

Bus Coupling Module to Input/Output Station

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88QT03–E/R2111

Application

The bus coupling module 88QT03 connects the station bus and the input/output station. The following input/output station modules can be connected:

- 70EA01–E/R1 Analog input module
(one data telegram per function unit)
- 70EA02–E/R1 Analog input module
(one data telegram per function unit)
- 70EB01–E/R1 Binary input module
(one data telegram per module)
- 70EB02–E/R4 Binary input module
(one data telegram per module)
- 70EB03–E/R1 Binary input module
(one data telegram per module)
- 70ER01/R1 Input module for checkback signals
(one data telegram per module)
- 70AA01/R1 Analog output module
(four data telegrams per module)
- 70AA02/R1 Analog output module
(four data telegrams per module)
- 70AB01–E/R1, R2 Binary output module
(one data telegram per module)
- 70PR03–E/R1, R2 Computing module
- 70AS04/R1 Compact drive control module
- 70AS06/R1 Compact drive module
for motor–driven actuators
- 70WB01/R1 Control room coupling module
(two data telegrams per module)
- 70BK03–E/R1, R2 Bus coupling module
(RS232, RS485 interfaces)

Connected to the station bus, the module behaves like a combined input/output module which is able to receive max. 255 telegrams from the station bus and transmit max. 200 telegrams to the station bus.

In relation to the input/output station the module acts as a processing module. It receives and transmits a total of up to 256 telegrams.

In conjunction with the module 88QB03–E/R0100 the bus coupling module can be installed in the PROCONTROL cabinets 89MS01 and 89MS02, too.

Features

The module can be plugged into any station of the PROCONTROL bus system. It requires two divisions.

It uses:

- One SS standard interface to the station bus
- One SEA standard interface to the input/output station
- Connections provided for hardware inputs.

As with all other station bus modules, the station bus address of this module is related to the place of installation.

However, the module may only be plugged onto even module addresses. The next higher (uneven) module address will be used automatically by the module and needs not be wired. However, it must not be assigned to another station bus module.

It transmits data from the input/output modules to the station bus.

It transmits the data received from the station bus to modules connected to the input/output station.

The connected input/output station modules are monitored for proper function.

Disturbances are signalled to the PROCONTROL system in the form of diagnosis telegrams. They are indicated additionally on the front panel of the module by means of LEDs (see “Annunciation functions”).

The module can simulate output data destined for the input/output station.

The module merely requires a 24 V supply (voltages required additionally are generated inside the module).

User lists are loaded into an EEPROM by means of the PDDS.

The standard interface to the input/output station is available both on the station bus connector X11 and the process connector X21. The interface on connector X11 can be disabled by means of plug–in jumpers.

Description

General basic functions

The module comprises the following three function blocks (see "Function diagram"):

- section for specific station bus functions (processor I)
- processing section (processor II)
- section for specific function of the input/output station.

These functions cooperate via two shared memories. The station–bus shared memory is assigned to the station bus and the input/output–station–bus shared memory to the input/output station.

Section for specific station–bus functions

This section performs the following main functions:

- Handling the overall data communication with the station bus using the SS standard interface. The data exchange is handled following the instructions given by the 88TV01/88TK05 station–bus control module.
- Monitoring the internal functions of the module and output of appropriate annunciations if a disturbance occurs (see "annunciation functions").
- Handling the internal data exchange between the station bus and the station–bus shared memory.

The shared memory assigned to the station–bus–specific section is composed of a receiving shared memory and a sending shared memory.

All data telegrams received from the station bus are buffered in the receiving shared memory. From there they are forwarded to the processing section for further processing.

All data telegrams provided by the processing section are buffered in the sending shared memory. When the module is called the telegrams are transmitted from here to the station bus.

The tasks assigned to the station–bus–specific section are performed by processor I.

Processing section

This section performs the following main functions:

- Marshalling input/output station telegrams from the input/output station shared memory to the station bus sending shared memory bit by bit or telegram by telegram.
- Marshalling station bus telegrams from the station bus receiving shared memory to the input/output station shared memory telegram by telegram or bit by bit.
- Input signal monitoring of data telegrams transferred from the input/output station.
- Generation of (application–specific) limit value telegrams from those analog telegrams received from the input/output station
- Plausibility limit monitoring (programmable) of analog value telegrams transferred from the input/output station to the station bus
- Monitoring of the internal module functions including output of annunciations signals in case of a disturbance ("see Annunciation functions")
- Simulation of output data to the input/output station
- Event processing.

The tasks assigned to the processing section are performed by processor II. For this purpose the processor is provided with a user program which contains the user data required.

The user program comprises (see "Initialization"):

- Bus address list (BAL)
- Marshalling list station bus – input/output station (RAN)
- Marshalling list input/output station – station bus (RAN)
- Limit value list (GRE)
- Measuring range expansion list.

Upon entry of the user–specific address and limit value data, the lists are generated automatically by the PDDS (Programming, Diagnostic and Display System) and are stored on the module in a non–volatile memory (EEPROM) (see "Operating modes: Initialization").

User data stored in the user EEPROM can be changed "on–line" by means of the PDDS.

Section for specific input/output station functions

This section comprises the following functions:

- Handling the data communication with the input/output station via the standard interface SEA. Data communication is handled following the instructions given by the input/output station control module 70BV01.
- Handling the internal data exchange between the input/output station and the shared memory of the input/output station.

These functions are performed by a control section:

The input/output station shared memory buffers all data telegrams which have to be transferred between the input/output station and the processing section (in sending and receiving direction).

The module functions are described in detail in the following.

Initialization

Initialization puts the bus coupling module in a defined starting position.

Initialization is as follows:

- Voltage connection (plugging in the module)
- Reception of the “Reset processing” instruction telegram.

The STEA disturbance LED is flashing for about 4 seconds during initialization.

Loading and saving user lists

The user loads the required marshalling, limit value and measuring range expansion lists via the bus into the RAM of the module by means of the PDDS. The PDDS ensures that the lists match. After further plausibility checks the module starts processing the user data stored in the RAM.

The user program is transferred from the RAM to the EEPROM with the instruction “save” (SAV) entered on the PDDS to store the user data in the nonvolatile EEPROM. From then on the module uses the lists in the EEPROM. Now the data in RAM can be changed or complemented.

Plugging modules into the input/output station

The bus coupling module 88QT03 and the input/output station modules may be plugged during operation.

When the bus coupling module is plugged in it will be initialized automatically (provided that the user lists have been loaded in the EEPROM) and after completion of initialization the input/output station is coupled to the station bus.

Processing

The processing section including the microprocessor II is the central part of the module. The station–bus and the input/output–station shared memories are the internal interfaces of the microprocessor. The transmission time between these shared memories is ≤ 20 ms (without limit value formation or measuring range expansion ≤ 10 ms).

The following applies to data exchange between these shared memories in general:

- In the station bus receiving shared memory 255 registers are available (for the data exchange station bus – input/output station)
- In the station bus transmitting shared memory 200 registers are available (for the data exchange input/output station – station bus)
- In the input/output station shared memory a total of 256 registers are available (for data exchange in both directions).

The addresses of the input/output station (input and output) telegrams and the register addresses of the input/output station shared memory are identical. But they can be assigned as desired.

The processing section performs the following (application-specific) functions:

- a) In input direction (input/output station – station bus)
 - Binary value telegrams:

Marshalling from the input/output station shared memory to any register of the station bus transmitting memory telegram by telegram; event processing. Marshalling can be either telegram by telegram or bit by bit.
 - Analog value telegrams:

Marshalling from the input/output station shared memory to any register of the station bus transmitting shared memory; input signal monitoring; limit value formation; modification of plausibility limits; event processing.
- b) In output direction (station bus – input/output station)
 - Binary value telegrams:

Marshalling from the station bus receiving shared memory to any register of the input/output station shared memory (= input/output station output address). Marshalling can be either telegram by telegram or bit by bit.
 - Analog value telegrams:

Marshalling from the station bus receiving shared memory to any register of the input/output station shared memory (= input/output station output address). Measuring range expansion may be programmed for each analog value.

A data telegram (analog or binary) received from the station bus may be output to several input/output station outputs (= input/output station output addresses) at the same time, depending on the user–specific programming.

Input signal monitoring

The analog values of the analog input modules connected to the input/output station are not monitored for plausibility.

Monitoring for plausibility may be programmed for the 70EAXx modules individually for each input signal, depending on user–specific requirements.

If the monitor responds bit 14 (process disturbance) will be set in diagnosis register 246.

The disturbed measured value, however, is transmitted together with the set disturbance bit. The disturbance LED ST is activated additionally,

Limit signal generation

In the processing section max. 4 limit signals can be generated for each analog value received by the input/output station.

The limit value telegram, thus generated is written into the register of the station bus sending shared memory directly following the analog register.

This is to ensure the logic allocation "analog value telegram/limit value telegram" in the PROCONTROL bus system.

The limit value telegrams are composed according to data type 3.

Max. 3 values can be programmed for limit signal generation, depending on the user-specific requirements:

- the actual limit value (0 % – 110 % of the measuring range selected)
- one out of four possible hysteresis values per limit value
- a maximum or minimum selection for each limit value.

These values are stored in the user EEPROM.

One out of the four following hysteresis values may be assigned to each limit value:

HY1 = 0.39 %

HY2 = 1.56 %

HY3 = 3.12 %

HY4 = 6.25 %

The hysteresis may be above or below the limit value depending on whether violation of the minimum or maximum value has been selected (see Fig. 1).

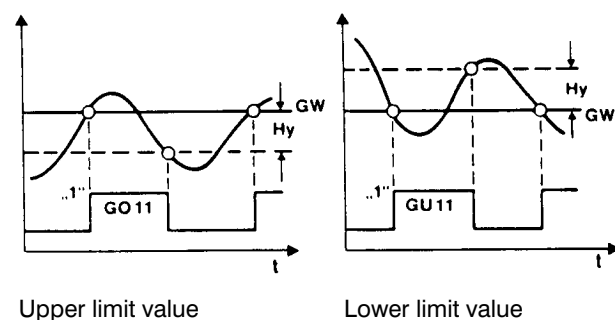


Fig. 1: Possible settings of the limit values

Any change of a limit signal is signalled to the station bus as an event.

When input signal monitoring responds all limit signals (GOXX, GUXX) belonging to the measured value are set to "0" and the disturbance bit (MXX, SMX) is set to "1" (see "Telegram assignment").

In the station bus sending shared memory two successive registers will be used for the analog value and limit values (even if no limit values are programmed by the user). The analog values are always written into registers with even addresses, the limit signals are written to the odd register following. Unprogrammed limit values are not transmitted to the station bus.

Event generation

Since input/output modules are not provided with an event feature this function will be carried out by the processing section of the module.

Normally, the coupling module is interrogated cyclically by the PROCONTROL bus system to transmit its data. If values change within the cycle time this fact will be treated as an "event".

If an event occurs the new values are given priority when transmitted to the PROCONTROL bus system.

Event triggering for limit signals

As soon as upper or lower limit values are violated, the changed limit signal will cause an event signal to be put out.

Any response of the input signal monitoring function also will cause an event signal to be put out.

Event triggering for analog input signals

The processing section monitors the measured value for changes of more than an adjustable value (threshold) since the last data transmission to the station bus. This threshold can be adjusted within 0.2 ... 199.9 % (default setting 0.39 %) in increments of approx. 0.2 %.

If the processing section detects a measured value change of more than the threshold specified, an event signal will be triggered only when an adjustable time (time-out) of 40 msec (default) or 200 msec has expired after the last event transmission to the station bus.

The corresponding entries into the limit-value list will be made from the PDDS.

Event triggering for binary input signals

The processing section monitors each binary input signal for any changes. Every changed binary input signal will cause an event signal to be put out.

Measuring range expansion

When analog values are transmitted from the station bus to the input/output station the measuring range can be expanded.

The expansion parameters X1 (= 0 %) and X2 (= 100 %) stored in the user EEPROM provide the processing section with the information required for a particular case (user-specific).

This makes it possible, for instance, to output only the range 10 mA (= X1) ... 15 mA (= X2) of a 0 ... 100 % signal received from the station bus in the form of a new 0/4 ... 20 mA signal to the input/output station.

The following condition applies to the expansion parameters:

$$| X2 - X1 | \geq 6.25 \%.$$

If this condition is not fulfilled "parameter error" will be signalled inside the module.

Data transmission with measuring range expansion increases the internal transmission time for all values transmitted to a total of 20 msec.

Addressing and data communication

The data telegrams to be received from the station bus are specified to the module under their send–location addresses and written to the receive registers of the station bus receiving shared memory. Specification is user–specific.

If no telegrams are received from the station bus the module reacts as follows:

- When data are marshalled telegram by telegram to the input/output station shared memory either the last valid value or zero is transmitted (see “Operating modes”). In telegrams with data types >0 the general disturbance bit (bit position 0) is set additionally.
- When data are marshalled bit by bit to the input/output station shared memory either the last valid value or “zero” is transmitted (see “Operating modes”).

If the general disturbance bit is set in a data telegram received from the station bus the response of the module depends on the position number of the processing program:

If the position number is smaller than or equal to P0005 zero will be transmitted to the input/output station shared memory.

If the position number is bigger than or equal to P0006 the value will not change.

If the input/output station receives no telegrams the corresponding station bus telegrams will not be transmitted to the PROCONTROL bus system.

Telegram allocation

The following table shows the significance of the bits in all telegrams which are generated by the input/output station modules.

In the form shown (not marshalled) they are written (from the input/output station shared memory) into the station bus sending shared memory (after user–specific marshalling). From there they are transmitted to the PROCONTROL bus system as send data telegrams (their send–location addresses are specified during programming). The column “Reg. No.” denotes the register address in the station bus sending shared memory (as a component of the overall send–location address).

As to their composition and bit significance the analog and binary telegrams which are generated inside the module (acc. to the user or firmware program) by the 70PR03 computing module, the 70BK03 coupling module or 70AS04/06 compact control module connected to the input/output station and which are transmitted to the PROCONTROL bus system correspond to the analog/binary structure shown in the following table.

Reg. No.	Information	Telegram																DA
		← Bit position →																
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
n	Analog value 70EA01 FEX (1...4)	VZ	100 %	50 %	25 %	12.5 %	6.25 %	3.125 %	1.56 %	0.78 %	0.39 %	0.195 %	0.097 %	0.048 %	0	0	SB	5
n+1	Limit value FEX (1...4)	0	0	0	GOX4	GUX4	MX4	GOX3	GUX3	MX3	GOX2	GUX2	MX2	GOX1	GUX1	MX1	SMX	3
n	Analog value 70EA02 FEX (1...4)	VZ	100 %	50 %	25 %	12.5 %	6.25 %	3.125 %	1.56 %	0.78 %	0.39 %	0.195 %	0.097 %	0.048 %	0	0	SB	5
n+1	Limit value FEX (1...4)	0	0	0	GOX4	GUX4	MX4	GOX3	GUX3	MX3	GOX2	GUX2	MX2	GOX1	GUX1	MX1	SMX	3
n	Binary value 70EB01 FE (1...16)	EB16	EB15	EB14	EB13	EB12	EB11	EB10	EB09	EB08	EB07	EB06	EB05	EB04	EB03	EB02	EB01 *)	**)
n	Binary value 70EB02 FE (1...16)	EB16	EB15	EB14	EB13	EB12	EB11	EB10	EB09	EB08	EB07	EB06	EB05	EB04	EB03	EB02	EB01 *)	**)
n	Binary value 70EB03 FE (1...5)	R52	R51	M05	R42	R41	M04	R32	R31	M03	R22	R21	M02	R12	R11	M01	SB	**)

Abbreviations:

SMX = general disturbance bit for telegram
 SB = disturbance bit for telegram
 MXX = individual disturbance annunciation for limit value X
 MOX = individual disturbance annunciation for change-over contact X
 RX1 = contact input (normally closed contact)
 RX2 = contact input (normally open contact)
 VZ = sign

GOXX = violation of limit value X
 (actual value above upper limit)
 GUXX = violation of limit value X
 (actual value below lower limit)
 FEX = function unit
 EBXX = binary input signal XX
 DA = data type in station bus telegram

*) not to be used for station bus ($\hat{=}$ general disturbance bit)
 **) for marshalling telegram by telegram: 0
 for marshalling bit by bit: 1

Input/output station: shared memory and input/output station allocation

The input/output station shared memory uses a total of 256 registers (as already mentioned) for data telegrams from and to the input/output station modules.

All input/output station modules require a start address under which they can be addressed by the bus control module 70BV01 (see module description "Bus Control module 70BV01", HESL 400 423).

The bus coupling module requires no address on the input/output station.

The addresses of the user modules connected to the input/output station are set with the address switches S2 and S3 (see module descriptions).

An input/output station address (set with S2 and S3) can be assigned to one input module only. 88QT03 signals the double use of addresses for input modules as error.

Irrespective of the number of module inputs actually used the total number of the addresses required for an input module (acc. to the total number of inputs) shall be considered for input/output station address allocation. Otherwise inadmissible double address allocation will occur.

In the section "Processing" it has been explained that output telegrams can be output to several output addresses of the input/output station simultaneously. Therefore, the condition mentioned above (avoiding double address allocation) bears no significance regarding data output to the input/output station. (As regards 70BV01) merely the input/output station address of the output modules is required to be set with the address switches. The module is informed about the possible multiple output of telegrams to output modules of the input/output station by the user program.

Simulation memory

All (analog or binary) output data to be transmitted to the input/output station can be simulated by means of the PDDS.

The simulation values specified by the user are written into the simulation memory by microprocessor II (after they have been received from the station–bus–specific section).

The real data – belonging to an output address of an input/output station – are continued to be received nevertheless and written into the input/output station shared memory. Therefore both values are always available on the module.

Simulated values are specified and cancelled by means of the appropriate instruction issued by the PDDS.

Diagnosis and annunciation functions

Disturbance annunciations on the module

The LEDs on the front panel of the module indicate the following disturbances:

	Designation of the LED
– Disturbance	ST
– Disturbance input/output station	STEA

The LED ST signals all disturbances of the module and of the data communication with the module.

The red LED STEA can either emit steady light or flash:

- Steady light: Disturbances of the input/output station or the input/output station interface inside the module.
- Flashing light: For appr. 4 s, either when the voltage is connected or data is copied internally from the EEPROM to the main memory (RAM). If STEA is switched off after appr. 4 s, the module is ready for operation. If STEA continues flashing a disturbance is present.

Disturbance annunciation signals to the alarm annunciation system

The alarm annunciation system and the control diagnosis system CDS receive disturbance signals transmitted by the bus coupling module via the bus.

The disturbances are stored and transmitted to the bus system as general disturbance signal via the interface SS (SST data line). In that event the bus system reads the internal diagnosis registers of the module for further evaluation.

Status signals

The yellow LED SIM is emitting steady light as long as at least one output value of the input/output station is being simulated. The LED will be activated, too if user data (e.g. address list, limit values) are changed "online" by means of the PDDS during operation or the module is using the lists stored in RAM.

The green LED EAVE is emitting steady light as long as the 88QT03 module is participating in the data transfer of the input/output station.

Diagnosis

A number of internal diagnostic functions are available on the module which form part of the basic module program (firmware) which is processed cyclically. These functions comprise:

- Functional test of the input/output station incl. the internal input/output station interface and monitoring the reception of the input/output station telegrams.
- Mutual check of the microprocessors I and II
- Check of internally generated data lists by means of parity bits (internal data protection)
- Receive time monitoring checks whether all station bus telegrams the module requires (acc. to the bus address list) are received on a regular basis. Receive time monitoring will respond (as is the case with all other station bus modules) if these telegrams fail to be received.
- Annunciation of external disturbances
The disturbance signal inputs SME1, SME2, SME3, SMS and STX on connector X21 are used for the diagnosis of external disturbance signals and are stored in the diagnosis register (register address 211). See Fig. 3.

When a disturbance occurs the type of fault is stored in the diagnosis register and a disturbance annunciation signal is transmitted to the PROCONTROL system.

Upon request the module outputs a telegram containing the data stored in the diagnosis register (register 246). See Fig. 2.

The contents of the diagnosis register, the signals from the general disturbance line, the annunciations on the CDS and the indication ST are shown in the Figs. 2 to 4.

Connection of the input/output station using 70BT01

The bus coupling module is connected to the input/output station by means of the 70BT01 bus isolation amplifier. If the module is intended to be installed in the cabinets ZS1 and ES1 the 89IQ10 connecting cable shall be used (max. length 5 m). If the module is intended to be installed in the cabinets 89MS01 and 89MS02 the cable 89IK05 shall be used.

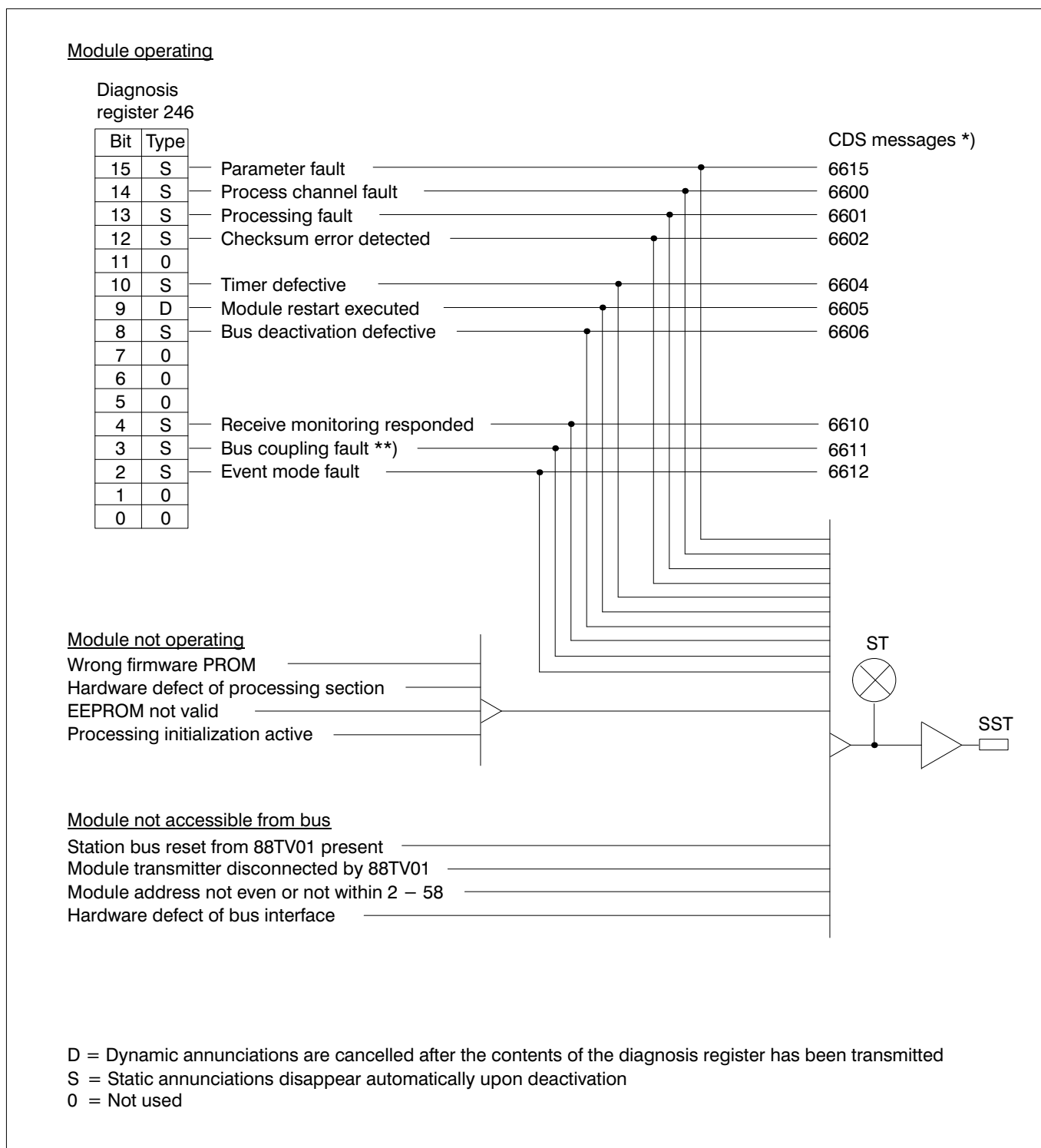


Fig. 2: Diagnosis messages of 88QT03, register 246

If the annunciation "Process channel fault" appears in the diagnosis register, this is due to any of the following causes:

- Reception of a disturbed data telegram from the input/output station
- Plausibility monitoring has responded

*) The control diagnosis system (CDS) provides a description for every message number. This description comprises:

- Information about cause and effect of the disturbance
- Recommendations for elimination.

Thus, fast disturbance elimination is ensured.

**) If "Bus coupling fault" is indicated in the diagnosis register the cause of the disturbance is located in the input/output station and indicated in the additional diagnosis register (register 211). See Figs. 3 to 4.

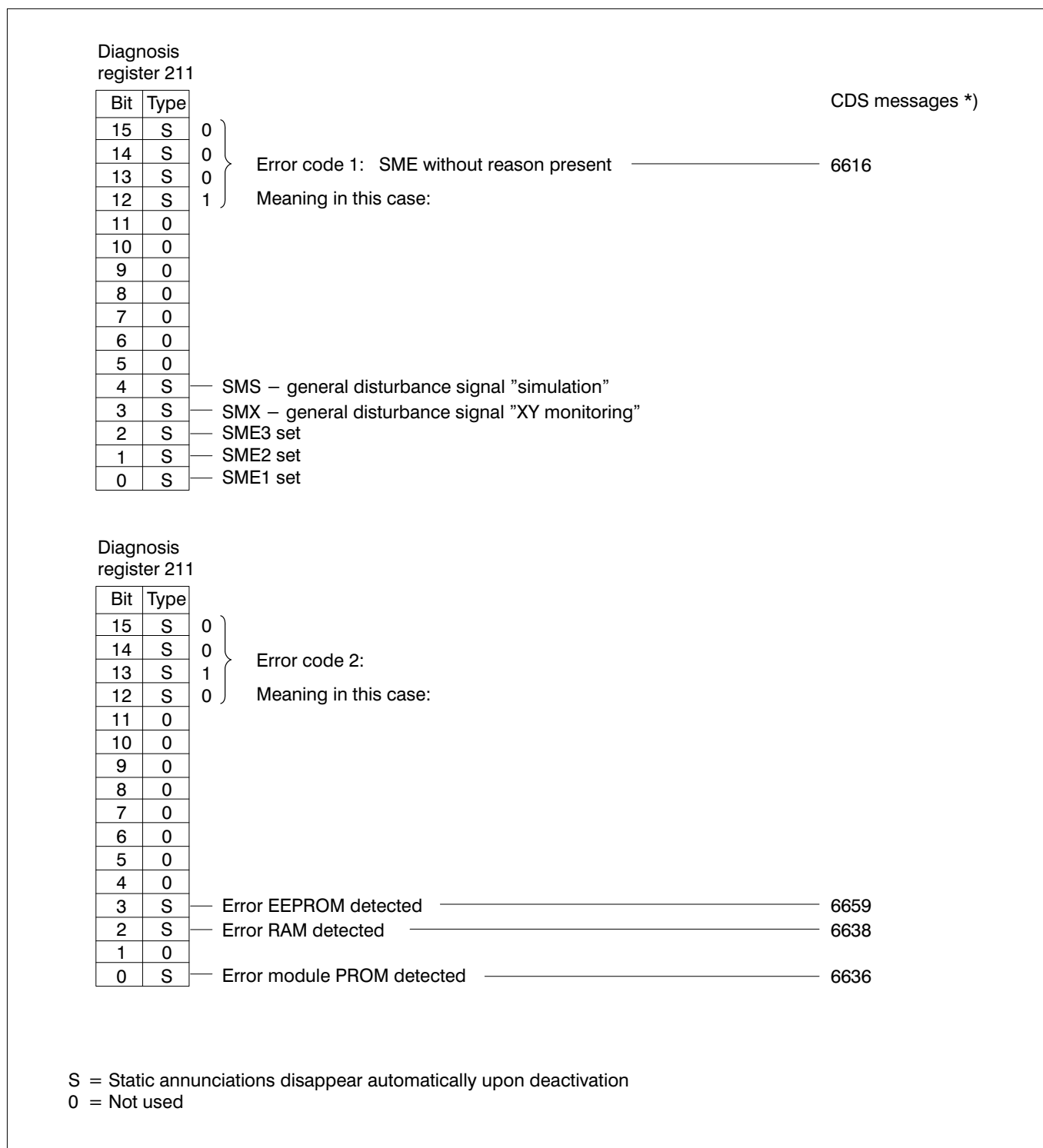


Fig. 3: Diagnosis messages of 88QT03, register 211

- *) The control diagnosis system (CDS) provides a description for every message number. This description comprises:
- Information about cause and effect of the disturbance
 - Recommendations for elimination.

Thus, fast disturbance elimination is ensured.

If several errors occur at the same time the error with the highest error code will be indicated.

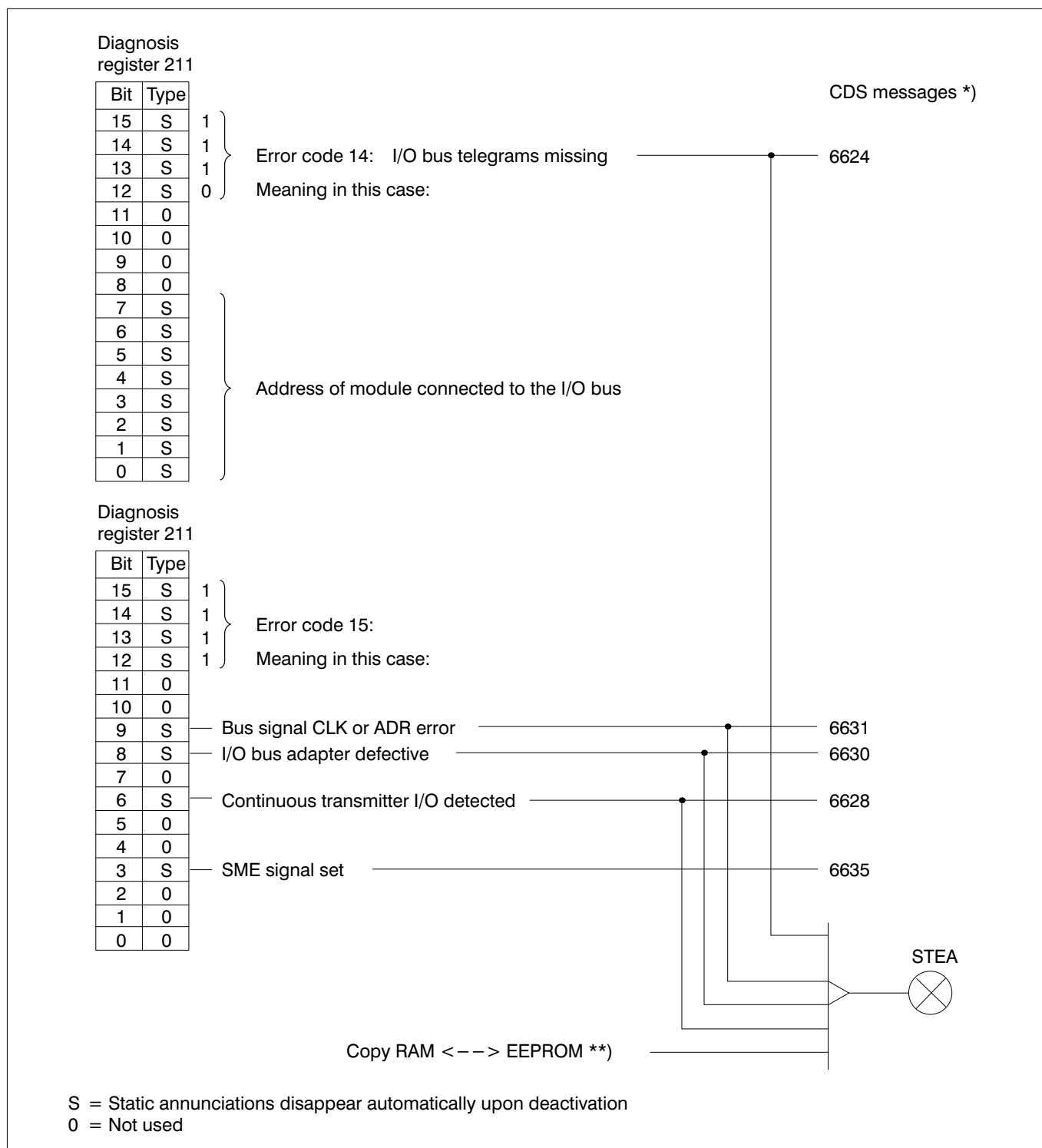


Fig. 4: Diagnosis messages of 88QT03, register 211

*) The control diagnosis system (CDS) provides a description for every message number. This description comprises:

- Information about cause and effect of the disturbance
- Recommendations for elimination.

Thus, fast disturbance elimination is ensured.

**) Flashing light

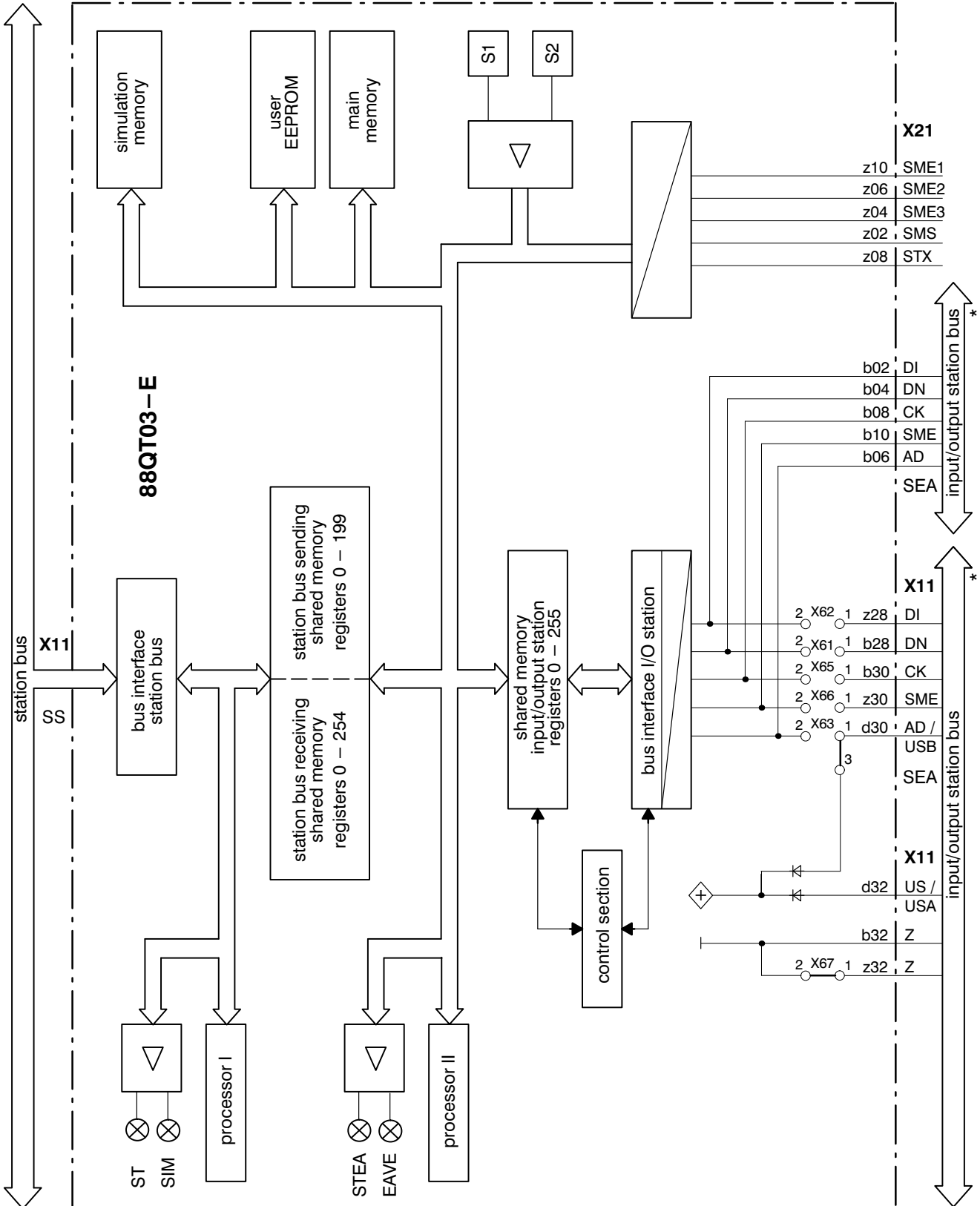
If several errors occur at the same time the error with the highest error code will be indicated.

Function diagram

Terminal designations

The module includes the connectors X11 and X21. X11 contains both standard interface SS to the station bus and stan-

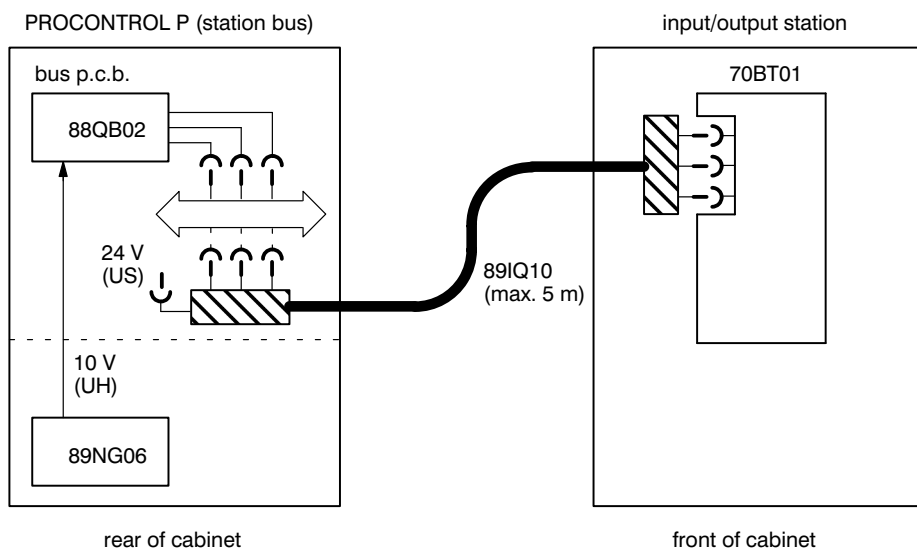
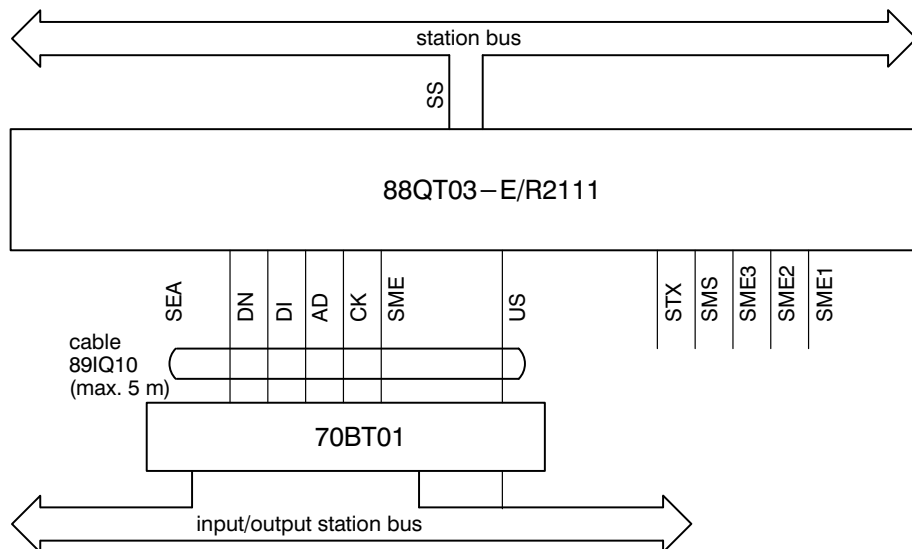
dard interface SEA to the input/output station. The latter can be disconnected by means of plug-in jumpers. X21 incorporates five binary inputs, via which single disturbance signals can be input into the PROCONTROL bus system, and the standard interface SEA to the input/output station.



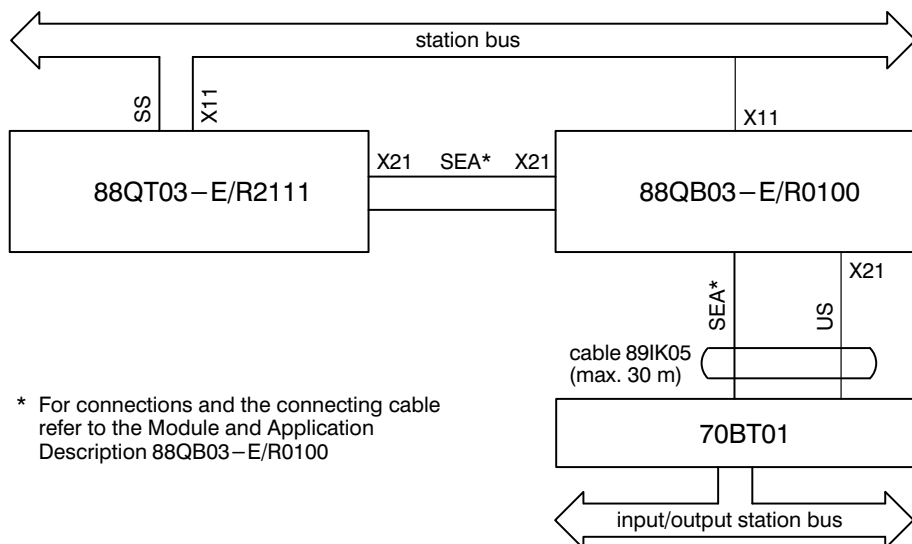
* Connection depending on PROCONTROL P cabinet in which the module is installed. Observe setting of plug-in jumpers X61 - X67!

Connection diagram

Use in the cabinets ZS1/ES1



Use in the cabinets 89MS01/89MS02



* For connections and the connecting cable refer to the Module and Application Description 88QB03-E/R0100

Mechanical design

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

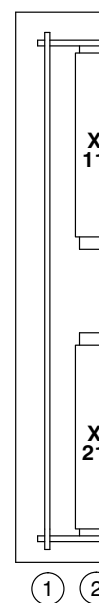
Connector: 1 x for station bus and input/output
station bus connection
48-pole, edge connector type F
(connector X11)

1 x for external disturbance signals
32-pole, edge connector type F
(connector X21)

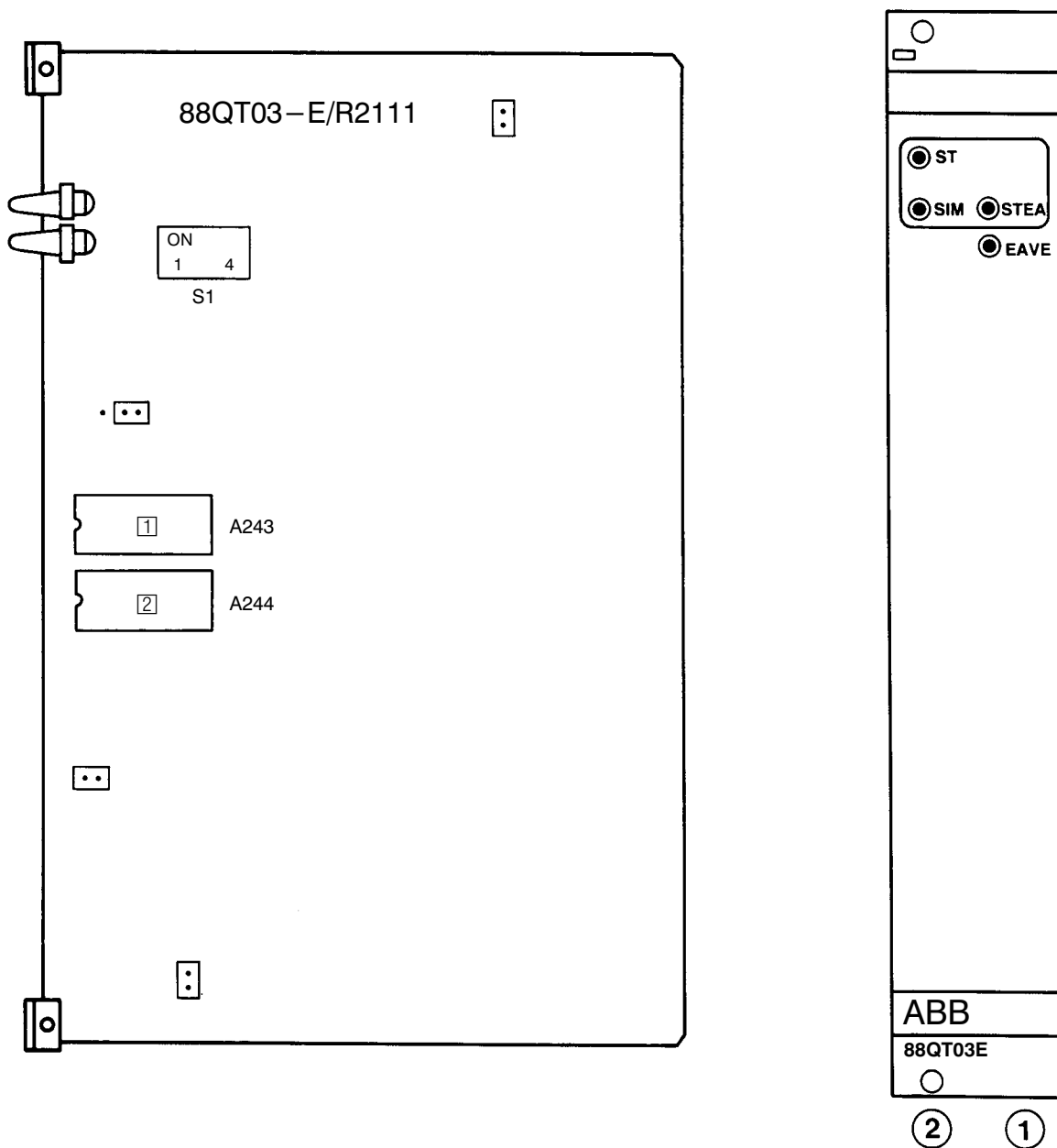
Weight: appr. 0.83 kg

Both boards are mechanically and electrically connected.

View of connector side:



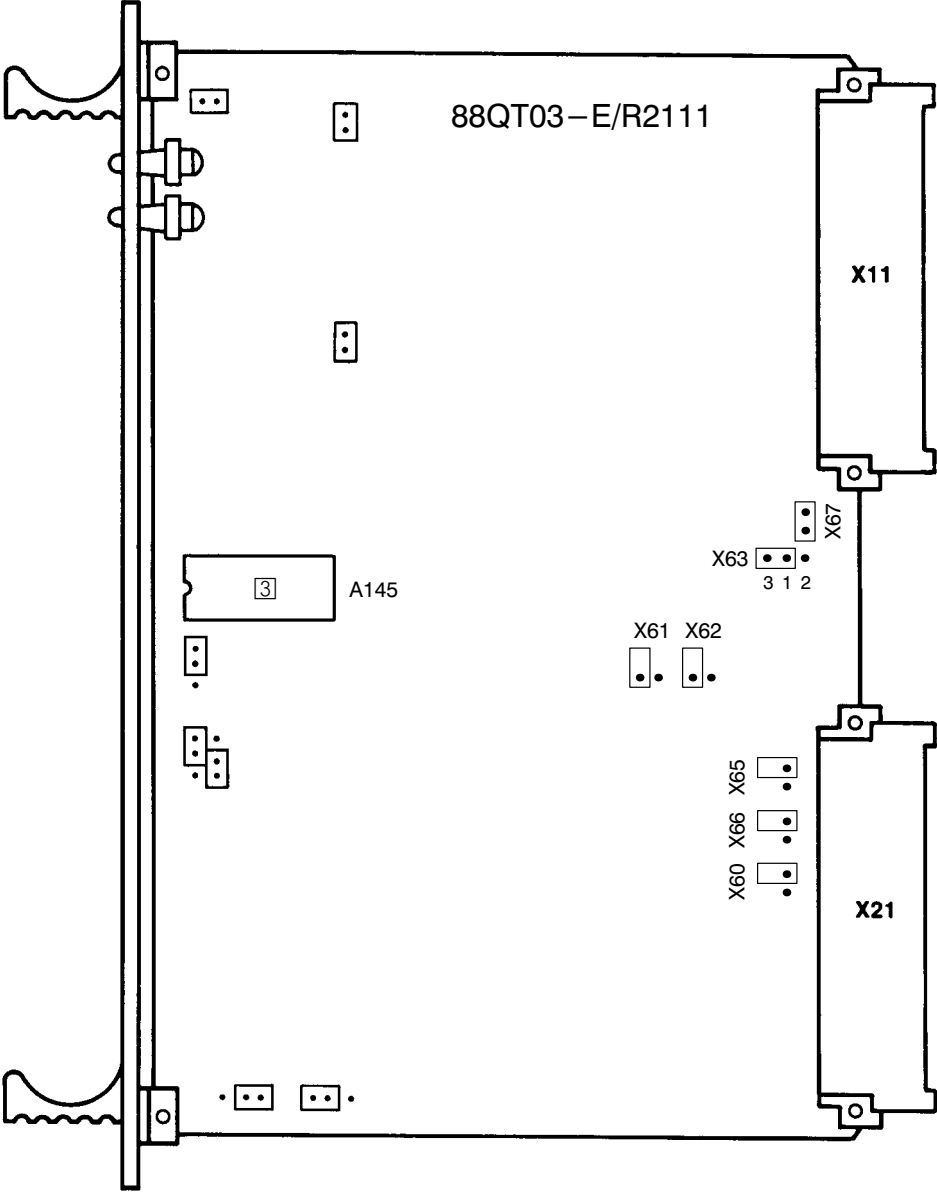
Position of switches, plug-in jumpers, memory modules on p.c.b. 1 and the front panel



Memory modules:	Order number: (component)	Order number: (programmed)
① Processing program, A243 (low-byte)	HETN 400 839 P1	GKWE 857 012 Pxxxx
② Processing program, A244 (high-byte)	HETN 400 839 P1	GKWE 857 013 Pxxxx

xxxx = position number depending on the applicable version.

Position of plug-in jumpers and memory module on p.c.b. 2



Memory module:	Order number: (component)	Order number: (programmed)
③ Station bus program, A145	HETN 400 829 P1	GKWE 857 011 Pxxxx

xxxx = position number depending on the applicable version.

Technical data

In addition to the system data the following values apply:

Power supply

Operating voltage	US = 24 V
Current consumption	IS = 0.5 A
Power dissipation, typ.	P = 12 W
Reference potential	Z = 0 V

Module interfaces

SS – standard interface to the station bus
SEA – standard interface to the input/output station

Input values

SME1, SME2, – external disturbance annunciations 1 input each
SME3, SMS,
STX

ORDER DATA

- Complete module:
Type designation: 88QT03–E/R2111 Order number: GJR2374500R2111
- Cable:
Type designation: 89IQ10 Order number: GKWE602215Rxxxx
(xxxx = length in cm, max. 500 cm)
- Memory modules:
see "Mechanical design"

Technical data are subject to change without notice!



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