Module and Application Description

PROCONTROL PF

Protection

Binary Control Module

4-fold

1KGF 100 840, Edition 10/04

83SR04-E/R1411

Application

The module is used for stored-program binary control tasks for protection purposes. It can be used for the following applications:

- Binary control for boiler protection
- Function group control (sequential control)

This module is intended to be used in conjunction with the process operator station.

It can be applied for the following operating mode:

- Binary control mode (and analog basic functions) with variable cycle time

The operating mode is set with function block TXT1 which is listed as the first element of the structure.

For binary control applications, up to 4 function group control circuits or 4 drive control circuits or combined drive and group control circuits per module can be implemented (the module cycle time has to be taken into account).

The module uses four 2–fold hardware interfaces (8 outputs) for the relay output modules or four 4–fold hardware interfaces (16 inputs) for the process.

Features

The module address is set automatically by plugging the module into the PROCONTROL station.

The telegrams received over the bus are checked by the module for error-free transmission by their parity bit.

The telegrams sent from the module to the bus are given parity bits.

The user program is stored on a nonvolatile memory (EEPROM). Loading and changing the user program takes place on-line over the bus.

The module is ready for operation when a valid user list has been loaded.

For communicating with process and switchgear, the module needs the following voltage:

USA/USB Operating voltage +24 V
internally divided into:
US11 Supply of contacts for process interface 1
US21 Supply of contacts for process interface 2
US31 Supply of contacts for process interface 3
US41 Supply of contacts for process interface 4

Voltages US11...US41 are short-circuit-proof and non-interfering.

The operating voltages and the external logic signals refer to reference conductor Z.

On the module front, light-emitting diodes will give the following indications:

ST Disturbance
SG Module disturbance

Signal lamp ST indicates disturbances of the module and of the data transfer with the module.

The signal lamp SG indicates pure module disturbances only.

Module design

The module essentially consists of the following:

- Process interface
- Station-bus interface
- Processing section

Process interface

In the process interface, the process signals are adapted to the module-internal signal level.

Station-bus interface

In the station bus interface, the module signals are adapted to the bus. This essentially involves a parallel/serial conversion.

Processing section

In order to process the signals coming from the process and the bus, the module is provided with a microprocessor which works in conjunction with the following memory areas via a module-internal bus:

Contents	Storage medium
Operating program	EPROM
Function blocks	EPROM
User program (structure, address, parameters, limit value and simulation list)	EEPROM
User program (structure, address, parameter, limit value and simulation list)	RAM
History values	RAM
Current module input and output signals (shared memory)	RAM

The operating program enables the microprocessor to run the basic operation of the module.

The memory for the function blocks contains prepared programs for performing various functions.

All function blocks and their inputs and outputs can be called up by the user via the engineering, documentation and service system (EDS) or via the programming, diagnosis and display system (PDDS).

The memory for the user program contains information on:

- how the function blocks are logically linked,
- which module inputs and outputs are assigned to which inputs and outputs of the function blocks,
- which fixed values are pre-specified for which inputs of the function blocks,
- which parameters are assigned to which inputs of the function blocks,
- which plant signals are assigned to which module inputs and outputs,
- which function blocks support the process interfaces,
- which limit value sets are assigned to the analog values,
- which function results, module input and output signals are simulated.

These data are defined by the user according to specific plant requirements.

For normal operation, the complete user program is filed in an EEPROM. For optimization purposes, a changed copy of the user program in the RAM can be used and stored later in the EEPROM after the optimization work is done.

Setting values can be specified by the user directly at the respective function block inputs or can be indicated in a separate parameter list.

If limit signals are formed by function block GRE, then the limit values (4 per GRE) are indicated in the limit value list.

Parameter and limit value lists can be changed any time during operation (on-line). They are assigned to RAM or EEPROM mode and are stored in the RAM or EEPROM.

The information between module and bus system is exchanged via the memory for the module input and output signals.

Structuring

For structuring, the neutral inputs and outputs of the individual function blocks are assigned module inputs and outputs or the inputs of the function blocks are assigned fixed values and parameters or outputs of other function blocks (function results). The structuring is based on the entries made by the user in the form of the so-called structure list.

For the structuring procedure, the following limit values of the module are to be adhered to:

- max. number of module inputs 287
- max. number of simulatable signals 32
- max. number of module outputs 223
- max. number of function results 255
- max. number of timers 136
- max. number of parameters 80
- max. number of limit value sets 16
- max. number of group control functions (GSA2) 4
- max. number of lines in the structure list 2886
- length of history value list (byte) 2048
- dimensioning of the shared memory (cf. ”Addressing”)

In this case, one line refers to one option for entry on the PDDS.

The precise procedure for structuring the function blocks is indicated in the function block descriptions

Addressing

General

The signal exchange between module and bus system takes place via a shared memory. The arriving telegrams which are to be received by the module and the function results which are to leave the module are buffered in this shared memory.

For this purpose, the shared memory uses send registers for the telegrams to be sent and receive register for telegrams to be received. Send registers are register numbers 0 through 63 and receive registers are register numbers 64 through 199.

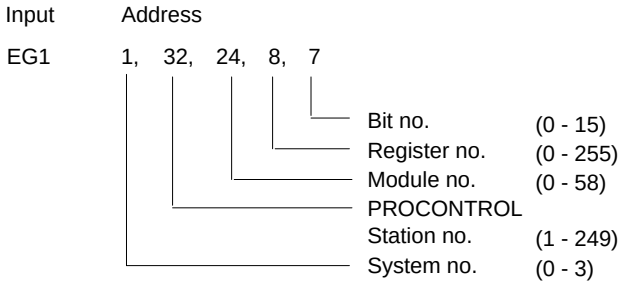
The module input and output signals are assigned to the registers of the shared memory by user entries from the PDDS.

The entries by the user are made in the form of an address list.

Address list for module inputs

In the address list for module inputs, each module input is assigned either the send-location address or the process interface of the signals to be received.

In the case of module inputs which receive their signals from the bus, addressing is done by assigning the send-location address to EGn, e.g.:



In the case of module inputs which receive their signals from the process operator station, the addressing is done by assigning L to EGn, e.g.:

The address list for inputs is translated by the PDDS into two internal lists, i.e. the ”bus address list” and the ”allocation list for module inputs”.

The bus address list contains the send addresses and the receive register numbers for all telegrams that are to be used by the module.

Received telegrams whose addresses are contained in the bus address list are written into the receive registers of the shared memory. Received telegrams whose addresses are not contained in the bus address list are ignored by the module.

The allocation list for module inputs contains for each module input the associated receive register number and, in the case of binary values, the bit position.

Address list for module outputs to the bus

In the address list for module outputs, for each signal that leaves the module a send register is defined and, in the case of binary signals, additionally a send bit, e.g.:

Address formation

The system and station address is set at the station-bus coupling module (or station-bus control module) and is then transmitted to all modules of one PROCONTROL station.

The module addresses are defined by connections made on the backplane so that the modules are set automatically when being plugged into their slot.

Limit value list

The limit value list contains 4 limit values for a maximum of 16 function blocks GRE (limit-signal generation for an analog value). It is stored in the EEPROM and - for RAM mode - in the RAM.

With the help of PDDS and EDS, limit value lists can be changed any time via a ”job memory” (RAM). In the case of EEPROM mode, these changes are stored in the EEPROM and in the RAM for RAM mode. When the user lists are transferred from the RAM into the EEPROM and vice versa, the limit value list is transferred also.

Parameter list

The parameter list contains up to 80 values for parameters of the function blocks. It is handled and stored like the limit value list.

Simulation list

Via the PDDS, a maximum of 32 module signals (function results, module inputs and module outputs) can be overwritten with constant values, i.e. be ”simulated”. This simulation list is handled and stored like the limit value list.

Event generation

For each system cycle, the module is prompted once by the PROCONTROL system to send the information stored in the send registers of the shared memory.

If values change within one cycle time, this will be treated as an event.

The module recognizes the following events:

- change of the status in the case of binary values
- change of an analog value by a fixed threshold of 0.39 % and expiration of a time-out of 200 msec since the last transmission (cyclic or per event).

Whenever an event occurs, the cyclic mode is interrupted and the new values are given priority and transmitted to the bus.

Disturbance bit evaluation, receive monitoring function

The telegrams received over the bus may be marked with a fault flag on bit position 0. This fault flag is generated by the sending module on the basis of plausibility checks and is set to ”1” if certain disturbances are present (cf. the respective module or function block descriptions).

In order to be able to recognize faults during signal transmission, the module is also equipped with a monitoring function for cyclic repetition of the input telegrams. If a signal is not repeated for a certain time (e.g. due to failure of the sending module), in the associated receive register of the shared memory, the bit of position 0 is set to ”1”. At the same time, in the case of binary-value telegrams all binary values are set to ”0”. In the case of analog values, the old value is maintained.

A set disturbance bit does not automatically cause a reaction in the module. If the disturbance bit of a telegram is to be evaluated, this is to be taken into account for the structuring procedure.

Disturbance bits of received telegrams can be used inside the module only. They are not taken over into telegrams to be sent.

Diagnosis and annunciation functions

Disturbance annunciations on the module

On the module front, light-emitting diodes indicate the following disturbances:

	LED designation
- Disturbance	ST
- Module disturbance	SG

Light-emitting diode ST indicates all disturbances of the module and the disturbances of data communication with the module.

Light-emitting diode SG indicates pure module disturbances.

Disturbance signals to the annunciation system

The annunciation system or the control diagnosis system CDS receive disturbance signals of the control module via the bus.

Diagnosis

The hardware and software functions of the module are monitored.

In the processing section of the module, the telegrams received and the formation of telegrams to be sent as well as the internal signal processing are monitored for possible faults (self-diagnosis).

In the case of a disturbance, the disturbance type is filed in the diagnosis register and, at the same time, a disturbance message is sent to the PROCONTROL system.

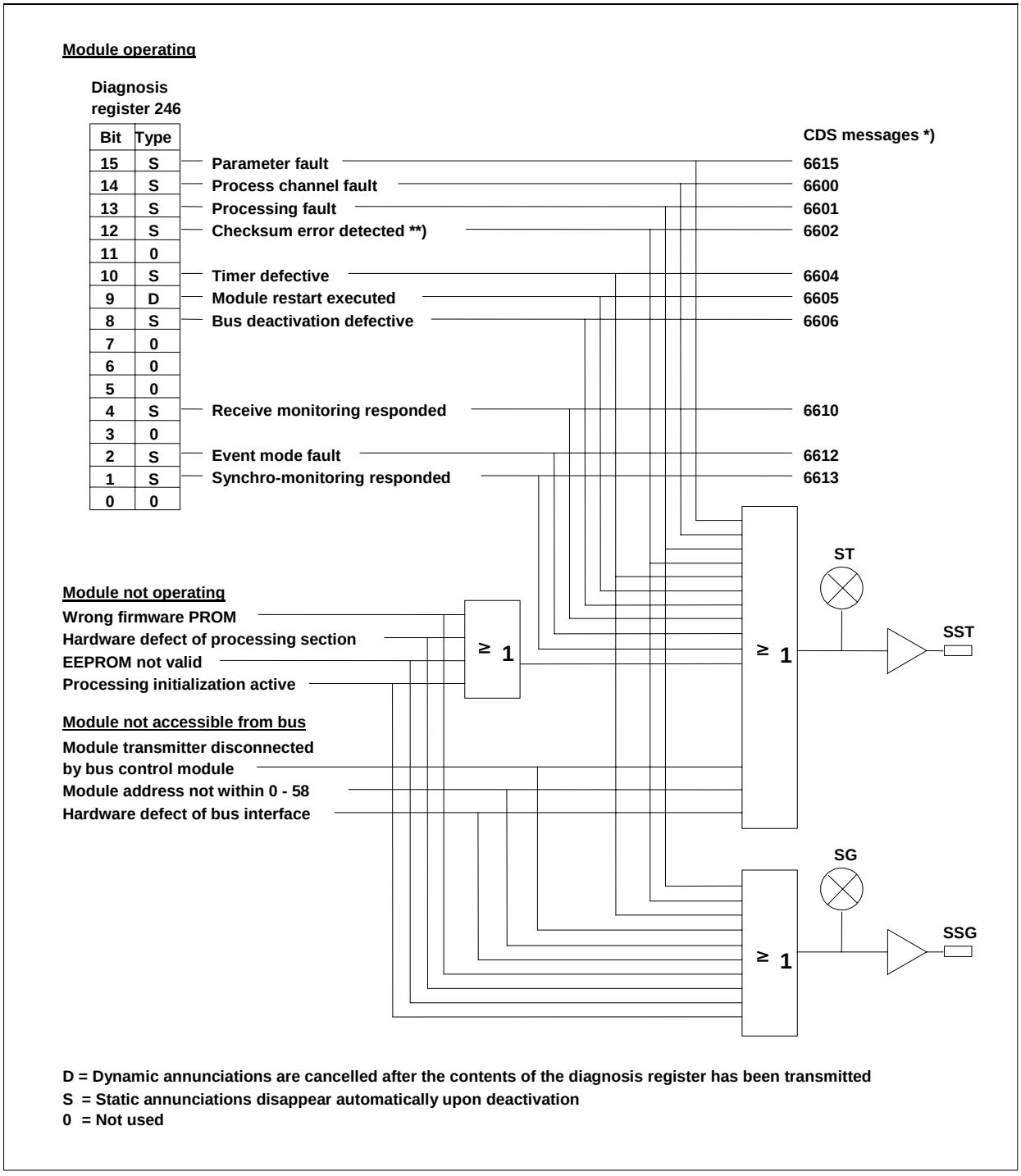
If the message ”process channel fault” is indicated in the diagnosis register, this may be due to the following reasons:

- Short-circuit at the outputs of the supply for contacts US11, US21, US31 or US41.
- Short-circuit at command outputs B11/B12/BV1, B21/B22/BV2, B31/B32/BV3 or B41/B42/BV4 (this disturbance is detected if output commands are present for more than 5 sec).
- Wire break at command outputs B11/B12/BV1, B21/B22/BV2, B31/B32/BV3 or B41/B42/BV4 (this disturbance is detected if no output command is detected).

If the message ”processing fault” is indicated in the diagnosis register, this may be due to the following reasons:

- No valid structuring,
- Driver transistor for command outputs B11/B12/BV1, B21/B22/BV2, B31/B32/BV3 or B41/B42/BV4 defective,
- Certain monitoring signals from function blocks EP07 and AP07.

Upon request, the module sends a telegram containing the data stored in the diagnosis register (register 246), cf. Figure 1.



**) This message also appears in the case of a RAM error.

Figure 1: 83SR04 diagnosis messages

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

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

Thus, fast disturbance elimination is ensured.

Operating states of the module

Initialization and bootstrapping with user lists

The initialization is effected either by plugging the module in or by connecting the voltage.

Initialization puts the module into a defined initial state. During initialization, disturbance light-emitting diodes ST and SG are on.

When the module is put into operation for the first time, no user program is available. The module indicates ”Processing fault” and disturbance light-emitting diodes ST and SG are on.

First the user program has to be transmitted from the PDDS via bus into the RAM of the module. If the structure list is the first one to be transmitted, the PDDS calls the other lists automatically. Upon each entry, the PDDS checks location and address in order to avoid wrong lists. The module checks every list received for plausibility.

Now the complete user program can be transmitted into the EEPROM upon a PDDS command.

Then the module is ready for operation and disturbance light-emitting diodes ST and SG go off.

Normal operation

The module processes the user program filed in the EEPROM.

During normal operation, the signals coming from the bus and the process interfaces are processed according to the entries made in the structure list.

Accordingly, commands are put out to the relay output modules and checkback signals from the process are sent over the bus.

Change of parameter and limit value list

Parameters and limit values can be changed via the PDDS (cf. ”limit-value list” and ”parameter list”).

Change of structure and address list

Structure and address list can be transferred from the module into the PDDS and can be changed there and transferred back to the module. This may be done according to the following procedure:

- The module should be in EEPROM mode
- Copy the complete user program from the EEPROM into the RAM using PDDS command ”KOP”
- Transfer the list (which is to be changed) from the EEPROM (or RAM) into the PDDS and change it
- Transfer the changed list into the module which means automatically storing it in the RAM
- Changing the module over from EEPROM mode into RAM mode using PDDS command ”UMS”, test new list
- For repeated change, change back into EEPROM mode and repeat the procedure

After successful testing, the complete user program can be transferred from the RAM into the nonvolatile EEPROM using:

- PDDS command ”Save” (SAV) or
- PDDS commands ”Copy RAM into EEPROM” (KOP) and ”Change-over from RAM to EEPROM” (UMS)

”Save” effects a copying of the lists and then an automatic change-over to the EEPROM without taking any influence on the processing taking place in the module or on the output of commands.

After change-overs based on command UMS (from RAM to EEPROM and from EEPROM to RAM), the user lists of RAM and EEPROM are compared. Only in the case of a discrepancy, the group control functions are set to ”Manual” mode, memory and timer elements are reset, and the commands present at the process interface are deactivated. For changed addresses at module inputs (EGn), the respective shared-memory entries are set to zero until the new data is received for the first time after the changeover. In the case of identical lists, processing is not interrupted.

Simulation

Via the PDDS, the module can be given constant values for max. 32 individual module signals. The simulation data are stored in the EEPROM for EEPROM mode and in the RAM for RAM mode.

When the user lists are transferred from the RAM into the EEPROM and vice versa, the simulation data are transferred also.

When change-overs between RAM and EEPROM are made, the respective simulation lists are maintained.

When a simulation is cancelled via the PDDS, the simulation data is deleted and the module will operate again with the data received over the bus or generated in the module.

Command functions

Activation from the control room

The module has no hard-wired control room interfaces, activation takes place over the bus.

Activation from a higher-level automatic system

A higher-level automatic system activates the module from the bus.

Command output

The output of commands for binary control functions (binary control) which were assigned certain process interfaces takes place via relay outputs B11/B12 ... B41/B42. These outputs activate the coupling relays.

The voltage for command outputs B11/B12 ... B41/B42 is provided for each function unit via a separate, internal voltage supply.

The outputs are short-circuit-proof and non-interfering.

Process signals

The process signals are connected via the hardware inputs of the module (cf. ”Function diagram” or ” Connection diagrams”).

Modes of operation

The module contains all function blocks needed for the binary control tasks for boiler protection. For a certain application, a selection of function blocks is determined for the ”operating mode”. This is done with the help of function block TXT1 which must be at the top of the structure list, followed by text modules TXT for function coding.

Operating mode	Module cycle time	Input TXT1
Binary control (and analog basic functions)	variable up to max. 700 ms *)	STR

*) protection requirements need to be taken into account.

The module cycle time results from number and type of the function blocks entered in the structure list. When function block EP07 is used, the minimum module cycle time is 25 msec.

The actually required time is filed in register 205 and can be read out from the PDDS.

For each module, the following scope of functions can be implemented:

- Boiler protection functions
- 4 group control functions e.g. GSA functions.

The module cycle time is to be taken into consideration.

The 4 process interfaces of the module including command outputs can be assigned to function blocks EP07 and AP07 whose inputs in the address list contain the abbreviation ”VPn”. The following allocations apply:

n = 1 Process interface 1
n = 2 Process interface 2
n = 3 Process interface 3
n = 4 Process interface 4

A connection to the control room is made via the process operator station.

Function blocks for the operating mode Binary control (STR)

In this operating mode, the function blocks can be used for all binary control tasks in the protection concept. Additionally, analog basic functions are available.

The module cycle time is variable, i.e. it results only from the function blocks applied.

In this operating mode, no disturbance bits are set with analog values except at the output of function block GRE.

Function block	**Abbrev.**
BINARY FUNCTIONS	
Switch-off delay element	ASV
2-out-of-3 selection, binary	B23
2-out-of-4 selection, binary	B24
M-out-of-N selection	BMN
Extended bit marshalling	BRA2
Switch-on delay element	ESV
Monostable flipflop ”break”	MOA
Monostable flipflop ”constant”	MOK
OR element	ODR
RS flipflop	RSR
AND element	UND
Counter	ZAE
BINARY GROUP CONTROL	
Group control function for sequential control	GSA2
Step function for multifunction	SCH1
LIMIT-SIGNAL ELEMENTS	
Limit signal for upper limit value	GOG
Limit signal for lower limit value	GUG
Limit signal generation	GRE

Function block	**Abbrev.**
ANALOG FUNCTIONS	
Absolute value generator	ABS
Divider	DIV
Maximum value selector	MAX
Minimum value selector	MIN
Multiplier	MUL
Monitoring and select function	MVN
Square root extractor	RAD
Summing multiplier	SMU
Disturbance bit suppression	SZU
Change-over switch	UMS
PUSHBUTTON SELECTION FUNCTIONS	
Pushbutton selection	TAW
Diagnosis	DIA
Text module for coding and remarks	TXT
Text module for setting the operating mode	TXT1
PROCESS INPUT AND OUTPUT FUNCTIONS	
Input of binary process signals	EP07
Output of binary process signals	AP07

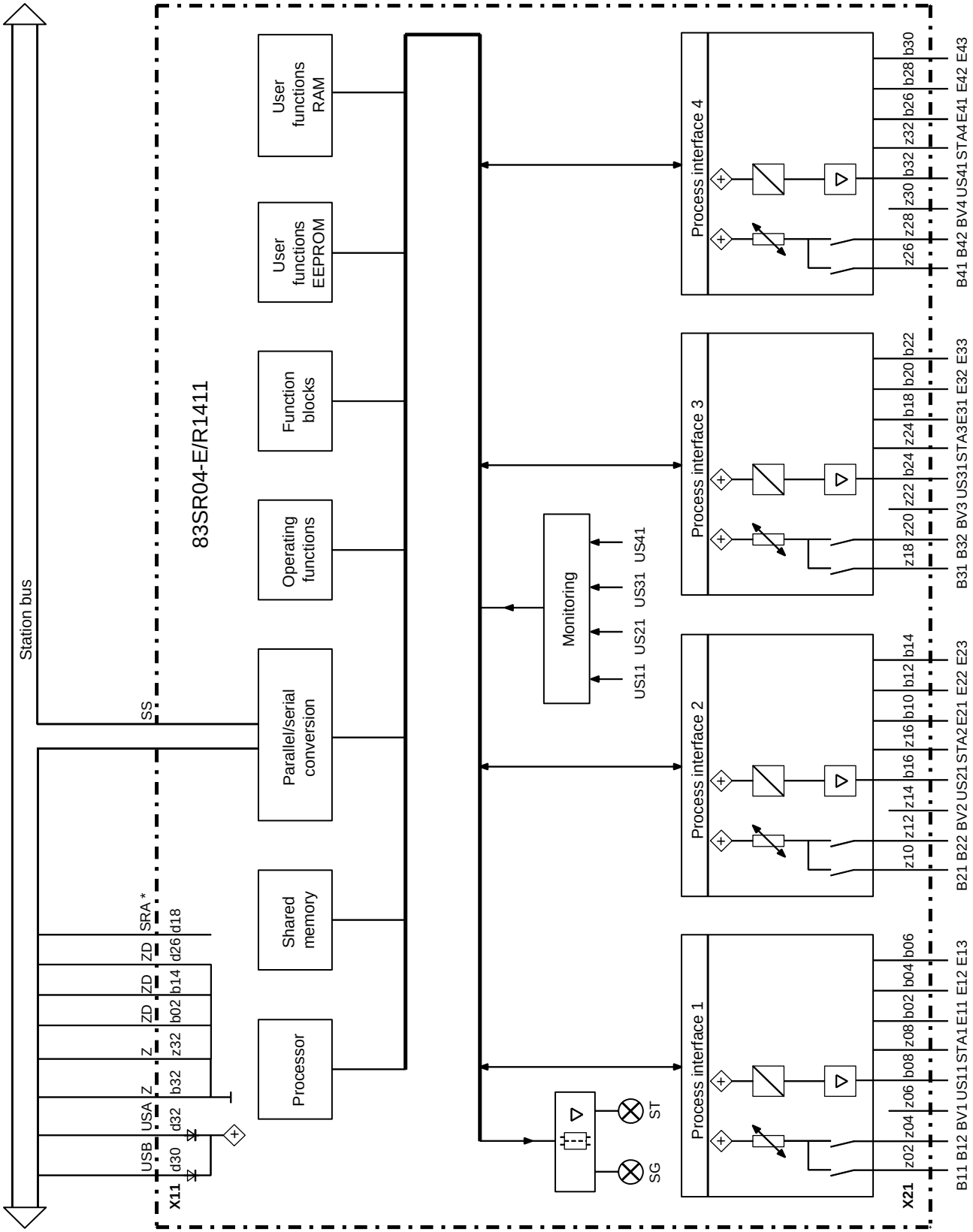
The exact specification of the function blocks as well as the procedure of structuring is indicated in the respective function block descriptions.

Function diagram

Terminal designations:

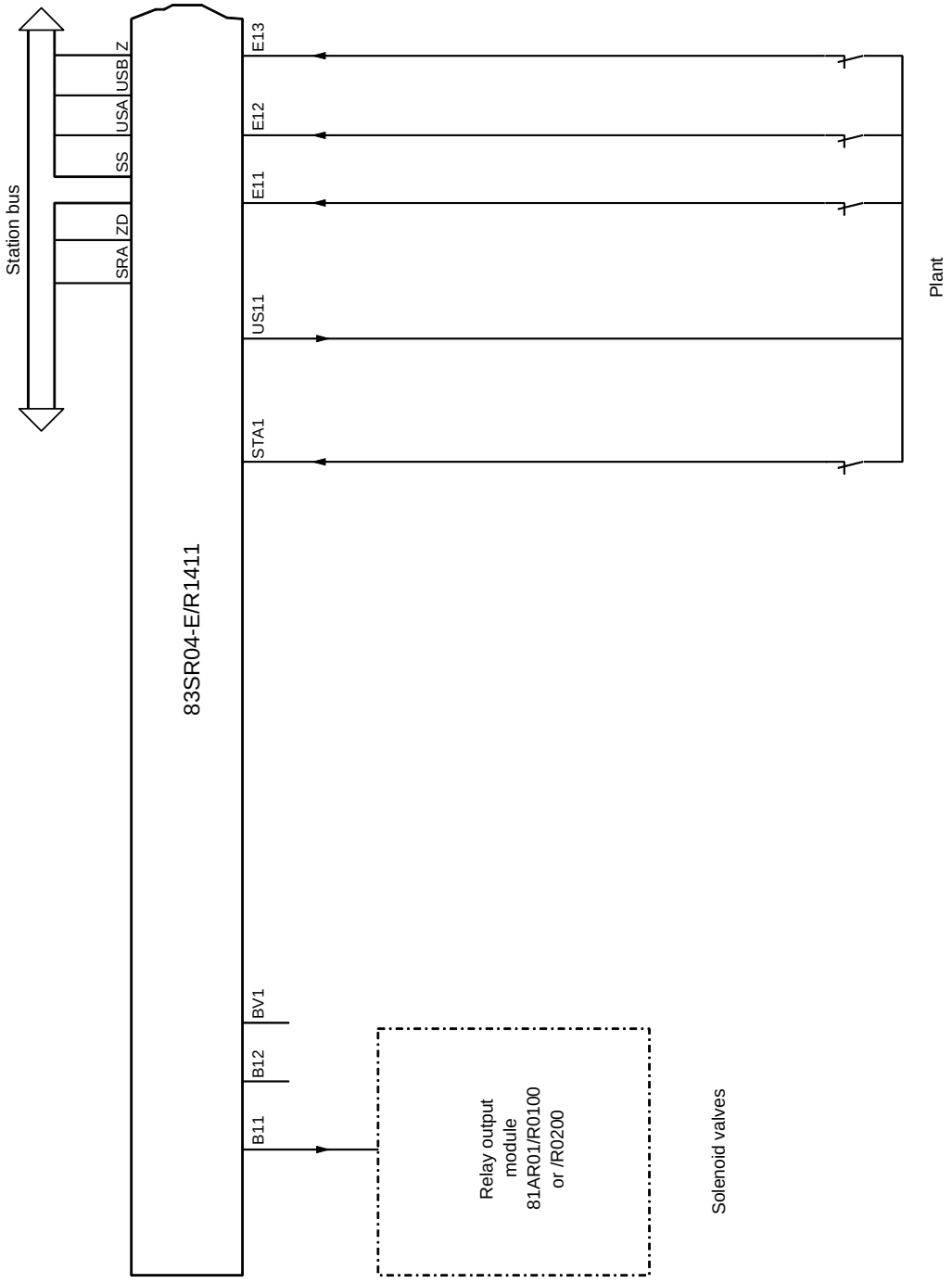
The printed-circuit board includes connectors X11 and X21.

Connector X21 contains all process inputs and outputs. Connector X11 contains the station bus terminal and operating voltages USA and USB.



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

Connection diagram for protection control
(function unit 1)



Mechanical design

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

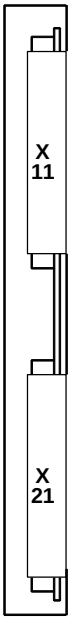
Connector: acc. to DIN 41 612

1 x For station bus connection, 48-pin edge-connector, type F (connector X11)

1 x For process connection, 32-pin edge-connector, type F (connector X21)

Weight: approx. 0.55 kg

View of connector side:

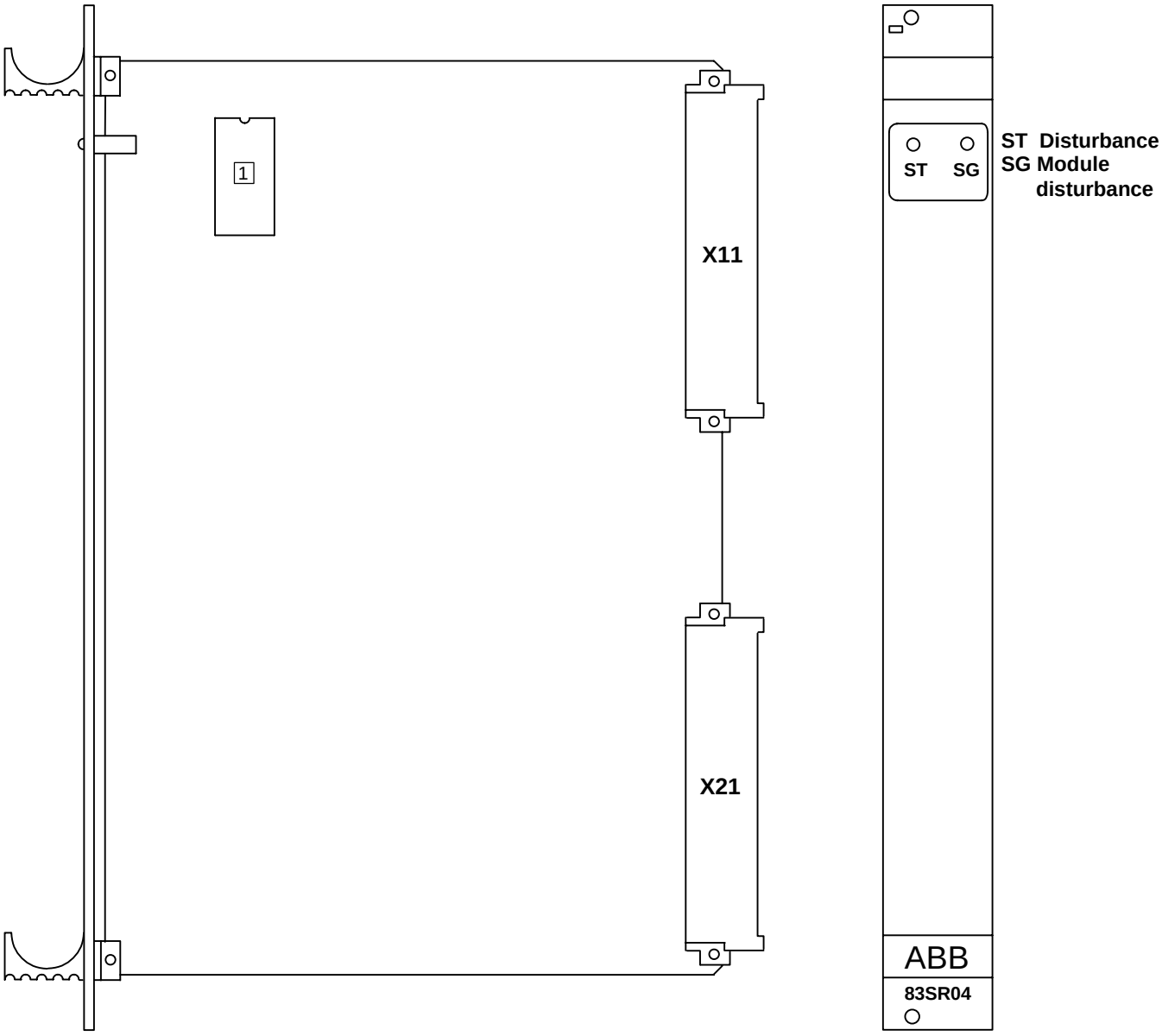


Contact assignments of the X21 process connector

View of contact side:

	b	*z*
02	E11	B11
04	E12	B12
06	E13	BV1
08	US11	STA1
10	E21	B21
12	E22	B22
14	E23	BV2
16	US21	STA2
18	E31	B31
20	E32	B32
22	E33	BV3
24	US31	STA3
26	E41	B41
28	E42	B42
30	E43	BV4
32	US41	STA4

Side view and view of the module front



1 EPROM programmed, order number: GJR2390245Pxxxx
xxxx = Position number according to the applicable program version.

Technical data

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

Power supply

Operating voltage Module	USA/USB = 24 V
Current consumption	IS = 145 mA + output currents
Power dissipation, active operating state	PV = 3.5 ... 7.0 W
non-active operating state	PV = 3.2 ... 3.5 W depending on operating voltage and configuration
Reference potential Process section	Z = 0 V
Reference potential Bus section	ZD = 0 V

Input values

Direct connections for 4 function units (FE)

Ex1	-	process signal x1	5 mA at 48 V
Ex2	-	process signal x2	5 mA at 48 V
Ex3	-	process signal x3	5 mA at 48 V
STAx	-	process signal x4	5 mA at 48 V

x from 1 to 4

Output values

CONTACT VOLTAGES

Contact voltages Process section for the inputs Ex1, Ex2, Ex3 and STAx	US11 = 48 V / ≤ 30 mA US21 = 48 V / ≤ 30 mA US31 = 48 V / ≤ 30 mA US41 = 48 V / ≤ 30 mA

x from 1 to 4

The outputs are short-circuit-proof and non-interacting.

PROCESS INTERFACE

Voltage supply of the 4 function units for the command outputs Bx1 and Bx2	24 V
The outputs are short-circuit-proof and non-interacting and are provided with a protective network	
	Loading capacity
Bx1 - Command output for x1	IS ≤ 80 mA
Bx2 - Command output for x2	IS ≤ 80 mA
BVx - Common command output for Bx1/Bx2 (wired return line)	IS ≤ 80 mA
For the connected load resistor the following limits apply	360 Ω ≤ R_{load} ≤ 15 kΩ
Service life of the relay output stages	≥ 20 million switching cycles

Wiring:

The wiring from the 83SR04 to the solenoid valves is done via relay output modules 81AR01/R0100 or /R0200.

Interference immunity (of process inputs and outputs)

Electrostatic discharge immunity	DIN EN 61000-4-2	8 kV / 4 kV
Radiated, radio-frequency, electromagnetic field, immunity	DIN EN 61000-4-3	10V/m
Electrical fast transient/burst immunity	DIN EN 61000-4-4	2 kV
Surge Immunity	DIN EN 61000-4-5	2 kV / 1 kV
Conducted disturbances immunity	DIN EN 61000-4-6	10 V

ORDERING DATA

Order No. Complete module:
Type designation: 83SR04-E/R1411 Order number: GJR2390200R1411

Technical data subject to change without notice!

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