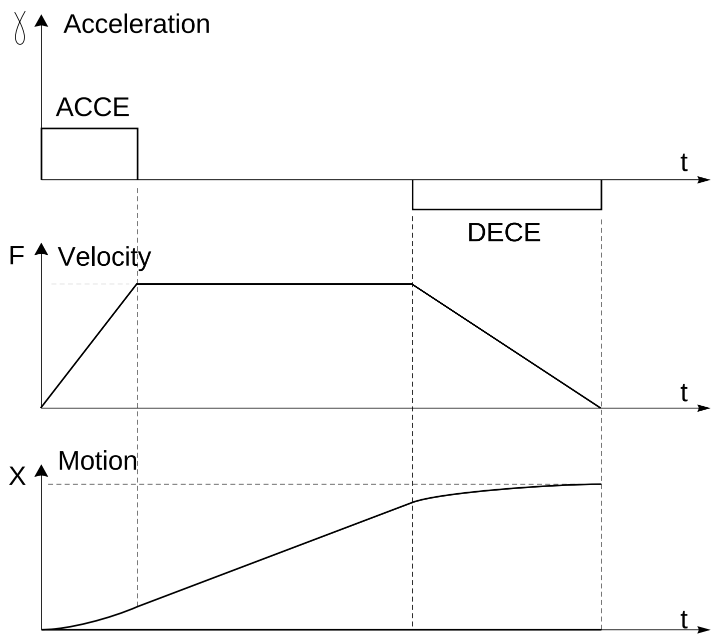
The module program, or AXM program allows totally independent control of simple or complex motion profiles.
The TSX AXM 162 module has no AXM program.

The module also exchanges data and can be synchronized with general application sequencing through the I/O bus and the standard communications interfaces used between the module and the PLC processor. The part of the PLC program dedicated to synchronization with the TSX AXM modules is referred to as the PLC program.

Axis Control Presentation

Main Characteristics

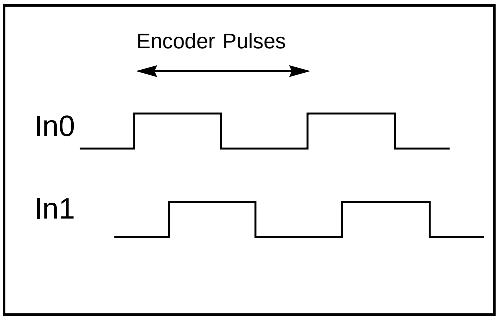
Inputs	Three inputs for incremental encoders: • Open collector 5/24 VDC on TSX AXM 172, • Line outputs (RS-422) on TSX AXM 182 / 162.
	One 24 VDC (cam) event detector input. One 24 VDC safety interlock input. Compatible with Cenelec standard proximity detectors.
Outputs	One ± 10 V analog output for a speed controller.
	Four auxiliary relay outputs with one dedicated to the speed controller safety interlock input.
Counting frequency	40 kHz max. for TSX AXM 172, 80 kHz max. for TSX AXM 182 / 162.
Servo loop	Proportional correction of deviation using feed forward (overshoot) compensation.
Move programming	• Specific motion control language for AXM 172 / 182: 254 program steps max. 32 basic instructions. • From CPU for AXM 162.
Application rule	A trapezoid velocity rule is applied: The ACCEleration and DECEleration values can be modified.



Axis Control Presentation

Adapting to Mechanical Characteristics

Given the maximum counter frequency accepted by the TSX AXM modules, the movement limit characteristics depend on the selected encoder and its resolution, defined as the distance covered by the moving part during one encoder pulse.



Maximum allowed encoder frequencies:
• TSX AXM 172 module : 40 kHz,
• TSX AXM 182 / 162 modules : 80 kHz.
The TSX AXM 182 / 162 modules have a "multiply by 4" feature that allows:
- Improving the sensor resolution by a factor of 4 with a given type of encoder, or
- Selection of an encoder that has 4 times less resolution when the resolution value is set.

In the Appendix Section (refer to Appendix pages A/5 and A/6) two tables “TSX AXM 172 / 182 / 162 module performance” summarize the maximum axis characteristics (length, velocity, etc).

A validity check on the values is provided by PL7-AXE during the definition of machine parameters.

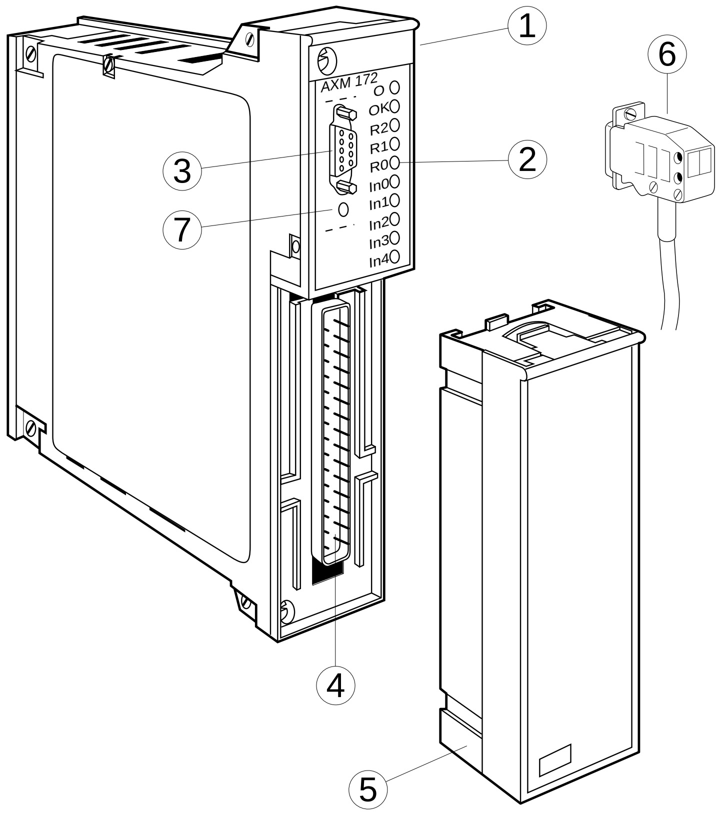
The table below illustrates the differences between the three types of module :

	Input interface	
	Open collector	RS 485
Programmable	TSX AXM 172	TSX AXM 182
Non programmable		TSX AXM 162

Axis Control Presentation

TSX AXM 172 module hardware presentation

The TSX AXM 172 is a single height module comprising the following parts:

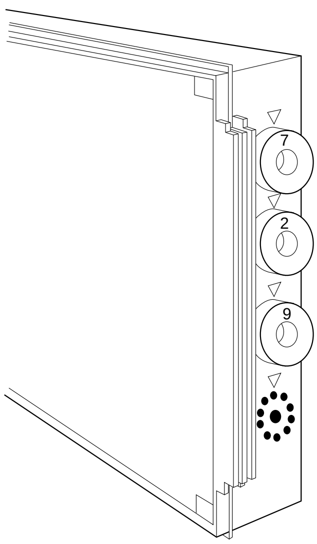


1. A protective enclosure.
2. 10 indicator LEDs:

   (F) Module failure,
   OK module power on and operating correctly,
   R0 to R2 relay outputs active,
   In0 to In4 inputs at 1.
3. A connector for the module analog output.
4. A connector for all encoder inputs to the module and the four relay outputs.
5. A removable TSX BLK 4 terminal block with 32 screw terminals available for connection.
6. A 9-pin TSX CAC 04 Sub-D connector.
7. An adjustment potentiometer for the analog output offset level.

Notes:

- The status of relay output R3 is not displayed,
- The TSX BLK 4 terminal block and the TSX CAC 04 connector are not supplied with the module but are absolutely necessary for using the module. For safety reasons, never replace the TSX CAC 04 connector with a similar connector.



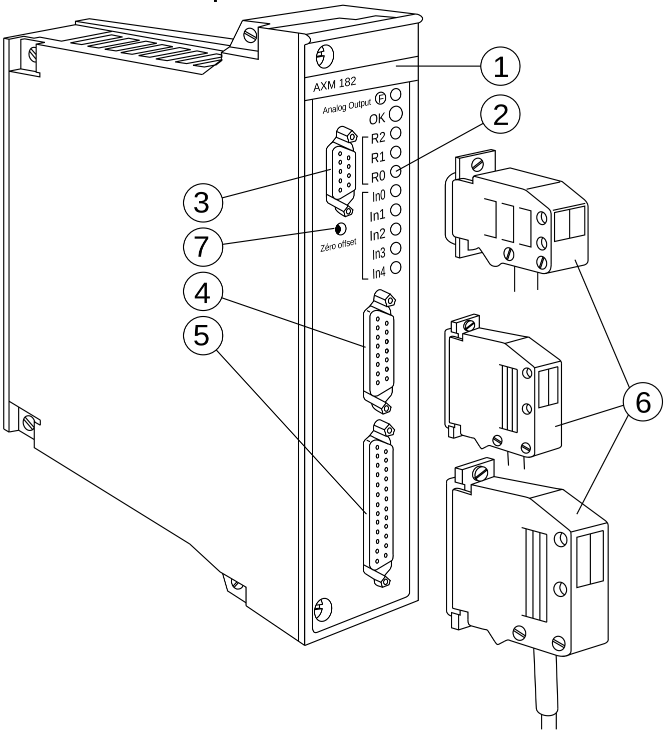
The software and hardware configuration code is 729.

1 Module Presentation 1

Axis Control Presentation

TSX AXM 182 / 162 module hardware presentation

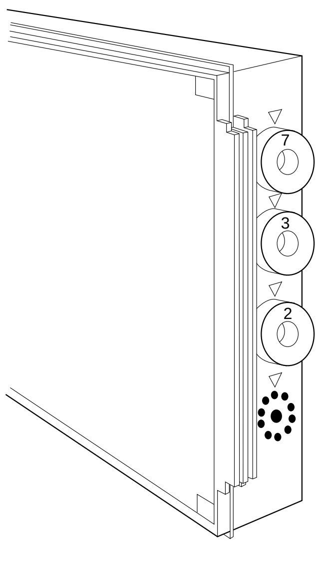
The TSX AXM 182 / 162 is a single height module comprising the following parts:



1. A protective enclosure.
2. 10 indicator LEDs:

   (F)Module failure,
   OK module power on and operating correctly,
   R0 to R2 relay outputs active,
   In0 to In4 inputs at 1.
3. A connector for the module analog output.
4. A connector for module auxiliary I/O connections and their supply lines.
5. A connector for encoder connection.
6. A connection kit comprising three Sub-D connectors that must be ordered separately. Ref. TSX CAC 06.
7. An adjustment potentiometer for the analog output offset level.
8. A 25-pin Sub-D connector for connecting the incremental encoder.

Note:
Connections must be made using the TSX CAC 06 connection kit or VY1-M621-CLC5 and VY1-M621-CLA cables.



The software and hardware configuration code is:
TSX AXM 182 : 732
TSX AXM 162 : 735.

1.2 Particulars of the TSX AXM 162 module

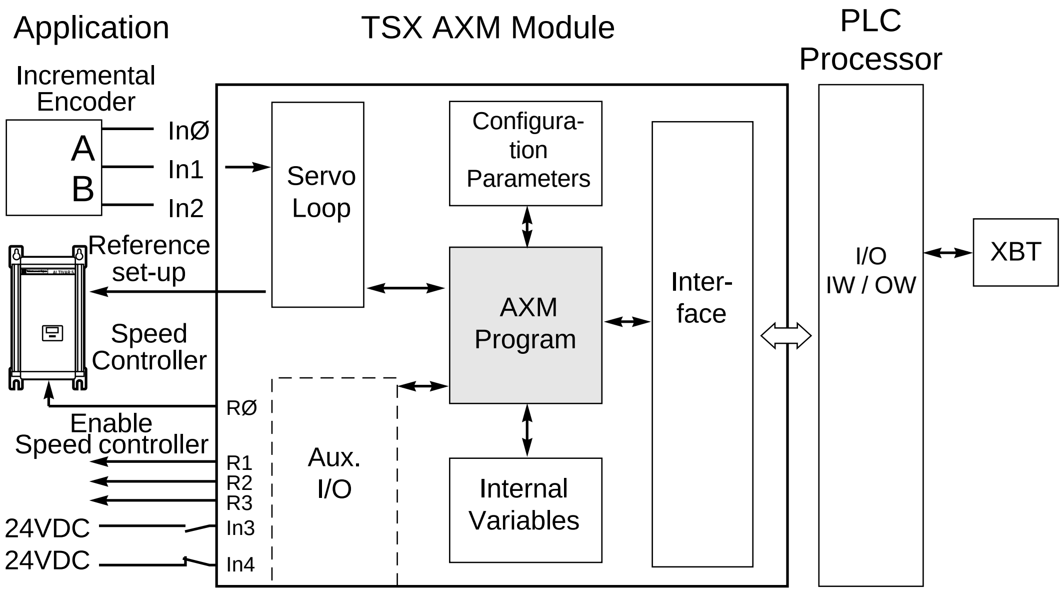
The TSX AXM 162 module is similar to the TSX AXM 182 module. Its difference lies in the fact that it does not have an “Automatic” mode (or program).
As this manual is common to all three modules, TSX AXM 172 / AXM 182 / AXM 162, it is therefore necessary to explain the significance of the lack of automatic mode. Section 5 "PROGRAMMING" does not concern the TSX AXM 162 module. On the other hand, paragraph 6.7 is entirely dedicated to programming moves from the CPU of the programmable controller.

In the rest of this document, so as to avoid reading parts unnecessarily, text which is not relevant to the TSX AXM 162 is highlighted in grey and a note is given at the bottom of the page.

List of functions not available on this module

- Automatic or program mode (cycle, point to point, step by step).
- Teaching of set points and consequently everything which concerns the internal set points table (WNi table).
- Fault processing by module program.

1.3 Internal Layout of the Modules



The TSX AXM modules incorporate five main functions:

- Moving part position servo control,
- Processing of the application programmed by the user,
- Operating functions,
- Interface with the application,
- Interface between the PLC processor and the TSX XBT terminal.

Servo position control

Depending on the position and velocity instructions and on the actual position of the moving part, the module generates the velocity command for the speed controller.

Application processing

The configuration parameter table adapts module operation to the application to be processed.
The module executes the AXM program entered by the user and derives the target positions and the motion velocities.

Operating functions (not shown in the diagram)

The internal software of the module supports a set of functions and checks that apply to module operation:

- Manual mode motion, manual reference set-up, etc.
- Deviation and stop checks, etc.

Application interface

This part comprises the module I/O described in Sub-section 1.4.

Interface between the PLC processor and the TSX XBT terminals

This function enables synchronization of the TSX AXM application with that of the PLC processor. Communication is “user transparent” when a TSX XBT terminal is used to control the module.
Functions not available on TSX AXM 162 module.

1 Module Presentation

1.4 Servo Loop

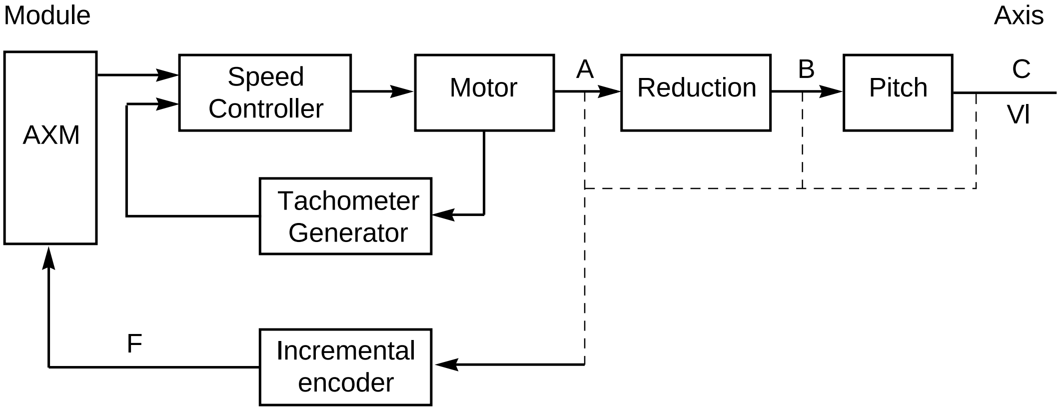
Main servo loop function

3

The servo loop is designed to link the position of a moving part to an instruction value.

As in all servo controlled components, static and dynamic components are dependent on the complete motion system (including both the algorithm and mechanical parts) and on the variation of the instruction over time.

Machine layout



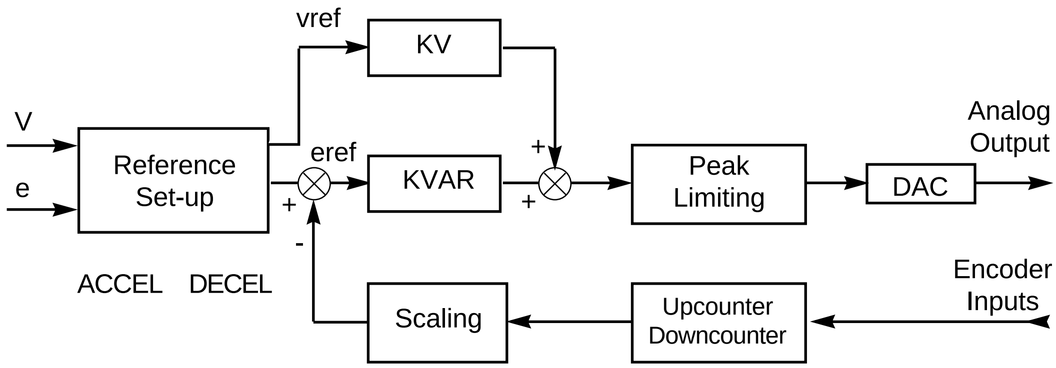
Pitch = distance covered in a single shaft revolution.

The incremental encoder can be either linear or rotary. In both cases it provides a signal with a frequency proportional to the velocity and a number of pulses that is proportional to the position.
Depending on the layout of the machine system, the sensor can be fitted in A, B or C positions (rotary in A and B, linear in C).

1 Module Presentation

Servo Loop

Diagram



Reference set-up

This function is not accessible by the user. It is used to enter the instruction values for eref = f(t) and vref = f(t) as a function of the overshoot and velocity values specified by the user along with the acceleration (ACCEL) and deceleration (DECEL) values set in the configuration and the velocity modulation factor.

Scaling

Depending on the maximum velocity, distance and resolution, the module calculates the value of the scaling factor KR (that is also referred to as the machine characteristic factor).

The user can access a fine adjustment of this factor from the TSX XBT terminal or PL7-AXE program to compensate for any lack of precision in the machine parameters entered in the configuration.

Upcounter/Downcounter

The sum of the sensor increments gives the position of the moving object and allows monitoring of its motion.

Servo Loop

KVAR

Proportional gain factor:

KVAR = C . KPOS . UMAX

C : Constant
UMAX : The value of the variable speed controller instruction corresponding to VMAX velocity (UMAX < 9 V).

The user enters the required KPOS value in the configuration and the module calculates the corresponding KVAR value.

Peak Limiting

The LIMV factor entered in the configuration allows the user to adjust the authorized velocity overrun value.

5% < LIMV < 20% of VMAX

KV

The feed forward factor or overshoot compensation factor is expressed as a percentage. 100% corresponds to the value that would completely remove any deviation at constant velocity when using a speed controller without continuous error.

When KV increases, the deviation decreases, however the risk of an overrun including the risk of stop point overshoot is increased. Therefore a compromise between the two must be found.

Note: In some cases, the deviation passes through a minimum level and may change sign when KV increases.

Digital Analog Converter (DAC)

The function of this circuit is to convert the digital output value (10 bits + sign) into an analog voltage of between +10 V and -10 V.

Sampling Rate

Although not shown by the diagram, the servo loop operates with a sampling rate of 10 ms.

1.5 Module I/O

Inputs

TSX AXM modules have five inputs In0, In1, In2, In3, In4.

In0, In1, In2: Incremental encoder inputs

These three inputs are designed to receive an incremental type position signal.

Various sensors can be used, such as:
- Rotary incremental encoder,
- Linear incremental encoders.
- signals from a MASAP variable speed controller.

In0 and In1 are designed to receive signals from a direction discriminator encoder.

In2 is designed to receive the zero marker signal from the incremental encoder.

In3: Event detection input

A 24V input designed to receive a signal from a position sensor when used with mechanical cam detection:
- For manual reference point set-up (determining the physical reference point),
- For motion with event sensing.

In4: Safety interlock input

The safety interlock input that must be kept supplied. When there is no voltage on this input, an emergency stop is caused on the axis.

Outputs

The module comprises one analog output and four relay outputs.

An analog output, ± 10V (10 bits + sign for TSX AXM 172 and 12 bits + sign for TSX AXM 182 / 162) designed for controlling a variable speed controller.

R0: **Relay output** designed to control the speed controller safety interlock input.
Relay R0 is controlled by the module. The analog output takes its value 200ms after the relay is enabled.

R1, R2, R3: **Auxiliary relay outputs**

These three outputs can be enabled by instructions from the AXM program and can be used for direct action on the application. These outputs can also be enabled by discrete I/O interface bits or by the TSX XBT terminal in other operating modes.

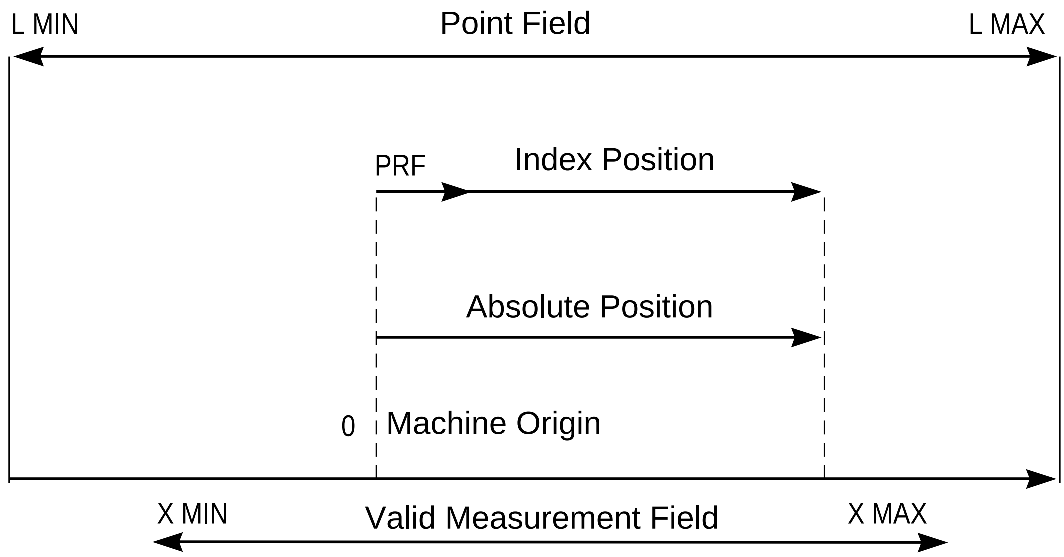
Note

The I/O connection and technical characteristics are described in Sub-sections 7.3, 8.2 and 8.3.

Functions not available on TSX AXM 162 module.

1.6 Positioning Functions

Position reference



Position calculation

The module generates the position measurement by counting the number of pulses received from an incremental encoder.

Position reference

Axis positions are given in relation to the reference point. The module enables the use of various reference point set-up procedures.

Point field

The field that comprises all measurement points is restricted only by the counting capacity and the resolution of the selected sensor.

Travel limit

By configuration, the user defines two travel limit positions referred to as soft stops (XMIN and XMAX). Axis or moving part motion is restricted to the distance between the two limits. This is the valid measurement field. The module will systematically stop the moving part if it moves outsid the soft stops.

Indexed positions

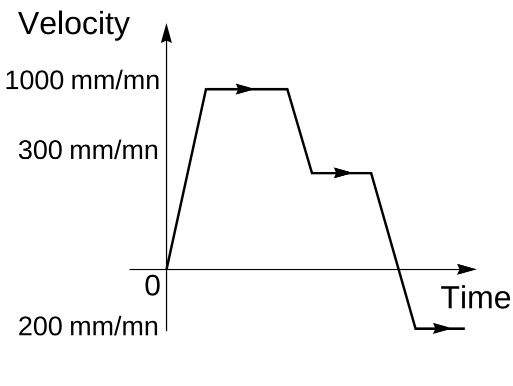
The moving part position can be referenced in relation to the PRF parameter (position index).

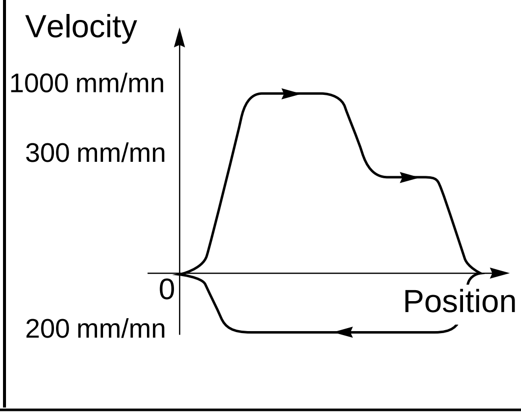
Functions not available on TSX AXM 162 module.

Positioning Functions

Various accessible positions

Velocity/Time presentation	Velocity/Position presentation





These two presentations illustrate actual moving part motion. The Velocity/ Position presentation has the advantage of showing both useful parameters in the same graph. The other graph showing Velocity/Time will be used later in this manual. **To simplify the illustration of motion with acceleration and deceleration periods, line segments will be used and not curves**. Negative velocities indicate reverse direction motion.

Positions

The module can process the following types of position:

- Immediate positions: positions where the value is given explicitly in the instruction,
- WNi internal positions (numbers 0 to 100): internal words designed to receive the positions obtained by teaching the module set points or by entering instructions,
- External positions provided by the TSX XBT terminal or by the PLC processor using register words OWxy,6 and OWxy,7.

Measurement units

The position, velocity and acceleration measurement units are physical units:

User defined physical units

The user defines the configuration parameters (refer to Sub-section 2.2), the physical units for the display of the measurement values by PL7-AXE and the TSX XBT terminal.

Module physical units

These are calculation units used by the module and the display units used for the measurement values in register words OWxy,4 to 7 and IWxy,6 and 7. They depend on the maximum velocity VMAX selected (remember that VMAX depends on the resolution, refer to the complete table given in the Appendix).

Functions not available on TSX AXM 162 module.

3

2.1 General

Purpose

A table of 32 parameters enables the adaptation of module operation to the application to be processed.

There are three types of parameters:

- Axis parameters (sensor resolution, maximum velocity, etc.),
- Servo loop parameters (position gain, etc.),
- Operating parameters (error detection and processing, etc.).

The module can only operate if this table has been filled-in and transferred to the internal memory by the user.

Parameter access

These parameters must be entered using PL7-AXE in Configuration Mode. Once the module has been configured, some of the parameters can also be modified :

- From a TSX XBT terminal,
- By AXM program instructions.

Access to modifications depends on the type of parameters selected:

A : Accessible only using PL7-AXE,
B : Can be modified using the TSX XBT terminal,
C : Can be modified using the TSX XBT terminal and AXM program instructions.

Selecting parameter values

When using PL7-AXE to enter the parameter table in Configuration Mode, once the resolution and maximum velocity parameters have been entered, default values are proposed for other parameters.

These parameters must be appropriate for the application.

The table on the following page is designed to guide the user in selecting the values of these parameters.

Functions not available on TSX AXM 162 module.

2.2 Parameter List

The table below gives the function of each parameter along with its possible values.

Parameters	Explanations and limit values	Type	Typical values
Sensor resolution RESOL	Distance travelled by the moving part between two sensor points (1 increment) See Appendix A.1. Min. limit : TSX AXM 172: 0.1 µm Max. limit: 1000.0 µm TSX AXM 182: 1 µm.	A	
Maximum velocity VMAX	Max. moving part velocity by applying the value UMAX velocity to the analogue output. See Appendix A.1 Min. limit : 11 mm/mn Max. limit : Value calculated by PL7-AXE, depending on the resolution of the selected sensor.	A	
User selected units:	Display units for all parameters, as opposed to the module units that are used for internal calculations.	A	
UPUL	Length unit : µm, mm, cm, dm, m		mm
UPUV	Velocity unit : mm/mn, cm/mn, dm/mn, m/mn		mm/mn
UPUA	Acceleration unit : mm/s^2, cm/s^2, dm/s^2, m/s^2		mm/s2
Soft stops XMAX XMIN	Valid measurement field See Section 4.2 Limits : The limit values are calculated by PL7-AXE depending on the resolution and maximum velocity.	A	
Acceleration Deceleration ACCE DECE	See Section 4.1 Limits : The limit values are calculated by PL7-AXE depending on the resolution and maximum velocity.	C	VMAX/6
Type of reference TYPEREF	See Section 4.1 Values : 1 = short cam + zero marker 2 = cam 3 = long cam and limit switch + zero marker	B	
Manual drive velocity VMAN	This is the velocity of the moving part in assisted man. mode, man. drive mode and man. set mode. Min. limit: 1 mm/mn, Max. limit: VMAX.	B	VMAX/10
“Stopped” velocity VSTOP	See Section 4.2 Min. limit: 1 mm/mn, Max. limit: VMAX.	C	VMAX/10

Parameter List

Parameters	Explanations and limit values		Type	Typical values
Stop time period TSTOP	See Section 4.2		B	
	Min. limit: 1 x 10ms,	Max. limit: 65535 x 10 ms.		1 sec
Target window TW	See Section 4.2 (Target Window Check).		C	
	Min. limit: 1 µm,	Max. limit: (XMAX-XMIN)/10.		
Max. deviation DMAX	See Section 4.2		C	
	Min. limit: 1 µm.	Max. limit: (XMAX-XMIN)/2.		
Speed controller voltage for VMAX /UMAX	Analog output voltage corresponding to max. velocity VMAX. Refer to appendix A1.		B	
	Min. limit: 1 volt,	Max. limit: 9 volts.		9
Position loop	Refer to appendix A2		B	
KPOS	Position gain :	1.00 to 32.00 s^{-1}		16
LIMV	Max. velocity tolerance :	5 to 20% over VMAX		20%
KV	Velocity correction factor	: 0 to 100%		20%
Deviation check	See Section 4.2			
MDMAX	Divert mask:	Y = Fault process. by XBT or PLC, N = On error, divert AXM program to divert step NDMAX.	B	Y
NDMAX	Divert step number: 0 to 253.		C	
Stop check	See Section 4.2			
MSTOP	Divert mask:	Y = Fault process. by XBT or PLC, N = On error, divert AXM program to divert step NSTOP.	B	Y
NSTOP	Divert step number: 0 to 253.		C	
Target window checks	See Section 4.2			
MTW	Divert mask:	Y = Fault process. by XBT or PLC, N = On error, divert AXM program to divert step NTW.	B	Y
NTW	Divert step number: 0 to 253.		C	

Functions not available on TSX AXM 162 module.

Parameter List

Parameters	Explanations and limit values	Type	Typical values
Sync. time-out period TSYN	See Section 4.2 Synchronization time-out: Min. limit: 1 x 10ms, Max. limit: 65535 x 10 ms.	B	
MSYN	Divert mask: Y = Error processed by XBT or PLC, N = On error, divert AXM program to NSYN divert step.	B	Y
NSYN	Divert step number: 0 to 253.	C	
PLC processor checks MCPUF	See Section 4.2 Divert mask: Y = Error processed by XBT or PLC, N = On error, divert AXM program to NCPUF divert step.	B	Y
NCPUF	Divert step number: 0 to 253.	C	
Number of internal positions NBWN (*)	Min. limit: 0, Max. limit: 100.	A	0

(*) The AXM program can use a maximum of 100 WNi internal positions.
The NBWN parameter determines the number of WNi internal positions numbered from WN0 that will be transferred when the application is stored in the internal memory of the PLC or saved to disk.

Functions not available on TSX AXM 162 module.

Important Note

Most of the operations described in this Section can be performed from three different systems.

- PL7-AXE which in addition to its configuration/programming function also allows the user to debug applications,
- A TSX XBT terminal,
- The user program (PLC program) via the PLC/TSX AXM module interface. For a given operation, the procedure that applies varies depending on which system the user wishes to use.

Rather than describe each operation three times, once for each system, the general procedure for each operation will be described. It is then up to the user to refer to the appropriate Section for the system to be used.

The user can refer to:

- Sub-section 6.4, that describes the interface between the user program and the module,
- Divider C2, Section 7 that describes PL7-AXE debug functions,
- Divider D, Section 3 that describes TSX XBT terminal functions.

3 Operating Modes 3

3.1 Module Modes

The module can control the motion of a moving part in five operating modes:
- Automatic,
- Manual reference set-up,
- Manual operation under visual control,
- Assisted manual operation,
- Servo loop disabled.

All of these modes can be selected from the TSX XBT terminal (or by a register word). However, an operating mode can only be selected when the moving part is stopped. If motion is in progress (or if the moving part is not declared as stopped), the Start command will be ignored by the module.
Once the mode and the associated parameter(s) have been selected, the Start command starts mode execution, the mode is enabled. The Stop command stops mode execution, the mode is disabled.
Selecting another mode when the currently selected mode is enabled will disable it.

Note: When the modes are controlled by the PLC program (by OW register word bits), execution can only be started when the mode is effectively selected by the module : identity between the selected mode and the information returned by the module and presence of the activation wait bit.

Automatic mode (or programmed mode)

The AXM program generated by the user and stored in the internal memory of the module automatically controls motion of the moving part.
This mode has three sub modes:

- **Automatic cycle**: The program is executed until the end of program instruction (END). This is the standard operating mode.
- **Automatic step-by-step**: After each program step is executed, the moving part is stopped and the module awaits a resume command. This mode is useful for debugging a program.
- **Automatic point to point**: the program is executed in sequence until an instruction with a stop order is reached, the module then waits for a restart command. This mode is useful for debugging an application.

Procedure:
- Select the sub-mode,
- Start mode: The moving part executes the trajectories defined by the AXM program.

Manual reference set-up mode

The user determines the direction of motion. The velocity of the moving part or axis feedrate is defined in the configuration using VMAN: manual velocity. The moving part automatically sets its reference point from a cam, depending on the type of reference point set-up selected (refer to Sub-section 4.1). This mode enables the axis to be referenced.

Note : The reference point can be set-up automatically using an instruction. This can be difficult to perform if the position of the moving part is not known precisely by the module (resulting in motion away from the cam, for example). A type 3 reference set-up (long cam at end of travel) can be used to avoid this risk.

Functions not available on TSX AXM 162 module

Module Modes

Procedure:
- Select the mode,
- Enter the reference point,
- Start the mode: The moving part moves towards the target position and stops (the Start command is implicit when using a TSX XBT terminal).

Manual control mode

Moving part motion and stopping are directly controlled by the user who can see the axis and moving part. The velocity of the moving part (VMAN parameter) is specified in the configuration. This mode is used to position the moving part during application debug phases.

Procedure:
- Select the mode,
- Enter the direction of motion,
- Start the mode: The moving part starts to move in the selected direction,
- Stop the mode: Stops the moving part, (The Start and Stop commands are implicit when using a TSX XBT terminal).

Note: For safety reasons, authorized motion is restricted to:
- XMAX - 2 x TW in the positive direction,
- XMIN + 2 x TW in the negative direction.

Assisted manual mode

The user enters the target position for the moving part. Moving part velocity is specified in the configuration by the VMAN parameter: Manual velocity. This mode is used to position the moving part during application debug steps. It can also be the primary operating mode in applications with basic motions.

Procedure:
- Select the mode,
- Enter the target position,
- Start the mode: The moving part moves to the target position and stops.

This is the preferred operating mode for the TSX AXM 162 module.

Servo loop disabled (open loop)

The module directly controls the analog output on open loop, i.e. the servo loop is disabled. This mode is used to analyze axis operation separately from the position control servo loop (e.g. for machine system adjustment).

Procedure:
- Select the mode,
- Enter the velocity of the moving part:

Module	TSX AXM 172	TSX AXM 182 / 162
TSX XBT 182	-1023/ +1023 x 10 mV	-1023/ +1023 x 10 mV
PL7-AXE Debug Mode	-1023/ +1023 x 10 mV	-4096/ +4096 x 2.5 mV

- Start the mode: The moving part moves in the specified direction at the specified velocity (with the ability to change the speed reference),
- Stop the mode: Returns the analog output level to 0 (causing return by gentle deceleration).

3.2 Module and Axis Status

B

Module status

When the module is operating without any faults, three module conditions can be defined :

- **Module not configured**
  No configuration parameter has been sent to the module and the module cannot control any motion. A PL7-AXE configuration must be loaded before any other operation is performed.
- **Module configured and stopped**
  A module state that enables the modification or the transfer of the configuration and the AXM program. In this state, the module cannot perform any motion, but it will however continue to calculate moving part position.
- **Module configured and running**
  In this state, the module is fully operational.

The module is stopped or started using a TSX XBT 182 terminal, a micro-computer running PL7-AXE or the PLC program through register or command words. When a PLC error (*) is present, it is indicated by the Fail LED being lit or the OK LED being extinguished. The status bit Ixy,S is also set to 1. Regardless of the cause of the error, the module is forced to stop.
(*) This applies to errors effecting the module itself and not application errors, described in Sub-section 4.2.

Axis status

Programmed axis
An AXM program must be loaded in the module with PL7-AXE (or from the PLC program using the AXM LD OFB).

Referenced axis
The axis has been referenced using one of the reference set-up procedures (refer to Sub-section 4.1).
The following table gives the different operating modes that can be accessed in each of the four states.

Axis state	Accessible modes
Programmed and referenced	All operating modes can be accessed
Programmed but not referenced	Manual reference point set-up and automatic mode if the first motion instruction is an automatic reference point set-up command
Not programmed but referenced	All operating modes can be accessed except for automatic mode
Not programmed not referenced	Manual reference point set-up

Note : Forced reference set-up also enables the axis to be referenced (see Sub-section 4.1).

Functions not available on TSX AXM 162 module

3.3 Safety Interlocks

Application safety interlocks

Input In4: Must have a 24 V supply. When this input is no longer supplied, an emergency stop error is caused. This stops the moving part, disables relay R0 and the currently selected mode.

This mode can be used as a safety interlock to ensure that the module can only operate when the speed controller is operational.

Relay output R0: This output is designed to control the speed controller enable input. Relay R0 is activated by the module as soon as the module starts running. It is immediately disabled if a module error occurs.

PLC safety interlock

The Emergency Stop bit: Bit Oxy,7 must be set to 1 by the PLC program or by the TSX XBT terminal.
Therefore, when this bit goes to 0, it causes an emergency stop fault:

- Stopping the moving part,
- Disabling relay R0,
- Disabling the currently selected operating mode.

Interlock On and Interlock Off modes

Interlock On:
If this is selected, a PLC error or stopping the PLC will stop the moving part and disable the currently selected module operating mode (PLC (CPU) error condition).

Interlock Off:
If this is selected, it allows the module to operate independently.
The safety interlock can be switched Off in Debug mode, allowing the module to operate with the PLC stopped, without causing a PLC (CPU) error.

The safety interlock can be selected through the TSX XBT terminal (Function F85) or by bit OWxy,0,E (1 = Interlock Off).

B

4.1 Motion

Motion functions performed by the module

In addition to the moving part motion commands, the module also performs other specific functions that cause motion. The table below shows the modes where these functions are available:

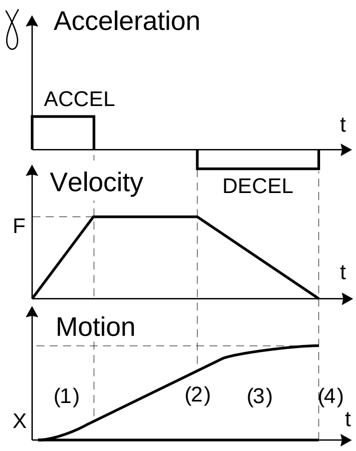
Mode: Function	Auto-matic	Manual Ref. Set-up	Manual Drive	Assisted Manual	Servo Off
Reference set-up	Yes	Yes	No	No	No
Forced ref. set-up	Module stopped, no errors				No (*)
Teaching set points	Moving part stopped, axis referenced, no errors				
Return from overshoot	Enabled after soft stop overshoot by the moving part and fault is acknowledged				

(*) Except for TSX XBT Function F95.

Motion

All motion commanded by the module (except when the servo loop is disabled) follows the velocity and acceleration rules shown below:

The internal module software generates a series of position instructions corresponding to the motion to be performed:



(1) Increase velocity according to the acceleration defined in the configuration,

(2) Constant velocity motion with the velocity set by instruction or by configuration (in manual modes),

(3) Deceleration with the parameters set in the configuration,

(4) Stop at a target position.

Functions not available on TSX AXM 162 module

Motion

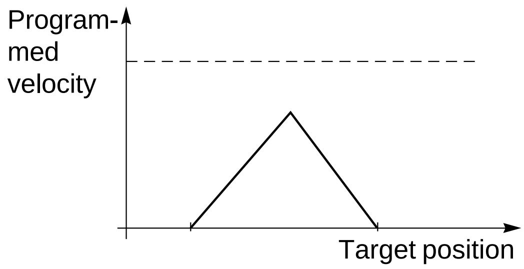
Attention:
- A motion command can only be executed if the axis is referenced. This still applies when the servo loop is disabled.
- Moving part stoppage is effectively declared only after the TSTOP time-out set in the configuration.

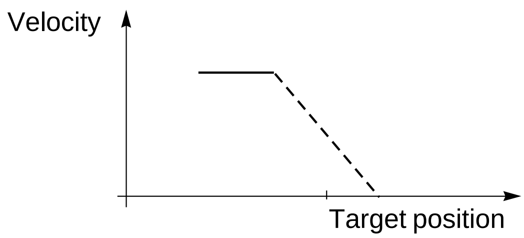
Velocity correction factor

The user has access (through the TSX XBT terminal or command register word) to a velocity correction factor that enables all velocity values to be multiplied by a factor of 0 to 2 in increments of 1/100 (TSX AXM 172) or 1/1000 (TSX AXM 182 / 162).

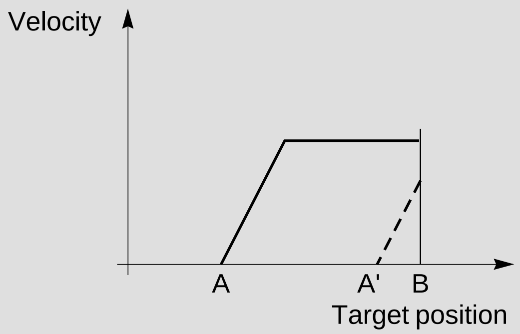
Special cases:

- **Motion with stop on target** :
  If the programmed or configured velocity cannot be reached during the motion command (distance too short), the module calculates the distance required for deceleration to the target point and automatically starts to decelerate once the minimum distance is reached. If the deceleration distance as entered is too short, the module rejects the command and stops the moving part.





- **Motion without stop** :
  If the motion command to be performed is impossible with the various parameters defined : acceleration, deceleration, target position, programmed (or configured) velocity, velocity correction factor, the module rejects the command and stops the moving part.



- **Other cases of command rejection** :
  - When two single step motion commands are programmed in opposite directions as a continuous move without allowing for motion reversal,
  - When a motion command is given for a non-referenced axis.

Functions not available on TSX AXM 162 module

Motion

Reference set-up

Reminder: An incremental encoder does not provide a position measurement, only a number of pulses proportional to the distance travelled. For this distance to indicate a position, a reference point must be set-up (usually = 0). This operation is the reference set-up. This allows the module to generate absolute position measurements using the incremental encoder. The reference set-up command is initiated by an AXM program command: SRP+ or SRP- or by a manual reference set-up command. The reference set-up procedure is identical in both directions. The module has two inputs that are used for reference set-up (IN2 for the zero marker and In3 for a cam) and 3 types of detection.

Type 1: Short cam (the cam signal is only present for a single zero marker pulse) and zero marker, the reference point is indicated by the cam presence signal on In3 and an edge on In2 (rising or falling) (see next page),

Type 2: Cam: The reference point is indicated by an edge on In3 (rising or falling) (see next page),

Type 3: Long cam and limit switch (the cam signal is present for a number of zero marker pulses) and the zero marker.
The reference is indicated in the same way as type 1.

Functions not available on TSX AXM 162 module

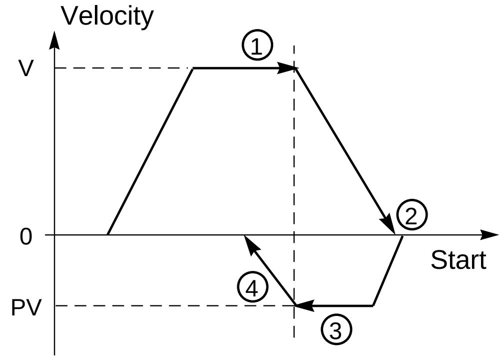
General description of the different phases of reference point set-up:

① Moving part motion at the programmed approach velocity or VMAN, until the reference point is reached,

② Stop the moving part when the reference point is sensed,

③ Return the moving part at Low Velocity (1) until the reference point is reached,

④ Load the external position EXT in the position measurement counter and stop the moving part.



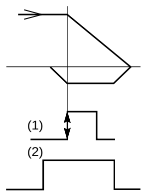
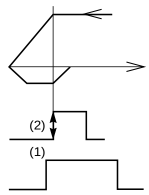
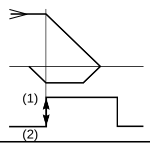
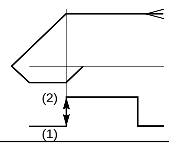
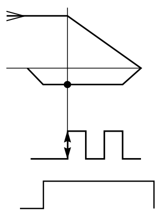
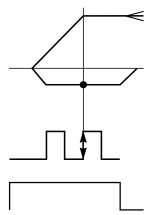
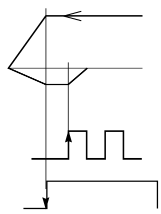
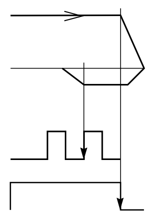
In reverse motion, the reference point set-up procedure is similar and its representation is symmetrical.

(1) Low Velocity (PV) is set to 1/8th of the approach speed for TSX AXM 172 modules and 1/16th of the approach speed for TSX AXM 182 / 162 modules.

The cam can be located in a position (called reference position PREF) other than the reference point. The offset value between machine reference and the reference point cam must be loaded in the external position register EXT.

Note: Type 3 operates differently (see table below and description on next page).

Detailed description of each type of reference set-up

		Off cam start		On cam start	
Type		+ Direct.	- Direct.	+ direct.	- direct.
Type 1 Motion				(1)	(1)
Zero Marker	In2				
Cam	In3				
Type 2 Motion				(1)	(1)
Cam	In3				
Type 3 Motion					
Zero Marker	In2				
Cam	In3				

(1) For type 1 and 2 reference set-ups, move the moving part away from the cam before referencing.

Type 3 special case

- Moving part stop in phase ④ is commanded when the cam is no longer present (falling edge on In3),
- **On cam**: The direction of motion is the opposite of that requested and moving part stop in phase ② is commanded when the cam is no longer present (falling edge on In3).

Forced reference point set-up

This is used to reference the axis without moving part motion.

Procedure:
- The moving part is stopped and no errors are present,
- Measure the moving part position in relation to the machine reference point,
- Load the measurement value in the external position register (PREF) or use the TSX XBT terminal,
- Forced reference set-up command: the current position measurement counter takes the loaded value.

Teaching set points

The set point teaching function enables the acquisition of set points by the module memory, by successively moving the moving part to the different positions to be stored.

These positions are stored in the WNi internal words. Up to 100 can be stored.

Procedure:
- Move the moving part to the position to be stored,
- Select the internal position number,
- Enter the Teach command.

The moving part must be stopped when the teach command is sent.

Note: The values of the WNi positions can also be set by AXM program, TSX XBT terminal or PL7-AXE instructions.

Return from soft stops

After the moving part overshoots the upper or lower travel stops called soft stops, this command is used to automatically return it within the permitted movement field:

- In + direction, the moving part is located at point XMAX + 2 x TW,
- In - direction, the moving part is located at point XMIN - 2 x TW.

Procedure:
- Error acknowledgment,
- Return from soft stop overshoot (backoff).

Functions not available on TSX AXM 162 module

4.2 Checks

Purpose

The check function is essential in position control applications due to moving part motion and the risks involved.
The checks are carried out internally and automatically by the module.
By default, all checks are enabled (module running). Some of these checks can however be disabled by AXM program instruction. The user can select the parameters assigned to the checks, to adapt them to the particular application.
These checks are used to detect moving part positioning errors, trajectory deviation errors or module and PLC errors.

B

Principle

Two types of checks are defined depending on the seriousness of the detected error:

- 1st. type: Detection of this type of error systematically quits the current operating mode.

  List of type 1 checks:
  - Soft stops (only operate if the axis is referenced),
  - Disable the servo loop,
  - PLC power supply error,
  - Terminal block unlocked.

  This type of check remains enabled regardless of the selected operating mode and causes:
  - Error indication,
  - Disable the servo loop,
  - Decelerate until DAC instruction value equals 0,
  - Disable the speed controller interlock relay R0,
  - Quit the mode (disable),
  - Await acknowledgment.

- 2nd. type: Detection of this type of error does not systematically quit the current operating mode.

  List of type 2 checks:

Mode	Position error	Target window	Stop	Synchro-nization	Emergency stop(*)	CPUF error
Automatic	Yes	Yes	Yes	Yes(**)	Yes	Yes
Manual ref.	Yes	No	Yes	No	Yes	Yes
Manual	Yes	No	Yes	No	Yes	Yes
Assisted man.	Yes	Yes	Yes	No	Yes	Yes
Open loop	No	No	No	No	Yes	Yes

(*) The emergency stop cannot be processed by the AXM program,
(**) This check is disabled in the step-by-step or point-to point sub-modes.

Functions not available on TSX AXM 162 module

Checks

This type of error can be processed in two different ways. The selection is made in the software parameter configuration table, for each check with the divert mask parameter.

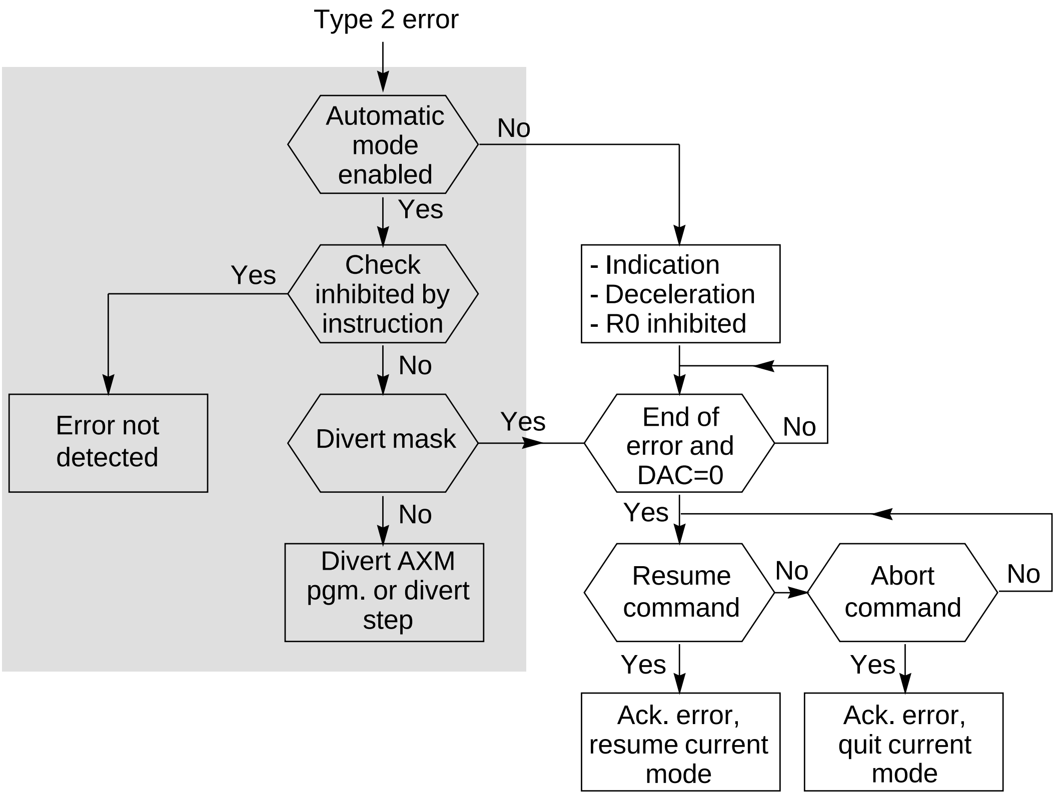
- **With operator intervention** (Divert mask = Yes):
  - Error indication,
  - Decelerate until DAC instruction = 0,
  - Disable the speed controller interlock relay R0,
  - Wait for a resume command or quit the current mode. During this waiting phase, the servo loop is disabled.
- **With an AXM program divert sequence** (Divert mask = No): (only in automatic mode)
  - Disable the check,
  - Divert to the program step defined in the configuration.

  It is advisable to start a divert program with a Stop instruction to stop the motion where an error was detected.
  It is necessary to enable the checks with the SCTL instruction, if checks will be required again.

The stop, position error, synchronization, target window and CPUF checks can be disabled by the RCTL instruction (refer to Sub-section 5.4).

Note: The Emergency Stop error cannot be inhibited or processed by a divert step.

The flow chart below provides a summary of the possible processing of type 2 errors:



Functions not available on TSX AXM 162 module

Checks

Parameters linked to the checks

The parameters linked to the checks must be defined in the configuration parameter table. Some of these parameters can be modified by the TSX XBT terminal and/or by the AXM program.

B

Soft stop checks (type 1)

The module checks that the position of the moving part remains within the two limit values XMIN (lower soft stop) and XMAX (higher soft stop). This check is enabled as soon as the axis is referenced. The return from soft stop overshoot command (backoff) allows the moving part to be automatically repositioned within the valid measurement field. After acknowledgment, return from overshoot is performed with the servo loop open.
Return velocity is calculated from the deceleration factor
DECEL: V = DECEL/100 (V in mm/s and DECEL in mm/s^2).

Calculation capacity overflow check (type 1)

The module checks to ensure that when a calculation is made it does not exceed the calculation capacity. The capacity level depends on the resolution selected and is set slightly above the maximum soft stop values accepted by PL7-AXE. This type of error causes axis referencing to be lost.

Module power supply check (type 1)

The module is supplied by the PLC. Configuration data, AXM program and WNi and CNi internal variables are saved by the module's internal battery backed-up memory. This type of error causes axis referencing to be lost.

Terminal block Check (type 1)

The module runs a continuous check to ensure that the TSX BLK 4 terminal block on TSX AXM 172 modules is locked into place. On TSX AXM 182 modules, it checks that the 25-pin connector is present. This type of error causes axis referencing to be lost.

Deviation check (type 2)

Deviation = position setting - measured position.
The module runs a continuous comparison (moving part stopped or in motion), between the calculated position (setting) and the measured position of the moving part. An error is detected when the position deviation is greater than the maximum allowed error DMAX defined by the user in the configuration.

Target window check (type 2)

When a move to position and stop command is requested, the module checks that the position reached corresponds to the requested position and is within the target window tolerance (TW) defined by the user. The check is made as soon as the moving part is declared stopped and is continued until a new motion command is executed. An error is declared when:
- Position reached > target position + TW, or
- Position reached < target position - TW.

Functions not available on TSX AXM 162 module

Checks

Stop check (type 2)

As soon as the velocity instruction value calculated by the module equals 0, the module starts the TSTOP timer. Once this is timed-out, the counter compares the measured moving part velocity and the “stopped” velocity VSTOP, this velocity being the threshold value below which the moving part is considered to be stopped.
If the measured velocity is greater than VSTOP, the module declares a stop error.
Once the moving part has stopped, the module runs a continuous check (every 10ms) of the velocity of the moving part, until a new motion command is executed.

Note: This check allows moving part hunting around the stop position.
Any drift of the moving part from the target will be detected by the target window check. The TSTOP parameter value should always be optimized.

In practice, to avoid errors, VSTOP must be greater than: resolution/10ms.
Example: If the resolution is 5 µm, VSTOP > 5 µm/10 ms, result 30mm/mn.

Synchronization check (type 2)

This check is activated by instruction M (refer to Sub-section 5.3).
The module continues to run its program while awaiting an event either from input In3 or from the PLC processor depending on the operand declared in the instruction.
If this event is not detected within the TSYN time-out, an error is declared by the module.

Emergency stop check (type 2)

An emergency stop error is detected when input In4 is no longer supplied or when the emergency stop bit Oxy,7 is at 0.

CPU error check (type 2)

When the PLC is stopped or a processor fault error occurs, a CPU error (CPUF) is declared.

Run with interlock off
In this operating mode a CPU error is ignored (no error indication, no divert processing step). The module will then operate independently of the PLC processor (with all the risks inherent to this type of operation).

Run with interlock on
In this mode the error is detected. In addition if SY8 (hold output bit) = 1, an error will set the module outputs to 0 (analog and relay outputs).

The selection of an operating mode with interlock on or off is made using the TSX XBT terminal or the PLC program.

Functions not available on TSX AXM 162 module

Checks

Disabling checks

In Manual Modes (manual drive, assisted manual and manual reference set-up), it is not possible to disable the checks. (The user can however invalidate them, e.g. during the debug phase, by giving the parameters values that are such that the checks are no longer able to operate).

In automatic (programmed) mode, it is possible to disable the stop, deviation, synchronization, target window and CPUF error checks using the RCTL instruction.

Notes:

- **The Emergency Stop check cannot be disabled.**
- **It is strongly recommended that the deviation check be invalidated only by entering a DMAX parameter value that is too high for an effective check. This check is the only way to detect a break or a failure in the encoder data link.**

Functions not available on TSX AXM 162 module

5 Programming TSX AXM 172 / 182 modules 5

5.1 Language Presentation

Presentation

The AXM module internal program (AXM program) enables automatic control of moving part motion.

The program comprises basic instructions that can be arranged in four families:

MOVE
- Motion
- Reference set-up

ORGANIZATION
- Subroutine
- Jump
- Timer
- Activate discrete outputs and synchronization

DATA CONTROL
- Internal counter control
- Position operations
- Parameter modification

CHECKS
- Enable/disable checks

Layout

A program comprises a succession of steps (up to 254 max.).

Each program step has a label (or step number) and the instruction comprises an instruction code and one or more operands.

E.g.:	10	GP1	F= 1000 mm/mn X= 500 mm
	Step Nbr.	Instruction code	Operands

Program execution

The program is executed step by step, in ascending step order until the end of program instruction is reached (except for the execution of jump and call subroutine commands, or a divert program).
The transition from one step to another is only completed when the current step has been executed.
Minimum instruction execution time = 10ms (corresponding to the module scan time).

Language Presentation

Program entry and modification

Program entry is made using PL7-AXE, modifications to velocity and position values can be made using the TSX XBT terminal.

Variables linked to the language

Positions

The positions that can be used by the instructions are :
- Current position,
- Immediate positions,
- Internal WNi positions,
- External positions.

These positions can be absolute or indexed:

- Absolute positions: Referenced to the machine reference point,
- Indexed positions: Referenced to PRF index.

AXM program control

These parameters are used to control and monitor AXM program execution.

- Four internal counters CN0 to CN3 (with values from 0 to 255) can be used for setting program loops (for repeated motion). These words can be loaded by the AXM program LDC instruction, from the TSX XBT terminal or the PLC program. They can be incremented or decremented.
- Comparison value: A value sent by the PLC processor (OWxy,3 Least Significant Byte) enables execution of the AXM program loop to be controlled from the PLC program or the TSX XBT terminal.
- Start step and current step numbers cannot be accessed directly through AXM program instructions, but can be used by the PLC program.

Motion and control parameters

These are type C parameters (see Sub-section 2.1). They can be changed by the MOD instruction.

Note:
- When a parameter is modified by program, it replaces the configuration parameter. It is up to the user to control these parameters in the AXM program at the start of the program.
- All parameters are retained on power break.

Velocity correction factor

Reminder : This factor, with a value between 0.01 and 2.00, that can be modified in steps of 1/100th (TSX AXM 172) or 1/1000th (TSX AXM 182) is set by the TSX XBT or a register word, and multiplies all velocities declared in the instructions (in the examples used here, the factor is assumed to be 1).

5.2 Move Instructions

Move to a Position

Without stopping : Instruction code GP1
And stop : Instruction code GP9

GP1 or GP9 F= Velocity X= Target position

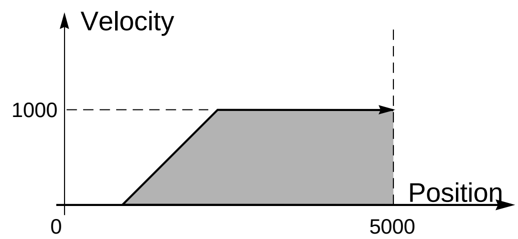
Operands:

Velocity : Immediate value expressed in user selected physical units

Position :
- Immediate position
- WNi internal position
- EXT external position (1)
- Immediate position: Immediate indexed position
- IWNi internal indexed position
- IEXT indexed external position (1)

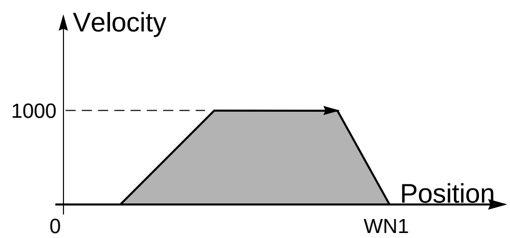
(1) Value provided by PLC program via OWxy,6/7 registers in module unit (cf. table appendix A1).

Example 1: GP1 F= 1000 mm/mn X= 5000 mm



Move to position 5000 mm at a velocity of 1000 mm/mn without stopping.

Example 2 : GP9 F= 1000 mm/mn X= WN1



Move to internal position WN1 (set by teaching)
at a velocity of 1000 mm/mn and stop.

Execution conditions:

- Axis referenced,
- Velocity ≤ VMAX defined in the configuration,
- Position between XMIN and XMAX,
- Indexed position: Position + PRF between XMIN and XMAX.

Move Instructions

Move until an event is detected (input In3)

In	+	direction without stopping	:	Instruction code G+1
In	-	direction without stopping	:	Instruction code G-1
In	+	direction and stop	:	Instruction code G+9
In	-	direction and stop	:	Instruction code G-9

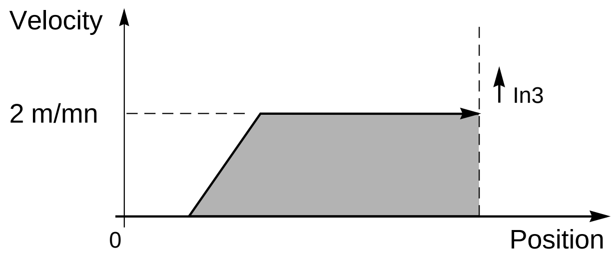
G+1 or G-1 G+9 or G-9	F= Velocity	EVENT= Event

Operands:

Velocity : Immediate value expressed in user selected physical units.

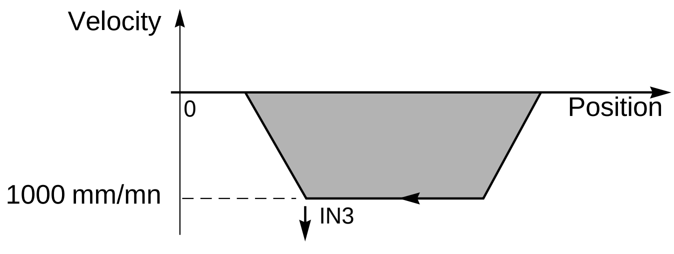
Event :
- UI3 rising edge on input In3,
- DI3 falling edge on input In3.

Example 1 : G+1 F= 2 mm/mn EVENT= UI3



Motion in positive direction at a velocity of 2 mm/mn until a rising edge is detected on input In3, without stopping on detection.

Example 2 : G-9 F= 1000 mm/mn EVENT= DI3



Motion in negative direction at a velocity of 1000 mm/mn until a falling edge is detected on Input In3, with a stop command given when the event is detected.

Execution conditions :

- Axis referenced,
- Velocity ≤ VMAX defined in the configuration.

Move Instructions

Reference set-up

In negative direction : instruction code SRP+
In positive direction : instruction code SRP-

SRP+ or SRP- F= Approach speed X= Position

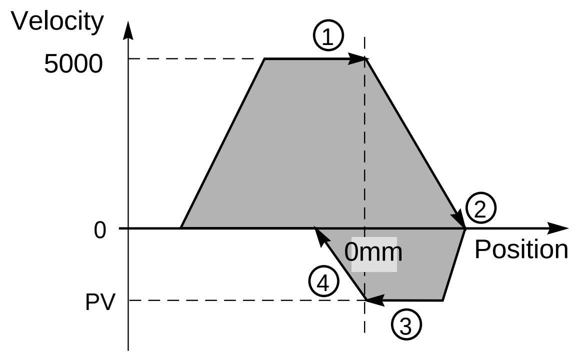
Operands :

Approach speed : Immediate value expressed in user selected units.

Position : Immediate position to load in the current measurement counter and expressed in user selected units (offset in relation to the reference point).

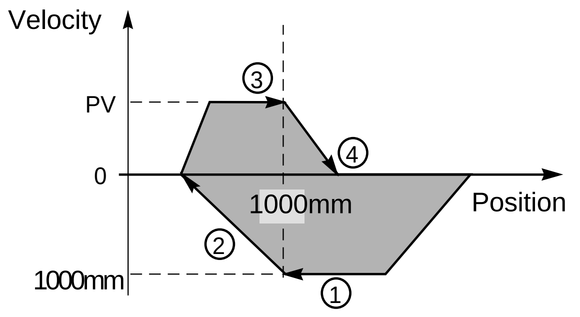
Note : The reference set-up procedure is described in Sub-section 4.1.

Example 1 : SRP+ F= 5000mm/mn X= 0 mm



Move at a speed of 5000 mm/mn in positive direction until the reference point is detected (mode 2), load 0 as current value and stop.

Example 2 : SRP- F= 1000mm/mn X= 1000 mm



Move at a speed of 1000 mm/mn in negative direction until the reference point is detected (mode 2), load position 1000 mm in the current value register and stop.

Execution conditions :

- Velocity ≤ VMAX defined in the configuration,
- Load position between XMIN and XMAX.

Move Instructions

Velocity to the target position : Instruction code PV

Purpose : Placed after a motion instruction without a stop on position command (GP1), this instruction changes the moving part velocity before the end of execution of the previous instruction to ensure that the selected velocity is reached when the moving part reaches the target position.

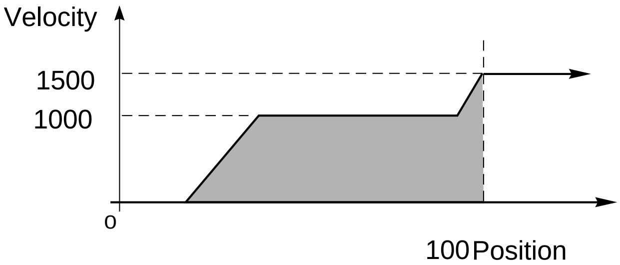
PV F= Velocity

Operand :

Velocity : Immediate value expressed in the user selected physical units.

Note : The PV instruction is interpreted before execution of the GP1 instruction. The module automatically calculates the position from which it must decelerate or accelerate.

Example : 1 GP1 F= 1000 mm/mn X=100 cm
2 PV F= 1500 mm/mn



Execution condition :

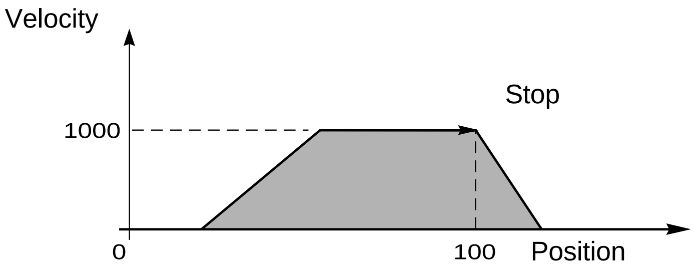
- Velocity ≤ VMAX defined in the configuration.

Immediate Stop

Instruction code STOP

Purpose : Causes the module to stop with a slow down period.

Example : 1 GP1 F= 1000 mm/mn X=100 cm
2 STOP



5.3 Move Organization Instructions

Unconditional Jump : Instruction code JMP

JMP	N= Program step number

Example : JMP N= 10 : Jump to step 10

Jump if CNi ≠ 0 : Instruction code JNZ

JNZ	N= Program step number CNi= CN0 to CN3

A jump to a given step is carried out as long as the value of the selected internal counter is different than 0.
When used with CNi increment and decrement instructions, it enables repeated execution of a set of instructions.

Example : JNZ N= 2 CN0 : Jump to step 2 if CN0 ≠ 0

Jump if the Immediate Value = OWxy,3 LSB : Instruction code JEX

JEX	N= Program step number VAL= Immediate value

A jump to a given step is carried out as long as the value of word OWxy,3 LSB (defined by the PLC program or XBT terminal) is equal to the immediate value defined in the instruction.

Example : JEX N= 10 VAL= 20 : Conditional jump to step 10 if OWxy,3 LSB equals 20

Jump if Position 1 > Position 2 : Instruction code JHP

JHP	N= Program step number X1= Position 1 X2= Position 2

Operands :

X1 :
- PRF index ref. position
- WNi internal position
- CP current position

X2 :
- WNi internal position
- CP current position
- EXT external position

Example : JHP N= 5 X1= WN6 X2= CP : Jump to step 5 if position WN6 > current position.

Move Organization Instructions

Jump if Position 1 > Immediate Position : Instruction code JHI

JHI	N= Program step number X1= Position 1 X2= Position 2

Operands :

X1 :
- PRF index value
- WNi internal position
- CP current position

X2 :
- WNi internal position

Example : JHI N= 5 X1= CP X2= 100cm : Jump to step 5 if current position > 100 cm.

Call subroutine : Instruction code CALL

CALL N= Program step number

Only one subroutine level is allowed.

Example : CALL N= 30 : Call the subroutine located at step 30

Return from subroutine : Instruction code RET

Timer : Instruction code TIME

TIME VAL= Value

Operand : Value= Timer value in tens of ms.

Example : TIME VAL= 500 x 10ms : 5 second timer

Await event : Instruction code WAIT

Program execution remains at this instruction as long as the programmed event is not detected by the module.

WAIT EVENT = Event

Event :
- UI3 rising edge on input In3,
- DI3 falling edge on input In3,
- CPU rising edge on CPU sync. bit OWxy,1,9.

Example : WAIT EVENT= UI3 : await rising edge on input In3.

Inactive instruction : Instruction code **NOP** (equivalent to a 10 ms delay).

End of AXM program : Instruction code **END**

Terminates program execution and sets bit IWxy,1,9 to 1 and bit IWxy,1,5 to 0. Program execution cannot resume without a new Start order.

Move Organization Instructions

Activate CPU sync., discrete outputs and interrupts : Instruction code M

This instruction has three purposes :

- Enable synchronization check (refer to Sub-section 6.2),
- Enable or disable relay outputs R1 to R3,
- Enable an interrupt to the CPU (refer to Sub-section 6.3).

M	SYN : Synchronization condition	OUT : Relay output status	IT : Interrupt

Operands :

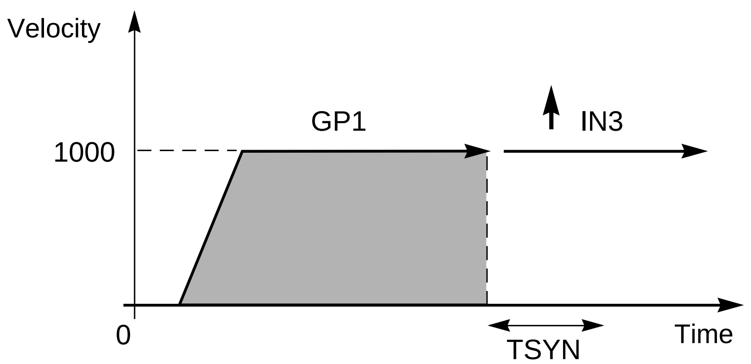
Synchronization condition :
- UI3 : Rising edge on input In3,
- DI3 : Falling edge on input In3,
- UC : Rising edge on the CPU resume bit OWxy,1,9,
- N : Disable synchronization check.

Output relay :
- Set of three 0s or 1s, 0 = Disable relay, 1 = Enable relay

XXX (with X = 0 or 1)
- State of relay R1
- State of relay R2
- State of relay R3

Interrupt :
- Y : Enable interrupt
- N : Disable interrupt

Example : 1 GP1 F= 1000 mm/mn X= 300 cm
2 M SYN= UI3 OUT= 001 IT= Y



When the module reaches the 300 cm position, step 2 is executed :
- The synchronization check is enabled,
- Relay R1 is enabled, relays R2 and R3 are disabled,
- An interrupt is sent to the PLC processor.

The module executes step 3 while waiting for a rising edge on input In3. If this rising edge does not occur within the TSYN time-out defined in the configuration, a synchronization error is caused (see Sub-section 6.2).

5.4 Data Control Instructions

Load Position 2 → Position 1 : Instruction code LDP.

Transfer the value of position 2 to position 1.

LDP	X1= Position 1	X2= Position 2

Operands :

Position 1 =
- PRF : Parametered indexed position
- WNi : Internal position

Position 2 =
- WNi : Internal position
- CP : Current position
- EXT : External position
- PRF : Parametered indexed position
- Immediate position

Example : LDP X1= WN1 X2= CP : Load the current position in the internal WNi position

Add Position 1 + Position 2 → Position 1: Instruction code ADD

Add positions 1 and 2, transfer the result to position 1.

ADD	X1= Position 1	X2= Position 2

Operands :

Position 1 =
- PRF : Parametered indexed position
- WNi : Internal position

Position 2 =
- WNi : Internal position
- CP : Current position
- EXT : External position
- PRF : Parametered indexed position
- Immediate position

Example : ADD X1= PRF X2= EXT : Add the PRF index to the external position and transfer the result to PRF.

Subtract Position 1 - Position 2 → Position 1: Instruction code SUB

Subtract positions 1 and 2, transfer the result to position 1.

SUB	X1= Position 1	X2= Position 2

Operands :

Position 1 =
- PRF : Parametered indexed position
- WNi : Internal position

Position 2 =
- WNi : Internal position
- CP : Current position
- EXT : External position
- PRF : Parametered indexed position
- Immediate position

Example : SUB X1= PRF X2= WN6 : Subtract internal position WN6 from the PRF index and transfer the result to PRF.

Data Control Instructions

Load the Immediate Value → CNi : Instruction code LDC

LDC	CNi=	Internal counter	VAL= Immediate value

Operand : Internal counter : CNi where i= 0, 1, 2 or 3
Immediate value : 0 to 255

Increment CNi : Instruction code INC

INC	CNi=	Internal counter

Operand: Internal counter : CNi where i= 0, 1, 2 or 3

Decrement CNi : Instruction code DEC

DEC	CNi=	Internal counter

Operand: Internal counter : CNi where i= 0, 1, 2 or 3

Parameter Modification : Instruction code MOD

Modify the values of type C parameters (refer to Sub-section 2.1) defined in the configuration parameter table.

MOD	PARAM= Parameter	VAL= Immediate value

Operands : Parameter=
- ACCE acceleration
- DECE deceleration
- DMAX maximum deviation
- VSTOP “stopped” velocity
- TSTOP stop time-out
- TW target window
- TSYN synchronization time-out
- NDMAX nbr of divert step on DMAX error
- NSTOP nbr of divert step on STOP error
- NTW nbr of divert step on TW error
- NSYN nbr of divert step on Sync. error
- NCPUF nbr of divert step on CPU fault

Immediate value=
- Parameter value
- Divert step number (0 to 253)

Store PRF on Rising Edge of In3 : Instruction code MPRF

Transfer the current position to the parametered indexed position when a rising edge is detected on input In3.

MPRF

Note : The instruction enables the position corresponding to an event to be saved (rising edge on input In2).
This instruction differs in that it is executed not when it is encountered in the program but when a rising edge on In3 is detected (see example 3 on page 5/14).
Its only effect is on the first rising edge which occurs. It is repeated only if the operation is repeated several times.

5.5 Check Instructions

Reminder

The checks are enabled by default. They can be disabled and enabled by the following instructions.

Disable a Check: Instruction code RCTL

```
RCTL  NAME = Name of check
```

Operand: Name of check =
- DMAX = Deviation check
- STOP = Stop check
- TW = Target window check
- SYN = Synchronization check
- CPUF = PLC processor check

Example: RCTL NAME = TW: Disable target window check.

Enable a Check: Instruction code SCTL

```
SCTL  NAME = Name of check
```

Operand: Name of check =
- DMAX = Deviation check
- STOP = Stop check
- TW = Target window check
- SYN = Synchronization check
- CPUF = PLC processor check

Example: SCTL NAME = TW: Enable target window check.

Note: When a fault condition appears and the fault is processed by diverting the AXM program (divert mask = N), the corresponding check is then automatically disabled. The SCTL instruction can then be used when required to re-enable the check. The emergency stop check cannot be disabled. After an End instruction, the Start command reactivates the checks that were previously disabled.

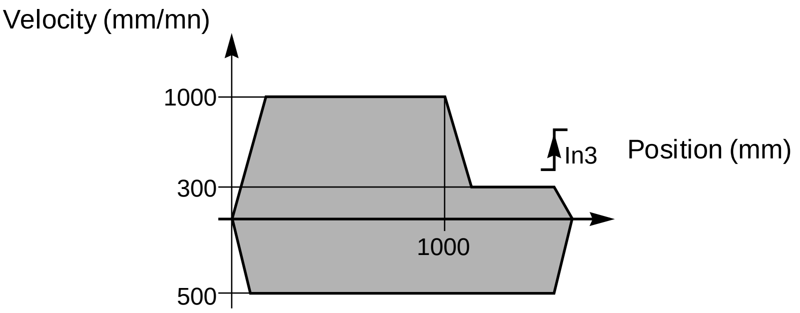
TRAP Instruction

This instruction is not user programmable. It only appears during operation and indicates one of the following conditions:
- A serious operating failure,
- A conflict between the declared program length and its actual length,
- Incomplete program entry (no END instruction entered at the end of the program).
- AXM program "side-tracked" towards a step which has not been programmed

When this instruction is encountered, AXM program execution and moving part motion is immediately interrupted.
If this type of failure occurs, check the AXM program. In particular check that the END instruction is in place, then restart AXM program execution from the start step.

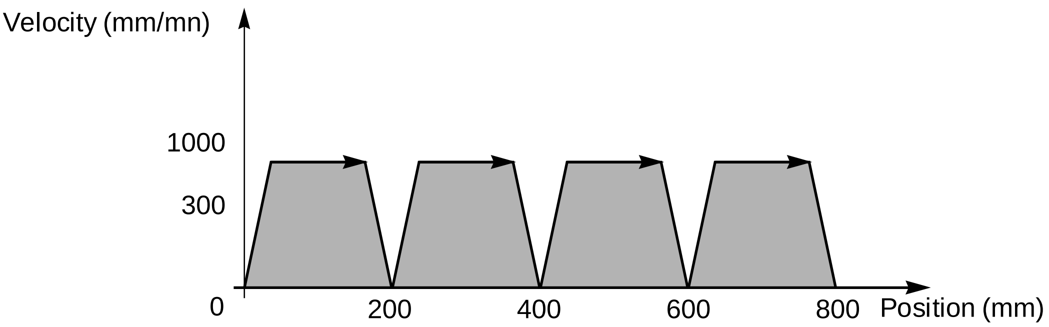
5.6 Examples

Example 1



0	GP1	F =	1000	mm/mn	X= 1000 mm
1	G+9	F =	300	mm/mn	EVENT= UI3
2	GP9	F =	500	mm/mn	X= 0 mm
3	END				

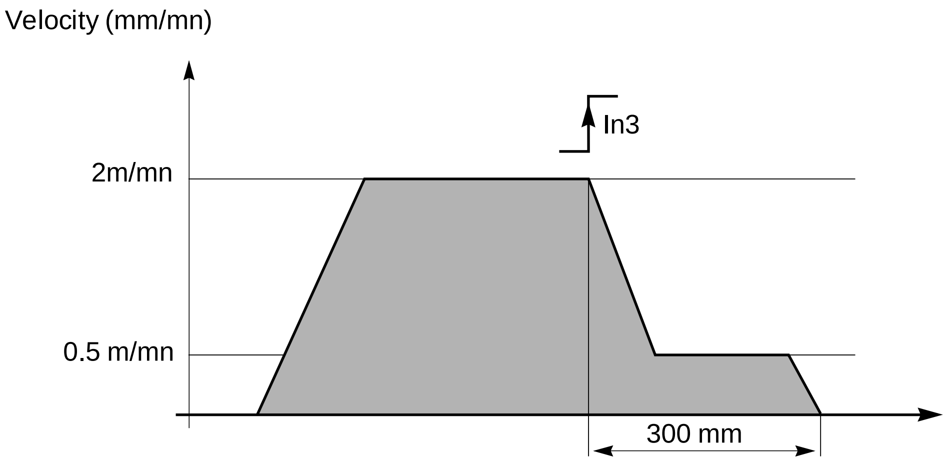
Example 2



0	LDP	X1= WN0	X2 = 200 mm
1	LDC	CN0	VAL= 4
2	GP9	F = 500 mm/mn	X = WN0
3	ADD	X1= WN0	X2 = 200 mm
4	DEC	CN0	
5	JNZ	N = 2	CN0
6	END		

Examples

Example 3 Synchronizing motion on event with relative motion.



1st. solution

1	G+1	F=2000 mm/mn	EVENT=U13
2	LDP	X1=PRF	X2=CP
3	GP9	F=500 mm/mn	X=I+300 mm

Effect of this sequence: Move in + direction at a velocity of 2m/mn until detection of a rising edge on In3, then move 300 mm at 500 mm/mn. once the event occurs. The current position is stored in the PRF register 10 ms after the event.

2nd. solution

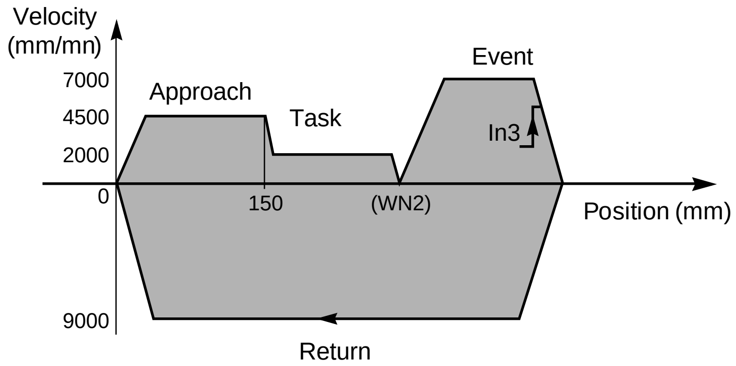
1	MPRF		
2	G+1	F=2000 mm/mn	EVENT=U13
3	GP9	F=500 mm/mn	X=I+300 mm

This sequence provides better performance as the current position is stored in the PRF register in real-time by using the MPRF instruction.

Examples

Example 4

Current cycle (steps 1 to 7)

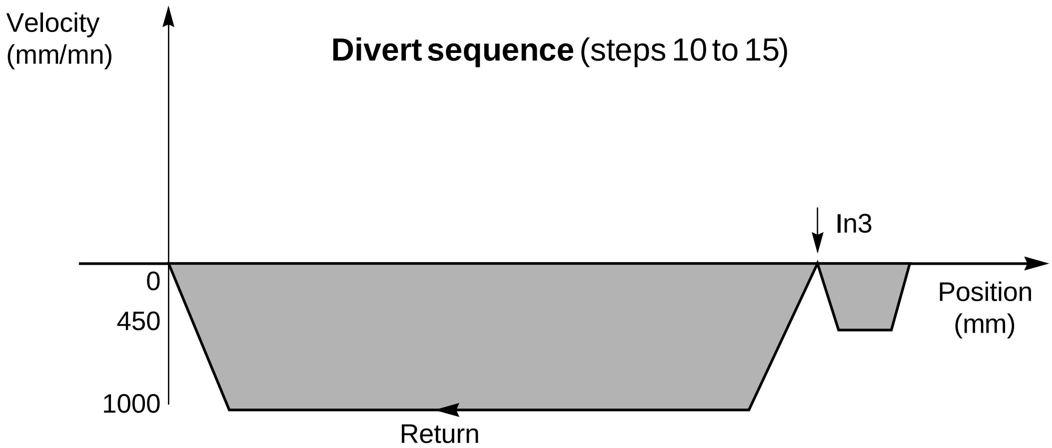


Preliminary operations:

- Teach position WN2
- Synchronization parameters: MSYN = N, NSYN = 10, TSYN = 1000ms

```
0   SRP-  F  =    900  mm/mn   X = 0   mm
1   GP1   F  =   4500  mm/mn   X = 150 mm
2   GP9   F  =   2000  mm/mn   X = WN2
3   TIME  VAL =  500 * 10ms
4   G+9   F  =   7000  mm/mn   EVENT = UI3
5   M     SYN = DI3            OUT = 111    IT = N
6   GP9   F  =   9000  mm/mn   X = 0   mm
7   JMP   N  = 1
8   NOP
9   NOP
10  STOP
11  G-9   F  =    450  mm/mn   EVENT= DI3
12  TIME  VAL =  500 * 10ms
13  GP9   F  =   1000  mm/mn   X = 0   mm
14  SCTL  NAME = SYN
15  END
```

The program comprises two parts. Steps 1 to 7 correspond to the normal sequence described by the motion diagram above. Steps 10 to 15 correspond to a divert sequence used in the event of a synchronization error. The divert step NSYN: 10 must be declared in the configuration (see diagram below).

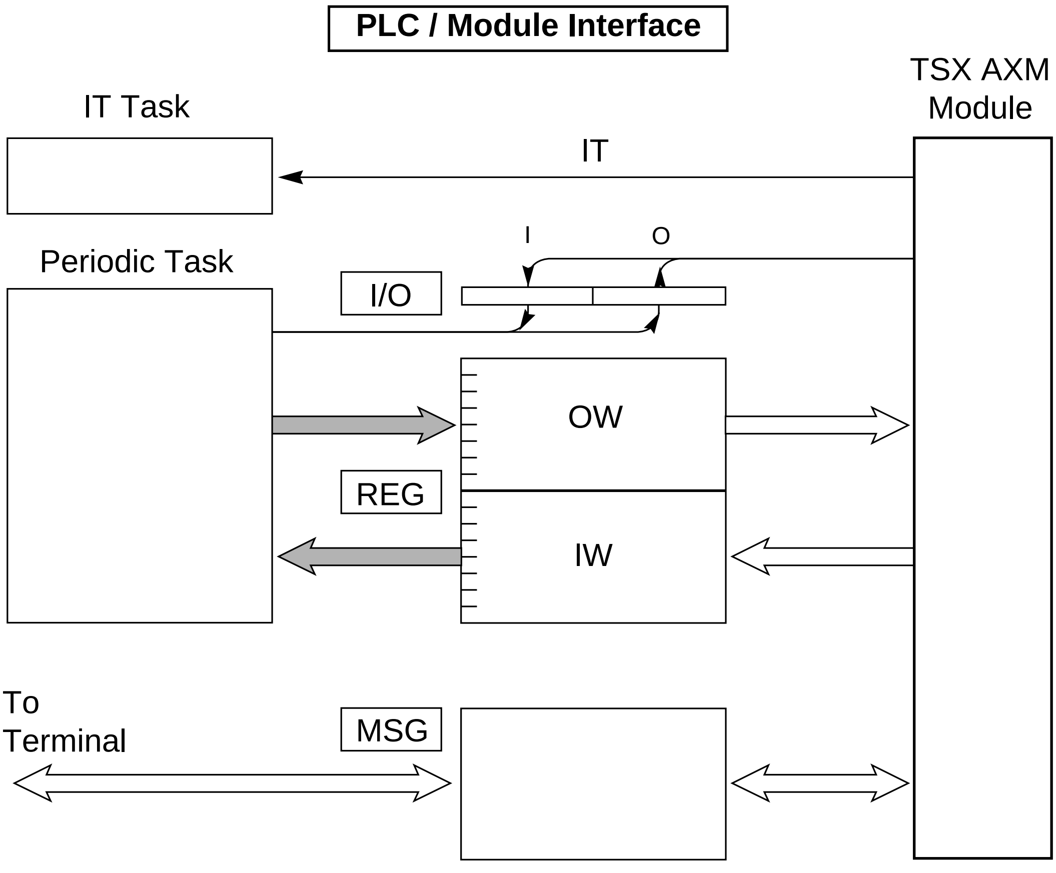


6.1 General

Reminders

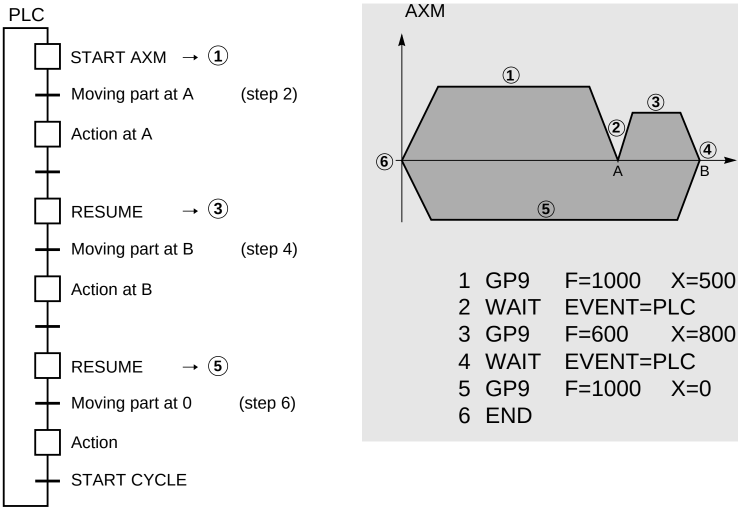
The module exchanges commands and data with the PLC processor via the PLC bus and the standard communication interfaces :

- **Discrete I/O interface** : Exchanges discrete I/O bits on each cycle of the task in which the module is configured,
- **Register interface** : Exchanges register words on each cycle of the task in which the module is configured,
- **Message interface** : Exchanges messages on request from the PLC program. With TSX AXM modules, this mode is not used by the PLC program, it is only used for dialog between TSX XBT terminals, FTX 507 workstations and TSX AXM modules,
- **Interrupt** : Lets the module activate the PLC program interrupt task.



The commands and the data provided on the Discrete I/O and Register interfaces let the user place the axis control function in the general PLC sequential control program (PLC program). This is illustrated by the diagram overleaf.

General



If the TSX XBT terminal remains operational during the operating phase (Fig.1A) available to the operator, the PL7-3 programming required to insert the axis control function will be reduced to the strict minimum. The terminal will be tasked with controlling the operating modes, errors and application transfers, etc.

Sub-section 6.2 is dedicated to this type of application. However, if the TSX XBT terminal does not remain in service once the Debug phase is complete, it is up to the application program to control module operation (Fig. 1.B).

Fig. 1.A

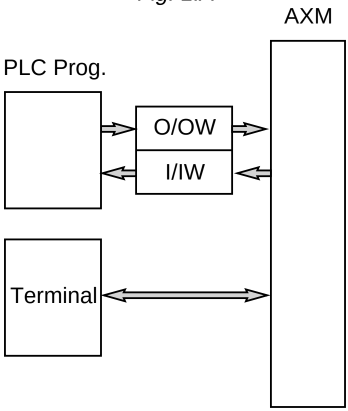
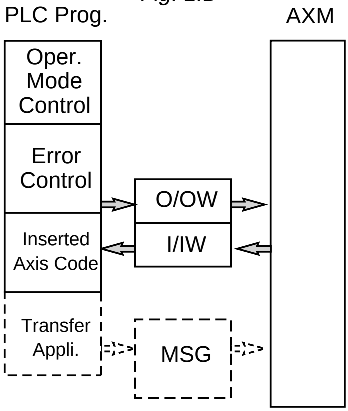


Fig. 1.B



This means that more programming will be required, using all of the resources provided by the Discrete I/O and Register interfaces described in Sub-section 6.4. Programming is simplified by the use of OFBs (described in Divider C3). Sub-section 6.3 describes this type of application.

Functions not available on TSX AXM 162 module

6.2 Integrating Axis Control into the Sequential Program

List of bits and words described in this section

Read by the PLC	Read by the AXM module
• AXM program step currently executed • Current position	• PLC event • Comparison value • CNi value • Start/Stop/Resume PLC program command • AXM program divert command • Emergency stop command • External position • Velocity modulation factor

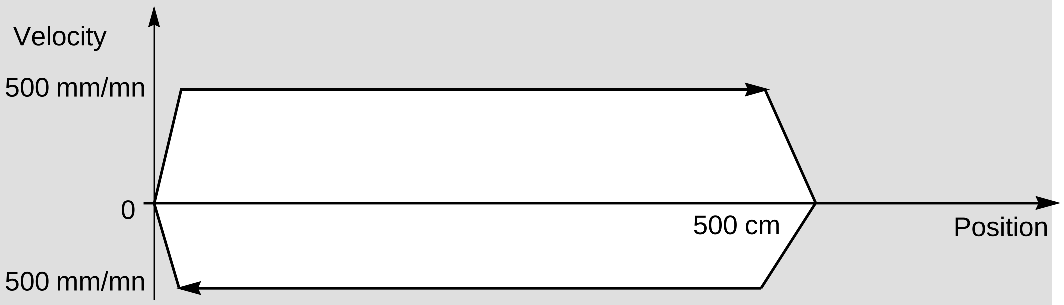
Current step number IWxy,2 MSB (AXM→PLC)

Using this byte, the PLC program can follow the evolution of the AXM program. Its use is illustrated in the example below.

Await PLC event OWxy,1,9 (PLC→AXM)

The WAIT EVENT= PLC instruction inhibits AXM program execution until bit OWxy,1,9 is set to 1 (rising edge) by the PLC program.

Example :



A moving part moves to a set point at 500 cm and stops there. Once the set point has been reached, the PLC program requests the loading of a pallet onto the moving part. Once this is done, the moving part returns to the start position.
The motion of the moving part is controlled by the module, while pallet loading is controlled by the PLC program.

AXM Program

```
5  GP9 F= 5000 mm/mn  X= 500 cm
6  WAIT EVENT= CPU
7  GP9 F=  500 mm/mn  X=   0 cm
8  JMP N=  5
```

PLC Program

```
IF [IW4,2 AND H’FF00' = H’0600']
        THEN SET O2,0
IF I3,0 THEN SET OW4,1,9
IF [IW4,2 AND H’FF00' = H’0700']
        THEN RESET O2,0;
              RESET OW4,1,9
```

Functions not available on TSX AXM 162 module

Integrating Axis Control into the Sequential Program

Synchronization check (PLC→AXM)

The instruction M SYN= CPU OUT =xxx IT=x starts a check by the PLC processor, on bit OWxy,1,9 changing from 0 to 1 (rising edge). If this bit has not been set to 1 before the TSYN time-out, a module synchronization error occurs or a divert sequence is executed.

Example

By adding the synchronization instruction M to the previous example, the module will also check pallet loading. If the pallet has not been loaded before the TSYN time-out defined in the configuration is reached, the AXM program is diverted to step 20 (defined in the NSYN configuration): return to the start position at high velocity.

```
5   GP9 F= 5000 mm/mn     X= 500 cm
6   M   SYN= CPU          OUT= 000      IT= N
7   WAIT                  EVENT= CPU
8   GP9 F=  500 mm/mn     X=   0 cm
9   JMP N= 5
..............................................
20  GP9 F= 5000 mm/mn     X=   0 cm
21  END
```

Comparison value OWxy,3 LSB (PLC→AXM)

The comparison register word is used to check the execution of the AXM program loops by the PLC program (JEX instruction).

Example

In the example above, a position sensor detects the last pallet. The unconditional jump JMP can be replaced by a conditional jump JEX. The jump is stopped when the last pallet is sensed (I3,1).

AXM Program

```
5   GP9 F= 5000 mm/mn     X= 500 cm
.................................
9   JEX N= 5    VAL= 1
10  GP9 F= 5000 mm/mn     X=   0 cm
11  END
.................................
```

PLC Program

```
............................
............................
IF I3,1 THEN 0 -> OW4,3
ELSE 1 -> OW4,3


............................
```

Loading the internal counters CNi by PLC program

OWxy,4 MSB : CNi counter number,
OWxy,4 LSB : CNi counter value,
OWxy,1,4 CNi counter preset command.
Word OWxy,4 and bit OWxy,1,4 are used to set the value of the CNi internal counters.
When used with the JNZ conditional jump instruction and CNi increment and decrement instructions, they can be used to control the number of executions of an instruction sequence from the PLC program.

Functions not available on TSX AXM 162 module

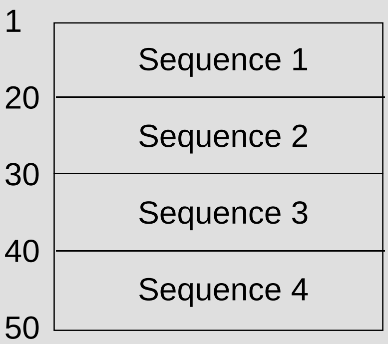
Integrating Axis Control into the Sequential Program

AXM Program Start/Stop/Resume (PLC→AXM)

AXM program execution can be started, stopped or resumed by the PLC program.
A rising edge on bit Oxy,4 starts the AXM program from the start step given in register word OWxy,3 (MSB).
A rising edge on bit Oxy,5 stops AXM program execution.
A rising edge on bit Oxy,6 resumes program execution from the current program step.

Example of use :
An AXM program is split into “sequences” and each sequence can be called by the PLC program depending on the application to be processed.

AXM Program



PLC Program

```
.................
<START SEQUENCE 2
IF I0,2 THEN  H'1400'—>OW4,3;
       SET  O4,4
IF IW4,1,5 THEN RESET O4,4
```

Divert AXM program request (PLC→AXM)

A rising edge on OWxy,1,8 triggers the divert command to the program step number specified in OWxy,3 (MSB).

Emergency stop request (PLC→AXM)

When bit Oxy,7 changes to 0, an emergency stop is triggered. (Stopping the moving part, stopping AXM program execution and sending an error indication).

Current position (AXM→PLC)

IWxy,6 and 7 store the moving part position expressed in module units (see overleaf).

Note : Value sampled by the module every 10ms, but the register word refresh cycle depends on the cycle of the task in which the module is configured.

External position (PLC→AXM)

The OWxy,6 (LSB) and OWxy,7 (MSB) registers enable the transfer of a value from the PLC to the AXM module. This value is then used for instructions that required the moving part to move to an "external point".

Functions not available on TSX AXM 162 module

Integrating Axis Control into the Sequential Program

Example of use

AXM Program

```
12 WAIT EVENT=PLC
13 GP9  F=2000mm/mn X=EXT
```

PLC Program

```
! IF [IWxy,2 AND H'FF00' = H'0C00']
     THEN CW150->OWxy,6 ; CW151->OWxy,7;
     SET OWxy,1,9
```

B

The value is expressed in the module length value. This depends on the range in which the VMAX parameter set in the configuration is defined.

	TSX AXM 172			TSX AXM 182		
VMAX (m/mn)	<34.56	<345.6	≥345.6	<54	<540	≥540
Unit	µm	10 µm	100 µm	µm	10 µm	100 µm

Attention

In general this unit is different from the unit selected for display.

Velocity modulation factor

This factor lets the user change the programmed velocity value by a factor of 0 to 2. It is initialized at 1 by the system and its value can be changed via the OWxy,5 register.

For more information, refer to sub-section 6.5 (Description of Discrete I/O and Register Interfaces).

Functions not available on TSX AXM 162 module

6.3 Using the Interrupts (TSX AXM 172 / 182)

This Sub-section does not apply to the TSX AXM 162

Purpose

Interrupt processing allows action at PLC program level to take effect without waiting for the start or the end of the I/O refresh cycle. This ensures fast PLC processor programmed "reaction" time to a module event.

Activation

The AXM program instruction : M SYN= ... OUT= ... IT= Y activates the PLC program interrupt task.
Execution of the PLC program interrupt task programmed by the user is activated as soon as instruction M is accepted by the module when execution is not masked.

Interrupt masking

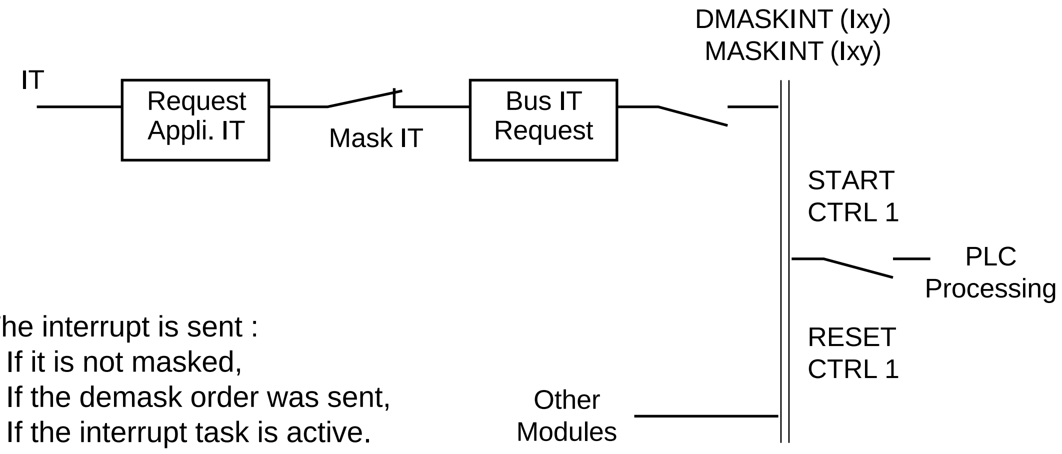
At module level :
- Interrupt masking bit OWxy,0,0 (1 = masking)

At PLC program level (refer to the PL7-3 Programming Manuals) :

- START CTRL 1 Validates the interrupt task,
- MASKINT (Ixy) Masks interrupts,
- DMASKINT (Ixy) Demasks interrupts.

Note : If an interrupt occurs while it is masked, the interrupt request will be maintained until it is acknowledged by the PLC processor (ACKINT(Ixy) instruction). The "interrupt request" bit IWxy,0,0 remains at 1 until the interrupt is acknowledged.

Summary diagram



The interrupt is sent :
- If it is not masked,
- If the demask order was sent,
- If the interrupt task is active.

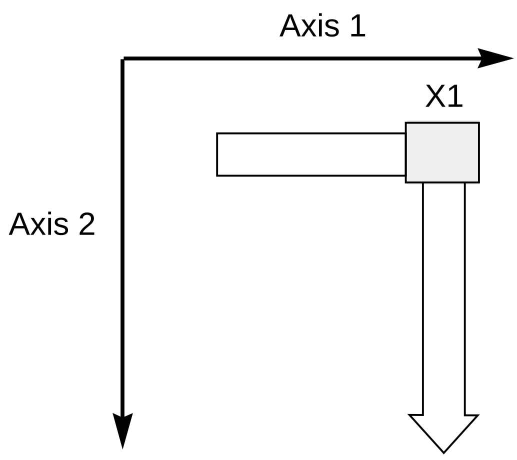
I/O access using the interrupt task

The I/O tables are updated on each cycle of the tasks where it is configured. In order to operate in real time, exchanges with the module using the interrupt task must use explicit exchange instructions.

Using the Interrupts (TSX AXM 172 /182)

Example

Synchronization of two axes.
The end of moving part motion on axis 1 triggers the moving part motion command on axis 2.
Axis 1 AXM in slot 2, rack 0,
Axis 2 AXM in slot 4, rack 0.



AXM Program Axis 1

```
..............................
50  GP9 F= 5000 mm/mn X= 500 cm
11  M SYN =N  OUT =000  IT =Y
..............................
AXM Program Axis 2
..............................
20  WAIT EVENT= CPU
21  GP9 F = 1000 mm/mn X= 600 cm
..............................
PLC Program master task

<Validate interrupt task
! L5  :IF SY0 THEN START CTRL1;
       DMASKINT(I2)
<Reset sync.
RESET OWy,1,9
```

PLC Program Interrupt task

```
<Read IT module axis 1
! L1     :READINT(I2,B0)
!  IF B0 THEN JUMP L10
.......................

<Interrupt processing
!  L10   :ACKINT(I2);RESET B0
!  SET OW4,1,9
<Save register words
   !     OW4,0->W10; OW4,1->W11;
OW4,2->W12; OW4,3->W13;
   OW4,4->W14; OW4,5->W15;
   OW4,6->W16; OW4,7->W17
<Immediate writing of registers !
!  WRITEREG(W10;I4)
   <End of processing
   ! EOP
```

Using the Interrupts (TSX AXM 172 /182)

Performance

The time taken to activate the interrupt task in the PLC is the sum of two times (tic + tip).

- tic : Time between the change of state of the interrupt input enable instruction (M) and the presence of the IT signal on the I/O bus. The tic value is less than 10 ms for TSX AXM modules.
- tip : Time between the presence of the IT signal on the I/O bus and the activation of the Interrupt task. This time depends on the type of PLC and whether fiber-optic connected remote I/O are used. It is not affected by the location of the module (basic rack or extension rack).

PLC	Local I/O (TSX LES)	Remote I/O (TSX LFS)
TSX 47-40	1.3 ms	-
TSX 67-40	1.3 ms	2.0 ms
TSX 87-40	0.8 ms	1.5 ms
TSX 107-40	0.5 ms	1.0 ms

6.4 Full Module Control from the PLC Processor

This Sub-section only applies to applications where the TSX XBT terminal does not remain in service during the operation phase. In this case, in addition to inserting the axis control function into the general sequential AXM program, the PLC must also :

- Control module and axis operating modes,
- Control process errors,
- Load applications when multiple applications are used.

6.4-1 Operating Mode Control

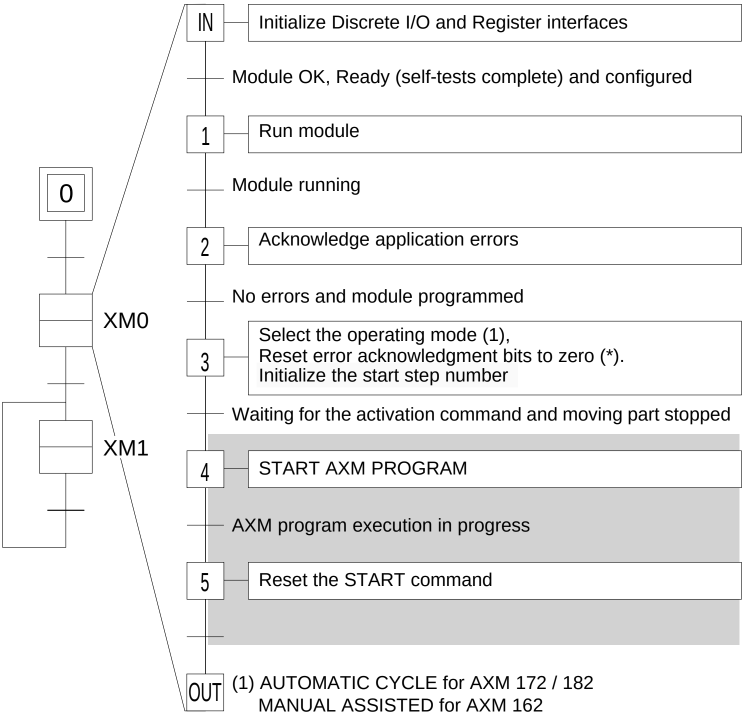
In almost all applications, the TSX AXM 172 / 182 modules are used in the Automatic Cycle Mode. The other modes available are only used in the Debug phase.
Operating mode control included selecting the Automatic Cycle Mode and starting AXM program execution on command from the PLC program.

For a TSX AXM 162 module, the ASSISTED MANUAL mode is used. Everything mentioned in this Sub-section applies to this module. The difference is in the method of programming movements (see Sub-section 6.6).

Functions not available on TSX AXM 162 module

Full Module Control from the PLC Processor

The Grafcet sequence below is a typical sequence that the user can write to execute the AXM module program in automatic cycle mode (once the module has been configured and programmed using PL7-AXE). This program sequence is run on cold restart or after initialization (INIT) from an FTX 507 workstation. If the sequence must be run on hot restart or in other conditions, it is up to the user to program this, in particular by using the pre-positioning features supported by PL7-3.



Note: This sequence assumes that:

- Reference set-up has already been performed, or
- That the first instruction of the AXM program is a reference set-up instruction SRP+ or SRP-. This condition means that only type 3 (cam at end of travel) reference set-up can be selected.

(*) Demask IT and activate the IT task if the interrupt function is used.

XM0: Initialization macro-step,
XM1: Operation macro-step (not described here).

Functions not available on TSX AXM 162 module

Full Module Control from the PLC Processor

B

```
TRANSITION : 1  from 0  to  1
==============================
IW4,0,3.NOT IW4,0,8.NOT IW4,0,4.NOT IW4,0,B

TRANSITION : 2  from 1  to  2
==============================
IW4,0,C

TRANSITION : 3  from 2  to  3
==============================
[IW4,2 AND H'FF'=0].NOT IW4,1,F.NOT IW4,1,E.IW4,1,B

TRANSITION : 4  from 3  to  4
==============================
IW4,1,8.I4,F.[IW4,1 AND H'F'=10]

TRANSITION : 5  from 4  to  5
==============================
IW4,1,5


STEP 0   ACTION ON ACTIVATION
================================
!       0->OW4,0->OW4,1->OW4,2->OW4,3->OW4,4->OW4,5->OW4,6->OW4,7
!       0->O4,0[8]
!       SET O4,7

STEP 1  ACTION ON ACTIVATION
================================
!       SET OW4,0,C

STEP 2  ACTION ON ACTIVATION
================================
!       H'7AAA'->OW4,2

STEP 3  ACTION ON ACTIVATION
================================
!       10->OW4,1;0->OW4,2;H'xx00'->OW4,3   (1)
!       DMASKINT(I4);START CTRL1         (2)

STEP 4  ACTION ON ACTIVATION
================================
!       SET O4,4                            (3)

STEP 5  ACTION ON ACTIVATION
================================
!       RESET O4,4
```

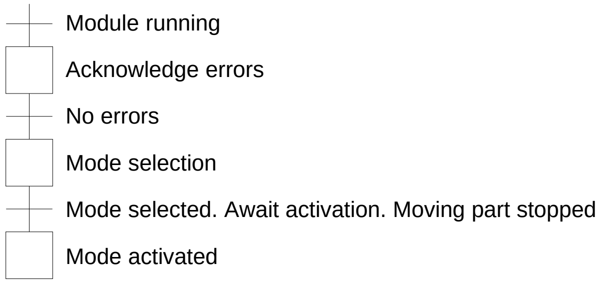
(1) Where xx = Start step of the AXM program expressed in hexadecimal notation,
(2) If ITs are used,
(3) In general, the START command is conditional on an event.
The resulting programming will look like this:
Ixy,i → O4,4 or IF [ ] THEN SET O4,4

Note : In this program, the module is located in slot 4 of the basic configuration rack.

Functions not available on TSX AXM 162 module

Full Module Control from the PLC Processor

If Automatic Mode is not used in the operating phase, or if the reference set-up procedure is initiated by an operator (type 1 and 2 reference set-up procedures where the direction of motion must be specified).
In this case, the previously described program sequence should be modified. The mode selection steps mode are shown below.



Naturally, it is possible to program the control of operating modes in a language other than Grafcet (Ladder or Literal), but it is then up to the user to guarantee the sequencing of operations.

AXM PG OFB
When the TSX AXM module is used in Automatic Cycle Mode, the program sequence described on page 6/11 is better replaced by the AXM PG OFB that performs the same task. The user has simply to specify the start program step and the event that triggers AXM program execution.
For a detailed description of the programming and use of this OFB, refer to Divider C3 of this manual.

6.4-2 Error Processing

It is possible to process stop position, target window, servo, synchronization and processor errors directly at module level by diverting the AXM program to a specified sequence.
However, other errors (soft stops, emergency stop, etc.) always requires PLC processor involvement.
The programming used depends entirely on the type of reaction required on the occurrence of one of these errors.

The example described here is not a programming recipe that covers all cases, but is provided as an illustration only.

Functions not available on TSX AXM 162 module

Full Module Control from the PLC Processor

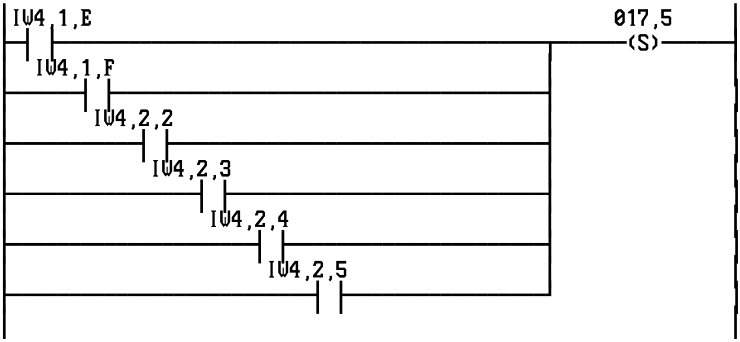
B

Processing description

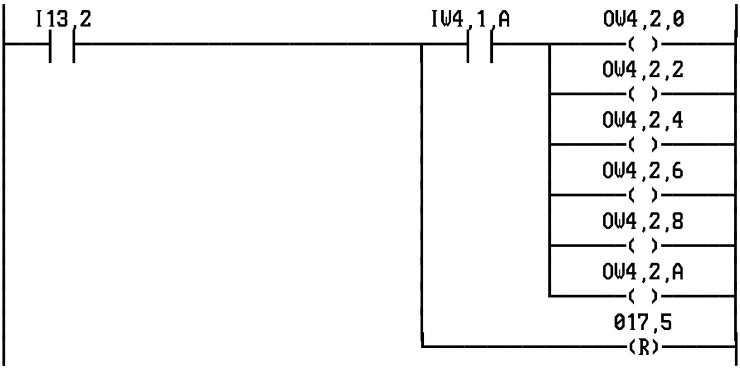
The occurrence of any type 2 error (stop, synchronization, target window, CPUF, servo, emergency stop) sounds a warning buzzer (017,5).
After intervention, the operator acknowledges the error through I13,2, allowing program execution to restart from the point where it was stopped.

Programming for type 2 errors.

SOUND WARNING BUZZER



ACKNOWLEDGE ERROR (AND RESUME AXM PGM EXECUTION)



Reminder: An error can only be acknowledged if it is no longer present. In some cases, this means that the operator must first intervene (emergency stop via In4).

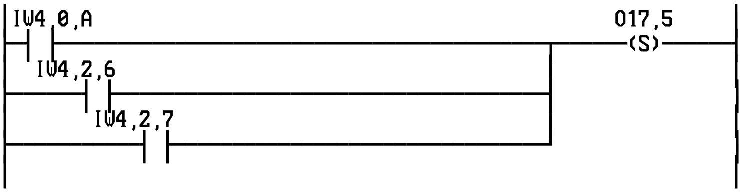
Full Module Control from the PLC Processor

Terminal block, Power failure and capacity overflow errors

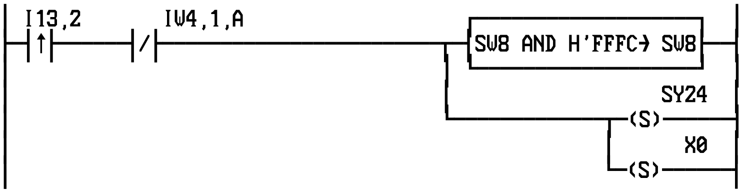
In normal operation, only a Power Failure error should occur. The other two errors are the result of incorrect operator intervention (at the wrong time in the cycle) or of a programming error.

These errors cause the loss of the axis reference and in addition to acknowledgment, require that the axis reference be set-up again. The simplest processing to take into account one of these errors is to restart the initialization sequence. This can be done as shown below:

SOUND WARNING BUZZER



RESTART THE INITIALIZATION SEQUENCE



Note: Errors are acknowledged in the initialization sequence.

Reminder: Step activation bits can only be accessed in the PRL.

Full Module Control from the PLC Processor

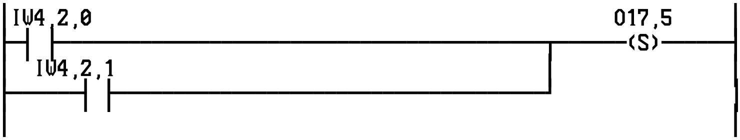
Soft stop error

Again, this error should not occur in normal operation if the Debug phase was correctly performed.

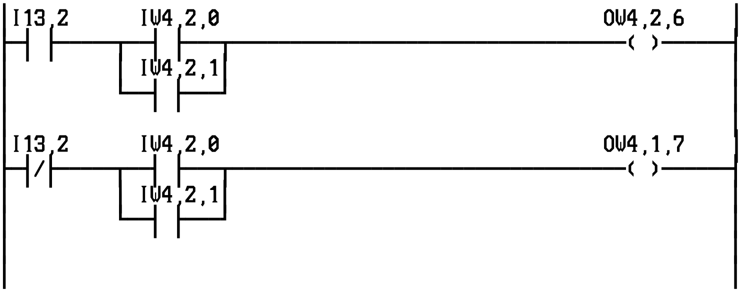
This type of error can be the result of a programming error or a mechanical failure. In these conditions it is not advisable to resume program execution immediately.

In the programming example below, the moving part is first cleared from the illegal area it entered and then the initialization sequence is run.

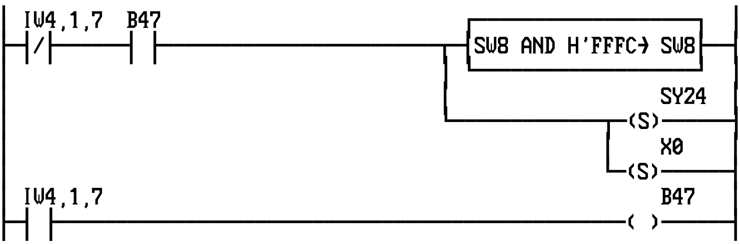
SOUND WARNING BUZZER



RETURN FROM SOFT STOP OVERSHOOT



TRIGGER THE INITIALIZATION SEQUENCE when the DEG.BL bit is reset.



AXM DG OFB

Instead of using the information sent via the register interface, it is possible to obtain this information from the Status word of the AXM DG OFB.

For more information on programming and using this OFB, refer to Divider C3 of this manual.

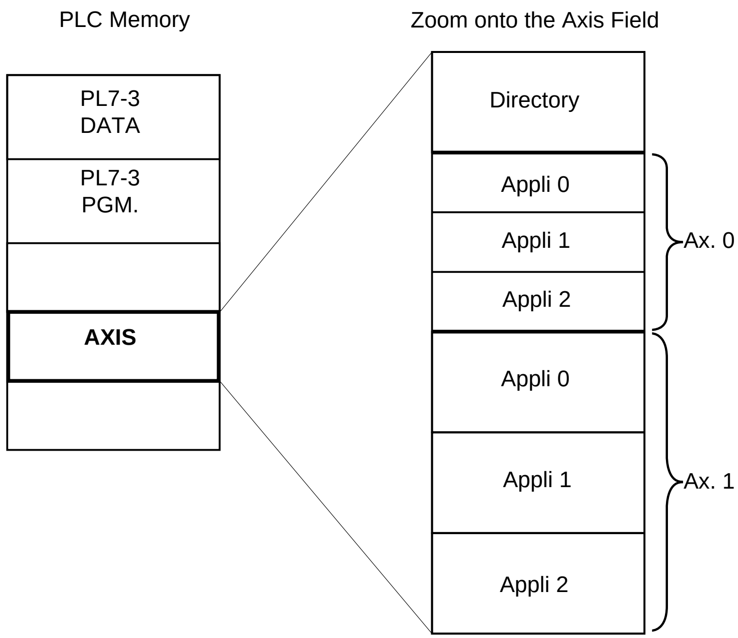
Full Module Control from the PLC Processor

6.4-3 Loading an Application from the PLC Program

Reminder

An application is an indivisible entity comprising three segments:
- Configuration segment,
- AXM program segment,
- Data segment (WNi).

A TSX AXM module can only store a single application. However, it is possible to store up to nine applications per axis in the PLC memory. These applications are stored in the dedicated Axis memory field.



Multiple applications

If the TSX AXM module uses multiple applications (corresponding to different production recipes), it is necessary to ensure that applications are transferred from the PLC memory to the AXM module memory.

The transfer is performed by the AXM LD OFB supplied on the PL7-AXE program diskette.

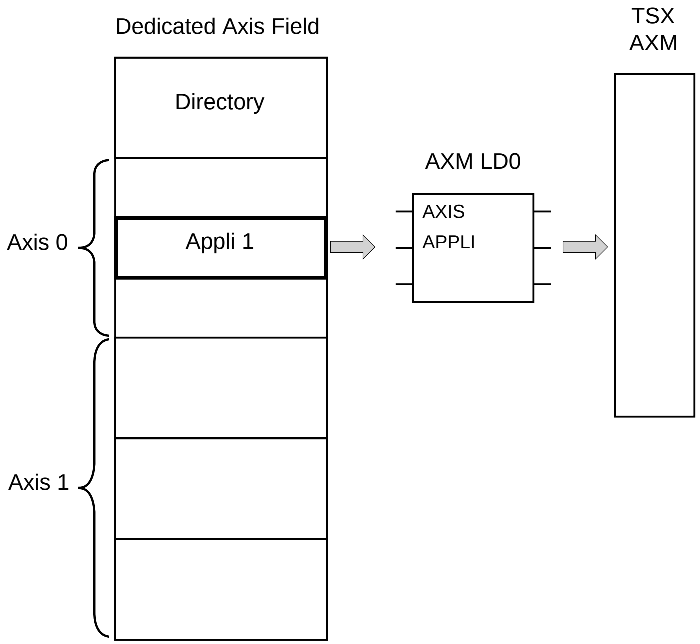
Functions not available on TSX AXM 162 module

B

Full Module Control from the PLC Processor

Naturally the transfer procedure implies that the applications have first been stored in the PLC memory using PL7-AXE.

Once an OFB has been assigned to each TSX AXM module to load an application, the user need only send this OFB the number of the application to transfer and activate the OFB.



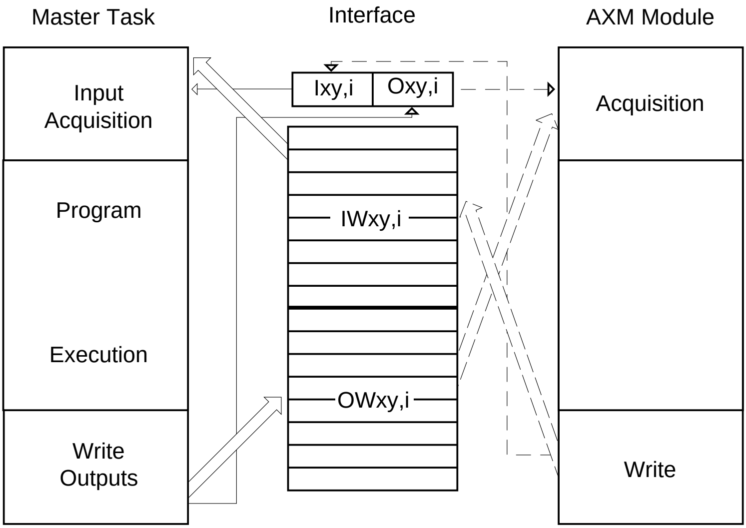
For more information on the AXM LD OFB, refer to Divider C3 in this manual.

6.5 Discrete I/O and Register Interfaces

This sub-section describes the information exchanged between the PLC processor and the TSX AXM module on each PLC cycle.

6.5-1 Reminder

At the start of each cycle, the PLC reads the contents of the discrete input (8 bits, Ixy,i) and the Register input (8 words, IWxy,i) interfaces.
At the end of each cycle, the PLC writes the contents of the discrete output (8 bits, Oxy,i) and the Register output (8 words, OWxy,i) interfaces.



The module uses the command from the PLC processor via the output interfaces (Oxy,i and OWxy,i) and returns boolean and numerical data via the input interfaces (Ixy,i and IWxy,i) using a procedure that is identical but has its own 10 ms cycle.

B

6.5-2 Interface Description

The following data is provided for each command:
- A mnemonic,
- The active state (1,0, rising edge),
- The conditions to meet for the command to take effect,
- The related operation.

The following data is provided for each bit:
- A mnemonic,
- The meaning of states 0 and 1 and, where necessary the cause of transitions (0 → 1 and 1 → 0),
- The conditions to meet so that the data is considered valid.

The following data is provided for each numerical value written by the PLC:
- The type of contents,
- The command to which it is assigned,
- The conditions to meet so that the value sent is accepted by the module.

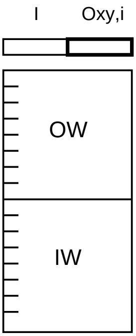
The following data is provided for each numerical value read by the PLC:
- The type of contents,
- The conditions to meet so that the value sent is accepted by the module.

To avoid repetition, the conditions for data validity common to all component elements are condensed at the beginning of each interface description (PLC running, Module running, etc).

6.5-3 Discrete Output Bits

Conditions common to all 8 bits:

- Module running
- PLC running



Oxy,i	
Oxy,0	Not used.
Oxy,1 (R1) 2 (R2) 3 (R3)	Control relays R1, R2, R3, Two active states 1: Relay closed, 0: Relay open, **Conditions** : Manual Mode **Note** : When the operating mode changes from Manual to Auto, the status of the outputs is not modified.
Oxy,4 (START)	**Active**: On rising edge, **Conditions** : Module awaiting activation IWxy,1,8, Moving part stopped Ixy,F. No errors: /IWxy,1,F./IWxy,1,F./IWxy,2,0 to 7. **Effect**: Activates the selected mode (in Automatic Modes, starts the AXM program from the step specified in OWxy,3 MSB).
Oxy,5 (STOP)	**Active**: On rising edge, **Conditions** : A mode currently being executed, **Effect** : Interrupts the selected operating mode.
Oxy,6 (RESUME)	**Active**: On rising edge. **Conditions** : Auto Mode interrupted, or AUTO S/S Mode while awaiting resume IWxy,1,8, **Effect**: AUTO S/S: Resumes from the next step, AUTO B/B or CYCLE: Resumes from the current step.
Oxy,7 (EMG STOP)	**Active**: At 0, **Conditions** : None, **Effect** : Generates an emergency stop error, **Consequences** : Stops the moving part, Interrupts the current mode.

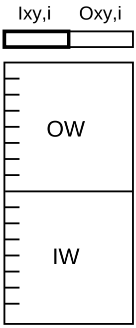
Functions not available on TSX AXM 162 module

Discrete I/O and Register Interfaces

6.5-4 Discrete Input Bits

Conditions common to all bits:

- Module running
- PLC running



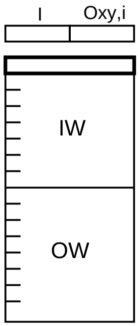
Ixy,i

Ixy,8 (R0) 9 (R1) A (R2) B (R3)	Reflects the state of relay outputs, Two significant states : 1 : relay closed, 0 : relay open. **Validity conditions :** None
Ixy,C	Not used.
Ixy,D (I3)	Reflect the state of input In3. Two significant states : 1 : Voltage present, 0 : Voltage absent. **Use** : Especially used to check that the moving part is on the reference set-up cam.
Ixy,E (RES)	At 1 when the module is reserved. (Reservation can be requested by: PL7-AXE, XBT terminal, PL7-3 application via OFB AXM LD).
Ixy,F (STOP)	Reflects the state of the moving part. Two significant states : 1 : Moving part stopped, 0 : Moving part moving. **NB** : Bit Ixy,F is set to 0 when the moving part is physically stopped for the time required to perform the stop test (TSTOP).

6.5 Discrete I/O and Register Interfaces

6.5-5 Input Register Words

Module status word



IWxy,0

Conditions common to all bits:
- PLC running

IWxy,0,0 (IT)	Reflects the state of the module interrupt Flag. **Condition:** Module running. Interrupt not masked. 0 → 1 When an interrupt is sent by the module, 1 → 0 When the interrupt is acknowledged by the PLC (ACK INT instruction (Ixy)).
IWxy,0,1	Not used (reserved).
IWxy,0,2 (RZM)	1 Indicates that the module MSG field is being reset, (Access to the module from the XBT terminal or from PL7-AXE is impossible). Normally it reflects OWxy,0,2.
IWxy,0,3	Module availability 1: Module ready, 0: Self-test in progress, Module failure. 0 → 1 When self-tests are completed after power-up. 1 → 0 When a type 1 module failure occurs.
IWxy,0,4 (SDEF)	IWxy,0,5 + IWxy,0,6 + IWxy,0,6 (+ means a logic "OR"). Combines errors.
IWxy,0,5	Type 2 error. Not used by these modules.
IWxy,0,6 (SDEF3)	Type 3 error (terminal block, overflow). 0 → 1 When an error occurs, 1 → 0 On error read request (1) on condition that the error is no longer present. **Note**: This bit is not used with the TSX AXM module.
IWxy,0,7	Type 4 error. Not used by these modules.
IWxy,0,8 (AXM HS)	Type 1 error (Module failure). 1: • Type 1 error detected during the self-test phase, or • Module code is different from the code declared in the I/O configuration, • No module. 0: Module OK.

(1) Command supported by PL7-AXE. (READBDEF)

Functions not available on TSX AXM 162 module

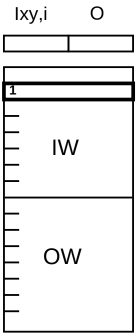
Discrete I/O and Register Interfaces

B

IWxy,0,9 (A TEST)	At 1 on power-up, changes to 0 when self-tests are complete. **Hint** : Do not use this bit to check module availability, test bit IWxy,0,3 instead.
IWxy,0,A (TER BLK)	Reflect terminal block state 1: Open, 0: Locked. **Note** : When IWxy,0,A changes to 1, IWxy,0,6 and IWxy,0,4 also change to 1.
IWxy,0,B (N CONF)	1 : Module not configured, 0 : Module configured. 0 → 1 When the application changes (module not initially configured), 1 → 0 On "DELETE APPLICATION" performed from PL7-AXE.
IWxy,0,C (AXM RUN)	1 : Module running. All functions are supported. 0 : Module stopped. Only the position monitoring function is supported. Normally reflects OWxy,0,C if the module is configured. Forced to 0 when the terminal block is opened.
IWxy,0,D	Not used (reserved)
IWxy,0,E (H SEC)	1 : Module operating with Safety Off (1), 0 : Module operating with Safety On. Normally reflects OWxy,0,E. **Condition**: Module running (1) On PLC failure or stoppage, module continues to operate.
IWxy,0,F (OUT DIS)	1 : Inhibited outputs (2), 0 : Active outputs (2), Normally reflects OWxy,0,F. (2) Only the R1, R2, R3 relay outputs are affected.

Discrete I/O and Register Interfaces

AXIS STATUS WORD (Nbr. 1)



IWxy,1

Conditions common to all bits

- PLC running
- Module running

IWxy,1,0 to IWxy,1,3 (MODE)	Nibble that defines the active operating mode 0000 None — 1000 Auto Step Mode 0001 Manual Ref. Set-up — 1001 Auto Block Mode 0010 Manual Drive — 1010 Auto Cycle Mode 0100 Assisted Manual — No other combinations 0111 No Servo Control Normally reflects the corresponding nibble of OWxy,1. It is set to 0000 if a soft stop error occurs or if the mode selected with the OWxy,1 nibble does not correspond to an authorized mode.
IWxy,1,4 (DIRECT)	Direction of travel or if moving part stopped, direction of the last motion. 1: Negative direction (reverse), 0: Positive direction (forward).
IWxy,1,5 (PROG RUN)	At 1: During AXM program execution. Information is valid if Auto Mode is selected. 0 → 1 When Start command is received, 1 → 0 When Stop command is received, When the End instruction is encountered. At 0 if a non Auto Mode is selected.
IWxy,1,6 (SET REF)	At 1 during Ref. Set-up. 0 → 1 When Start cmd. received in Man. Ref. Set-up Mode, or when the SRP instruction is executed in Auto Mode. 1 → 0 When Ref. set-up is complete. When a Stop command is received during Ref. Set-up.
IWxy,1,7 (DEG BL)	At 1 during return from soft stop overrun is in. **Condition**: Soft stop error present (IWxy,2,0 or IWxy,2,1). 0 → 1 When a soft stop error occurs, 1 → 0 When return from soft stop overshoot is complete. When a Stop cmd. received during overshoot return.
IWxy,1,8 (ATTENTE)	At 1 when the selected mode can be activated. 1 → 0 When the mode is activated (by Oxy,4), When the mode becomes inactive (set point reached in Assisted Man. Mode, End instruction in Auto). 0 → 1 On receiving a Stop command, When the mode is changed, When a command is refused.

Functions not available on TSX AXM 162 module

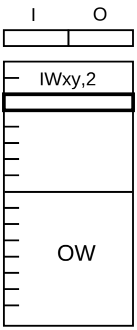
Discrete I/O and Register Interfaces

B

IWxy,1,9 (END PROG)	At 1 at the end of the AXM program (END inst.). **Condition**: Auto Mode selected. 0 → 1 When the END instruction is encountered, 1 → 0 On receiving a Start command (Oxy,4). Remains in the same state if the mode changes.
IWxy,1,A (AXE REF)	At 1 when the axis is referenced (Ref. Set-up performed). 0 → 1 When Ref. Set-up completed or when Ref. Set-up is forced. 1 → 0 When the terminal block is opened, If a Power Fail error occurs, If a capacity overflow occurs.
IWxy,1,B (AXM PROG)	At 1 if the module is programmed. 0 → 1 When an application comprising an AXM program is changed. 1 → 0 When an application without an AXM program is changed. When the Program is deleted, or When the Application is deleted. } From PL7-AXE
IWxy,1,C (I4 ARTURG)	Reflects the state of input In4. 1 Voltage present (no errors), 0 Voltage absent (supply failure). **Note:** When this bit changes to 1 an Emergency Stop error occurs (IWxy,2,3).
IWxy,1,D (RFS CDE)	At 1 when the command cannot be executed 0 → 1 When a non executable command is encountered (refer to the various Command Refusals described in Appendix, Sub-section 9.7). 1 → 0 As soon as a valid command is given. **Note:** In Auto Mode, Command Refusal stops AXM program execution. A Start program is required to start the program again.
IWxy,1,E (DEF SYN)	At 1 if a synchronization error is present, **Conditions:** Synch. error not masked. Auto Mode selected. 0 → 1 When the error occurs (TSYN overrun), 1 → 0 On an acknowledgment command (OWxy,2,4 or OWxy,2,5).
IWxy,1,F (DEF DMAX)	At 1 if a divergence error occurs. **Condition**: Any Mode except Servo Off. 0 → 1 When the error occurs (DMAX exceeded), 1 → 0 On an acknowledgment command (OWxy,2,2 or OWxy,2,3).

Functions not available on TSX AXM 162 module

Discrete I/O and Register Interfaces



Axis status word (Nbr. 2)

IWxy,2

Conditions common to all bits

- PLC running.
- Module running.

IWxy,2,0 (DEF BL-)	At 1 when the moving part has passed the lower soft stop. **Condition** : Axis referenced. 0 → 1 When LSS passed, 1 → 0 Once the moving part is back within the valid interval (position > LSS + 2 x TW) and error acknowledged (OWxy,2,C).
IWxy,2,1 (DEF BL+)	At 1 when the moving part has passed the upper soft stop. **Conditions** : Axis referenced. 0 → 1 When HSS passed, 1 → 0 Once the moving part is back within the valid interval (position < HSS - 2 x TW) and the error acknowledged (OWxy,2,C).
IWxy,2,2 (DEFSTP)	At 1 when a stop error occurs. **Conditions**: All modes except Servo Off, Stop error not masked. 0 → 1 When the error occurs (V>VSTOP after TSTOP), 1 → 0 On acknowledgment (OWxy,2,0 or OWxy,2,1).
IWxy,2,3 (DEFARUR)	At 1 when a emergency stop error occurs. **Conditions**: None. 0 → 1 When the error occurs (supply lost to In4 or Oxy,7 goes to 0), 1 → 0 On acknowledgment (OWxy,2,A or OWxy,2,B), if the error is no longer present (voltage present on In4 and Oxy,7 at 1).
IWxy,2,4 (DEFTW)	At 1 when a target window error occurs. **Conditions**: Assisted Manual and Auto Modes, TW error not masked. 0 → 1 When error occurs (error t > TW, moving part stopped), 1 → 0 On acknowledgment (OWxy,2,6 or OWxy,2,7).
IWxy,2,5 (DEF CPU)	At 1 when a CPU error occurs. **Conditions**: Module in Safety On Mode (OWxy,0,E at 0), CPU error not masked. 0 → 1 When error occurs (CPU stoppage or failure), 1 → 0 On acknowledgment (OWxy,2,8 or OWxy,2,9), if the PLC is running.

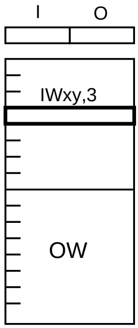
Discrete I/O and Register Interfaces

B

IWxy,2,6 (DEF PWF)	At 1 indicates that the module detected a supply failure. 0 → 1 When a supply error occurs that exceeds the autonomy of the power supply (200 ms). **Note**: A change to 1 loses the axis reference. 1 → 0 On acknowledgment (OWxy,2,E), or on power-up.
IWxy,2,7 (DEF OVF)	At 1 if a calculation capacity overflow occurs. 0 → 1 On overflow (measurement overflow), 1 → 0 On acknowledgment (OWxy,2,D). **Note**: When bit IWxy,2,7 changes to 1, the position is forced to 0. This error results in losing the axis reference.
IWxy,2,8 to IWxy,2,F	Currently executed program step. **Condition**: Auto Mode. (If the current Mode is not Auto: Last step number executed in Auto).

Functions not available on TSX AXM 162 module

Conditions common to words IWxy,3 to 7
- PLC running,
- Module running.



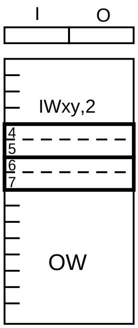
IWxy,3

Least signif. byte: Last program step executed before the AXM program was diverted to a divert sequence (diversion caused by a PLC command via OWxy,1,8 or by a masked error).

Conditions : Auto Mode.
(If the current mode is different: Store the contents).

Most signif. byte: Last program step that generated an interrupt (this can only be a M.SYN= OUT=. . . ST=Y type instruction).

Conditions : Auto Mode selected.
If the mode is different, the contents are stored.



IWxy,4
IWxy,5

Position error is expressed in module physical units (1), format Double length (2).
- LSB in IWxy,4.
- MSB in IWxy,5.

Conditions: No errors.

IWxy,6
IWxy,7

Position expressed in module physical units (1), format: Double length (2).
- LSB in IWxy,6.
- MSB in IWxy,7.

Conditions: Axis referenced.
Note: The position value is valid even if the module is stopped (OWxy,0,C at 0).

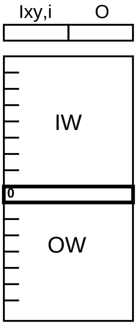
(1) Module physical units.

	AXM 172			AXM 182		
VMAX (m/mn)	< 34.56	< 345.6	≥345.6	<54	<540	≥540
Unit	µm	x10µm	x100µm	µm	x10µm	x100µm

(2) For ease of use of these variables, transfer the LSB and MSB to two consecutive words in the W field and select DW.
E.g.: ! IWxy,6 → W100 ; IWxy,7 → W101
DW 100 the contains the position.

Functions not available on TSX AXM 162 module

6.5-6 Output Register Words



MODULE COMMAND WORD

OWxy,0

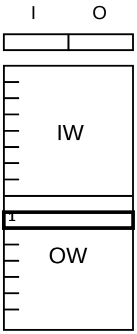
Conditions common to all bits

- PLC running.

OWxy,0,0 (MASK IT)	Mask / Demask the interrupts. **Conditions** : Module running. **Effect**:At 1: Mask the interrupts sent by the module. At 0: Demasking. If the module sends an interrupt while ITs are masked, the last interrupt will be sent to the PLC when ITs are demasked.
OWxy,0,1	Not used (reserved).
OWxy,0,2	Active at 1: Reset message field. **Conditions**: None. **Effect**:Access to the module in MSG mode is ignored. **Consequences**: It is impossible to access the module from the TSX XBT terminal or from PL7-AXE when this bit is at 1.
OWxy,0,3 to OWxy,0,B	Not used (reserved).
OWxy,0,C (AXM R/S)	Module RUN/STOP command. **Conditions** : Module configured, self-tests completed. **Effect**: At 1: Module running, At 0: Module stopped.
OWxy,0,D	Not used (reserved).
OWxy,0,E (AXM HSEC)	Safety Off/Safety On command. **Conditions** : Module running. **Effect**:At 1: Module running with safety off : if the PLC stops or fails, the module runs independently. At 1: Module running with safety off : if the PLC stops or fails, a CPU error is generated (the resulting processing depends on the configuration).
OWxy,0,F (OUT DIS)	Active at 1: Inhibits module outputs. **Conditions :** None. **Effect**:Outputs R1, R2, R3 are forced to 0, (the analog output and output R0 retain their state).

Functions not available on TSX AXM 162 module

Discrete I/O and Register Interfaces



AXIS CONTROL WORD (Nbr. 1)

OWxy,1

Conditions common to all bits
- PLC running,
- Module running.

OWxy,1,0 to OWxy,1,3 (MODE)	Mode selection nibble : 0000 None 0001 MAN. REF. SET-UP 0010 MANUAL DRIVE 0100 ASSISTED MAN 0111 SERVO OFF 1000 AUTO STEP-BY-STEP 1001 AUTO POINT-TO POINT 1010 AUTO CYCLE No other combinations are allowed. **Conditions** : • In Manual, Assisted Manual and Servo Off modes : Axis referenced. • In all modes, the moving part must be stopped.
OWxy,1,4 (PRES CN)	Active on rising edge: Load CNi. **Conditions** : CNi number selected from OWxy,1,4 (Most Significant Byte) ≤ 3 **Effect**:Transfers to the counter CNi selected by the MSB of register OWxy,4 the content of the Least Significant Byte of this same register.
OWxy,1,5 (LDWNi)	Active on rising edge: Load WNi (teach set point procedure). **Conditions** : • Axis referenced. WNi number selected in OWxy,4, (Most Significant Byte) ≤ 99. • Moving part positioned first. **Effect** :Transfers to the module table of set points at the address specified by the MSB of register OWxy,4 the contents of the current position.
OWxy,1,6 (POFOR)	Active on rising edge: Forced Reference Set-up. **Conditions** : • Position in registers OWxy,6/7 in module units must be within the valid interval, (LSS ≤ Start position ≤ HSS), • Moving part stopped: Ixy,F = 1, • Any mode except Servo Off. **Effect**:Transfers the position contained in registers OWxy, 6/7 to the module current position register. The axis is referenced (IWxy,1,A = 1).

Functions not available on TSX AXM 162 module

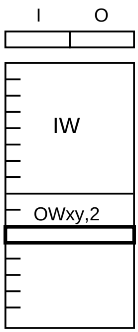
Discrete I/O and Register Interfaces

B

OWxy,1,7 (DEG BL)	Active on rising edge: Return from soft stop. **Conditions** : Soft stop error present, (IWxy,2,0 or IWxy,2,1), but first acknowledged (OWxy,2,C). **Effect**:Returns the moving part to the valid interval, this is: • HSS - 2 x TW if the moving part has reached HSS, • LSS + 2 x TW until the moving part reaches LSS.
OWxy,1,8 (DIVERT)	Active on rising edge: Divert AXM program. **Condition** : Auto Mode selected. The step number specified in register OWxy,3 must correspond to an AXM program step. **Effect**:Diverts the program to the step specified in the Most Significant Byte of register OWxy,3. If an error is present when the divert command is received, the program will only divert once the error has been acknowledged by a Resume command.
OWxy,1,9 (EVENTCPU)	Active on rising edge: Synchronization. **Condition** : Auto Mode. AXM pgm. awaiting WAIT EVENT = CPU instruction, or Instruction M awaiting synchronization. **Effect**:1 Instruction WAIT EVENT = CPU, proceed to the next instruction. 2 Instruction M SYN = CPU, Freeze TSYN time-out.
OWxy,1,A (SENS)	Direction of motion. **Condition** : Manual or Manual Set-up Modes. **Effect**:With the Start command (Oxy,4) it determines the direction of the moving part. 1 : Negative direction (reverse), 0 : Positive direction (forward). **Note**: This bit is not updated by the TSX XBT terminal when it requests motion via the X+ or X- keys.
OWxy,1,E to OWxy,1,F	Not used (reserved).

Functions not available on TSX AXM 162 module

Discrete I/O and Register Interfaces



AXIS STATUS WORD (NBR. 2)

OWxy,2

Conditions common to all bits
- PLC running,
- Module running.

OWxy,2,0 OWxy,2,2 OWxy,2,4 OWxy,2,6 OWxy,2,8 OWxy,2,A	Acknowledge and resume mode on Stop error, Acknowledge and resume mode on Deviation error, Acknowledge and resume mode on Synchronization error, Acknowledge and resume mode on Target Window error, Acknowledge and resume mode on PLC error, Acknowledge and resume mode on Emergency Stop error. All of these bits operate according to the following principle: Active on rising edge. **Condition** : Corresponding error present, Error not masked, For CPU error: Module in Safety On Mode, Auto Mode (1). **Effect**:Acknowledge the error and resume program execution. **Note**: In the case of Stop, Target Window, CPU, Emergency Stop errors, the program can only resume when the error is no longer present. (1) If Manual mode is selected when the error occurs, the Resume command has the same effect as the Abort command.
OWxy,2,1 OWxy,2,3 OWxy,2,5 OWxy,2,7 OWxy,2,9 OWxy,2,B	Acknowledge and abort the mode on Stop error, Acknowledge and abort the mode on Deviation error, Acknowledge and abort the mode on Synchronization error, Acknowledge and abort the mode on Target Window error, Acknowledge and abort the mode on CPU error, Acknowledge and abort the mode on Emergency Stop error. All of these bits use the following principle: Active on rising edge. **Condition** : Corresponding error present, Error not masked. For CPU error: Module in Safety Mode. **Effect**:Acknowledges the error and resumes the current mode. Return to the state awaiting activation (IWxy,1,8). **Note**: In the case of CPU and Emergency Stop errors, acknowledgment is only effective when the error ends.

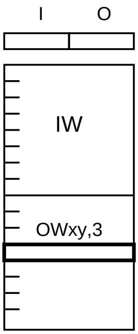
Functions not available on TSX AXM 162 module

B

OWxy,2,C	Active on rising edge: Acknowledge software stops. **Conditions** : Soft stop present (IWxy,2,0 or IWxy,2,1). **Effect**: Acknowledge error. Return of the moving part within the valid interval must be requested: • By the PLC via the DEG BL command (OWxy,1,7) that is only accepted after acknowledgment, • Manually.
OWxy,2,D	Active on rising edge: Ack. Calculation Overflow error. **Conditions** : Calculation Overflow error present. **Effect** : Acknowledge error. **Reminder**: This error causes the loss of the axis reference. The acknowledgment must be followed by a Reference Set-up command.
OWxy,2,E	Active on rising edge: Acknowledge PWF error. **Condition** : PWF error present. **Effect**:Acknowledge error.
OWxy,2,F	Not used (reserved).

Conditions common to words OWxy,3 to OWxy,7

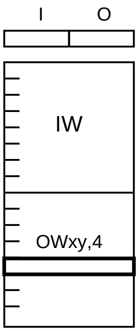
- PLC running,
- Module running.



OWxy,3

Least signif. byte: Comparison register.
Used by the JEX instruction that compares the contents of this register to a parameter value.
Condition: Auto Mode selected,
JEX Instruction.

Most signif. byte: Start or divert step.
Used in Auto Mode by the Start (Oxy,4) and Divert commands (OWxy,1,8).
It specifies the step number from which the AXM program is started/diverted.
Condition: Auto Mode selected.



OWxy,4

Least signif. byte: Value CNi.
Used by the PRSCN command (OWxy,1,4):
It specifies the value to load in counter CNi defined by the Most Significant Byte.
Conditions: None.

Most signif. byte: Number CNi or WNi
Used by:

- Command PRSCN (OWxy,1,4) to specify the number of the counter in which the value contained in the LSB is loaded.

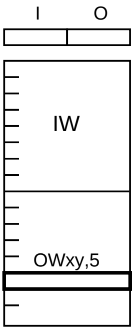
Condition: Contents ≤ 3.

- Command LDWNi (OWxy,1,5) to specify the address in the module table of internal positions (WNi table) where the value of the current moving part position is loaded.

Condition: Contents ≤ 99.
Axis referenced.
Moving part already in position.

Functions not available on TSX AXM 162 module

Discrete I/O and Register Interfaces



OWxy,5

Depending on the current mode, this register has two functions.

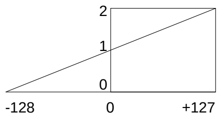
1. Servo off mode: D/A converter value.

LSB weighting:	10 mV for TSX AXM 172
	2.5mV for TSX AXM 182 / 162
Variation range	[-1024, +1023] for AXM 172
	[-4096, + 4095] for AXM 182 / 162

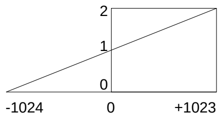
Conditions: Servo off mode currently selected.
[IWxy,1 AND 'H'000F' = 7] AND NOT IWxy,1,8

Attention: Any change of value is immediately applied.

2. Other modes: Velocity modulation value follows the correspondence diagram shown below.



AXM 172



AXM 182 / 162

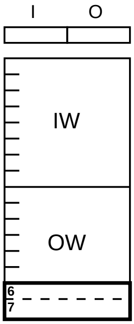
The multiplication factor affects the velocity of motion:
- VMAN in Manual Mode,
- Parameter F of the motion command in Auto Mode.

The effect of a modification of the value of this factor is:
- Immediate with a TSX AXM 182 / 162 module in Manual Control Mode, in Assisted Manual or in Automatic Mode if the current instruction is GP1 or GP9.
- Delayed until the next command in all other cases, i.e.:
  - Regardless of the situation when a TSX AXM 172 module is used,
  - In Automatic Mode when a TSX AXM 182 module is used and the current instruction is type G± or SRP±.

  It is this modulation factor which is used by the TSX AXM 162 to determine the velocity of the movement.

Functions not available on TSX AXM 162 module

Discrete I/O and Register Interfaces



OWxy,6 OWxy,7

Register or external set point.

Used to transfer a set point from the PLC program to the module. It is expressed in module physical units (refer to the table for IWxy,6/7), double length format (1).
- LSB in OWxy,6,
- MSB in OWxy,7.

B

The set point type depends on the module operating mode :
- It is the start position value if the Manual Set Point Mode is selected,
- it is the target point value if the selected mode is Assisted Manual or Automatic mode.

In the latter, the register value is set by the instructions :

or	GP1 GP9	F=	or	X = EXT X = I + EXT

Conditions:
- The position must be within the valid interval defined by the soft stops,
- Manual Ref. Set-up Mode, Assisted Manual Mode or Automatic Mode.

(1) For ease of use, initialize a double word with the value and transfer each of the two words to the registers: ! 1 000 000 → DW 100 ; W100 → OWxy,6 ; W101 → OWxy,7.

Functions not available on TSX AXM 162 module

6.6 Access Conflicts

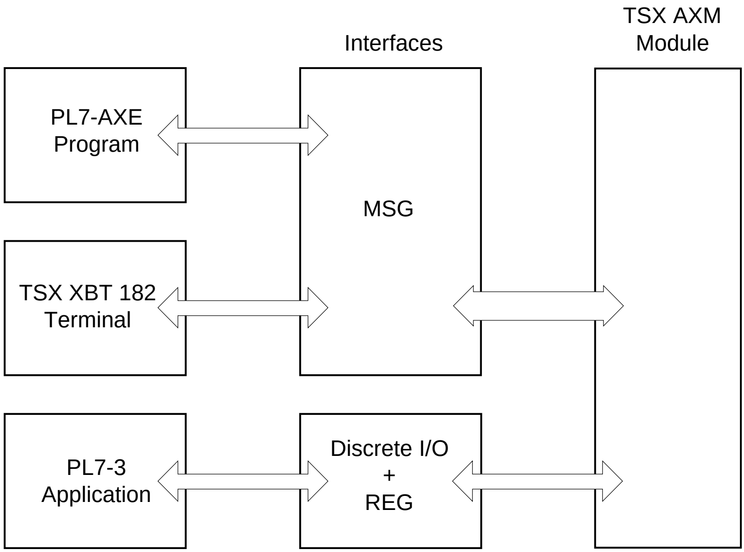
6.6-1 Reservation Mechanism

B

Module reservation

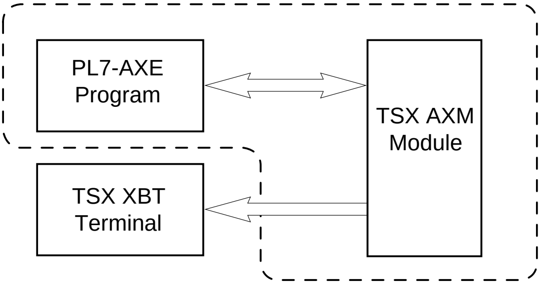
The entities that are likely to dialog with a TSX AXM module are :

- PL7-AXE during the debug phase of an application,
- TSX XBT terminals,
- PL7-3 applications being executed by the PLC processor, via the Discrete I/O and Register interfaces.



The first two entities (PL7-AXE and TSX XBT terminals) use the same resources at module level. To avoid access conflicts, a "reservation" mechanism was developed. It operates as follows: when a terminal wishes to access the module to perform a modification, it must first reserve the module. The reservation is only effective if the module is not already reserved. Reservation means that it is impossible for another terminal to access the module for the duration of the operation.

Access Conflicts



Example: The TSX AXM module is reserved by the PL7-AXE program. The TSX XBT terminal is only allowed to access the module for data display purposes.

Reservation by PL7-AXE

The situations described below cause the PL7-AXE program to reserve the TSX AXM module.

- Modification of the configuration,
- Modification of the AXM program,
- Use of the Debug Mode,
- Application transfer AXM ⟷ TSX
  AXM ⟷ DISK

Reservation by TSX XBT 182 terminal

(Incomplete list provided as an example only)

- Application transfer AXM ⟷ TSX,
- Modification of the parameters of a program instruction,
- Selection of an operating mode.

The module is released:

- By PL7-AXE as soon as the current operation is complete (writing the configuration, writing the AXM program, transfer completed).
- By the TSX XBT terminal:
  - When the keyswitch is set to the Configuration position,
  - When the Auto mode is selected.

Any attempt to access a module in a mode that requires reservation while the module is already reserved by another terminal will cause the message AXM RESERVED to be displayed.

Functions not available on the TSX AXM 162 module

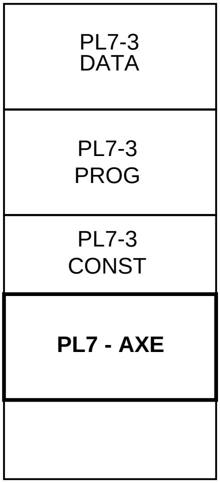
Access Conflicts

PLC memory reservation

In the same way that there is a reservation mechanism for the TSX AXM module, there is a similar reservation mechanism for the PLC memory. Reservation only affects the dedicated field used to store axis control applications.

Reminder on V4 level PLC memory layout

The PLC memory is divided into dedicated segments, one of which is dedicated to axis control.



The only entities that are allowed access to the dedicated Axis field are:

- The PL7-AXE program,
- TSX XBT terminals,
- The AXM LD OFB, a PL7-3 language option (Refer to Divider C3 of this manual).

Therefore if a terminal attempts to access a dedicated Axis field when it has already been reserved by another entity, the message TSX NOT RESERVED will be displayed to warn the user that the reservation request **was not** accepted.
The various types of reservation, although used less often, are the same as those of TSX AXM modules.

Access Conflicts

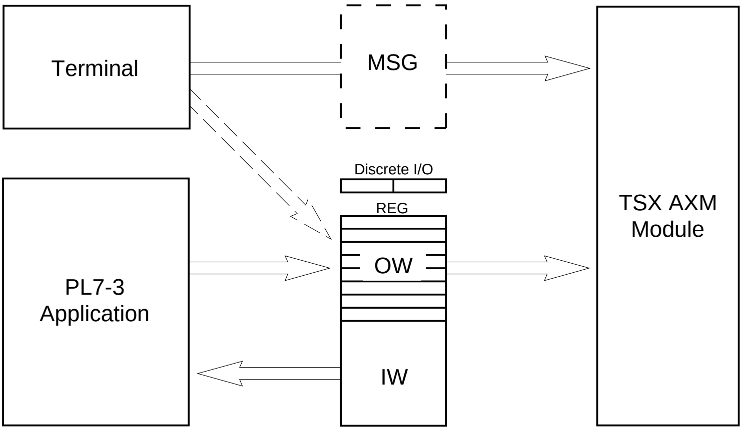
6.6-2 PL7-3/Terminal Access Conflicts

Access conflicts between the PL7-3 application and a terminal (TSX XBT or PL7-AXE running on an FTX 507 terminal) may sometimes occur, especially during the debug phase.

Causes

The PL7-3 application communicates with TSX AXM modules via the Discrete I/O and Register (REG) interfaces. The terminals dialog with the TSX AXM module mainly through the Message (MSG) interface but ensure that the Discrete I/O and REG interfaces (path shown in dotted lines) are updated with the commands sent via the MSG interface.

PLC processor
message system



When the PLC processor is running, the O and OW fields are periodically refreshed by the PL7-3 application PL7-3. This means that commands from the terminal may not always take effect.

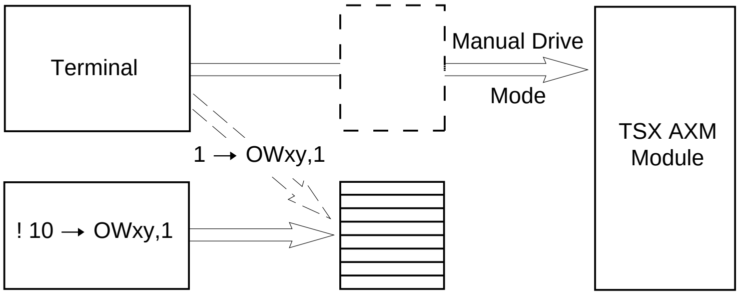
Access Conflicts

Example:

The PL7-3 application continually selects the Automatic Mode with the instruction:

! 10 → OWxy,1

The user attempts to select Manual Drive Mode from the TSX XBT terminal. This means the terminal sends a request directly to the TSX AXM module selecting Manual Drive Mode via the Register (REG) interface REG (1 → OWxy,1). However, on the next PLC cycle, the PL7-3 application will override this and the Automatic Mode will remain selected. This instruction may also cause the message SYSTEM ERROR to be displayed by the TSX XBT terminal.



Access Conflicts

Rules to observe to avoid these conflicts

1st case: The TSX XBT terminal is not used during normal operation, but only during the debug phase.

Proceed in two stages:

1st stage:
- Select TSX AXM module Safety Off Mode,
- Stop the PLC,
- Make the TSX XBT terminal take the part of the PL7-3 application (operating mode selection, start program, synchronization, etc.).

2nd stage:
- Set the PLC to Run,
- Restrict the TSX XBT 182 terminal to an observer function.

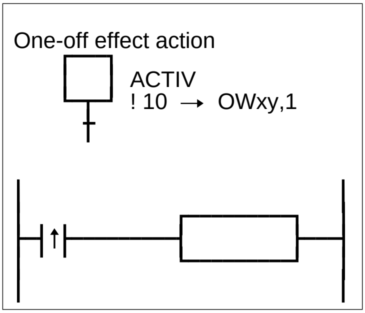
Repeat this as often as necessary.

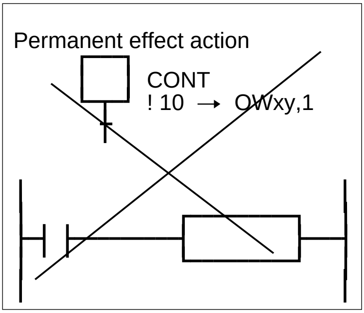
2nd case: The TSX XBT 182 terminal is used during normal operation in conjunction with a PL7-3 application.

Ensure that the areas of influence of the terminal and the application program are exclusive.

Example:
A TSX XBT 182 terminal dedicated to displaying and acknowledging system error conditions.
The PL7-3 application controls operating mode selection and starts the module program.

PL7-3 application programming instructions
To avoid disabling the TSX XBT terminal, be sure to program one-off actions rather that permanent effect actions.





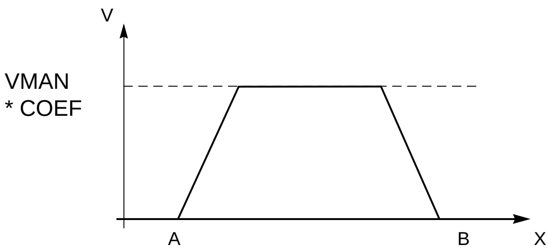
Attention: If the AXM PG OFB is used, the actions performed are not directly displayed in PL7-3. It is up to the user to keep in mind the various objects used by this function block. If necessary, refer to Divider C3 of this manual for a full description of OFBs.

6.7 TSX AXM 162 module - Programming motion

6.7-1 Principle

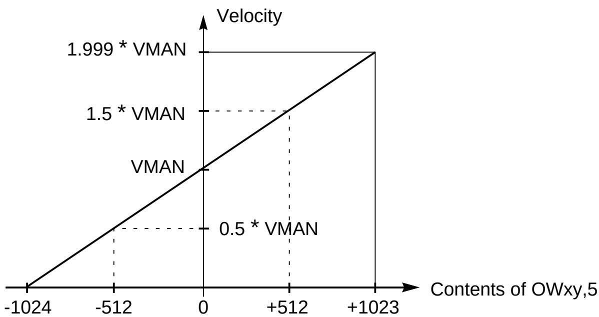
The TSX AXM 162 module is used in Assisted manual mode for controlling movements as it does not have move instructions.

In this mode, the module most be provided with the target point, the move to be performed at a velocity equal to the product of the velocity, specified in the VMAN configuration parameters, multiplied by the velocity correction factor.



The velocity correction factor variation band is from 0.001 to 1.999. By setting the value of VMAN to that of VMAX /2 a velocity variation can be achieved from $\frac{VMAX}{2048}$ to VMAX in steps of $\frac{1}{2048}$ of VMAX.

The PLC provides the target point for each move made, (via the registers OWxy,6/7) and the velocity correction factor which will enable the required velocity to be achieved (via the register OWxy,5).



The TSX AXM 162 module appears therefore as a "sub-processor" of the PLC for motion control.

TSX AXM 162 module - Programming motion

6.7-2 Implementation

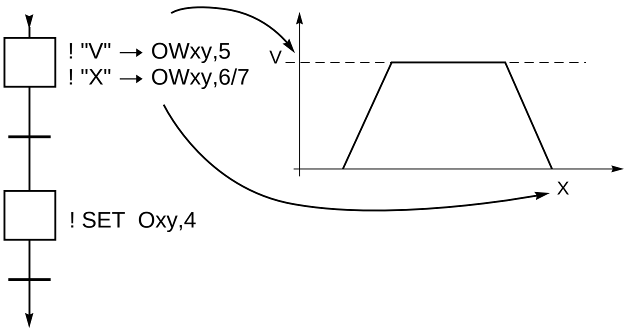
For each motion to be made, the PLC provides the following information :
- the target point in registers OWxy,6/7, expressed in module physical units (1),
- the velocity correction coefficient in register OWxy,5 enabling the required motion velocity to be reached :

$$COEF = \frac{V}{VMAN} \quad \text{contents OWxy,5} = 1024 * (COEF - 1)$$

where the contents of OWxy,5 = 1024 * (COEF - 1) are taken then, on the following cycle the execution order is given via bit Oxy,4.

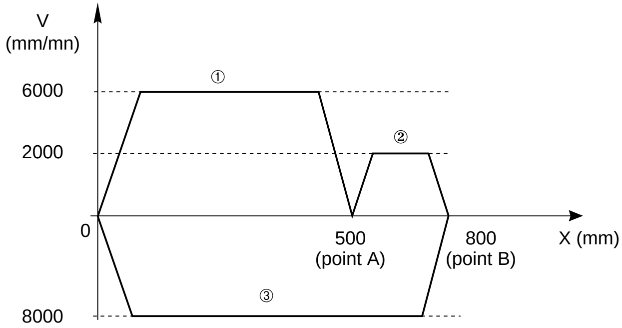
(1) Module physical unit : this is a function of the VMAX parameter.

VMAX (m/mn)	< 54	≥ 54 < 540	≥ 540
Unit	µm	x10µm	x100µm



Note : The sequencing is imperative i.e. bit Oxy,4 must not be set to 1 except on the cycle following that of modification of the registers.

6.7-3 Example : To perform the following cycle :



The moving part starts at point 0. Following a Start Cycle command, it moves to point A at a velocity of 6000 mm/mn where the first operation is performed (command given by O17,0).

Once the operation has been completed (information provided by I16,0) the moving part goes to point b at a speed of 2000 mm/mn where the second operation is performed (command given by O17,1). When this second operation is competed (information provided by I16,1) the moving part returns to point 0 at a speed of 8000 mm/mn and waits for another Start Cycle command.

Determining the values of registers OWxy5, 6 and 7 for each move

The positions must be expressed in module units. The velocities must be at manual velocity VMAN to enter the velocity correction coefficient value.
In this example, assume that the module is at slot n°4 and that is has been configured with :

VMAX = 10 000 mm/mn VMAN = 5000 mm/mn TW = 0.1 mm

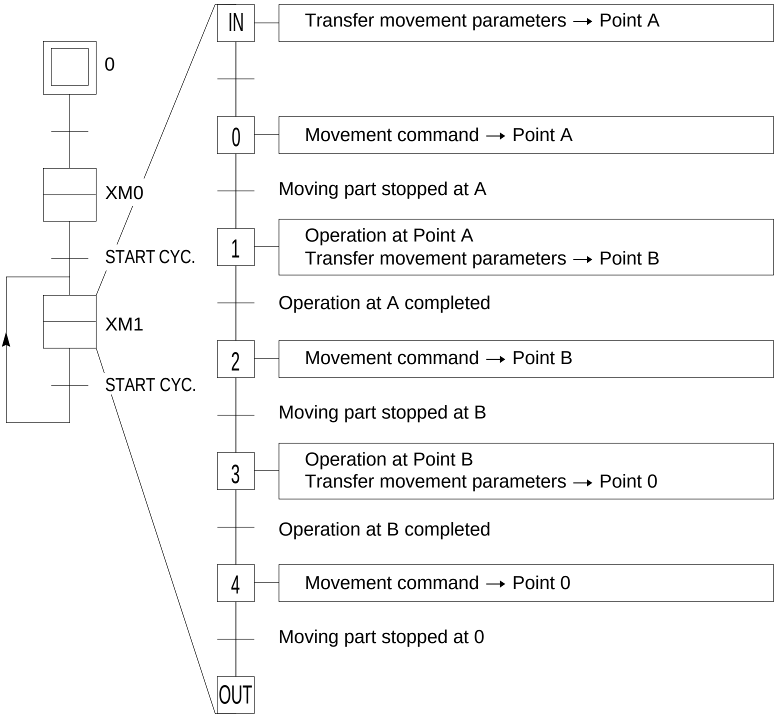
The module physical unit gives the value of VMAX as µm.

N° segment	**Postion**		**velocity**		
	X	Contents OW4,6/7	V	Velocity corr. coeff. (1)	Contents OW4,5 (2)
1	500	500 000	6000	1,2	205
2	800	800 000	2000	0,4	-613
3	0	0	8000	1,6	+613

(1) Velocity correction coefficient = V / VMAN
(2) Contents OWxy,5 = 1024* (COEF - 1)

TSX AXM 162 module - Programming movements

PLC program



XM0 : Initialization of macro-step described on page 6/11.

Step IN : **Action on activation**
< Movement parameters to Point A
! 500 000 → DW100 ; W100 → OW4,6 ; W101 → OW4,7 ;
205 → OW4,5

Step 0 : **Action on activation**
< Movement command to A
! SET 04,4

Step 1 : **Action on activation**
! RESET 04,4
< Operation at Point A
! SET 017,0
< Movement parameters to Point B
! 800 000 → DW100 ; W100 → OW4,6 ; W101 → OW4,7 ;
-613 → OW4,5

TSX AXM 162 module - Programming the movements

Step 2 : **Action on activation**
< Movement command to B
! SET 04,4

Step 3 : **Action on activation**
! RESET 04,4
< Operation at Point B
! SET 017,1
< Movement parameters to Point 0
! 0 → OW4,6 → OW4,7 ; +613 → OW4,5

Step 4 : **Action on activation**
< Command to return to 0
! SET 04,4

Step 4 : **Action on activation**
! RESET 04,4

Transition 0 → 1
! I4,F.B15

Transition 1 → 2
! I16,0

Transition 2 → 3
! I4,F.B15

Transition 3 → 4
! I16,1

Transition 4 → OUT
! I4,F.B15

B15 is a data bit indicating that the moving part has reached the required point. It can be specified in pre-processing.

Pre-processing PRL

<Calculate the target window limits (in microns)
! DW100 - 100 → DW102 ; DW100 + 100 → DW104
<Specify position of the moving part in double length
! IW4,6 → DW106 ; IW4,7 → DW107
<Compare the position achieved with the target postion
! IF [DW106 > DW102]•[DW106 < DW104]
THEN SET B15 ELSE RESET B15.

7.1 Location and Hardware Code

Possible module locations

TSX AXM modules can be installed in any PLC rack that is equipped with the complete bus:

Basic PLC	TSX / PMX P47 4 ●● TSX / PMX P67 4 ●● TSX / PMX P87 4 ●● TSX / PMX P107 4 ●●	All slots, numbered from 0 to 7
Local or remote extension racks	TSX RKN 8/8F/8W11 TSX RKN 5	All slots

However, it is not possible to install a TSX AXM module in a TSX RKE 8/8W11/7 direct extension rack.

General rule

As TSX AXM modules have a high band-pass level, they should be kept away from all sources of electromagnetic radiation and from all components carrying or switching high voltages.

Configuration code

TSX AXM modules have a three figure decimal hardware configuration code which is coded ex-factory on the three female coding devices on the back of the module:

- TSX AXM 172: Code 729,
- TSX AXM 182: Code 732,
- TSX AXM 162: Code 735.

To install the module, set the PLC rack coding devices to the appropriate value.

Reminder: The same code is used as the software configuration code which is entered from the terminal when the PL7-3 I/O configuration is defined.

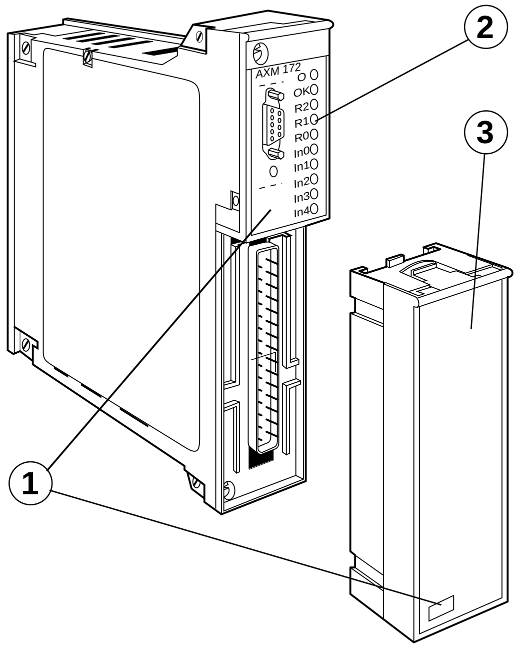
7.2 Identifying the Module

Label location

TSX AXM 172 modules comprise:

- Slots for user selected clip-in characters ①,
- A technical label ②,
  They are supplied with a wiring label that should be affixed to the TSX BLK 4 terminal block ③.

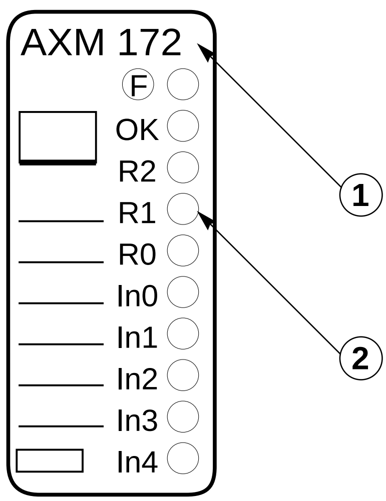
TSX AXM 172



Clip-in characters

Clip-in characters are used to identify the location of the module and the terminal block.

E.g.: I27, I: Input, Rack 2, Slot 7.



Technical label

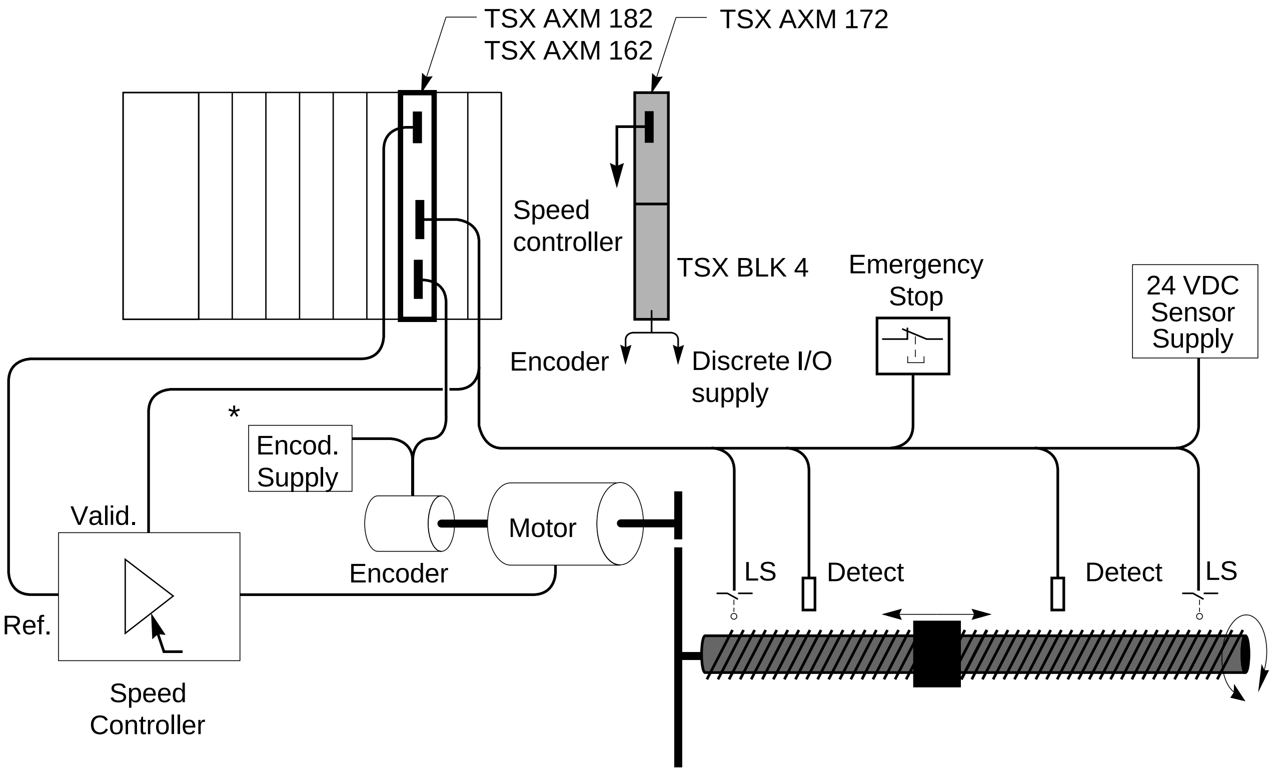
Affixed to the front panel of the module, it identifies:

① The type of module,

② The assignment of the LEDs.

7.3 Connecting the Module

7.3-1 Overview



Note: The emergency stop and limit switches **must** act directly on the power circuit.

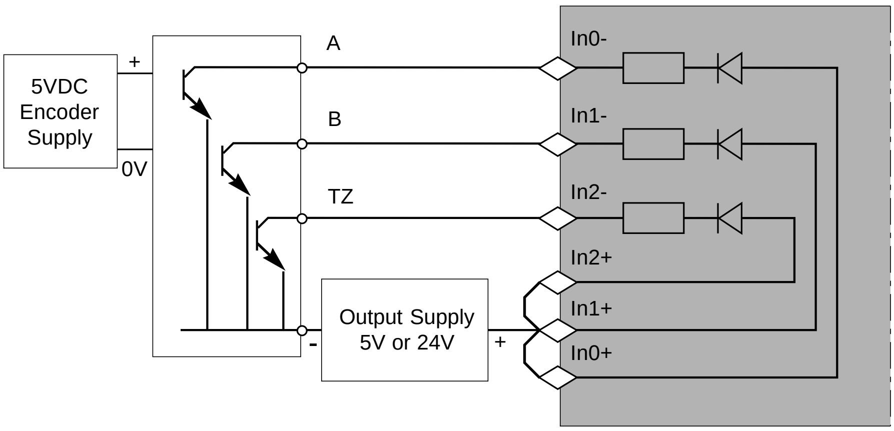
(*) Encoder supply : 5VDC or 24 VDC for TSX AXM 172 module.
Encoder supply : 5VDC TSX AXM 182 / 162 module.

7.3-2 Connecting the I/O (block diagram)

TSX AXM 172 encoder inputs

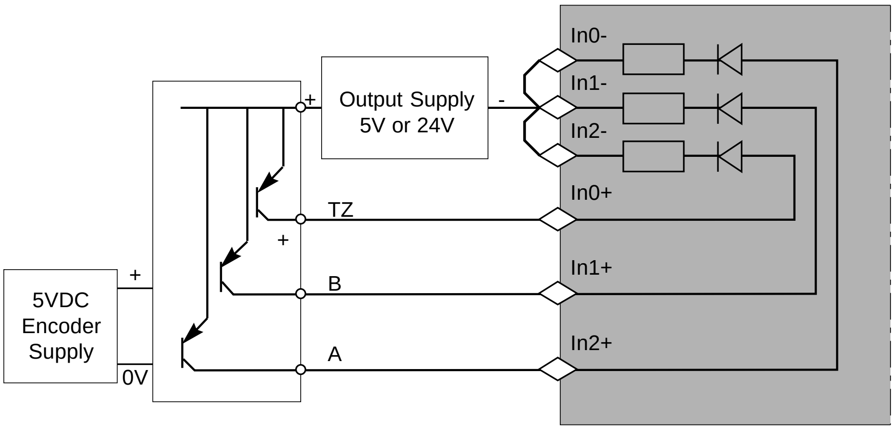
Encoder open collector NPN output

Process **Module**



Encoder open collector PNP output

Process **Module**

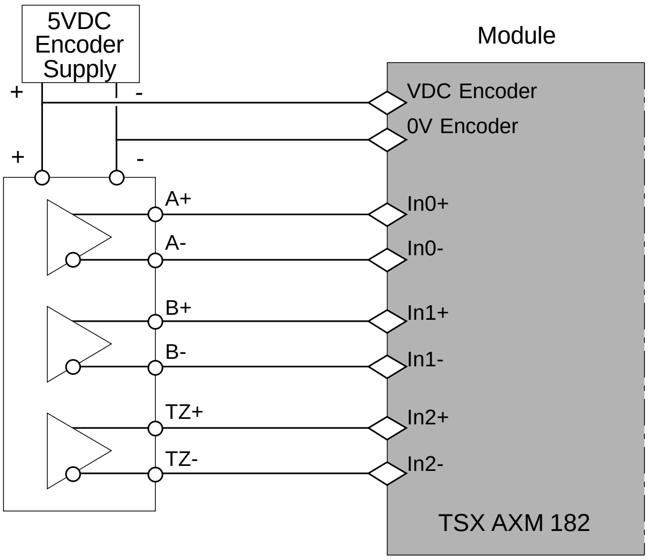


Connecting the Module

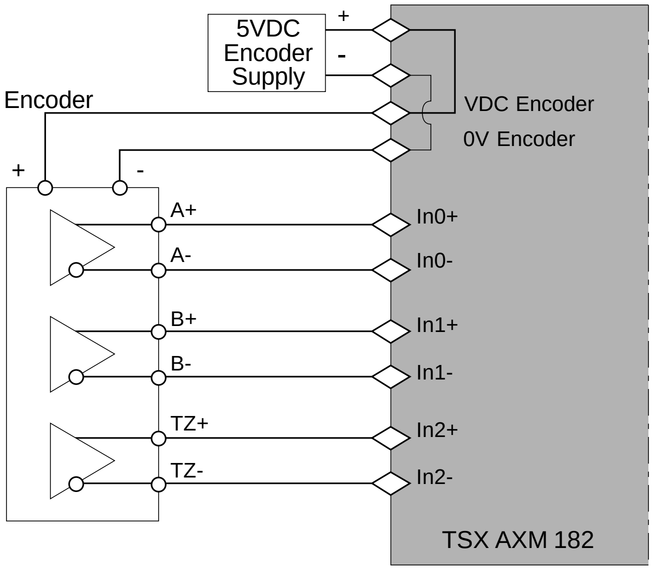
Connecting the I/O

TSX AXM 182 / 162 encoder inputs

Distance > 20 meters



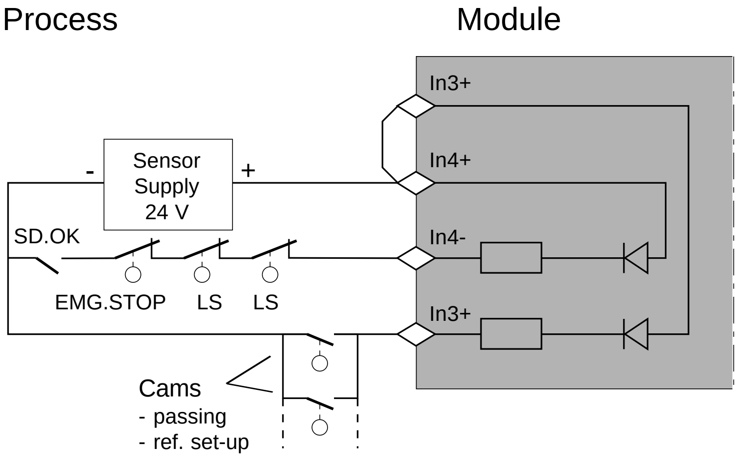
Distance < 20 meters



Connecting the Module

Connecting the I/O (block diagram)

Sensor inputs



Attention

The emergency stop and limit switches MUST act directly on the power side. The contacts in series on input In4 are only auxiliary contacts. The auxiliary contact used by the emergency stop is absolutely necessary. The other contacts for the limit switches are optional. The consequences of choices made are described below:

1st. case: Auxiliary contacts are wired to input In4 (as shown in the diagram). If these contacts are triggered, the moving part must be returned to its proper position by external intervention (manually or by a direct command from the PLC processor) as the absence of voltage on input In4 means that the module cannot request motion.

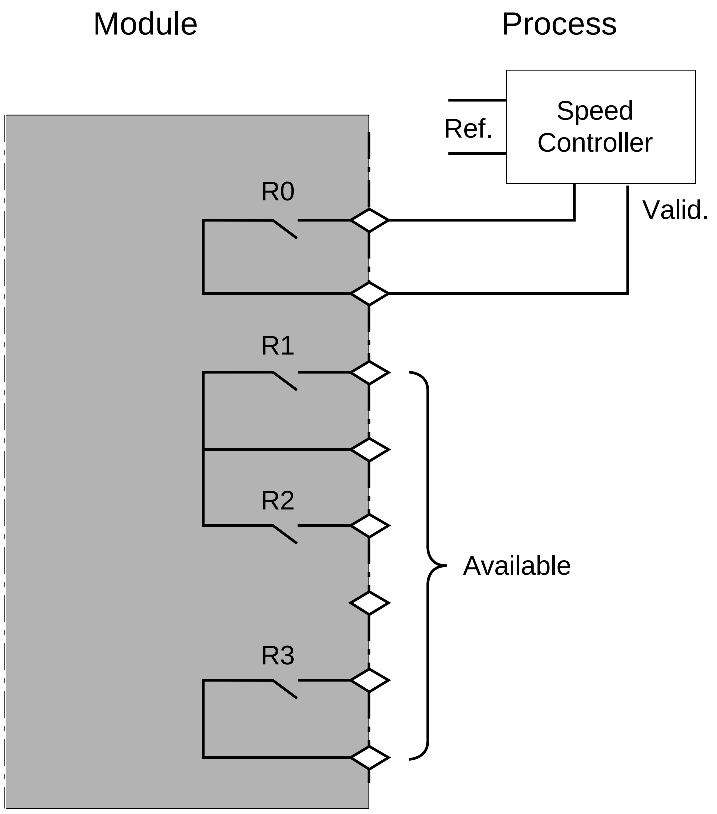
2nd. case: No auxiliary contacts are wired to input In4.
The module is not informed that it can no longer request or control motion. This situation usually causes a deviation or target window error condition.
If no error occurs (excessive parameter tolerance), the module will continue to maintain a voltage on the analog output. This will cause the moving part to jump as soon as the limit switch is reset. It is therefore recommended that the module be reset in relation to the process, e.g. by pressing the emergency stop button.

Note: In all cases, excessive travel that causes an overrun is due to incorrect axis reference set-up:
- Incorrectly defined software stop positions,
- Reference set-up performed with an incorrect value.

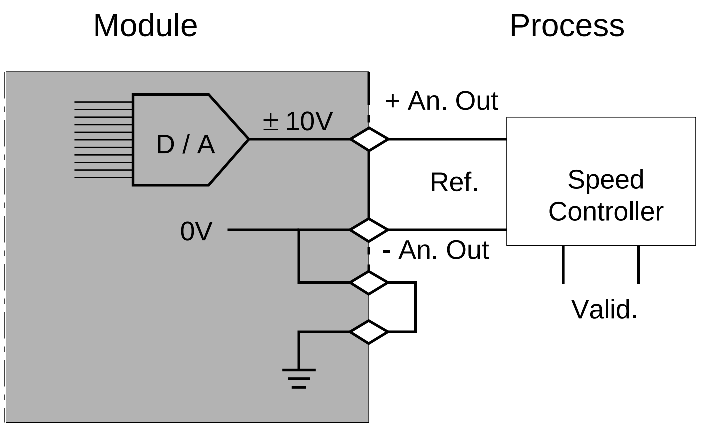
Connecting the Module

Connecting the I/O

Relay outputs



Analog output



Connecting the Module

7.3-3 Terminal Block and Connectors

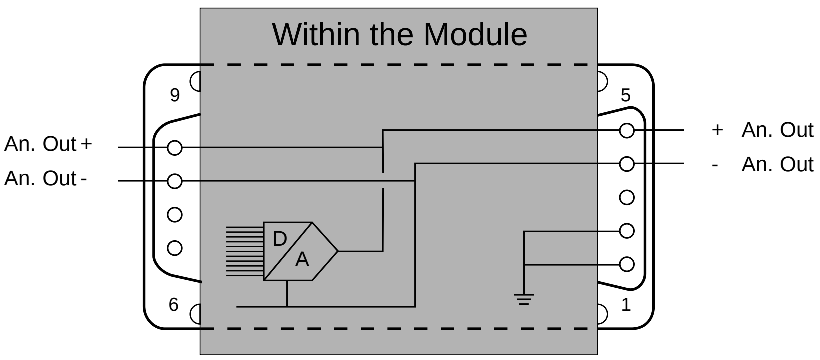
TSX AXM 172 Module

Connections are made using:
- A TSX BLK 4 terminal block for the I/O and power supplies,
- A TSX CAC 04 connection kit for the analog output.

- **TSX BLK 4 terminal block**. This removable terminal block is equipped with 32 screw terminals. The terminal block is wired according to the configuration selected and the user's requirements.

Signals			TSX BLK 4 Terminal Block			Signals	
Input	In4	24V	A8	C1	-	Input	In4
Input	In3	24V	A7	C2	-	Input	In3
Input	In2	24V	A6	C3	-	Input	In2
Input	In2	5V	A5	C4	5V	Input	In1
Input	In1	24V	A4	C5	-	Input	In1
Input	In0	24V	A3	C6	-	Input	In0
Output	R2	F	A2	C7	5V	Input	In0
Output	R1	F	A1	C8	O	Output	R2
		O	B8	D1	C	Common outputs R1 R2	
Output	R0 (contact a)	C	B7	D2	F	Output	R0 (contact a)
Output	R0 (contact b)	F	B6	D3	O		
		O	B5	D4	C	Output	R0 (contact b)
Output	R3 (contact a)	C	B4	D5	F	Output	R3 (contact a)
Output	R3 (contact b)	F	B3	D6	O		
		O	B2	D7	C	Output	R3 (contact b)
Ground			B1	D8		Ground	

- **TSX CAC 04 connector**. A 9-pin Sub-D connector. Its metal coated plastic casing ensures ground continuity.



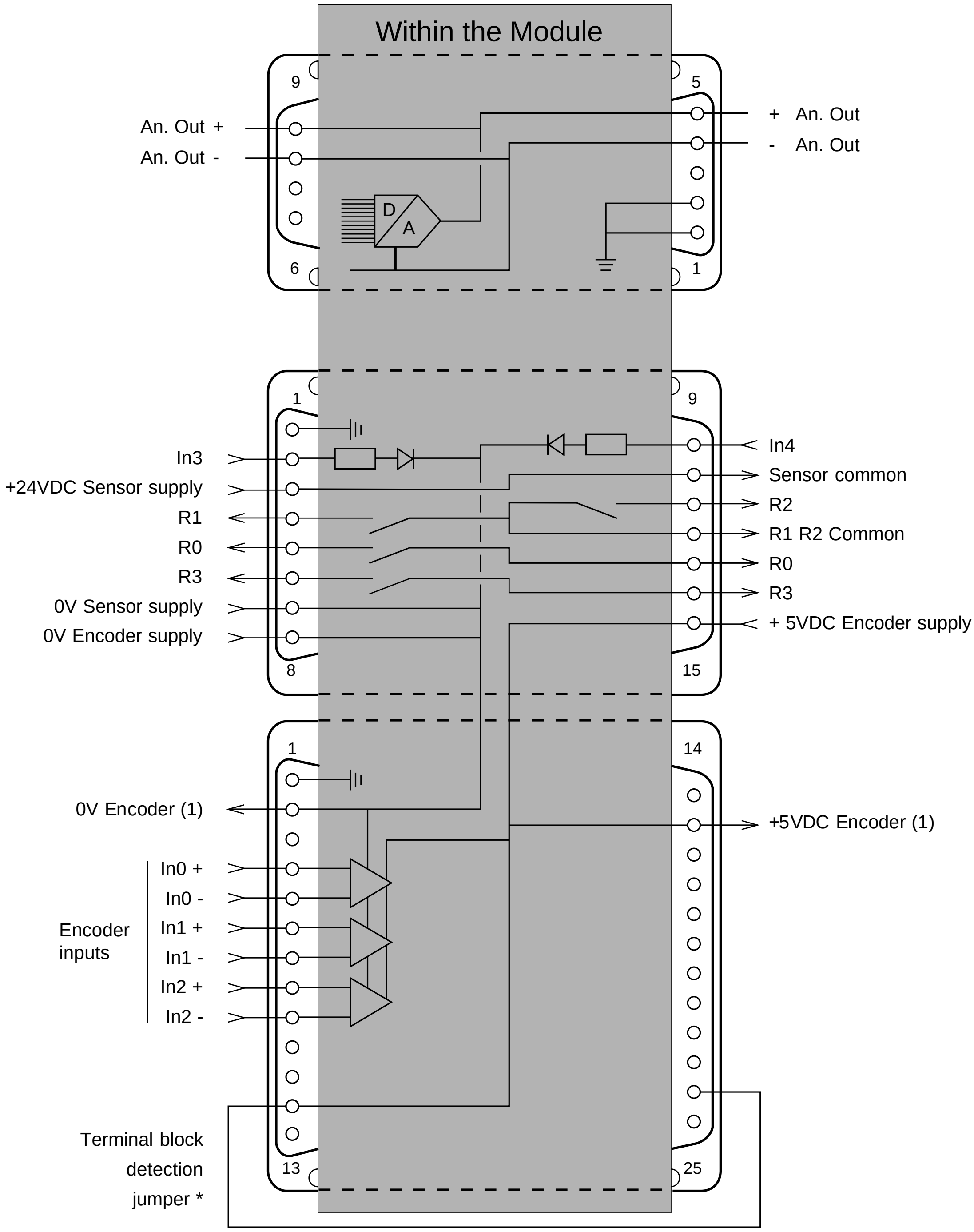
Male connector seen from the pin side

Connecting the Module

TSX AXM 182 / 162 module

Connections are made using the TSX CAC 06 connection kit that comprises:
- A 9-pin male Sub-D connector for connecting the analog output,
- A 15-pin male connector for connecting discrete I/O and their power supplies,
- A 25-pin male Sub-D connector for connecting the encoder,
- 3 metal coated plastic connector cases that ensure ground continuity.

Connectors seen from the pin side



(1) If the length of the cable that connects the encoder to the module exceeds 20 meters, the encoder must be supplied with 5 VDC from a local supply source. This line must still be returned to the 25-pin connector to ensure terminal block presence testing.

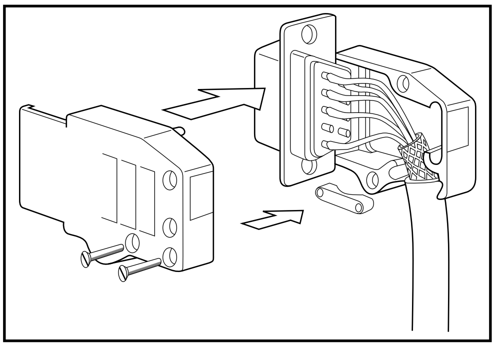
7.3-4 Wiring Precautions

Principles

To protect the signals from induced noise in serial and common modes, the following precautions should be observed:

Type of cables
The minimum wire cross-sectional area in the cables used should be 0.22 mm^2 (AWG 24).

Shield grounding



a) For Sub-D connectors:
- Connect the shields together,
- Crimp the shield in the metal coated plastic connector case,

b) For TSX BLK 4 terminal blocks (TSX AXM 172 modules)
- Connect the shielding of the cables to the PLC ground through the TSX RAC 20 grounding strip that must be installed on the PLC rack (except for the analog output, the connection should be made directly to the connector).

Grouping the cables in bundles:
Bundles of multiple twisted pair cables can be formed where the signals carried are of the same type and have the same reference to ground.

Cable routing:
- Keep the counting signal wires away from the discrete I/O wires, (especially relay output wires) and power cables,
- Avoid close parallel runs (the cables should be at least 20 cm (8 inches) apart). Make any crossings at right angles.

Connecting the inputs

Compatibility with incremental encoders

Inputs In0, In1, In2 are designed to receive signals from an incremental encoder.

The encoders used must have:
- An NPN open collector or totem-pole output when used with a TSX AXM 172 module (5 V or 24 V supply),
- A line transmitter (RS-422) when used with TSX AXM 182 / 162 modules (5 V supply).

Telemecanique has a complete range of rotary and incremental encoders that are compatible with TSX AXM modules.

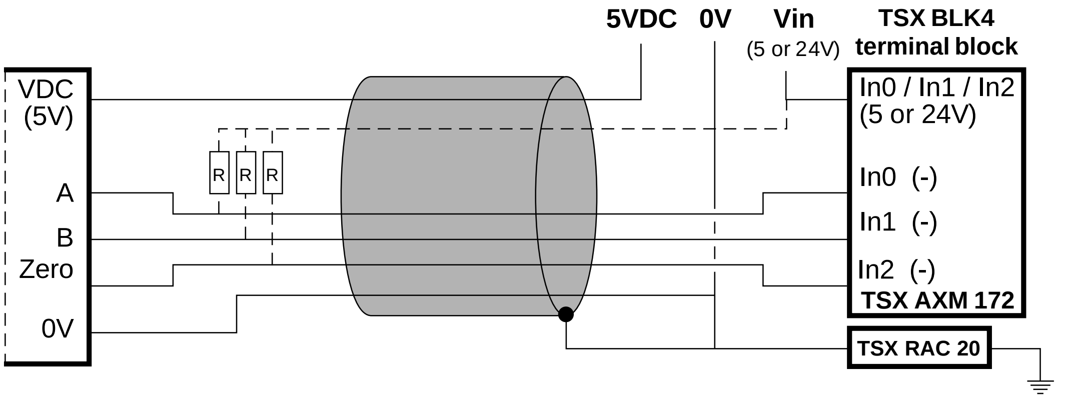
Note: TSX AXM 172 modules are not designed to operate with differential output encoders (signals $\overline{A}A$, $\overline{B}B$, $\overline{Z}Z$).

Connecting the Module

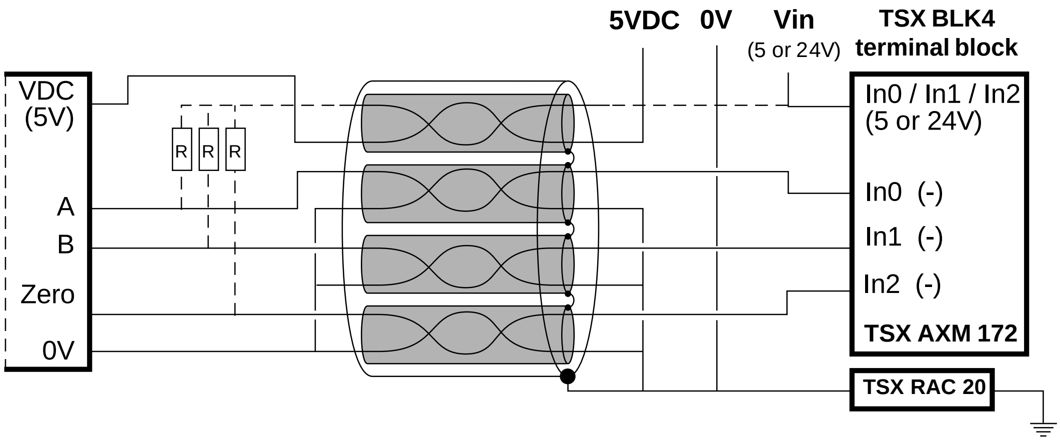
Connecting an incremental encoder to a TSX AXM 172 module

These diagrams illustrate the connection of an NPN open collector output encoder.

Connection 1: Wiring with common shielding.



Connection 2: Wiring with shielded twisted pairs.



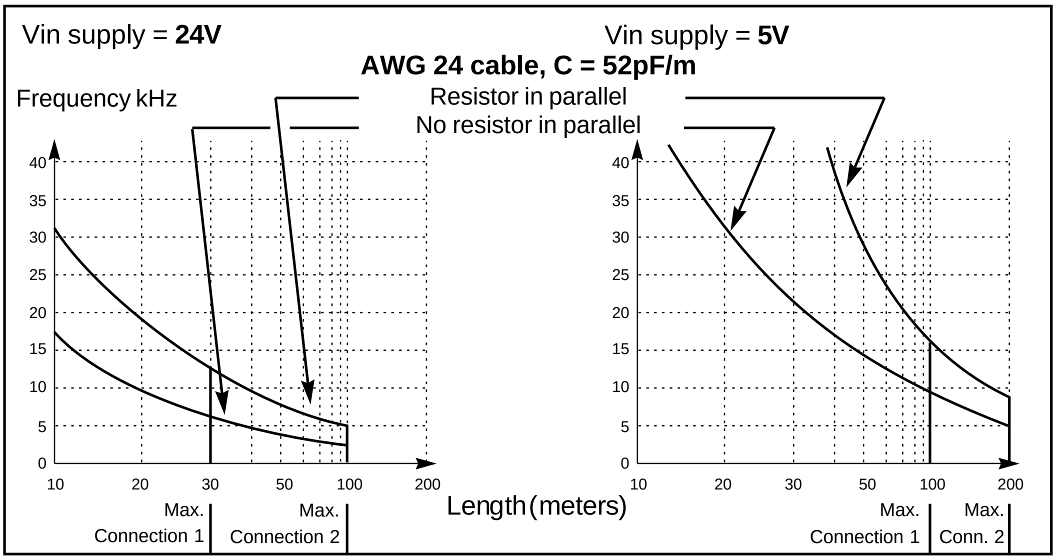
In both of the connection diagrams shown above, resistors can be inserted to on the encoder side to increase the permissible input frequencies.

Resistor values: R=1.5 Kohms for Vin=24V R=330 ohms for Vin= 5V.

The graphs on the next page show the permissible length of cable between the module and the encoder (depending on the input supply voltage, the input frequency desired and the type of wiring connection used) for AWG 24 cable with a capacity of 52.5 pF/meter.

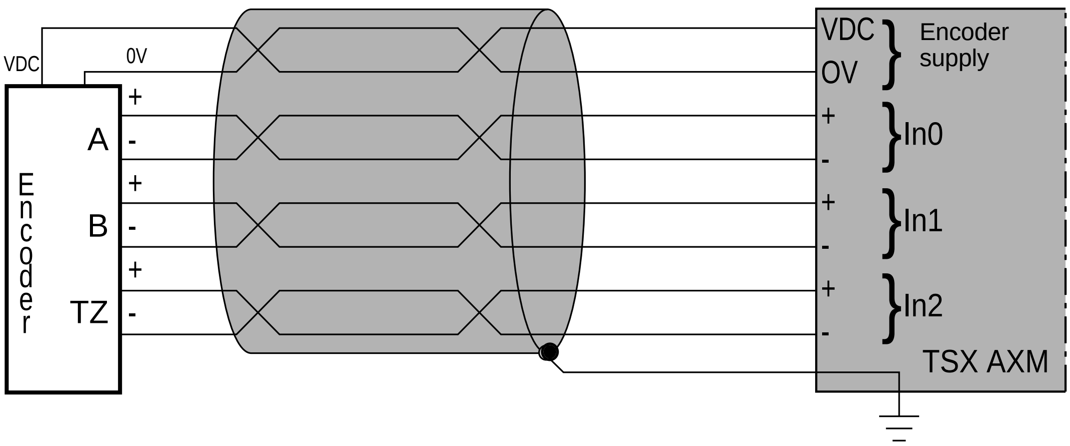
Connecting the Module

Open collector encoders



Note: Encoders with Totem-pole outputs can deliver input frequencies of 40 kHz up to a distance of 50 meters with either type of connection.

Connecting an incremental encoder to a TSX AXM 182 / 162 module



Remarks: For the position of the encoder supply, refer to the connection diagram for TSX AXM 182 / 162 module encoder inputs on page 7/5 of this manual.

The RS-422 serial link will support a cable length of up to 100 meters max. over the frequency range accepted by the module ($\leq$ 80 kHz) when an AWG 24 cable with a capacity of 52.5 pF/meter is used.

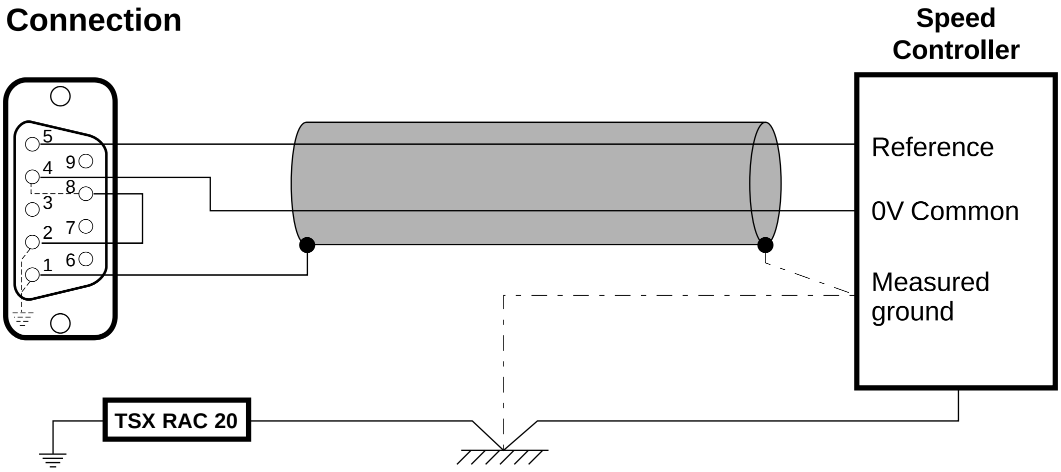
Inputs In3 and In4

Inputs In3 and In4 (24 V) are compatible with Cenelec standard proximity detectors.

Connecting the Module

Analog output

Connection



Guidelines

- Follow the instructions provided by the speed controller manufacturer (direct differential inputs),
- **The speed controller inputs must be isolated from the mains supply** (0V at the module end is returned to ground),
- The cable that connects the analog output to the input of the speed controller must not be broken (no intermediate connections),
- The PLC and speed controller ground wires must be connected to the same point,
- The maximum wire gauge must be used for the ground cables (at least 2.5 mm^2),
- The connections shown by must be tried before use, depending on the application.

These guidelines (except for the second which is an absolute rule) are given for information only and can be modified to suit the application.

Relay outputs

Relay outputs are not protected against shorting. It is recommended that a fuse be fitted in series with the power supply of the load:
- 380V FA 3.15 A 5x20 supply fuse,
- 250V FA 3,15 A 6x30 supply fuse.

For AC inductive loads, an RC ≥ 22nF // 47 ohm circuit should be placed on the load connectors.
For DC inductive loads, a discharge diode should be placed on the load connectors.

Reminder : Relay output R0 is designed for connection to the enable input of the speed controller.

7.4 Preliminary Adjustments

7.4-1 Preparations

This Sub-section provides guidelines only. In all cases, the user must follow the instructions given by the speed controller manufacturer.

B

Initial checks

- Check all wiring,
- Check that motion can take place without danger,
- Check that the mechanical end of travel switches are wired correctly and meet all applicable safety requirements (they must normally act directly on the supply sequence to the speed drive),
- Check the direction of tachometer dynamo connection.

Adjusting the speed drive

Adjust the speed drive for correct operation according to the instructions provided by the manufacturer. Remember that speed drive instruction values can also be supplied by the module in Servo Off Mode.

Adjusting the current loop

- Set the maximum value for the current supplied by the speed controller to a value acceptable to the motor (switching dissipation) and to the moving part (acceleration torque),
- Set the current loop sensitivity.

Set the velocity loop

- Set the maximum working velocity. Set a speed controllers instruction level equal to the value set in the module configuration,
- Set the velocity loop gain,
- Set the offset.

Set the current limit depending on the velocity.

7.4-2 Service Introduction

The procedure described below corresponds to module service introduction performed from the TSX XBT terminal.
Service introduction can also be performed from PL7-AXE. For further information, refer to Divider C2, Appendix A3.

Module configuration

To adjust the servo loop, the user must first assign specific values to certain configuration parameters, while other parameters take values corresponding to the application.

Modified parameters	Values
VSTOP	VMAX/10
TSTOP	1 second
TW	linear sensor length /10
DMAX	linear sensor length /10
KPOS	16
LIMV	10 %
KV	0 %

Forced reference set-up

It is important that only the Service Introduction Function be selected. Function F95 on the TSX XBT terminal.

Reference point set-up ensures a referenced axis and activates the following functions:
- Limit switches,
- Backoff from limit switch overrun.

Note: Operation will only be correct if the direction of moving part motion is the same as that of the measurement read from the TSX XBT terminal.

Procedure

- Do not acknowledge the emergency stop error,
- Set the module to Run: F93,
- Select the Interlock Disabled Mode: F85,
- Stop the PLC (using the FTX 507 terminal),
- Select the Service Introduction Function F95 and press <ENTER> to validate the selection,
- Measure the position of the moving part in relation to the reference set-up cam (an imprecise measurement) using an external measurement source,
- Force reference point set-up by entering the measured value with its sign as a reference position.

Effect of Function F95

This function sets the module to Run, in Servo Off Mode.
It resets the analog output and enables forced reference point set-up.

Checking the maximum frequency

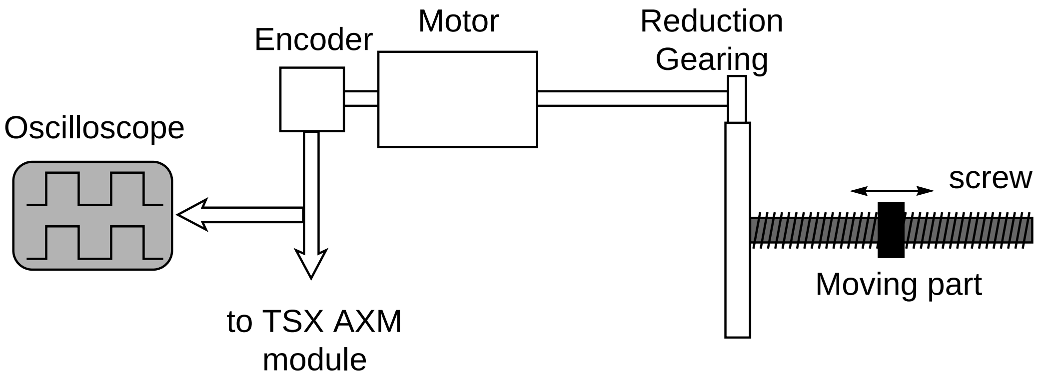
This optional check lets the user ensure that the operational limits of the module will not be exceeded.
It is performed in Servo Off Mode.

- Apply a voltage equal to UMAX $(1 + \frac{LIMV}{100})$,
- Check that the pulse frequency obtained is less than:
- 40 kHz for a TSX AXM 172 module,
- 80 kHz for TSX AXM 182 / 162 modules.

Note: This check can be delicate to perform, as it requires:

- Being able to brutally apply the maximum input voltage to the speed controller,
- That the axis be long enough to allow adequate time to observe motion.

  To reduce these effects, apply a voltage that is only a certain percent of the maximum voltage UMAX (1+LIMV/100) and check that the resulting frequency on the input to the module does not exceed the same percentage of the maximum frequency.



Preliminary Adjustments

Checking the direction of encoder connection and direction of moving part motion

> It is important that only the Service Introduction Mode be selected. Function F95 on the TSX XBT 172 terminal.

- Cancel the emergency stop (F87) and acknowledge the emergency stop error,
- Display ± 100 mV on the output from the DAC (in Servo Off Mode).

DAC Output	Position	Measurement	Corrective Action
Positive	Rising	Rising	None (connection OK)
Positive	Rising	Falling	Reverse measurement (1)
Positive	Falling	Falling	Reverse motion (2)
Positive	Falling	Rising	Reverse motion and measurement
Negative	Falling	Falling	None (connection OK)
Negative	Falling	Rising	Reverse measurement (1)
Negative	Rising	Rising	Reverse motion (2)
Negative	Rising	Falling	Reverse motion and measurement

(1) Reversing the measurement means reversing the encoder connection wires: Inputs In0 and In1 (Refer to Sub-section 7.3).

(2) Reversing the motion means that the machine system is incorrectly wired.

First ensure that the analog output is correctly connected: Terminal 4 or 8 connected to the speed drive 0V line. If the connection is correct but the fault persists, check the motor to speed drive connection wiring (reverse the direction of inductance and tachometer dynamo connection).

- If the connection is incorrect, rewire the entire system (select Emergency Stop Function F87).

Preliminary Adjustments

Checking the distance displayed in relation to the distance travelled

- Make a note of the start position X1,
- Make the moving part move a significant distance,
- Make a note of the end position X2,
- Calculate the distance covered X2 - X1 (as recorded by the module),
- Measure the distance actually travelled,
- Check that the two values are equal or very close.

If the two values are radically different, an error occurred when calculating the Resolution parameter. Refer to the Appendix.

If the two values are very close, though not equal, the error can be corrected using the Machine Characteristic Factor setting and adjustment procedure described later.

Setting the module offset

This adjustment is optional and ensures that position errors are kept to a minimum.

Procedure:

- Select any operating mode except Servo Off,
- Ensure that relay R0 is activated (the corresponding LED is lit),
- Using a screwdriver, adjust the potentiometer on the front panel of the module to obtain the smallest possible difference between the instruction and measurement values.

Preliminary Adjustments

Self-adjustment procedure for the machine characteristic factor KR

This adjustment is designed to correct errors caused by imprecise configuration parameters and mechanical tolerances in the mechanical system.

Procedure:
- Manually set-up the reference point (if the moving part is distant from the cam, use the Servo Off Mode to bring it closer),
- Select Assisted Manual Mode,
- As target position, select a value corresponding to the longest possible travel: Position 1,
- Start motion (START Mode),
- Use an external device with adequate precision to measure the position reached by the moving part.

Commands	XBT Display	Comments
<FUNCT> 61 <ENTER>		Procedure selection.
	AX 0 KR D? UM	
10005		Enter the value of the measured distance, (value 10000 displayed and 10005 measured in this example).
	AX 0 KR D 10005UM	
ENTER		
	AX 0 KR ERROR ? UM	Enter the value of the position error between the measured position and the displayed position (Position 1): • Error = Calculated measurement - Measured value, • Automatic calculation of the factor by the terminal.
-5		
	AX 0 KR ERROR -5 UM	
ENTER		
	AX 0 KR ADJUSTMENT OK	

Note:
- Repeat the reference set-up and move the moving part to Position 1. The position error should be less than that required, if not, repeat the procedure.
- **Any modification to the RESOL AND V MAX parameters by PL7-AXE will reset the KR factor.**

7.4-3 Adjustments

Adjusting the position gain KPOS

The moving part has inertia equal to the maximum value encountered in the application:

- Select Assisted Manual Mode,
- Move the moving part from Position 1 to Position 2 and back,
- Display the position error when stopped,
- Adjust KPOS: Function F47 to obtain an acceptable error level while ensuring adequate stability (otherwise review the design of the machine),
- Set VMAN = VMAX (Function F41),
- Move the moving part from Position 1 to Position 2 and back again and, if required, adjust KPOS once again.

Adjusting the feed forward gain KV

- Select Assisted Manual Mode,
- Move the moving part from Position 1 to Position 2 and back at velocity VMAX. Display the position obtained when the moving part is in constant velocity motion,
- Adjust KV (Function F49) to obtain the required sign and error values,

Note: If the target point overshoot is too great, KV can be reduced slightly.

Offset adjustment display (optional)

When the moving part is stopped, adjust the potentiometer on the front panel to obtain the smallest possible position error.

Adjusting the maximum position error DMAX and the target window TW

- Select Assisted Manual Mode,
- Adjust DMAX: Function F4 and TW: Function F44, to obtain the required values.

Move the moving part from Position 1 to Position 2 and back, the module should not cause an error condition. If an error condition occurs, repeat the adjustment of KR, KPOS and KV, then adjust DMAX and TW again.

Adjusting the velocity limit LIMV

- Set LIMV to the required value: Function F48,
- Move the moving part from Position 1 to Position 2 and back. The module should not cause a DMAX error. If one occurs, increase LIMV or adjust DMAX.

Adjusting the stop check parameters VSTOP and TSTOP

The velocity must be less than VSTOP at the end of the TSTOP time-out. TSTOP counts down from the moment the position reference reaches the value of the requested position.

- Set VSTOP: Function F42 and set TSTOP: Function F43 to the required values.
- Move the moving part from Position 1 to Position 2 and back. The module should not cause a stop error. If one occurs, repeat the adjustment of VSTOP and TSTOP,
- Set the manual motion velocity VMAN to the required value.

7.5 Module Diagnostics

A module error (1) is indicated in one of the ways listed below:
• FAIL LED lit,
• OK LED extinguished,
and bit Ixy,S is set to 1.
Regardless of the cause of the error, the module is forced to the Stop Module state.

When no TSX XBT terminal is connected, it is possible to perform fast diagnostics on the module and to take corrective action.

LED		Diagnostics	Corrective Action
FAIL	OK		
0	1	Module OK	
1	0	Module failure	Replace the module.
0	0	Terminal block error or module error	Check that terminal blk. locked (*). Replace the module if the error remains after removing and re-installing the module.

(*) On TSX AXM 182 / 162 modules, check that the strap between terminals 12 and 24 of the 25-pin connector is present and that the encoder supply is OK.

(1) Internal module errors are referred to here as opposed to application errors (described in Sub-section 4.2).

B

8 Specifications

8.1 Power Consumption

The power supply to the modules is provided by the PLC.

	Max. Power Consumption	
Power Supply	TSX AXM 172	TSX AXM 182 / 162
5 V Logic	460 mA	500 mA
+12 V Logic	30 mA	30 mA
+ 12 V Power	120 mA (*)	120 mA (*)

(*) Add 20 mA per relay energized.

Battery back-up (configuration and program)

Battery life	40 (20) days at 25°C. (45°C.)
Battery charge time	40 hours at 45°C.

8.2 Input Characteristics

Counter inputs In0, In1, In2 on TSX AXM 172 modules

The inputs are compatible with:

- 5 V or 24 V incremental encoders with open collector or totem-pole outputs.

Rated voltage	5 VDC	24 VDC
Typical current	12.5 mA	15 mA
Voltage limits	4.75 to 7 V	19.2 to 30 V
Input impedance	370 to 430 ohm	1.5 to 1.7 Kohm
Voltage for state 1	> 3.75 V	> 11 V
Current for state 1	> 7 mA	> 6 mA
Voltage for state 0	< 1.5 V	< 5 V
Current for state 0	< 2 mA	< 2 mA
Line resistance (1)	< 30 ohm	< 500 ohm
Leakage	> 30 Kohm	> 30 Kohm

(1) For a 0.3 V drop on the encoder output.

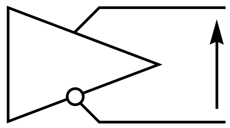
Protection	5V Input	24V Input
Permanent inverse voltage	-5 V	-25 V
Temporary inverse voltage (1 minute)	-12 V	-48 V
Permanent direct voltage	10 V	30 V
Temporary direct voltage (5 minutes)	12 V	48 V

Dynamic characteristics	40 KHz

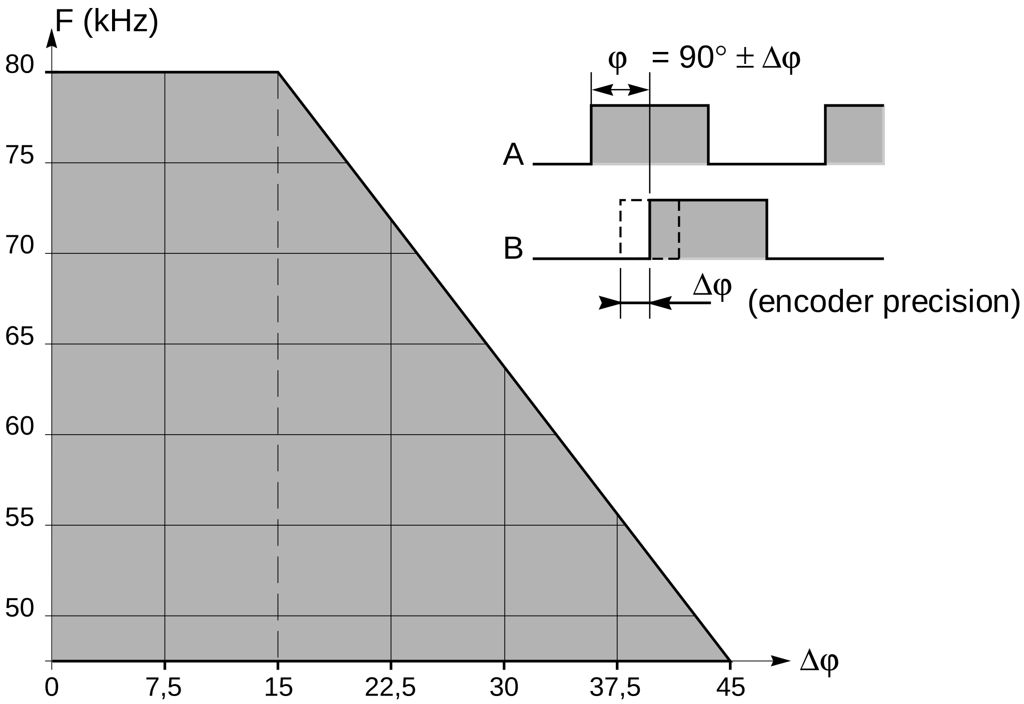
Input Characteristics

Inputs In0, In1, In2 on TSX AXM 182 / 162 modules

These inputs are compatible with line output (RS-422) incremental encoders.

Characteristics		Values
	Voltage for state 1	≥ 0.2 V
	Voltage for state 0	≤ -0.2 V
	Hysteresis	50 mV
Allowed common mode voltage		≤ 7 V
Allowed differential mode voltage		≤ 12 V
Total terminator resistance		90 ohm
Encoder supply voltage		4.75 to 5.25 VDC
Phase shift between two signals A and B		≤ 15 degrees (1)

(1) If the phase shift error between the two signals A and B is more than 15 degrees, the input frequency is limited as shown in the diagram below.



Input Characteristics

Auxiliary inputs In3, In4

These inputs are compatible with Cenelec standard proximity sensors.

Rated voltage	24 VDC
Rated current	16.5 mA
Voltage limits	19.2 to 30 V
Input impedance	1360 to 1560 ohm
Voltage for state 1	> 11 V
Current for state 1	> 6 mA
Voltage for state 0	< 5 V
Current for state 0	< 2 mA
Line resistance	< 500 ohm (on dry contact)
Leakage resistance	> 30 Kohm
Response time on In3 (change state)	50 to 250 µs
Response time on In4 (change state)	
TSX AXM 172	5 to 20 ms
TSX AXM 182	50 to 250 µs

Protection: Characteristics are identical to those of 24 V inputs In0, In1, In2 on TSX AXM 172 modules.

General characteristics

Isolation

Between inputs and bus	1500 Veff
Between channels (inputs and outputs)	500 Veff

8.3 Output Characteristics

Analog output

	TSX AXM 172	TSX AXM 182 /162
Range	± 10 V	± 10 V
True range	- 10.24 V to + 10.24 V	- 10.24 V to + 10.24 V
Resolution	10 bits + sign	12 bits + sign
LSB value	10 mV	2.5 mV
Divert value	0 V	0 V
Monotonicity	yes	yes
Differential linearity	+ 0.024 in % of FSR	+ 0.024 in % of FSR
Max. output load	1 Kohm	1 Kohm
Recovery time	≤ 100 µs	≤ 200 µs
Max. output rate	± 10 mA	± 10 mA
Protection	Against shorting and overloading	

Precision at 25°C. (with offset adjusted)

Gain error	± 2.6 %	± 2.6 %

Temperature drift

Gain drift	137 ppm/°C	137 ppm/°C
Offset drift	2 ppm/°C FSR	2 ppm/°C FSR

FSR: Full Scale Range, i.e. 10.24 V.

Internal logic isolation	1500 Veff	1500 Veff
Isolation resistance	1000 Mohm	1000 Mohm
Impedance/to ground	20 Mohm 0.1 µF 630V	20 Mohm, 0.1 µF

Reminder: The component controlled by the analog output must be isolated from the mains.

Output Characteristics

Relay outputs

	Common to TSX AXM 172/182/162
AC operating voltage	24 VAC
DC operating voltage	5 to 24 VDC
Admissible switchable AC current	0.4 A (1)
Admissible switchable DC current	0.8 A (2)
Minimum admissible load	0.5 mA at 1 V
Response time to close	< 5 ms
Response time to open	< 5 ms

(1) Admissible current for 0.5 million operations. For 1 million operations, the admissible current should be I = 0.2 A. If an inductive load is used, fit an RC circuit to it where RC > 22nF // 47 ohm.

(2) Admissible current for 1 million operations. For 4 million operations, the admissible current should be I = 0.4 A. If an inductive load is used, fit a discharge diode to the load terminals.

Protection :

The outputs are not protected against shorting. It is recommended that a fuse be fitted in series with the power supply (3.15 A).

Isolation :

	Common to TSX AXM 172/182/162 modules
Between channels (inputs or outputs)	500 Veff
Between outputs and bus	1000 Veff
Between contacts on the same output	500 V

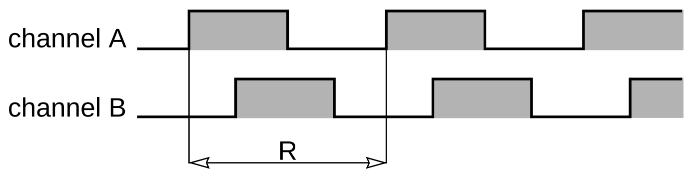
8

A.1 Determining Parameters

Reminder TSX AXM modules determine the position measurement value from data sent by a phase shifted incremental encoder. The number of pulses is proportional to the distance traveled by the moving part. The phase shift between signals A and B indicates the direction of motion.

RESOL parameter: Resolution

This is the distance that must be covered by the moving part to obtain a variation of one increment in the sensor signal (or the distance separating two consecutive rising edges on the same channel).



Where :
N = Number of pulses per revolution (rotary sensor) or along the length of the linear measurement.

L = Usable measurement length.
With a linear measurement, the calculation of R is immediate:

R = L/N

When a rotary encoder is used, be sure to allow for the position of the reduction gearing.

R = ne . Pitch / N

ne = Equivalent reduction ratio. It is the product of the reduction ratios between the encoder and the pitch (e.g. ne = 1).

In all cases:

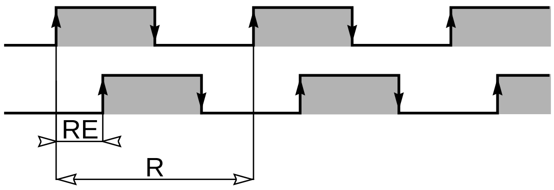
Vl = F.R and e = I.R

Vl : Linear velocity,
e : Distance travelled,
F : Frequency,
I : Number of increments for a given motion.

Determining Parameters

TSX AXM 182 / 162 Special features: Quadruple multiplication.

Whereas a TSX AXM 172 module takes into account the rising edge on signal A to determine the distance travelled, TSX AXM182 /162 modules take into account both rising and falling edges of signals A and B.



The value of parameter R that must be entered in the configuration always corresponds to the distance between two successive rising edges on the same channel, but TSX AXM 182 / 162 modules evaluate the distance travelled using an equivalent resolution value RE that is four times greater. This ensures:

- Greater precision and therefore improved motion data, or
- The same level of precision with four times the resolution and therefore a maximum speed that is four times greater).

Example: System specifications require a precision of 1/1024th of a revolution:

1st case: Select a 1024 pts/rev encoder: the equivalent resolution that sets the precision is 1/4096th of a revolution.

2nd case: Select a resolution corresponding to the required precision: It is then possible to select a 256 pts/rev encoder.

Determining Parameters

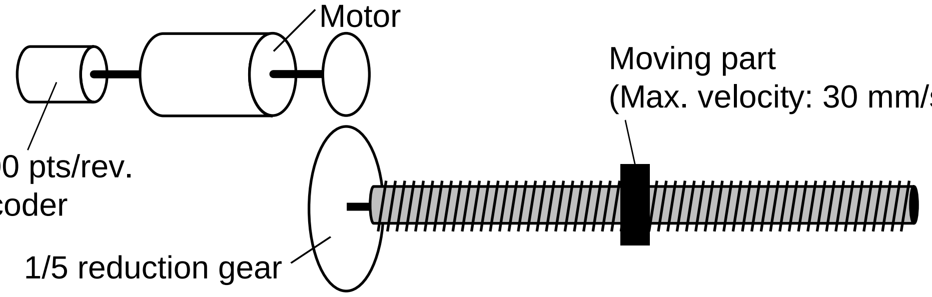
VMAX parameter: Maximum operating velocity

This is closely related to the selected resolution and can never exceed a value corresponding to an input frequency of:
- 36 kHz for a TSX AXM 172 module,
- 72 kHz for TSX AXM 182 / 162 modules.

UMAX and LIMV parameters:

UMAX is the voltage that must be applied to the input of the speed drive to obtain a velocity equal to VMAX.
As far as possible, set the speed drive to obtain the maximum velocity VMAX at a voltage that is as close as possible to 9 V without exceeding this level. Restricting the voltage to 9 V means that during speed transition periods there is enough of a reserve to allow a temporary overvoltage. The amplitude of this overvoltage is determined by the LIMV value: If there are no mechanical restrictions, caused either by the maximum acceptable frequency or by the module, the following values should be selected:
UMAX = 9 V and LIMV = 10 %.

Example: To control an axis with the following characteristics:



The maximum linear velocity is 30 mm/sec. or 1800 mm/minute.
The axis is driven by a motor that can run at 3000 rpm, driving a screw via a 1/5 reduction gear. The encoder is located on the motor shaft. An open collector encoder output is assumed (requiring the use of a TSX AXM 172 module).

- The Resolution parameter (distance traveled by the moving part between two encoder increments) is equal to:

$$\text{Me} \bullet \frac{\text{Pitch}}{N} = \frac{1}{5} \times \frac{5}{1000} = 1\ \mu\text{m}$$

- The VMAX maximum operating velocity parameter is 1800 mm/minute.
- Assuming it is possible to adjust the speed drive to obtain maximum velocity at a level of 9 V on the input to the speed drive.
  The UMAX parameter is therefore 9 V.
- A 10 % overvoltage during transition to full speed is allowed.
  The LIMV parameter is therefore 10.

> Coherence of the RESOL, VMAX and UMAX parameters must absolutely be ensured or incoherent results will be obtained from the servo loop during normal operation.

Determining Parameters

Parameters XMAX, XMIN (limit switches),
UPUL, UPUV, UPUA (length, velocity and acceleration display units),
ACCE, DECE (acceleration, deceleration),
The tables on pages A/5 and A/6 show the following data for each type of module, depending on the selected value of the VMAX parameter:

- The maximum axis length (maximum values allowed for parameters XMAX and XMIN),
- The min. and max. values of the acceleration and deceleration parameters,
- The display units (length, velocity, acceleration) allowed,

along with the length unit used by the module (given for information only).

Parameters VSTOP, TSTOP
TW, DMAX
KPOS, KV
The values used for the various parameters are closely related to the type of process to control and the performance levels required from the servo loop. It is therefore difficult to give typical values. Without any precise indications, the parameters can be initialized with the values recommended for the Adjust/Set-up phase, i.e.:

Parameters	Value
VSTOP	VMAX / 10
TSTOP	1 sec
TW	(XMAX-XMIN) / 10
DMAX	(XMAX-XMIN) / 10
KPOS	16
KV	0

The first four parameters can then be adjusted experimentally from a TSX XBT 182 terminal.
For servo loop parameters (KPOS, KV) it is possible to preset their values as described on pages A/7 and A/8. Naturally, this does not remove the need for later adjustment of these values.

TSX AXM 172 Module Performance

VMAX ≤ 2.16 x resol
(m / mn) (µm)
0.1 µm ≤ RESOL ≤ 1000 µm

Depending on the maximum application velocity selected, this table lists the other maximum application parameter values.

VMAX appli. m/mn		≤ 2.16	≤ 4.32	≤ 8.64	≤ 17.28	≤ 34.56	≤ 43.2	≤ 86.4	≤ 172.8	≤ 345.6	≤ 432	≤ 864	≤ 1728	≤ 2160
Axis length (meters)		±13.15	±26.3	±52.65	±105.35	±210.7	±263.4	±526.5	±1053.5	±2107	±2634	±5269	±10539	±13150
ACCEL min. mm/s^2		1					10				100			
ACCEL max. m/s^2 (1)		3.6	7.2	14.4	28.8	57.6	72	144	288	576	720	1440	2880	3600
Display Units	UPUL	µm, mm, cm, m					mm, cm, m				mm, cm, m			
	UPUV	mm/mn, cm/mn, m/mn					cm/mn, m/mn				m/mn			
	UPUA	mm/s^2, cm/s^2, m/s^2					cm/s^2, m/s^2				m/s^2			
Length Calcul. Unit (2)		µm					x 10 µm				x 100 µm			

(1) Theoretical value corresponding to the acceleration rate that lets the moving part go from 0 to VMAX in 10 ms,

(2) Internal calculation unit used by the module. This unit must be used for positions sent by the PLC to the module via registers OWxy,6/7 and those sent from the module to the PLC on registers IWxy,6/7 (current position) and IWxy,5 (deviation).

TSX AXM 182 / 162 Module Performance

VMAX ≤ 4,32 x resol
(m / mn) (µm)
1.0 µm ≤ RESOL ≤ 1000 µm

Depending on the maximum application velocity selected, this table lists the other maximum application parameter values.

VMAX m/mn		≤ 5.4	≤ 10.8	≤ 21.6	≤ 43.2	≤ 54	≤ 108	≤ 216	≤ 432	≤ 540	≤ 1080	≤ 2160	≤ 4320
Axis length (meters)		±30	±60	±120	±240	±300	±600	±1200	±2400	±3000	±6000	±12000	±24000
ACCEL min. mm/s^2		1					10				100		
ACCEL max. m/s^2 (1)		4.5	9	18	36	45	90	180	360	450	900	1800	3600
Display Units	Length	µm, mm, cm, dm, m					mm, cm, dm, m				mm, cm, dm, m		
	Velocity	mm/mn, cm/mn, dm/mn, m/mn					cm/mn, dm/mn, m/mn				m/mn		
	Accel.	mm/s^2, cm/s^2, dm/s^2, m/s^2					cm/s^2, dm/s^2, m/s^2				m/s^2		
Length Calculation Unit (2)		µm					x 10 µm				x 100 µm		

(1) Theoretical value corresponding to the acceleration rate that lets the moving part go from 0 to VMAX in 20 ms (2 module cycles),

(2) Internal calculation unit used by the module. This unit must be used for positions sent by the PLC to the module via registers OWxy,6/7 and those sent from the module to the PLC on registers IWxy,6/7 (current position) and IWxy,5 (deviation).

Predetermining the parameters of the servo loop

Position gain (KPOS)

The performance of the mechanical system are usually expressed as a function of position gain KPOS.

KPOS = V / de

V : Velocity,
de : Deviation error.

The velocity and the position are measured at the same point on the machine.

KPOS: Represents the static gain of the transfer function with an open loop. If the velocity is constant, KPOS represents the inverse value of the time required to absorb the deviation error. This value is expressed as 1/second.

Increasing the position gain KPOS improves precision. Reducing KPOS improves system stability, causing a precision/stability trade-off).

When the speed drive is correctly set-up, complete machine system performance can be expressed by the following approximation formula:

$4\ m^2.KPOS.T = 1$

T = Time constant for the complete speed drive/motor/mechanical system.

m = Stability factor.

Overshoot value on an indice response as a function of m:

Overshoot	50%	4%	0%
m	0.2	0.707	1

Example:

If T = 30ms and the user requires a maximum overshoot of 4%, m = 0.707, the resulting value of KPOS is:

$KPOS = 1/4m^2.T = 1/(4.(0.707)^2.30.10^{-3}) = 16\ s^{-1}$

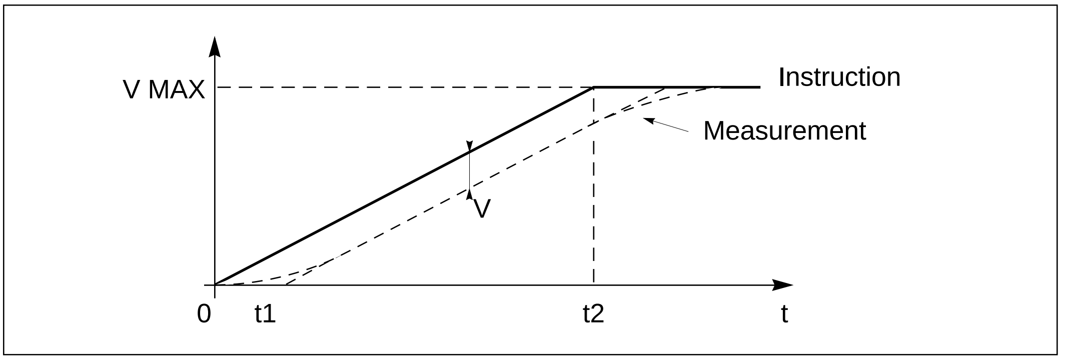
Determining Parameters

Identifying the parameter T

- Set a speed drive value with a linear evolution over time. The slope should be such that the speed drive does not have to limit the intensity level of the signal,
- Read the velocity instruction and the actual velocity (from the tachometer-dynamo),
- In these conditions T is given by one of the two formulas listed below:

T = t1

T = V/P where P = VMAX / t2



Feed forward gain KV

The feed forward gain factor set by the user is expressed as a percentage. 100% corresponds to the value that would totally absorb the deviation error at constant velocity for a speed drive that has no continuous velocity error.

When KV increases, the deviation error is reduced but the risk of overshoot, including target point overshoot, increased. It is therefore up to the user to find a compromise that ensures sufficient accuracy.

Note: In some case, the deviation error passes through a minimum value with a possible change of sign when the value of KV is increased.

The fact that there are two separate adjustments (KPOS and KV), lets the user obtain the best possible compromise for each application, between precision, stability and velocity.

Assuming that the speed drive is correctly adjusted, the transfer function is as follows:

$$\frac{e(p)}{eref(p)} = \frac{(1+ KV.p/100.KPOS)}{T.p^2/KPOS + p/KPOS +1}$$

e(p) = A Laplace transform of the expression of actual machine motion over time.

eref(p) = A Laplace transform of the required machine motion over time (servo loop reference).

A.2 Servo Loop Performance

Error transfer function

$$\frac{de(p)}{eref(p)} = \frac{p}{KPOS} \;.\; (Tp + 1 - KV/100) \;.\; \frac{1}{T.p^2/KPOS + p/KPOS + 1}$$

This function lets the user determine theoretical average error values after stabilisation depending on the input signal. It is assumed that there is no continuous speed drive error.

Note: All of these formulas are provided for information only, they assume that the machine system is fully set up and correctly adjusted.

Response to a step: eref(t) = Constant

$$\underset{t \to \text{infinity}}{de(t)} = \pm R + dev$$

R : resolution
dev : induced error due to the speed drive (*).

Reponse to a slope: eref(t) = V.t (V = velocity)

$$\underset{t \to \text{infinity}}{de(t)} = \frac{2}{KPOS} \;.\; (1 - KV/100)\, V \pm R + dev$$

or

$$\underset{t \to \text{infinity}}{de(t)} = R \;.\; (\pm 1 + \frac{72000}{KPOS} \;.\; k \;.\; (1 - KV/100)) + dev$$

with $k = \frac{\text{operating velocity}}{\text{maximum velocity}}$

Response to a 2nd degree function: eref(t) = 1/2 A.t^2
(A = acceleration)

- where KV = / 100 $\underset{t \to \text{infinity}}{de(t)} = \text{infinity}$

- where KV = 100 $\underset{t \to \text{infinity}}{de(t)} = \frac{2}{KPOS}\; T.\,A + R + dev$

If the variable Ta = VMAX/A is introduced

$$\underset{t \to \text{infinity}}{de(t)} = R\, (\pm 1 + \frac{72000}{KPOS} \;.VMAX\;.\; \frac{T}{Ta}) + dev$$

(*) Note: $dev(t) = dy(t) \;.\; ne \;.\; \frac{Pitch}{KPOS.\, H}$

where 1/H = static gain of the entire speed drive/motor assembly
dy(t)= error in volts on the input to the speed drive

A.3 Glossary

Axis referenced

Module status once the reference point has been set. Position measurements are only significant, and motion is only authorized in this state.

Cam

A raised plate or boss on an axis which actuates a limit switch when a moving part passes over it.

Current position measurement

Position measurement value updated every 10 ms, expressed by the module in physical units.

Default mode

An AXM program sequence that is called when a failure occurs (if divert mask = No). The starting step for this sequence is defined in the software configuration and can be modified by an instruction.

Direction discriminator

A microprogram which indicates the direction of moving part movement.

Deviation

Difference between calculated position and the actual position during motion.

Emergency stop

Motion stoppage with deceleration declared in the configuration.

Event

A rising or a falling edge detected on input In3.

Forced reference point setting

Procedure used for loading the current position measurement value at a predefined value in the external position register on a command from the PLC processor. This operation references the axis.

Higher soft stop (XMAX)

Higher position measurement that must not be exceeded by the motion of the moving part (set in the configuration).

Incremental encoder

A device for measuring movement that generates a pulse for each increment of linear or rotary movement. The direction is defined by two 90° phase-shifted signals.

Lower soft stop (XMIN)

Lower position measurement that must not be exceeded by moving part motion (set in the configuration).

Machine characteristic factor

Machine parameter adaptation characteristics. An XBT self-adjustment procedure is used to add precision to the value and to avoid any possible loss of precision in the definition of these machine parameters.

Module physical units

Physical units that are directly used as I/O by the module, especially for register interfaces.

Move

A succession of basic motions

Parametered indexed position (PRF)

Index value for calculating indexed positions, absolute position = index (PRF) + indexed position.

Glossary

Point field

The field of all measurement points, limited by the maximum counting capacity: -2,147,483,648 and +2,147,483,647 increments.

Point to point

A series of instructions between two motion instructions with stop commands.

Positions :

External : Position sent by the PLC program or by the TSX XBT to the module,
Immediate : Position explicitly contained in the instruction,
Indexed : Position referenced in relation to the PRF index value,
Internal : Position stored in the module by a teach procedure or by program (LDP instruction).

Reference point

Machine axis measurement reference point.

Reference point set-up

Procedure for loading the current position measurement value by moving part motion or loading the preset value into the current value on the occurrence of an event (In2/In3).

Return from soft stop overshoot

After a soft stop overshoot, low velocity moving part return within the soft stops.

Safety system

In this mode a PLC processor fault or stopping the PLC causes the immediate and systematic movement stoppage.

Target window

(TW parameter) positioning tolerance around the stop point.

User units

Physical units for display and entry of all values with PL7-AXE software or TSX XBT terminals.

Valid measurement field

The field of measurement points between the two soft stops.

Feedforward gain

A factor used to adjust the velocity anticipation action of the positioning servo loop (a compromise between the dynamic position error and the stop point overshoot).

Speed reference

Theoretical moving part velocity calculated by the module using the maximum acceleration and velocity rules.

Velocity correction coefficient

A multiplication factor applied to all velocities configured and programmed in the module (velocity peaks restricted to VMAX).
Variation : 0.01 to 1.99 for TSX AXM 172 module
0.001 to 1.999 for TSX AXM 182 / 162 modules

Zero mark

A pulse supplied by a rotary incremental encoder. It is sensed on each complete axis revolution (connect to In2).

Functions not available on TSX AXM 162 module

A.4 Abbreviations

A	ACCE	Acceleration
	AXM (pgm)	AXM program. AXM module internal program
C	CONF	Configuration
	CNi	Internal counter
	CP	Current position
	CPU	PLC processor
	CPUF	CPU Fail (PLC processor)
D	DAC	Digital/Analog converter
	DECE	Deceleration
	DI3	Falling edge on input In3
	DMAX	Max. deviation
E	EVENT	Event
	EXT	External (position)
F	F	Velocity
I	IEXT	Indexed external position
	IPmm	Immediate position
	IT	Interrupt
	IWNi	Indexed internal position
K	KPOS	Position gain
	KR	Machine characteristic factor
	KV	Feed forward
L	LIMV	Velocity limit
M	MCPUF	CPUF divert mask
	MDMAX	Position error divert mask
	MSTOP	Stop check divert mask
	MSYN	Synchronization fault divert mask
	MTW	Target window fault divert mask
N	NBWN	Number of WNis stored
	NCPUF	Divert step, CPUF
	NDMAX	Divert step, deviaiton error
	NSTOP	Divert step, stop check error
	NSYN	Divert step, synchronization error
	NTW	Divert step, on target window error
O	OUT	Discrete output (R3, R2, R1 set)
P	PARAM	Parameter
	PRF	Position index value
	PCPU	Part of the PLC program dedicated to axis control
T	TYPEREF	Type of reference point
	TSTOP	Stop time-out
	TSYN	Synchronization time-out
	TW	Target window

Abbreviations

U	UI3	Rising edge on input I3
	UMAX	Speed reference for speed controller corresponding to VMAX
	UPUL	User defined length unit
	UPUV	User defined velocity unit
	UPUA	User defined acceleration unit
V	VMAN	Velocity manual mode
	VSTOP	Maximum velocity level when “stopped”
W	WNi	Internal module position
X	X	Position
	XMAX	Higher soft stop
	XMIN	Lower soft stop

A5 Formulas

TSX AXM Configuration Formula

Module units: Length =.................. Velocity =.................. Acceleration =...................

Access	XBT Function	Parameters	Values
A	F31	RESOL sensor resolution	.... µm
A	F32	VMAX maximum velocity	.... mm/mn
A	 F33 F34 F35	USER SELECTED UNITS: • UPUL Length • UPUV Velocity • UPUA Acceleration	 µm, mm, cm, dm, m mm/mn, cm/mn, dm/mn, m/mn mm/s², cm/s², dm/s², m/s²
A	F36 F37	XMAX Higher soft stop XMIN Lower soft stop	....
C	F38 F39	ACCE Acceleration DECE Deceleration	....
B	F40	TYPEREF Type ref. point setting	1 2 3
B	F41	VMAN manual velocity	....
C C	F42 F43	VSTOP velocity at “stop” TSTOP stop time-out	....10 ms
C	F44	TW target window	....
C	F45	DMAX max. deviation error	....
B	F46	UMAX VSD instruction for VMAX	....
B	 F47 F48 F49	POSITION LOOP: • KPOS Position gain • LIMV Exceed velocity value • KV Velocity feedforward	 .... 1/s .... % Vmax .... %
B C	F50 F51	MDMAX divert mask for DMAX NDMAX divert step nbr. for DMAX	Y N ....
B C	F52 F53	MSTOP divert mask for VSTOP NSTOP divert step nbr. for VSTOP	Y N ....
B C	F54 F55	MTW divert mask for TW NTW divert step nbr. for TW	Y N ....
C B C	F56 F57 F58	TSYN Sync. time-out MSYN Sync. divert mask NSYN Sync. divert step nbr.	.... 10 ms Y N ....
B B	F59 F60	MCPUF Divert mask for CPUF NCPUF Divert step on CPUF	Y N ....
A		NBWN Number of saved WNs	....

Access: A= modify in configuration, B= mod. in config. and with XBT, C= B + modify by program

Formulas

TSX AXM Programming Sheet

Axis Nbr.:
Application Nbr.:
Location Address:

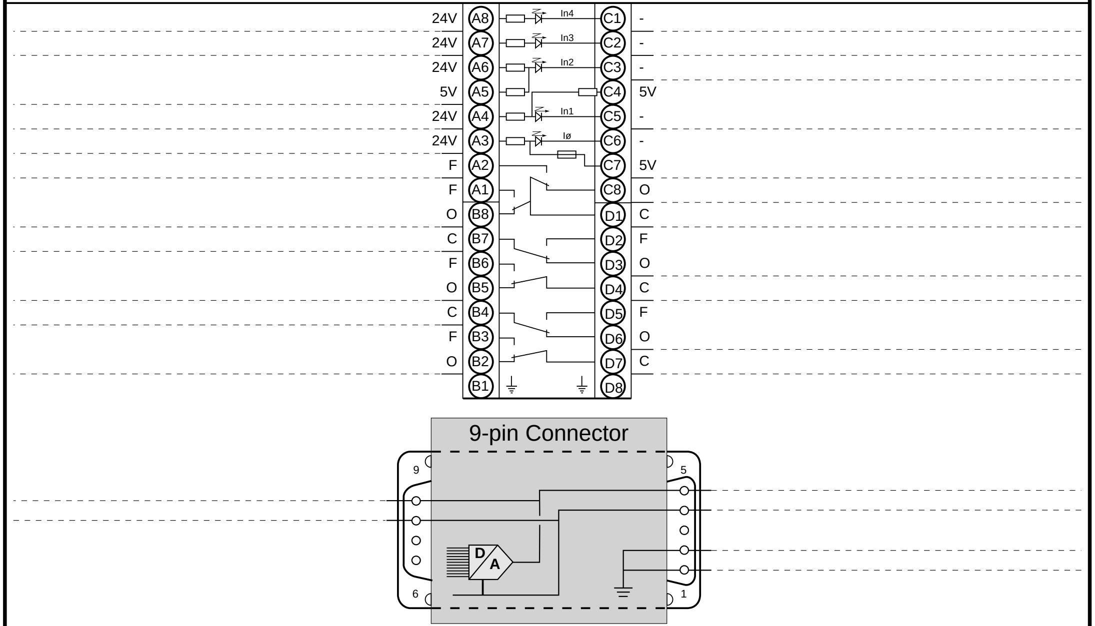
TSX Address: .W..
Archive Name:
Application Name:

Step Nbr	INSTRUCTIONS	COMMENTS

	Update	By	Date	Design	Draftsman	Date	
	A..............	....	....				Sheet
	B..............	....	....				
	C	....	....				

TSX AXM 172 WIRING SHEET

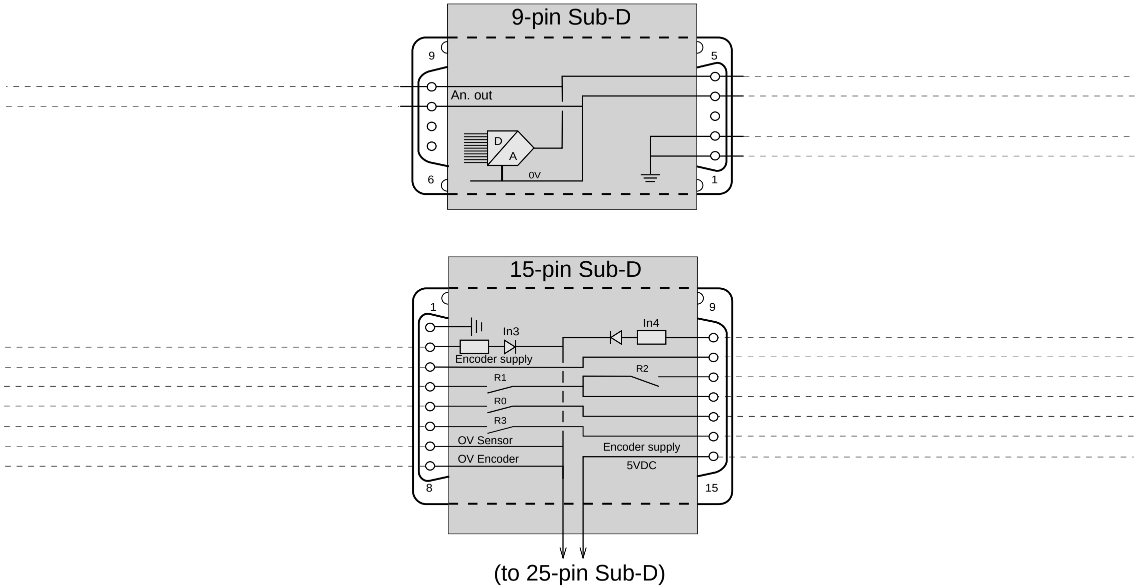
Wiring	TSX BLK 4 Terminal Block	Wiring



Update	By	Date	Design	Draftsman	Date	Telemecanique
A						
B						
C						

TSX AXM 182 / 162 WIRING SHEET

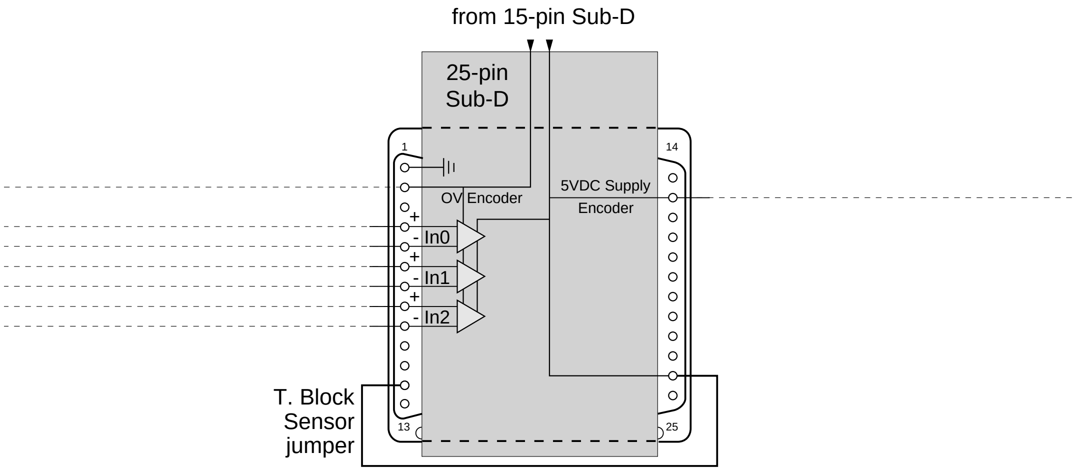
Wiring	Connector	Wiring



Update	By	Date	Design	Draftsman	Date	Telemecanique
A						
B						
C						

TSX AXM 182 / 162 WIRING SHEET

Wiring	TSX BLK 4 Terminal Block	Wiring



Update	By	Date	Design	Draftsman	Date	Telemecanique
A						
B						
C						

A.6 Index

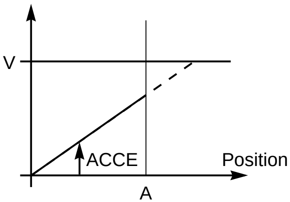
A.7 Application Diagnostics Assistance

Experience with axis control modules has shown that some situations may appear unusual. These are recognized by:
• Refusal to execute a command (1),
• Unusual module response.

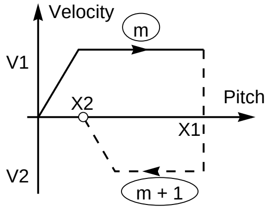
The tables shown on the following pages show examples of typical symptoms that may occur along with their probable cause and the recommended corrective action that the user should attempt to solve the problem.
This manual does not attempt to list all possible error conditions and the list may be completed by the user's own experience.

(1) A COMMAND REFUSED message causes:
• The module to stop,
• The module program to stop on the instruction that caused the refusal,
• RFS CDE in the register interface to be set to 1 (IWxy,1,D),
• The error LED on the TSX XBT 182 terminal to light.

Refusal to execute a command

Symptoms	Probable Cause	Corrective Action
Command refusal when executing a command. GP1 F = X = **Note**: This situation may occur: • When execution is requested, • When a **resume** command is sent after an error, • When a **restart** command is sent after **stop.**	The distance to travel does not allow the moving part to reach the specified velocity.  0 : Initial position, A: Target position, V: Velocity to reach at point A,	1 Immediately: • Increase the acceleration value, or • Move the moving part in manual mode in the opposite direction. 2 Later: • Modify the program.
Command refusal when executing a move to target position instruction or a motion command in **manual** mode.	Axis not referenced (set-up).	Calibrate (set-up) the axis.
Command refusal when executing a move to external set point instruction. GP1 F = X = EXT or GP9 F = X = EXT	The target point in the EXT register (OWxy,6/7) is outside of the valid interval (> HSS or < LSS).	Check the coherence of the value sent in relation to module measurement units.

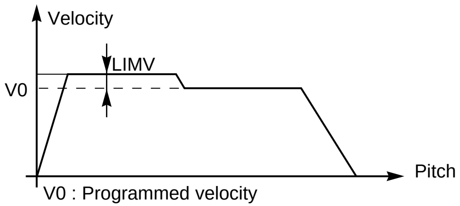
Refusal to execute a command

Symptoms	Probable Cause	Corrective Action
Command refusal when synchronizing two GP1 instructions. m GP1 F = V1 X = X1 m+1 GP1 F = V2 X = X2	The two instructions generate motion in opposite directions.  Reminder: Reversing the direction of motion without first stopping the moving part is not allowed.	1 Immediately: • Resume program execution from the step corresponding to the instruction that caused the **command refusal**. 2 Later: • Modify the program. To immediately reverse the direction of motion, use the following procedure: m-1 RCTL STOP m GP1 F = V1 X = X1 m+1 STOP m+2 GP1 F = V2 X = X2 Select maximum deceleration and acceleration rates compatible with the mechanical system.
Command refusal when executing a move to indexed position instruction. GP1 F = X = I + x or GP9 F = X = I + x	• The value in the PRF register does not meet the condition: LSS ≤ PRF ≤ HSS	This check, that may not be justified, cannot be deleted. To avoid this symptom, give the soft stops symmetrical values in relation to 0.

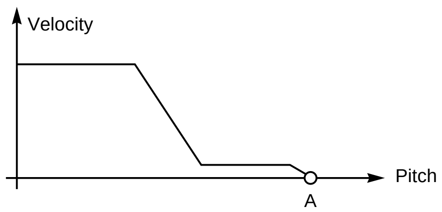
Refusal to execute a command

Symptoms	Probable Cause	Corrective Action
Command refusal when executing a move to indexed point instruction. GP1 F = X = I + x or GP9 F = X = I + x	The target point (PRF + x) is outside of the valid interval. (Programming error).	Correct the program.
Command refusal after encountering a **TRAP** instruction in the AXM program.	• No END instruction in the program, • No jump to step instruction programmed, • No divert to step instruction programmed, • Wrong start step programmed.	Correct the program.
Command refusal when Forced Reference Set-up is requested or Open Loop mode selected or when the mode selected is not present.	Refusal is justified.	Perform a Forced Ref. Set-up in another mode. **Reminder :** if the axis is not referenced POFOR cannot be performed except in the POMAN and AUTO modes
Command refusal (with an XBT terminal system error) when a motion command is requested in **Manual Mode.**	In Manual Mode the target point is: * HSS - 2 x TW in + direction, * LSS + 2 x TW in - direction. A **command refusal** occurs if the moving part has already overrun the soft stops and the command would move it even further away from the stops. This situation occurs especially when the Target Window value is too "large".	• Check the Target Window value and adjust it again if necessary, • Move the moving part in the reverse direction.

Unexpected servo loop performance

Symptoms	Probable Cause	Corrective Action
Deviation increases during travel.	• Inadequate LIMV parameter value, • Incoherent RESOL and VMAX parameters.	• Increase the value of LIMV, • Check the calculations for RESOL and VMAX.
Stop error occurs even before the moving part has stopped.	Incoherent RESOL and VMAX parameters.	Check the calculation of these parameters.
During motion, the velocity follows the variation shown below.  	The acceleration value set in the configuration is too large in relation to the performance of the mechanical system. **Note**: The servo loop is still able to absorb the deviation error over time.	Optimize the value of the ACCEL parameter and, if required adjust the servo loop parameters (KPOS and KV).

Unexpected servo loop performance

Symptoms	Probable Cause	Corrective Action
In **Manual Mode**, when the X+ or X- command is released, the moving part restarts in the reverse direction before stopping. In **Auto** or **Assisted Manual Modes**, the moving part overruns the target before returning to it.	The deceleration value set in the configuration is too great in relation to the performance of the mechanical system.	Optimize the value of the DECEL, parameter and, if necessary, reset the servo loop adjustment parameters (KPOS, KV).
The moving part jerks (oscillation effect around the target).	These effects show servo loop parameters that are set too "tightly".	Reset the KPOS and KV parameters.
The target point is reached as shown below. 	These effects show servo loop parameters that are set too "loosely".	Reset the parameters, in particular, increase the value of KV. Attention: Increasing the parameter values may cause performance instability.

Other errors

Symptoms	Probable Cause	Corrective Action
The **return from soft stop overrun** command has no effect (i.e. the moving part is not returned within the valid interval).	The output voltage from the module is not enough to overcome the inertia of the mechanical system.	Increase the value of the DECEL parameter (which defines the velocity to apply when returning from soft stop overrun).
An error occurs when a new mode is selected. AUTO → MAN	A "residual" error is present. Example: A deviation error was detected and processed at module program level and by a divert sequence. However, the accumulated deviation was not absorbed. Therefore the error remains when the user selects AUTO → MAN.	Use the normal acknowledgment procedure: Abort (or Resume).
A stop error or a target point error at step m (or another motion instruction) m GP9 F = X = m + 1 GP9 F = X = Acknowledging the error by resuming motion will cause the same error to reoccur.	Acknowledgment by a resume command resets the check before restarting execution of the next instruction. If conditions have not changed, there is still a risk that the error will occur again.	Increase the tolerance to avoid unexpected errors, or in the case of a Target Window error, return the moving part to the required position using some other means.

Introduction

Divider C covers the presentation of the PL7-AXS Axis Control program. This divider comprises three parts:

- **C1** A short description of the various program components.
- **C2** A description of the axis control implementation program and its use with TSX AXM 172/182 / 162 axis control modules.
- **C3** A description of axis control Optional Function Blocks, known as OFBs. These are a new extension of PL7-3 language designed to simplify programming and to control intelligent modules from the PLC processor.

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TXT L PL7-AXS V4 Axis Control Program

C1 Introduction

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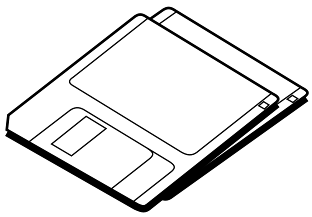
2 TXT L PL7 AXS V4 Axis Control Program 2

2.1 Hardware Presentation

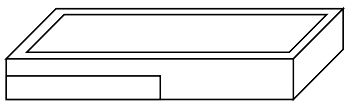
The TXT L PL7 AXS V42 software pack comprises:

- Two 3 1/2" program diskettes:
  - The PL7-AXE set-up program diskette: TXT LF PL7 AXS V42,
  - The OFB diskette comprising AXM LD, AXM DG and AXM PG OFBs: TXT LF FB AXS V42,
- A software access key,
- This manual, TXT DM PL7 AXS V4E.

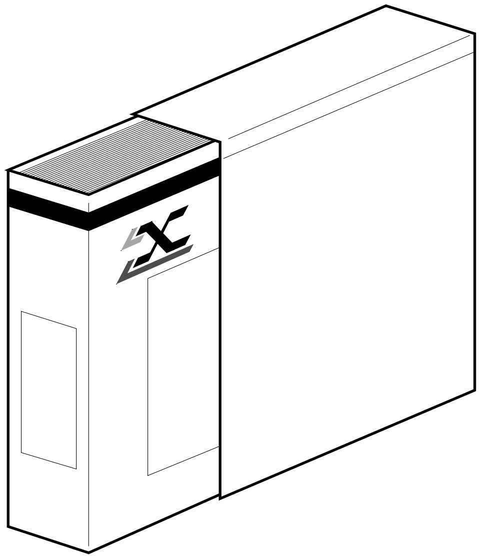
Diskettes



Software Key



TXT DM PL7 AXS V4E
Documentation



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2.2 PL7-AXE Implementation Program

Purpose

The PL7-AXE program is a multi-lingual program allowing the user to select English, French, German, Italian or Spanish as the working language. It runs on an FTX 507 workstation or on an IBM PS/2 (or compatible computer) for use in setting up and implementing TSX AXM axis control modules and their applications. It provides:

- A menu driven user interface that assists the user when entering application parameters,
- An editor for creating and modifying AXM programs (using PIC language),
- The ability to store programs on diskette and to print out program listings,
- The ability to transfer the application (machine parameters and motion program) to various forms of memory storage.

Working Memories

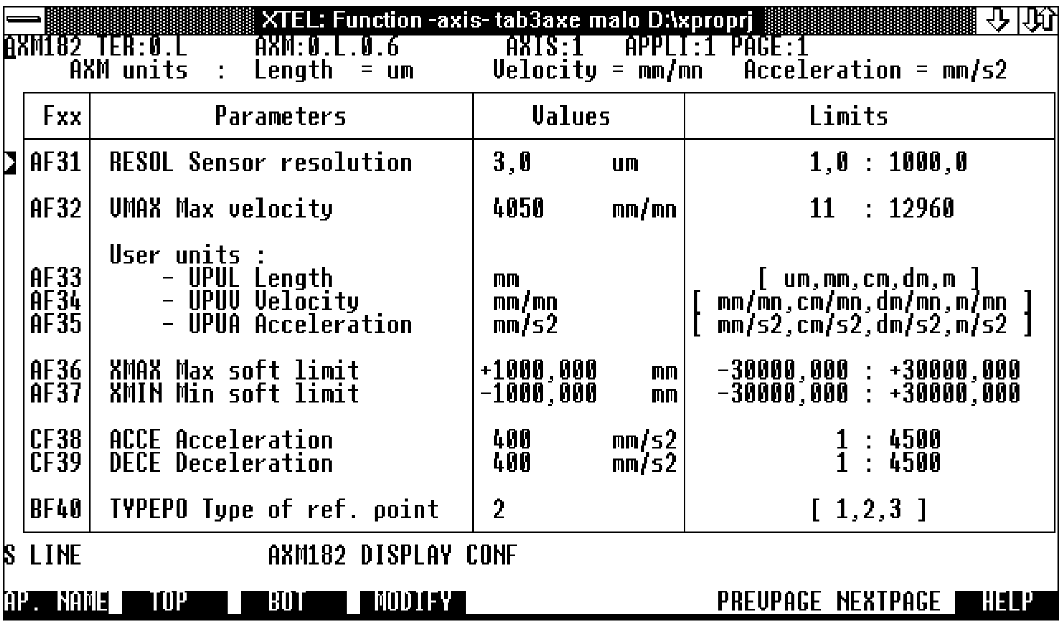
The PL7-AXE program lets the user develop applications for TSX AXM modules directly in various storage locations:

- Hard disk when working in a design office environment,
- PLC memory when storing applications,
- TSX AXM module internal memory when executing the program.

Parameter Entry

The Configuration mode lets the user access a set of screens that allow entry of the various application parameters:

- Axis parameters (sensor resolution, maximum velocity, etc.),
- Servo loop parameters (position gain, etc.),
- Operating parameters (user specified measurement units, error processing, etc.).


XTEL: Function -axis- tab3axe malo D:\xproprj
AXM182 TER:0.L AXM:0.L.0.6 AXIS:1 APPLI:1 PAGE:1
AXM units : Length = um Velocity = mm/mn Acceleration = mm/s2

Fxx	Parameters	Values	Limits
AF31	RESOL Sensor resolution	3,0 um	1,0 : 1000,0
AF32	VMAX Max velocity	4050 mm/mn	11 : 12960
	User units :		
AF33	- UPUL Length	mm	[um,mm,cm,dm,m]
AF34	- UPUV Velocity	mm/mn	[mm/mn,cm/mn,dm/mn,m/mn]
AF35	- UPUA Acceleration	mm/s2	[mm/s2,cm/s2,dm/s2,m/s2]
AF36	XMAX Max soft limit	+1000,000 mm	-30000,000 : +30000,000
AF37	XMIN Min soft limit	-1000,000 mm	-30000,000 : +30000,000
CF38	ACCE Acceleration	400 mm/s2	1 : 4500
CF39	DECE Deceleration	400 mm/s2	1 : 4500
BF40	TYPEPO Type of ref. point	2	[1,2,3]

S LINE AXM182 DISPLAY CONF
AP. NAME TOP BOT MODIFY PREVPAGE NEXTPAGE HELP

PL7-AXE Implementation Program

Program Entry

```
XTEL: Function -axis- tab3axe malo D:\xproprj
AXM182 TER:0.L      AXM:0.L.0.6        AXIS:1    APPLI:1   TOP

 0   LDC    CN0    VAL= 4
 1   SRP+   F= 1000    mm/mn    X=   0,000       mm
 2   WAIT   EVENT= UC
 3   GP9    F= 1000    mm/mn    X= -50,000       mm
 4   M      SYN= UC    OUT= 000    IT= Y
 5   WAIT   EVENT= UC
 6   GP9    F= 1000    mm/mn    X= -10,000       mm
 7   M      SYN= UC    OUT= 000    IT= Y
 8   WAIT   EVENT= UC
 9   DEC    CN0
S LINE              AXM182 DISPLAY PROG

 STEP    TOP     BOT     MODIFY   SAVE   RESTORE  PREVPAGE NEXTPAGE   HELP
```

The Program mode provides assisted AXM program entry with automatic coherence checks performed on the values entered and the configuration parameters.
The entry and modification of a program are made easy by insert and duplicate actions and by the automatic numbering of program steps.

The on-line provides the user with a list of instruction codes and their associated operands.

Other Functions Available

Debug:

Is only available when the selected working memory is a TSX AXM module. This function displays the information received from the module and can be used to control various operations (e.g. selection of an operating mode, fault acknowledgment).

Note:
A more complete set of debug functions is provided by the TSX XBT 182 operator terminal.

Program storage:

An AXM application comprising the configuration parameters, the AXM program and the internal variables can be stored on disk or in the user memory of a TSX Series 7 PLC.

- On disk: An FTX 507 workstation (or PS/2 compatible) is required when later retrieving the program,
- In the PLC user memory: The dedicated axis field allows the user to store a number of applications. The required application can be transferred using the PL7-AXE program or a TSX XBT 182 terminal or under control of the PLC program via an AXM LD OFB.

Printing:

The program lets the user print-out all or part of an AXM application on a printer connected to the terminal.

Utility functions:

These functions are specific to each type of memory storage. They let the user display a list of the applications available, delete programs and applications.

2.2 Different versions - Compatibility rules

Two versions of the PL7-AXE program are available :

- Version V4.1 (reference TXT LF PL7 AXS V4) which is only compatible with V4 configurations, that is to say for a model 40 PLC. This version, available from October 1990 to November 1991, can only be used with TSX AXM 172 and TSX AXM 182 modules and is limited to 16 axes per configuration.
- Version V4.5 (reference TXT LF PL7 AXS V42) available since December 1991, offers additional features :
  1 - Compatibility with V3 configurations (1) (model 47-30, 67-20, 87-30 PLCs),
  2 - Limited to 64 axes,
  3 - TSX AXM 162 module handling,
  4 - Image of dedicated AXE field may be generated in LOCAL mode.

Version V4.5 is completely compatible with applications generated with version 4.1.

Criteria	PL7-AXE V4.1	PL7-AXE V4.5
Number of axis	≤ 16	≤ 64 (2)
Suitable modules	TSX AXM 172 TSX AXM 182	TSX AXM 172 TSX AXM 182 TSX AXM 162
Application generated (.BIN file) in local mode	NO	YES
Compatibility with V3 configuration	NO	YES

(1) With the following restrictions :
- The directory can only be created in CONNECTED mode,
- V3 PLCs can only be used with TSX AXM 172 modules.

(2) Configuration V4 :
Up to 64 axes can be handled by the software but this is limited by the capacity of the CPU :

Type of processor	Number of modules
P47-40	4
P67-40	16
P87-40	32
P107-40	56

V3 Configuration : Number of axis limited to 16.

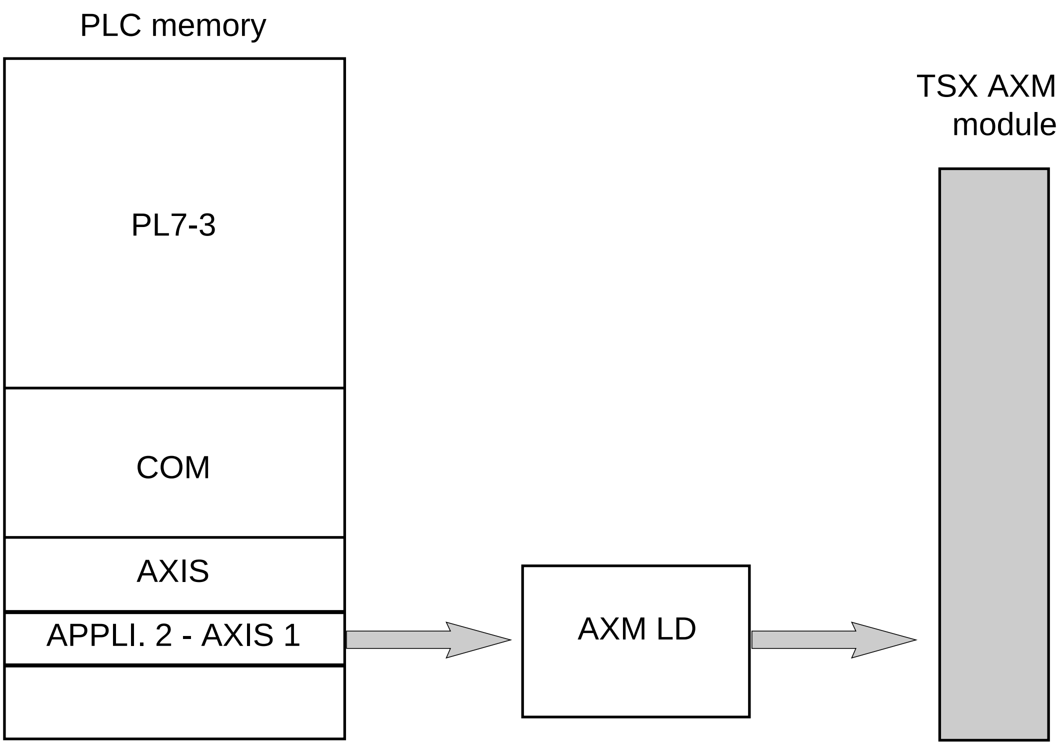
PL7-AXE Implementation Program

Section C2 of this manual (sections 1 to 8 + Appendix) describes the operation of the PL7-AXE program version 4.5 when it is used to create and debug applications which are to be executed on TSX AXM 172 or TSX AXM 182 modules in V4 type configurations.
Section C2 is applicable for creating and debugging applications for the TSX AXM 162 module given that all the restrictions mentioned in Appendix A7 are taken into consideration.
Appendix A6 provides information on the differences which are encountered by the program when it is used to generate applications which are to be executed on TSX AXM 172 modules with V3 type configurations.

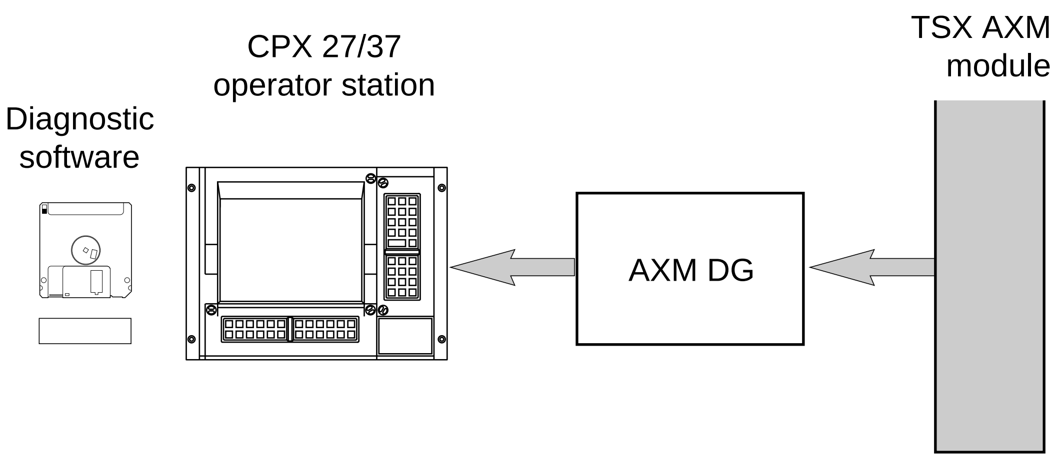
3.1 Composition

The family of axis control OFBs comprises three OFBs (1):

- AXM LD for transferring axis control applications from the PLC memory to the TSX AXM module memory.



- AXM DG that collects and formats some of the data provided by the TSX AXM modules ready for processing by the Applidiag program (diagnostics program).



- AXM PG performs all the operations necessary when starting programs for the TSX AXM 172 and 182 modules.

  It is the same as the initialization sequence in sub-section 6.4, divider B.

3.2 Different versions of OFB AXE programs

As with PL7-AXE, there are two versions of AXE OFBs.

- version V4.1 (reference TXT LF FB AXS V4) which only has the AXMLD OFB and is capable of handling up to 16 axes.
- version V4.5 (reference TXT LF FB AXS V42) which has three AXMLD, AXMDG and AXMPG OFBs and is capable of handling up to 64 axes.

Section C3 of this manual describes AXE OFB version 4.5. A procedure for updating an application presently using an AXMLD V4.1 OFB is provided in the appendix of this section.

Section	Page
1 Introduction and installation	

TXT L PL7 AXS V4 Axis Control Program

C2 - Implementation Program

C2 - Implementation Program

1.1 General

1.1-1 Functions available with PL7-AXE

PL7-AXE software, reference TXT L PL7 AXS V5E, is a help program for programming and installing axis control applications.

PL7-AXE software comprises :

- A software function for entering the configuration and program of TSX AXM 162/172/182 modules
- Optional function blocks
  - program loading OFB
  - diagnostic OFB
  - automatic mode management OFB.

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- **Functions associated with the axis control modules**
  - assistance with entering configuration and program parameters using menus and on-line documentation,
  - assistance with diagnostics and debugging,
  - transferring the configuration and the program between the PLC memory, the module memory and the disk,
  - documenting the configuration and the program,
  - archiving the configuration and the program to disk,
  - printing the configuration and the program.

1.2 Configuration required for PL7-AXE

To install PL7-AXE requires an FTX 417/507 terminal or an IBM PS/2 microcomputer or compatible PC with :

- OS/2 operating system, version 1.3 or 2.1.
- The MINI X-TEL or X-TEL Software Workshop, reference TXT L BASE V5● or TXT L BJR V5●.
- PL7-3 software, reference TXT L PL7 3 V5●, TXT L PL7 3D V5● or TXT L PL7 3T V5●.
- A minimum of 4 Mb of RAM memory and a 40 Mb hard disk.

Important

> Telemecanique cannot guarantee correct operation of this software on all microcomputers or compatible PCs on the market with the above-mentioned characteristics.

1.3 Checking the hardware

The TXT L PL7 AXS V5 software package comprises :

- A 3" 1/2 diskette, reference TXT LF PL7 AXS V5,
- A 3" 1/2 diskette, reference TXT LF FB AXS V42,
- A software protection key,
- A licence agreement,
- This manual, reference TXT DM PL7 AXS V5.

To use PL7-AXE, the following hardware should be used :

- An FTX 417/507 terminal or an IBM PS/2 microcomputer or compatible PC (see required configuration section 1.2).
- A terminal/PLC connection cable for an FTX 417/507 terminal.
- A terminal/PLC connection kit for an IBM PS/2 microcomputer or compatible PC, comprising :
  - an RS 232C/current loop converter,
  - converter/microcomputer connection cable with a 9-pin connector,
  - converter/microcomputer connection cable with a 25-pin connector,
  - converter/PLC connection cable,
  - a TSX SCC 02 software key support.

1.4 Connections

All connections specific to the terminal (monitor, keyboard, mouse, printer, software key support, etc) are assumed to be in place, this section only describes fitting the software key. To do this, place the key in the empty slot in the key support.

This operation must be carried out with the equipment switched off.

Note

This software key contains the access rights needed to access PL7-AXE. The Key Manager tool, supplied with each Software Workshop, allows these rights to be transferred to the working key so that all rights are grouped on one key (the working key) so as to free a slot on the key support.

For further details about this tool, refer to the X-TEL or MINI X-TEL database manual.

The PL7-AXE V5 software key is identical to that of PL7-AXE V4.

1.5 Installing the software

1.5-1 Preliminary operations

Before installing PL7-AXE on the hard disk it is advisable to :

- Read the licence agreement and guarantee concerning copying restrictions and installation of the software.
- Make a duplicate of the diskette required for installation to avoid any accidental damage to the original diskette and work only with the copy.

Important

The PL7-AXE program disks are supplied in the write-locked position. Do not alter the position of the locking tabs.

1.5-2 Installation procedure

The following operations must be performed prior to installing PL7-AXE :

- Check that the MINI X-TEL or X-TEL V5 Software Workshop is already installed :
  - if so, install PL7-AXE according to the procedure described below,
  - otherwise, first install the MINI X-TEL or X-TEL Software Workshop (refer to the manual for the database concerned).
- Close all the current sessions. To do this :
  - open the Electronic Office Manager window,
  - pull down the Electronic Office menu and select the "Close all..." item,
  - confirm by pressing the Close all button.

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Installing PL7-AXE software

- Open an OS/2 full-screen session. To do this :
  - open the Start Programs window,
  - pull down the Group menu and select the Main Group item,
  - select the OS/2 full-screen session item. The [C:\] prompt is displayed on the screen.
- Insert the TXT LF PL7 AXS V5 diskette in the drive.
- Enter the drive identifier (a: or b:), then confirm with <Enter>.
- From the new prompt (for example [A:\] or [B:\]), type **Install** then confirm with <Enter>.
- Follow the procedure displayed on the screen.
- When installation is complete, replace the diskette with the second diskette (reference TXT LF FB AXS V42).
- Type the **Install** command then confirm with <Enter>.
- Follow the procedure displayed on the screen.
- When the installation is complete and if it is the last one, check the configuration. Confirm with <Enter>.
- Remove the diskette from the drive and return to the Software Workshop using the <Ctrl><Esc> command.

1.6 Using the keyboard and the mouse

Using the keyboard

To use PL7-AXE , Telemecanique recommends a 102-key QWERTY keyboard.

Certain PL7-3 function keys (CLEAR, ZOOM, QUIT, etc), which are also used by PL7-AXE, are not printed as standard on the keyboard, but are accessed by another key or combination of keys.

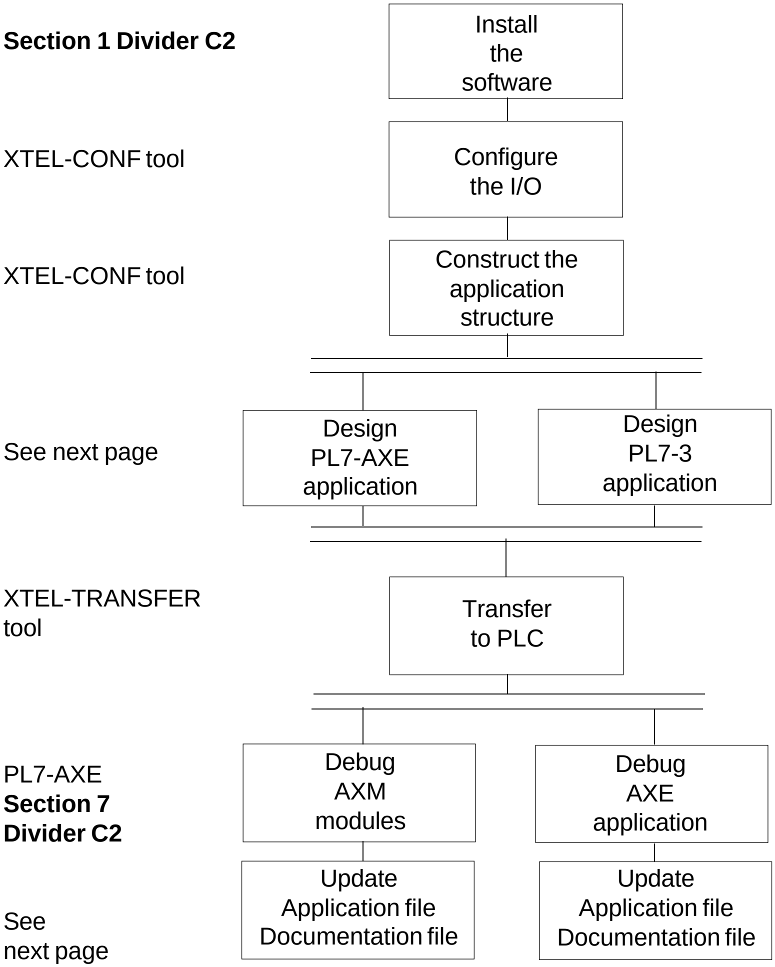
These keys, common to several programs, are described in the PL7-3 Operating modes manual, section 3.1 in divider A.

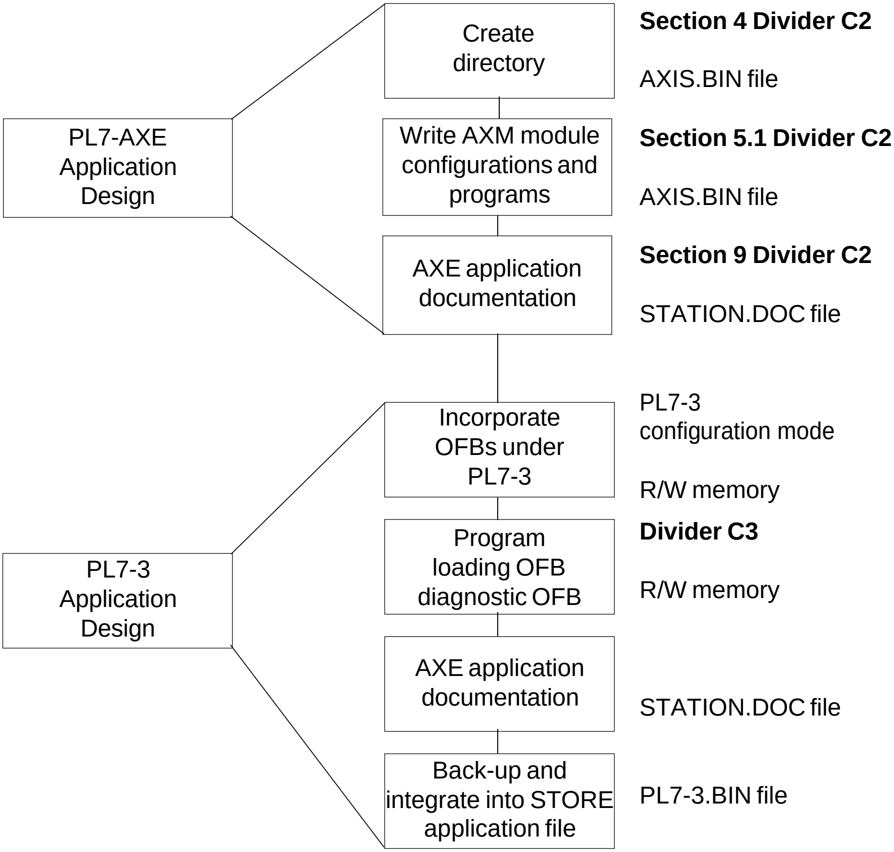
Using the mouse

As for the keyboard, detailed use of the mouse is described in the PL7-3 Operating modes manual, section 3.2 in divider A.

1.7 Methodology for installing an axis control application on a TSX/PMX V5 programmable controller

The following methodology is intended as a guide to the user when creating, debugging, archiving and documenting a communication application. This methodology refers to each operation without going into detail about the operations required.




PL7-AXE Application Design
Create directory
Section 4 Divider C2
AXIS.BIN file
Write AXM module configurations and programs
Section 5.1 Divider C2
AXIS.BIN file
AXE application documentation
Section 9 Divider C2
STATION.DOC file
PL7-3 Application Design
Incorporate OFBs under PL7-3
PL7-3 configuration mode
R/W memory
Program loading OFB diagnostic OFB
Divider C3
R/W memory
AXE application documentation
STATION.DOC file
Back-up and integrate into STORE application file
PL7-3.BIN file

2.1 Accessing the configuration and programming software

Configuration and programming software for TSX AXM xxx axis control modules is accessed by opening the main PL7-AXE function window. To do this :

① Open the Start programs window by double clicking on the corresponding item

② Pull down the Group menu and activate the Telemecanique item

③ Open the User window by double clicking on the X-TEL item

④ Enter the user parameters (name and password) and then confirm to open the Volumes window

⑤ Open a volume by double clicking on the icon of the volume to be opened

⑥ Open a project by double clicking on the icon of the project to be opened

⑦ Open a station by double clicking on the icon of the station to be opened

⑧ Open the PL7-AXE function by double clicking on the corresponding AXIS icon. If this icon is not displayed in the secondary Functions window even though the software has been installed, this indicates that the function has not yet been defined. To do this :
- pull down the Define menu and activate the New item
- click on AXIS then on OK.

⑨ For greater ease, open the AXIS full screen window by clicking on the "arrow up" button of the window.

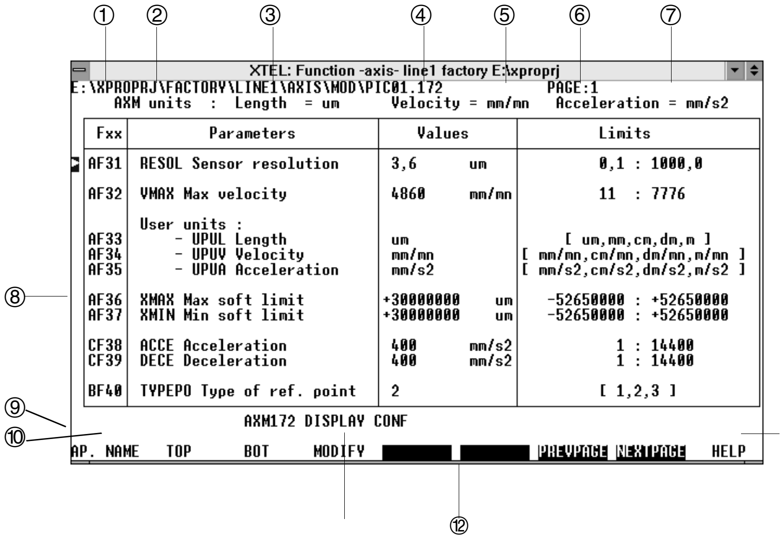
Notes

- If a PL7-AXE session is already open (the corresponding icon appears on the screen outside the secondary Functions window), double click on this icon to open the corresponding window.
- To close a session, click on the corresponding icon to pull down a menu. Then click on the Shutdown/Close command.

2.2 Introduction to the display screen

The window which displays the PL7-AXE screens is known as the display screen. All items specific to the X-TEL Software Workshop (icons, window title, window commands, etc) are described in the Software Workshop manual.

Information displayed



① Working memory,
② Network address for the terminal,
③ Working memory and its address if AXM MEM or TSX/PMX MEM,
④ Axis number or file name if AXM file or TSX/PMX file working memory,
⑤ Application number,
⑥ Current page number,
⑦ Name of application (only in TSX/PMX MEM, TSX/PMX file or AXM file),
⑧ Display zone available for the application (configuration, program, etc),
⑨ Real-time event zone, indicating PLC status (connected),
⑩ Parameter entry line,
Zone indicating current operation (DISPLAY, MODIF, etc),
⑫ F1 to F9 soft key display line,
Message zone for syntax or entry errors, or confirmation request.

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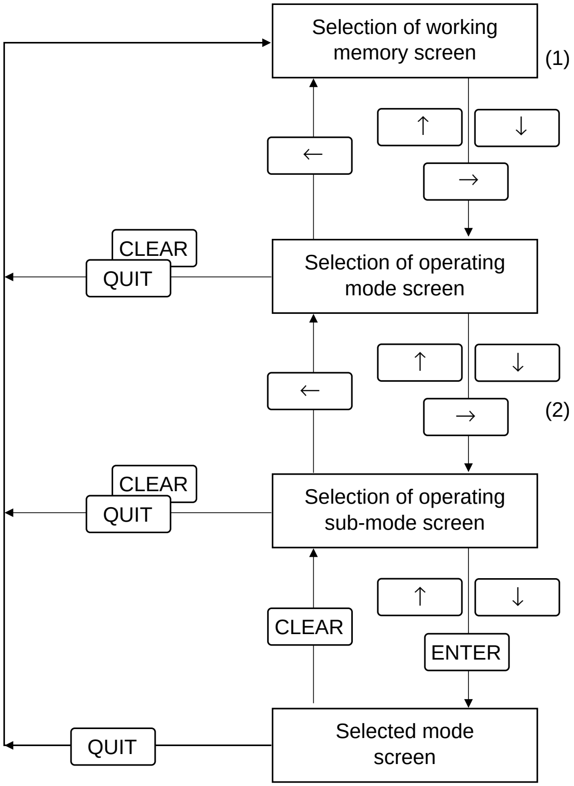
Screen sequences



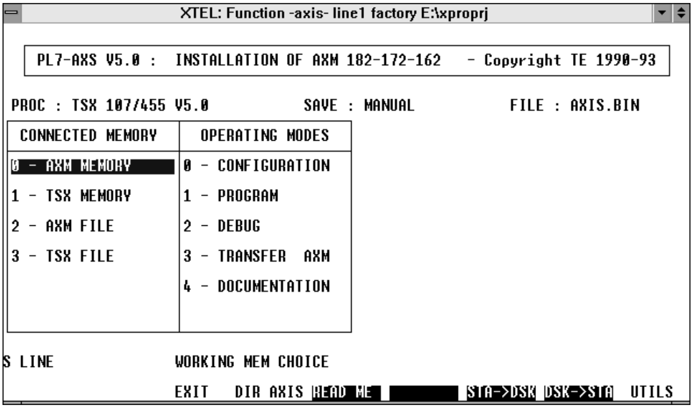
(1) To access AXM MEMORY or TSX/PMX MEMORY in connected mode, ensure that :

- a configuration memory file has previously been transferred to the PLC memory,
- at least one TSX AXM module is declared in the XTEL-CONF I/O configuration.

(2) In DEBUG, TRANSFER and DOCUMENT modes.

2.3 Selecting modes

The choice of modes screen, the basic PL7-AXE screen, provides access to all the functions available with this software.



This screen has two parts :

- a menu zone for selecting :
  - the working memory (module, PLC or disk),
  - the operating mode (configuration, programming, debug, transfer and documentation),
  - an operating sub-mode for the debug mode or transfer mode.
- an information zone which indicates (in connected operation) :
  - the type of processor and its version,
  - the associated file name and type of store.

Role of the function keys

< ↑ > < ↓ >	used to move the cursor in the active column : working memory, operating modes or operating sub-modes. An item in a column can also be selected by entering its number.
< → > < ← >	used to move from one column to another.
<Enter>	confirms the selections made.

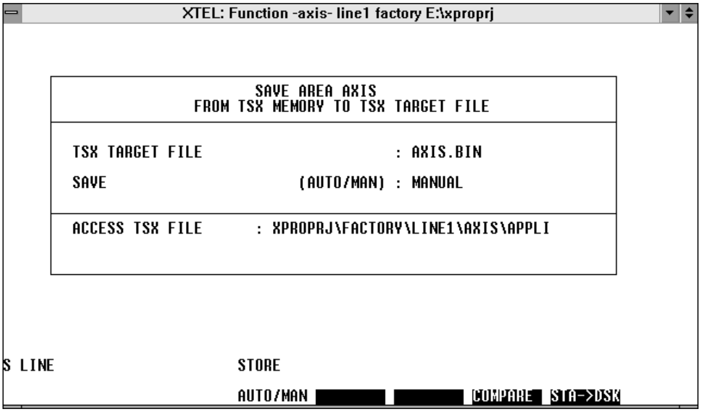
Role of the soft keys

[EXIT] causes PL7-AXE to quit with the possibility of saving and comparing.

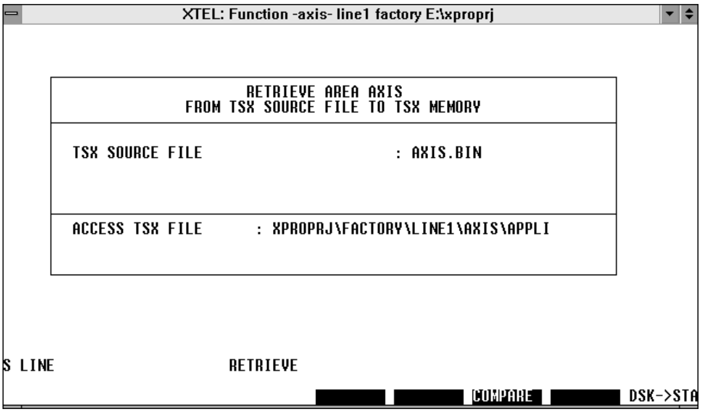
[READ ME] provides access to on-line documentation.

The following 2 keys are offered when the working memory selected is the TSX/PMX PLC memory.

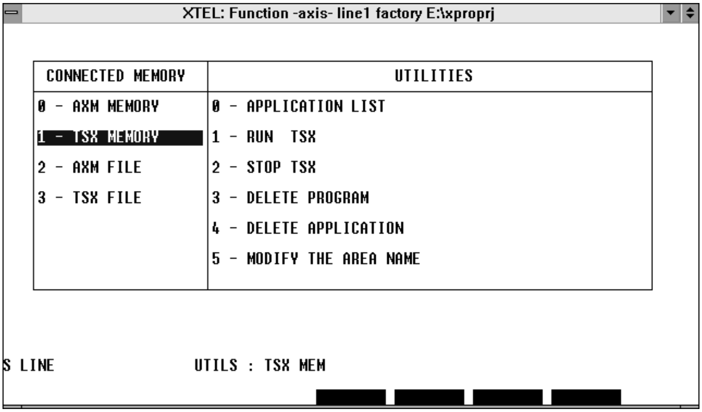
[STA→DSK] accesses a store function in the AXE zone of the TSX/PMX memory in the AXIS.BIN file on disk.



[DSK→STA] enables the AXIS.BIN file on disk to be retrieved from the AXE zone to the TSX/PMX memory.



[UTILS] accesses the utilities functions.

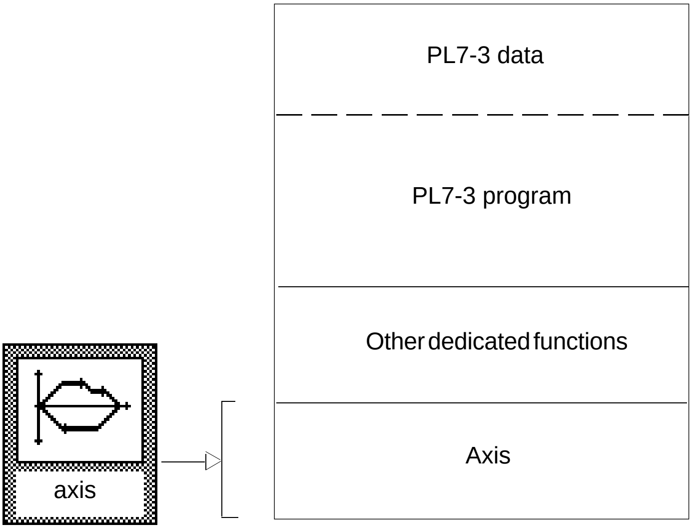


Other soft keys, specific to the selected mode, are described in section 2, selecting working memory.

2.4 Relationship with PLC memory

2.4-1 Dedicated axis zone in the PLC memory

If the PL7-AXE function is declared for a station, a dedicated axis zone is automatically created by the XTEL-CONF tool when the STATION.APP file is generated. The size of this zone is set by the XTEL-CONF tool by default, and may be modified by the user. The position of this zone is determined by the size of the PL7-3 and other dedicated zones which it follows.



Contents of the axis zone

When the PLC memory image is created, the XTEL-CONF tool creates an empty zone. This can then be filled by PL7-AXE (1). It comprises :

- the directory, consisting of :
  - a correspondence table between the logic numbers (0 to 63) and the physical positions of the modules in the racks. The program offers default assignments (2) which may be modified,
  - a table which gives the start address and the size of the applications stored in the dedicated zone,
- the applications, in ascending logic number order.

(1) *Providing the PLC memory image or the PL7-3 application contains the I/O configuration and the slots are occupied by TSX AXM modules.*

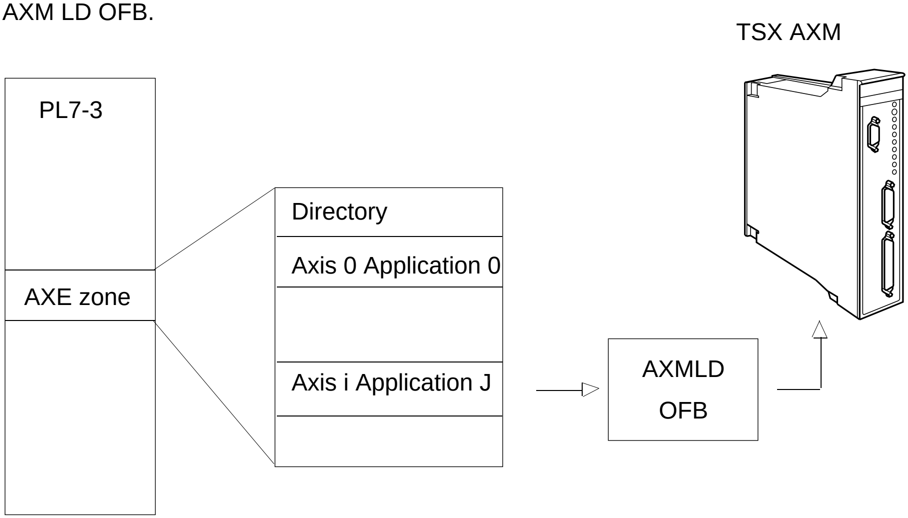
(2) *Ascending numbering from 0 to 63 in the order of the modules in the XTEL-CONF configuration.*

Dedicated AXE zone

Correspondence table between axis n° and module location	Directory
Address and size of stored configurations	Directory
AXIS 0 APPLICATION 0	
AXIS 0 APPLICATION 1	
AXIS 1 APPLICATION 0	
AXIS n APPLICATION 0	
AXIS n APPLICATION 1	

This zone contains the information which can be accessed by the PL7-AXE functions concerned with its organization and by the axis control OFBs. A compacting function is used to optimize the contents. A copy of this dedicated AXE zone is stored in the AXIS.BIN file under the AXIS\APPLI directory on the hard disk (or diskette).

An application stored in this zone can be transferred to the TSX AXM xxx module by the AXM LD OFB.



The AXMLD OFB is described in section 2, divider C2.

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2.4-2 Reservation while operating in connected mode

Any FTX 417/507 terminal or microcomputer can be physically connected to any TSX/PMX PLC station on the same MAPWAY/ETHWAY/FIPWAY/ETHERNET network. Because of this, several terminals can request to be logically connected to the same PLC station.

In order to avoid access or procedural conflicts, each terminal must request reservation of the entire dedicated AXE zone. This reservation can only take place while reading from or writing to the directory or to an axis control application.

If the dedicated AXE zone is not already reserved, the requester can access this zone. From this moment, any attempt by another terminal to access is refused and the message TSX ALREADY RESERVED appears. This reservation is cancelled when work has been completed.

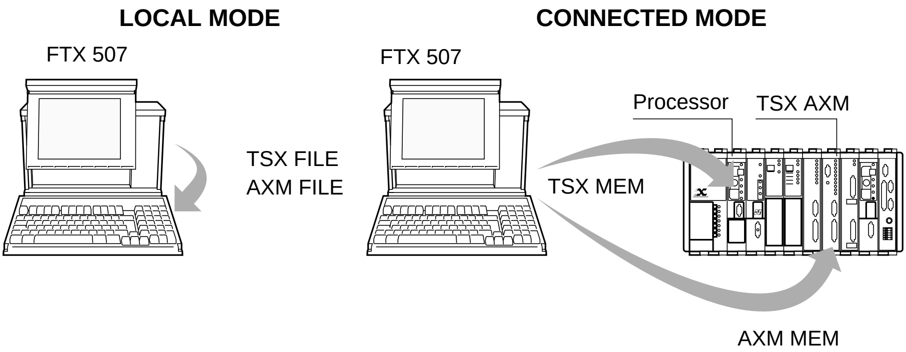
Caution

PL7-AXE cannot be used to set up a remote station over a TELWAY network.

2.5 Methodology

The AXM configuration software can be used :

- in local mode, working on the disk,
- in connected mode, working on the module memory (AXM MEM) or the PLC memory (TSX/PMX MEM).



The use of local mode is recommended when creating AXE applications and the dedicated AXE zone. Although there is nothing to stop a complete application being created in connected mode, it is really designed for modification, correction and debugging.

Implementation is in three phases :

	Program mode (local)	**Debug mode (connected)**
1st phase	Create directory	
2nd phase	Write the AXM applications	Modify the AXM applications
3rd phase	Document the AXM	Update Documentation

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1st phase : Creating the directory

- Open the main PL7-AXE window.
- Select the TSX/PMX File memory.
- Select AXIS DIR (the software automatically recognizes STATION.APP files). Quit by pressing ENTER.

2nd phase : Creating the application

- In Program mode : select the TSX/PMX File (Local) and for each axis :
  - select the axis number and the application number
  - create the configuration (CONFIGURATION)
  - create the PIC program (PROGRAM)
- In Debug mode : select AXM-MEM (connected)
  - modify the configuration and the program
  - update TSX/PMX MEM using the Transfer function (AXM.MEM TRANSFER TSX/PMX MEM)

3rd phase : Documentation

- In Program mode : select the TSX/PMX File
  - document each application (output to printer or to STATION.DOC file (XTEL-DOC))
- In Debug mode : select TSX/PMX MEM

Note

In TSX/PMX File mode, PL7-AXE works directly on the AXIS.BIN file. It is not necessary to perform saves.

3.1 Introduction

The choice of working memory defines the PL7-AXE operating mode : local or connected.

Local mode operation

In this case, the hard disk is selected as the working memory.
In local mode the user can :

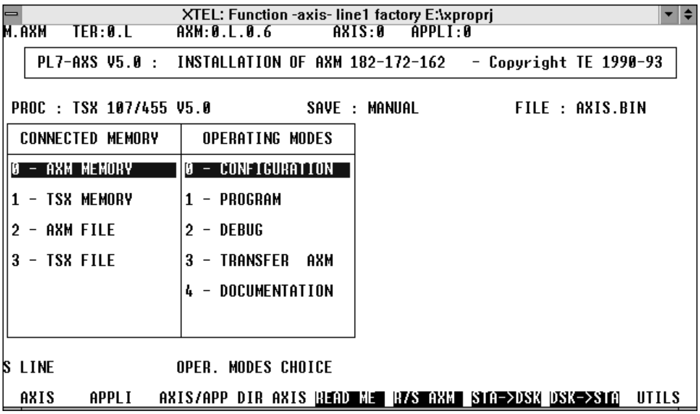
- define the configurations and the programs for each module application (AXM file). Applications created in this way are not associated with any module.
- generate the AXIS.BIN file, image of the dedicated AXE zone (TSX/PMX file).

Connected mode operation

In this case the AXM memory (module memory) or TSX/PMX memory (PLC dedicated zone) is chosen as the working memory. In connected mode the user can :

- generate or modify a configuration,
- generate the dedicated AXE zone,
- transfer configurations from the disk to the modules or to the dedicated zone in the PLC memory.

When the terminal is connected to an AXM MEM module, PL7-AXE can also be used for debugging.



3.1-1 Role of the common soft keys

Details of the soft keys common to the different modes are given below :

[AXIS] selects the number of the working module. In documentation mode, the "*" character confirms all the AXM modules which are configured.

[APPLI] selects the number of the application. In documentation mode, the "*" character confirms all the applications of the selected module. AXIS = * and APPLI = * enable documentation of all the channels stored in the TSX/PMX memory or in the TSX/PMX file.

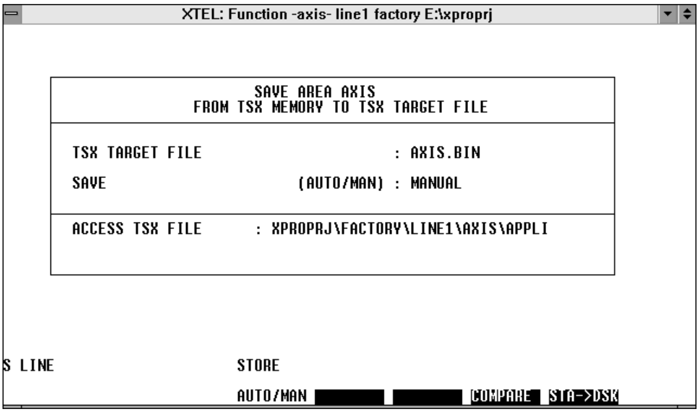
[AXIS/APP] selects the number of the module and of the working application.

[DIR AXIS] provides access to the AXE directory screen (see section 4.2 in divider C).

[READ ME] provides access to the PL7-AXE help screens.

[R/S TSX] or **[R/S PMX]**
sets the PLC to RUN or to STOP.

[STA→DSK] displays a screen which allows the contents of the dedicated AXE zone to be stored to disk, as an AXIS.BIN file in the AXIS\APPLI sub-directory :

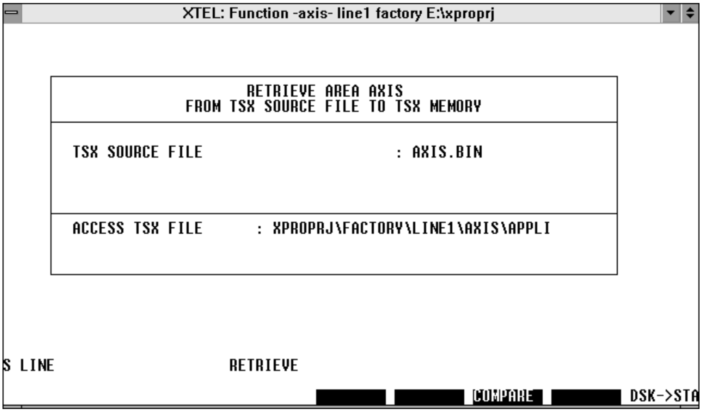


[AUTO/MAN] allows the type of store operation to be selected in connected mode. In automatic mode, all modifications are systematically stored. In manual mode, modifications are not stored unless the [STA→DSK] key is pressed.

[COMPARE] starts the comparison between the source files and the target files.

[STA→DSK] stores a file and starts up after confirmation.

[DSK→STA] displays a screen which allows the contents of an AXIS.BIN file, previously stored to disk, to be transferred to the dedicated AXE zone of the PLC memory :



[COMPARE] starts the comparison between the source file and the dedicated AXE zone of the PLC.

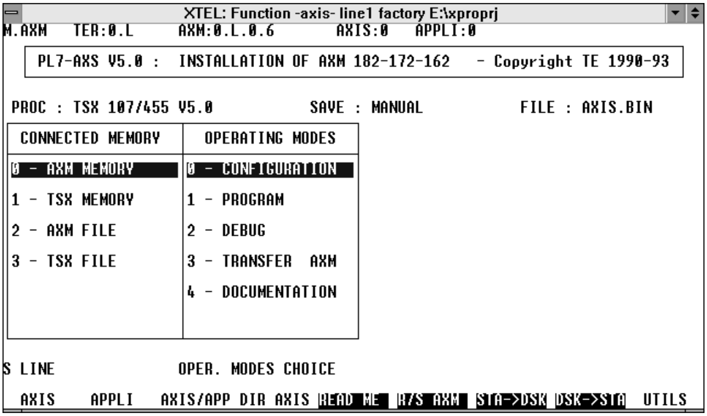
[DSK→STA] retrieves the selected AXIS.BIN files to the dedicated AXE zone in the PLC memory.

3.2 Selecting AXM MEMORY

The AXM memory is the only one which can be used for debugging and operating modules.

The application is stored directly in the module memory on each confirmation.

The AXM memory can only be used if a STATION.APP configuration file, containing at least the I/O configuration performed under XTEL-CONF, has previously been transferred to the PLC memory. The PLC can be in STOP or in RUN.



[UTILS] accesses the utilities functions associated with the AXM memory :

0 - APPLICATION CHARACTERISTICS : displays a table of the application characteristics contained in the module selected : axis number, application number, geographic address in the PLC, application name, module type and version.

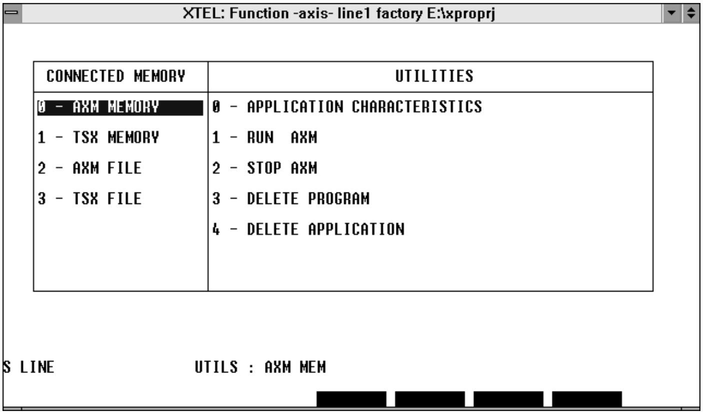
1 - RUN AXM : RUN the AXM TSX module.

2 - **STOP AXM** : STOP the AXM TSX module.

3 - **DELETE THE PROGRAM** : allows the PIC program to be deleted while maintaining the configuration and the internal WNi variables.

4 - DELETE THE APPLICATION : deletes the entire module memory (PIC, configuration and internal variables).

Each of these functions is confirmed by the (ENTER) key. The (CLEAR) key returns the user to the selection screen.



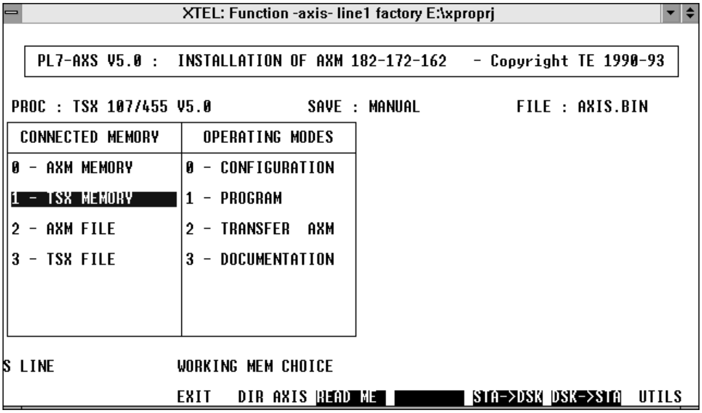
Note : In CONFIGURATION and PROGRAM modes, the following message is displayed if the application number selected does not correspond to the application number of the module :
APPLI AXE < > APPLI EXPECTED
but the application can still be accessed. However, when ENTER is pressed to store the application, another message requests confirmation from the user :
N.APPLI AXM UNEXPECTED, WRITE APPLI?
The <YES> soft key stores the application with the specified number.
The <NO> soft key retains the initial application with its original number.

3.3 Selecting TSX/PMX MEMORY

The PLC memory is essentially for archiving. It allows the various configurations to be stored in the dedicated AXE zone of the PLC memory.

This store operation allows the PLC program to reload the applications into the modules, via the AXMLD optional function block, if required. (The AXMLD OFB is described in section 2 in divider C3).

The TSX/PMX MEMORY can only be used if the I/O configuration performed under XTEL-CONF has previously been transferred to the PLC memory. The PLC can be in STOP or in RUN.



[UTILS] accesses the utilities functions associated with the TSX/PMX MEMORY :

0 - LIST THE APPLICATIONS : displays the list of applications associated with a module :

• the upper box indicates the number, the geographic address and the type of module,

• the lower box indicates the application number, the name, the date and time of creation or last modification, as well as the size of all the applications stored in the PLC memory.

1 - RUN TSX or RUN PMX : sets the PLC to RUN,

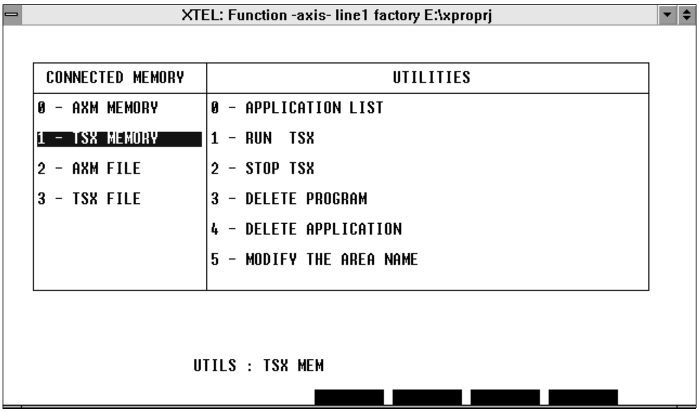
2 - STOP TSX or STOP PMX : sets the PLC to STOP,

3 - DELETE THE PROGRAM : clears the PIC program of the selected application, after confirmation.

4 - DELETE THE APPLICATION : deletes the entire selected application, after confirmation.

<AXIS>	selects the axis number
<APPLI>	provides access to the application n°
<AXIS/APP>	displays the directory.

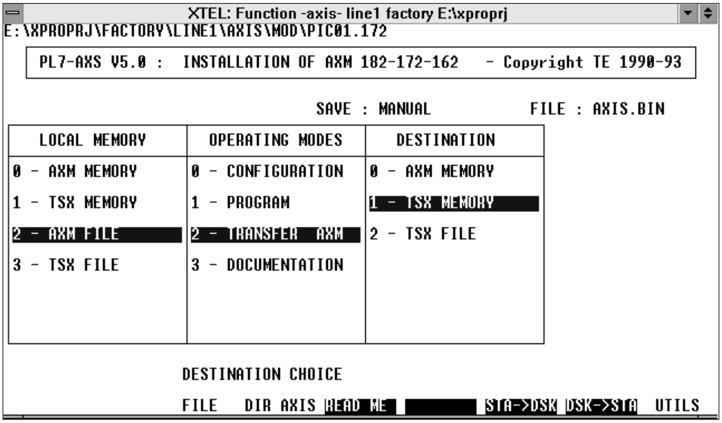
5 - MODIFY THE AREA NAME : assigns a name of up to 24 characters to the dedicated AXE zone in the TSX/PMX memory.



3.4 Selecting an AXM file

This is recommended for creating AXM configurations in the design office, or as a means of archiving. It does not require the PLC, the module, nor the X-TEL CONF configuration.

The applications are stored on the hard disk or diskette (defined in the VOLUMES of the X-TEL Software Workshop) as they are entered.
The applications created are "anonymous" : they are not associated with any module and are not dependent on any PL7-3 application (library function).



[UTILS] accesses the utilities functions associated with the DISK memory :

0 - MOD DIRECTORY

Displays the list of files contained in the AXIS\MOD directory, the module type (162, 172 or 182) and the size of the application.

1 - LIST OF APPLICATIONS (162)

Table of the list of TSX AXM 162 application files stored in the AXIS/MOD directory with the creation date and the size of the application alongside.

The (CLEAR) key returns the user to the selection screen.

2 - LIST OF APPLICATIONS (172)

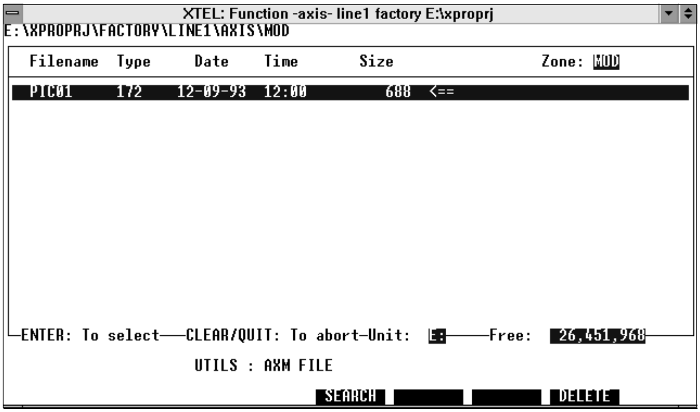
The same as the preceding function but for TSX AXM 172 application files.

3 - LIST OF APPLICATIONS (182)

The same as function 2 but for TSX AXM 182 application files.

4 - DELETE THE PROGRAM

Destroys the PIC program of the file specified using the <FILE> soft key. The file retains the configuration. To completely destroy an application file, the <DELETE> soft key must be used.



Two soft keys are common to the disk utilities.

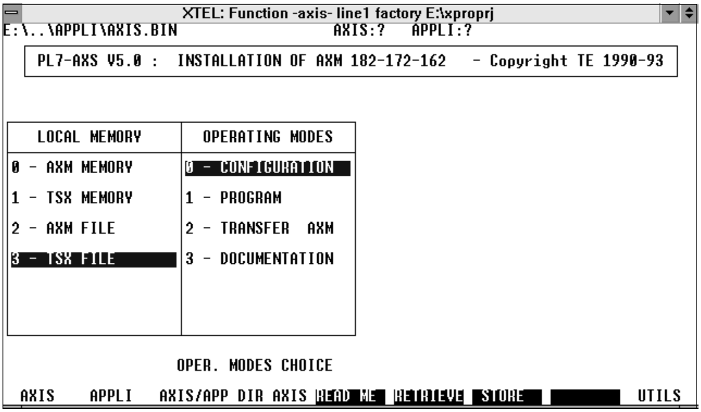
[SEARCH] searches for a file in a list.

[DELETE] deletes, after confirmation (YES), the file indicated by the cursor.

3.5 Selecting a TSX/PMX file

This mode allows an image of the PLC memory to be created in Local mode.

To use the TSX/PMX file, the station configuration must have previously been created using XTEL-CONF.

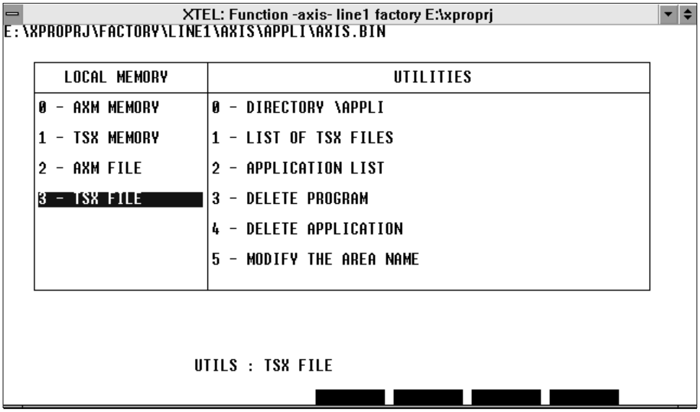


[STORE] Stores the configuration in an xxx .BIN file. By default, the store name is AXIS.BIN. The screen displays two keys :

- **[FILE]** enables selection of another name for the store file : xxx.BIN
- **[STORE]** executes the store function.

[RETRIEVE] Enables an xxx.BIN file, previously stored using the STORE function, to be retrieved.
The file is restored in the X-TEL zone under the name : AXIS.BIN.

[UTILS] accesses the utilities functions associated with the TSX/PMX file :



0 - DIRECTORY\APPLI : displays the list of files contained in the directory :
AXIS\APPLI (xxx.BIN, xxx.DOC files etc).

1 - LIST OF TSX/PMX FILES : displays the list of configuration files (xxx.BIN files).

2 - LIST OF APPLICATIONS : displays the list of all the applications linked to an AXM module in the current xxx.BIN file.

3 - DELETE THE PROGRAM : deletes the program specified by an axis number and an application number in the current xxx.BIN file.

4 - DELETE THE APPLICATION : deletes the application specified by an axis number and an application number in the current xxx.BIN file.

5 - MODIFY AREA NAME : assigns a comment of up to 24 characters to the current xxx.BIN file.

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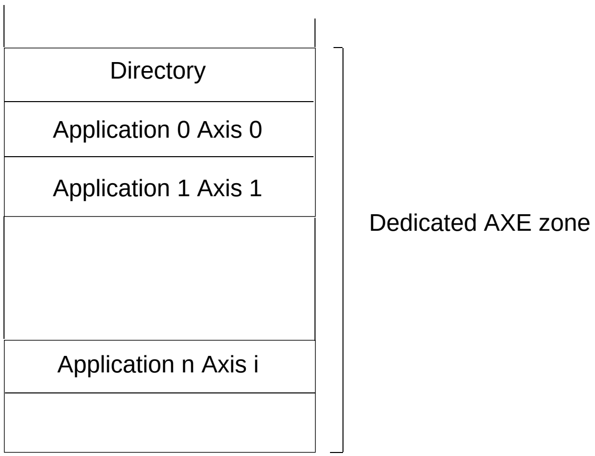
4.1 Dedicated AXE zone

This PLC memory zone is used for storing the directory and the various applications which may be loaded into the AXM modules. This zone is managed entirely by PL7-AXE :

- The directory is created by PL7-AXM.
- The configurations are entered :
  - either by direct entry to the TSX/PMX memory, from PL7-AXE,
  - or by transferring an AXM FILE to the TSX/PMX MEMORY,
  - or by transferring an AXM MEMORY to the TSX/PMX MEMORY.



Any attempt to transfer a application to the PLC memory or to modify an existing application may be preceded by one of the following two messages :

- **Area full :** The size of the dedicated AXE zone is insufficient to receive the new application. The size of the zone can be modified using the XTEL-CONF tool.
- **Area to be compacted :** The size of the dedicated AXE zone is sufficient, provided that it is compacted. Optimizing the dedicated zone in this way removes the "holes" created during transfer operations or when applications are deleted. Compacting is performed by the [PACK] key accessible from the directory screen (see section 4.2).

4.2 Directory

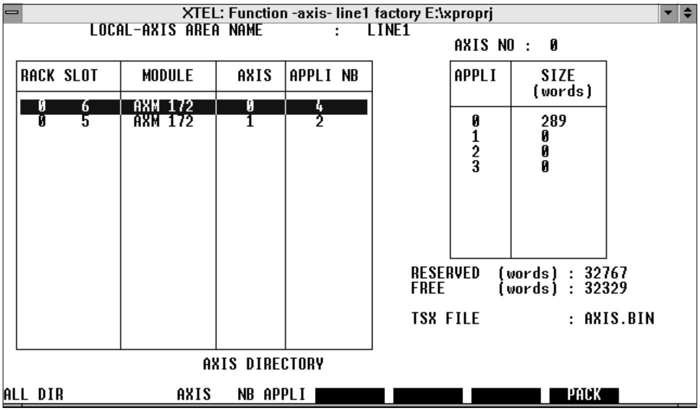
An axis control application is defined by :

- an axis (or module) number from 0 to 63,
- an application number from 0 to 8.

It is the directory which defines the correspondence between the geographic position of the modules in the I/O configuration and the logic numbers.

Created by PL7-AXE, the directory is stored initially in the dedicated AXE zone of the PLC memory. The first 64 AXM modules in the I/O configuration are allocated an axis number from 0 to 63 in ascending order.
The allocation of these numbers may be modified by the user.

If PL7-AXE is operating in connected mode (AXM MEMORY or TSX/PMX MEMORY), the [DIR AXIS] soft key will display the AXIS DIRECTORY screen (or enable this directory to be created).



TSX/PMX-AXM space

RESERVED The number of reserved words is fixed by XTEL-CONF. This number cannot be modified by PL7-AXE.

FREE The number of free words represents the memory area not used.

TSX FILE AXIS.BIN is the name under which the dedicated AXE zone is stored on disk using the [STORE] command.

Soft keys

[ALL DIR] provides a detailed view of the AXIS directory, specifying for each logic number :

- its geographic location : rack, module,
- its type (TSX AXM 162, TSX AXM 172, TSX AXM 182, etc),
- the number of the associated AXM,
- the size assigned to each application.

[TOP]	displays the start of the directory,
[BOT]	displays the end of the directory,
[PREVPAGE]	displays the previous page,
[NEXTPAGE]	displays the next page.

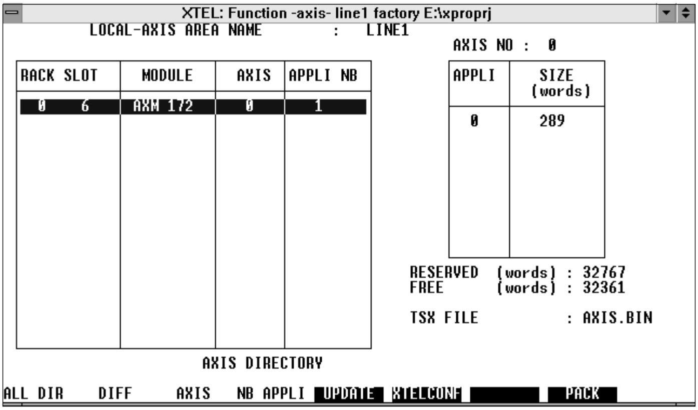
This is the view of the directory which will be provided in the documentation.

[AXIS] is used to modify the default assignment of the axis numbers. A number can only be assigned to one slot.

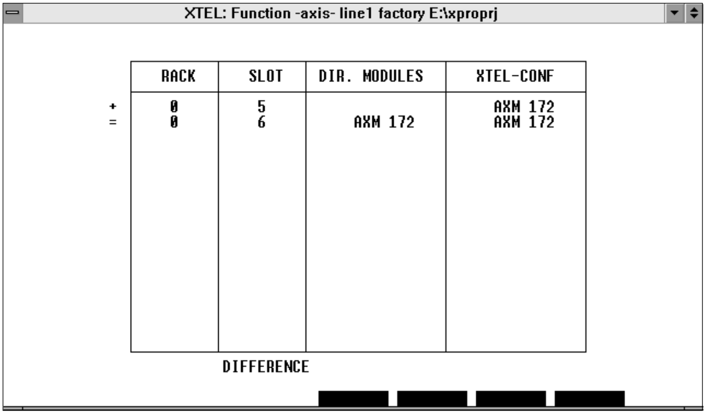
[PACK] compresses the dedicated AXE zone. It is also used to recover empty spaces which have been created, for example, when applications have been deleted.

[.../...] only displayed if the configuration is made up of more than 16 TSX AXM modules. It enables movement from one group to another.

[UPDATE] Modification of a slot, or the addition or removal of an AXM module affecting an I/O configuration using XTEL-CONF, is indicated in the AXIS directory by an asterisk which precedes each module concerned. Displayed only in this case, the [UPDATE] key causes the directory to be updated following each new I/O configuration defined by XTEL-CONF.



[DIFF] displays the differences between the configuration of the AXM modules stored in the AXIS directory and the current I/O configuration of the AXM modules in X-TEL.
In connected mode, the current I/O configuration of the AXM modules corresponds to the I/O configuration stored in the PLC.
In local mode, the current I/O configuration of the AXM modules corresponds to the I/O configuration defined under XTEL-CONF.
This key is not displayed unless a difference is detected (addition, removal or modification of a module).



Meaning of the characters in the margin :
= no change
+ module added
- module removed
different type of module

If a configuration is made up of more than 16 modules, the following soft keys are displayed :

[TOP] accesses the first module on the first page of the directory,

[BOT] accesses the first module on the last page of the directory,

[PREVPAGE] accesses the first module on the previous page of the directory,

[NEXTPAGE] accesses the first module on the next page of the directory.

[XTEL-CONF] displayed if there is a discrepancy between the directory and the I/O configuration defined under XTEL-CONF. This key enables XTEL-CONF to be launched directly from PL7-AXE.

5.1 Mode Description

Purpose of the mode

The Configuration Mode lets the user enter the table of parameters for the application. The function of each parameter is described in Divider B, Sub-section 2.2, of this manual.

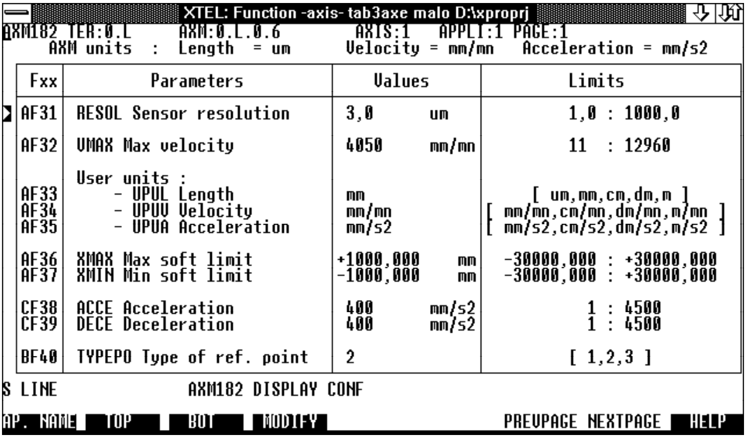
Accessing the mode

From the Mode Selection Display:

- Select the working memory (refer to Sub-section 3),
- (⟶) Allows access to the operating modes,
- Enter the axis and application numbers (or file name if disk storage is selected).
- Select the Configuration Mode.

Configuration mode screens

Each of the four screens in the mode comprises four columns.



".Fxx" Column, indicates for each parameter:

- The Write access mode:
  A = Configuration mode only,
  B = Configuration mode and through the TSX XBT terminal,
  C = Configuration mode and through the TSX XBT terminal and through AXM program instructions.
- The TSX XBT terminal function number used to access the parameters.

"Parameters" Column, gives the designation of each parameter.

"Values" Column, parameter value display field. This column is filled in by the user.

"Limits" Column, lists the maximum and minimum values for each parameter.

Note: The first line indicates the physical units used by the module. They are a function of the displayed maximum speed VMAX.

5.1 Mode Description

Purpose of the mode

The Configuration Mode lets the user enter the table of parameters for the application. The function of each parameter is described in Divider B, Sub-section 2.2, of this manual.

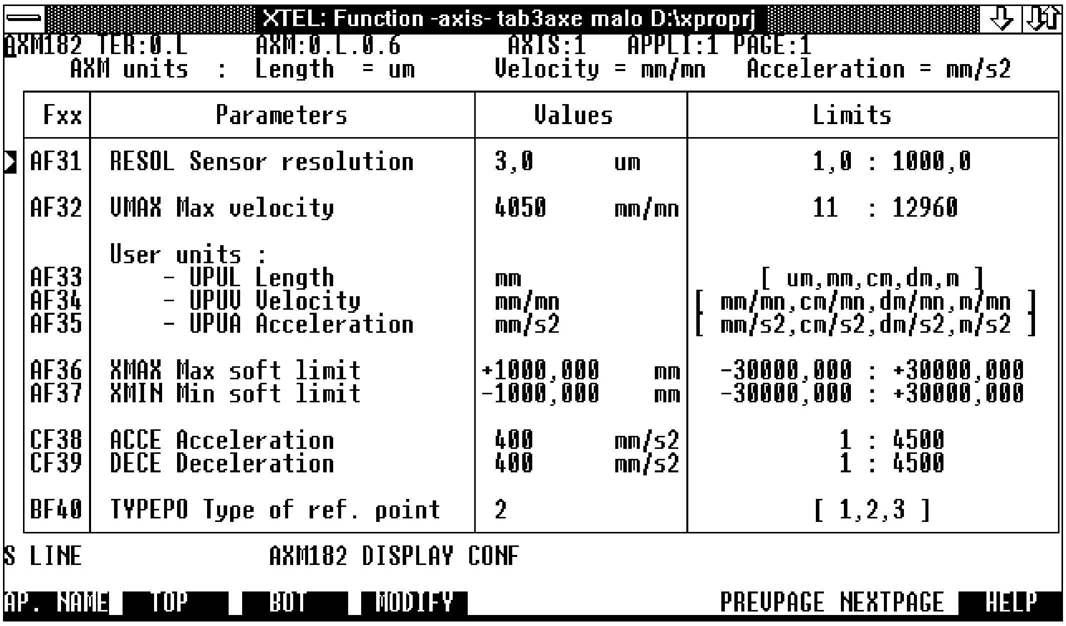
Accessing the mode

From the Mode Selection Display:

- Select the working memory (refer to Sub-section 3),
- (   ) Allows access to the operating modes,
- Enter the axis and application numbers (or file name if disk storage is selected).
- Select the Configuration Mode.

Configuration mode screens

Each of the four screens in the mode comprises four columns.



XTEL: Function -axis- tab3axe malo D:\xproprj

AXM182 TER:0.L   AXM:0.L.0.6   AXIS:1 APPLI:1 PAGE:1

AXM units : Length = um   Velocity = mm/mn   Acceleration = mm/s2

Fxx	Parameters	Values	Limits
AF31	RESOL Sensor resolution	3,0 um	1,0 : 1000,0
AF32	VMAX Max velocity	4050 mm/mn	11 : 12960
	User units :		
AF33	- UPUL Length	mm	[um,mm,cm,dm,m]
AF34	- UPUV Velocity	mm/mn	[mm/mn,cm/mn,dm/mn,m/mn]
AF35	- UPUA Acceleration	mm/s2	[mm/s2,cm/s2,dm/s2,m/s2]
AF36	XMAX Max soft limit	+1000,000 mm	-30000,000 : +30000,000
AF37	XMIN Min soft limit	-1000,000 mm	-30000,000 : +30000,000
CF38	ACCE Acceleration	400 mm/s2	1 : 4500
CF39	DECE Deceleration	400 mm/s2	1 : 4500
BF40	TYPEPO Type of ref. point	2	[1,2,3]

S LINE   AXM182 DISPLAY CONF

AP. NAME TOP BOT MODIFY   PREVPAGE NEXTPAGE HELP

".Fxx" Column, indicates for each parameter:

- The Write access mode:
  A = Configuration mode only,
  B = Configuration mode and through the TSX XBT terminal,
  C = Configuration mode and through the TSX XBT terminal and through AXM program instructions.
- The TSX XBT terminal function number used to access the parameters.

"Parameters" Column, gives the designation of each parameter.

"Values" Column, parameter value display field. This column is filled in by the user.

"Limits" Column, lists the maximum and minimum values for each parameter.

Note: The first line indicates the physical units used by the module. They are a function of the displayed maximum speed VMAX.

Mode Description

Data entry and display procedure

- When creating a configuration, this mode lets the user directly enter the first two parameters. They must be entered before the user can access other parameters.

- Once the first two parameters are entered, the mode changes to Display (DISP-CONF screen). All other parameters take a default value.

Note: It is possible to validate the configuration at this point, but the default parameters may not be appropriate for the application.

- To modify the other parameters:

  - Press Cursor Up and Cursor Down to select the various parameters on the same page,

    - [AP. NAME] To select the application name (16 alphanumeric characters max.),
    - [NEXTPAGE] To access the next page,
    - [PREVPAGE] To access the previous page,
    - [TOP] For direct access to the first page,
    - [BOT] For direct access to the last page,
    - [MODIFY] To modify the parameter selected by the cursor in the data entry line,
    - <ENTER> Validates each parameter once it has been modified.

Once all of the parameters are entered:

- <ENTER> Validates the configuration data entered and returns the user to the Mode Selection Screen.

- <QUIT>+[YES] or <CLEAR>+[YES] Cancels the modifications made and returns the user to the Mode Selection Screen.

Note: PL7-AXE checks the coherence of the values entered. Any values that are out of bounds will be rejected by the terminal.

Modifying a configuration

There are two possible cases:

- **The AXM program has not been entered**: The principle of the modification is the same as that described on the previous page. Only the modification of both the resolution and maximum velocity parameters can cause a loss of all other parameters:
  - If the resolution is reduced and the velocity VMAX is no longer within the new limit values,
  - If the maximum velocity VMAX is reduced and this reduction sets new limits for other parameters.
- **The AXM program has been entered**: The new parameters may be incompatible with the immediate values declared in the program or with the WNi internal positions.

In this case, when validation of the new configuration is requested, the terminal prompts the user to:
- Individually modify invalid operands in AXM program instructions,
- Individually modify the WNi internal positions.

If the user does not want to modify the program and the internal set points and accept the modification of the configuration, or if the program and internal set points are to be completely cleared:

<QUIT> lets the user access the following dynamic soft keys:

- [DEL PROG] Clears the entire AXM program,
- [DEL WNIs] Resets all WNi internal positions to the value of the lower soft stop XMIN.
- [RECONF] Lets the user return to the Configuration Mode Screen.

The configuration can only be validated if the AXM program configuration parameters and the internal positions are not mutually exclusive.

Note: Modification of some parameters (resolution, etc.) will reset the Machine Characteristic Factor (KR) and can therefore require that this factor be readjusted. This can be done either with PL7-AXE (refer to Sub-section 7.4) or with a TSX XBT 182 terminal (Function F61). If the Machine Characteristic Factor is changed, the user is warned by the message "WRITE OK, ATTENTION KR MODIFIED" when the complete configuration is validated.

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6.1 Mode Description

Purpose

The Programming Mode lets the user enter and modify AXM programs. Instructions and operands are not described in this Section (refer to Divider B, Section 5).

It is not available for the TSX AXM 162.

[HELP] lists all of the instructions and operands available.

Access to the Mode

From the Mode Selection Display,

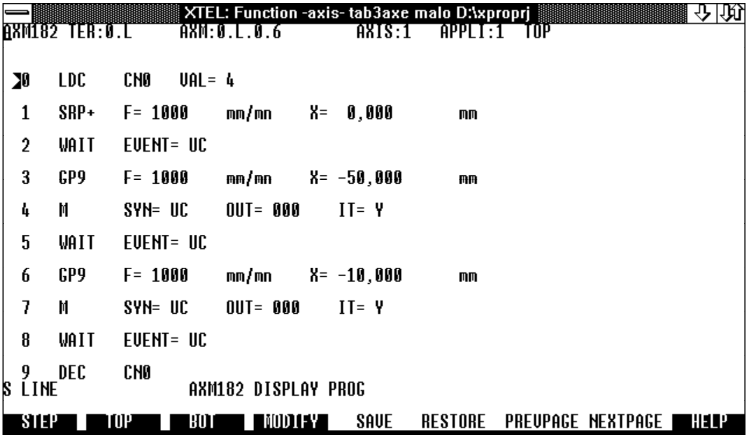
- Select the working memory (refer to Section 3),
- (→) lets the user access the operating modes,
- Enter the axis and application numbers (or file name if disk storage is selected),
- Select the Programming Mode.

Note: The application parameter table must always be entered first in Configuration Mode.

Screens

The screen displayed lets the user enter program steps. A full screen editor is provided:

- Three working modes are available:
- INSERT-PROG : For creating the program or inserting a program step,
- MODIF-PROG : For modifying program steps that have already been entered,
- DISP-PROG : For reading the program.



Mode Description

Entry Procedure

When a program is created, the mode directly prompts the user to enter program steps (from the INSERT-PROG screen), in rising order of step number.

- Enter the instruction code,
- [NEXT F] Displays the format, the operand units and prompts the user to enter the first operand,
- [NEXT F] Enables access to the next operand, and so on until the last operand has been entered (for instructions with multiple operands),
- <Enter> Validates the program step entered and prompts the user to enter the next program step.
- [PREV F] Lets the user access the previous operand or instruction code, if the cursor is located on the first operand.

Program steps are automatically numbered as they are entered.

[CLEAR] Quits the INSERT-PROG working mode and selects the program display mode DISP-PROG.

<Enter> Validates the program entered and returns the user to the Mode Selection Screen.

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Display Procedure

Since the number of steps in an AXM program may exceed the capacity of the display screen (10 pages max.), the following keys are available:

(↓)	Access to the next step,
(↑)	Access to the previous step,
[STEP]	Direct access to a program step by entering its number,
[TOP]	Direct access to the first program step,
[BOT]	Direct access to the last program step,
[PREVPAGE]	Jump back 10 steps,
[NEXTPAGE]	Jump forward 10 steps.

Mode Description

Modification Procedure

Modifying an existing step:

- Use the cursor to select the program step to be modified,
- [MODIFY] lets the user modify the selected step.

Deleting a step:

- Use the cursor to select the program step to be deleted,
- <Del> Deletes the selected program step,

  The steps are then renumbered automatically (*).

Inserting a Step:

- Use the cursor to select the program step that should precede the instruction to be inserted,
- <Ins> Lets the user enter a new program step,

  The step numbers are automatically shifted (*).

(*) **Attention**: No jump instructions or subroutine calls are updated. It is up to the user to ensure that jumps and program loops remain coherent.

Modification Procedure

- Position the cursor on the program step comprising the instruction to be duplicated,
- [SAVE] will save the program step in buffer memory,
- Position the cursor on the program step that should come after the instruction to be restored,
- [RESTORE] will restore the saved instruction.

The same instruction can continue to be restored as long as a new instruction has not been saved.

Help Screen

[HELP] Lets the user access nine screens that describe the various instructions and arguments available.

The dynamic soft keys displayed enable access to all of the pages :
[TOP] [BOT] [NEXTPAGE] [PREVPAGE]

[CLEAR] Returns the user to the Programming Mode Screen.
[ERROR?] Lets the user determine the reason that the operand selected by the cursor is not valid (value out of bounds, etc.).

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2

7.1 Mode Selection

Purpose

The Debug Mode lets the user display and modify discrete I/O bits, module register words, internal positions (WNi) and internal counters (CNi).

Accessing the Mode

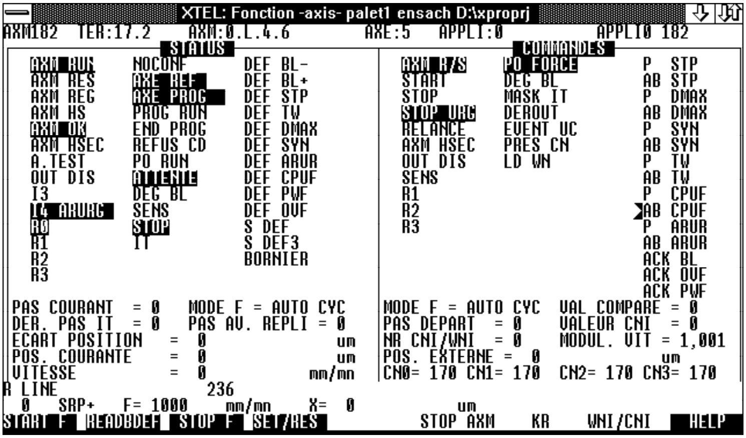
From the Mode Selection Screen:

- Select the AXM memory (this is the only working memory that lets the user access the Debug Mode),
- (→) lets the user access the Operating Modes,
- Enter the axis and application numbers,
- (2) <Enter> selects the Debug Mode,

A third column will then be displayed with the other two.

- (→) lets the user access the selected function,
- (0) <Enter> selects the STATUS / COMMANDS screen,
- (1) <Enter> lets the user access the contents of the WNi table.

7.2 Command Status Screen



This screen displays the information and the commands that are available to the discrete I/O and register interfaces as mnemonics.
The left side of the screen shows information supplied by the module on the discrete I/O (Ixy,i) and register (IWxy,i) interfaces.
The right side of the screen shows the commands destined for the modules that are sent via the discrete I/O (Oxy,i) and register (OWxy,i) interfaces.
The parameters displayed across the bottom of the screen are from the IW or OW register words (except for the velocity (speed) that is acquired via Message Mode).
The boolean information available is displayed in the upper part of the screen as shown on the next page:

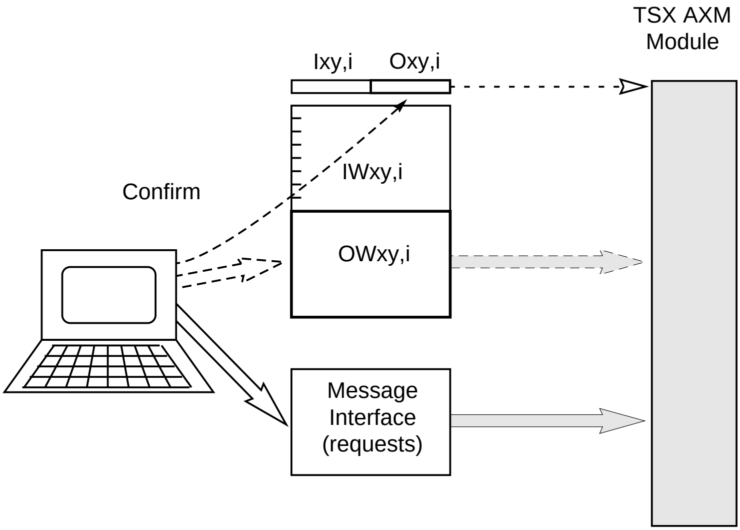
Command Status Screen

Left column:	Information/commands relative to module status,
Center column:	Information/commands relative to axis status,
Right column:	Information/commands relative to error handling,

Bits at 1 are displayed in reverse video.

The [HELP] key calls-up a screen describing the function of the information/ command selected by the cursor.

Note: Any modification of a control bit or of a numerical value results in the sending of a request addressed to the module via the message interface. Updating the bit of the appropriate register in the discrete output (Oxy,i) or register (Oxy,j) interface only confirms the modification requested by the request.



This mechanism explains why commands sent in Debug Mode are performed even if the PLC is stopped (on condition that the TSX AXM module safety interlock is not selected) while the same commands sent from the PL7-3 data screen do not take effect.
(When the PLC is stopped, it routes messages but does not refresh the discrete I/O and register interfaces).

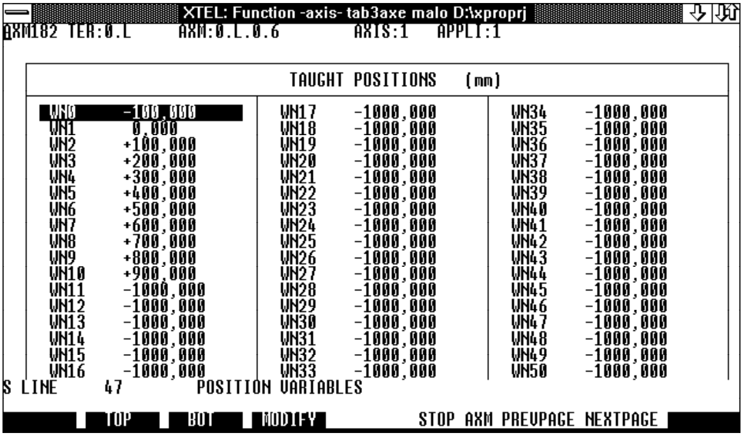
Command Status Screen

Dynamic soft keys

[READ BDEF]	Acknowledges a terminal block error,
[START F]	Activates the selected mode,
[SET/RES]	Lets the user modify the state of an output bit. To do this position the cursor on the bit using the cursor keys and select the dynamic soft key,
[STOP F]	Deactives the currently selected mode,
[STOP AXM]	Stops the TSX AXM module,
[KR]	Lets the user set the machine characteristic factor,
[WNi/CNi]	Lets the user access the table of internal values (WNi) and counter values (CNi).
[HELP]	Defines the function of the element selected by the cursor.

7.3 Access to WNi Internal Positions

The internal positions are accessed from the previous screen by selecting the [WNi/CNi] dynamic soft key or from the primary window of the Debug Mode.



[NEXTPAGE]	Calls-up the next table,
[PREVPAGE]	Returns the user to the previous page,
[MODIFY]	Lets the user modify the values of the internal position displayed in reverse video. Use the cursor keys to select the required WNi position,
[STOP AXM]	Stops the TSX AXM module,
[TOP]	Returns the user to the first screen (WN0 to WN50),
[BOT]	Lets the user access the last screen (counter CNi).

Access to CNi internal counters

From the screen shown above:

[NEXTPAGE] or [BOT]	Lets the user access the values of the four internal counters CNi,
[MODIFY]	Lets the user modify the value of the internal counter displayed in reverse video. Use the cursor keys to select the required counter CNi,
[STOP AXM]	Stops the TSX AXM module,
[PREVPAGE]	Returns the user to the screens displaying the internal positions WNi.

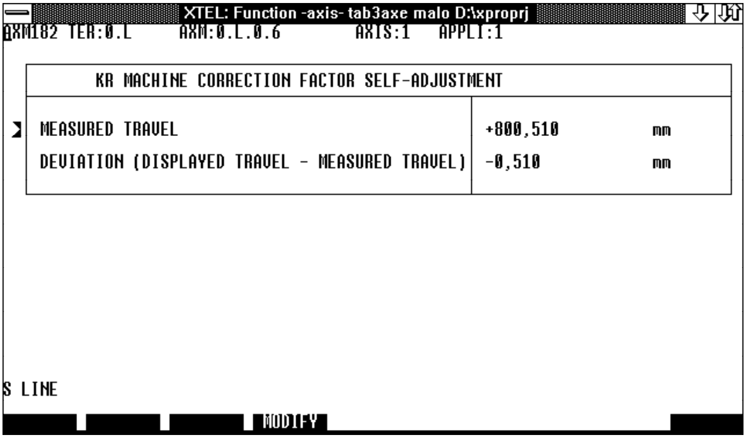
7.4 Setting the Machine Factor KR

Purpose

The machine characteristic factor (KR) is the correction factor used by the module to scale, or adjust, travel measurements from the encoder pulses received.
This factor is calculated by PL7-AXE from configuration parameters. There is however a procedure which allows the user to adjust the value of this factor in order to compensate for any errors due to imprecise configuration parameters or mechanical tolerances.
This adjustment can also be performed from TSX XBT 182 terminals.
The correction factor must be adjusted if the deviation between the measured travel and the displayed travel is excessive (checks should be performed over the greatest possible travel).
Modification of some configuration parameters can reset the correction factor and require that it be checked and adjusted again.
In this case the user is warned by the message "WRITE OK, ATTENTION KR MODIFIED".

Access

The function is accessed from the Status/Command screen by pressing [KR].



Setting the Machine Factor KR

Procedure

From the Status/Command screen:

- Perform a manual reference set-up:
  - Select the mode : MODE F = MAN RFP
  - Origin = 0 : POS. EXT = 0
  - Ref. set direction : [SET/RES] DIR
  - Start ref. set : [SET/RES] START
- Select Assisted Manual Mode:
  - Select the mode : MOD F = MAN SET
- Select the value corresponding to the longest possible travel as the target point:
  - EXTERNAL POS. = MAX. LEN.
- Start travel: [SET/RES] START
- Use a precise external measurement to determine the position reached by the moving part.
- Enter the value obtained in the "measured travel" field:
- Calculate the deviation (displayed travel - measured travel) and enter this value in the "deviation" field,
- Enter the deviation and press <ENTER>,

<ENTER> Starts the self-adjustment sequence.

- Wait for the system to return to the Status/Commands screen.
- Set the reference point again,
- Perform travel to position 1 and check that the deviation error is now negligible or non-existent. Otherwise repeat the procedure.

Notes: If the message "INCOMPATIBLE PARAMETERS" is displayed, this means that there is a resolution value error in the configuration parameters entered. Do not attempt to improve the correction factor precision, check the resolution value instead.

The adjusted value of KR is only stored in the module memory.
It is up to the user to perform the MEM AXM → MEM TSX or MEM AXM → DISK transfers necessary to ensure that up to date back-ups are available.

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8.1 Mode Description

Purpose

This mode lets the user transfer an application (configuration, program and internal variables WNi and CNi), from the source memory to the target memory.

The table below shows all possible transfers:

Source \ Target	AXM MEM	TSX MEM	AXM FILE	TSX FILE
AXM MEM	no	yes	yes	no
TSX MEM	yes	no	yes	no
AXM FILE	yes	yes	no	yes
TSX FILE	no	no	yes	no

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2

Access

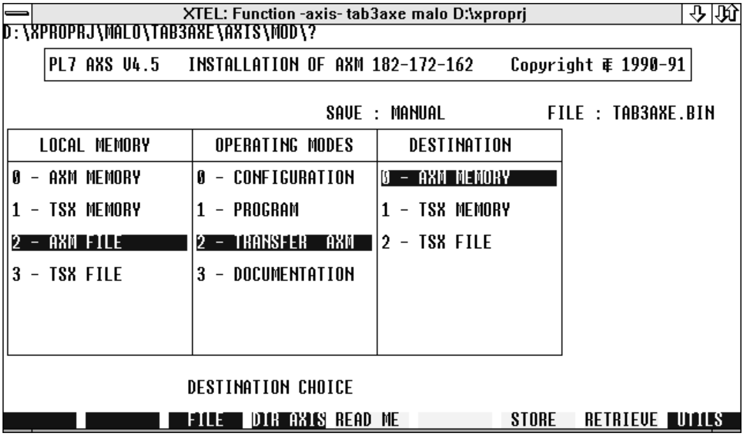
From the Mode Selection Screen,

- Select the source memory where the application to be transferred is stored (Working Memory),
- (→) Access to the operating modes,
- Selects the Transfer Mode. A third column is desplayed next to the other two columns,
- (→) Access to the target memory. Use the cursor keys or the appropriate number keys to select this memory from the list displayed.
- Define which application should be transferred:

  Enter the axis or application number or the file name.
- Press <Enter> to access the appropriate selection screen.

Mode Description

Screen



This screen displays two boxes:

- One box lists the selected source and target memories. The selected target memory can be changed at any time by pressing the cursor up or cursor down keys,
- One box that identifies the application selected for transfer and its axis and application assignment.

[COMPARE] Compares the source and target applications.

Transfer procedure

The transfer procedure requires that the user select the target address. Use the cursor up and cursor down keys to change the selected target memory.

If the target is the PLC or AXM module memory

- [AXIS] Lets the user enter the axis number,
- [APPLI] Lets the user enter the application number,
- [AXIS/APP] Lets the user move the cursor to select the Axis Nbr./Application Nbr. pair,
- <Enter> Starts the transfer.

If the target is the AXM module memory, PL7-AXE will prompt the user to stop the module. This is necessary before the transfer can be performed.

If the target is a disk

- [FILE] Lets the user select the file,
- <Enter> Starts the transfer.

9 Documentation Mode 9

9.1 Mode Description

Purpose

This mode lets the user print out (paper copy from a printer) or print to disk (store as a file) documentation on all or a part of an axis control application (configuration + program + internal variables). If the documentation file is printed to disk, it can be reused later in XTEL-DOC.

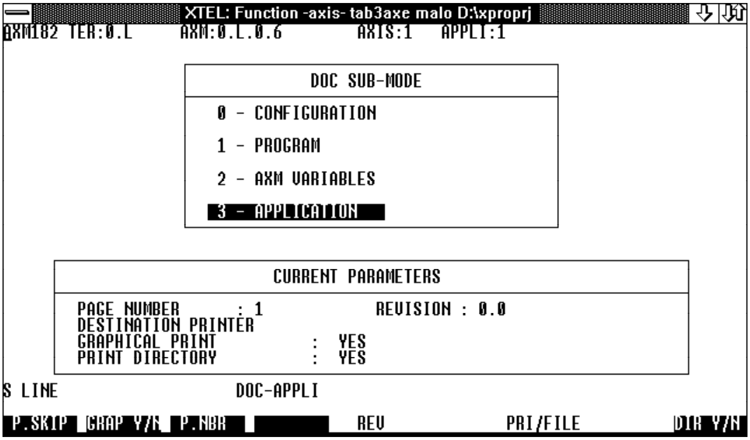
Access

From the Mode Selection Screen:

- Select the location where the application to print is stored (Working Memory),
- (→) Lets the user access the operating modes,
- Select the Documentation Mode. A third column is displayed next to the other two columns.
- (→) Lets the user select which part of the application file should be printed.
- Define the application to document:

  Axis and application number or file name,
- <Enter> Lets the user access the appropriate mode selection screen.

Screen



Mode Description

The screen comprises two boxes. One reminds the user which sub-mode is selected, the other displays the current parameters.

- [GRAP Y/N] Defines the type of printout (graphic or not),
- [PRI-FILE] Defines the output target device: printer or disk,
- [FILE] Defines the output target file (only when printing to disk),
- [DIR Y/N] Prints the directory.

Important

When **print to disk** is selected, the output file will be located in:
- The AXIS\APPLI directory if the print directory option is selected ([DIR Y/N] dynamic soft key),
- The AXIS\MOD directory if the print directory option is not selected.

In both cases the file name takes a .DOC extension.

To ensure that the documentation file generated can later be used in XTEL-DOC, always ensure that two conditions are met:
- The file is stored in the AXIS\APPLI directory,
- The file is generated with the graphic print out option selected (selected with [GRAP Y/N]).

Print procedure (including print to disk)

In connected mode (TSX MEM or AXM MEM selected) the [AXIS] and [APPLI] keys let the user select the application to document with the following options:
- To document all applications for a given axis, enter the wildcard "*" in place of the application number,
- To document applications for all axes, enter the wildcard "*" in place of both the axis number and the application number.

<Enter> Starts the print-out or the transfer to disk.

From this screen, the cursor up and cursor down keys can be used to let the user select another part of the application documentation file to print-out.

In addition, the sub-mode screen lets the user access the following dynamic soft keys:

- [PSKIP] Skips one page,
- [P.NBR] Enter the start of print-out page number (absolute page numbering),
- [REV] Enter the revision number of the application.

Documentation file description

The complete application documentation file comprises:
- The configuration (2 pages),
- The AXM program (20 program steps per page),
- The variables (WNi and CNi),
- The extended directory, if this option is requested (the number of pages is variable).

Mode Description

Example of a printed listing page (Configuration)

AXM units Length = um Velocity = mm/mn Acceleration = mm/s2

Fxx	Parameters	Values	Limits
AF31	RESOL Sensor resolution	3,0 um	1,0 1000,0
AF32	VMAX Max velocity	4050 mm/mn	11 12960
User units			
AF33	- UPUL Length	mm	[um,mm,cm,dm,m]
AF34	- UPUV Velocity	mm/mn	[mm/mn,cm/mn,dm/mn,m/mn]
AF35	- UPUA Acceleration	mm/s2	[mm/s2,cm/s2,dm/s2,m/s2]
AF36	XMAX Max soft limit	+1000,000 mm	-30000,000 +30000,000
AF37	XMIN Min soft limit	-1000,000 mm	-30000,000 +30000,000
CF38	ACCE Acceleration	400 mm/s2	1 4500
CF39	DECE Deceleration	400 mm/s2	1 4500
BF40	TYPEPO Type of ref. point	2 [1,2,3]	

AXM units Length = um Velocity = mm/mn Acceleration = mm/s2

Fxx	Parameters	Values	Limits
BF41	VMAN Manual velocity	1000 mm/mn	1 4050
CF42	VSTOP Stop velocity	200 mm/mn	1 4050
CF43	TSTOP Stop time-out	10 10 ms	1 65535
CF44	TW Target Window	1,001 mm	0,001 6000,000
CF45	DMAX Max deviation	10,000 mm	0,001 30000,000
BF46	UMAX Max voltage	2,25 V	1,00 9,00
BF47	KPOS Position gain	16,00 1/s	1,00 32,00
BF48	LIMV Velocity limitation	10 %Vmax	5 20
BF49	KV Velocity correction	80 %	0 100

application	object	rev	date	page
AXIS 1 APPLI 0	CONF	0.0	03-18-91	3 -1

Identification — Heading — Revision level — Heading/Page — Page Nbr.

Mode Description

Example of a printed listing page (Configuration)

AXM 182

AXM units Length = um Velocity = mm/mn Acceleration = mm/s2

Fxx	Parameters	Values	Limits
BF50	MDMAX Mask treatment DMAX	Y [Y,N]	
CF51	NDMAX Default step nb DMAX	0 0 32	
BF52	MSTOP Mask treatment VSTOP	Y [Y,N]	
CF53	NSTOP Default step nb VSTOP	0 0 32	
BF54	MTW Mask treatment TW	Y [Y,N]	
CF55	NTW Default step nb TW	0 0 32	

AXM units Length = um Velocity = mm/mn Acceleration = mm/s2

Fxx	Parameters	Values	Limits
CF56	TSYN Synchro time-out	3000 10 ms	1 65535
BF57	MSYN Mask treatment syn	Y [Y,N]	
CF58	NSYN Default step nb syn	0 0 32	
BF59	MCPUF Mask treatment CPUF	Y [Y,N]	
CF60	NCPUF Default step nb CPUF	0 0 32	
NBWN	Nb of WN saved	100 0 100	

application	application name	object	rev	date	page	
AXIS 1	APPLI 0	CONF	0.0	03-18-91	3	5
AXM 182						

SUMMARY	part	page
TITLE PAGE	1	
AXIS 1	2	

application	rev	date	page	
LISTING SUMMARY	0.0	03-18-91	4	1
TELEMECANIQUE				

Mode Description

TSX Memory   Title Page   0.0   16/10/90   1 -1   Telemecanique

```
0    LDC    CN0   VAL= 4
1    SRP+   F= 1000    mm/mn    X=  0,000       mm
2    WAIT   EVENT= UC
3    GP9    F= 1000    mm/mn    X= -50,000      mm
4    M      SYN= UC    OUT= 000    IT= Y
5    WAIT   EVENT= UC
6    GP9    F= 1000    mm/mn    X= -10,000      mm
7    DEC    CN0
8    JNZ    N= 10   CN0
9    JMP    N= 14
10   INC    CN0
11   M      SYN= UC    OUT= 000    IT= Y
12   WAIT   EVENT= UC
13   DEC    CN0
14   JNZ    N= 3    CN0
15   END
       EOP
```

application	application name	object	rev	date	page
AXIS 1 AXM 182	APPLI 0	PROG	0.0	03-18-91	2 -1

SUMMARY	part	page
TITLE PAGE	1	
AXIS 1	2	

application	rev	date	page
LISTING SUMMARY TELEMECANIQUE	0.0	03-18-91	3 -1

C 2

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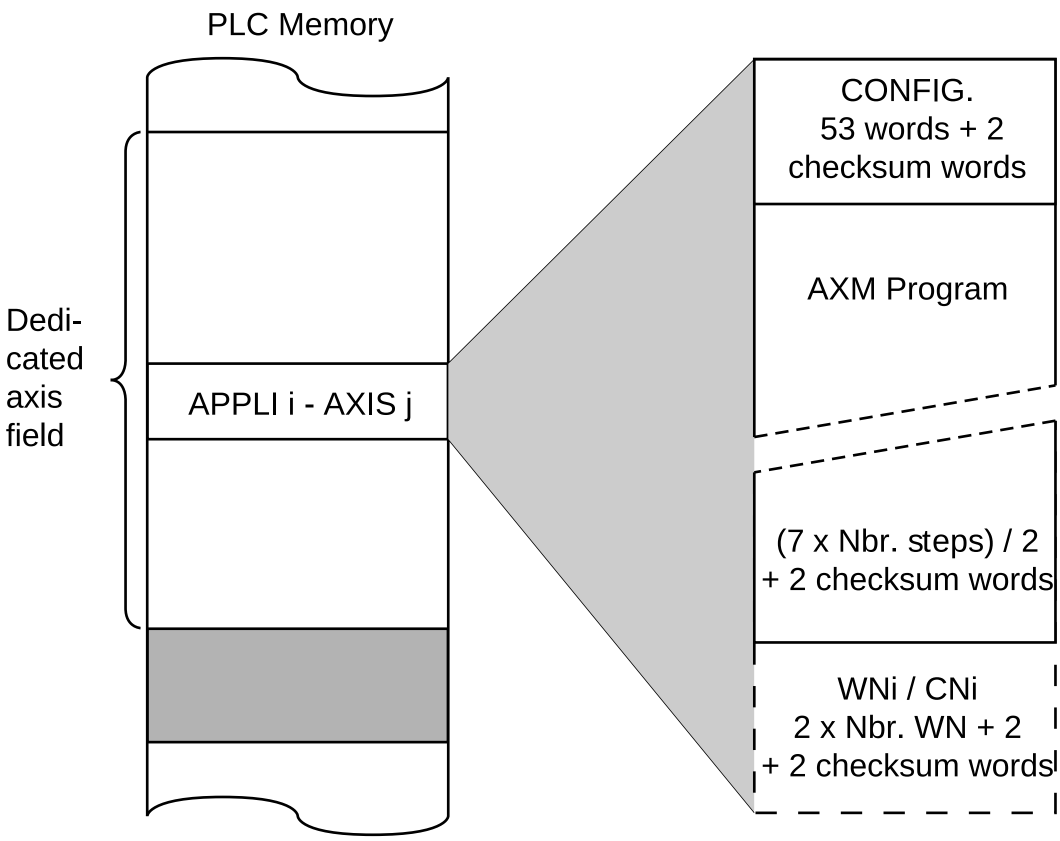
A1 Application Size and Layout

The information shown below is provided as a guide only.
It is not absolutely necessary to know this information when setting up axis control applications.

An application comprises three parts :

- The configuration with a preset size of 106 bytes (53 words).
- The module internal program whose size depends on the number of steps (each step requires 7 bytes, or 3.5 words).
- The table of internal variables:
  - When stored in the module memory this table systematically comprises 100 variables numbered WN0 to WN99 (400 bytes) and the four counters CN0 to CN3 (4 bytes).
  - When stored in the PLC memory or on disk, this table only comprises the exact number of WNs stored (this parameter is declared in the configuration) and four counters numbered CN0 to CN3. Its size is therefore (in words) 2+Nbr. WNs+2 (the WNi variables are double length ones).



The maximum size of an application in the PLC memory (with 253 program steps, 100 stored WN variables) is:

[53+2] + [(254x7)/2+2] + [(100x2)+2+2] = 1150 words

A2 Index

A3 Adjustment and Initial Set-up of an Axis with PL7-AXE

Caution

A procedure for adjustment and initial set-up of an axis using a TSX XBT 182 operator terminal is described in Divider B, Sub-section 7.4. If such a terminal is not available, it is possible to perform all of these operations using PL7-AXE. Some are performed in Configuration mode, others in Debug mode.

However, given that the program does not have the same on-line adjustment possibilities as a TSX XBT 182 terminal, this procedure is more complex to use. It is important to remember the following points:

- Any change of a parameter value requires a modification of the configuration,
- Any modification of the configuration causes the loss of the axis calibration,
- Any modification of the configuration causes the module to Stop. It is up to the user to reset the module to Run, if necessary.

In addition, the user must ensure that each command given in Debug mode produces the expected result.

Example: Selecting the Manual Mode from the Commands half-screen. Use the Information half-screen to check that the Manual Mode is selected.

For commands sent by bits, never forget that the module reacts to rising edges (a change from 0 to 1) and that it is up to the user to reset the bit to 0 afterwards.

Modification of certain configuration parameters will reinitialize the machine factor KR. The user is advised of this when the configuration is validated by the system displaying the message "WRITE OK, ATTENTION KR MODIFIED".

Adjustment and Initial Set-up of an Axis with PL7-AXE

Procedure

- Perform the preliminary checks and adjust the speed drive as described in Divider B, Sub-section 7.4-1.
- With a previously configured TSX AXM module, perform the operations described in Divider B, Sub-section 7.4-2 and adapt them to the operating environment provided by the Debug mode.

Identification used for binary variables

$\boxed{\text{AXM R/S}}$: bit at 1
AXM R/S : bit at 0

Forced reference set-up

As the INIT function is not available when PL7-AXE is used, the set-up sequence is modified as shown below:

Initial state: PLC Stopped Module Stopped	Command	Resulting State
• Set the module to Run	$\boxed{\text{AXM / RS}}$	$\boxed{\text{AXM RUN}}$ $\boxed{\text{DEF ARUR}}$
• Set the Emergency Stop bit to 1	$\boxed{\text{STOP URG}}$	
• Acknowledge the Emergency Stop error	$\boxed{\text{AB ARUR}}$	DEF ARUR $\boxed{\text{STOP}}$ $\boxed{\text{R0}}$
• Select interlock disabled	$\boxed{\text{AXM HSEC}}$	$\boxed{\text{AXM HSEC}}$
• Acknowledge the PLC error (otherwise)	$\boxed{\text{AB CPUF}}$	DEF CPUF
• Select Manual Set-up mode	MOD F = MAN RFP ($\boxed{\text{MODIFY}}$ key)	MOD F = MAN RFP $\boxed{\text{WAIT}}$
• Measure the approximate position of the moving part in relation to the start cam and enter this value into the external position register (in user units) Example:	POS.EXT.= 300,000 mm	
• Force a reference set-up.	$\boxed{\text{FOR. REF}}$	$\boxed{\text{AXE REF}}$ Cur.Pos. = 300,00mm.

Checking the direction of moving part travel

Only the Open Loop Mode selection procedure is described here. For the conclusions which should be drawn from the resulting effects, refer to Divider B, Sub-section 7.4-2.

	Command	Resulting State
• Select open loop mode	MOD F = OPEN LOOP	MOD F = OPEN LOOP
• 100 mV analog counter output	VAL CNA = 40 (1)	WAIT
• Activate the mode	START or <START F>	WAIT CUR. POS. evolves
• Once the results are seen, deactivate the mode	STOP or <STOP F>	Moving part stops

Make any corrections required

Checking the maximum frequency (optional)

By making the same preparations as described in Divider B, Sub-section 7.4-2, apply, to the output of the analog counter, a voltage equal to:
UMAX $(1 + \frac{LIMV}{100})$ and check that the frequency of the resulting pulses does not exceed:

- 40 KHz for a TSX AXM 172 module,
- 80 KHz for a TSX AXM 182 module,

The procedure is identical to the one described above.

(1) LSB = 2.5 mV for TSX AXM 182
10 mV for TSX AXM 172

Checking the distance travelled / distance displayed

Still using the same Open Loop Mode, follow the instructions in Divider B, Sub-section 7.4-2.

Setting the module offset

As above.

Setting the machine factor KR.

This must be performed if the deviation between the distance actually covered and the distance displayed exceeds the level of precision required.

The adjustment procedure that applies when PL7-AXE is used is described in Sub-section 7.4.

Setting the KPOS and KV gains and other parameters

The principle is the same as that described in Sub-section 7.4-2, Divider B. Only the procedure required for using Manual Mode is described here.

	Command	Resulting State
• Select the Manual Set-up Mode	MOD F = MAN SET	MOD F = MAN SET
• Enter the target point in the external point register Example:	POS.EXT. = 60,000 mm	WAIT
• Activate the mode (Don't forget to reset the Start bit)	START	STOP

Reminder: The parameter values can only be modified in the configuration mode.

A4 Diagnostic Assistance

While the various operations are being performed, certain messages may be displayed to warn the user that a request made cannot be performed or that an additional confirmation is required.

Some of these messages are self-explanatory, but others may require some additional explanation.

The tables on the next page provide a complete list of these messages, the events that may cause them and the suggested corrective action that should be taken.

MESSAGE / CIRCUMSTANCES	PROBABLE CAUSE	CORRECTIVE ACTION
UNEXPECTED AXIS N. When accessing the module memory.	• The axis number stored in the module is not the same as the logical number that corresponds to the slot used. This situation is caused by changing modules or swapping their positions.	• Transfer one of the applications stored in PLC memory to the module memory.
UNEXPECTED AXM APPLI. N., READ APPLI? When accessing the module memory.	• The application number stored in the module memory is different from that entered by the user.	• To identify the application number stored in the module memory, select [UTILS] followed by the APPLICATION CHARACTERISTICS function, • To change the number, read the application and press <Enter> to validate. The application will be rewritten in the module memory with the newly selected application number.
SPACE FULL When attempting an AXM → TSX transfer or when modifying the directory or creating an application in PLC memory.	• There is not enough space available in the dedicated Axis field to accept the modification.	• If it is impossible to gain extra space (e.g. by deleting applications), then the size of the dedicated field should be changed (.APP file). Refer to the X-TEL Software Workshop manual (TXT DM XTEL V4E) Divider D, Section 2.
SPACE TO PACK When modifying an application or a directory in PLC memory.	• The PLC memory field is big enough to accept the modification on condition that free space is recovered (memory packing).	• Use the [PACK] dynamic soft key.
APPLICATION NOT IN DIRECTORY During an AXM → TSX transfer. (This message is displayed when writing to PLC memory (TSX MEM) is confirmed when the application was read from the AXM module memory (AXM MEM) after a "UNEXPECTED AXM APPLI. NBR., READ APPLI?" message was displayed and the requested application number exceeds the maximum number defined in the directory.	• The application number is the module does not correspond to a number listed in the directory (e.g.: appli 3 when only two applications are defined in the directory). Cause: Changing the module or modifying the directory.	• If the situation was caused by changing the module, transfer one of the applications stored in the PLC memory to the module. • If the situation was caused by a reduction in the number of applications listed in the directory, modify either the number of applications listed ([DIR AXIS] then [NB APP]) or the application number (AXM → DISK transfer then DISK → AXM transfer, taking care to specify the new application number).

MESSAGE / CIRCUMSTANCES	PROBABLE CAUSE	REMEDIAL ACTION
INVALID STOP PROG After counting down from 12 to 0 when modifying a program in a module.	• Application error present.	• Acknowledge the error before making the modification.
WRITE OK, WARNING KR MODIFIED when modifying a configuration. NB: This message is **only** displayed if the KR factor has been set since the last modification to the configuration.	• Modification certain parameters causes reinitialization of the machine characteristic factor.	• Reset this factor: • From the TSX XBT 182 terminal, or • From PL7-AXE in Debug mode.
AXIS INCOMPATIBLE WITH THE I/O CONFIG when attempting to access the AXM memory.	• The module that is present is not the same type as the one declared in the I/O configuration. E.g.: TSX AXM 172 in place of a TSX AXM 182 module.	• Correct the PL7-3 I/O configuration.
AXIS INCOMPATIBLE WITH THE DIRECTORY in debug mode.	Possible cause: PL7-3 application transfer (Terminal → PLC in progress).	Wait for the end of the transfer and repeat the request.
MESSAGE REFUSED 3 on attempting to access a station via the Mapway network.	Nonexistent network number or nonexistent station number or module faulty.	Redefine the STATION/NETWORK pair.
MESSAGE REFUSED 10 on any attempt to access the module.	• Message reset bit. (OWxy,0,2) is at 1	• Set this bit to 0.
DIRECTORY MODIFIED BY ANOTHER PROCESS	Probable cause: PLC memory loaded from XTEL-MEM.	
TARGET DESTINATION INCOMPATIBILITY ERROR	• Attempt to transfer an AXM file to a different type of module (e.g. 172 FILE to AXM 182)	• Select a file with an extension corresponding to the type of module

A5 PL7-AXE User Access Rights

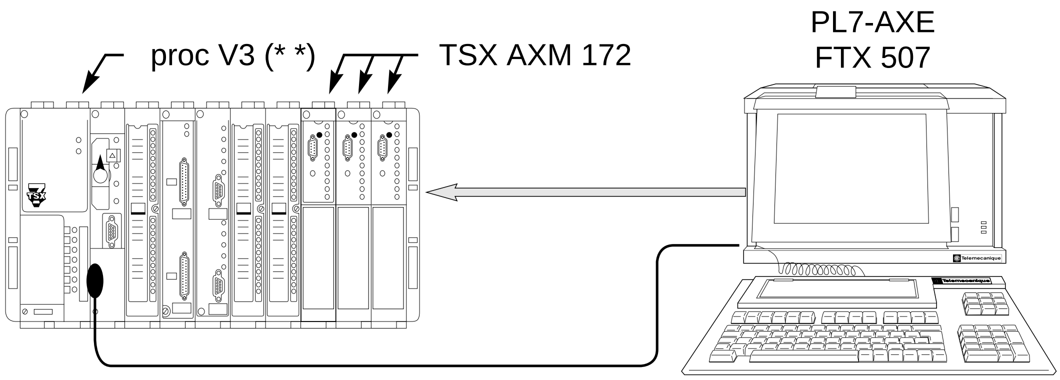
Selected Mode	User Levels					
	Operate		Adjust		Program	
	min.	MAX.	min.	MAX.	min.	MAX.
CONFIGURATION						
Display	no	yes	yes	yes	yes	yes
Modification	no	no	yes	yes	yes	yes
PROGRAMMING						
Display	no	yes	yes	yes	yes	yes
Modification	no	no	no	no	yes	yes
DEBUG						
Status / Commands						
Display	yes	yes	yes	yes	yes	yes
Modification	no	yes(*)	yes	yes	yes	yes
Errors						
Display	yes	yes	yes	yes	yes	yes
Acknowledge	no	yes	yes	yes	yes	yes
Set Wi						
Display	no	yes	yes	yes	yes	yes
Modification	no	no	yes	yes	yes	yes
Set KR	no	no	yes	yes	yes	yes
TRANSFER						
TSX module	no	no	yes	yes	yes	yes
Hard disk	no	no	no	no	yes	yes
DOCUMENTATION	no	no	yes	yes	yes	yes
DIRECTORY						
Display	no	yes	yes	yes	yes	yes
Modification	no	no	no	no	yes	yes
UTILITIES						
Module						
Appli. charac.	no	no	yes	yes	yes	yes
Mod. RUN/STOP	no	no	yes	yes	yes	yes
Del. appli. pgm.	no	no	no	no	yes	yes
TSX						
Appli. list	no	no	yes	yes	yes	yes
TSX RUN/STOP	no	no	no	yes	yes	yes
Del. appli. pgm.	no	no	no	no	yes	yes
HARD DISK						
Directory	no	no	no	no	yes	yes
Appli. list	no	no	no	no	yes	yes

(*) partial

A6 Use of PL7-AXE in V3 configuration

1. General

Version V4.5 of PL7-AXE (reference no. TXT LF PL7 AXS V42E) is compatible with V3 configurations.



(* *) TSX 47-30, TSX 67-20, TSX 87-30

Most of the information in section C2 also applies to PL7-AXE when it is used to generate applications which will be run on a V3 PLC.
There are however some differences which are partly due to the limitations of these PLCs :

- no dedicated zones

and partly due to the required compatibility when running TSX TS6 AXB 72 software on a TSX T607 terminal which is also capable of generating this type of application. The following restrictions apply :

- The number of axis control modules is limited to 16
- The software can only be run on a TSX AXM 172 module
- Applications must be stored in the Wi or CWi zone in PLC memory.

These differences result in a number of limitations when using the software :

- The user must work in connected mode (TSX MEMORY) when creating the directory.
- The user must handle application storage addresses in TSX memory.

These restrictions do have an impact on the different sub-sections of section C2. The table on the next page summarises the sub-sections which apply without restriction to V3 configurations in contrast with those that require some modification.
The section which follows provides further information about using PL7-AXE with this type of configuration.

Use of PL7-AXE in V3 configuration

List of sub-sections which apply to V3 configurations

1 Using the program	1.1	Installation	YES	
	1.2	Accessing PL7-AXE	YES	
2 General principles	2.1	User environment	YES	
	2.2	X-TEL environment	NO	
	2.3	PLC memory dedicated AXIS field	NO	
	2.4	Reservation mechanism	NO	
	2.5	Recommended work practice	NO	
3 Memory types	3.1	Selecting the memory	YES	(1)
	3.2	Module memory : AXM MEMORY	YES	
	3.3	PLC memory : TSX MEMORY	YES	
	3.4	Disk memory : AXM FILE	YES	(2)
	3.5	Disk memory : TSX FILE	NO	
4 Dedicated AXIS field	4.1	Access	NO	
	4.2	Contents	NO	
	4.3	Purpose of dynamic soft keys	NO	
	4.4	PLC ⟷ Disk transfers	NO	
5 Configuration mode	5.1	Mode description	YES	
6 Programming mode	6.1	Mode description	YES	
7 Debug mode	7.1	Mode selection	YES	
	7.2	Command status screen	YES	
	7.3	Access to internal positions	YES	
	7.4	Setting the machine factor KR	YES	
8 Transfer mode	8.1	Mode description	YES	(1)
9 Documentation mode	9.1	Mode description	YES	
A Appendix	A1	Application size and layout	YES	
	A2	Index	YES	
	A3	Adjustment and initial set-up	YES	
	A4	Diagnostic assistance	YES	
	A5	User access rights	YES	

(1) Restriction : TSX FILE memory not available
(2) Restriction : the TSX AXM 172 is the only module to which this applies

2. X-TEL environment

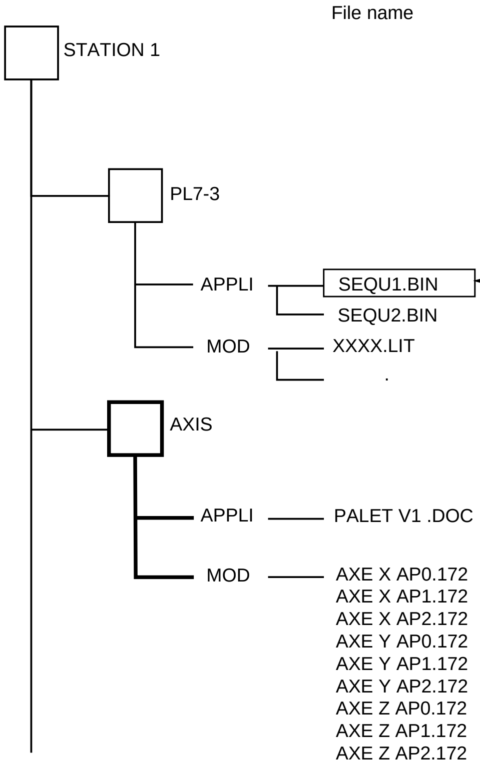
Because a V3 PLC does not have any dedicated zones, the structure of applications is simplified considerably. The diagram on the next page should be compared with that on pages 2-12 and 2-13.

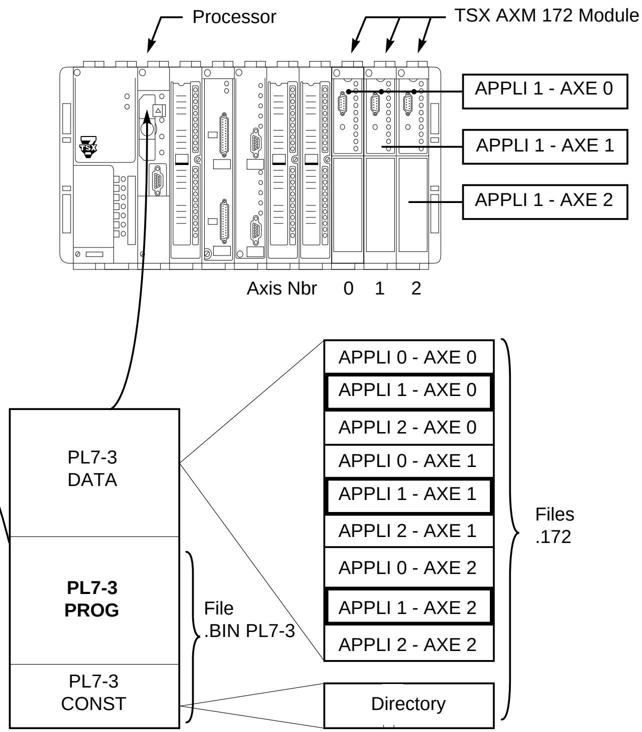
Differences between a V3 and a V4 station

At PLC level : no dedicated zones
- All memory is delegated to PL7-3
- The axis directory is located in the CW zone
- Applications are stored in the W or CW zone

At file tree structure level
- No APP directory
- No "dedicated" directory apart from PL7-3 and PL7-AXE
- No .BIN files in the AXIS\APPLI sub-directory, only .DOC files
- Only .172 files in the AXIS\MOD sub-directory.

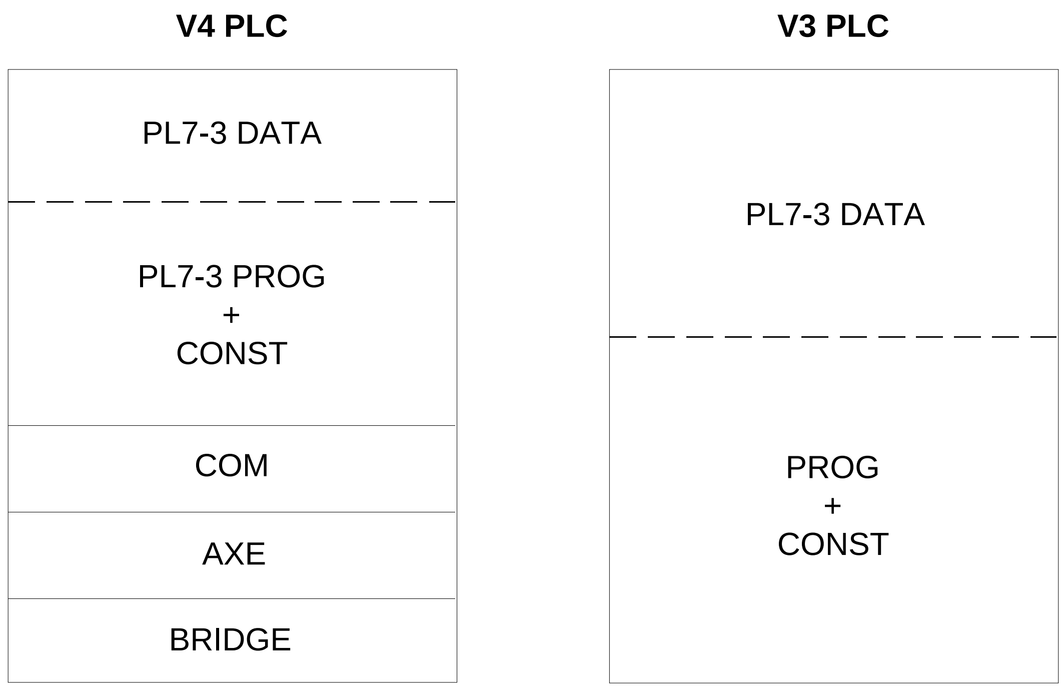
The link between the PLC memory layout and the files generated by the PL7-AXE software.





3. "Dedicated AXIS field"

With a V3 PLC the memory is not organized in dedicated zones as it is with a V4 PLC ; the available memory field is all assigned to PL7-3.



PL7-AXE therefore has to use the memory field (in the W or CW zone). It is up to the user to reserve in these two zones the necessary area for handling the axis control modules (directory and application storage).
With a V3 PLC, the directory is stored in the CW zone at the address indicated in CW0.

Example : CW0 = 100 : directory stored in CW100
(It is advisable to put the directory in CW1 so that the start of the CW zone is set aside for this purpose).

The axis control applications which are intended to be run on TSX AXM 172 modules can be stored in the CW or the W zones.
If the amount of memory required to store all the applications is not excessive, use of the CW zone is recommended. If it is significant, particularly if it exceeds 5000 words, the W zone must be used.

Impact of selecting W/CW

1. The CW zone is stored on diskette with PL7-3 when a STORE is performed, whilst the W zone is only stored on an explicit command.
2. The CW zone may be a PROM, and cannot therefore be modified.

4. Reservation mechanism

As in the case of V4 configurations, there is a reservation mechanism which is designed to avoid any conflicts of access to the same zone from different program. However it operates in a slightly different way due to the fact that there is no dedicated AXIS zone in a V3 configuration.
- The reservation affects the whole of the PLC memory,
- It is designed to avoid conflicts of access to the CW zone between PL7-AXE and PL7-3.

Operating principle

- The software which requires access to the PLC memory makes a reservation request,
- If the PLC has not already been reserved, the program making the request is then authorised to have access.
  From this moment any attempt to gain access by another program results in a refusal identified by the message TSX NOT RESERVED.
- Changing from connected to local mode causes the reservation to be cancelled.

With PL7-AXE, changing into "local mode" is performed :
- either once the AXM FILE memory has been selected at the time of validating the operating mode,
- or by use of the [LOCAL] dynamic soft key displayed on the main menu bar when returning to connected mode (AXM FILE or TSX FILE).

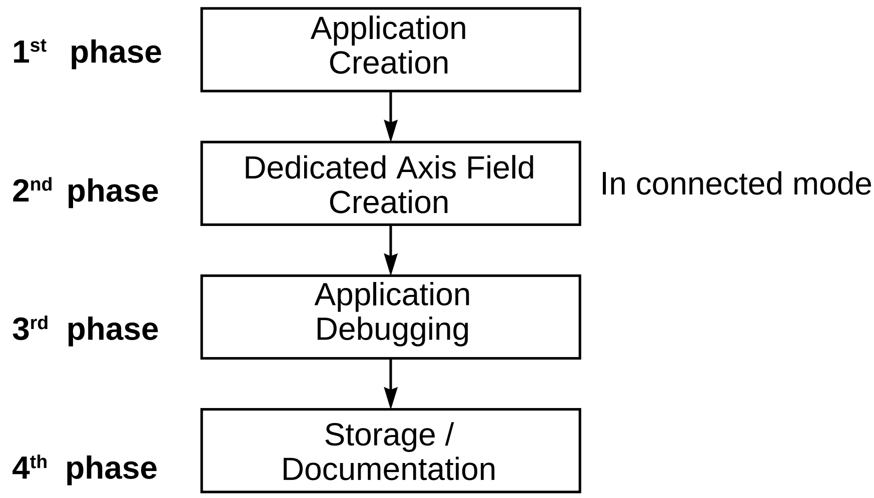
A consequence of this reservation mechanism :
It is not possible, as was previously the case with a V4 configuration, to gain simultaneous access to the same PLC from both PL7-3 and PL7-AXE (whether from the same terminal or 2 different terminals).

5. Recommended work practice

The only differences to the recommendations in paragraph 2.5 are in relation to the characteristics of V3 PLCs.

- No dedicated AXIS field (resulting in no .APP files and the directory being located in the CW zone).
- No TSX FILE memory (resulting in the requirement to work in connected mode in order to create the directory).

The recommended approach comprises the same four phases :

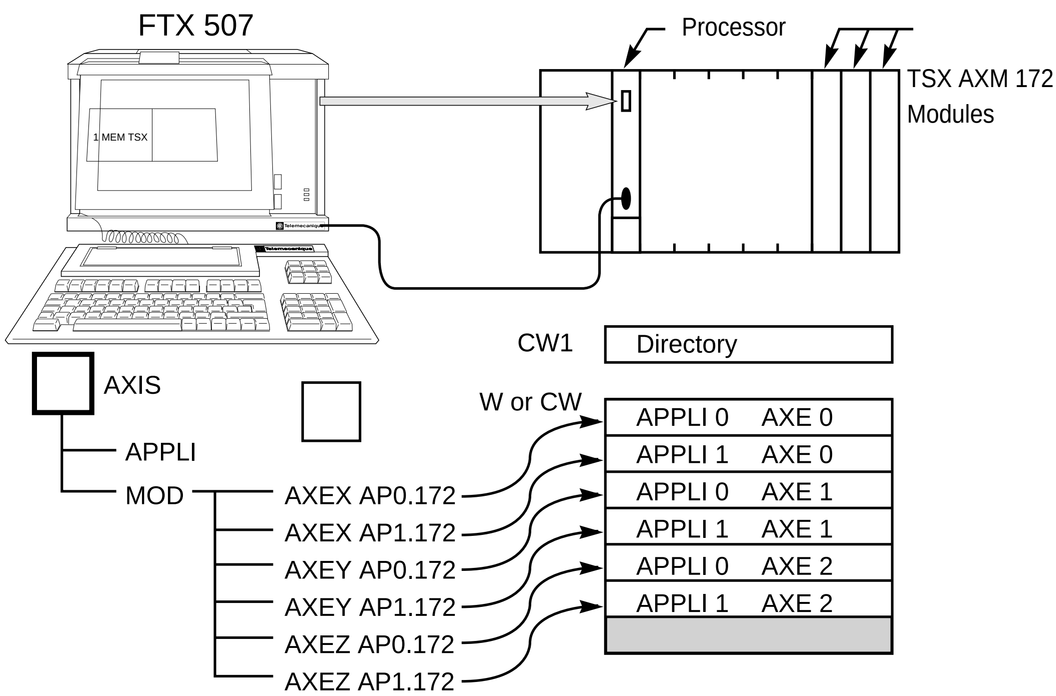


1st phase : identical to paragraph 2.5 in all respects except that it only generates .172 files.

2nd phase : Creating the dedicated AXIS field.

Note : The terminology, although incorrect, is retained in order to be consistent with the recommended work practice in paragraph 2.5.

- Reboot PL7-AXE in CONNECTED mode (TSX memory).

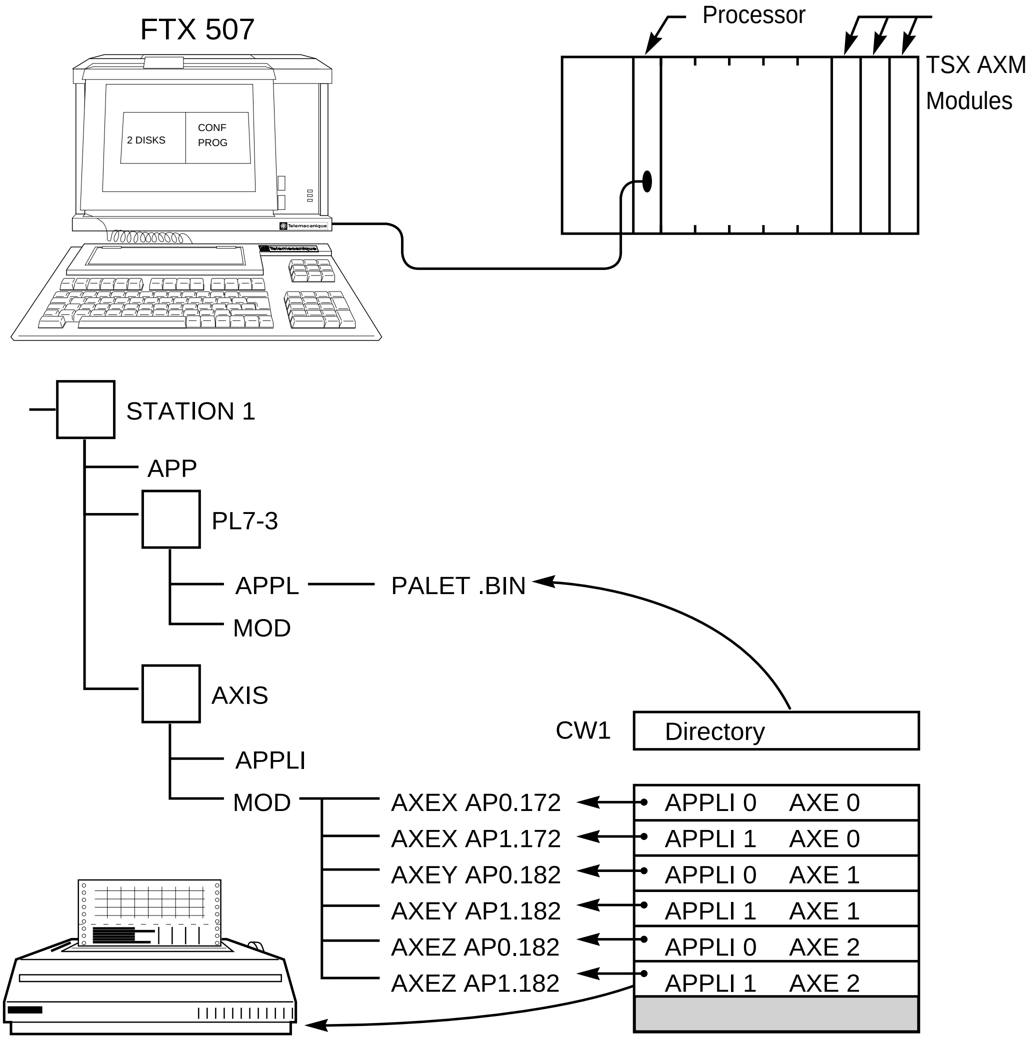


Use of PL7-AXE in V3 configuration

- Create the directory
- Transfer each application from the hard disk to the PLC memory.

3rd phase : Debugging the applications
Identical to paragraph 2.5 except that the XBT terminal must be a TSX XBT 172 to be compatible with V3 PLCs.

4th phase : Storage / documentation



- Terminal in TSX MEM connected mode.
- Transfer each of the axis control applications from the TSX memory to the disk (1), keeping the original file names (file .172 in the AXIS \ MOD directory)②.
- Boot up PL7-3 and transfer the application to the PL7-3 / APPLI directory. This operation backs up the directory and any applications stored in the CW zone. If necessary, back up the W zone which is assigned to application storage (TRANSFER mode, SAVE/RESTORE function).
- Reboot PL7-AXE in local mode (AXM FILE or TSX FILE) and document each of the applications (on hard copy or .DOC files stored in the AXIS \ MOD "directory").

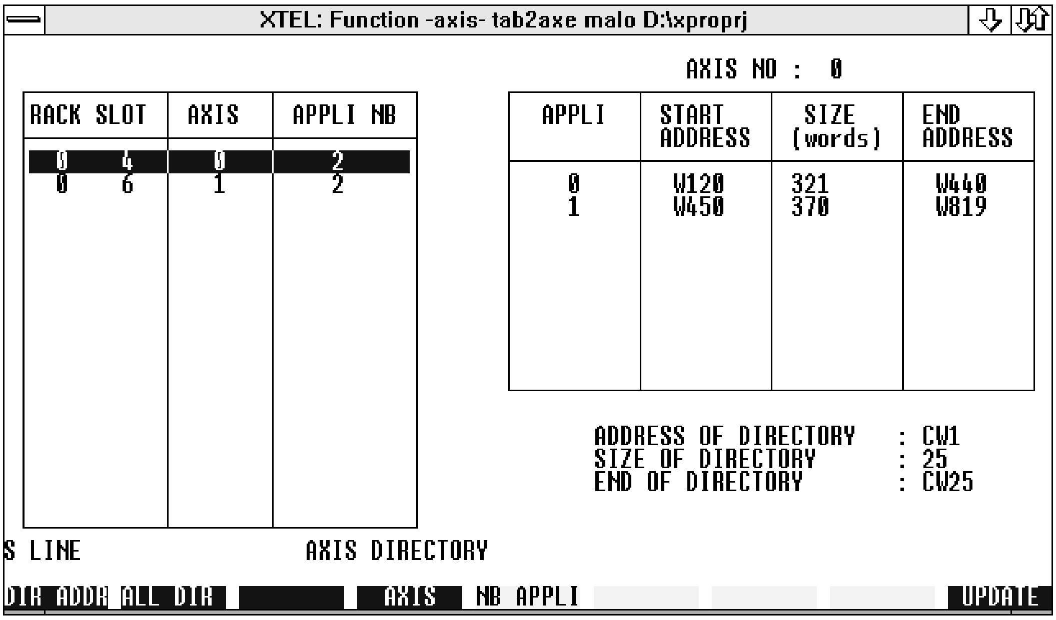
(1) This operation is not necessary if the applications were not modified during the debug phase.

Use of PL7-AXE in V3 configuration

6. Directory handling

From the Mode Selection Screen.

[DIR AXIS] accesses the screen below :



- [DIR ADDR] lets the user define the address of the directory in CWi memory (i≠0), the length of the directory being calculated by the software automatically,
- [AXIS] lets the user modify how the axis numbers offered by default are assigned (a number can only be assigned to one slot),
- [NB APPLI] lets the user define the number of applications per axis, using the arrow keys to select the axis number,
- defines the storage address for each application :
  - select the axis by using the up and down arrow keys,
  - (→) accesses the Applications box (if the number of applications is other than 0),
  - [ADDR] lets the user select the type of Wi or CWi word and the application storage address.

Caution : No check is made of overlap between applications, and it is up to the user to estimate the size of his application and keep a sufficient safety margin when selecting storage addresses (see Appendix A1). An application overlap will result in the following message when the affected application is read : ERROR WNi(PROG), ABANDON APPLI? [YES] deletes the application, [NO] reinitializes just the affected part.

Use of PL7-AXE in V3 configuration

The directory which is created can be modified as long as certain precautions are taken :

- Ensure that changing a storage address does not cause the application to be transferred automatically to the new zone. The user is responsible for checking this.
- Check that any new address does not cause an overlap with another application.

The user can also modify the PL7-3 application configuration, by modifying the module location or the number of CWi or Wi words.

Changing the location of TSX AXM 172 modules

When a directory has already been created and the user wishes to move a TSX AXM 172 module within the PLC configuration or remove a TSX AXM 172 module from the configuration altogether.

When a directory is read, modules that have been relocated or removed are preceded by an asterisk.

[UP DATE] will update the directory to reflect the new PL7-3 configuration.

Changing the number of words allowed in the PL7-3 configuration

When a directory has already been created and the user wishes to change the number of CWi or Wi words.

When a directory is read, the addresses which exceed the maximum permissible number of words are preceded by an asterisk.

The user must change the invalid addresses one by one.

Note : If the length of the directory is greater than the configured number of CWi words, an asterisk precedes the directory address.

Utility keys

- CTRL W displays the configured number of Wi words.
- CTRL C displays the configured number of constant CWi words.

A7 Restrictions on the use of PL7-AXE with a TSX AXM 162 module

Reminder

The TSX AXM 162 module cannot be programmed, which results in the following :

- An application is limited to a single configuration : there is no internal module program or table of internal positions. (In addition, the configuration is cut off from all parameters which enable fault processing by the module program.)
- Operating modes
  * AUTOMATIC CYCLE
  * AUTOMATIC BLOCK BY BLOCK
  * AUTOMATIC STEP BY STEP

are not available.

PL7-AXE takes these restrictions into account by only offering the user those functions which are available on the TSX AXM 162 module and refusing any attempt to access a non-existent function.

General principles

- The main menu screen (selection of memory and mode) and the screens which can be accessed with the [UTILS] key are identical for all module types.
  In the case of the TSX AXM 162 module any attempt to access the PROGRAMMING mode, whether for the purpose of creation or deletion (using the DELETE THE PROGRAM function in the utilities) results in the message PROHIBITED FOR AXM 162s. This message is also displayed if an attempt is made to access the table of internal WNi variables.

- In DEBUG mode, only the operating modes which are available on the TSX AXM 162 are offered, and only the appropriate information appears on the STATUS/COMMANDS screen.

  The next page contains a summary on the restrictions for use of PL7-AXE with the TSX AXM 162 module that apply to each chapter of section C2.

Restrictions on using a TSX AXM 162 module

Chap. 1 : USING THE PROGRAM : None
Chap. 2 : GENERAL PRINCIPLES : None
Chap. 3 : MEMORY TYPES

Mode Selection Screen

Selection of PROGRAMMING mode not permitted

Utilities

DELETE THE PROGRAM function not permitted
DELETE THE APPLICATION function causes the configuration to be deleted.

Chap. 4 : DEDICATED AXIS FIELD : None

Chap. 5 : CONFIGURATION MODE
The configuration comprises only two screens

Chap. 6 : PROGRAMMING MODE
This chapter does not apply to TSX AXM 162

NB : Any attempt to access the PROGRAMMING mode is barred (message PROHIBITED FOR AXM 162s)

Chap. 7 : DEBUG MODE
Access barred to screen of WNi table

STATUS/COMMANDS screen

Only the information which is appropriate to the TSX AXM 162 is included. Information and commands concerning the following do not therefore appear :
- program operation
- interrupt system
- sync fault handling
- WNi/CNi management
- interrupts

Dynamic soft keys

The [WNi/CNi] key does not exist.
The [AUTO CYC], [AUTO B/B] and [AUTO S/S] keys are not offered when changing mode.

Chap. 8 : TRANSFER MODE : None

Chap. 9 : DOCUMENTATION MODE
The listing which is produced is limited to the single configuration (1 page only)

Chap. A : APPENDIX

A1 : Application size and layout : these are limited to the configuration.

A2 to A6 : None

C3 - Optional Function Blocks (OFBs)

C
3

C
3

1 Operation (common to all the OFBs) 1

1.1 Reminder of the concept of OFBs

Introduction

The optional function blocks are not a part of PL7-3 language but an extension to it.
They are classed by family : communication, analog axis control/PID control; each family being supplied with specialized set-up software.

Axis control family
AXM LD AXM DG AXM PG

A family has various types of OFB and therefore may be used several times.

Once introduced into the PL7-3 language, they resemble standard function blocks (timers, counters, etc.) but have their own special features (EXEC instruction, dedicated memory field).
They may only be introduced to V4 applications which will operate on model 40 PLCs.

Description

On a PLC, an OFB represents ;
- A sequence of instructions (not accessible), unique regardless of the number of declared OFBs of the same type, located in the PL7-3 PROG OFBs field
- An area in the PL7-3 DATA OFB field for each use
- An area in the PL7-3 CONST OFB field for each use

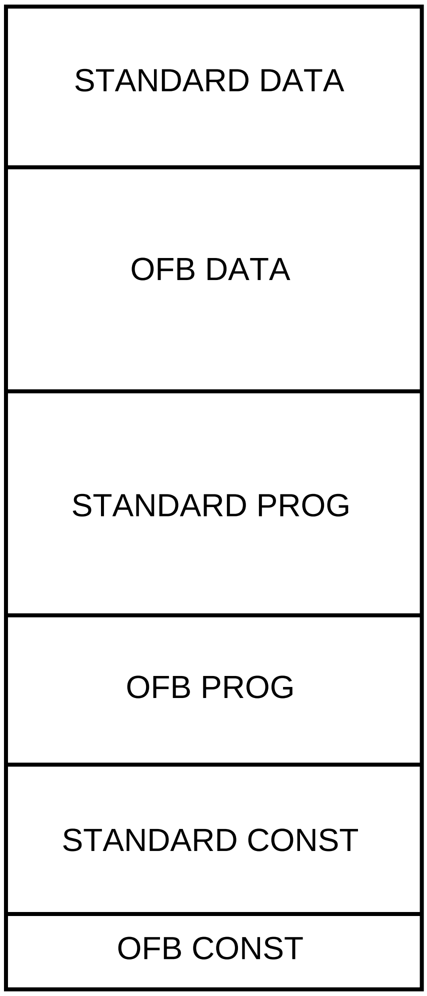
E.g. : The AXMLD OFB used for 3 TSX AXM modules

PL7-3 PROG field	AXM LD
PL7-3 CONST field	AXM LD 0 AXM LD 1 AXM LD 2
PL7-3 DATA field	AXM LD 0 AXM LD 1 AXM LD 2

Reminder of the concept of OFBs

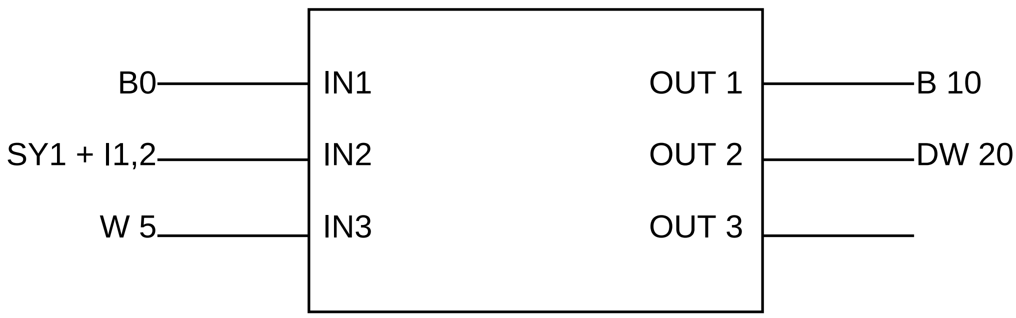
Reminder

The DATA, PROG and CONST parts of the PL7-3 dedicated field are sub-divided so as to reserve an area for the OFBs.



In addition to its constants and internal data a function block has its own I/O parameters to which are associated values, PL7-3 variables or equations.

Example :



This graphic format can only be accessed in the programming phase for assigning the I/O parameters.

1 Operation (common to all the OFBs) 1

Reminder of the concept of OFBs

Use

To use a type of OFB in a PL7-3 program, it is necessary :
- to declare the type of OFB in the PL7-3 configuration,
- to determine the number of OFBs of each type which are to be used.

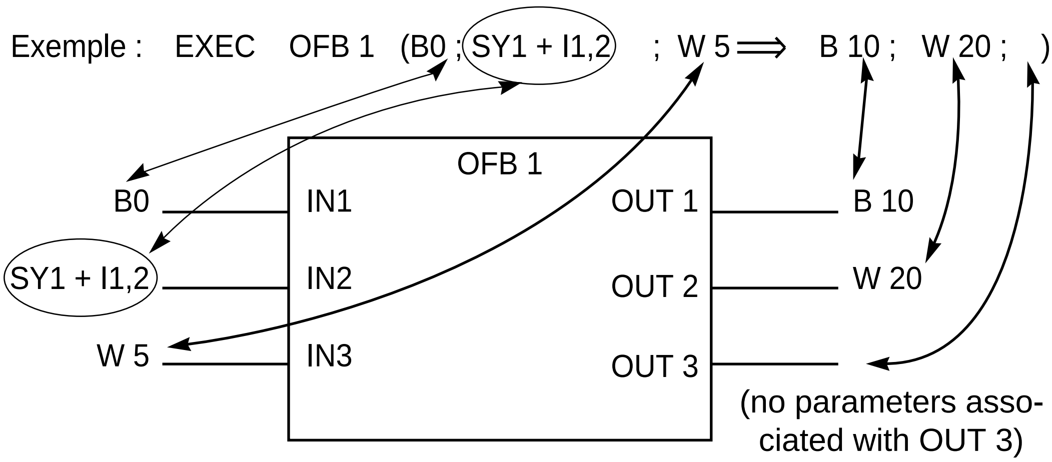
This OFB can then be used in LITERAL language

! EXEC OFB i (; ; ⟹ ; ;)

or in ladder language, which will require the use of an OPERATE block.

⟹ Separator between the input and output parameters.
; Separator between 2 input parameters or 2 output parameters

The PL7-3 variables associated with the I/O parameters are in parentheses**.**



If a parameter has not been assigned, its place in the instruction syntax is empty.

1.2 Configuration

Introduction

Optional Function Blocks (OFBs) are supplied on the diskette labelled TXT BF PL7 AXS V42.
The installation procedure for OFBs is described in Divider C2, Sub-section 1.1.

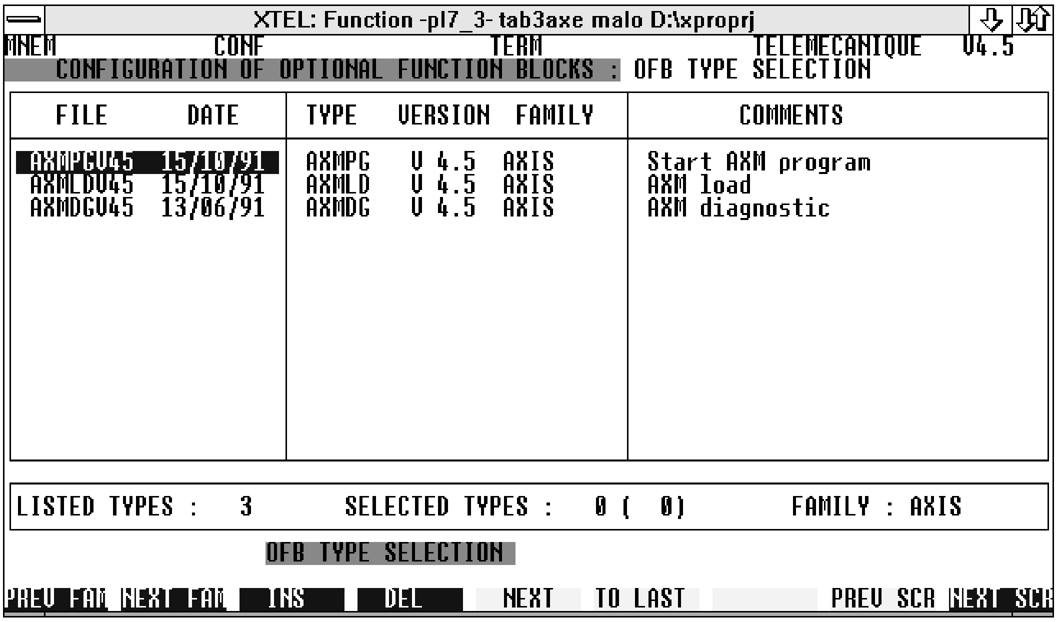
To use an OFB on a station, it is necessary :
- To have the Axis icon available for this station (2),
- To declare all OFBs in PL7-3,
- To set the number of instances of use,

} Configuration mode

- To program the OFBs (in PL7-3, Programming Mode).

Declaring OFBs

OFBs are declared in PL7-3 Configuration Mode
- Select item 5 from the menu - OPTIONAL FUNCTION BLOCKS
- A list of all available OFB families will be displayed
- If the AXIS OFB family is not present, select the [NEW OFB] dynamic soft key to display a list of the AXIS OFBs that are available.



(1) Should this not be the case, then the program has not been installed for this station. Refer to Divider C2, Sub-section 1.1.

Configuration

The [PREV FAM] and [NEXT FAM] dynamic soft keys let the user display all OFB families available to this station.

Use the ↓ and ↑ cursor keys to select an OFB for use and press the [INS] dynamic soft key. The selected OFB will become an object in PL7-3 language, similar to the standard function blocks (timers, counters, etc.).

Repeat this procedure to select all the OFBs to be used. Confirm with ENTER.

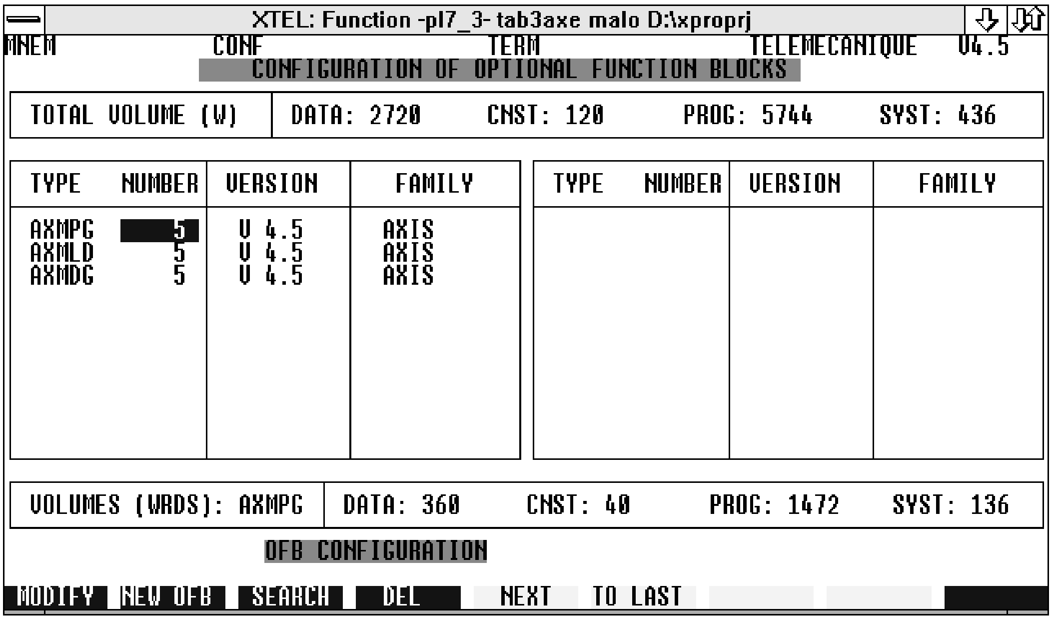
The [DEL] dynamic soft key will delete an OFB from PL7-3 language.

Declaring the number of times OFBs are used

In the same way as the number of timers or counters required for use is declared in PL7-3, the number of times an OFB will be used must also be declared (the term instances of use is also used).

This operation is performed whilst still in PL7-3 Configuration Mode with menu item 5 OPTIONAL FUNCTION BLOCKS.

- Once the various types of OFB are declared, a new screen then lets the user define the number of times each type of OFB will be used.



- Use the [MODIFY] dynamic soft key to enter the number of times that each defined OFB will be used.

Configuration

NB: Ensure that for each type of OFB that will be used, the declared number of instances of use is the same as the number of axis control modules.

Example: In a configuration with three TSX AXM modules, the AXM LD OFB is used to transfer the application from the PLC memory to the module memory (MEM TSX → MEM AXM).

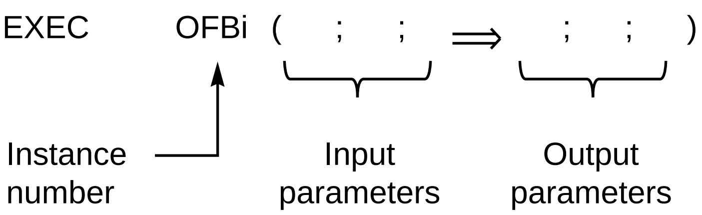
Once three AXM LD OFBs have been declared, the program will create AXM LD0, AXM LD1 and AXM LD2 that the user can later assign to the three axes.

- Once the number of times each type of OFB will be used is declared, confirm by pressing <Enter>.

1.3 Programming

Syntax

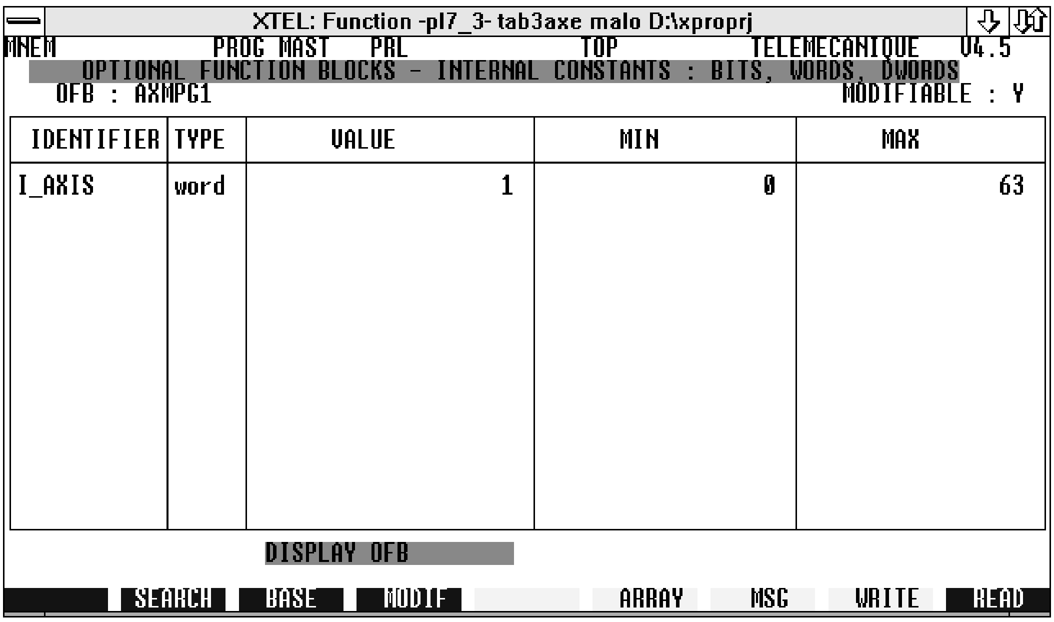
OFBs can be used in any program module, in Literal or Ladder languages (using an OPERATE block). In both cases, the same syntax applies:



PL7-3 lets the user access the [EXEC] dynamic soft key and two other dynamic soft keys [CONTENT] and [PARAM] that specify respectively the values of the OFB constants and the I/O parameters.

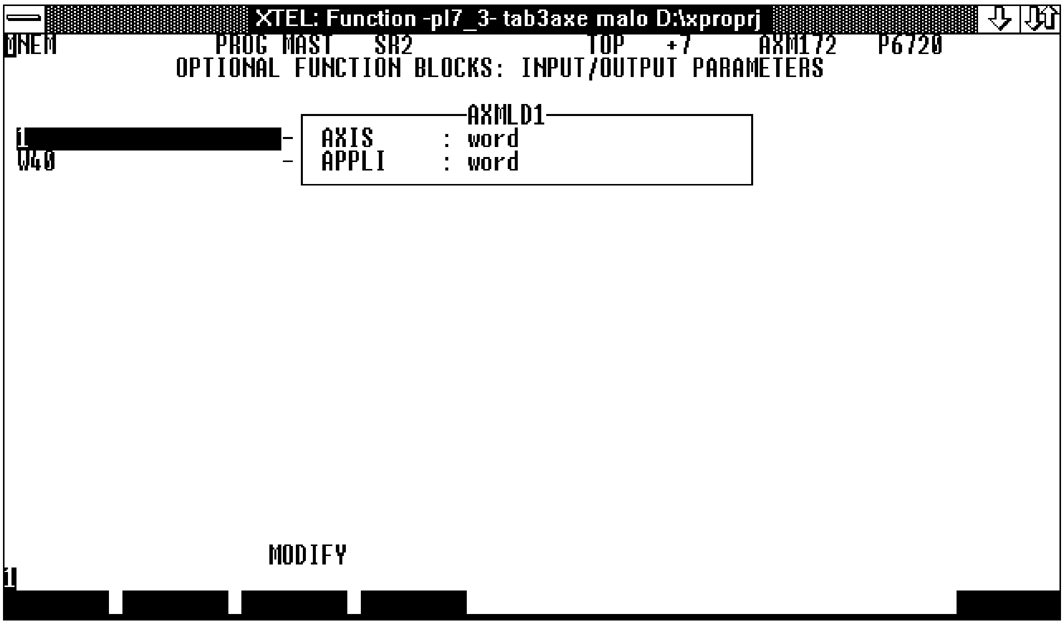
An instruction is entered using the following procedure:

- Select [EXEC]
  Result ! EXEC
- Enter the mnemonic for the OFB followed by a number
  Example ! EXEC AXM LD0
- Press [CONTENT]
  A new screen will be displayed showing the value of the internal constants. Initialize each constant and press <Enter> to validate.



Programming

- Press [PARAM]. The OFB is then displayed graphically. Assign a PL7-3 variable or an equation to each Input/Output parameter (1). A coherence check is performed.



- Press <Enter> to validate the screen.

- Press <Enter> to validate the equation.

Result: ! EXEC AXM LD0 (1;W40 →)

Internal data when it exists, can be read and written from the PL7-3 program. The data can be accessed by its mnemonic.

E.g.: IF AXM LD0, READY THEN …

(1) This assignment is not required for all parameters.

- Some input parameters do not have to be used.
- Bit type output parameters are directly accessible by PL7-3 in mnemonic format.

E.g.: IF AXM LD0, READY THEN …

Programming

SUMMARY

Programming an OFB requires:

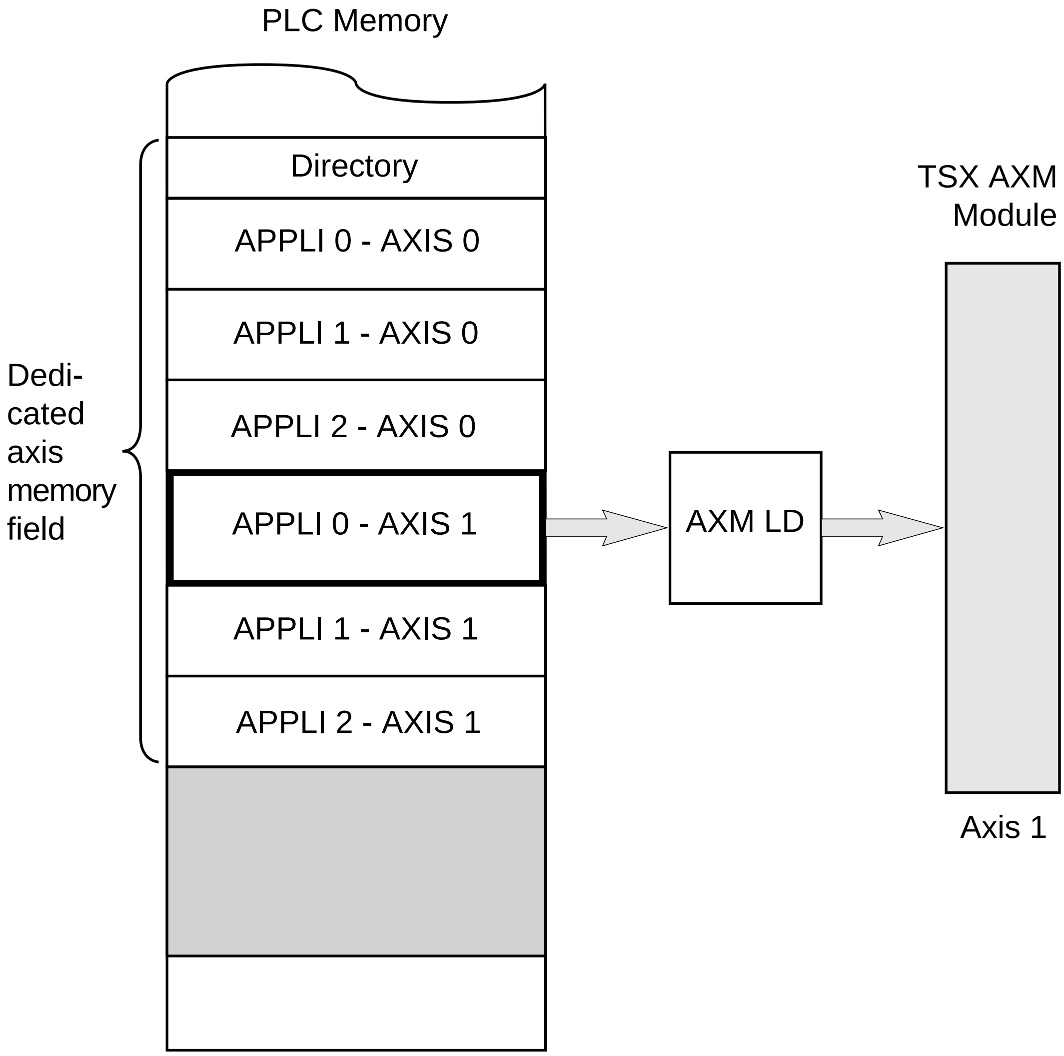
- Initialization of its internal constants,
- Assignment of its I/O parameters,
- Modification of its internal data.

The first two operations are performed once only in the programming phase. The third operation is performed on execution, before the EXEC instruction.

2 The AXM LD OFB

2.1 Purpose

The AXM LD OFB will on request, transfer the contents of the application stored in the dedicated axis field of the PLC memory to a TSX AXM 172, TSX AXM 182 or TSX AXM 162 axis control module.



2.2 Presentation

The AXM LD OFB has internal constants, internal data and input parameters. It does not have output parameters.

The constants and parameters are defined during the programming phase. The internal data is used when the OFB is executed.

AXM LD
AXIS : WORD
APPLI : WORD

DATA	CONSTANTS
ERROR	IAXIS
STATUS	
READY	
LOAD	

Internal constants

IAXIS: Specifies the axis number that the OFB is assigned to. Its value is between 0 and 63. It has a default value of 64, which means the OFB cannot be used unless this parameter has been defined.

NB: Make sure that the OFB has the same number as the axis.
E.g.: AXM LD1 assigned to axis 1.

Internal data

READY: (BIT) Is set to 0 during the transfer and is reset to 1 as soon as the transfer is completed.
This bit changing from 0 to 1 determines whether the module can resume running.

This bit can be directly evaluated by the AXM LDi, READY mnemonic.

ERROR: (BIT) Goes to 1 if the transfer is unsuccessful. It is set to 0 at the start of a transfer.
This bit can be evaluated directly by the AXM LDi, ERROR mnemonic.

STATUS: (WORD) Identifies why a transfer was unsuccessful.
Each bit among the 16 identifies an error cause.

Presentation

Bit	Description
0	TSX AXM module not working
1	Module refuses to Stop
2	Module reserved by another user
3	No terminal block
4	Not used
5	Module not present
6	Axis number not defined in the directory
7	Directory not defined
8	Module type does not correspond to the declared type
9	Application number does not exist
10	Application refused by the module
11	Not used
12	Transfer interrupted by a power break or a Reset command
13	OFB version incompatible with the PLC version
14	Communication with the module not possible
15	System error

LOAD: (BIT) Setting this bit to 1 starts the transfer of the application specified by a number in APPLI, to the axis number specified in AXIS. Its effect is therefore the same as the EXEC AXM LD instruction.
This variable should only be changed by an adjustment terminal.
Typical use: Loading an application after changing the module.

Input parameters

AXIS: (WORD) Automatically initialized by a cold restart of the PLC with the contents of the IAXIS constant. This parameter can be modified by the user. This possibility lets the same AXM LD OFB be used for a number of axis. In the absence of any modification, the OFB is assigned to the axis number specified by IAXIS.

APPLI: (WORD) Specifies the number of the application to transfer. By default this word is initialized at 10 and it must be assigned an immediate value or a PL7-3 word type variable that is initialized with the number of the application to transfer, before execution of the EXEC AXM LD instruction.

Important

If this parameter is not initialized, the default value (9) means that the OFB cannot be run as it corresponds to an application number that is outside the limits allowed (0 to 8).

Presentation

Table of OFB status determined from the ERROR and READY bits

ERROR	READY	OFB Status
0	0	Transfer in progress
0	1	Transfer completed correctly
1	1	Transfer unsuccessful (1)
1	0	Normally impossible state

(1) The contents of the Status word will identify the cause.

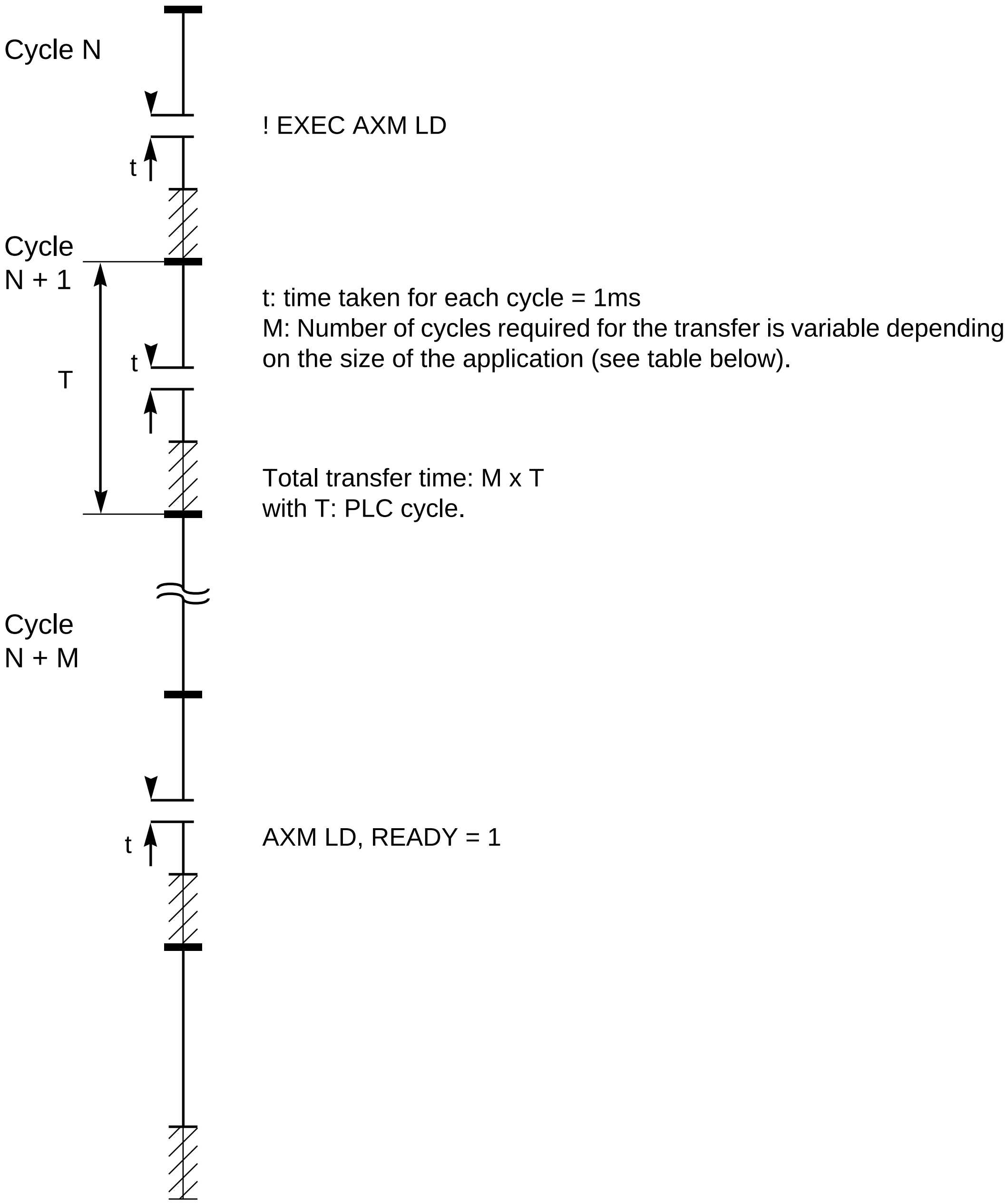
Memory occupation

Program field	Data field	Constants field
3750 words for any number of uses	336 words for each use	8 words for each use

Presentation

Execution time

The transfer of an application requires a number of PLC cycles. It is therefore necessary to distinguish the time required to transfer an application (time between the EXEC OFB request and the time the AXM LD, READY bit changes from 0 to 1) from the PLC time required during each PLC cycle.

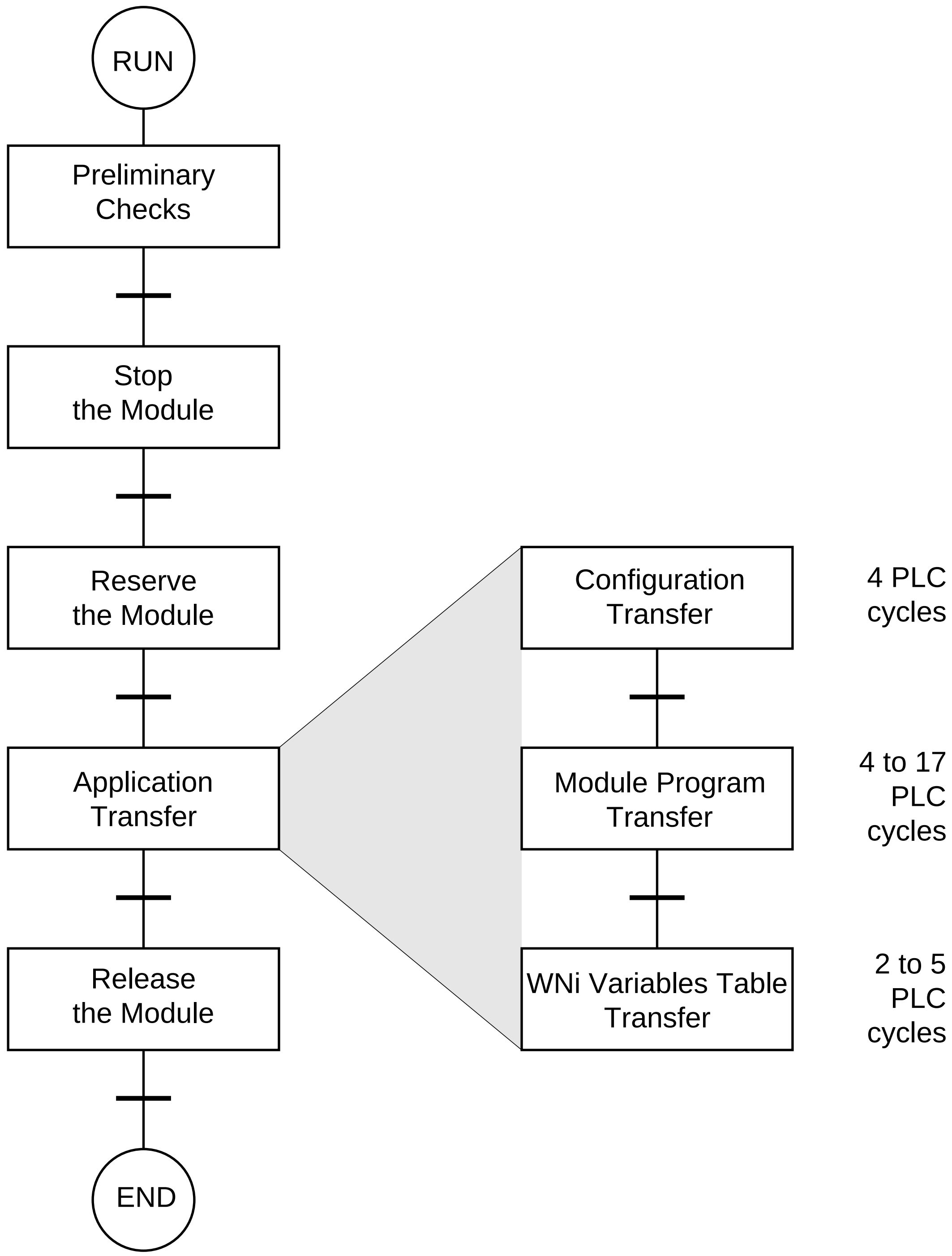


Typical application	M
Minimum application: CONF only Appli. + AXM pgm. with n steps and no WNi	6 8 + n x 7 / 120
Appli. + AXM pgm. with n steps and K WNi Maximum application CONF + AXM of 253 steps + 100 WN	9 + n x 7/120 + K/30 28

2.3 Internal Operation

Internal operation diagram

The AXM LD OFB performs all of the operations required to transfer the application as shown in the simplified diagram below:



For a TSX AXM 162 module

The application does not have a module program or WNi table. Only the CONFIGURATION is transferred by the AXMLD OFB.

Internal Operation

Checks performed by the OFB before executing the transfer.

1 • TSX AXM 172, TSX AXM 182 or TSX AXM 162 module present in the location corresponding to the axis number.
2 • Module ready to run (self-test phase completed and no module errors found).
3 • Module not reserved by another user (TSX XBT 182 terminal or PL7-AXE program).
4 • Coherent application number.
5 • Integrity of the application to transfer checked (Checksum tested).

If these conditions are met, the OFB starts the load sequence.

Execution requires a number of PLC cycles. The exact number of cycles depends on the size of the program (number of step) and on the number of WNi variables stored in the PLC memory.

Each step must be executed correctly before the next step can be executed. If not, the transfer is cancelled.

Reaction to a mains power break/return

If a transfer is in progress when a power break occurs, the OFB reacts by setting:
- The AXM LD Error bit to 1,
- Bit 12 of the Status variable to 1.

Reaction to a cold restart

The parameters are reinitialized with the default values. The content of the IAXIS internal constant is transferred to the AXIS input parameter.

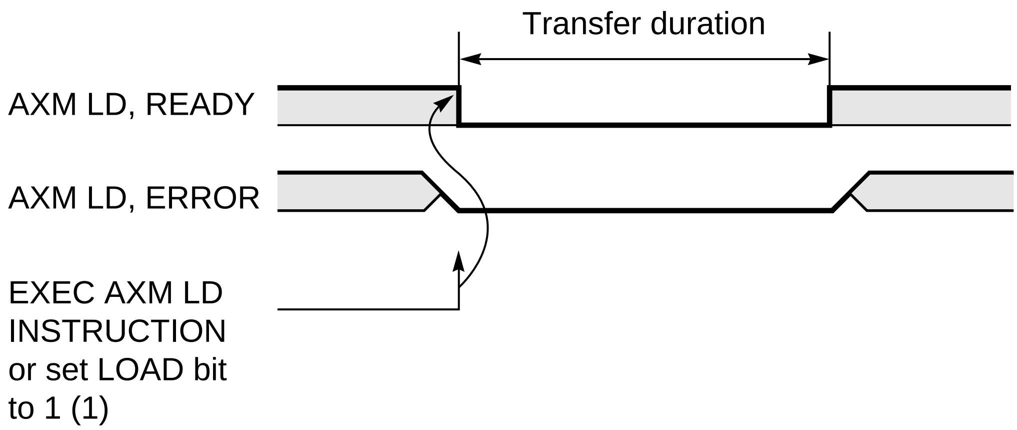
Reservation

As the transfer of an application requires a number of PLC cycles, the AXM LD OFB uses the reservation routine (described in Divider B, Sub-section 6.6) in the same way as a terminal. This means that:
- If the module is already reserved, the transfer is refused (ERROR bit and STATUS bit 2 go to 1) the instruction EXEC AXMLD must be repeated,
- If a terminal attempts to access the module while the transfer is in progress, it will receive the refusal message AXM RESERVED.

C
3

External view

The EXEC AXM LD instruction starts the transfer sequence if the OFB is not already being executed.
While this sequence is being run, the AXM LD, READY and AXM LD, ERROR bits are set to 0.
Once the transfer is complete, the AXM LD, READY bit is reset to 1 and the AXM LD, ERROR bit is set to 1 if the transfer was unsuccessful. The AXM LD Status variable allows the user to identify the type of problem encountered.



The module is not reset to Run by the OFB
It is up to the user to do this once the transfer is complete, i.e. when the AXM LD, READY bit changes from 0 → 1 on condition that the ERROR bit is at 0.

If the EXEC AXM LD instruction is encountered again while a transfer is in progress, it is ignored.

It is up to the user to ensure that the EXEC AXM LD instruction is only scanned once in a program. This instruction should be conditional on an event that will only occur once during a PLC cycle (bit SY0, SY1, rising edge, etc.).

(1) Using PL7-3 (in DATA mode) or SYSDIAG.

Typical programming

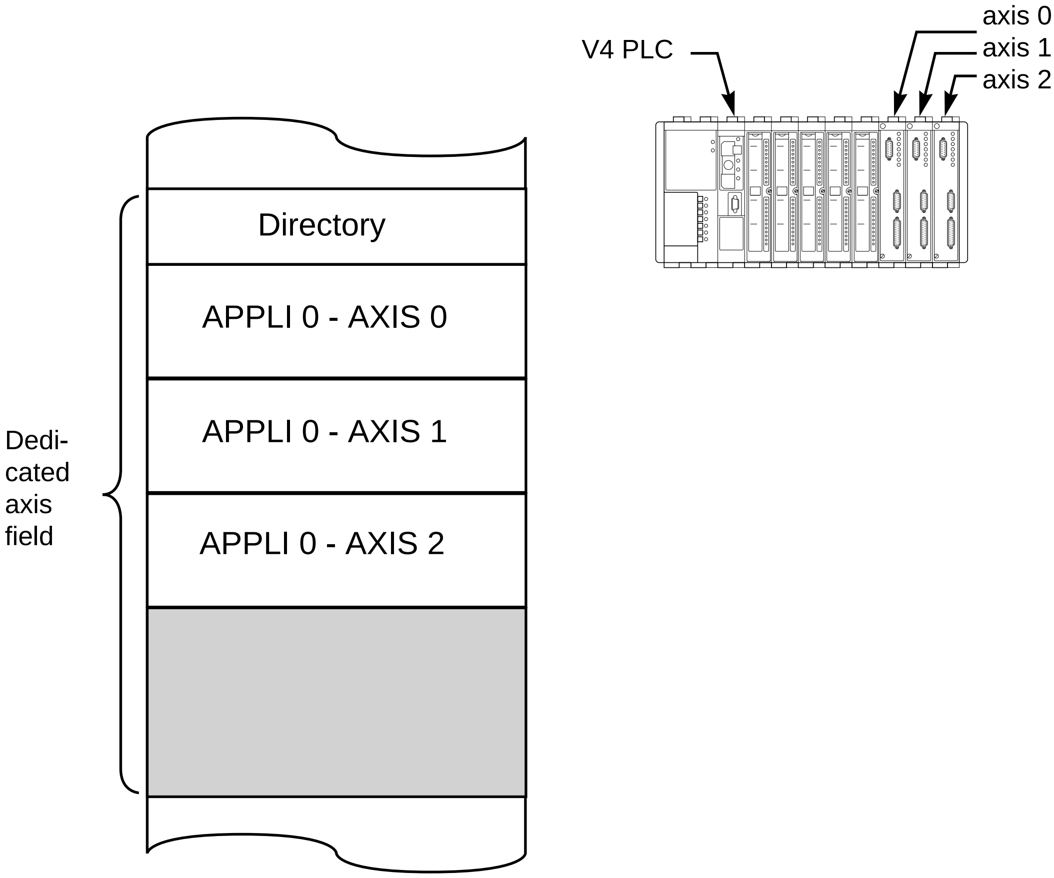
```
! IF B10. AXM LD0, READY
  THEN EXEC AXM LD0 ( ; ⟹ ) ; RESET B10

! IF RE(I2,0). AXM LD0, READY
  THEN EXEC AXM LD0 ( ; ⟹ )
```

In Grafcet, it is preferable to program the EXEC AXM LD instruction on **activation** of a step rather than when the step is **active** (continuous).

Note: During the transfer, the module is reserved by the OFB. Any attempt by another user to access the module (TSX XBT 182 terminal, PL7-AXE program) will generate the message AXM RESERVED.

2.4 Examples

Example 1: Assume a configuration with three TSX AXM modules, i.e. three axes numbered 0 to 2. Each axis always executes the same application. Therefore only one application is stored in the PLC memory for each axis.



The stored application located in the PLC memory should be transferred to the module memory on:

- A warm or cold restart,
- Receipt of an operator command.

Examples

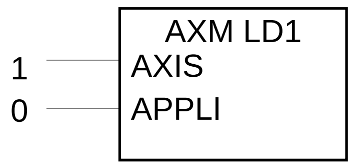
1st solution (recommended)

An OFB is assigned to each axis,
(AXM LD0 to axis 0, AXM LD1 to axis 1, AXM LD2 to axis 2).

Programming

```
<  FOLLOWING WARM OR COLD RESTART
!  IF SY1 THEN RESET B0
!  IF [NOT B0 + RE (I1,0)] .AXM LD0, READY
        THEN EXEC AXM LD0 (0 ; 0     )
!  IF [NOT B0 + RE (I1,0)] .AXM LD1, READY
        THEN EXEC AXM LD1 (1 ; 0     )
!  IF [NOT B0 + RE (I1,0)] .AXM LD2, READY
        THEN EXEC AXM LD2 (2 ; 0     )
!  SET B0
```

The values between parentheses can be entered
- Explicitly, or
- Using the [PARAM] dynamic soft key that displays the OFB graphically.



Effect of the sequence shown above

On a cold restart (SY0), a warm restart (SY1), or a rising edge on input I1,0 the three applications are simultaneously transferred from the PLC memory to the modules.

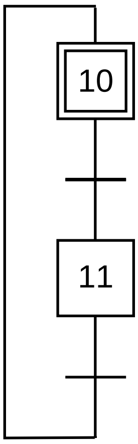
Question: Why use RE (I1,0) rather than I1,0 to trigger the transfer?

Answer: If I1,0 is used, the OFB will continue to transfer the application as long as I1,0 remains at 1.
Setting the modules to Run must be conditional on the end of transfer.

```
! IF AXM LD0, READY. NOT AXM LD0,ERROR
      THEN SET OW5, 0, C

! IF AXM LD1, READY. NOT AXM LD1,ERROR
      THEN SET OW6, 0, C

! IF AXM LD2, READY. NOT AXM LD2, ERROR

      THEN SET 0W7, 0, C
```

Examples

Grafcet can be used to sequence the operations.



ACTIV

! EXEC AXM LD0 (0; 0⟹)

AXM LD0, READY. NOT AXM LD0, ERROR

ACTIV ! SET OW5, 0, C

RE (I1,0)

This sequence is automatically activated on a cold restart. For it to be activated on a warm restart, activation of step 10 on a warm restart must be explicitly programmed in the PRL.

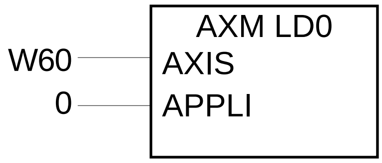
! IF SY1 THEN SET X10 ; RESET X 11

Examples

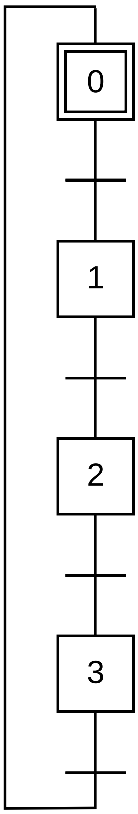
2nd solution (cost-effective)

Only a single OFB is used for the three axes. The AXIS parameter must be modified on each execution and therefore assigned to a variable. Given the necessary sequencing of the three transfers, Grafcet must be used.

Configuration



Programming



ACTIV
! 0→ W60 ; EXEC AXM LD0 (W60 ; 0⟹)

AXM LD0, READY. NOT AXM LD0, ERROR

ACTIV ! SET OW5, 0, C
! 1→ W60 ; EXEC AXM LD0 (W60 ; 0⟹)

AXM LD0, READY. NOT AXM LD0, ERROR

ACTIV ! SET OW6, 0, C
! 2→ W60 ; EXEC AXM LD0 (W60 ; 0⟹)

AXM LD0, READY. NOT AXM LD0, ERROR

ACTIV ! SET OW7, 0, C

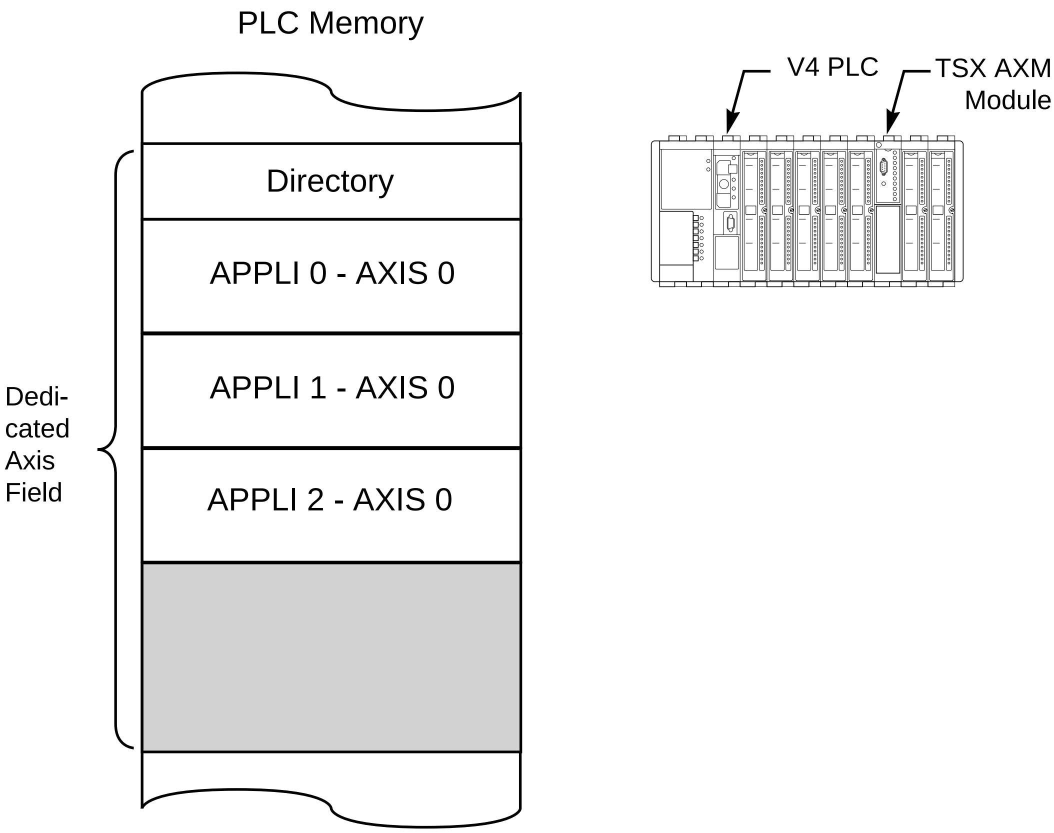
I1, 0

Once again this sequence will only be activated on a hot restart if the activation of step 0 on a warm restart is explicitly programmed in the PRL.

! IF SY1 THEN SET X0 ; RESET X1 ; RESET X2 ; RESET X3

Examples

Example 2: Assume a configuration comprising a TSX AXM module (axis 0) that may execute three different applications.

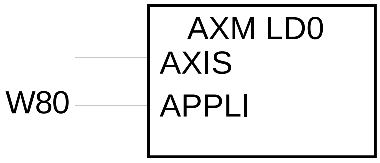


The requirement is to transfer from PLC memory to the module:

- Application 0 on warm or cold restart,
- Application 1 when bit B1 goes to 1,
- Application 2 when bit B2 goes to 1,
  on condition that the module is not executing an application.

Solution

- Assign the AXM LD0 OFB to axis 0 by giving the IAXIS internal constant the value 0.
- Assign a PL7-3 variable whose contents will be modified on each execution of the OFB to the APPLI input parameter.



The AXIS parameter is not assigned as it is initialized by default to the value on the IAXIS internal constant, i.e. 0.

Programming

! IF SY0 + SY1 THEN 0 → W80 ; EXEC AXM LD0 (; W80 ⟹)

! IF B1 . AXM LD0, READY
THEN 1 → W80 ; EXEC AXM LD0 (; W80 ⟹) ; RESET B1

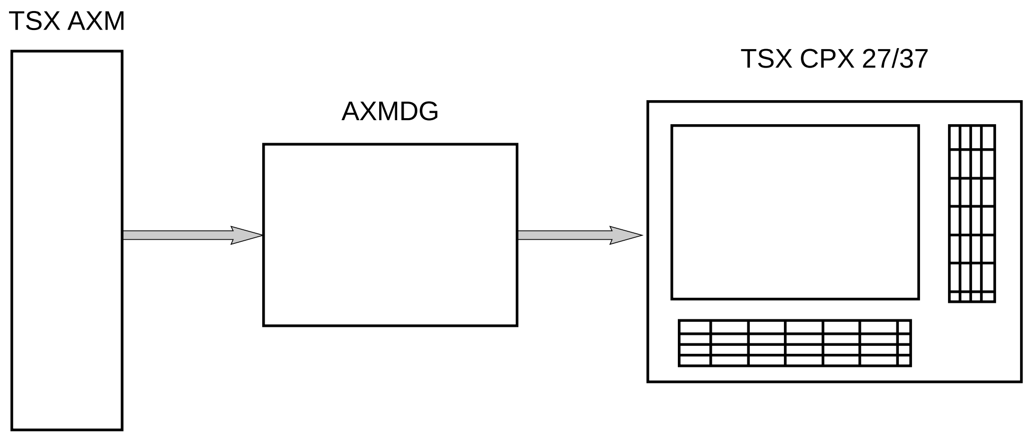
! IF B2 . AXM LD0, READY . IW5,1,9
THEN 2 → W80 ; EXEC AXM LD0 (; W80 ⟹) ; RESET B2

! IF AXM LD0, READY . NOT AXM LD0, ERROR THEN SET OW5,0,C

3 The AXMDG OFB 3

3.1 Purpose

The AXMDG OFB collects the fault information from an AXM module for treatment by a diagnostic program (APPLIDIAG or SYSDIAG) run from an operator dialogue terminal.



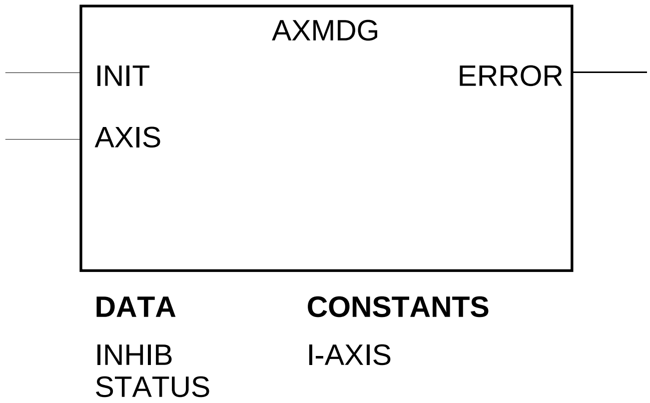
This OFB is one of the elements in the fault transmission sequence which are necessary for the DIAGNOSTIC function.

Operating principle

When a fault appears the OFB ERROR bit goes to 1 and the STATUS word bit corresponding to the fault also goes to 1. The fault can then be highlighted on the operator terminal screen so that, after remedying it, the operator can acknowledge the fault using the INIT command.

3.2 Presentation

The AXM DG OFB has internal constants, internal data, and I/O parameters. Constants are defined during the programming phase. Internal data is used during execution. The I/O parameters must be left undefined.



Internal constants

I-AXIS This specifies the number of the axis to which the OFB is assigned, and is between 0 and 63. The default value is 64, which means the OFB cannot be used unless this parameter has been defined.

NB : Make sure that the OFB number corresponds to the number of the axis.

Internal data

INHIB This bit should normally be at 0. It can be set to 1 to inhibit fault monitoring in which case the ERROR bit and the STATUS word are forced to 0.

STATUS 16 bit word where each bit corresponds to a type of fault.
Two types of fault can be identified :
- faults associated with the module itself (bits 0,1 and 11 to 15)
- application faults : those relating to axis control by the module.

Presentation

For your information : Some of the information in this word also reaches the CPU via the IW register interface bias. The column on the right of the table below indicates the relevant bit.

Bit nbr.	Type of fault	Corresponding IW
0	Module not working	0,8
1	Terminal block unlocked	0,A
2	Moving part below lower soft stop level	2,0
3	Moving part above upper soft stop level	2,1
4	Emergency stop fault	2,3
5	Moving part stop fault	2,2
6	Axis not referenced (1)	2,6 or 2,7
7	Measurement/setting deviation exceeds upper limit	1,F
8	Moving part not visible in target window	2,4
9	Synchronization fault	1,E
10	Command refused	1,D
11	Module not present	-
12	Type of module physically present different to type of module declared in configuration	-
13	Directory (2) non-existent or unreadable	-
14	Communication with the module not possible	-
15	System error	-

(1) This most commonly occurs after a power break or calculation overflow.

(2) See section C1, sub-section 4.2.

Input parameters

INIT Bit reserved for use with diagnostic programs that acknowledge internal module faults. Setting to 1 causes the ERROR bit and the STATUS word to be set to 0.

Note :
1 - Application faults are acknowledged from the PL7-3 application in the PLC, or from the TSX XBT 182 terminal.
2 - The INIT input must not be wired (see sub-section 3.4 for further details).

Presentation

AXIS This parameter identifies the number of the axis to which the OFB is assigned. It is initialized automatically on a cold restart with the contents of the I-AXIS constant. It can be modified but this is not recommended. As with the INIT parameter, this input should not be wired.

Output parameters

ERROR Bit used by diagnostic program
0 : no fault
1 : one or more faults present, disappeared but not yet acknowledged.

Note :
1 - This bit is not wired.
2 - It can be tested by the PLC program (IF AXMDG3, ERROR THEN ...)

Memory occupation

Program field	Data field	Constants field
1700 words for any number of uses	140 words for each use	8 words for each use

Run time

This depends on the type of processor :

TSX 47 40 / 67 40 : about 1 ms
TSX 87 40 : about 0.5 ms
TSX 107 40 : about 0.4 ms

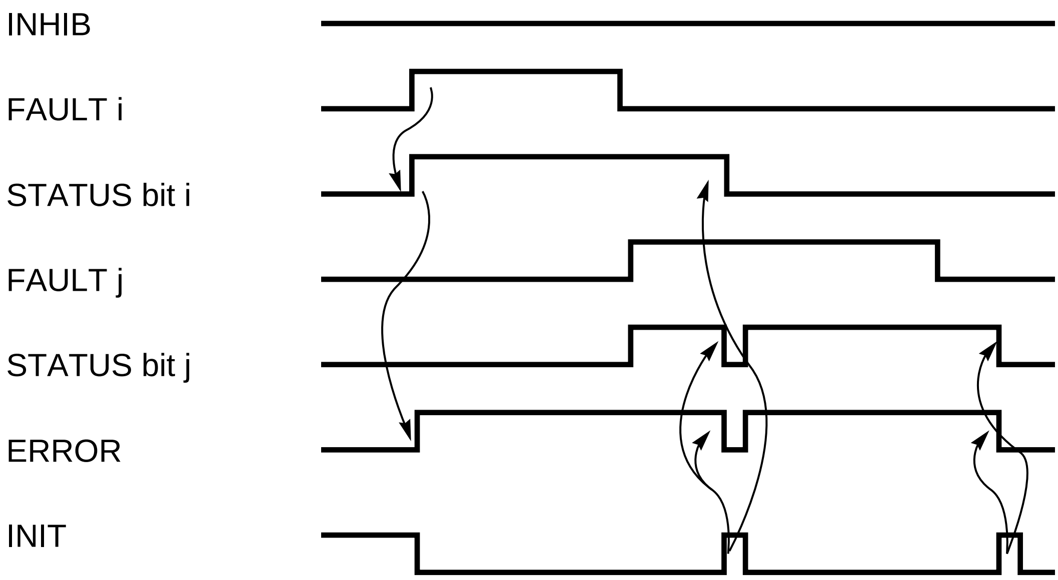
Although the EXEC instruction must be included in a user task (MASTER task), the execution rate of this function block is about 200 ms.

3.3 Internal operation

External view

When any fault occurs, on condition that the INHIB internal data is at 0, the ERROR bit and the STATUS word bit assigned to this type of fault go to 1. If the fault disappears before Init is activated, it remains memorized in the STATUS word.

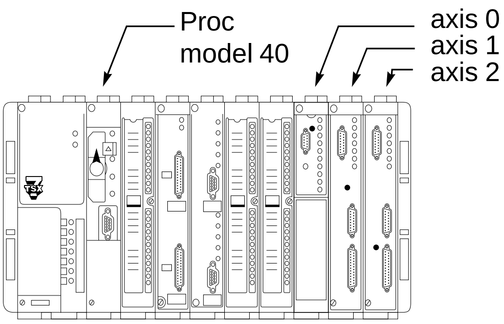
The ERROR bit only returns to 0 after an INIT command if no fault is present.



It is up to the user to ensure that the EXEC AXMDG instruction is only scanned once by the program, thus making the instruction conditional on an event which only occurs only during a PLC cycle (SY0, SY1, etc.).

3.4 Examples

Assume a configuration with 3 axis control modules, ie. 3 axes numbered 0 to 2.



- Declare 3 uses of the AXMDG OFB.
- Initialize the I-AXIS parameter with the axis number corresponding to the OFB number :
  Example : AXMDG0 I-AXIS = 0
- Program the following sequence in the MASTER task :

```
! IF SY0 + SY1
      THEN      EXEC AXMDG0 ( ; => ) ; EXEC AXMDG1 ( ; => ) ;
                EXEC AXMDG2 ( ; => )
```

The OFBs are then ready to be used by APPLIDIAG. If you wish to interrupt monitoring, set the INHIB bit to 1. This can be performed from the program :

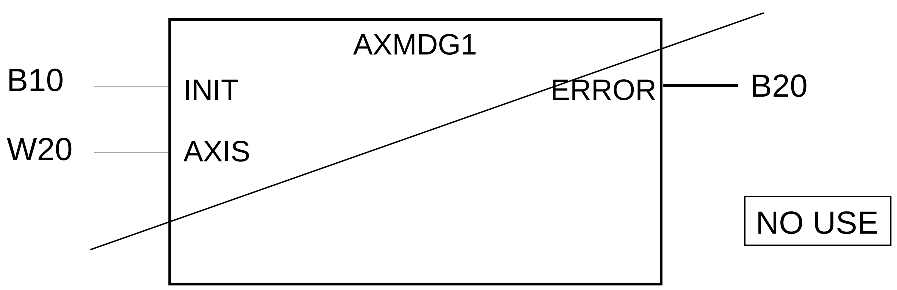
```
! IF B70  THEN     SET AXMDG0, INHIB
          ELSE     RESET AXMDG0, INHIB
```

or from PL7-3, APPLIDIAG, SYSDIAG.

If you wish to use the information provided by the OFBs from the PLC program, transfer the contents of STATUS to an internal word, then test each of the bits used by the following program (axis 1) :

```
! IF AXMDG1, ERROR
      THEN      AXMDG1, STATUS      W60
      ELSE      JUMP L 10

! IF W60,0 THEN ...

! IF W60,F THEN ...
! L 10
```

Note : Given the operating rules of the OFBs, it serves no purpose to wire their I/O, as they cannot be updated.



Examples

Reason : Values from PL7-3 objects (B10, W20, B20) are only transferred to the OFB parameters when the EXEC instruction is scanned. However, for an AXMDG OFB, the EXEC instruction should only be scanned once.
If, for the sake of interest, this wiring is performed, it is seen that the INIT input remains at ø whatever the state of bit B10, that the AXIS input retains parity with I-AXIS whatever the value of W20 and that B20 remains at 0 even if the output ERROR goes to 1.

Note : Even if the I/O parameters can still be read from the program
Example : IF AXMDG0, ERROR THEN ....
they cannot be written to. Only diagnostic programs can force the INIT input.

4 The AXMPG OFB 4

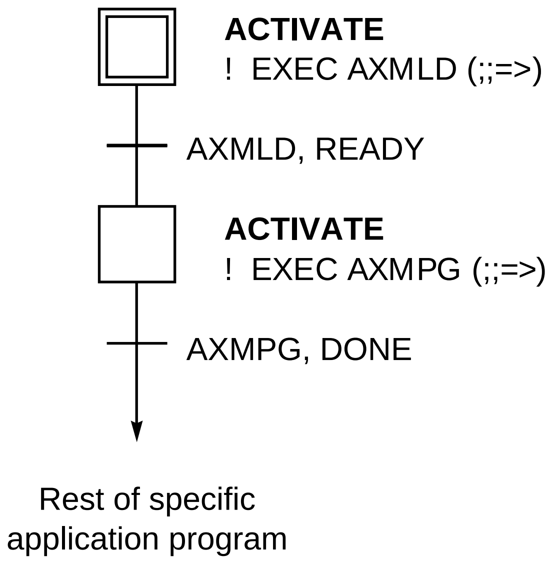
4.1 Purpose

The AXMPG OFB performs all the necessary functions for setting the internal program module into operation. It has a similar effect to the GRAFCET initialization sequence described in section B, sub-section 6.4 (pages 6/11, 6/12).

- Module set to run
- Fault acknowledgement
- Selection of AUTOMATIC CYCLE mode
  (normal operating mode for TSX AXM 172 and TSX AXM 182 modules).
- (START AXM) mode activated

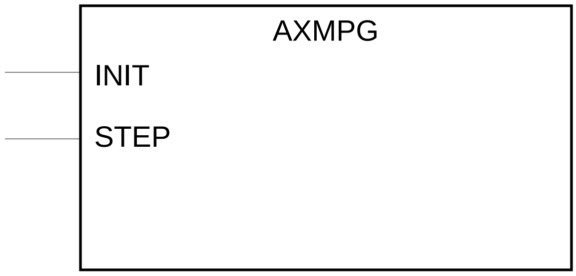
Because of its very nature the AXMPG OFB is not relevant to the TSX AXM 162 module. If however an AXMPG OFB is accidentally assigned to this type of module, no damage will occur.

When linked with the configuration loading OFB (AXMLD), it reduces the amount of programming required to initialize the TSX AXM module :



4.2 Presentation

The AXMPG OFB has internal constants, internal data, and input parameters. It does not have output parameters.
Constants and parameters are defined during the programming phase. Internal data is used during execution.



DATA	CONSTANTS
ERROR STATUS DONE	I-AXIS

Internal constants

I-AXIS This specifies the axis number to which the OFB is assigned, and is between 0 and 63. It has a default value of 64, which means the OFB cannot be used unless this parameter has been defined.

NB : Make sure the OFB number corresponds to the axis number.

Internal data

ERROR (BIT)	Changes to 1 if a problem is encountered
STATUS (WORD)	Allows the problem to be identified. Each of these 16 bits can identify a cause of an error.

Presentation

Bit nbr.	Nature of problem
0	Module missing or not working
1	START command results in a COMMAND REFUSED (1)
2	Fault acknowledgement not possible
3	Module Run command or transfer to AUTOMATIC CYCLE refused (2)
4	Module not configured or not programmed
5	Initial step number >254 or program already in operation (3)
6 to 11	Not used
12	Execution of OFB cancelled due to power break
13	Directory (4) non-existent or unreadable
14	Communication with the module not possible
15	System error

(1) For the reasons for the COMMAND REFUSED message, see section B, sub-section 9.7.

(2) This occurs when the PLC program intervenes and cancels the order given by the OFB.

(3) If this occurs, request a program stop (bit Oxy,5) before reactivating the OFB.

(4) See section C1, sub-section 4.2.

DONE Goes to 0 on receiving the EXEC instruction. Goes back to 1 once the program is in operation. Can be checked by the mnemonic AXMPGi, DONE.

Input parameters

AXIS (word) Initialized automatically when the PLC is cold-started from inside the I-AXIS constant. This parameter can be modified by the user, which makes it possible to use the same AXMPG OFB for several axes. Unless it has been modified, this OFB is therefore assigned to the axis number specified by I-AXIS.

STEP (word) Denotes the initial step number.
This must be lower than the final program step number and must in any case be lower than 254. When this parameter has not been defined, the default value (255) means the OFB cannot be used.

Presentation

Memory space occupied

Program space	Data space	Constant space
1600 words for any number of uses	75 words for each use	8 words for each use

Run time

The sequence for setting the internal program module into operation requires several PLC cycles. It is therefore necessary to make a distinction between the time required for the sequence to run (number of cycles between the EXEC command and the moment when the bit AXMPG, DONE goes to 1) and the CPU time occupied during each cycle.

Number of cycles : Between 5 and 10 depending on the initial module state.

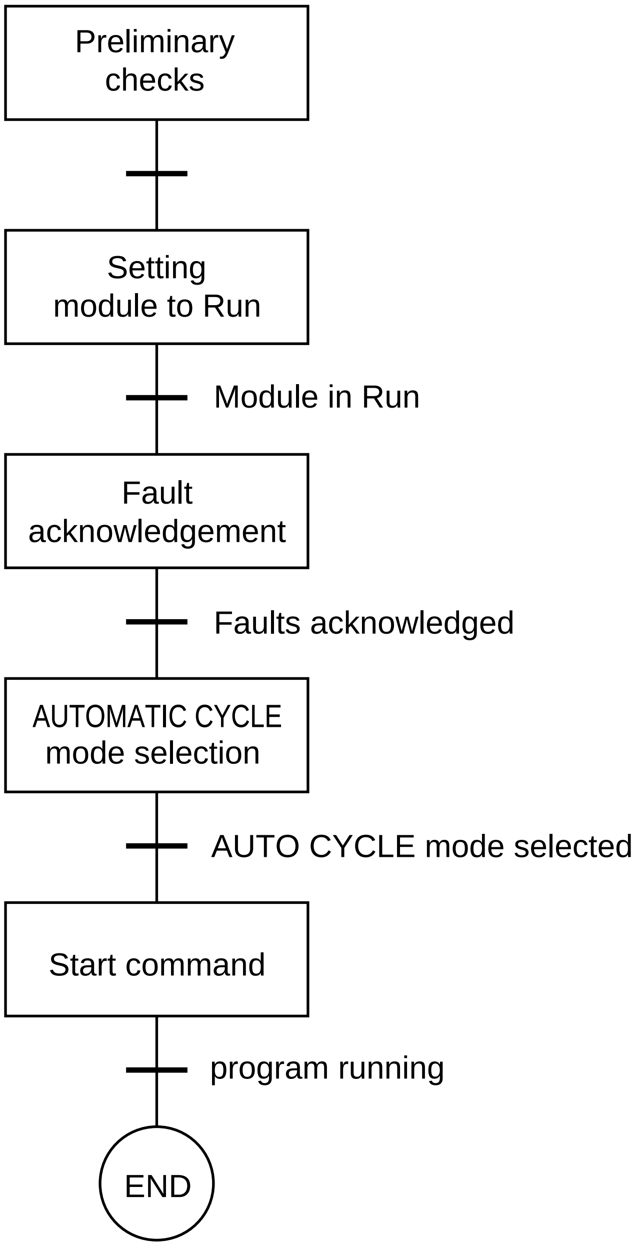
CPU occupied for (per cycle) :

Processor	TSX 67 40	:	about 1.5 ms
	TSX 87 40	:	about 0.6 ms
	TSX 107 40	:	about 0.5 ms

4.3 Internal Operation

Chart of internal operation

The AXMPG OFB performs all the necessary steps for the internal program module to be started, as shown by the (simplified) chart below :



Checks performed by the OFB before running the sequence

- Presence of a TSX AXM 172 or TSX AXM 182 module in the slot specified by the axis number and auto-test phase completed.
- AXM 172 / 182 module configured and programmed.
- Program not running.
- Start step number lower than 255.
- Valid directory in existence.
- Valid axis number.

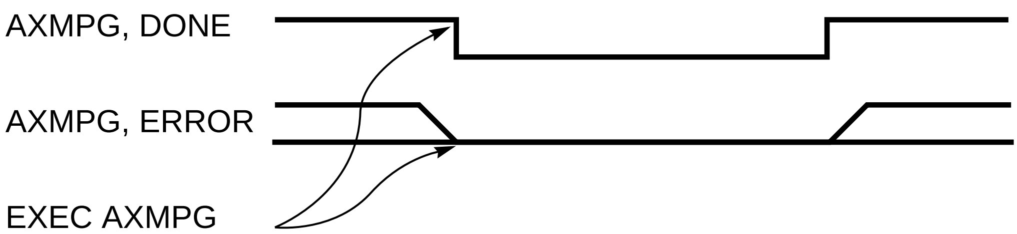
Reaction to a power break / return

If a power break occurs during the execution of the program start-up sequence, the OFB goes to the following state when the power returns :
- bit AXMPG, ERROR at 1,
- bit 12 of STATUS variable at 1.

External view

The EXEC AXMPG instruction causes the sequence to run, provided that :
- the module is programmed,
- the program is not running,
- the AXMPG, DONE bit is at 1,
- the start step number is lower than 255.

During sequence running, the AXMPG, DONE and AXMPG, ERROR bits are set to 0.
Once the program has started, the AXMPG, DONE bit goes to 1 ; if any stage does not run correctly, both the AXMPG, DONE bit and the AXMPG, ERROR bit go to 1.



Internal Operation

Programming rules

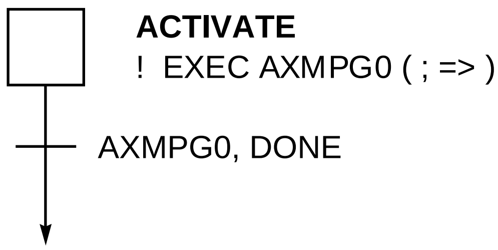
It is absolutely essential that the EXEC AXMPG instruction is programmed in the task where the AXM module is configured.
Take care that this instruction is only scanned once.

LITERAL LANGUAGE

```
! IF B11        THEN    EXEC AXMPG0 ( ; => ) ; RESET B11
or
! IF RE (I2,1)  THEN    EXEC AXMPG0 ( ; => )
```

GRAFCET LANGUAGE

Program the EXEC instruction on **activation** of the step rather than when the step is active.

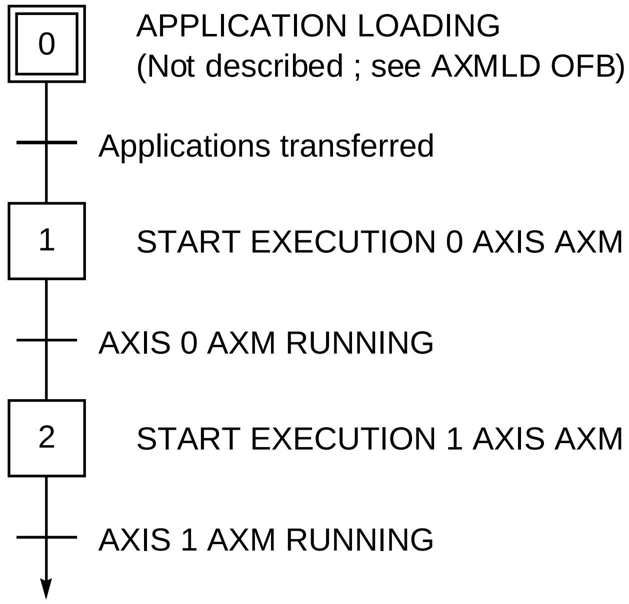


Notes : The AXMPG OFB does not perform reference point set-up. It is therefore essential that the module internal program begins with an instruction for reference point set-up (SRP+ or SRP-) before any motion command. This instruction must be for a type 3 (cam at end of travel), as this is the only reference point setting mode in which it is possible to specify motion direction once and for all.

4.4 Examples

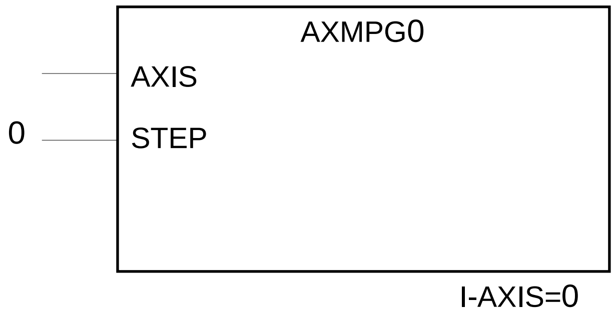
Assume a configuration comprising 2 axes 0 and 1. After loading the required application into each of the two modules, start execution of the axis 0 module program at step number 0, then the axis 1 module program at step number 10.

Programming :

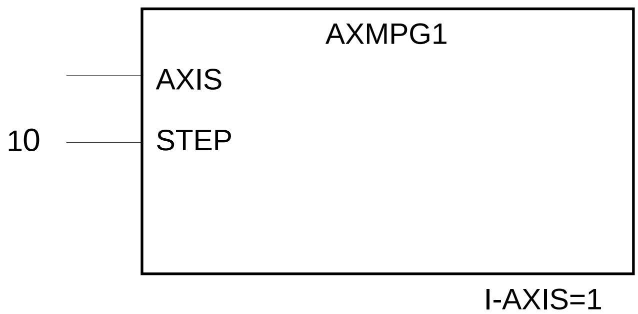


1st solution : Assign an AXMPG OFB to each axis and configure the axis number with the constant I-AXIS.

Stage 1 : **Action on activation**
! EXEC AXMPG0 (; 0 =>)



Stage 2 : **Action on activation**
! EXEC AXMPG1 (; 10 =>)

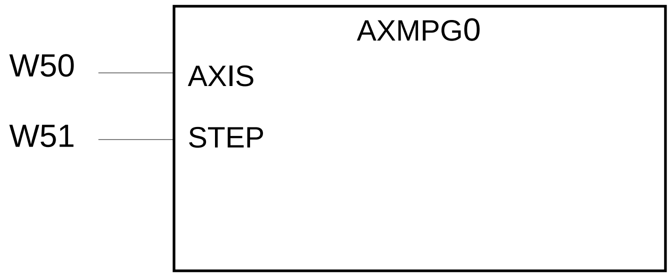


Transition 1 2
! AXMPG0, DONE.NOT AXMPG0, ERROR

Transition 2 3
! AXMPG1, DONE.NOT AXMPG1, ERROR

Examples

2nd solution : Use only one OFB, ensuring that its AXIS parameter has been initialized before starting execution.
Input parameters are assigned as follows :



Stage 1 : **Action on activation**
! 0 W50 ; 0 W51
EXEC AXMPG0 (W50 ; W51 =>)

Stage 2 : **Action on activation**
! 1 W50 ; 10 W51 ; EXEC AXMPG0 (W50 ; W51 =>)

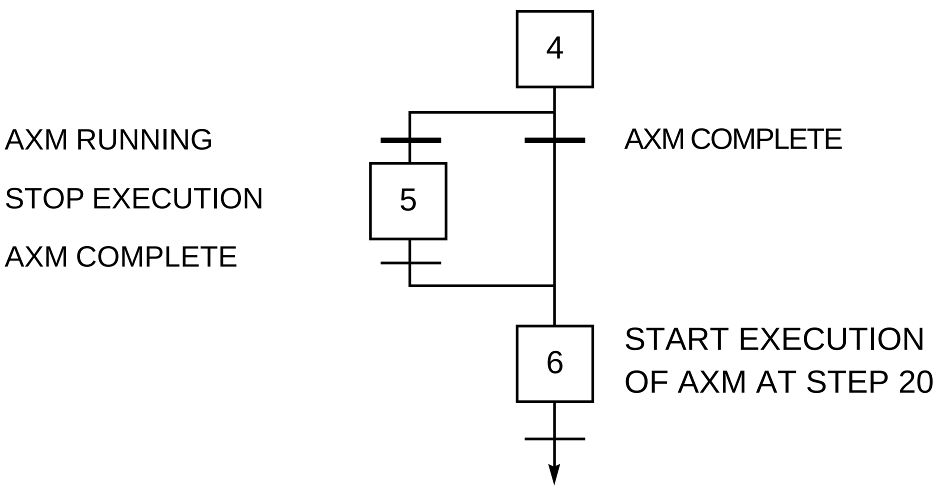
Transition 1 2
! AXMPG0, DONE.NOT AXMPG0, ERROR

Transition 2 3
! AXMPG0, DONE.NOT AXMPG0, ERROR

Example of a module program comprising several possible start points

0	SRP -	F	=	2000	x = 0
1	GP9	F	=	6000	x = 200
19	END				
20	SRP -	F	=	4000	x = 0
21	G + 9	F	=	2000	EVENT = UI3
35	END				

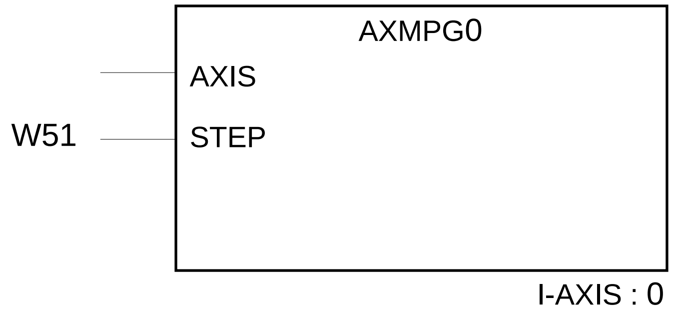
It is up to the user to ensure prior to starting execution that there is no program running or, if necessary, to stop the program :



Examples

Stage 5 : **Action on activation**
! SET 04,5

Stage 6 : **Action on activation**
! RESET 04,5
! 20 W51 ; EXEC AXMPG0 (; W51 =>)



Transition 4 5
! IW4,1,5

Transition 4 6
! NOT IW4,1,5
or ! IW4,1,9

Transition 5 6
! NOT IW4,1,5

Transition 6 7
! AXMPG0, DONE.NOT AXMPG0, ERROR

Note : In this example the AXM module is assumed to be in slot 4.

A Appendix

A.1 Replacing an AXMLD V4.1 OFB with an AXMLD V4.5 OFB

Initial situation

A PL7-3 application has AXMLD version 4.1 OFBs.
The user wishes to replace these version 4.1 OFBs with version 4.5 OFBs, simply to bring them up to date, or because he needs to exceed the limit of 16 axes imposed by the V4.1 version.
This update is made by reconfiguring the PL7-3 application.

Procedure

- Install the diskettes containing the OFBs.
- Open a PL7-3 window.
- RETRIEVE the application to be updated.
- Select CONFIGURATION mode, and then item 5 - OPTIONAL FUNCTION BLOCKS.
- Press the NEW key.
- Select the AXMLD V4.5 OFB.
- Press the INSERT key.
- Reconfigure the application.

The application is now ready to be loaded into the PLC.

Introduction

There are two models of the TSX XBT 182 terminal:
- The TSX XBT 182.1 is a dedicated axis control terminal,
- The TSX XBT 182.2 is a multifunction version of the terminal.

This manual describes the specific axis control functions that apply to both versions of the TSX XBT 182 terminal.
The standard operator dialog functions, only available when using a TSX XBT 182.2 terminal are described in detail in the XBT User's Manual supplied with this terminal.

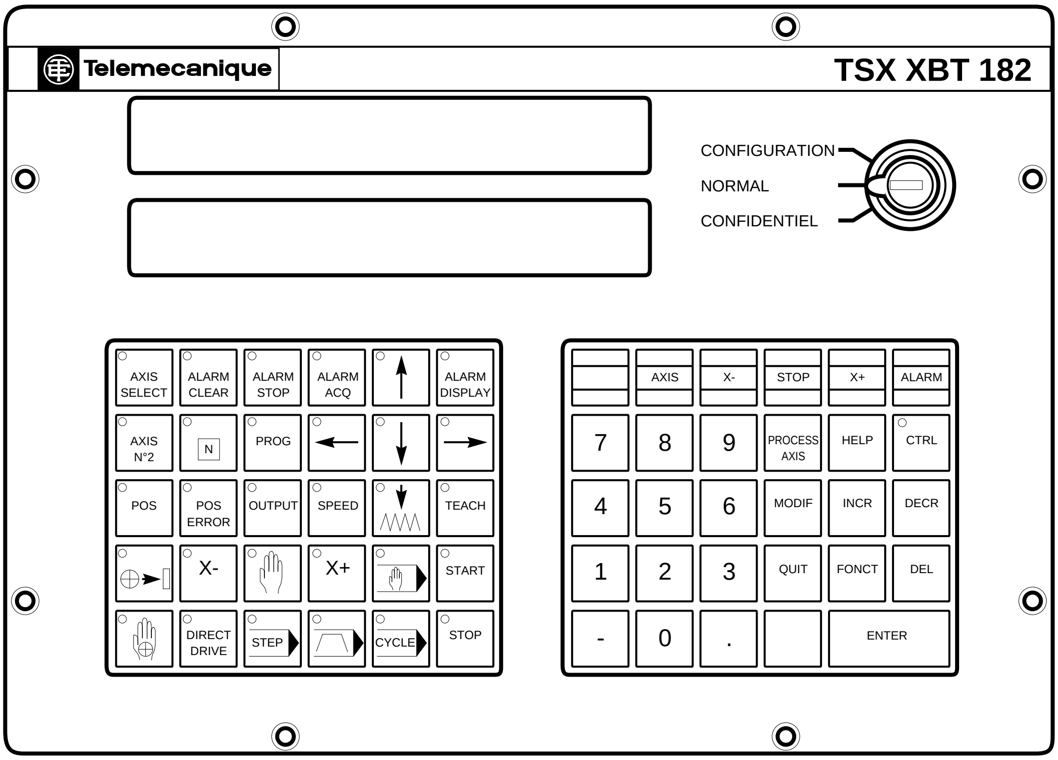
Contents

TSX XBT 182 Operator Terminal

TSX XBT 182 Operator Terminal

0.1 TSX XBT 182 Operator Terminal/Adjustment Terminal

General



This manual describes the various operating modes available, and the rules that apply when using TSX XBT 182 terminals.

TSX XBT 182 terminals let the user operate axes controlled by TSX AXM 172 or TSX AXM 182 modules installed in TSX Series 7 Model 40 (V4 level) PLCs (TSX 47-40 / TSX 67-40 / TSX 87-40 / TSX 107-40).

The TSX XBT 182.1 terminal is a dedicated axis control terminal while the TSX XBT 182.2 terminal offers in addition to these special functions, all of the features of an XBT C8-250 operator dialog terminal.

TSX XBT 182 Operator Terminal/Adjustment Terminal

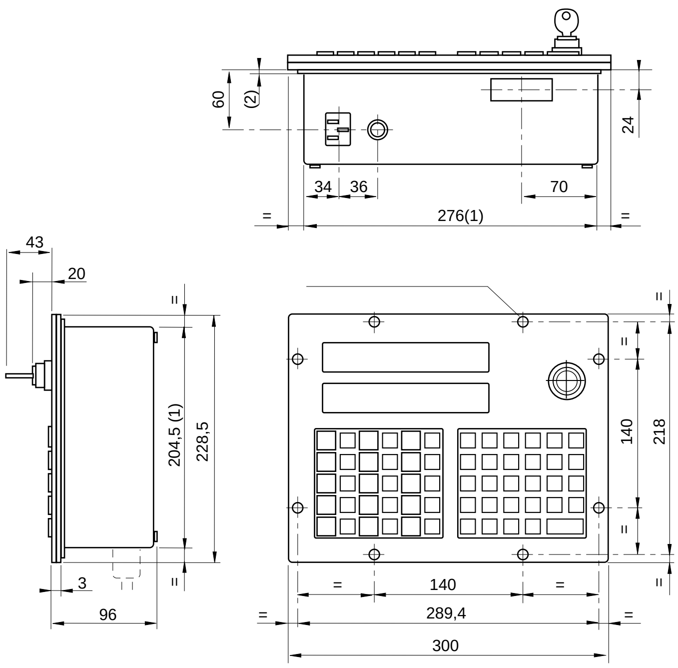
Hardware Characteristics

Keyboard	Industrial, meets IP 65 specifications.
Mode of Installation	Flush mount with seal attached to the terminal. 8 mounting screws.
Type of Case	Front panel in black finished steel, 3 mm thick with back panel in ABS plastic.
Connection	Mains supply connector (2 wires + ground). Transmission connector (25-pin female).
Weight	3.1 Kg.

Electrical Characteristics

Mains Supply	TSX XBT 182.1 or 182.2 : 220 VAC
Supply Ripple	+10% -15%
Max. Power Consumption	20 W
Frequency	46 to 64 Hz

Dimensions



(1) minimum mounting plate cut-out dimensions,
(2) 10 mm max. mounting plate thickness.

0.2 TSX XBT 182.2 Terminal Special Functions

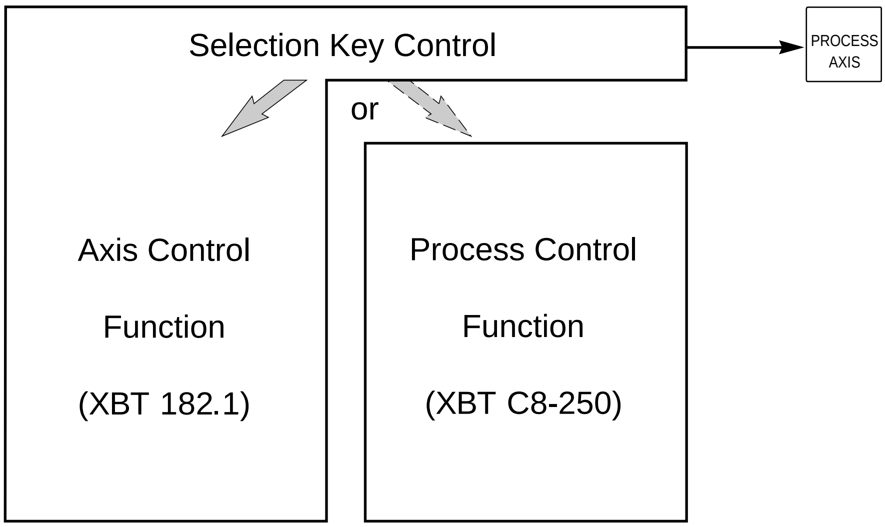
The TSX XBT 182.2 terminal has two operating modes:

- Axis mode that is the same as a TSX XBT 182.1 terminal, i.e. a dedicated axis control terminal,
- Process mode that is the same as an XBT C8-250 terminal, i.e. an operator dialog terminal.

These two modes are mutually exclusive. At any one time a TSX XBT 182.2 terminal can operate as a dedicated axis control terminal or as an operator dialog terminal. The user can switch between the two modes of operation simply by pressing a key: 

The software design of the terminal comprises two separate parts:

- One part that controls the terminal when the Axis Control Mode is selected,
- A second part that controls the terminal when the Process Control Mode is selected.
- The Axis Control function handles control of the mode selection key.



This layout implies certain constraints:

1. Although a single data link is used between the Terminal and the PLC, it must be configured separately for both Access Control and Process Control Modes (AXIS and PROCESS),
2. On power-up, the terminal will automatically select the Axis Control Mode (AXIS).

0.3 Presentation Rules

Graphics Used

Display

First display line

Second display line

A dashed underline indicates a flashing message.

Keys

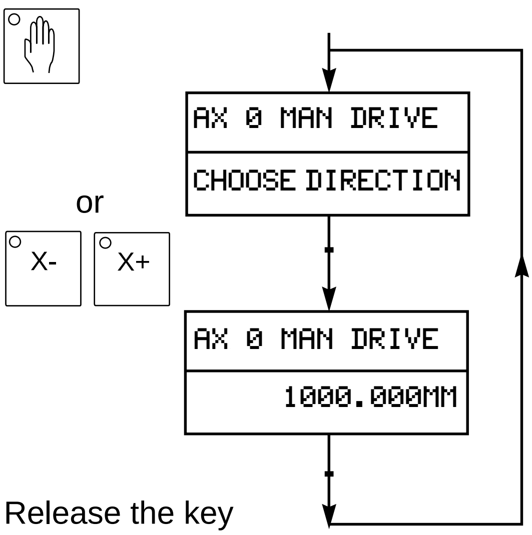
These are shown either by their pictogram or between angle brackets, < >, especially in the text.

Reading the block diagrams illustrating a succession of operator commands

The block diagrams given in this manual resemble the Grafcet method. They do not however follow all Grafcet representation rules for ease of presentation and understanding.

Example

Commands	XBT Display	Comments



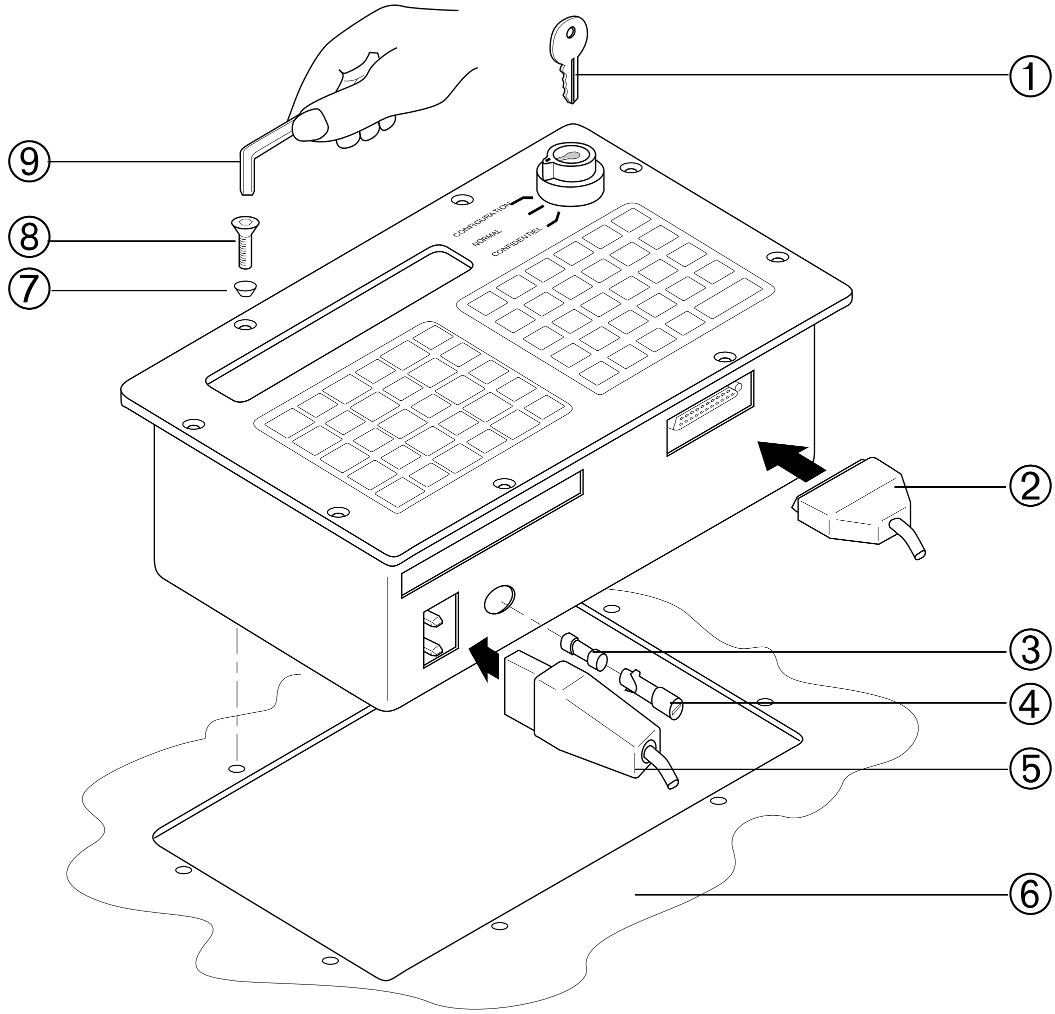
Basic display for the motion direction selection mode.

Command for **moving the moving part in the selected direction**:
- X+ = positive direction
- X- = negative direction

The moving part will move as long as the key remains depressed.
The 2nd display line gives the current position of the moving part.

TSX XBT terminal commands can be taken to represent the transition conditions in the chart, while the XBT display and the AXM commands (mode selection, moving part motion, etc.) represent actions.
The diagrams show examples of entries made. These examples must be interpreted by the user and adapted to each specific application. They do not cover every special case and the user should be familiar with the data entry principles described in Sub-section 2.1.

1.1 Installation



① Key for keyswitch,

② Cable with 25-pin male Sub-D connector (refer to Sub-section 1.1),

③ Quick acting protection fuse 5x20 mm, 315 mA, 250 V,

④ Fuse holder,

⑤ Standard mains power cord (2 wires + ground),

⑥ Cut-out for flush mounting,

⑦ Washers with integral seal (supplied),

⑧ Mounting screws, F/90 MA (not supplied),

⑨ Allen key for mounting screws (not supplied).

Notes:

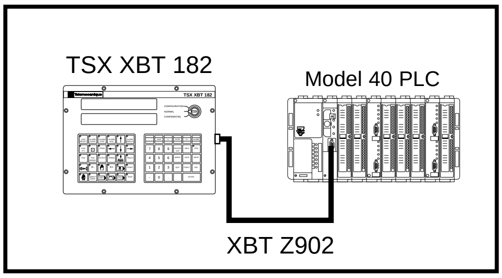
- The TSX XBT 182 terminal will power-up as soon as the mains power cord is connected (there is no On/Off switch fitted),
- Self-tests can be run to check correct operation of the terminal (refer to the Appendix, Sub-section 11.1).

1.2 Connecting the Terminal

The TSX XBT 182 terminal can be connected to the programming port of a TSX Series 7 Model 40 PLC or to a TSX SCM 21 module with UNI-TE protocol.
Reminder: As soon as the connection is established and the protocol is declared, all of the TSX XBT 182 terminal's functions and operating modes can be used.

Connection to the programming port of a PLC

An XBT Z902 cable comprising:
- A 25-pin male connector for the XBT end,
- A 9-pin male connector for the programming port end.

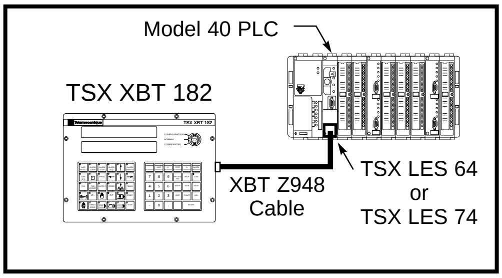


The data link protocol used is the Series 7 Adjust protocol (to be selected on power-up).

Connection to the Uni-Telway port of a PLC

This connection mode can only be used with a PLC processor that has a built-in Uni-Telway interface. These include TSX 47-420/TSX 67-420/TSX 87-420/ TSX 107-420 PLCs.

An XBT Z948 cable is required, comprising:
- A 25-pin male connector for the XBT end,
- An end without a connector, prepared for connection to a tap junction,
- A TSX LES 64 or TSX LES 74 tap junction.



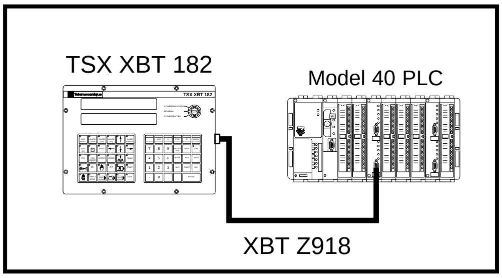
Connecting the Terminal

Connection to a TSX SCM 21 module

The TSX SCM 21 module used must comprise the UNI-TE protocol (type 6 adaptor): TSX SCM 2116 or TSX SCM 2146 modules.
In both cases connection must be made to the lower connector (channel 1).
The TSX SCM 21module must be declared in the PLC I/O configuration: module code 697.

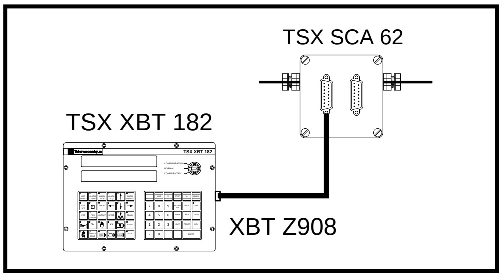
- **Point-to-point mode connection:**

An XBT Z908 cable comprising:
- A 25-pin male connector for the XBT terminal end,
- A 25-pin male connector to plug into the female connector on the TSX SCM 21 module.



- **Multipoint connection:**

An XBT Z908 cable comprising:
- A 25-pin male connector for the XBT terminal end,
- A 15-pin male connector to plug into one of the female connectors on the TSX SCA 62 tap junction.



The data link protocol used is Uni-TE (to be selected on power-up, as described in Sub-section 1.3).

Mains Supply

A power cord connects the terminal to a 220 VAC 50/60Hz mains power supply.

1.3 Service Introduction

On initial service introduction, or after a power break, regardless of the position of the mode selection keyswitch, the following display sequence is shown by the terminal:

Commands	XBT Display	Comments
	PROTOCOL 0=SERIE7 1=UNITE	Depending on the selected protocol: • SERIE7 when using the programming port. • UNITE when connected to a TSX SCM 21 module.
0 or 1		
	AX NO=??	• Enter the axis number.
0 to 15 ENTER		Displays the status of the selected axis.
	AX 0 RUN PR AUTO CYC RF	

It may be necessary to select the XBT Configuration mode:

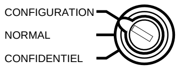
- To modify the stored language,
- To modify the characteristics of the currently selected data line.

To do this, set the mode selection key to Configuration.

The diagram on the opposite page describes the characteristics selection procedure:

- Selection of the message display language,
- Modification of the communication protocol,
- Access to data line characteristics.

Service Introduction

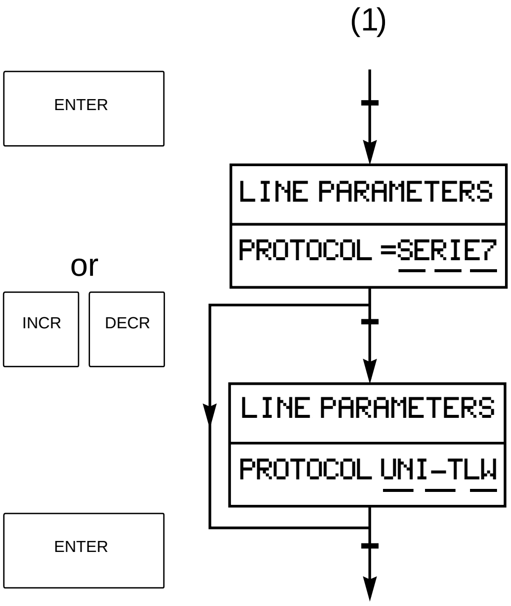
Commands	XBT Display	Comments
		
	MODE = CONFIGUR.	Screen that appears on mode selection.
Language selection FONCT		
	LANGUAGE / 0=FR 1=ENG	Displays the languages available. Enter the number corresponding to the selected language.
0 or 1		
	LANG. = ENGLISH	
FONCT		
	LINE PARAMETERS	Change to line configuration: • Protocol modification, or • Access to data link characteristics (1) (refer to next page).
Protocol modification FONCT	(1)	
	PROTOCOL / 0=SERIE7 1=UNITE	Screen identical to that on displayed on power-up.
FONCT		

Note: It is possible for the user to quit the Configuration mode at any time. Any selections made are automatically stored by the TSX XBT terminal on power-down.

Service Introduction

Access to data link characteristics (review/modification)

Commands	XBT Display	Comments



Refer to the previous page for how to access this screen.

Enables access to UNI-TE protocol parameters.

Validates the protocol and allows access to the line characteristics.

The table below lists the corresponding data line characteristics for each protocol, <ENTER> allows access to the next parameter.

Protocol	SERIES 7	UNI-TLW
Data Link	CL Passing	RS-485 (*)
Mode	HDX	HDX
Speed	Current speed	9600 (*)
Format	8 bits	8 bits
Parity	Odd	Odd (*)
Stop	1 bit	1 bit (*)

(*) These characteristics can be modified by using the <INCR> and <DECR> keys:

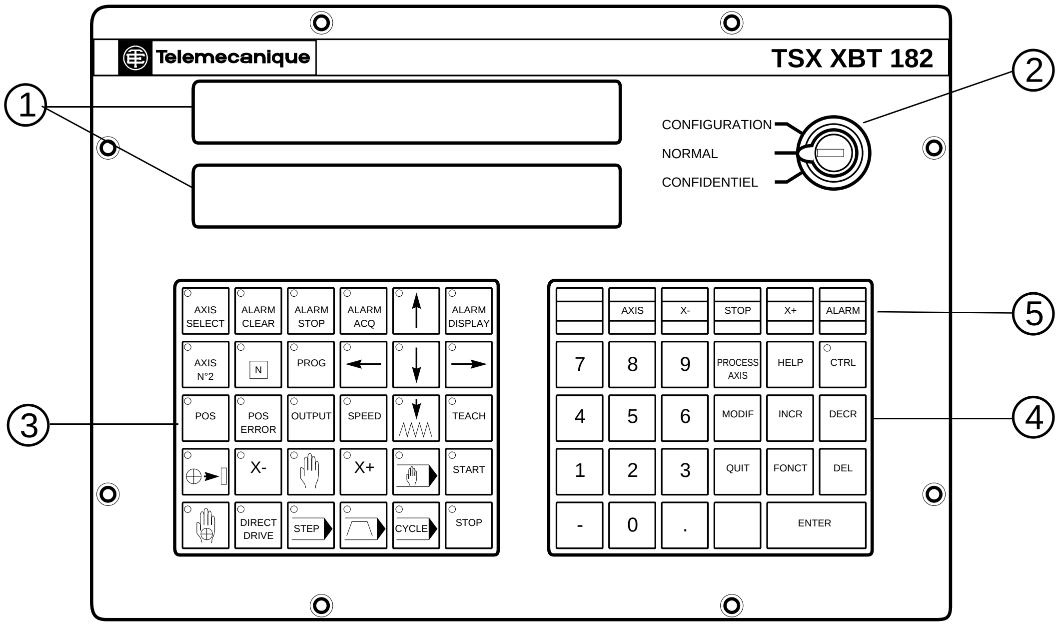
- Data link : RS-485, RS-232,
- Speed : 9600, 19200,
- Parity : None, Even, Odd,
- Stop : 1 bit, 2 bits.

XBT 182.2 Special Case

In addition to configuring the serial link line in axis control mode as described previously, the terminal must also be configured in process control mode. The correct procedure is fully described in the XBT-C8 User's Manual, Sub-section 4.1 supplied with the terminal.

2 Using the Terminal

2.1 Presentation and Data Entry Principles



(1) 2 lines of 16 characters for operator dialog:
- 1st line : Operator guide,
- 2nd line : Parameter values.

(2) XBT operating modes selection keyswitch (3 positions).

(3) Function keypad with 30 direct access keys for:
- Selecting the terminal operating mode,
- Following moving part motion,
- Displaying programs,
- Selecting direct access auxiliary functions,
- Monitoring and acknowledging faults.

(4) Service keypad:
- For Indirect access to auxiliary functions (accessed via <FONCT> key),
- With keys for parameter entry.

(5) Six indicator LEDs:
- AXIS : Shows that the Axis Control Mode is selected,
- X- : Shows that the moving part is moving in the negative direction, or stores the last motion if the Stop LED is lit,
- STOP : Shows that the moving part is stopped,
- X+ : Shows that the moving part is moving in the positive direction, or stores the last motion if the Stop LED is lit,
- ALARM : Shows that a fault on the current axis has been detected.

- The sixth indicator LED is not used.

Function Selection Principle

Direct access functions (Function keypad):
These functions are selected as soon as the appropriate key is pressed.

These keys each comprise a built-in indicator LED, that is only used by the mode selection function. The indicator shows the currently selected operating mode.

Indirect access functions (Service keypad):
These functions are selected by pressing the following key sequence:

<FONCT> <Function Nbr.> <ENTER> This sequence displays the parameters assigned to the selected function.

Modifying numerical parameters (Service keypad)

MODIF — Access to parameter modification. The parameter starts to blink. A new value can be entered from the service keyboard.

ENTER — Validates the data entry: the parameter takes the value entered (if it is correct) and the display stops blinking.

QUIT — Cancels the current data entry: the parameter retains its original value.

DEL — Deletes a character during data entry.

DECR INCR — For some parameters, these keys can be used to increment or decrement their value.

Modifying Boolean parameters - Simplified modification sequence

MODIF — Blinking display of the inverse state of the currently selected parameter.

ENTER — Validates the displayed state.

Description of keys (Function keypad)

Type	Key	Function	Refer to
	AXIS SELECT	Select axis, display axis/module status.	SS 2.4
Errors	ALARM DISPLAY	Display errors for the selected axis.	SS 10.1
	ALARM CLEAR	Acknowledge error command. Resume selected mode command (type 2 fault).	SS 10.2
	ALARM STOP	Acknowledge error command. Quit selected mode command (type 2 fault).	SS 10.2
	ALARM ACQ	Acknowledge error command. (systematic quit) (type 1 fault).	SS 10.2
AXM Program	N	Display instruction currently being executed.	SS 5.1
	PROG	Display instruction. Operand modification: positions, velocities.	SS 5.1 SS 5.2
Display Control	↑	Display previous function or instruction.	SS 3.4 SS 5.1
	↓	Display next function or instruction.	SS 3.4 SS 5.1
	→	Select next parameter or operand.	SS 4.2 SS 5.1
	←	Select previous parameter or operand.	SS 4.2 SS 5.1
Motion Monitoring	POS	Display true position of the moving part and the target position.	SS 4.2
	POS ERROR	Display position error (deviation)	SS 4.2
	AXIS N°2	Simultaneously display the positions of both axes (including the current axis).	SS 4.2
	OUTPUT	Display/modify status of the auxiliary relay outputs.	SS 4.2
	SPEED	Display true velocity of the moving part (and its programmed velocity).	SS 4.2

Presentation and Data Entry Principles

Type	Key	Function	Refer to
Auxiliary Functions		Velocity correction factor.	SS 6.2
	TEACH	Teach set points (WNi) (1)	SS 6.3
		Forced reference point set-up.	SS 6.1
Mode Selection		Manual mode with visual control.	SS 3.3
	X-	Move the moving part in - direction, in manual or reference set-up mode.	SS 3.3 SS 3.5
	X+	Move the moving part in + direction, in manual or reference set-up mode.	SS 3.3 SS 3.5
		Assisted manual mode	SS 3.4
		Manual reference point set-up mode.	SS 3.5
	DIRECT DRIVE	Direct Drive Mode (Servo loop disabled).	SS 3.6
	STEP	Automatic step-by-step mode (1)	SS 3.2
		Automatic block-by-block mode (1)	SS 3.2
	CYCLE	Automatic cycle mode (1)	SS 3.2
	START	Starts execution of the selected mode.	SS 3.1
	STOP	Stops execution of the selected mode.	SS 3.1
Others	PROCESS AXIS	Selects Process Mode when a TSX XBT 182.2 terminal is used (not used on TSX XBT 182.1 terminals).	SS 2.5
	CTRL	Runs Self-tests, in Confidential Mode (refer to the Appendix, Sub-section 11.1 or the XBT User's Manual).	
	HELP	Not used.	

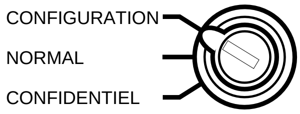
(1) Key not relevant for TSX AXM 162 module

2.2 TSX XBT Operating Modes

TSX XBT 182 terminal operating modes are selected through the keyswitch located on the front panel.
The Normal mode is a sub-mode of the Confidential Mode. It does not allow parameter modification.

XBT Configuration Mode

This mode allows:

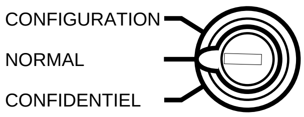


- Message language selection: French, English or German, (1)
- Communication protocol selection,
- Display and modification of line characteristics.

Note: Selecting this mode cancels TSX AXM 182 module reservation by the TSX XBT terminal.(refer to Divider B, Sub-section 6.6).

XBT Normal Mode

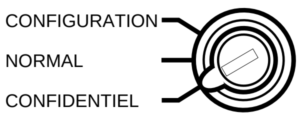
This mode allows:



- Display of configuration parameters,
- Display of the AXM program,
- Display of WNi internal positions,
- Monitoring of moving part motion,
- Selection and execution of the following modes:
  - Manual operation with visual control,
  - Assisted manual operation,
  - Automatic cycle and block-by-block.

XBT Confidential Mode

This mode offers all of the functions of the Normal Mode, and in addition allows:



- Modification of type B and C configuration parameters,
- Modification of operands (positions and velocities) AXM program,
- Teaching WNi internal positions,
- Forced reference setting,
- Selection and execution of the following modes:
  - Servo loop disabled,
  - Automatic step-by-step motion.

Changing the keyswitch setting

Changing the position of the key has no effect on the mode currently executed by the TSX AXM 182 module.

NORMAL ↔ CONFIDENTIAL: No effect on the display in progress.

NORMAL or CONFIDENTIAL → CONFIGURATION: Quits the Display mode and the current TSX XBT action.

(1) The choice available is between English and French.

2.3 Functions Available on the TSX XBT Terminal

Functions	Access		Mode	
	Direct	Indirect	Normal	Confidential
Operating modes				
Automatic cycle (1)	X		X	X
Automatic block-by-block (1)	X		X	X
Automatic step-by-step (1)	X			X
Manual	X		X	X
Assisted manual	X			X
Manual reference set-up	X			X
Servo loop disabled	X			X
Motion monitoring				
Moving part position	X		X	X
Position error	X		X	X
Moving part velocity	X		X	X
Relay output status	X		D	D/M
Second axis position	X		X	X
AXM program				
Display current step (1)	X		X	X
Display a step (1)	X		X	X
Modify operands (1)	X			X
Auxiliary functions				
Teach set points (1)	X			X
Velocity correction factor	X			X
Forced reference set-up	X			X
Divert AXM program (1)		F80	D	D/M
External position EXT		F81	D	D/M
Internal counter CNi (1)		F82	D	D/M
Standard status register		F83	D	D
Mask/Demask IT (1)		F84	D	D/M
RUN safety enabled/disabled		F85	D	D/M
Inhibited outputs		F86	D	D/M
Emergency stop		F87	D	D/M
Return to soft stops		F88	D/M	D/M
Synchronization with PLC (1)		F89	D/M	D/M
Application title		F90	D	D
List of application titles		F91	D	D
Module location		F92	D	D
Module RUN/STOP		F93	D	D/M
Display errors on other axes		F94	D	D
Service introduction function		F95	D	D/M
Machine factor		F61	D	D/M
PRF parameter (index)		F62	D	D
Configuration access				
Display		F31 - F60	X	X
Modification		F38 - F60		X
Transfers				
TSX → AXM		F71	X	X
AXM → TSX		F70		X
Faults				
• Display	X		X	X
• Acknowledgment	X		X	X

D = Display mode access, M = Modification mode access.
(1) Key not relevant for TSX AXM 162 module

2.4 Axis/Module Status

Display Axis/Module status

[AXIS SELECT]

Enables access to the status of the previously selected axis.

Axis Nbr.: 0 to 15

```
AX 0  RUN   NPR
MAN SET  RF   D
```

Status:
- NC :Not Configured
- STOP
- RUN

- NPR:NotProgrammed
- PR : Programmed

- D : Fault

- RF : Referenced axis
- NRF: Axis not referenced.

Selected mode:
- INACTIVE : No mode selected
- AUTO CYC : Automatic cycle
- AUTO S/S : Automatic step-by-step
- AUTO B/B : Automatic block-by-block
- MAN DRIVE : Manual
- MAN SET : Assisted manual mode
- MAN RFP : Manual reference set-up
- OPEN LOOP : Servo loop disabled

Selecting a new axis

Commands	XBT Display	Comments
AXIS SELECT	AX 0 RUN PR AUTO CYC RF	Display the status of the axis.
MODIF	AX NO:??	
4		Enter an axis number.
ENTER	AX 4 RUN PR MAN SET RF	Newly selected axis status.

2.5 Operator Dialog Terminal

This sub-section only applies to TSX XBT 182.2 terminals.

The PROCESS AXIS key is always active active and can be pressed to toggle between Process and Axis Modes.

Commands	XBT Display	Comments
PROCESS AXIS	PASSAGE AXIS PROCESS	Operator Dialog Terminal Mode Operation (1)
ENTER		
PROCESS AXIS	PASSAGE PROCESS AXIS	Axis Control Terminal Mode Operation
ENTER		

(1) For a complete description of this mode, refer to the XBT User's Manual.

3 Selecting the Operating Mode 3

3.1 General Principles

Conditions for operating mode selection

	Step	Automatic Block	Cycle	Manual drive	Assisted manual	Manual Ref.	No Servo
XBT mode	STEP		CYCLE				DIRECT DRIVE
Normal	no	yes	yes	yes	no	no	no
Confidential	yes (1)	yes (1)	yes (1)	yes	yes	yes	yes

General conditions: Module running and no faults present.

(1) TSX AXM 172 or TSX AXM 182 modules

Selection principle

- Pressing a key to select a different operating mode disables the currently selected mode,
- The corresponding key indicator LED lights,
- The display shows the axis/module status as long as the function is not active,
- The appropriate mode display appears:

Selected Axis Nbr.

```
AX 0  AUTO CYC
N START   =  0
```

Abbreviated mode designation.
Linked parameter or condition to meet to activate the mode.

START

STOP

Starts mode execution, (except in Manual or Manual Ref. Set-up modes where <X+> <X-> are used to activate the mode).

Stops execution of the current mode.

The table below lists the parameters that are accessible in each of the operating modes (refer to Sub-section 4.1).

	Position	Position error	Velocity	Discrete I/O	Step in prog.
Automatic	yes	yes	yes	yes	yes
Manual			no		
Assisted Manual	yes	yes	yes	yes	no
Manual Ref. Set-up	yes	yes	yes	yes	no
Open Loop	yes	no	yes	yes	no

3 Selecting the Operating Mode

3.2 Automatic Mode

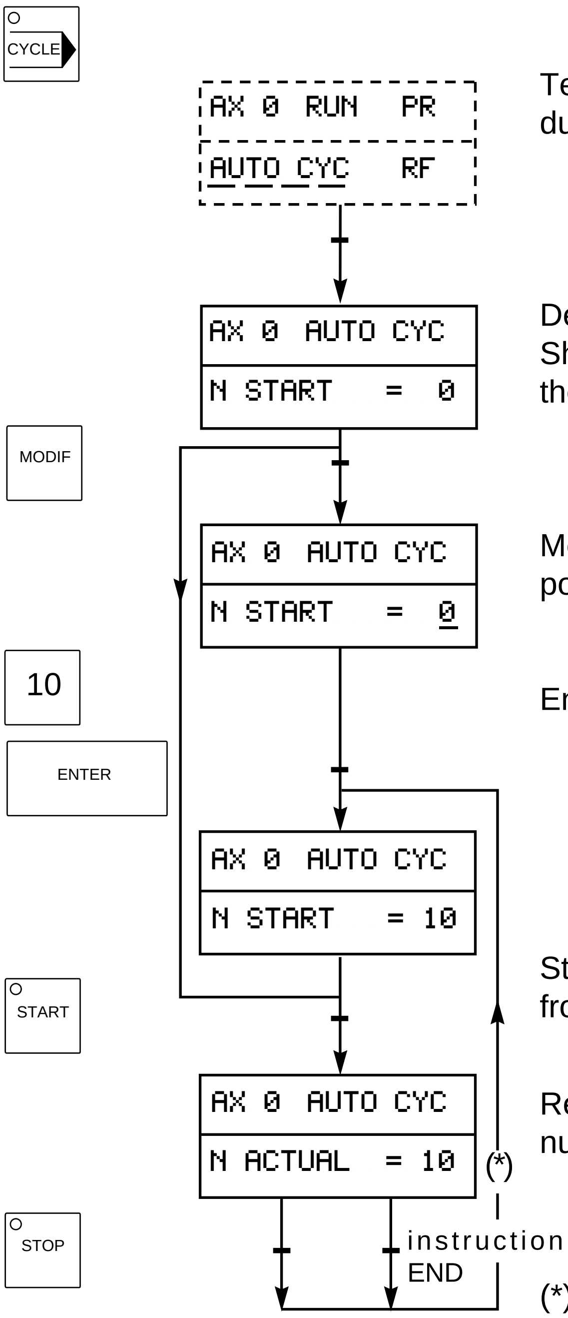
Activation conditions

- Module configured,
- Module running,
- Module programmed,
- No errors.

Automatic cycle sub-mode

(not relevant to TSX AXM 162 module)

Commands	XBT Display	Comments



Temporary display that appears during mode selection.

Dedicated mode display.
Shows the starting step number for the AXM program.

Modification of the start step is possible.

Enter the new start step.

Starts AXM program execution from the start step.

Real time display of the step number being executed.

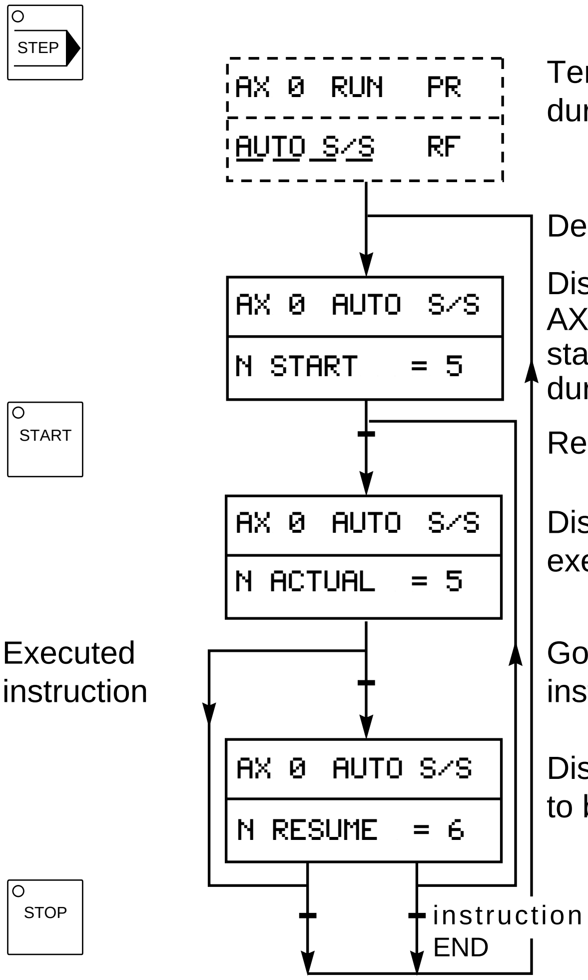
(*) 0 if the start step was not modified.

Automatic Mode

Automatic step-by-step sub-mode

(not relevant to TSX AXM 162 module)

Commands — XBT Display — Comments



Temporary display that appears during mode selection.

Dedicated mode display.

Displays the start step for the AXM program. (modification of the start step follows the same procedure as the Automatic cycle mode).

Resume order from the next step.

Displays the step number being executed.

Go to the next display as soon as the instruction is executed.

Displays the number of the next step to be executed.

Automatic block-by-block sub-mode

(not relevant to TSX AXM 162 module)

The screens follow in the same sequence as the step-by-step mode, with the following differences:

- Mode name: AUTO B/B
- Restart after each move instruction with stop a command.

Special cases

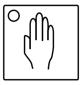
- If the AXM program is already being executed when one of the automatic sub-modes is selected, the screen that shows the current step is displayed immediately,
- If the AXM program is waiting to resume, the user can continue the program by pressing <START>.

3.3 Manual Drive Mode

Enable conditions

- Module configured,
- Module running,
- Calibrated axis,
- No errors.

Access

Commands	XBT Display	Comments
	AX 0 RUN PR MAN DRIVE RF	Temporary display that appears during mode selection.
	AX 0 MAN DRIVE CHOOSE DIRECTION	Basic display for selecting the direction of motion.
X- or X+	AX 0 MAN DRIVE 1000.000MM	Command for **Moving part motion in the selected direction**: • X+ = Positive direction, • X- = Negative direction. The moving part will move as long as the key remains pressed. The second display line displays the current position of the moving part.
Release the key		

Note

The velocity of the moving part is set in the AXM configuration AXM (VMAN parameter) if the velocity correction factor is at 1, if not:

Velocity = VMAN x Correction factor

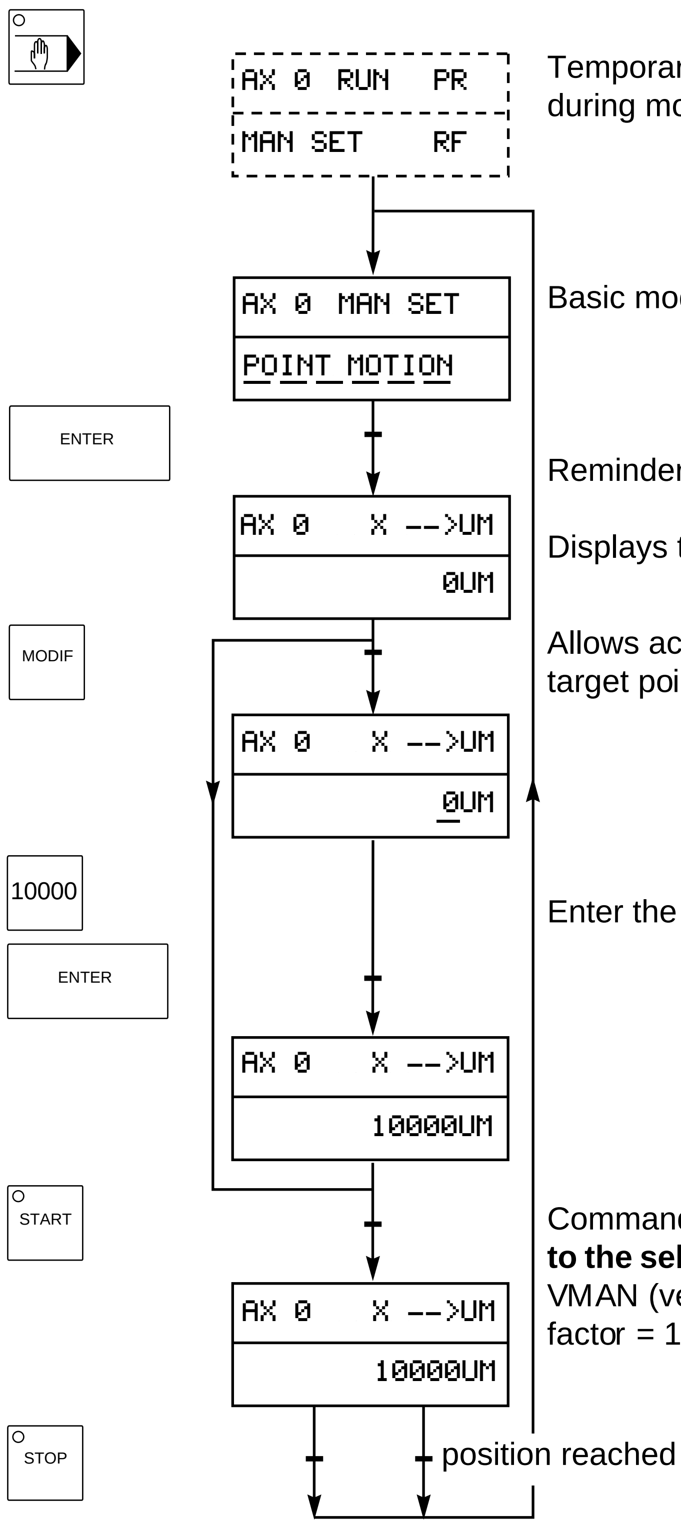
3.4 Assisted Manual Mode

Enable conditions

- Module configured,
- Module running,
- Calibrated axis and divert step.

Access to motion to set point command

Commands XBT Display Comments



Temporary display that appears during mode selection.

Basic mode display.

Reminder of user units.

Displays target point.

Allows access to modification of the target point (in Confidential Mode).

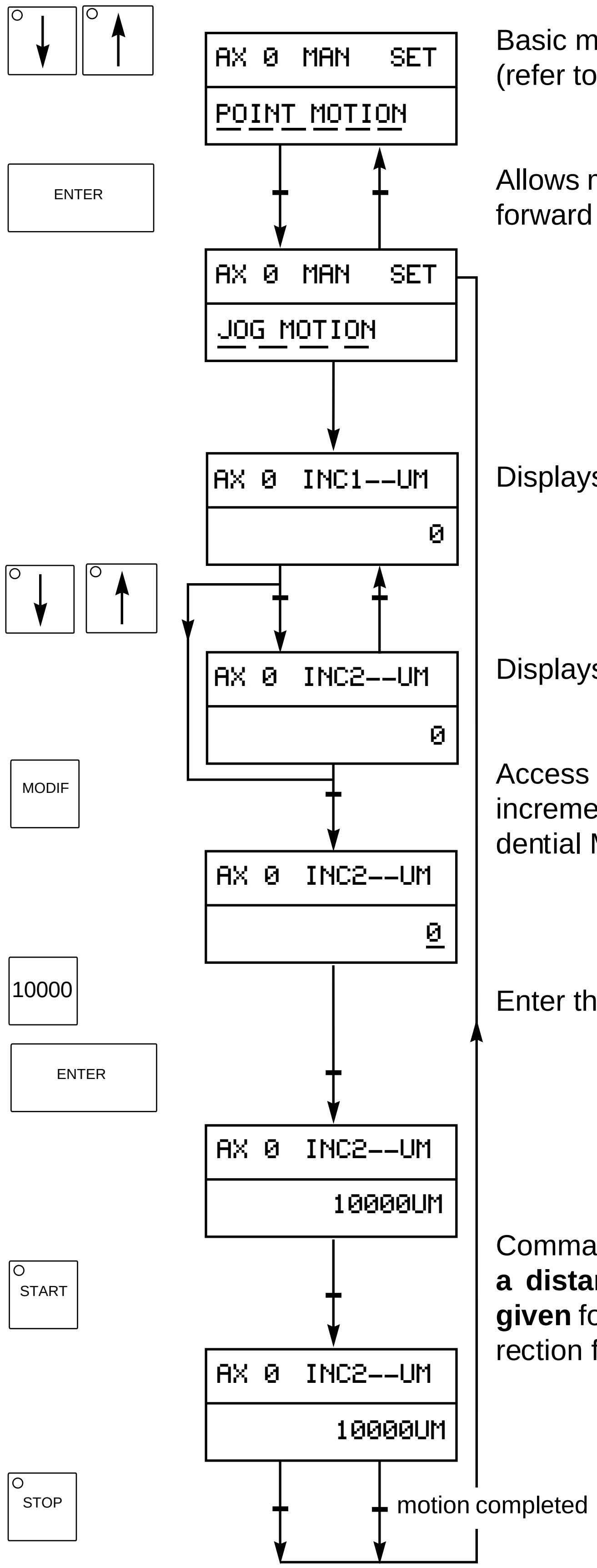
Enter the new target position.

Command for **moving part motion to the selected set point** at velocity VMAN (velocity correction factor = 1).

Assisted Manual Mode

Access to incremental motion

Commands XBT Display Comments



Basic mode display (refer to previous page).

Allows motion to jog the moving part forward one step.

Displays jog increment 1.

Displays jog increment 2.

Access to modification of the jog increment selected (in XBT Confidential Mode).

Enter the jog increment value.

Commands **moving part motion for a distance equal to the increment given** for velocity (if the velocity correction factor = 1).

3.5 Manual Reference Set-up Mode

Validation conditions

- Module configured,
- Module running,
- No errors.

Access

Commands	XBT Display	Comments
	AX 0 RUN PR MAN RFP NRF	Temporary display that appears during mode selection.
	AX 0 MAN RFP 120.000 MM	Display the value in the register.
MODIF	AX 0 MAN RFP 120.000 MM	
0	AX 0 MAN RFP 0	Enter the reference position (1).
ENTER	AX 0 MAN RFP CHOOSE DIRECTION	Mode display.
X+ X-	AX 0 MAN RFP ADV. MOTION	**Starts moving part motion** • X+ Forward direction (2), • X- Reverse direction (2), The key can be released. Motion velocity = VMAN (if velocity correction factor = 1).
STOP	Ref. Set-up AX 0 RUN PR MAN RFP RF	Display the axis status once reference set-up is complete.

Note

(1) Can be different than 0. The only condition that must be met is: LSS < Start Position < HSS.

(2) Except when type 3 (cam at end of travel) reference set-up is used and the moving part is on the cam at the time. In this case motion takes place in the opposite direction to that specified.

3.6 Open Loop Mode

Enable conditions

- Module configured,
- Module running,
- Axis calibrated,
- No errors.

Access

Commands	XBT Display	Comments
DIRECT DRIVE	AX 0 RUN PR OPEN LOOP RF	Temporary display that appears during mode selection.
	AX 0 OPEN LOOP DAC 0	Display linked to the mode. Displays the velocity instruction in mV for TSX AXM 182 (-10230 to +10230) and in tens of mV for TSX AXM 172 (-1023 to +1023).
MODIF	AX 0 OPEN LOOP DAC 0	Access to instruction modification.
100 ENTER	AX 0 OPEN LOOP DAC 100	Enter the new value.
INCR or DECR	AX 0 OPEN LOOP DAC 101	Increments or decrements the instruction value (min. increment = 10mV).
START	AX 0 OPEN LOOP DAC 101 (*)	**Moving part motion command**. (*) if no incrementing.
STOP		Commands moving part stoppage.

4 Motion Monitoring 4

4.1 Motion Monitoring Function Principles

This function allows the display of the following data on the axis selected by the XBT terminal:

- Position of the moving part,
- Position error (deviation),
- Output status,
- Velocity of the moving part,
- Simultaneous display of the position of another axis.

The table below lists the access conditions for each parameter:

Position of the moving part	POS	• Module configured
Position error (deviation)	POS ERROR	• Module configured • Operating mode ≠ open loop
Velocity of the moving part	SPEED	• Module configured
Relay outputs	OUTPUT	• Module configured
Position of another axis	AXIS N°2	• Module configured • Module running

Note: The Manual Drive mode does not allow access to any of these functions if either of the X+ or X- keys is being pressed, otherwise all functions are enabled.

In addition to the display, the indicator LEDs allow monitoring of moving part motion.

- X- : The moving part moves in negative direction, or stores the last move if Stop LED lit.
- STOP : The moving part is stopped.
- X+ : The moving part moves in positive direction, or stores the last move if Stop LED lit.

4.2 Parameter Display

Position

POS

Real-time display of the moving part position in user units.

XBT Display	Comments
AX 0 2.000 MM	Current moving part position.
--> 100.000 MM	Target position.

Position error (deviation)

POS ERROR

Real-time display of the position deviation (error), i.e. the difference between the actual position of the moving part in relation to the position instruction command. This value is displayed in user selected units.

XBT Display	Comments
AX 0 DEVIATION	
0.100 MM	Actual position deviation.

Output status

This function displays the status of the relay outputs. Modification is possible so long as Automatic mode is not selected.

Commands	XBT Display	Comments
OUTPUT	AX 0 R0 R1 R2 R3 0 1 1 0	Related display, the blinking output shows the output where the status can be modified.
or ← →		Enables selection of another output.
	AX 0 R0 R1 R2 R3 0 1 1 0	The newly selected output is displayed and blinks.
MODIF		Modifies relay status. **Note**: Relay output R0 cannot be modified (safety interlock).
	AX 0 R0 R1 R2 R3 0 1 1 1	

Parameter Display

Velocity

SPEED

Displays the velocity in real-time, in user units.

XBT Display	Comments
AX 0 2400MM/MM	True moving part velocity,
--> 2500MM/MM	Programmed velocity.

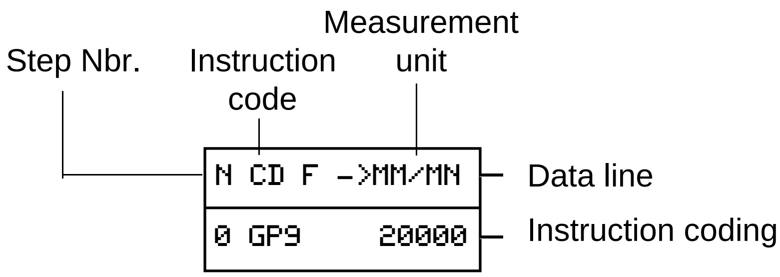
Display the position of another axis

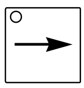
Commands	XBT Display	Comments
AXIS N°2		
	AX 0 256.030MM AX?	Displays the position of a moving part on the current axis. Allows entry of the number of the other axis.
5		Enter the axis number.
ENTER		
	AX 0 256.030MM	Moving part position, axis 0
	AX 5 5.100CM	Moving part position, axis 5

5.1 Display AXM Program (1)

Display Principle

The terminal can display the instruction being executed or any other instruction in the AXM program.



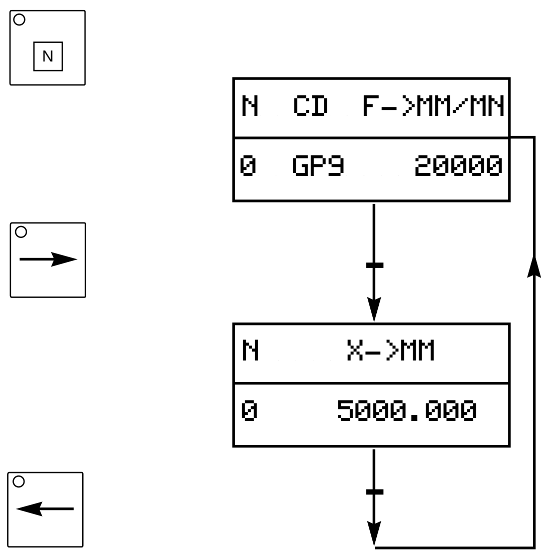


Displays other operands of the selected instruction.

Display current step

Condition: Automatic mode selected.

Commands	XBT Display	Comments



Displays the program step currently being executed.

Access to the next operand of the current step.

Return to previous operand.

(1) Not relevant to TSX AXM 162 module

5.2 Modify AXM Program Parameters (1)

Display AXM Program

Access condition: The module must programmed.

Commands	XBT Display	Comments
PROG	N 	
4	N 4	Enter the step number to be displayed (step 0 by default).
ENTER	N CD F->MM/MN 4 GP1 40000	Displays the selected program step.
→	N X->MM 4 7000.000	Access to the next operand (access to all operands of an instruction).
←	N CD F->MM/MN 4 GP1 40000	Return to previous operand.
↓	N CD F->MM/MN 5 G+1 40000	Access to the next step (access is possible up to the last step entered).
↑		Return to previous step.

(1) Not relevant to TSX AXM 162 module

Modify AXM Program Parameters

Program modification is accessible in Confidential mode, allowing access to:

- Velocity values,
- Immediate positions.

Commands	XBT Display	Comments
		Display the program step to be modified.
	N CD F->MM/MN 1 GP1 4000	Displays the selected program step.
MODIF		Access to velocity modification.
	N CD F->MM/MN 1 GP1 4000	
2000		
ENTER		Enter the new value.
	N CD F->MM/MN 1 GP1 2000	

Modifications can be made during AXM program execution.

If the instruction to be modified is being executed, the parameter modification will only be accepted once execution is completed.

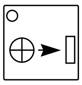
6 Direct Access Auxiliary Functions 6

6.1 Forced Reference Set-up

Validation conditions

- Module configured,
- Nodule running,
- No errors,
- No active operating modes and servo loop disabled mode not selected,
- Moving part stopped (Stop LED lit),
- XBT mode: Confidential.

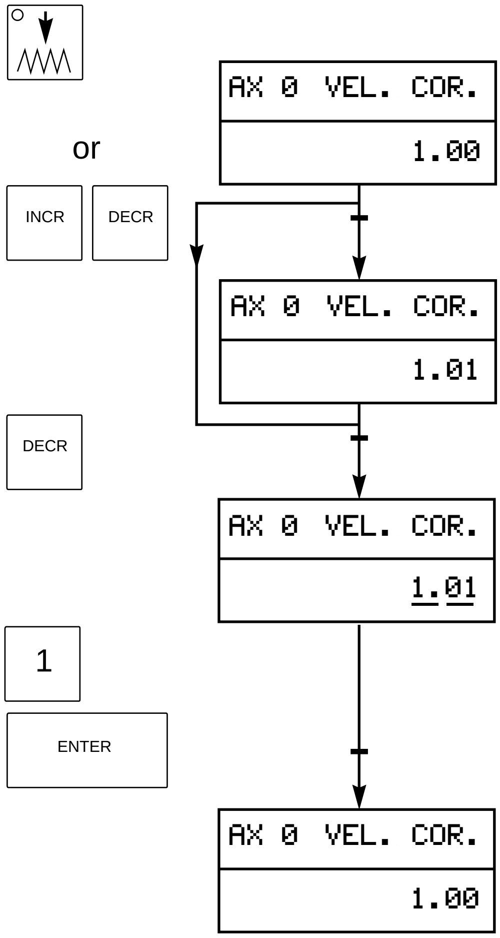
Access

Commands	XBT Display	Comments
	AX 0 RFP FORCE 1000000UM	Display linked to the function Displays the external position
MODIF	AX 0 FORCE 1000000UM	Access to position value modification.
0	AX 0 FORCE 0 UM	Enter the new value assigned to the position.
ENTER	AX 0 RUN PR AUTO CYC RF	**Commands reference set-up** (0 or 1000000 if no modification in the example). Return to the display related to the current mode. RF: indicates that the axis is calibrated (referenced).

6.2 Velocity Correction Factor

Access

Commands	XBT Display	Comments



Display linked to function.

Displays the factor value.

Increments or decrements the factor value.

Access to factor modification.

Enter the new factor value: (see below)

Reminder : The velocity correction factor multiplies all programmed and configured velocities (but cannot exceed the limit set by VMAX).

Performance differences depending on the type of module.

	TSX AXM 172	TSX AXM 182
• Number of digits in the factor: • Min. value • Max. value	3 E.g.: 1.78 0.01 1.99	4 E.g.: 1.782 0.001 1.999
• Factor modification accepted.	Deferred until the next motion command.	Immediate in Manual mode (Assisted man.) and in Auto Mode for instructions GP1 / GP9. Deferred until the next command in all other cases.

6.3 Teaching Set Points (1)

Validation conditions

- Module configured,
- Module running,
- Calibrated axis,
- No errors,
- WNi set points can be displayed in XBT Normal Mode, but values can only be acquired in Confidential Mode.

Access

The user has two options when teaching set points:
- Position the moving part in Manual mode on the set point,
- Directly enter the value of an immediate set point.

1st. Option: Position the moving part on the set point.

Commands	XBT Display	Comments
TEACH	W?? 	Display linked to the function
ENTER	↓	Enters the WNi number to store.
	W 1 – 250000UM X 5500UM	Displays the content of WN1. Displays the current position of the moving part.
or ↓ ↑	↓	Allows access to the next or the previous word (optional).
	W 2 – 250000UM 5500UM	Displays the content of WN2. Displays the current position of the moving part.
MODIF	↓	Allows access to current position in the selected WNi word.
	W 2 – 250000UM 5500UM	
ENTER	↓	
	W 2 – 5500UM 5500UM	Stores the current position of the moving part in a WNi word.

(1) Not relevant to TSX AXM 162 module

Teaching Set Points

2nd. Option: Entering a calculated immediate value.

Commands	XBT Display	Comments
TEACH	W??	Display linked to the function
2		Enters the WNi number to store.
	W 2 – 250000UM X 5500UM	Displays the contents of WN2. Displays current moving part position.
MODIF	W 2 – 250000UM 5500UM	Allows access to acquisition of a new value within the limits XMIN and XMAX.
100000 ENTER		Enter the new value
	W 2 100000UM 5500UM	

Note: Modification of a WNi internal position by entering a value calculated by the user can also be carried out while moving part motion is in progress.

7 Indirect Access Auxiliary Functions

7.1 Selecting Indirect Access Auxiliary Functions

Access

The example below covers the principles of:

- Selection,
- Display,
- Modification.

Commands	XBT Display	Comments
FONCT	F	
82	F82	Enter the function number
ENTER	CN0 CN1 CN2 CN3 255 252 47 112	Value of the 4 internal counters.
MODIF	CN0 CN1 CN2 CN3 255 252 47 112	Access to modification.
→ or ←	CN0 CN1 CN2 CN3 255 252 47 112	Selecting the counter to modify.
100 ENTER	CN0 CN1 CN2 CN3 255 100 47 112	Enter the new value between 0 and 255.

7.2 Function Description

F80 Divert the AXM program (1)

AX 0 DIVERT AXM	
N START = 5	Divert step number.

The divert step number can be modified.

<START> causes the AXM program to divert to the predefined step.

Access: Only in Confidential Mode during AXM program execution.

F81 Display/modify the external position

AX 0 EXT -> UM	Set point display unit.
1000	External set point value (OWxy,6/7).

Access: Display in Normal and Confidential Modes, modify in Confidential Mode only.

F82 Display/modify the CNi internal counters (1)

CN0	CN1	CN2	CN3	
255	252	47	112	Value of the 4 internal counters.

The values of the internal counters can be modified: <MODIF> key.
(   ) and (   ) allow access to the counter to be modified.

Access: Display in Normal and Confidential Modes, modify in Confidential Mode only.

F83 Display the standard status word (IWxy,0)

IT0	SFB	SFB3
0	0	0

IT0: Interrupt request indicator.
SFB: Module error (Status error bit).
SFB3: Application fault.

F	S-TEST	TBLK
0	0	0

F: Module failure.
S-TEST: Self-test in progress.
TBLK: Terminal block error.

(1) Not relevant to TSX AXM 162 module

Function Description

F83 (contd) Display the standard status word (contd).

```
NCONF R/S   ADJ
  0    1     0
```

NCONF = Module awaiting a configuration.
R/S = Module running,
ADJ = Adjust state.

```
SEC    OUT.DIS.
 0        0
```

SEC = Interlock disabled,
OUT.DIS. = Inhibited outputs.

Note: Bits active at 1 (0= complementary status),
Access: In Normal and Confidential Modes.

F84 Select interrupt masking or demasking.(1)

```
AX 0     MSK IT
LAST IT N =   0
```

Indicates the function used:
- MSK = Mask,
- DMSK = Demask.

LAST IT N = Step number that caused the IT.

<MODIF> <ENTER> allows selection of the interrupt mask or demask function.
Access: Display in Normal and Confidential Modes, modify in Confidential Mode only.

F85 Select Safety Interlock On/Off modes

```
AX 0  MODULE
SAFETY ON
```

Indicates the selected mode:

- Safety Interlock On,
- Safety Interlock Off.

Reminder : the Safety Interlock Off mode allows module control by the XBT terminal with the PLC Stopped.
<MODIF>+<ENTER> selects the complementary mode.
Access: Display in Normal and Confidential Modes, modify in Confidential Mode only.

F86 Inhibit the output

```
AX 0 OUT   ENAB
R=1011 DAC=   0
```

- ENAB enabled outputs,
- DISAB disabled outputs (2),
- R= Status of relay outputs R0 to R3.
- DAC= D/A converter output,

TSX AXM 172: x 10 mV,
TSX AXM 182: x 2.5 mV.

<MODIF>+<ENTER> selects enabled or disabled outputs.
Access: Display in Normal & Confidential Modes, modify in Confid. only.

(1) Not relevant to TSX AXM 162 module
(2) Inhibit only affects relay outputs R1 to R3.

Function Description

F87 Enable/disable the emergency stop function.

```
AX 0  EMG STOP
    ENABLE
```

or DISABLE if the emergency stop is already activated.

<MODIF>+<ENTER> causes emergency stop or ends the emergency stop.
Access: In Confidential Mode.

F88 Return the moving part from soft stop overrun.

```
AX 0   BACKOFF
XMAX
```

or XMIN if the moving part location is less than the lower soft stop.

Causes automatic return of the moving part. The fault must first be acknowledged by pressing <ALARM ACQ>..
Note: Once the fault is acknowledged, pressing <ENTER> will also return the moving part from overrun without using function F88.
Access: In Normal and Confidential Modes.

F89 PLC processor synchronization (1)

```
AX 0  CPU SYNC
    ACTIVATE
```

<ENTER> causes synchronization of the AXM program (refer to synchronization command M).
Access: Normal & Confidential Modes, AXM pgm. execution in progress.

F90 Display the name of the current application.

```
AX 0 APPLI NAME
PALLETS
```

Access: In Normal and Confidential Modes.

F91 Display the name of the applications stored in the PLC.

```
AX 1 3 APPLI(S)
LOAD
```

Gives the number of applications on the selected axis.

( ) or ( ) allow the name of the next or previous application to be read.
Access: In Normal and Confidential Modes.

(1) Not relevant to TSX AXM 162 module

Function Description

F92

Display the location of the module in the PLC rack.

AX 0
S=254 R=0 M= 4

- S = Station number (254 by default),
- R = Rack number,
- M = Slot number (Module Nbr.).

Access: In Normal and Confidential Modes.

F93

Module Run/Stop.

AX 0
STOP MODULE

or RUN MODULE if the module is stopped.

<MODIF>+<ENTER> toggles between module modes Run and Stop.
Access: In Confidential Modes.

F94

Display errors on other axes.

DEF. OTHER AXES
0 1 5

Numbers of the axes with errors.

Access: In Normal and Confidential Modes.

F95

Service introduction function (refer to Divider B, Sub-section 7.4).

AX 0
INIT AXM

F61

Adjusting the machine characteristic factor KR (refer to Divider B, Sub-section 7.4).

AX 0	KR
D?	UM

F62

Display the position index value.

AX 0 PRF -->UM
1000

Unit reminder

Parameter value

Access: For display in Normal and Confidential Modes.

8 Access to the Configuration Parameter Table 8

8.1 Configuration Parameter Access Principles

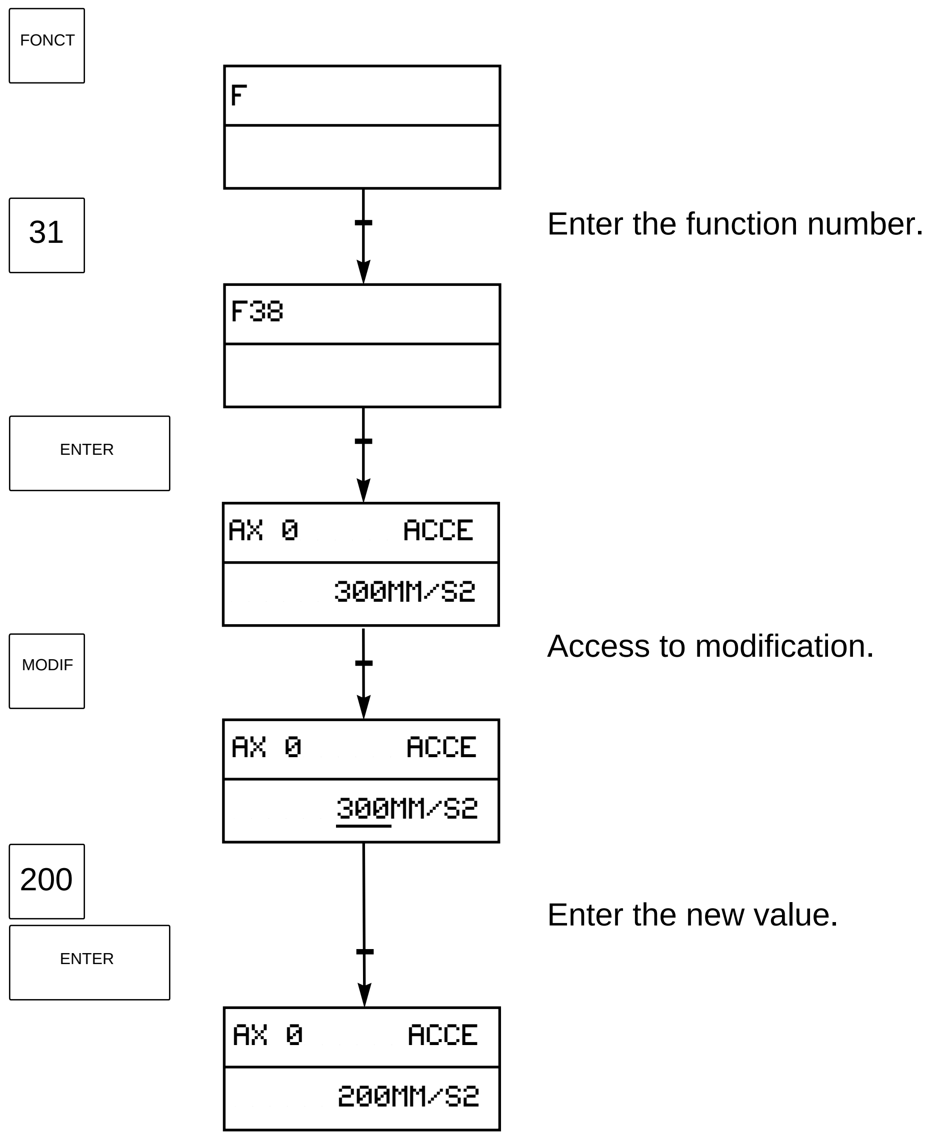
Access

The following example covers all of the options available for display and modification.

The modification of a configuration parameter linked to motion is not accepted directly when it applies to the motion in progress. The modification will only become effective for the next motion command.

The table in Sub-section 8.2 lists the parameters that can be modified.

Commands	XBT Display	Comments



Note: For values with only two states, <MODIF> will toggle between the two possible states.

8.2 Parameter List

Configuration parameters	Function	Modif.	Mnemonic
Sensor resolution	F31		RESOL
Maximum velocity	F32		VMAX
User selected length unit	F33		UPUL
User selected velocity unit	F34		UPUV
User selected acceleration unit	F35		UPUA
Higher soft stop (Max.)	F36		XMAX
Lower soft stop (Min.)	F37		XMIN
Acceleration	F38	X	ACCE
Deceleration	F39	X	DECE
Type of reference	F40	X	TYPEREF
Manual control velocity	F41	X	VMAN
Stopped velocity	F42	X	VSTOP
Stop time period	F43	X	TSTOP
Target window	F44	X	TW
Max. position error (deviation)	F45	X	DMAX
Speed drive max. voltage	F46	X	UMAX
Position gain	F47	X	KPOS
Max. velocity tolerance	F48	X	LIMV
Velocity correction factor	F49	X	KV
DMAX error divert mask (1)	F50	X	MDMAX
DMAX divert step (1)	F51	X	NDMAX
VSTOP error divert mask (1)	F52	X	MSTOP
VSTOP divert step (1)	F53	X	NSTOP
TW error divert mask(1)	F54	X	MTW
TW divert step (1)	F55	X	NTW
Synchronization time-out (1)	F56	X	TSYN
Synchronization error divert mask (1)	F57	X	MSYN
Synchronization error divert step (1)	F58	X	NSYN
CPUF divert mask (1)	F59	X	MCPUF
CPUF divert step (1)	F60	X	NCPUF
Machine characteristic factor	F61	X (2)	KR

Note: The configuration parameters can be scrolled using the Cursor Up and Cursor Down keys.

(1) Not relevant to TSX AXM 162 module

(2) This parameter cannot be displayed as it is an intermediate value and therefore its value is meaningless.
The procedure for setting and adjusting this value is described in Divider B, Sub-section 7.4.

9 Application Transfer 9

9.1 TSX → AXM Transfer

Purpose

Allows the transfer of an application previously stored in the PLC user memory (Wi or CWi) to the module.

Prior Conditions

- Module Stopped,
- Directory defined,
- Application number corresponding to an existing application.

Procedure

Commands	XBT Display	Comments
<FONCT> 71 <ENTER>		Select the function (indirect access function).
	AX 0 TRANSFER TSX -> AXM	
	AX 0 APPLI NUM ?	
1		Enter the number of the application to transfer.
	AX 0 APPLI NUM 1	
ENTER		Starts the transfer.
	AX 0 TRANSFER CONF AXM WNCN	Transfer results. When the application comprises: • A configuration, • An AXM program, • WNi and CNi variables.

9.2 AXM → TSX Transfer

Purpose

Enables an AXM application to be saved in the PLC’s user memory.

Validation Conditions

The application number must be coherent with the number of applications defined in the directory.

The application must have the same layout (same size and same program) as its image in the PLC memory (i.e. the parameter values for velocity, position, etc. may have been modified but not the instructions themselves, nor the layout of the AXM program).

Procedure

Commands	XBT Display	Comments
<FONCT> 70 <ENTER>		• Select the function (indirect access function) • Starts the transfer.
	AX 0 TRANSFER AXM -> TSX	
	↓	Transfer complete.
	AX 0 TRANSFER CONF AXM WNCN	Transfer result.

10.1 Error Display

ALARM

This indicator blinks when at least one error or command refusal has occurred on the selected axis.

If the axis state is displayed, the letter D blinking on the second display line indicates error detection.

Commands	XBT Display	Comments
ALARM DISPLAY	AX 0 2	Displays the number of errors detected on the selected axis.
↓	10 EMG STOP CLEAR / STOP	Lets the user access error designation. Displays type of acknowledgment.
↓	01 STOP FAULT ACKNOWLEDGE	
↓		

Notes: Function F94 displays the numbers of axes with at least one error.

To determine the types of errors on each axis, it is necessary to select the axis (refer to Sub-section 2.4).

10.2 Error Acknowledgment

Type 1 error

24 TER. BLOCK
ACKNOWLEDGE

ALARM ACQ — Acknowledges the error if it has ended.

MESSAGE	CODE	ERROR
TER. BLOCK	24	Terminal block unlocked or missing
LIMIT (*)	20	Soft stop (limit switch)
OVERFLOW	22	Calculation overflow
POWER FAIL	23	Power break

(*) Soft stop errors must be acknowledged by pressing <ENTER> F88 before returning the moving part from overrun.

Type 2 error

10 EMG STOP
CLEAR /STOP

ALARM CLEAR — Acknowledges the error and continues the current program.

ALARM STOP — Acknowledges the error and quits (deactivates) the current program.

MESSAGE	CODE	ERROR
EMG STOP	10	Emergency stop: Bit Oxy,7 at 0
EMG STOP I4	10	Emergency stop: Input In4 not supplied
DEVIATION	02	Position error (deviation)
SYNC. ERROR	03	Synchronization
TARGET WINDOW	04	Target window
CPU FAIL	05	PLC stopped or PLC error
STOP ERROR	01	Stop

Special case

COMM REFUSED	An impossible motion command has been requested. Acknowledged by the next valid command. Divider B, Appendix Sub-section 9.7 describes the reasons for command refusal.

A Appendix A

A.1 Self-tests

Purpose

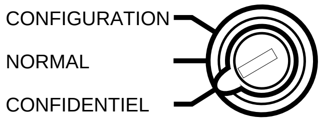
The self-tests check correct terminal operation (e.g. when the system is first installed).

A self-test can be performed even when the terminal is not connected to a TSX Series 7 PLC. Essential terminal components are tested sequentially: RAM, PROM, Buzzer, Display, etc.

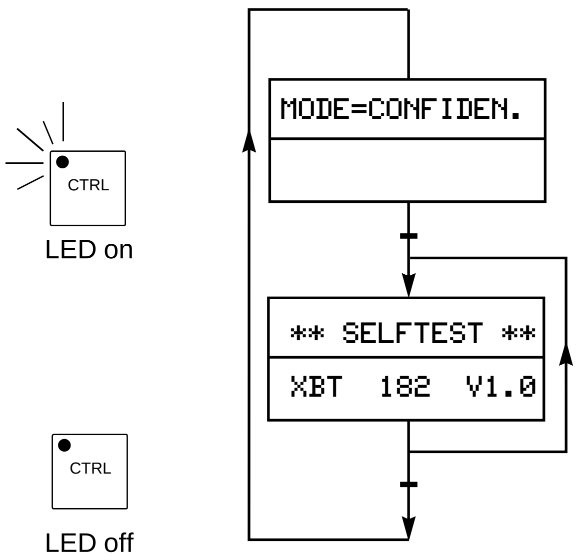
The <ENTER> key can be pressed at any time to jump from one test to another.

Access

The self-tests are accessible in Confidential Mode.



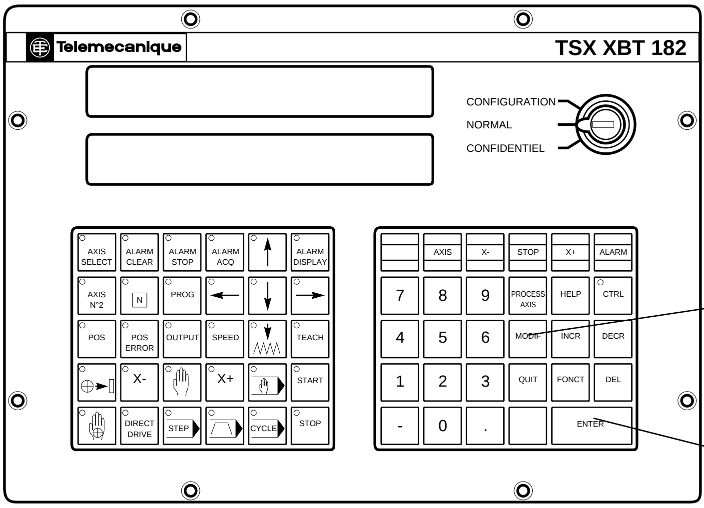
Commands	XBT Display	Description



To exit the self-test procedure and return to Confidential Mode functions, press <CTRL> at any time.

Self-tests

Self-test execution procedure



Keys that are active during the self-test procedure:

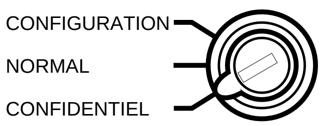
Start test,

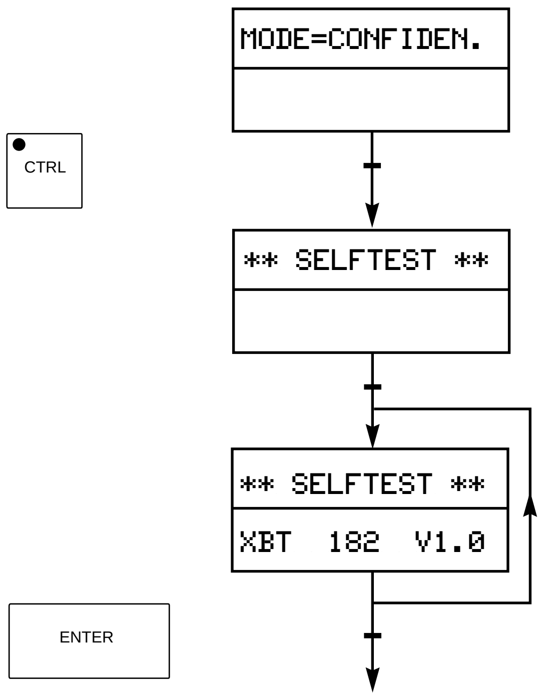
Validate test and move to the next step.

The <ENTER> key can be pressed at any time to jump from one test to another.

To exit the self-test procedure press <CTRL> or turn the key.

Commands	XBT Display	Description





The XBT terminal software version is displayed.

Self-tests

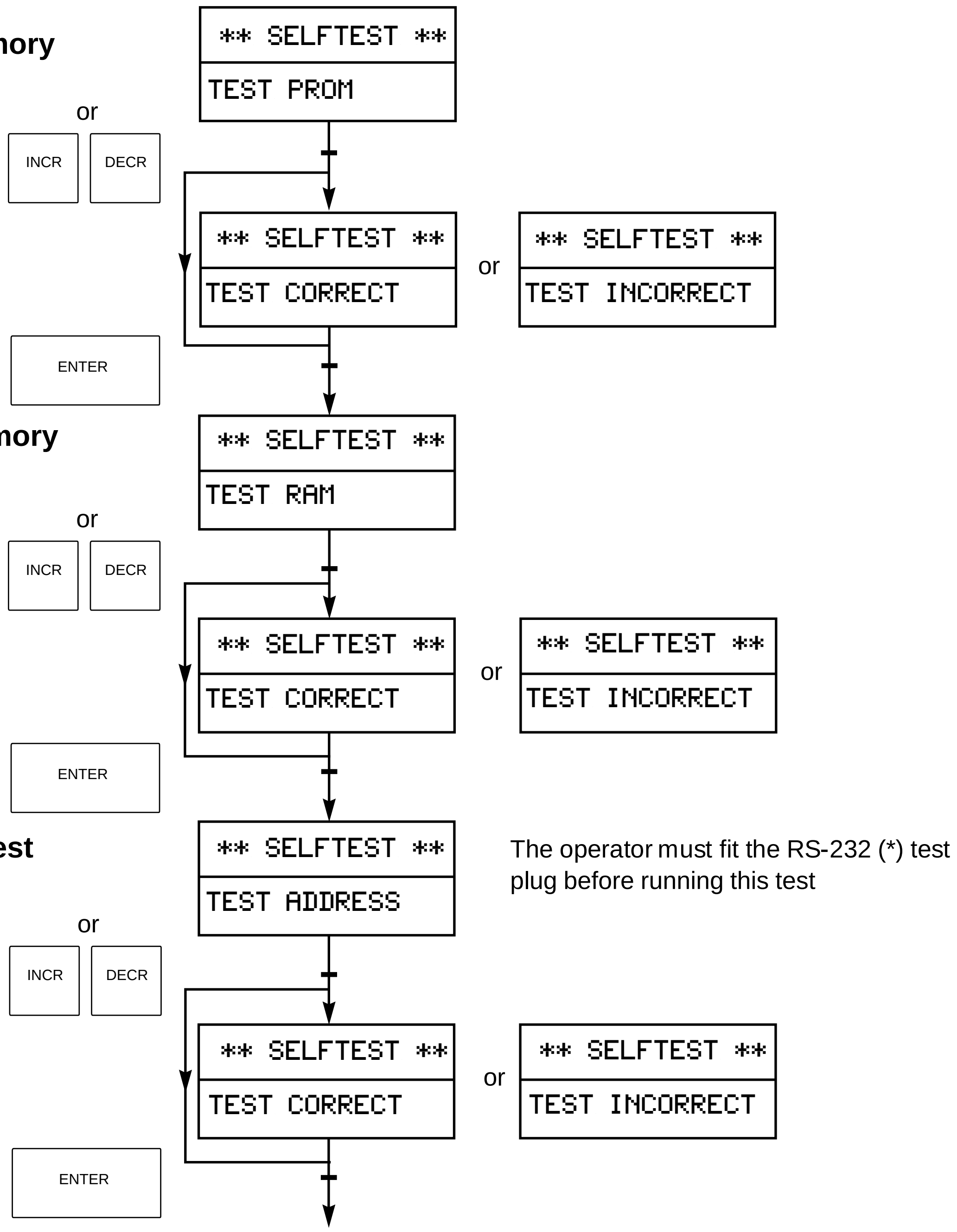
Memory tests

Commands	XBT Display	Description

Program memory test

Message memory test

Addressing test



(*) Refer to the wiring diagram at the end of this section for information on how to wire the test plugs.

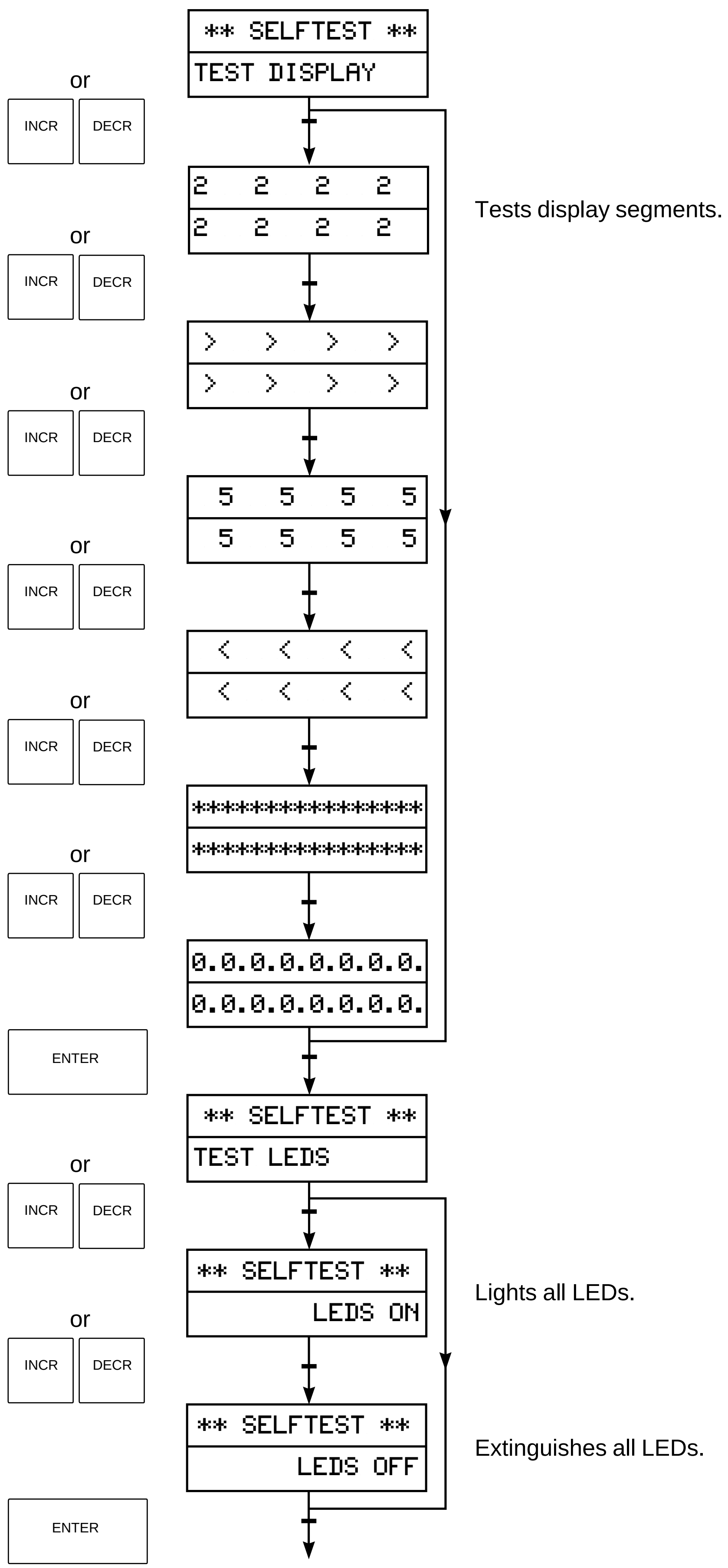
Self-tests

Commands	XBT Display	Description
	** SELFTEST ** TEST KEYBOARD	Pressing a key will display the key code.
INCR	INCR	
9	9	To perform a complete test, press all keys, except: [FONCT] That jumps to the next Auxiliary function, <ENTER> That jumps to the next test, and [CTRL] That exits the auxiliary functions mode.
DEL	DEL	
AXIS SELECT	F01	
ENTER	** SELFTEST ** TEST KEYBOARD	
INCR	** SELFTEST ** MODE=CONFIDEN.	Turn the key.
CONFIGURATION NORMAL CONFIDENTIEL	** SELFTEST ** MODE=NORMAL	Display the corresponding mode.
CONFIGURATION NORMAL CONFIDENTIEL	** SELFTEST ** MODE=CONFIGUR.	
CONFIGURATION NORMAL CONFIDENTIEL	** SELFTEST ** MODE=CONFIDEN.	Return to Confidential Mode to perform the remaining tests..
ENTER		

Self-tests

Test display units

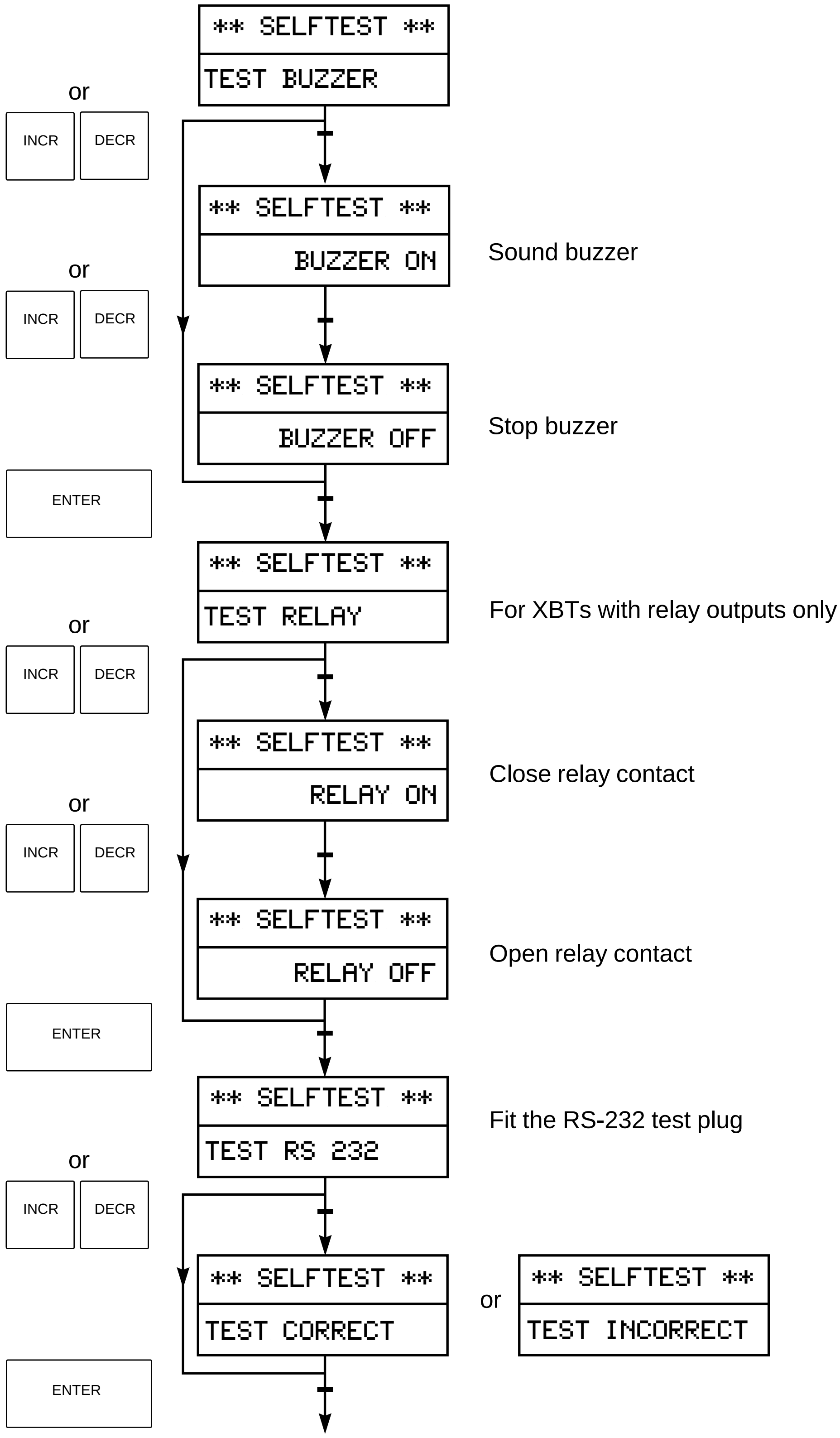
Commands XBT Display Description



Self-tests

Test outputs

Commands	XBT Display	Description

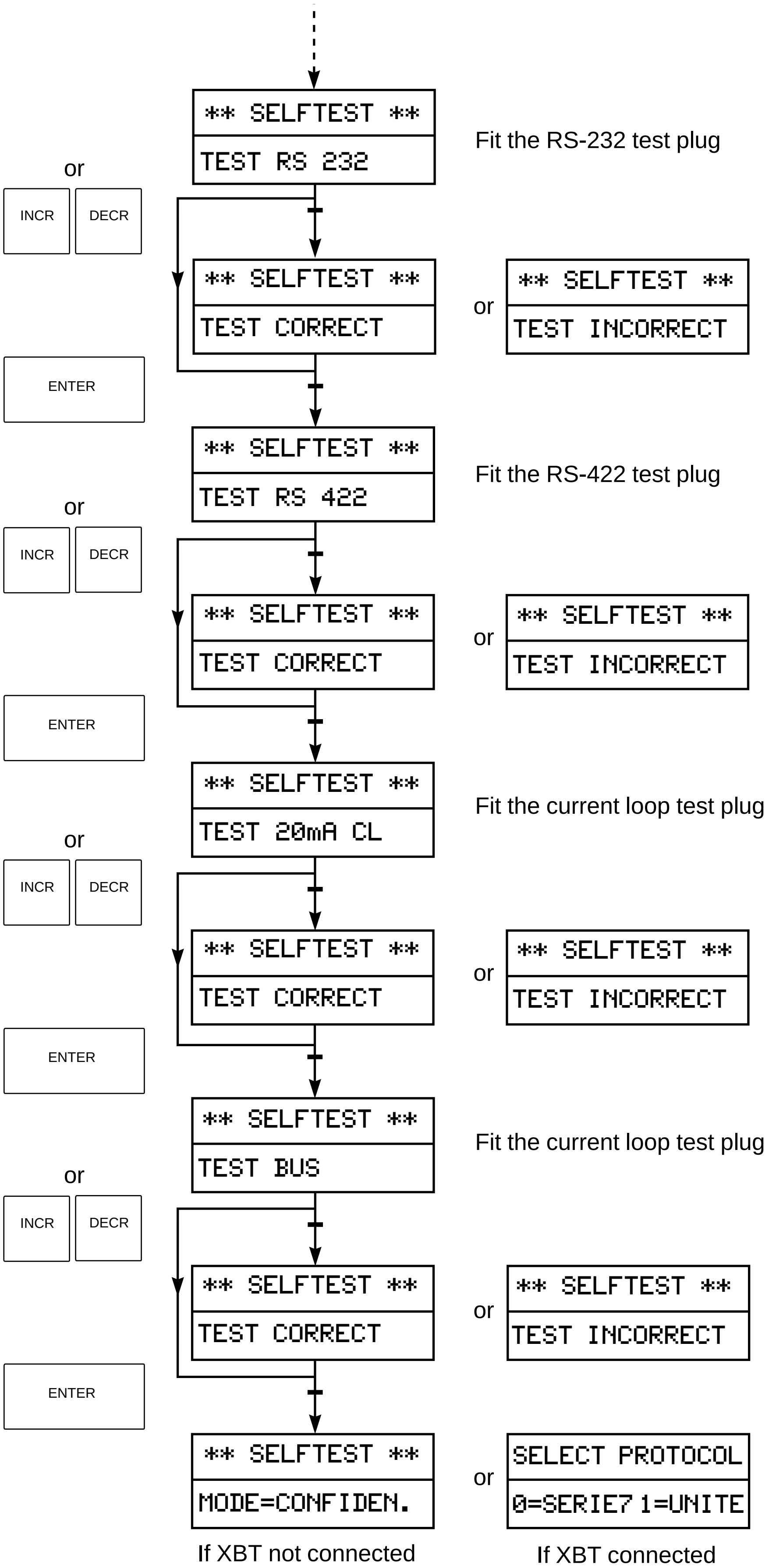


Data link test

Self-tests

Test outputs

Commands XBT Display Description



Self-tests

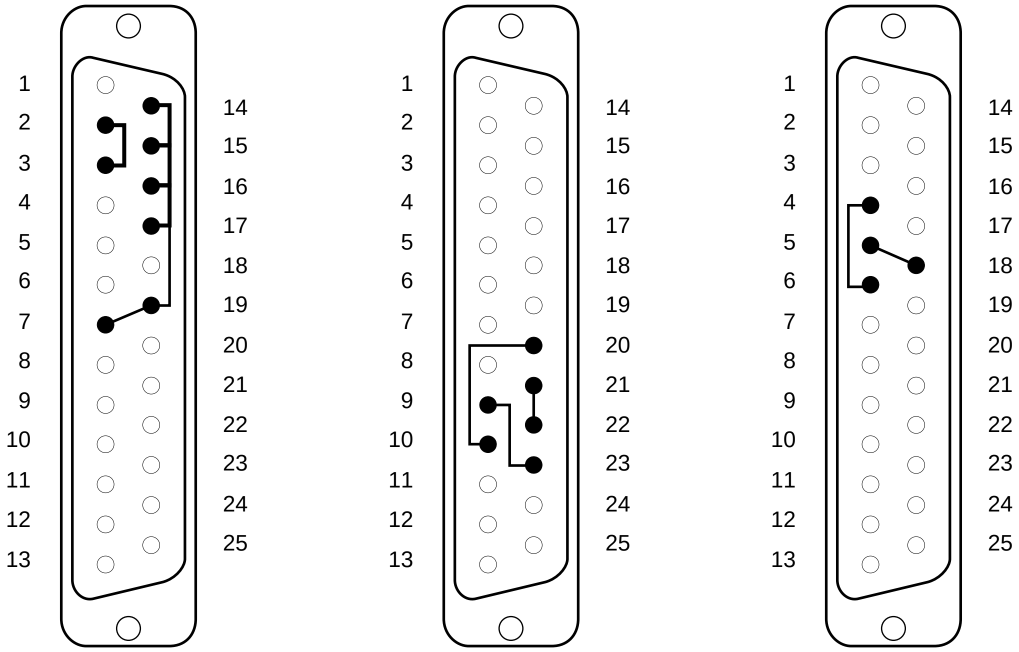
Wiring the test plugs

The test plugs are not supplied ready to use, it is up to the user to wire their own, using a connecter plug and the diagrams below. The diagrams apply to the three types of test that can be performed.

RS-232 and Addressing Test Plug

20mA Current Loop Test Plug

RS-422 Test Plug



A.2 List of Abbreviations

A	ACCE	Acceleration
	ACK	Acknowledgment
	ADJ	Adjust
	APP	Application
	AST	Assisted manual mode
	AUTO	Automatic
	AX	Axis
	AXM	TSX AXM 172 or 182 module
B	B/B	Block-by-Block (Point-to-Point)
C	CD	Code
	CL PASS	Passive current loop
	CM	Centimeter
	CONF	Configuration
	CONFIG	Configuration
	CPU	PLC processor
	CYC	Cycle
D	D	Error (Fault)
	DAC	Digital/Analog converter
	DECE	Deceleration
	DEU	German
	DIVERT	Divert
	DMAX	Max. deviation allowed
	DMSK	Demask
E	ENA	Enable
	ENG	English
	EXT	External (set point)
F	F	Velocity (feedrate)
	FBIT	Fault bit
	FR	French
H	HDX	Half duplex
	HS	Unserviceable
	IT	Interrupt
K	KPOS	Position gain
	KR	Machine characteristic factor
	KV	Velocity correction factor
L	LAST	Last
	LIMV	Maximum velocity (manual modes)

List of Abbreviations

M	M	Meter
	MAN	Manual mode
	MCPUF	Mask CPUF error
	MDMAX	Mask DMAX error
	MOD	Mode
	MOT	Motion
	MM	Millimeter
	MSTOP	Mask VSTOP error
	MSYN	Mask Syncronization error
	MTW	Mask TW error
N	N	Number
	NC	Not configured
	NCONF	Not configured
	NCPUF	CPUF divert step
	NDMAX	DMAX divert step
	NPR	Not programmed
	NSTOP	VSTOP divert step
	NSYN	Sync. error divert step
	NTW	TW divert step
O	OUT	Output
	OUTDIS	Output available
P	PARM	Parameter
	POS	Position
	POSIT	Position
	PR	Programmed
	PRF	Index parameter
	PROG	Programmed
R	REF	Referenced (reference point set-up)
	RESOL	Resolution
	REV	Reverse
	R/S	Run/Stop
S	S^2	Seconds squared
	SAFE	Safety interlock
	SELECT	Selected
	S-TEST	Self-test
	SYN	Synchronization
T	T	Relay output (discrete I/O)
	TBLK	Terminal block
	TSTOP	Stop time-out
	TSYN	Synchronization time-out
	TSX	TSX Series 7 PLC
	TYPEREF	Type of reference
	TW	Target window

D

List of Abbreviations

U	UM	Micron
	UMAX	Speed drive max. voltage
	UNI-TLW	Uni-Telway
	UPUA	User units: Acceleration
	UPUL	User units: Length
	UPUV	User units: Velocity
V	VAL	Value
	VEL	Velocity
	VEL COR	Velocity correction
	VMAX	Maximum velocity
	VMAN	Manual control velocity
	VSTOP	Stopped velocity
W	WAIT	Wait
X	X	Position
	XMAX	Higher soft stop (Max.)
	XMIN	Lower soft stop (Min.)

A.3 Diagnostic Assistance

A number of operator errors (incorrect parameter values, selecting a function when the selected mode does not allow it, etc.) are indicated by the terminal buzzer sounding.

In some cases, an error message is also displayed to indicate the reason for command refusal. Table 1 lists the various messages that may be displayed and their cause. In most cases, this is enough to allow the operator to take corrective action.

In other cases a generic message may be displayed or the system may react unexpectedly, leaving the user to perform troubleshooting diagnostics to determine the cause. Table 2 lists the most frequently encountered symptoms. It cannot cover all possible situations, and the user can add to it as specific situations are encountered in operational use.

Diagnostic Assistance

Table 1

Commands that cannot be executed.

(A full list of errors caused by the application or the module is located in Sub-section 10.2.)

Number	Message	Description
1.1	AXIS NOT PROG.	The selected AXM module does not have a loaded program.
1.2	AXIS NOT REF.	The axis is not calibrated (refer enced). Set the reference point in order to access the selected function.
1.3	AXM PGM STOP	AXM program execution is not in progress. <START> in Automatic Mode will start the program.
1.4	WAIT RESTRT AXM	The AXM program is waiting for a resume command. Press <START>. In step or block modes.
1.5	MACHINE RUN	The moving part is in motion or stop checks are still in progress. Wait for it to stop before entering the required command.
1.5	MACHINE STOP	The moving part is stopped.
1.6	INACTIVE MODE	The selected mode is inactive. <START> mode to activate it.
1.7	MODE ERROR	The selected function is not enabled in the currently selected operating mode.
1.9	BACKOFF IMPOSS.	The return from soft limit overshoot function is only enabled if there is: • No soft stop error, • No other error inhibiting moving part motion.

Diagnostic Assistance

2.1	AXM STOPPED	Function cannot be accessed with the module Stopped. Place module in Run: Function F93.
2.2	AXM NOT CONF.	Function cannot be accessed, module not configured.
2.3	AXM RUNNING	Function cannot be accessed with the module Running. Stop module: Function F93.
2.4	AXM NOT RESERV	The AXM module is reserved by another terminal. Repeat the operation.
3.1	TSX STOP	Function cannot be accessed with the module stopped: • Set PLC to Run, or • Select Safety Off mode (F85).
3.3	TSX NOT CONF.	The PLC is not configured, no AXM functions are available.
3.6	TSX NOT RESERV	The dedicated axis field in the PLC memory is already reserved by an other user.
4.1	SYSTEM ERROR	Refer to the possible causes (described on the following pages). Repeat the command.
4.2	DIRECTORY ERROR	The directory was not created (1).
4.3	APPLI NOT DEF	The nbr. of applis in the AXM exceeds the nbr. of applis declared.
4.4	KEY ERROR	The function cannot be accessed in the selected XBT mode. Change the keyswitch position.
	APPLI FAIL	Invalid application.
	DIFF.APPLI.LEN	The size of the application in AXM memory is different from the image in TSX memory. Transfer by is F70 illegal.

(1) This message can also be obtained on a TSX XBT 182 terminal version 1.0, for a configuration :
- having more than 16 axes
- having at least a TSX 162 module

Diagnostic Assistance

Table 2:

Situations that may cause generic messages to be displayed, or unexpected system responses.

System Error message: This message is displayed when a after an TSX XBT terminal command, an unexpected system response occurs. This situation can be caused by various events (no response from the module, conflict between the TSX XBT terminal and the PLC, etc.).

Unexpected System Reactions and Probable Causes

System Reaction	Probable Causes	Remedial Action
SYSTEM ERROR when function F70 is used (AXM → TSX Transfer).	• The axis number stored in the module is not the same as the logical axis number corresponding to the slot used. • The Axis Nbr./Application Nbr. pair stored in the module does not exist in the directory. (These situations are caused by replacing or moving modules within the racks).	• If this situation is not caused by inverting modules, transfer the back-up copy of the application from the PLC (TSX) memory to the AXM module memory.
SYSTEM ERROR when attempting to change modes.	• An application error is present. This makes it impossible to change modes. • Conflict between the XBT terminal and the PLC program.	• Acknowledge the error before attempting to change modes. • To check this condition: • Select AXM Safety Off Mode (Function F 86), • Stop execution of the PLC program. If the condition ends, this was the correct action.
SYSTEM ERROR and COMMAND REFUSAL when a Manual Mode motion command is entered.	• Moving part position incompatible with the selected direction of motion. A target window value that is too large may cause this situation.	• Enter a "reasonable" value for the target window.

Unexpected System Reactions and Probable Causes

System Reaction	Probable Causes	Remedial Action
Error not acknowledged after an ABORT command.	• If the error ends, →	Check that the AXM module is indeed running (Function F 93). As soon as the module starts running, this will acknowledge the error.
XBT goes into a LINE FAULT as soon as the UNI-TE protocol is selected.	• XBT/SCM 21 or XBT/SCI disconnected, • The line parameters of the XBT and SCM or SCI are incompatible (incorrectly configured).	• Check the type of cables and the connections, • Check the parameters.
XBT goes into a LINE FAULT as soon as the axis number is selected.	• Module absent, or module physically present is of a type different to that declared in the PL7-3 configuration • RESET MESSAGE bit (OWxy,0,2) at 1.	• Reset the bit to 0 and, if necessary correct the PLC program.
The START key has no effect (+ buzzer).	• START command before a mode was selected, • START command before stop check time-out.	• Wait for the Stop LED to go out. If necessary, adjust the Stop parameter.
COMMUNIC ERROR	Incorrect Time-Out parameter in the TSX SCM 21 module configuration.	Reset the value of this parameter to 30 ms.

A.4 Index

Index

A.5 Setting-up an Axis from a TSX XBT 182

Refer to Divider B, Sub-section 7.4 for a full description.

A.6 Different software versions

There are two software versions for the TSX XBT 182 axis control terminal :

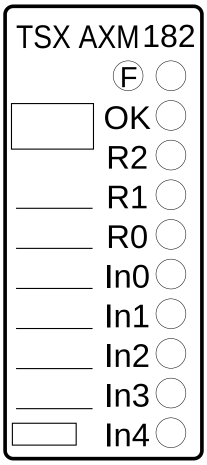
- Version V1 (available October 1990 to November 1991) operates with configurations having a maximum of 16 TSX AXM 172 or TSX AXM 182 axis control modules,
- Version V2 (available December 1991 onwards) is restricted to 16 axes (even if the configuration has more than 16 modules), and is compatible with all 3 types of module, TSX AXM 172, TSX AXM 182 and TSX AXM 162.

Comparison table of the two versions

Criteria	Version V1	Version V2
Number of axes handled	16	16
Behaviour if configuration has more than 16 axes	Fault appears with message DIRECT. NOT AVAIL.	Restricted to 16 Access to more than 16 axes not possible
Types of modules handled	TSX AXM 172 TSX AXM 182	TSX AXM 172 TSX AXM 182 TSX AXM 162
Behaviour when configuration includes TSX AXM 162 modules	Message DIRECT. NOT AVAIL.	Normal

Divider D of this manual describes the operation of the TSX XBT 182 terminal under version V2. Taking into account the previous restrictions, this manual applies equally to version V1. However, TSX XBT 182 terminal version V2 does not perform a coherence check of operator commands with the type of module. Thus, for a TSX AXM 162 module (non programmable), the programming mode commands are sent to the module without filtering, which refuses them (message AXM NOT PROGRAMMED). For the same type of modules, the TSX XBT 182 terminal accesses the WNi internal dimensions table (TEACH key) and the CNi counters (F82 function) which, although not used, are nevertheless present. The same applies to the configuration parameters relative to fault processing (functions F50 to F60).

Indicator LEDs



Red "F" LED	Module failure,
Green "OK" LED	Module powered-up and operating correctly,
Red "Rx" LEDs	Relay outputs active (output R3 is not shown),
Red "Inx" LEDs	Inputs powered-up or at 1.

Note: The In4 indicator must always be lit during normal operation showing that motor drive current is present.

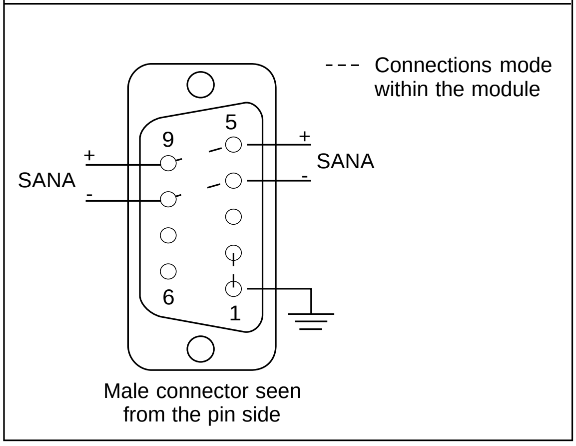
Characteristics

- Installation: Any slot in a TSX 47-40/67-40/87-40/107-40 basic rack or TSX RCE 860 or TSX RCF 860 extension rack.
- Locating devices and software configuration code: TSX AXM 172: 729, TSX AXM 182: 732, TSX AXM 162: 735.
- Response to a power/break return (power break of at least 10 ms):
  - Immediate travel stoppage,
  - Quit AXM program,
  - Axis calibration lost,
  - Software configuration and AXM program are protected by the internal battery back-up of the module.

Connections

Common to TSX AXM 172 / AXM 182 / AXM 162

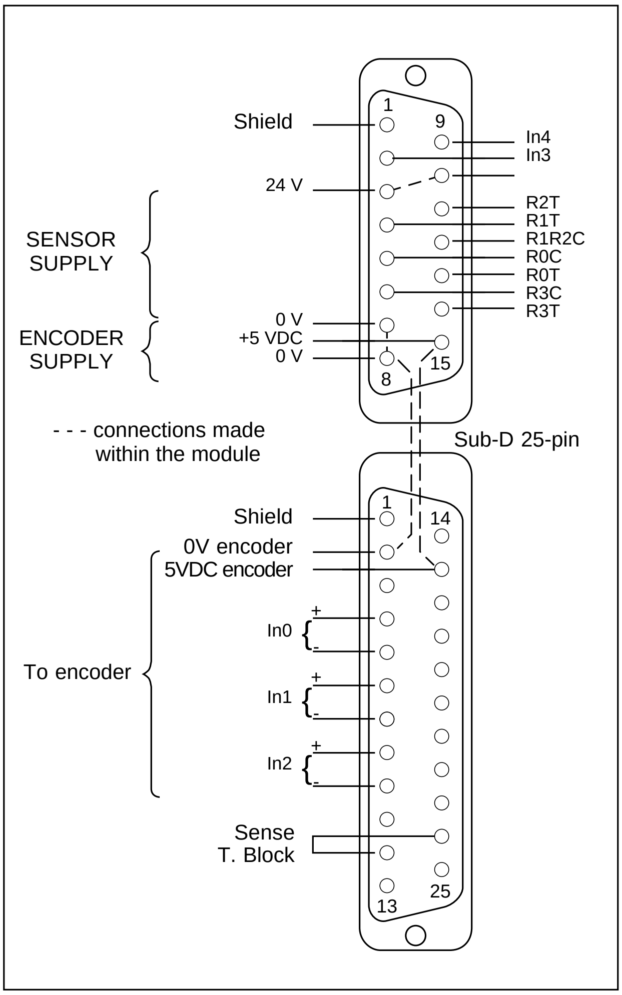
Sub-D 9-pin Connector



Specific to TSX AXM 172

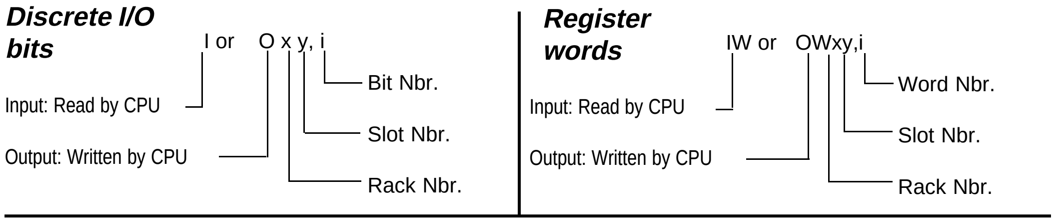
Signals	BLK 4 Term. Block		Signals
Input In4 24V	A8	C1	— Input In4
Input In3 24V	A7	C2	— Input In3
Input In2 24V	A6	C3	— Input In2
5V	A5	C4	5V Input In1
Input In1 24V	A4	C5	—
Input In0 24V	A3	C6	— Input In0
Output R2 NO	A2	C7	5V
Output R1 NO	A1	C8	NC Output R2
NC	B8	D1	C Common R1 R2
Output R0 C	B7	D2	NO Output R0
Output R0 NO	B6	D3	NC
NC	B5	D4	C Output R0
Output R3 C	B4	D5	NO Output R3
Output R3 NO	B3	D6	NC
NC	B2	D7	C Output R3
Ground	B1	D8	Ground

Specific to TSX AXM 182 / AXM 162



PLC/AXM Interface

Addressing



Discrete I/O Bits

Ixy, F E D C B A 9 8

Oxy, 7 6 5 4 3 2 1 0

Ixy, 8	1 = Output relay R0 active
Ixy, 9	1 = Output relay R1 active
Ixy, A	1 = Output relay R2 active
Ixy, B	1 = Output relay R3 active
Ixy, C	Reserved
Ixy, D	1 = Input In3 supplied
Ixy, E	1 = Module reserved
Ixy, F	1 = Moving part stopped

Oxy, 0	Reserved
Oxy, 1	1 = Activate output relay R1
Oxy, 2	1 = Activate output relay R2
Oxy, 3	1 = Activate output relay R3
Oxy, 4	1 = START operating mode
Oxy, 5	1 = STOP operating mode
Oxy, 6 *	1 = Resume from the next step (step-by-step) Resume current step (after Stop)
Oxy, 7	0 = Emergency stop command

8 Input Register Words

IWxy, 0	Standard Status Word (F … 0)
IWxy, 1	Complementary Status Word 1 (F … 0)
IWxy, 2	Complementary Status Word 2 (Current Step Nbr. * … 7 … 0)
IWxy, 3 *	Last IT Step / Step Nbr. Before Divert Instruction
IWxy, 4 *	Position Error (LSB)
IWxy, 5	Position Error (MSB)
IWxy, 6	Position (LSB)
IWxy, 7	Position (MSB)

8 Output Register Words

OWxy, 0	Standard Command Word (F … 0)
OWxy, 1	Complementary Command Word 1 (F … 0)
OWxy, 2	Complementary Command Word 2 (F … 0)
OWxy, 3 *	Start Step Nbr. / Comparison Value
OWxy, 4 *	CNi or WNi Word Nbr. / CNi Word Value
OWxy, 5	DAC Value (open loop) or Velocity Correction Factor
OWxy, 6	External Set Position (LSB)
OWxy, 7	External Set Position (MSB)

* Not relevant to TSX AXM 162 module.

OWxy, 0 Standard Command Word

F E D C B A 9 8 7 6 5 4 3 2 1 0

0*	1 = Mask the interrupt
2	1 = Reset message system to 0 (Text block)
C	1 = Change module state to Run 0 = Change module state to Stop
E	1 = "Safety Off" mode
F	1 = Inhibit outputs

OWxy, 2 Complementary Command Word 2

F E D C B A 9 8 7 6 5 4 3 2 1 0

0	↑ = Acknowledge stop error and resume current mode
1	↑ = Acknowledge stop error and quit current mode
2	↑ = Acknowledge position error and resume current mode
3	↑ = Acknowledge position error and quit current mode
4*	↑ = Acknowledge synchronization error and resume AXM program
5*	↑ = Acknowledge synchronization error and quit automatic mode
6	↑ = Acknowledge TW error and resume current mode
7	↑ = Acknowledge TW error and quit current mode
8	↑ = Acknowledge CPUF and resume current mode
9	↑ = Acknowledge CPUF and quit current mode
A	↑ = Acknowledge emergency stop error and resume current mode
B	↑ = Acknowledge emergency stop error and quit current mode
C	↑ = Acknowledge soft stop error
D	↑ = Acknowledge calculation overflow
E	↑ = Acknowledge PWF error
F	↑ = Reserved

OWxy, 1 Complementary Command Word 1

F E D C B A 9 8 7 6 5 4 3 2 1 0

0 1 2 3	Operating mode selection nibble 0000 None 0111 Open loop 0001 Manual reference set-up 0010 Manual operation 0100 Assisted manual operation * 1000 Automatic step-by-step mode * 1001 Automatic block-by-block mode * 1010 Automatic cycle mode *
4*	↑ = Preset one of the four CNi internal words CNi Nbr. OWxy,4 (MSB) CNi Value OWxy,4 (LSB)
5*	↑ = Load one of the WNi internal positions WNi Nbr. OWxy,4 (MSB) Current position value WNi value
6	↑ = Forced reference set-up OWxy,6 and OWxy,7 are loaded in the current position measurement
7	↑ = Return moving part from soft stop overrun
8*	↑ = Divert the AXM program to the step given by register word OWxy,3
9*	↑ = Synchronization in automatic mode
A	In manual or manual reference set-up mode: 1 = Move command in - direction 0 = Move command in + direction

* Not relevant to TSX AXM 162 module.

IWxy, 0 Standard status word

F E D C B A 9 8 7 6 5 4 3 2 1 0

0 *	1 = IT AXM CPU, reset to 0 by acknowledgment
1	Reserved
2	1 = Reset the message system (Text block)
3	1 = Module ready
4	1 = Module general error or store error
5	Reserved
6	1 = Module type 3 error or store error
7	Reserved
8	1 = Module failure
9	1 = Self-tests in progress
A	1 = Terminal block not locked
B	1 = Awaiting configuration 0 = Module configured
C	1 = Module running 0 = Module stopped
D	Reserved
E	1 = Safety mode off
F	1 = Inhibited output state

IWxy, 1 Complementary status word 1

F E D C B A 9 8 7 6 5 4 3 2 1 0

0 1 2 3	Operating mode nibble 0000 None 0111 Open loop 0001 Manual reference set-up 0010 Manual operation 0100 Assisted manual operation 1000 Automatic step-by-step mode * 1001 Automatic block-by-block mode * 1010 Automatic cycle *
4	1 = Move in - direction 0 = Move in + direction or store the last motion direction if stopped
5 *	1 = AXM program running
6	1 = Reference set-up in progress
7	1 = Return from soft stop overrun
8	1 = Awaiting a start command for the selected operating mode
9 *	1 = End of AXM program
A	1 = Referenced axis
B *	1 = AXM program loaded in module memory
C	0 = Supply to input In4 lost
D	1 = Motion command refused
E *	1 = AXM program synchronization error
F	1 = Position error

IWxy,2 Complementary status word 2

F E D C B A 9 8 7 6 5 4 3 2 1 0

Current Step Nbr. *

0	1 = Moving part position ≤ Lower Soft Stop
1	1 = Moving part position ≤ Higher Soft Stop
2	1 = Stop error
3	1 = Emergency stop active (In4 or Oxy,7)
4	1 = Current position measurement outside of the target window
5	1 = PLC error or PLC stopped
6	1 = Process PWF error
7	1 = Calculation overflow error

* Not relevant to TSX AXM 162 module.

Configuration

Access	XBT Function	Parameters	Values
A	F31	RESOL Sensor resolution	Units: µm Limits: 0.1 and 1000.0
A	F32	VMAX Maximum velocity	Units: mm/mn
A 	 F33 F34 F35	USER UNITS . UPUL Length . UPUV Velocity . UPUA Acceleration	 Units: µm, mm, cm, dm, m Units: mm/mn, cm/mn, dm/mn, m/mn Units: mm/s^2, cm/s^2, dm/s^2, m/s^2
A	F36 F37	XMAX Higher Soft Stop XMIN Lower Soft Stop	
C	F38 F39	ACCE Acceleration DECE Deceleration	
B	F40	TYPEPO Type of reference set-up	1 = Short cam + Marker 2 = Cam 3 = Long cam to zero + Marker
B	F41	VMAN Manual mode velocity	Limits: 1 mm/mn and VMAX
C B	F42 F43	VSTOP Stopped velocity TSTOP Stop time-out	Limits: 1 mm/mn and VMAX Units: 10 ms Limits: 65535
C	F44	TW Target window	Limits: 1 µm and (XMAX-XMIN)/2
C	F45	DMAX Max. position deviation	Limits: 1 µm and XMAX-XMIN
B	F46	UMAX Speed drive level for VMAX	Units: Volts Limits: 1.00 and 9.00
B	F47 F48 F49	SERVO POSITION: . KPOS Position gain . LIMV Velocity limit . KV Feedforward factor	 Units: 1/s Limits: 1.00 and 32.00 Units: % Vmax Limits: 5 and 20 Units: Volts Limits: 0 and 100
B C	F50 * F51 *	MDMAX DMAX divert mask NDMAX DMAX divert step	Y = YES N = NO Limits: 0 and 253
B C	F52 * F53 *	MSTOP VSTOP divert mask NSTOP VSTOP divert step	Y = YES N = NO Limits: 0 and 253
B C	F54 * F55 *	MTW TW divert mask NTW TW divert step	Y = YES N = NO Limits: 0 and 253
C B C	F56 * F57 * F58 *	TSYN Synchronization time-out MSYN Synchronization divert mask NSYN Synchronization divert step	Units: 10 ms Limits: 1 and 65535 Y = YES N = NO Limits: 0 and 253
B B	F59 * F60 *	MCPUF CPUF divert mask NCPUF CPUF divert step	Y = YES N = NO Limits: 0 and 253
A	*	NBWN Nbr. of stored WN	Limits: 0 and 100

Access: A = Modify in the configuration, B = A + Modify with XBT terminal, C = B + Modify by AXM program.

* Not relevant to TSX AXM 162 module.

TSX AXM 172 / AXM 182 modules : List of Instructions

Positioning Instructions	Code	Velocity	Position or Event
Move to a target point			
Move to a position and continue	GP1	F =	X = Imm.Pos.,WNi,EXT,I Imm.Pos.,IWNi,IEXT
Move to a position and stop	GP9	F =	X = Imm.Pos.,WNi,EXT,I Imm.Pos.,IWNi,IEXT
Move on an event			
Move in + direction until an event and continue	G + 1	F =	EVENT = UI3,DI3
Move in - direction until an event and continue	G - 1	F =	EVENT = UI3,DI3
Move in + direction until an event and stop	G + 9	F =	EVENT = UI3,DI3
Move in - direction until an event and stop	G - 9	F =	EVENT = UI3,DI3
Reference set-up			
Reference set-up in positive direction	SRP+	F =	X = Immediate position
Reference set-up in negative direction	SRP-	F =	X = Immediate position
Other positioning instructions			
Velocity at target point	PV	F =	
Immediate stop	STOP		

Abbreviations

ACCE = Acceleration
CP = Current position
CNi = Internal counter
CPUF = PLC processor error
DECE = Deceleration
DI3 = Falling edge on module input In3
DMAX = Max. position deviation
EVENT = Event
EXT = External position from XBT or PLC OWxy,6 and 7
F = Velocity
I Imm.Pos. = Immediate referenced position
IEXT = Referenced external position

IT = Interrupt
IWNi = Internal referened point
N = Step Nbr., No synchronization, No IT
NAME = Name of check
NCPUF = Divert step if CPUF
NDMAX = Divert step if deviation error
NSTOP = Divert step if stop error
NSYN = Divert step if synchronization error
NTW = Divert step if target window error
OUT = Discrete outputs (R3,R2,R1 set)
PARAM = Parameter
Pos.Imm = Immediate position

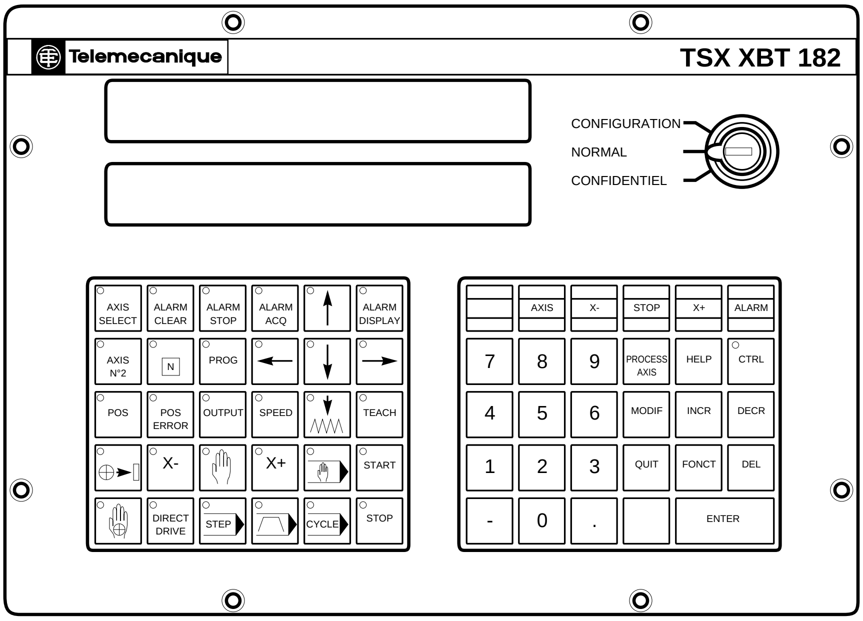
PRF = Parametered reference position
STOP = Stop check
SYN = Synchronization condition
TSTOP = Stop check time-out
TSYN = Synchronization time-out
TW = Target window
UC = PLC processor (CPU)
UI3 = Rising edge on module input In3
VAL = Value
VSTOP = Stopped velocity
WNi = Internal set point obtained by teaching
X = Position
Y = Yes

TSX AXM 172 / AXM 182 modules : List of Instructions (continued)

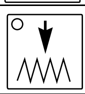
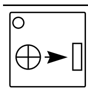
Other Instructions	Code	1st. Operand	2nd. Operand	3rd. Operand
Organization and Motion Instructions				
Unconditional jump	JMP	N = Step Nbr.		
Jump if CNi ≠ 0	JNZ	N = Step Nbr.	CNi	
Jump if immediate value = OWxy,3 LSB	JEX	N = Step Nbr.	VAL = Value	
Jump if Position 1 > Position 2	JHP	N = Step Nbr.	X1 = PRF, WNi, CP	X2 = WNi,CP,EXT
Jump if Position 1 > Immediate position	JHI	N = Step Nbr.	X1 = PRF, WNi, CP	X2 = Immediate position
Call subroutine	CALL	N = Step Nbr.		
Return from subroutine	RET			
Timer	TIME	VAL = Value X 10 ms		
Await event	WAIT	EVENT = UI3, DI3, UC		
Activate discrete outputs and synchronization	M	SYN = UI3, DI3, UC, N	OUT = Output value	IT = Y,N
No action instruction	NOP			
End AXM program	END			
Variable Control Instructions				
Load Position 2 → Position 1	LDP	X1 = PRF, WNi	X2 = WNi,CP,EXT,PRF,PImm	
Add Position 1 + Position 2 → Position 1	ADD	X1 = PRF, WNi	X2 = WNi,CP,EXT,PRF,PImm	
Subtract Position 1 - Position 2 → Position 1	SUB	X1 = PRF, WNi	X2 = WNi,CP,EXT,PRF,PImm	
Increment CNi	INC	CNi		
Decrement CNi	DEC	CNi		
Load immediate values → CNi	LDC	CNi	VAL = Value	
Modify parameters	MOD	PARAM = *	VAL = Value	
Store PRF on rising edge of IN3	MPRF			
Test Instructions				
Start a test	SCTL	DMAX,STOP,TW,SYN,CPUF		
End a test	RCTL	DMAX,STOP,TW,SYN,CPUF		

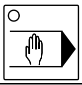
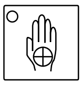
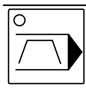
* PARAM = ACCE, DECE, DMAX, VSTOP, TW, TSYN, NDMAX, NSTOP, NTW, NSYN, TSTOP, NCPUF

F



Function keypad (left-hand keypad)

	AXIS SELECT	Axis slection, Axis/Module status display.
Errors	ALARM DISPLAY	Display errors on the selected axis.
	ALARM CLEAR	Error acknowledgment command and resume selected mode command (type 2 error).
	ALARM STOP	Error acknowledgment command and quit selected mode command (type 2 error).
	ALARM ACQ	Error acknowledgment (systematically quit) (type 1 error).
AXM Program	N	Display the currently executed instruction.
	PROG	Display an instruction, Modify operands: positions, velocity.
Display Control	↑	Display the previous function or instruction.
	↓	Display the next function or instruction.
	→	Select the next parameter or operand.
	←	Select the previous parameter or operand.
Auxiliary Functions		Velocity correction factor.
	TEACH	Teach set point (WNi).
		Forced reference set-up.

Motion Monitoring	POS	Display the actual position of the moving part and its target position.
	POS ERROR	Display the position error (deviation).
	AXIS N°2	Simultaneous position display for two axes (including the current axis).
	OUTPUT	Display/Modify the status of the auxiliary relay outputs.
	SPEED	Display actual moving part velocity and its programmed velocity.
Mode Selection		Manual control mode.
	X-	Move the moving part in the - direction (in manual or reference set-up modes).
	X+	Move the moving part in the + direction (in manual or reference set-up modes).
		Assisted manual mode.
		Manual reference set-up mode.
	DIRECT DRIVE	Direct drive mode.
	STEP	Automatic step-by-step mode.
		Automatic block-by-block (point-to-point) mode.
	CYCLE	Automatic cycle mode.
	START	Activate the selected mode.
	STOP	Deactivate the selected mode.

Service Keypad (right-hand keypad)

LEDs	AXIS	Indicates that axis control is operational Selected by the PROCESS/AXIS key.
	X^-	Move in negative direction or store the last motion if the STOP LED is lit.
	STOP	Moving part stopped.
	X^+	Move in positive direction or store the last motion if the STOP LED is lit.
	ALARM	Error detected on the current axis.

Service Keypad	PROCESS AXIS	Toggles between AXIS PROCESS modes (TSX XBT 182.2 only
	FONCT	Indirect access functions.

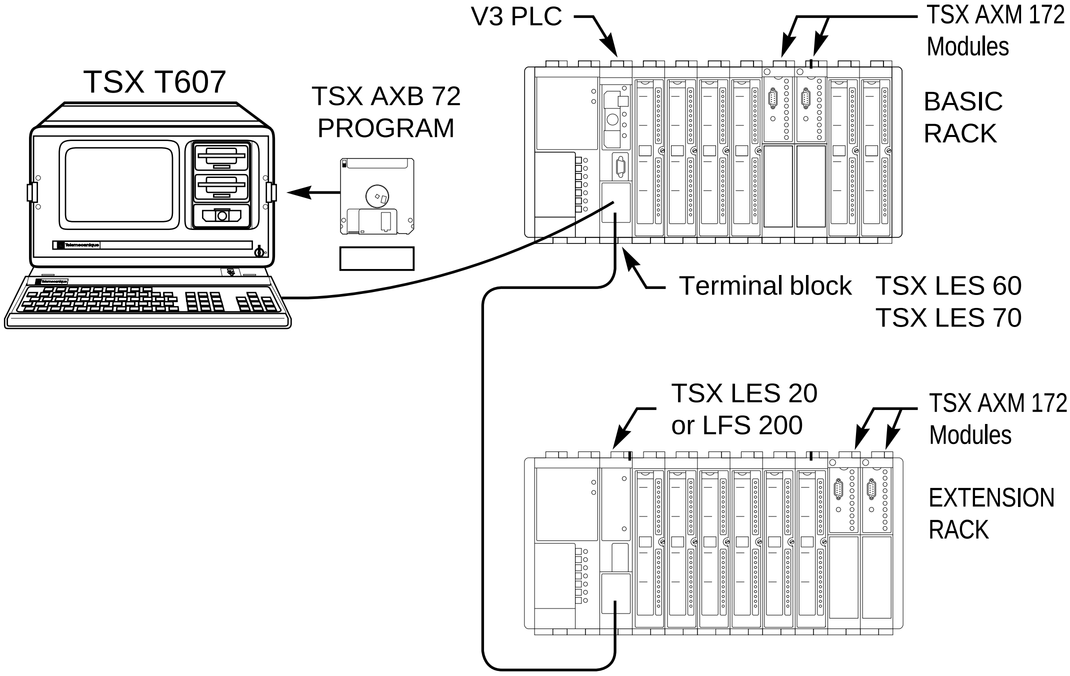
Function	Configuration Parameters	Modif.	Mnemonic
F31	Sensor resolution		RESOL
F32	Maximum velocity		VMAX
F33	User selected length unit		UPUL
F34	User selected velocity unit		UPUV
F35	User selected acceleration unit		UPUA
F36	Higher soft stop		XMAX
F37	Lower soft stop		XMIN
F38	Acceleration	X	ACCE
F39	Deceleration	X	DECE
F40	Type of reference set-up	X	TYPEPO
F41	Manual mode velocity	X	VMAN
F42	Stopped velocity	X	VSTOP
F43	Stop time-out	X	TSTOP
F44	Target window	X	TW
F45	Maximum error (deviation)	X	DMAX
F46	Speed drive voltage for VMAX	X	UMAX
F47	Position gain	X	KPOS
F48	Velocity limit	X	LIMV
F49	Velocity feedforward gain	X	KV
F50	DMAX error divert mask	X	MDMAX
F51	DMAX error divert step	X	NDMAX
F52	Stop error divert mask	X	MSTOP
F53	Stop error divert step	X	NSTOP
F54	Target window error divert mask	X	MTW
F55	Target window error divert step	X	NTW
F56	Synchronization time-out	X	TSYN
F57	Synchronization error divert mask	X	MSYN
F58	Synchronization divert step	X	NSYN
F59	CPUF error divert mask	X	MCPUF
F60	CPUF divert step	X	NCPUF

Function	List of Functions	Mnemonic
F61	Machine characteristic factor	KR
F62	Parametered referenced position	PRF
F70	AXM PLC (TSX) memory transfer	-
F71	PLC (TSX) AXM memory transfer	-
F80	Divert AXM program	DIVERT AXM
F81	External position	EXT
F82	Internal counters	CNi
F83	Status register word	-
F84	Mask/Demask IT	MSK/DMSK
F85	Select Safety On/Safety Off Mode	-
F86	Inhibit/Enable AXM outputs	OUT
F87	Emergency stop	EMG STOP
F88	Return from soft stop overrun	XMIN/XMAX
F89	PLC Synchronization	ACK CPU
F90	Application name	APPLI NAME
F91	Stored application names	
F92	Module position in the rack	-
F93	Module RUN/STOP	RUN/STOP
F94	Display axis errors	DEF.
F95	Service introduction function	-

G Upgrading from V3 to V4

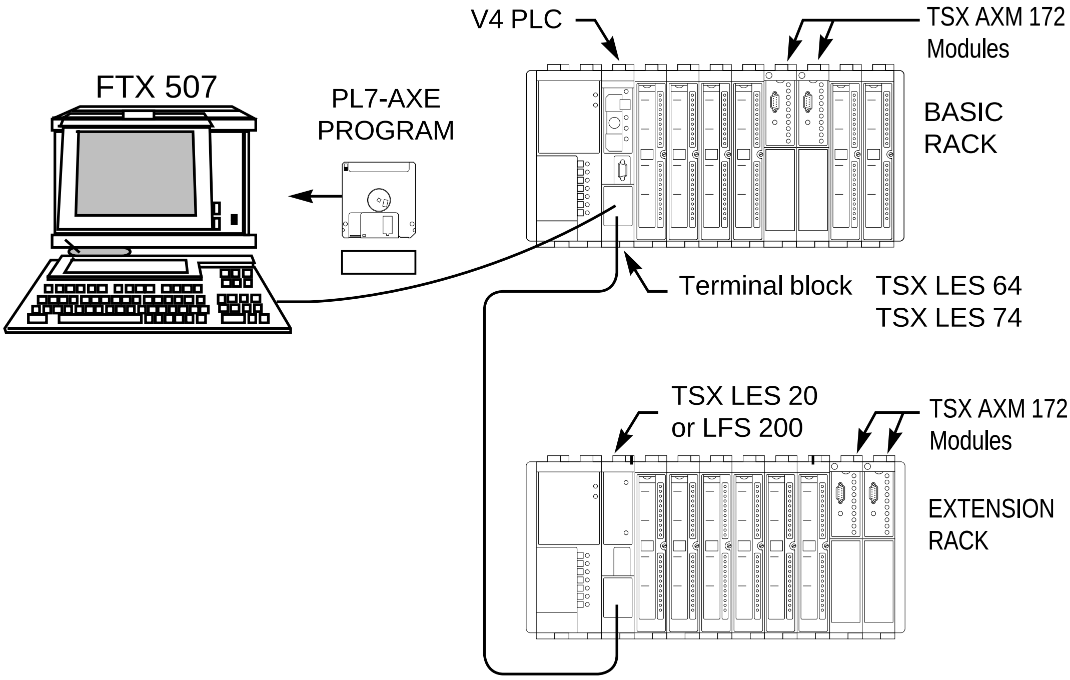
Initial situation

An installed V3 level configuration with TSX AXM 172 modules.
The axis control applications were developed using TSX AXB 72 software on a TSX T607 terminal.



Possible upgrade

The solution is an "upgrade to V4", i.e. replace the V3 level PLC with a V4 level PLC. The result is the configuration shown below.



Upgrading from V3 to V4

Performing this upgrade requires:
- Hardware modifications,
- Application update.

Note: An upgrade from V3 to V4 is possible with not limiting conditions if the V3 level PLC is a TSX 47-30 or TSX 67-20. Certain conditions apply however if the V3 level PLC is a TSX 87-30 (refer to the PL7-3 Operating Modes V4 Manual (TXT DM PL7 3 V4) Sub-section 18.6).

Upgrading from V3 to V4

Hardware upgrade

1 - Upgrades that are not specific to axis control applications

V3 Configuration	V4 Configuration
TSX T607 Terminal PL7-3 V3 Software V3 PLC TSX LES 60/70 Terminal block	FTX 507 Workstation (1) with the X-TEL Software Workshop PL7-3 V4 Software V4 PLC TSX LES 64/74 Terminal block

(1) Or IBM PS/2 or compatible microcomputer

2 - Upgrades that are specific to axis control applications

V3 Configuration	V4 Configuration
TSX AXB 72 Software (TSX XBT 172 Terminal)	TXT L PL7 AXS V4 Software (TSX XBT 182 Terminal)

Software update

1 - Updates that are not specific to axis control applications

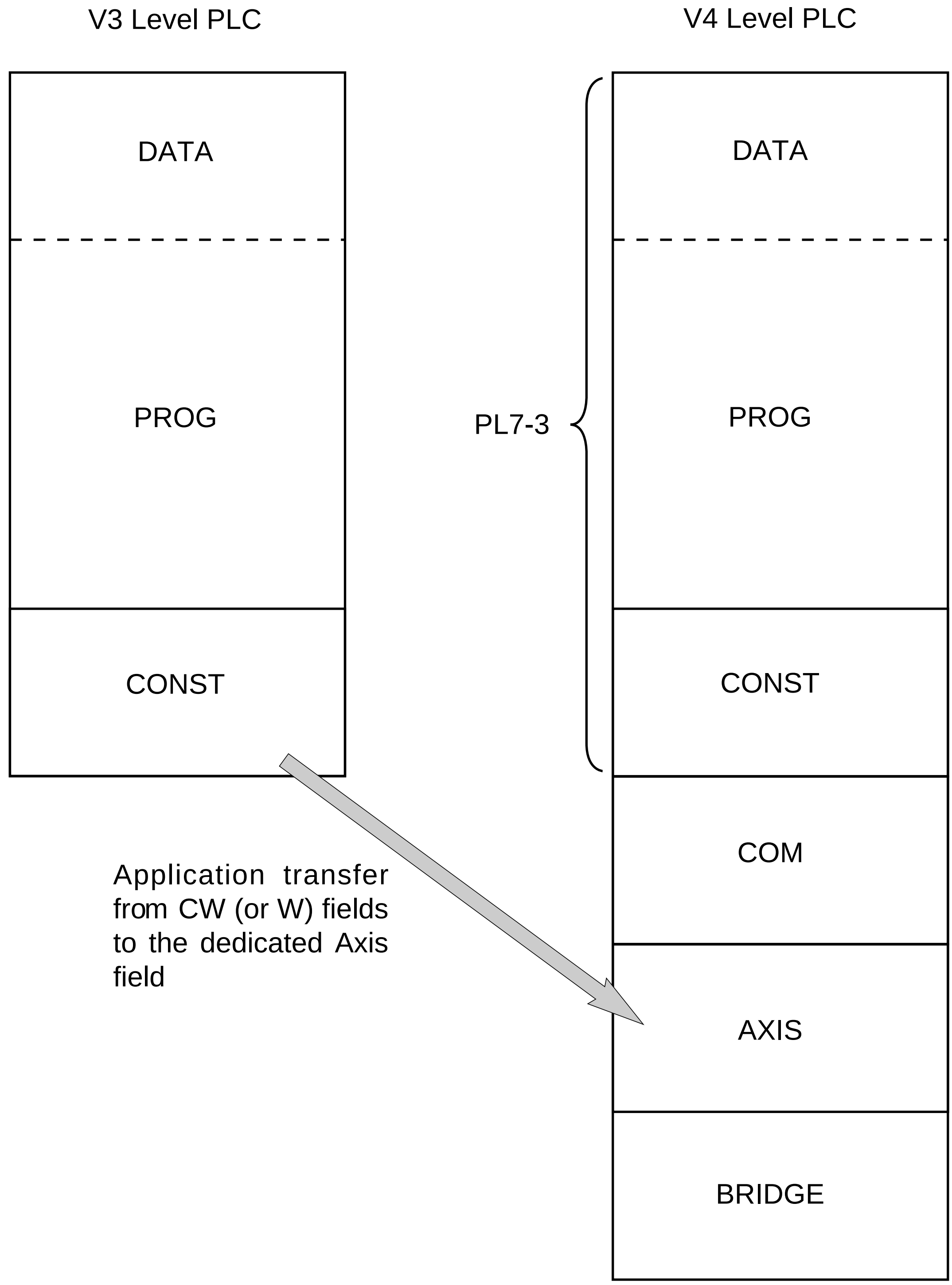
The V3 level PL7-3 application is updated to V4 level so that it can be executed by a V4 level PLC. An image of the PLC memory must also be generated (.APP file) using XTEL-MEM and this image must be transferred to the PLC memory.

2 - Updates that are specific to axis control applications

An axis control application (a complete system comprising a configuration, an AXM program and a data table) is not modified when the V3 to V4 update is performed.

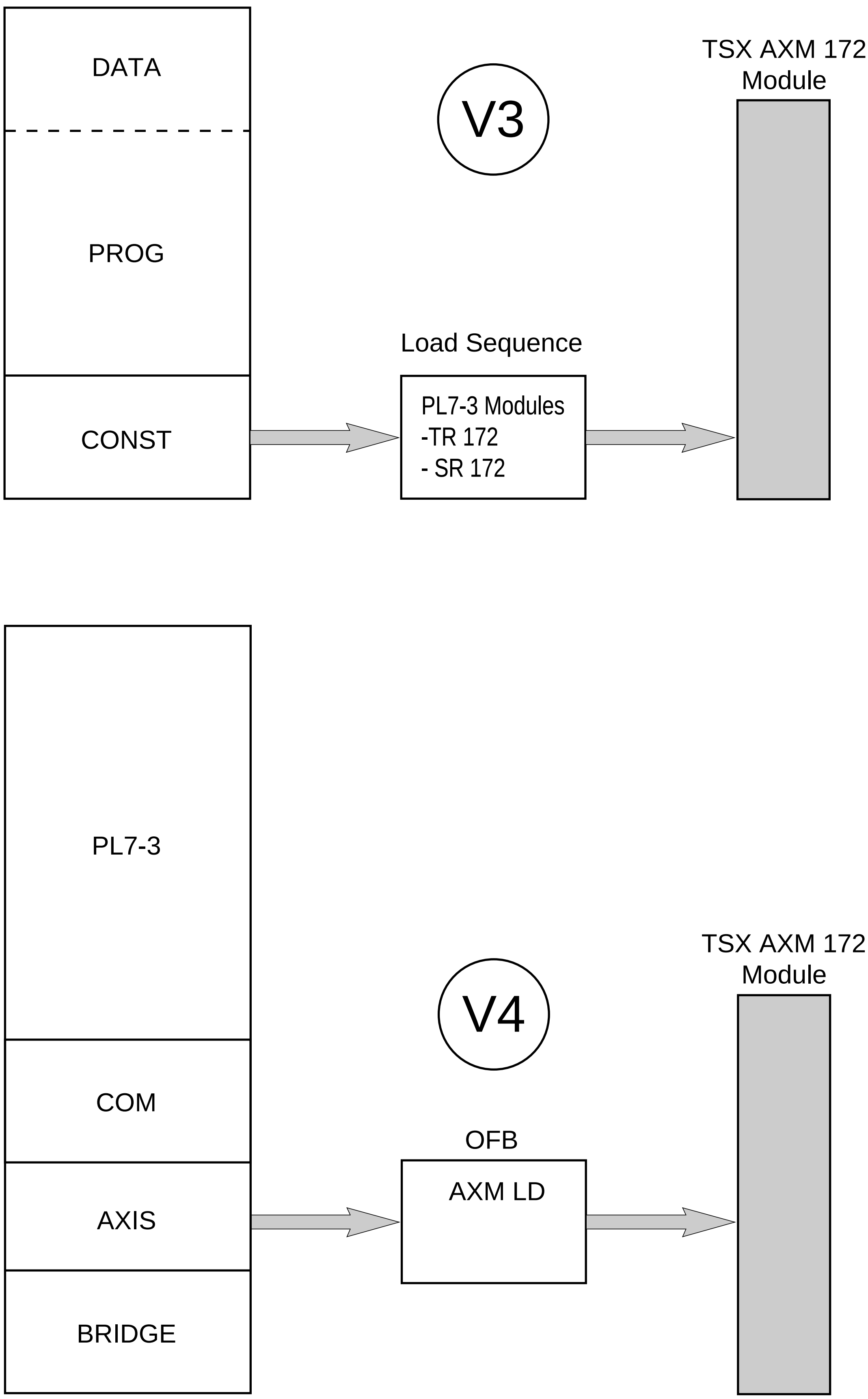
The modifications to be performed are due to the changes in the layout of the PLC memory (as shown in Fig. 3). This update results in:
• Creating the dedicated Axis field, using XTEL-MEM,
• Creating the directory, using PL7-AXE,
• Transferring applications previously stored in the CONST or PL7-3 DATA fields to the dedicated Axis field,
• Replacing the application change sequence with a call to the AXM LD OFB (as shown in Fig. 4) where this is required.

Fig 3: PLC memory layout changes and their effects



Upgrading from V3 to V4

Fig 4: Updating the application transfer procedure



Upgrading from V3 to V4

Procedure

1st. step: **Generate the PLC memory image,**
Create the dedicated axis field.
Using XTEL-MEM.
Generate an .APP file that includes a PL7-3 field that is big enough to contain the V4 level application and an Axis field that is big enough to accept the axis control applications.

2nd. step: **Updating the PL7-3 application to V4 level.**
The complete procedure is described in Section 18 of the PL7-3 Operating Modes V4 manual (TXT DM PL7-3 V4E).

3rd. step: **Transfer to the PLC memory.**
Replace the V3 level PLC processor with a V4 level PLC processor. THIS MUST ONLY BE DONE WITH THE PLC POWERED-DOWN! Then transfer the .APP program to the PLC memory.

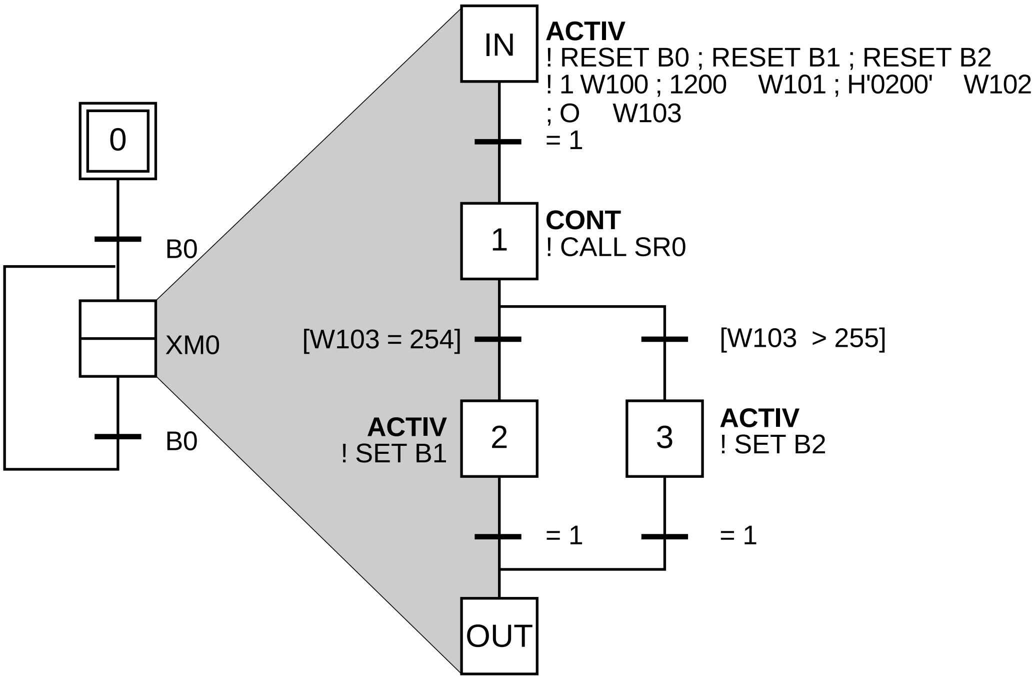
4th. step: **Creating the directory.**
With MEM TSX selected in PL7-AXE.
- DIR AXIS lets the user access the directory,
- If the numbering proposed by default is not suitable, renumber the axes and update the directory by selecting UPDATE .
- For each axis, declare the number of applications that will be stored in the PLC memory.
- Validate the directory.

5th. step: **Transferring the applications to the dedicated axis field.**
- Transfer all of the applications saved in the CW or W fields of the PLC memory to the dedicated Axis field.
  The detailed procedure, depending on various factors, is described after page 1/9 in this Section.

6th. step: **Replacing the application load sequence with a call to the AXM LD OFB.**

Reminder: This step is only required if the TSX AXM 172 modules will execute multiple applications (corresponding to different production recipes).
In this case the load sequence included on the TSX AXB 72 program diskette and comprising two programming modules TR 172 and SR 172 to transfer respectively to SR0 and SR1.
To trigger the transfer, a Grafcet sequence is required. A typical programming example is provided in the documentation.

Upgrading from V3 to V4



To activate the sequence, the program sets bit B0 to 1 and waits for B1 and/or B2 to change to 1.
W100 and W101 specify the application storage address (W 1200). W 102 specifies the location of the module in the rack (Rack 0, Slot 2 in this example).

Evolution: V4 level memory management requires the use of the AXM LD OFB that works from the logical axis number and not the physical location of the module in the rack.

The modifications described overleaf should be made from PL7-3.

Note: For clarity, a 6th. step is used for modifications to the PL7-3 program affecting the application transfer sequence. In fact these modifications can be performed immediately after updating the PL7-3 application to V4 level, i.e. during step 2.

7th. step: **Storage.**
Using PL7-AXE.

- One by one, transfer all applications from the PLC (TSX) memory to the disk (stored in the AXIS\MOD directory),

- Save the contents of the dedicated field to disk
  DIR AXIS to access commands,

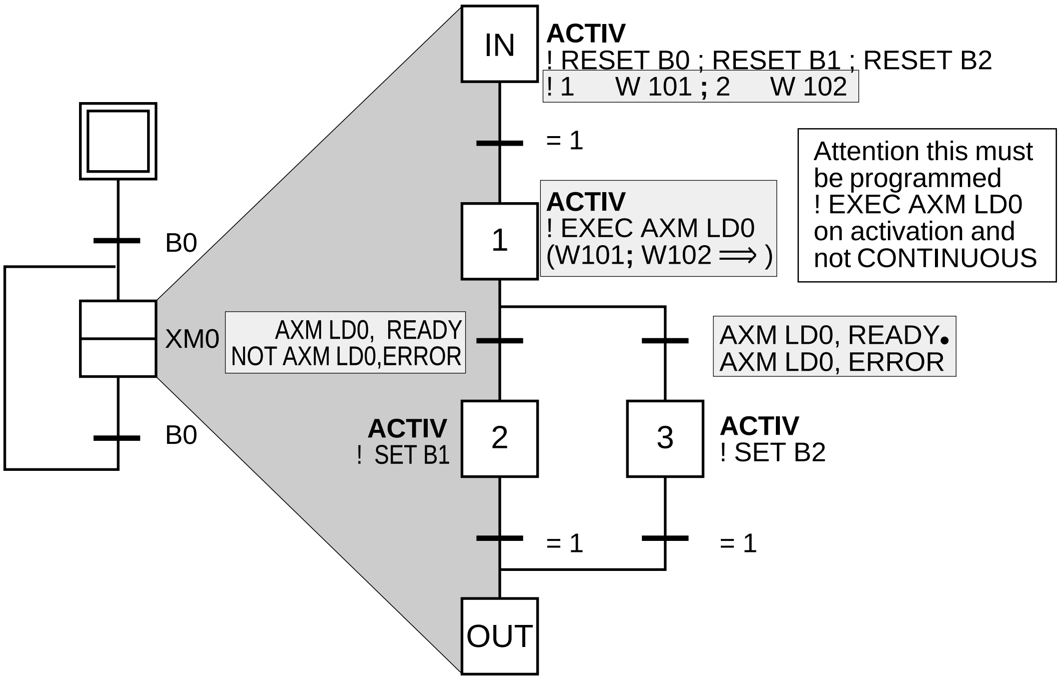
  STORE to transfer the contents of the dedicated axis field to disk (in the AXIS\APPLI field).

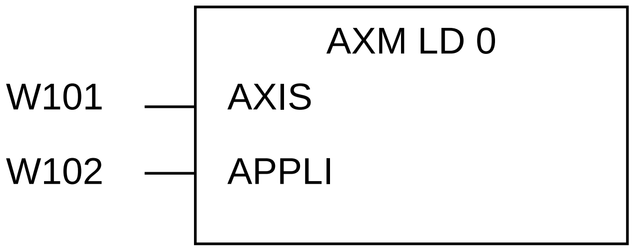
Upgrading from V3 to V4

Procedure for replacing the application load sequence with a call to the AXM LD OFB.

a) Declare the AXM LD OFB
With PL7-3 in Configuration Mode. The procedure is described in Divider C3.

b) Modify the Grafcet sequence
Assuming that the sequence corresponds to the loading of application 2 in axis 1, the simplest modification with modified parts shaded is:





Application loading is always triggered by B0 changing to 1 and when it is complete, this is indicated by B1 or B2.

c) Delete subroutines SR0 and SR1
These are no longer used by the transfer sequence so they can be deleted or recovered for other uses.

Note: The modification proposed here is the one that can be performed in the most transparent manner, requiring the least modifications.
However, this modification does not fully use all of the features of AXM LD OFB programming.
For optimal programming, especially to avoid the Grafcet sequence, refer to Divider C3, Section 2.

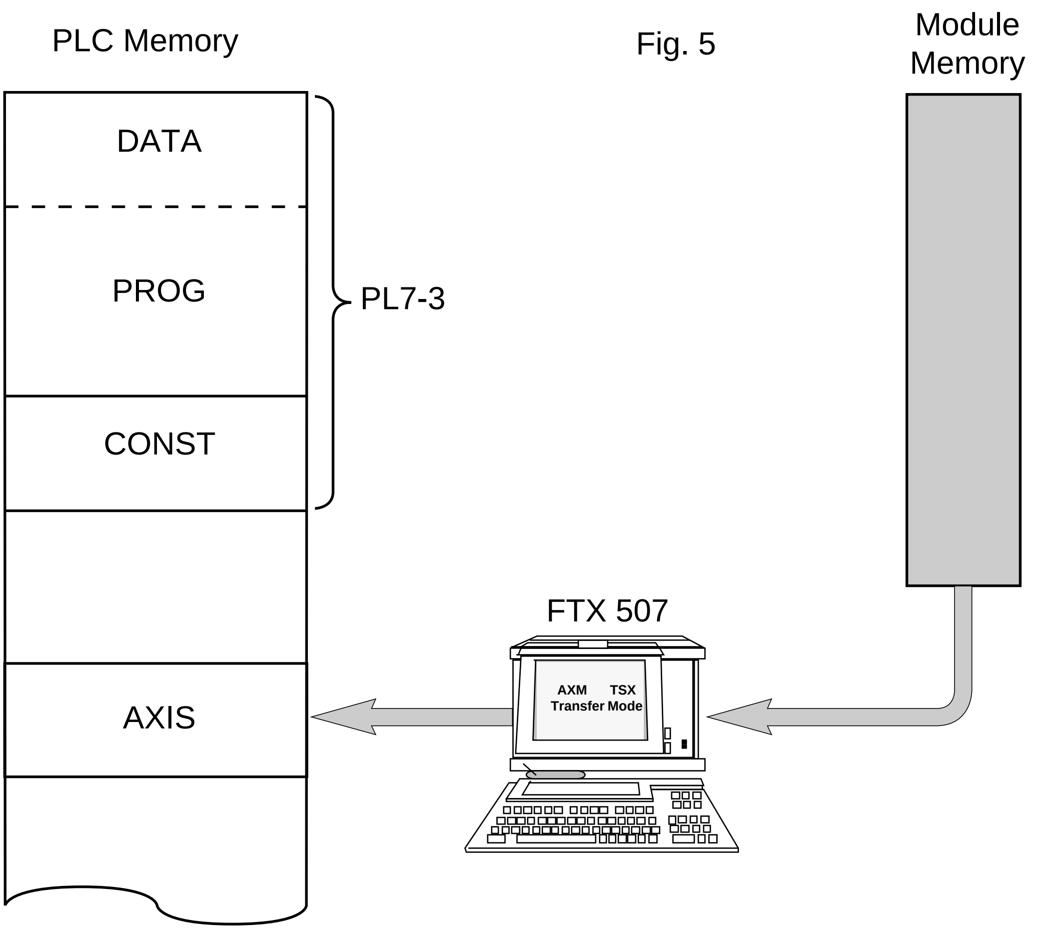
Upgrading from V3 to V4

Procedure for retrieving applications in the dedicated Axis field

1st. case: The TSX AXM 172 module(s) only executes a single application.

Therefore, there is only one application stored in the PLC memory (CW or W field) for each axis.
The transfer of applications stored in the PL7-3 (CW or W) field to the dedicated Axis field simply requires transferring the application from the module(s) to the PLC (TSX) memory using the Transfer function in PL7-AXE.

Fig. 5

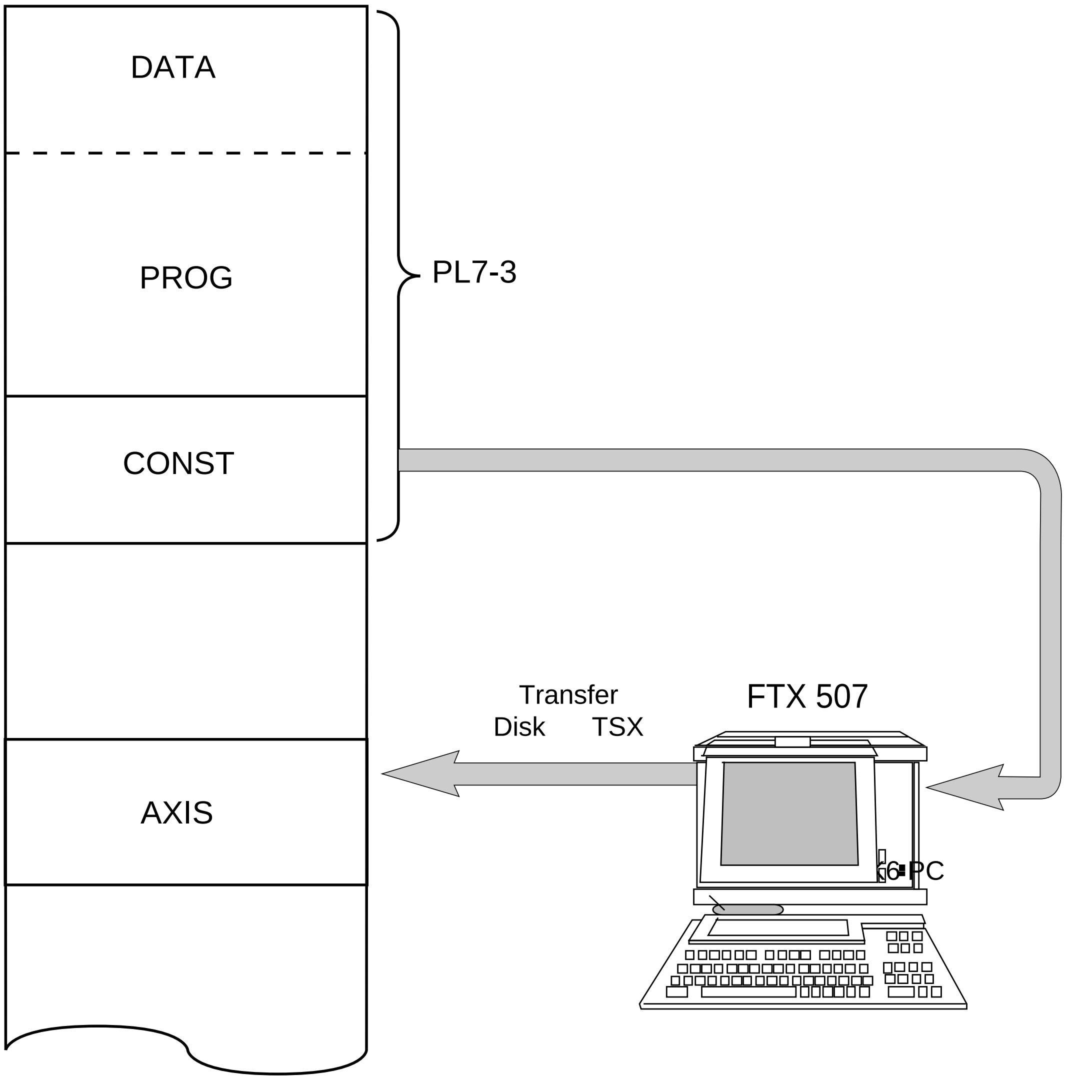


Upgrading from V3 to V4

2nd. case: **The TSX AXM 172 module(s) may execute various applications.**
There is therefore more than one application stored in the memory (CW or W field).
The transfer of applications form the PL7-3 field (CW or W) to the dedicated axis field is performed by diskette:

PLC Memory

Fig. 7



Upgrading from V3 to V4

1st. step: **TSX T607 terminal connected to a V3 level PLC.**
Using TSX AXB 72, transfer all of the applications from the PLC (TSX) memory to a diskette.

2nd. step: **FTX 507 Workstation (1) connected to a V4 level PLC.**

- Using the T607 TO PC program (under DOS), transfer the applications from the diskette to the hard disk (AXIS\MOD directory).
  (Refer to the X-TEL Software Workshop manual (TXT DM XTEL V4E).

⚠ All of the files generated by TSX AXB 72 have a .BIN extension.
When these files are transferred to the AXIS\MOD directory, the .BIN extension must be changed to .172.

- Using PL7-AXE in Transfer Mode, transfer all of the applications from the disk to the PLC (TSX) memory where they are automatically stored in the dedicated Axis field.

(1) If an IBM PS/2 or compatible is used, TSX LK6 PC software is required to copy the applications from diskette to hard disk. The .BIN extension must still be changed to .172.