Module and Application Description

PROCONTROL P

Input, Output, Signal Conditioning

Input Module for Resistance Thermometers, 4–fold

81EW01–E/R2010/R2111 /R2212/R2310 /R2313/R2414

Publication No.
D KW 4303 89 E, edition 09/90
Replacing GKWE 705 154 E, edition 06/88

Application

The input module is used to connect resistance thermometers PT 100, PT 100x, PT 50, CU 100, CU 50, GR 21 and GR 23.

The module incorporates four function units. Each input circuit is monitored individually. Up to four limit signals may be formed for each measured value.

The module is available in 6 different hardware versions:

81EW01–E/R2010 – for connecting
resistance thermometers PT 100
to DIN 43760
Measuring ranges 0...150 °C
0...300 °C
0...600 °C

81EW01–E/R2111 – for connecting
resistance thermometers GR 21
Measuring ranges 0...150 °C
0...300 °C
0...600 °C

81EW01–E/R2212 – for connecting
resistance thermometers GR 23
Measuring range 0...150 °C

81EW01–E/R2310 – for connecting
resistance thermometers PT 100
to DIN 43760
Measuring ranges 0...150 °C
0...300 °C
0...600 °C

81EW01–E/R2313 – for connecting
resistance thermometers PT 100x
to DIN 43760
Measuring ranges 0...150 °C
0...300 °C
0...600 °C

and for connecting
resistance thermometers CU 100
Measuring range 0...150 °C

81EW01–E/R2414 – for connecting
resistance thermometers PT 50
Measuring ranges 0...150 °C
0...300 °C
0...600 °C

and for connecting
resistance thermometers CU 50
Measuring range 0...150 °C

Features

The module may be plugged into any multi–purpose processing station of the PROCONTROL bus systems. It includes a standard interface with the PROCONTROL station bus.

The module transmits the converted input signals in the form of telegrams via the station bus to the PROCONTROL bus system. The telegrams are monitored prior to transmission and provided with parity bits. This ensures the monitoring of error–free transmission for the receiving module.

The input circuits are supplied separately by voltage transformers and are thus potential–free with respect to each other. The input signals are carried to the processing section in isolated mode. This ensures non–interaction between the process section and the bus section.

Any response of the input signal monitor is indicated as a disturbance signal (ST) on the front side of the module.

The measuring range for each function unit is set by means of switches on the module.

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Signal conditioning and monitoring

The first function unit is described below. The others operate in the same way.

Signal input

The resistance thermometer is supplied by the input module with a constant current of 2.1 mA via terminals IK11 (+) and IK 12. The voltage across the resistance thermometer is fed to a differential amplifier via inputs U11 (+) and U12. The gain and, hence, the measuring range is set by means of two switches.

The transmitter can be connected in two–wire or four–wire arrangement (see “Connection diagrams”).

In the case of two–wire arrangement, supply and measuring lines are not separated. The line resistance is included as a measuring error according to the following equation:

$$Rtot = Rxx + \frac{2L}{Kappa \cdot Ø}$$

where L = Line length, single
Kappa = Specific conductance of the line
Ø = Cross section in mm^2
xx = Resistance thermometer

The output signal of the differential amplifier is fed to the frequency/digital converter via a voltage/frequency conversion and a potential isolation facility. This forms a 13 bit data word (12 bits + sign), which is sent from the processing section to the PROCONTROL bus system as a data telegram.

To ensure proper evaluation of the measured value the processing section is informed of the set measuring range in coded form. This is also done by means of switches.

Effect of interference voltages

Interference voltages on the input lines are suppressed by module–internal protective circuits.

Input signal monitoring

The digitized input signal is monitored for plausibility within permanently set limits. The monitor responds if the input signal exceeds 150 % of the set measuring range or falls below –18.75 %.

Monitoring is performed in the processing section by the microprocessor. If the monitor responds, the red light–emitting diode for disturbance annunciation ST at the front of the module emits a steady light. The disturbed measured value is transferred, however, together with a set disturbance bit.

An open circuit in the line to the resistance thermometer is recognized by the input signal monitor as a disturbance.

In order to prevent disturbance annunciations from unused function units, the input signal monitor for these function units can be blocked. Four contacts of switch S3 are used therefor (see “Operating modes”).

Linearization

The digitized input signal is linearized in the processing section by the microprocessor. For this purpose a PROM (programmable read–only memory) is provided which contains the characteristic curve of the resistance thermometer. The measured value sent to the station bus always corresponds to the measured temperature.

Formation of limit signals

Four limit signals can be generated on the module for each measured value. For each individual limit value four different hysteresis values can be selected.

The limit signals are formed in the processing section by the microprocessor.

Limit values and the corresponding hysteresis values are written to specified memory areas of the user–PROM as a limit value list (see “Data communication...”).

A duplicate of the limit value list is also filed in a RAM on the module for the purpose of making on–line changes to these values.

A change of a limit signal is signalled as an “Event” to the station bus.

When the input signal monitor responds, all the limit signals (GOXX, GUXX) allocated to the measured value are set to “0” and the disturbance bits (MXX, SMX) are set to “1” (see Table 1).

After power on, the limit signals are passed on to the station–bus with a delay.

The range for the limit values is 0 % – 110 % of the set measuring range.

Formation of event

The input module is normally requested cyclically by the PROCONTROL bus system to transfer its measured values. If the values change within the cycle time, this is treated as an “Event”. The input module recognizes the following occurrences as an event:

– Change of a limit signal
– Response of the input signal monitor
– Change of a measured value by an adjustable value within an adjustable time since the last transfer to the station bus (see “Operating modes”).

If an event occurs, the new values are transferred with priority to the PROCONTROL bus system.

Signal output

The module transfers the data telegrams to the station bus via its standard interface. Data transfer takes place serially. Therefore, the processing section performs a parallel/serial conversion of the data.

Designation of the signals

The conditioned and digitized input signals and the limit signals formed in the module are written to specified registers (see “Data communication ...”). The processing section writes the following information into the address section of the data telegram:

- System address (possible 0 ... 3)
- Station address (possible 1 ... 249)
- Module address (possible 1 ... 58)
- Register address (possible 0 ... 7)
  for signals
  Register address 246
  for diagnosis data)

Thus each signal is clearly designated.

Operating modes

The input module incorporates several switches with which the various operating modes can be set.

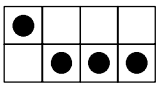
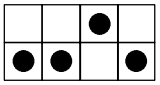
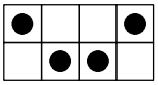
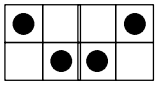
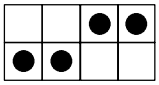
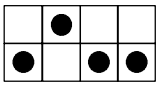
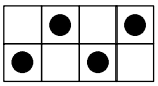
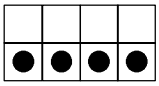
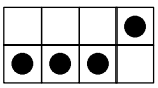
The position and the designation of the switches on the module are shown under “Mechanical design”.

Measuring range

The module operates within a range of −50 % ... +150 % of the set measuring range. The measured values, too, are transmitted in this range. But below −18.75 % and above 150 % the monitor responds unless it is disabled (see ”Input signal monitoring”).

With contacts 1 to 4 of the switches S101 (function unit 1) to S401 (function unit 4) the measuring ranges for each function unit can be set according to the following table in the analog section.

Measuring range 3 goes up to 600 °C (= 100 %). But as the device operates up to 150 %, temperatures up to 900 °C can be measured.

		Resistance thermometers and module version				
		PT100, PT100x R2010, R2310 R2313	CU100 R2313	GR21, PT50 R2111, R2414	GR23 R2212	CU 50 R2314
Measuring range						
0...150 °C		:1 :2 :3 :4	:1 :2 :3 :4	:1 :2 :3 :4	:1 :2 :3 :4	:1 :2 :3 :4
S101 S201 S301 S401	ON					
	**	:1 :2	:1 :2	:1 :2	:1 :2	:1 :2
S2	ON					
0...300 °C		:1 :2 :3 :4		:1 :2 :3 :4		
S101 S201 S301 S401	ON					
	**	:1 :2		:1 :2		
S2	ON					
0...600 °C		:1 :2 :3 :4		:1 :2 :3 :4		
S101 S201 S301 S401	ON					
	**	:1 :2		:1 :2		
S2	ON					

** Contact designation of the switch S2 is valid for function unit 1
Contact designation for function unit 2 = 3 4
Contact designation for function unit 3 = 5 6
Contact designation for function unit 4 = 7 8

Input signal monitoring

In order to prevent disturbance annunciations from unused function units, or in the case of an intended range limit violation, the input signal monitor can be blocked with contacts 1 to 4 of switch 3.

Monitoring	Function Unit		1	2	3	4
		S3	:1	:2	:3	:4
blocked		ON	●	●	●	●
effective	*	ON				
			●	●	●	●

*= Settings as delivered

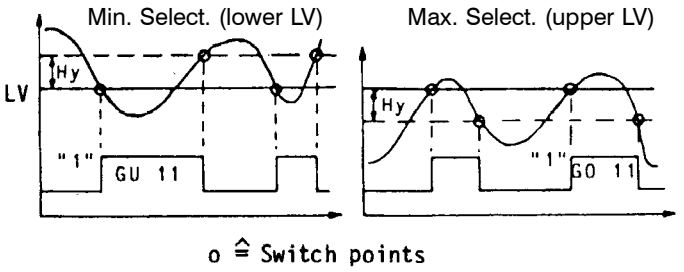
Formation of limit signals

Four independent limit signals can be formed for each function unit. One of the following four hysteresis values can be allocated to each limit value:

HY1 = 0.39 %
HY2 = 1.56 % (Standard setting)
HY3 = 3.12 %
HY4 = 6.25 %

Limit value and hysteresis are written to a user PROM by programming. No switches are provided on the module for this purpose.

The hysteresis can be above or below the limit value, depending on whether a violation of the minimum or maximum value was selected.



o ≙ Switch points

Important

Even if no limit values are required, the (blank) PROM *must* be plugged in for operation. Otherwise, the module will not operate correctly.

These values are also available as duplicates in a RAM. The microprocessor always works with the RAM values. It is thus possible to change the values via the control system operator station or the programming, diagnostic and display system (PDDS). The RAM values are lost in the event of a power failure. When the module is supplied with power again, the original PROM values are transferred to the RAM, and the microprocessor can work with them. Subsequent updating of the values is then readily possible via the above–mentioned units.

Event generation for the analog signals

In addition to direct event generation by a change in a limit signal or by response of the input signal monitor, an event can also be generated by a change in an analog value.

The processing section monitors the measured value for changes which exceed the permissible set percentage in relation to the last value transferred to the station bus. This value can be specified as a threshold value in percent for each function unit within a range of 0.2 % via the control system operator station. If no threshold value is programmed by the user, the module is automatically set internally to a value of 0.8 %.

A change in the analog value by more than the specified or automatically selected threshold value generates an event only if a set period of time has elapsed since the last transfer to the station bus.

Two time periods can be set for each function unit via contacts 1 to 4 of switch S1.

Set Time	Function Unit		1	2	3	4
		S1	:1	:2	:3	:4
200 ms		ON	●	●	●	●
1000 ms*		ON				
			●	●	●	●

* = Setting as delivered

Diagnosis

The processing section of the module continuously monitors the input signals, the processing and the generation of data telegrams (self–diagnosis).

In the event of a disturbance, the type of disturbance is filed in the diagnosis register (see “Data communication...”) and a disturbance annunciation is sent simultaneously to the PROCONTROL bus system. The diagnosis register is then read out from the control system operator station for evaluation.

It is also possible to scan the current status of the module at any time from the control system operator station (remote diagnosis).

Data communication with the module

Formation of addresses

The system and station addresses are the same for all modules in a multi–purpose processing station. They are set on the modules jointly and automatically via the station–bus control module.

The module address is set automatically by plugging the module into the slot provided within the multi–purpose processing station.

The data words of the analog input signals and the diagnosis results are written to specific registers in the shared memory.

The number of the register is at the same time the register address. A register is permanently allocated to each data word. This takes place automatically by connecting a process signal to the process connector of the module.

Reading out data

Address information is necessary to read out the register contents. Table 1 below shows this address information and the contents of the relevant register. The addresses identified by ’a’ can be freely selected and are based on the place of installation of the modules.

Type of Information	Address Word				Data Word (Bit Address)															DA
	System	Station	Module	Register	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Analog Value FE1	a	a	a	0	VZ	100 %	50 %	25 %	12.5 %	6.25 %	3.125 %	1.56 %	0.78 %	0.39 %	0.195 %	0.097 %	0,048 %	MB1		SM 1	6
						MW1															
Binary values (from 4 limit values) to FE1	a	a	a	1				GO 14	GU 14	M 14	GO 13	GU 13	M 13	GO 12	GU 12	M 12	GO 11	GU 11	M 11	SM 1	3
Analog Value FE4	a	a	a	6	VZ	MW4												MB4		SM4	6
Binary values to FE4	a	a	a	7				GO 44	GU 44	M 44	. . .						GO 41	GU 41	M 41	SM 4	3
Diagnosis Register	a	a	a	246	Processing and Process Disturbed			Bus Adaption Disturbed			Reception Disturbed			Transmission Disturbed							0

Table 1 with bit significance (applies to all analog value telegrams)

Explanation:

SMX = General disturbance single telegram
MXX = Limit value X single telegram
FEX = Function unit X
VZ = Sign
a = Address freely selectable (according to place of installation)
GOXX = Upper limit value X violated
GUXX = Lower limit value X violated
MBX = Measuring range
MWX = Digital measured value
DA = Type of data

Note:

In the case of unprogrammed limit values for each function unit, the associated bits MXX, GUXX and GOXX in the limit value telegram are always set to “0”.

Annunciation functions

Disturbance annunciations on the module

A red light–emitting diode ST is provided at the front of the module. It emits a steady light if disturbances occur in the module or if the monitor for a function unit responds.

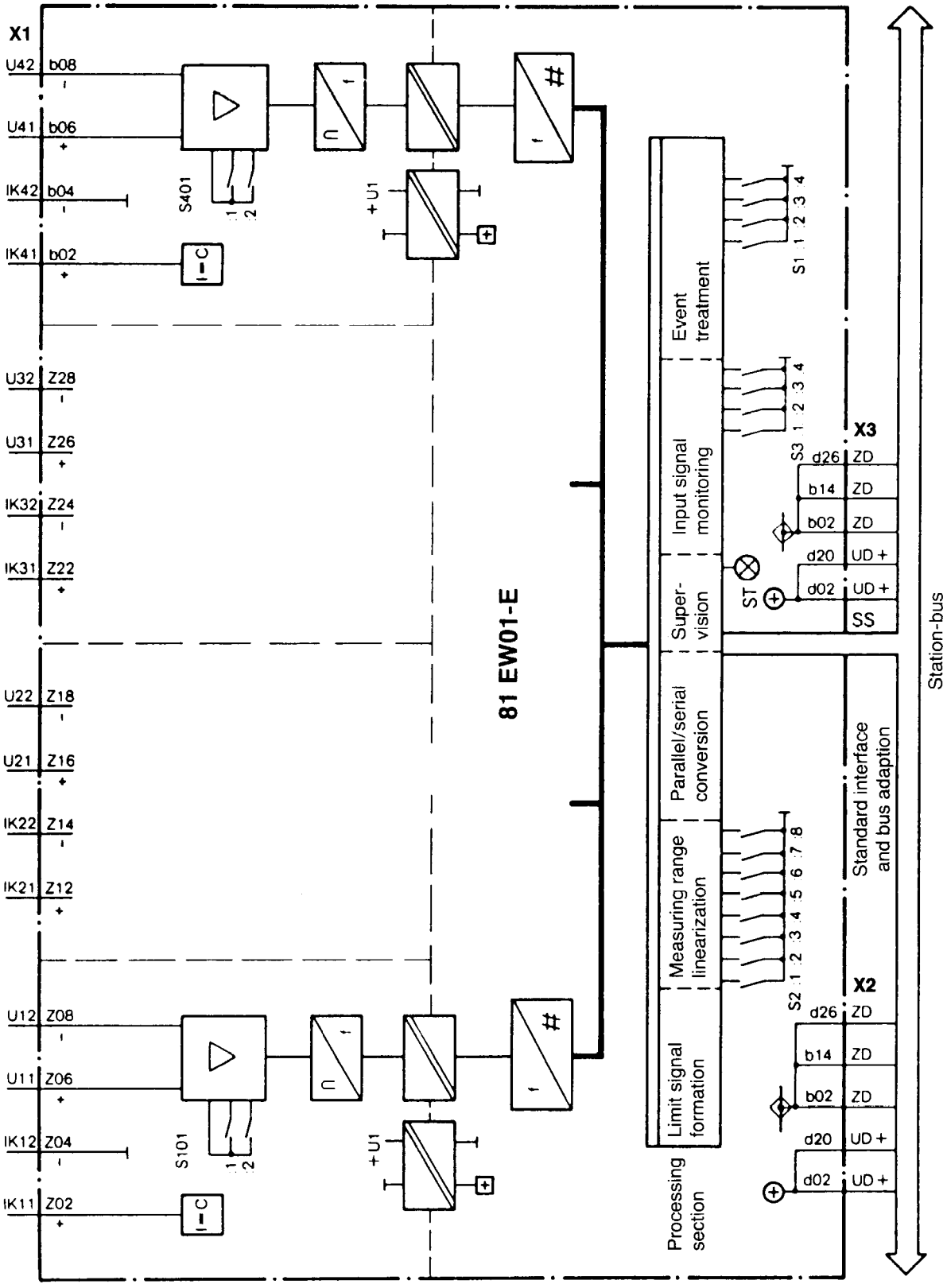
Annunciation functions to the station bus

Events or disturbances are recognized by the processing section. Events are signalled immediately. Disturbances are stored. The signal “General disturbance station” is sent simultaneously. The diagnosis register is then read out from the control system operator station for evaluation.

Functional diagram

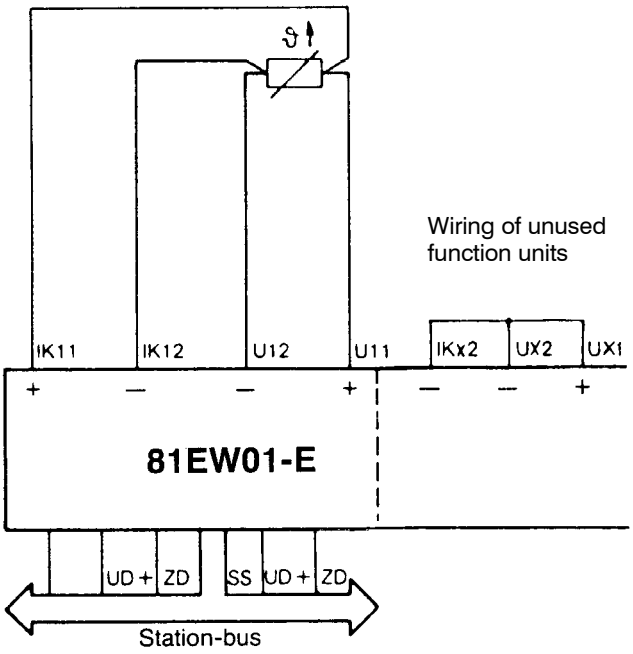
Terminal designations: The module consists of two printed circuit boards (see “Mechanical design”). The input PCB is equipped with connectors X1 and X2. Connector X1 contains all process inputs.

Connector X2 contains all voltages for this PCB. The processing circuit board is equipped with connector X3. It incorporates the standard interface to the station bus and the operating voltages for this printed circuit board.

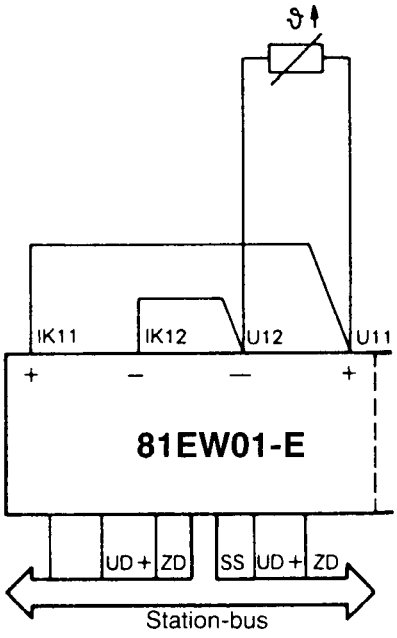


Connection diagrams

Four–wire arrangement



Two–wire arrangement



Unused function units must be bridged on connector X1 in accordance with the above connection diagram (left–hand diagram). The following applies here: X = 1...4, correspon–ding to the four function units of the module.

Mechanical design

Board size: 6 units, 2 divisions, 160 mm deep

Connector: to DIN 41 612

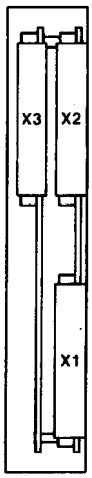
2 x for station–bus connection,
48–pole, edge–connector type F
(connectors X2, X3)

1 x for process connection,
32–pole, edge–connector type F
(connector X1)

Weight: approx. 0.79 kg

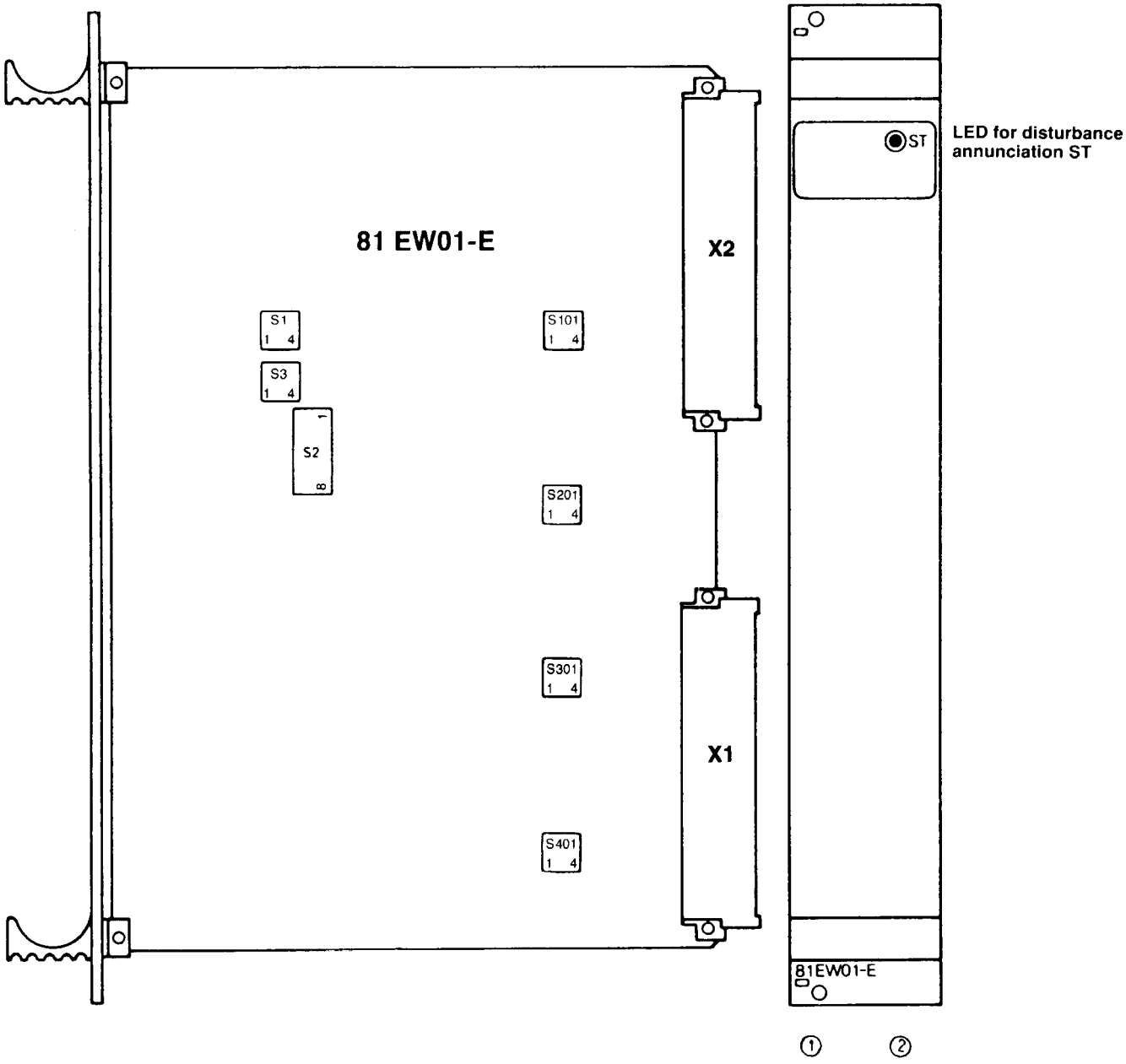
Both printed circuit boards are connected with each other me-chanically and electrically.

View of connector side:



Position of the switches on printed circuit board 1 and front panel

Mounting locations 1101/1102 ... 1401/1402 are equipped as required for calibrating the module in the factory and may be ignored by the user when the module is used.

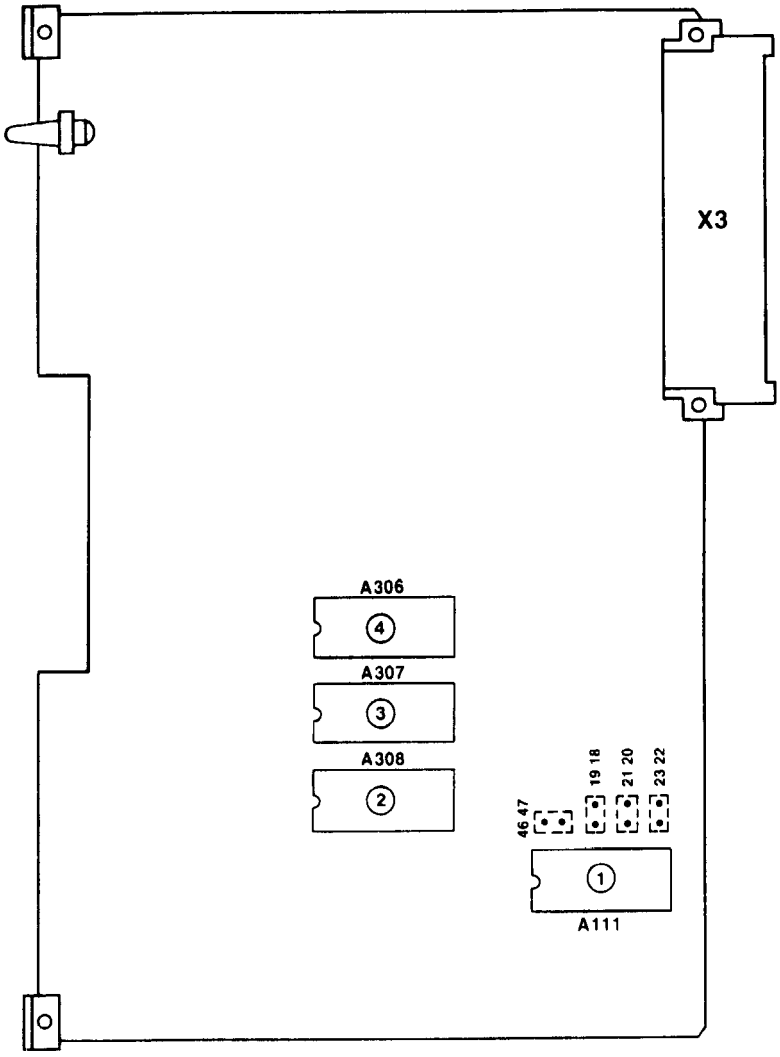


Explanation:

① = Input printed circuit board

② = Processing printed circuit board

Position of the plug–in memory modules and plug–in jumpers on the processing pcb



Memory modules:		Order–number: (Component)	Order–number: (PROM programmed)
① = Limit–value RAM	A111	HETN400765P1(6116)	Jumpers 18–19, 20–21
② = Bus and module program,	A308 (EPROM)	GJT110034P1 (2732A)	GJR2350701Pxxxx
③ = Bus and module program,	A307 (EPROM)	GJT110034P1 (2732A)	GJR2350702Pxxxx (for R2010) GJR2350703Pxxxx (for R2111) GJR2350704Pxxxx (for R2212) GJR2350702Pxxxx (for R2310) GJR2350705Pxxxx (for R2313) GJR2350706Pxxxx (for R2314)
④ = Limit value EPROM	A306	GJT110034P1 (2732A)	

Note:

The mounting position of the components is marked by an imprint on the printed circuit board.

xxxx = Position numbers corresponding to the appropriate revision status.

Technical data

In addition to the system data the following values apply:

Power supply

Operating voltage BUS section	UD+ = +5 V
Current consumption	I_D = 1.2 A
Power dissipation, typ.	P_v = 6 W
Reference potential BUS section	ZD = 0 V

Input values

U11/U12	– Transmitter voltage	> 0 mV ... 750 mV
to	Input resistance	≥ 10 megaohms
U41/U42	Common–mode rejection signals	120 dB
	Series–mode rejection at 50 Hz	60 dB

Output values

IK11/IK12	– Constant current for transmitter	2.1 mA
to	Load resistance	max. 360 ohms
IK41/IK42		

SS – Standard interface to the station bus

Error specification

Errors on delivery	< 0.1 %
Error of quantization	< 0.025 %
Linearity error	< 0.1 %
Effect of temperature (typ. < 50 ppm/K)	< 200 ppm/K
Effect of supply voltage variations	none
Error due to digital linearization	< +/–0.05 %
Common–mode rejection	> 120 dB
Series–mode rejection	> 55 dB
Aging 1st year	< 0.2 %
Total error incl. aging for all measuring ranges	< 1 %

ORDERING DATA

1. Complete module:

Type designation:	81EW01–E/R2010	Order number: GJR2341800R2010
	81EW01–E/R2111	GJR2371900R2111
	81EW01–E/R2212	GJR2371900R2212
	81EW01–E/R2310	GJR2371900R2310
	81EW01–E/R2313	GJR2371900R2313
	81EW01–E/R2414	GJR2371900R2414

2. Memory modules: see “Mechanical design”

Technical data subject to change without notice!

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