Module and Application Description

PROCONTROL P

Input, Output
Signal Conditioning

Input Module for Analog Signals Independent of Potential

16−fold, 0/4...20 mA, 0...5 mA, 0...50 mA

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81EA04−E/R1210

Application

This input module is used for current signal input throughout the signal ranges of 0 ... 5 mA, 0 ... 20 mA, 4 ... 20 mA or 0 ... 50 mA, independent of the potential.

The process part of the module is electrically isolated against the processing section and against the USA, USB, and Z potentials.

The input channels are formed by high−resistance instrument amplifiers and are mutually isolated by an impedance of 400 kΩ. This allows input of current signals on different potential levels.

The module allows for a maximum of four independent correcting or filtering calculations using structurable function blocks.

The correcting variable as well as the two auxiliary correcting variables can be specified for each function block either from the function units or alternatively via the bus.

Output of the corrected values always is via the bus. In addition to the corrected values, the limit signals of analog signals and status messages from function blocks are put out to the bus system.

Features

This module can be plugged into any station belonging to the PROCONTROL bus system. It is equipped with a standard interface for the PROCONTROL station bus.

It transmits the converted input signals in the form of telegrams via the station bus to the PROCONTROL bus system. The telegrams are monitored before being sent and are given parity bits. This way, checking for fault−free transmission on the receiver side is ensured.

The telegrams received via the station bus are checked by the module on the basis of their parity bits for fault−free transmission.

The individual function units are mutually non−interfering as well as non−interfering with the processing section (station bus).

For each function unit, one of the four signal ranges 0 ... 20 mA, 4 ... 20 mA, 0 ... 5 mA or 0 ... 50 mA can be selected.

Activation of internal monitoring circuits or input signal monitoring circuits is indicated as disturbance annunciation ST (general disturbance signal) on the module front.

Activation of internal monitoring circuits is also indicated as disturbance annunciation SG (module disturbance) on the module front.

Disturbance voltages on the input lines are suppressed by means of protective circuits inside the module.

Signal conditioning and monitoring

In the following, the first function unit is described. The other function units operate accordingly.

Signal input

Signal input is via inputs E011 and E012. The input current is converted into a measuring voltage using a 50 Ohm measuring resistor in the input circuit. The 16 measuring circuits are connected to the analog multiplexers by the isolating amplifier independent of the potential (200 V common−mode range). The converted input signal is transmitted through the analog multiplexer to an input amplifier which is provided once for all 16 function units.

An analog/digital converter converts the input signal into a 12−bit data word (a 10−bit data word in the range of 0 ... 5 mA).

The individually, for each function unit selectable signal range is indicated in the configuration list. Entries into the configuration list are made via the PDDS.

Measuring amplifier and analog/digital converter are monitored by means of reference voltages.

The digital input signal is connected through to the processing section as a non−interfering signal. The processing section processes the input signal , calculates the sign, and files the data word in the shared memory. Upon request, the module will send the data word to the PROCONTROL bus system in the form of a telegram.

Input signal monitoring

The digitized input signal is monitored for plausibility. The monitoring function responds as soon as the input signal exceeds the upper (OG) or lower limit (UG).

The limit values can be specified in the configuration list. Standard setting for these limits are 118 % and −6.25 %.

If the monitoring circuit responds, the red disturbance annunciation lamp ST on the module front will show a steady light. In the diagnosis register, the bit for "process channel fault" is set. The disturbed measured value will be transmitted together with a fault flag.

The input signal monitoring can be suppressed individually for each measuring circuit. This is done by entering the respective maximum limits (−200 %, +199,9 %) into the configuration list. The entry is made from the PDDS.

Event generation

Under normal operating conditions, the input module is cyclically asked by the PROCONTROL bus system to send its measured values. If values change within the given cycle time, this change will be treated as an "event".

As soon as an event occurs, the new values will be given priority and are transmitted to the PROCONTROL bus system.

Event triggering for limit signals

In case upper or lower limit values are violated, the change of the limit signals will cause an event message.

Likewise, response of the input signal monitoring will cause an event message to be generated.

Event triggering for analog signals

The processing section monitors the measured value for changes by more than a selectable value (threshold) since the last data transmission to the station bus took place. This threshold can be specified within 0.2 ... 6.8 % (standard setting is 1.56 %) in increments of approx. 0.2 %.

In case the processing section identifies a measured value change by a value greater than the threshold specified, this will effect an event message only if a settable time (time−out) of 40 msec or 200 msec (standard setting) has expired after the last event transmission to the station bus took place.

The appropriate entries into the configuration list are made from the PDDS.

Limit signal generation

For each function unit, four independent limit signals can be programmed. Each of these limit values can be assigned one of the four hysteresis values below:

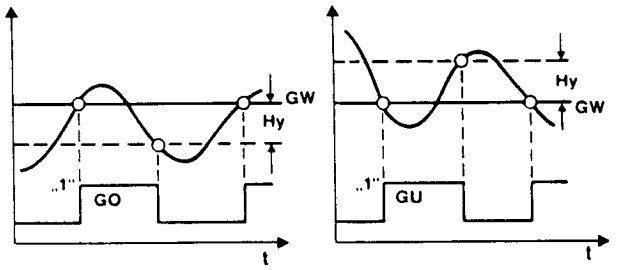
HY1 = 0.39 %

HY2 = 1.56 % (standard setting)

HY3 = 3.12 %

HY4 = 6.25 %

The hysteresis may be above or below the limit value depending on whether minimum−value or maximum−value violation has been preselected (see Figure 1).



Upper limit value

GO:
upper limit value exceeded

Lower limit value

GU:
lower limit value exceeded

Figure 1: Possible settings for limit values

Limit signal formation is done in the processing section. Limit values and the corresponding hysteresis values are stored as a limit value list in a fail−safe EEPROM.

There may be an additional limit value list in the RAM memory. Processing will use that list appropriate to the operating mode preselected by the PDDS (change−over EEPROM <−> RAM).

In the event of supply voltage failure, the RAM values are lost. After voltage supply is restored, processing will continue using the EEPROM limit−value list.

A limit signal change is indicated to the station bus as an "event".

In case input signal monitoring has responded, all limit signals assigned to the measured value are set to "0" and all related disturbance signals are set to "1".

The limit value range is within −150 % ... +150 % of the signal range selected.

In case correcting functions are used, possible limit signals are always derived from the corrected analog value.

Correcting calculation

Structuring

For pressure and temperature correction, the correction of flow rate and level measurements, as well as for filtering measured values, the module uses a number of stored function blocks.

The following function blocks are available:

− Correcting function for flow rate with water/steam	KOR1
− Correcting function for flow rate with gases at a variable reference pressure	KOR3
− Correcting function for level	NIV
− Non−linear filtering	FIL

For each function unit one function block can be used, but only a maximum of four per module.

The function blocks have inputs to be used for specifying the correcting variable and basic calculation values. They also have outputs for putting out the corrected value and internal status messages. This corrected analog value is written into the register belonging to that function unit to which the function blocks are allocated.

Furthermore, it is possible to additionally transmit the uncorrected analog values (raw values) over the bus system in the form of data telegrams. For this purpose, the raw values are written into certain registers of the shared memory.

For the correcting operation, the inputs must be assigned hardware inputs, bus module inputs as well as fixed values. These data are specified by the user. This procedure is referred to as structuring. All the data together form the so−called structuring list which is filed on the module as a part of the user program.

The precise procedure of structuring the function blocks is described in the appropriate function block descriptions.

Structuring is to be based on the following limit values of the module:

− Max. number of correcting functions	4
− Max. number of bus module inputs (EGn)	20

The cycle time needed for structural processing is calculated by the module itself and is entered into module register 205.

Disturbance bit

Telegrams (e.g. correcting variables) received over the bus can be given a set disturbance bit (position 0). This fault flag is generated by the send module based on the plausibility checks and is set to "1" when certain disturbances are present.

A set disturbance bit of an input telegram influences the calculation of the corrected value only in so far as the corrected value will also be given a disturbance bit. The disturbance bit of the corrected value is available on the bus.

Additionally, the module is provided with a monitoring function for cyclic renewal of the telegrams received from the bus. In case a signal is not renewed within a certain period of time (e.g. due to a failing send module), the bit for position 0 will be set in the receive register of the shared memory. This will effect the correcting calculations as described above.

Simulation

Simulation of send registers

Simulation of send registers is possible for any analog transmitter. It is done from the PDDS, and a max. of 16 send registers can be simulated.

Simulation of receive registers

Simulation of receive registers is possible with the function blocks of the correcting and filtering calculations. It is done over the PDDS. A maximum of 20 bus signals can be simulated.

Signal output

The module sends the data telegrams over its standard interface to the station bus. Data transmission is done serially.

Identification of the signals

The conditioned and digitized input signals as well as the limit signals generated inside the module are written into certain registers. The processing section writes the following data into the address part of the data telegram:

- System address (possible within 0 ... 3)
- Station address (possible within 1 ... 249)
- Module address (possible within 0 ... 58)
- Register address (possible within 0 ... 31 for analog values and limit signals
  100 for status messages
  101 ... 104 for raw values
  205 for module cycle time
  246 for diagnosis data)

By these data, every signal is unambiguously identified.

Operating modes

The module does not have a configuration list in the EEPROM when delivered. It needs to be drawn up according to user–specific needs on the PDDS. The module only knows its station address and its module address, and waits for a valid configuration list from the PDDS under this address. During this stage, the module does not participate in bus communication, however, it can be addressed over the bus from the PDDS.

Disturbance annunciation lamps ST and SG are on during this time, and the respective signal lines are activated.

Configuration list

The configuration list contains all data relevant for the module, grouped according to function units.

	Value range	Standard setting
Transmitter type, measuring range	0 ... 20 mA 4 ... 20 mA 0 ... 5 mA 0 ... 50 mA	4 ... 20 mA
Lower plausibility limit	− 200 ... 0 %	− 6.25 %
Upper plausibility limit	0 ... 199.9 %	118 %
Threshold	0.2 ... 6.8 % (increments of approx. 0.2 %)	1.56 %
Time–out	40, 200 msec	200 msec
Sending the raw value	Yes, No	No
No. of the correcting function	(1 ... 4); KOR1, KOR3, NIV, FIL	–
Filter function *)	16 2/3 Hz, 50 Hz, 60 Hz	50 Hz

Table 1: Configuration list

*) Setting applies to all function units.

Data transfer with the module

Address formation

The system and station addresses of all modules belonging to one and the same PROCONTROL station are identical. The address is automatically set by means of the station bus control module.

The setting of the module address takes place when the module is plugged into the corresponding slot of the PROCONTROL station.

The data words of the analog input signals and the diagnosis results are written into certain registers of the shared memory. The number of the register is also the register address. Each data word is assigned a specific register. This assignment is effected automatically by connecting a process signal to the process connector of the module.

There are no telegrams sent for unused function units.

If none of the four possible limit values of an existing input signal is programmed, the respective limit signal telegram will not be sent.

In the case of incompletely programmed limit values of an input signal, the bits related to the non−programmed limit values will always be set to ”0” in the limit signal telegram.

Reading−out data

For reading out the contents of a register, address data are required. Tables 2 and 3 show these address entries as well as the contents of the registers concerned.

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 %	0	0	SM	5
						MW1															
Limit signals FE1	a	a	a	1	0	0	0	GO 4	GU 4	M 4	GO 3	GU 3	M 3	GO 2	GU 2	M 2	GO 1	GU 1	M 1	SM	3
Analog value FE2	a	a	a	2	VZ	MW2												0	0	SM	5
Limit signals FE2	a	a	a	3	0	0	0	GO 4	GU 4	M 4	GO 3	GU 3	M 3	GO 2	GU 2	M 2	GO 1	GU 1	M 1	SM	3
Analog value FE16	a	a	a	30	VZ	MW16												0	0	SM	5
Limit signals FE16	a	a	a	31	0	0	0	GO 4	GU 4	M 4	GO 3	GU 3	M 3	GO 2	GU 2	M 2	GO 1	GU 1	M 1	SM	3
Module cycle time	a	a	a	205	Time value 100 msec			Time value 10 msec			Time value 1 msec			Time value 0.1 msec							0
Diagnosis register	a	a	a	246	Allocation see Figure 2																0

Table 2: Register allocation and bit significance of the telegrams

Explanation:

FE = function unit, analog input
DA = data type
SM = general disturbance signal, telegram
VZ = sign
MWn = digital measured value
GOn = max. limit value n violated
GUn = min. limit value n violated
Mn = single disturbance signal, limit value n
a = address according to place of installation

Note:

In the case of limit signals (disturbance−free), both bits GU and GO are always non−equivalent.

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	
Status message, function block	a	a	a	100	0	0	0	MF3	MF 2	MF 1	MF 3	MF 2	MF 1	MF 3	MF 2	MF 1	MF 3	MF 2	MF 1	SM	1
								Function block 4			Function block 3			Function block 2			Function block 1				
Raw value 1	a	a	a	101	VZ	100 %	50 %	25 %	12.5 %	6.25 %	3.125 %	1.56 %	0.78 %	0.39 %	0.195 %	0.097 %	0.048 %	0	0	SM	5
						Raw value for function block 1															
Raw value 2	a	a	a	102	VZ	Raw value for function block 2												0	0	SM	5
Raw value 3	a	a	a	103	VZ	Raw value for function block 3												0	0	SM	5
Raw value 4	a	a	a	104	VZ	Raw value for function block 4												0	0	SM	5

Table 3: Register allocation and bit significance of the additional telegrams for structuring

Explanation:

DA = data type
SM = general disturbance signal, telegram
VZ = sign
MFn = status message n
(signal outputs of the function blocks)
a = address according to place of installation

Note:

Telegrams of registers 101 through 104 will be sent only if the raw values are put out also and if the respective correcting function has been structured.

Diagnosis and annunciation functions

Disturbance annunciations on the module

Two light−emitting diodes on the module front indicate:

	Designation of LED
− Disturbance	ST
− Module disturbance	SG

Light−emitting diode ST annunciates all disturbances of the module as well as disturbances of data transfer with the module.

Light−emitting diode SG annunciates module disturbances only.

Disturbance messages to the annunciation system

The annunciation system or the CDS control diagnosis system receive disturbance messages over the bus coming from the input module.

Diagnosis

In the processing section of the module the telegrams received, the formation of the telegrams to be received as well as the internal signal conditioning function are monitored for fault−free condition (self−diagnosis).

In the event of a disturbance, the type of the fault is filed in the diagnosis register, and at the same time a general disturbance signal is sent to the PROCONTROL system.

Upon request, the module sends a telegram containing the data stored in the diagnosis register (register 246) (see Figure 2).

The contents of the diagnosis register, the signals of the general disturbance line, the annunciations on the CDS and annunciation ST are shown in Figure 2.

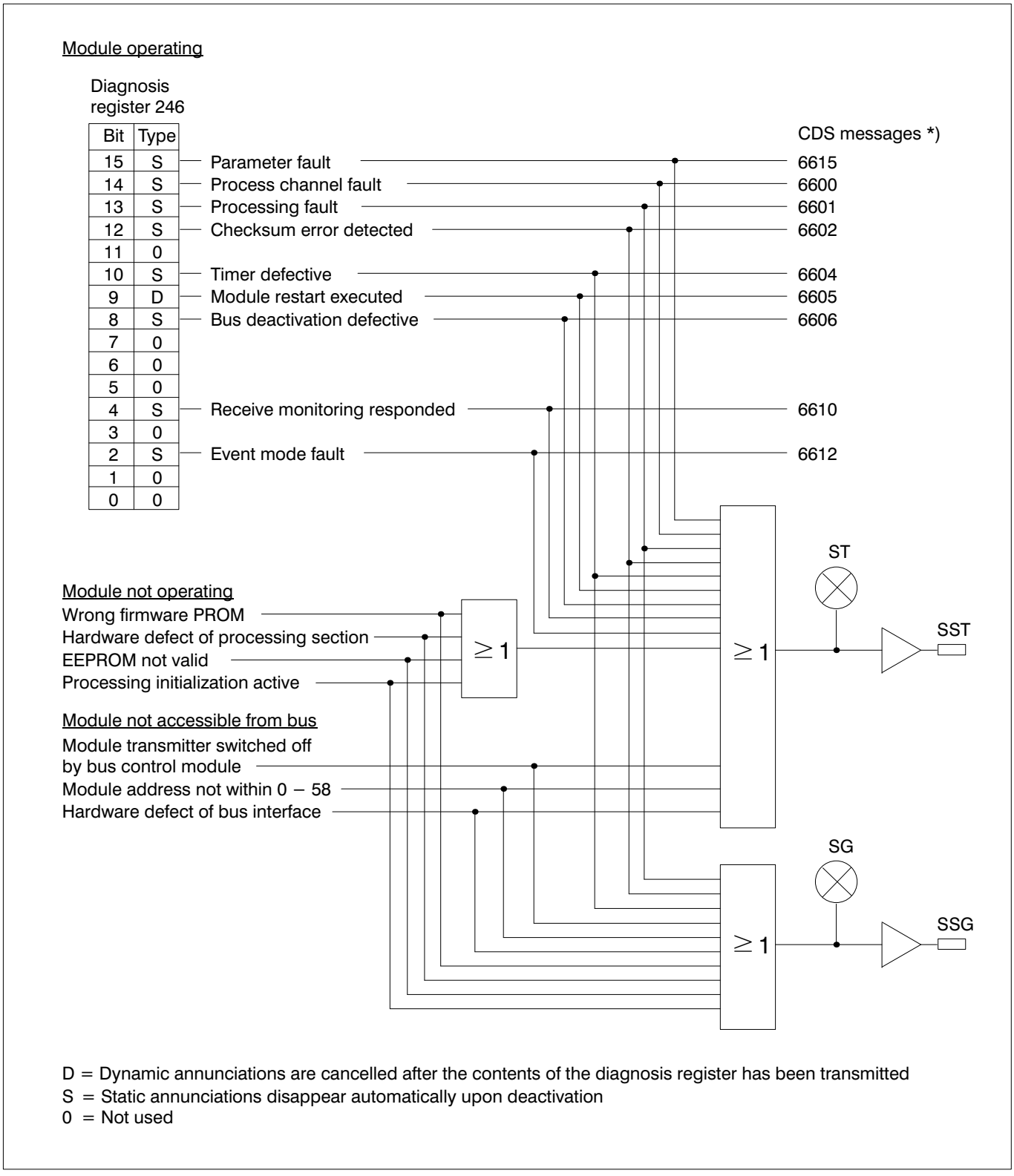


Figure 2: 81EA04 diagnosis messages

In case the ”Processing fault” message is indicated in the diagnosis register, this may be due to the following reasons:

– Hardware fault in the analog section

– Loss of the balancing values for the reference voltages.

*) The control diagnosis system (CDS) provides a description for every annunciation number. This description provides, among other data:

– Information on cause and effect of the disturbance

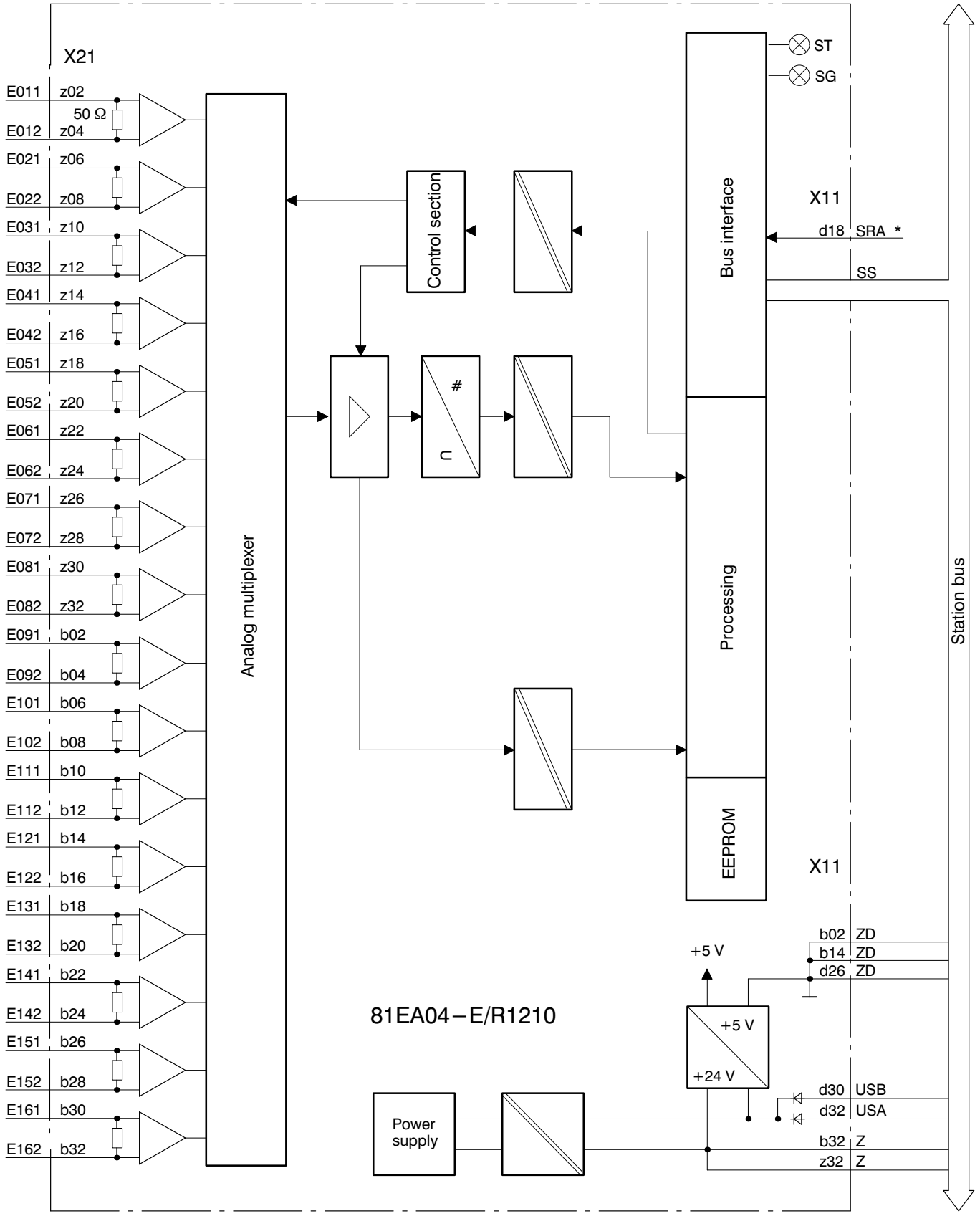
– Recommendations for its elimination.

This makes for fast elimination of disturbances.

Function diagram

Terminal designations: The module consists of a printed-circuit board (see “Mechanical design”). The printed–circuit board is equipped with connectors X21 and X11. Connector X21 includes all process inputs.

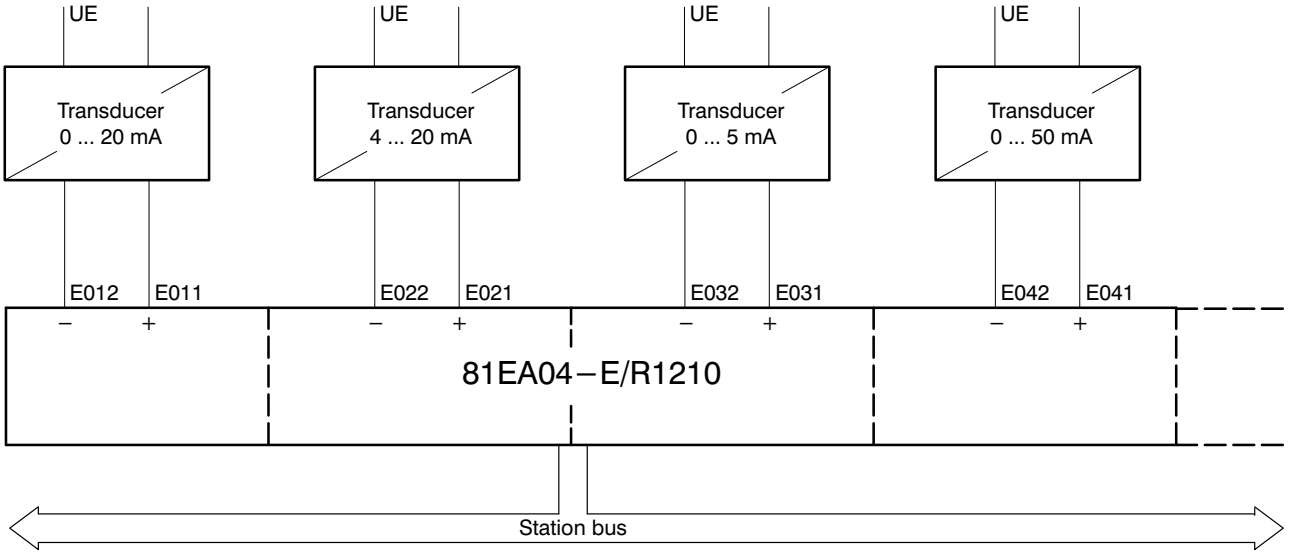
Connector X11 contains the standard interface with the station bus and the operating voltages for the module.



* For proper functioning of the module, terminal X11/d18 has to be connected to ZD (once per subrack).

Connection diagram

External transducer supply



Mechanical design

Board size: 6 units, 1 division, 160 mm deep

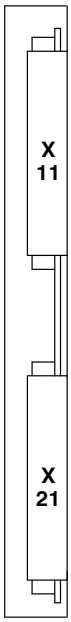
Connector: to DIN 41612

1 x for station bus connection,
48−pole edge connector, type F
(connector X11)

1 x for process connection,
32−pole edge connector, type F
(connector X21)

Weight: approx. 0.5 kg

View of the connector side:

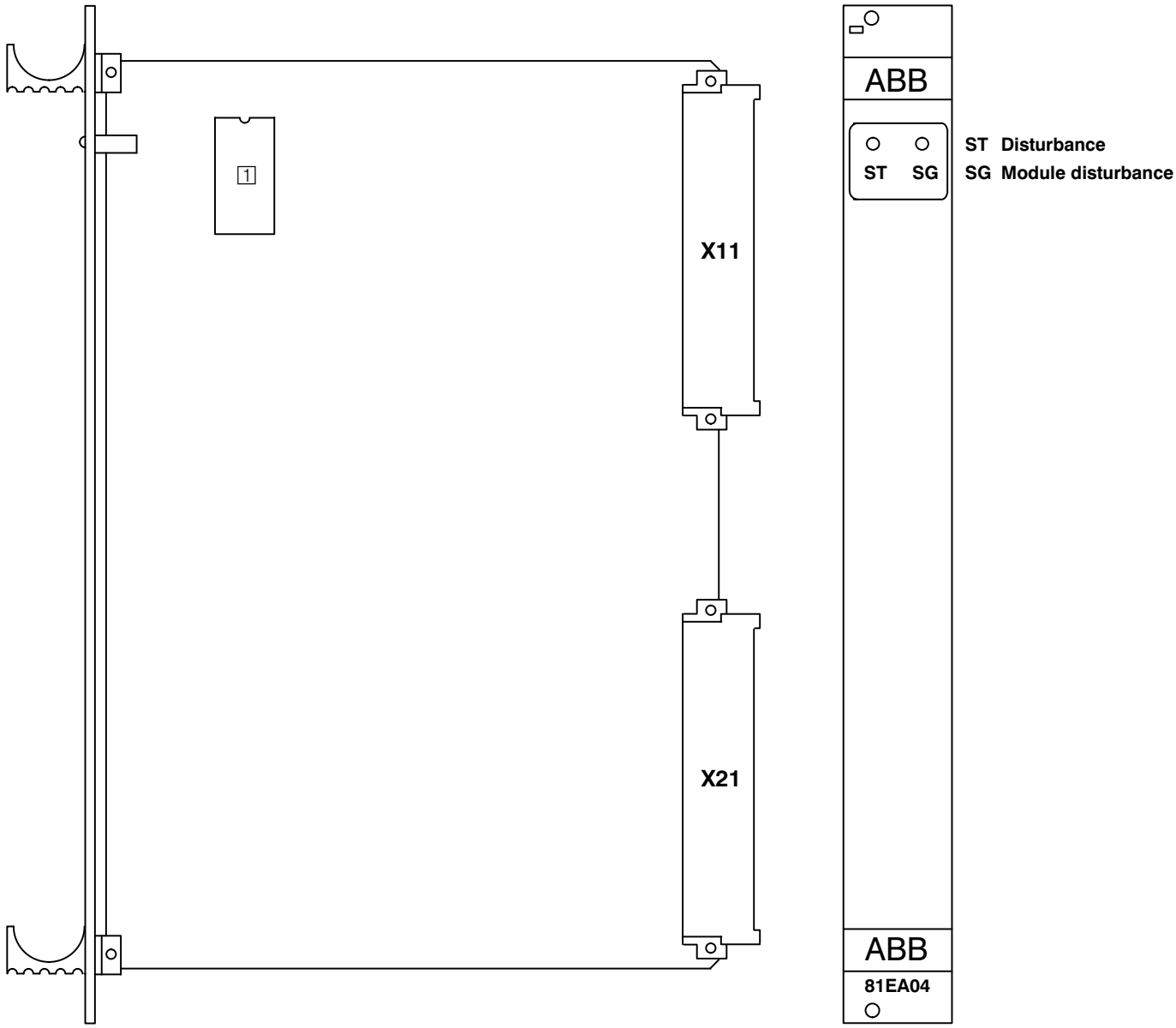


Contact assignments of process connector X21

View of the contact side:

	b	*z*
02	E091	E011
04	E092	E012
06	E101	E021
08	E102	E022
10	E111	E031
12	E112	E032
14	E121	E041
16	E122	E042
18	E131	E051
20	E132	E052
22	E141	E061
24	E142	E062
26	E151	E071
28	E152	E072
30	E161	E081
32	E162	E082

View of module front and module side



1 EPROM, programmed, order number: GJR2393441Pxxxx
xxxx = position number indicating the applicable program version.

Technical data

In addition to the system data, the following values apply:

Power supply

Operating voltage	+24 V
Current consumption at 24 V	< 280 mA
Reference potential	0 V
Power dissipation at 24 V without signal currents	< 6.8 W
Power dissipation due to signal currents at 100 %	
5 mA input	0.001 W/channel
20 mA input	0.020 W/channel
50 mA input	0.125 W/channel

Input values

Input current, nominal signal range	0 ... 20 mA
(corresponds to 0 ... 100 %)	4 ... 20 mA
	0 ... 5 mA
	0 ... 50 mA
Maximum range for nominal signal ranges 0/4 ... 20 mA, 0 ... 5 mA	−1 ... 30 mA
Maximum range for nominal signal range 0 ... 50 mA	−3 ... 75 mA
Measuring resistor	50 Ohm
Destruction limits	+/− 80 mA
Line resistor (supply and return line)	≤ 100 Ohm

Accuracy

All data referenced to 100 % of the signal range (5 or 20 or 50 mA, unless otherwise specified)	
Accuracy (over a temperature range of 0 to 70 °C, ageing, voltage range)	< 0.3 %
Accuracy present on delivery (23 °C)	< 0.1 %
Quantization error for nominal ranges 0/4 ... 20 mA, 0 ... 50 mA	< 0.02 %
Quantization error for nominal range 0 ... 5 mA	< 0,1 %
Linearity error	< 0.1 %
Temperature sensitivity	< 50 ppm/K (typ. 30 ppm/K)
Error due to digital linearization	1 LSB
Resolution, at 0 ... 20 mA	12 bits
at 4 ... 20 mA	12 bits
at 0 ... 5 mA	10 bits
at 0 ... 50 mA	12 bits
Common−mode rejection against potential Z	120 dB
Normal−mode rejection at 16 2/3, 50 and 60 Hz	50 dB
Maximum potential difference between 2 channels	200 V
Isolating impedance between 2 channels	typ. 400 kOhm
Effect of potential difference between 2 channels on the measured value	typ. 80 dB

Processing time

For complete module (without function blocks)		80 msec
Additional times when function blocks are used (for each function)	KOR1	105 msec
	KOR3	125 msec
	NIV	105 msec
	FIL	70 msec

Initialization time

Upon voltage connection or plugging−in the module	
without use of function blocks	1 ... 12 sec
with use of function blocks	2 ... 22 sec

Noise immunity (of process inputs and outputs)

ESD acc. to IEC 801/2	8 kV against front plate
EMC acc. to IEC 801/4	1 kV burst
Destruction acc. to (IEC 801/5), Draft: IEC TC 65 (Sec) 137	1 kV against reference potential

ORDERING DATA

Order no. for complete module:

Type designation: 81EA04−E/R1210 Order number: GJR2393400R1210

Technical data are subject to change without notice!

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