Module Description

PROCONTROL P

Binary and Analog Control

Controller for Single Functions

with Operator's Console and
Analog Process Interface

Publication No.
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83SR05 – E/R11..

Application

The module is used for stored–program analog control of a process variable. The module incorporates a continuous output for correcting variable output. The following actuators can be activated:

– electro–hydraulic actuators

– electro–pneumatic actuators

– motor–driven actuators

With electro–hydraulic or electro–pneumatic actuators, positioning is performed locally directly at the transducer. With motor–driven actuators, positioning is performed in a continuously operating power electronic unit (type PE01 or PD02 of Messrs. Hartmann und Braun).

The basic module version is described in the following module description. The capabilities of the individual versions are dealt with in the corresponding application descriptions and functional block descriptions.

Features

The module can be plugged into every multi–purpose processing station of a PROCONTROL bus system. It incorporates a standard interface to the PROCONTROL station–bus.

The telegrams received via the station–bus are checked by the module for error–free transfer on the basis of their parity bits.

The telegrams sent from the module to the station–bus are provided with parity bits to ensure error–free transfer.

The module requires the following voltages for communication with the operator's console, the process and the switchgear:

US Operating voltage +24 V
branched internally to supply the following elements:
- US1 Pushbuttons, operator's console
- US2 Process contact transmitters (e.g. limit switches)
- US3 Power electronic contact transmitter
- UV Auxiliary voltage –24 V for increasing the communication voltage for contact inputs

UM +24 V annunciation voltage for monitoring and signalling failure of the operating or communication voltage.

The module terminals connected to UM are short–circuit–proof. Therefore, this voltage is not fuse–protected in the module.

If UM fails, the analog control function of the module remains fully effective. The voltages US1, US2 and US3 are protected in the module by PTC resistors and, therefore, do not require separate fuses.

The operating voltage US and the external logic signals are related to conductor Z. The operating voltages UD+ and UB are related to conductor ZD.

The following annunciations are indicated at the front of the module via light–emitting diodes.:

– Simulation	SIM
– Module disturbance	ST
– Annunciations to the operator's console	
Annunciation MANUAL	(LH)
Annunciation AUTOMATIC	(LA)
Disturbance annunciation	(LM)

The function of the annunciation lamp LM is not affected if the voltage US fails.

One connector X1 provided at the front of the module permits connection of the following units:

– Battery pack 89NB02
(Order No. GJR2355100R0100)
for backing module internal RAM

– RAM erasing device 89PL01
(Order No. GJR2386000R0100)
for erasing module internal RAM.

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Module design

The module essentially consists of the following:

– Binary and analog process interface
– Binary and analog control room interface
– Station–bus interface
– Processing section

Binary process interface

In this process interface, the binary process signals are adapted to the module–internal signal levels, and the module–internal signals are adapted to the signal level outside the module.

Analog process interface

In this process interface, the analog process signals are adapted to the module–internal signal levels, and the module–internal signals are converted to analog process signals.

The process interface comprises one analog input and two analog outputs.

These are provided for the following purposes:

Analog input	Any process variable (normally controlled variable X)
Analog output	Position setpoint for positioning circuit or power electronics

The analog output is permanently connected with the corresponding output of the standard function Proportional output.

The analog input enables a stand–alone analog control loop to be set up in connection with the standard functions Controller and Proportional output. In this case, the analog input is assigned to the controlled variable.

Binary control room interface

In this control room interface, the pushbutton commands are adapted to the module–internal signal levels, and the module–internal signals are adapted to the annunciation lamps in the control room.

Analog control room interface

In this control room interface, the position set–point is output simultaneously for display in the control room. The corresponding analog output is permanently connected with the analog output of the process interface.

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 signals coming from the process, the control room and the bus, the module is equipped with a microprocessor which works in conjunction with the following memory areas via a module–internal bus.

– Memory for operating program
– Memory for module input and output signals (shared memory)
– Memory for standard functions
– Memory for user program
– Memory for parameters and historic values
– RAM for structure list and limit value list

The operating program enables the microprocessor to perform the basic operations of the control module.

The exchange of information with the data transfer system takes place via the memory for the module input and output signals. It is used to buffer the signals.

The memory for the standard functions contains the ready programs for implementing the control functions.

The filed set of standard functions is selected in such a way that the specified task can be performed without additional modules. For instance, a higher–level setpoint control can be implemented in addition to the actual analog control function.

All standard functions with their inputs and outputs contained on the module can be called by the user via the control system operator station or the PDDS.

The memory for the user program contains information as to:

– how the standard functions are interconnected
– which module inputs and outputs are allocated to the inputs and outputs of the standard functions
– which constants are specified to the individual inputs of the standard functions
– which parameters are specified to the individual inputs of the standard functions
– which plant signals are allocated to the module inputs and outputs
– which sets of limit values are allocated to the analog values (applicable to module version R1145 only).

These data are specified by the user according to the plant involved, in a process which is called structuring and addressing.

The user program is stored on an erasable PROM (EPROM).

The memory for parameters, limit values and historic values is used to file parameters (e.g. KP, TN, TV, etc.), limit values and important intermediate results from computing operations (e.g. setpoints).

The parameters are determined by the user and specified to the corresponding inputs for the standard functions during structuring.

For each analog value, the limit values are entered as sets of limit values in the form of a limit value list (see section “Limit value list”).

A RAM with an external backup battery is used as memory, i.e. the parameters and limit values can be altered during operation (on–line).

The RAM for the structure list serves for simultaneous filing of the structure list. This permits on–line modifications to be made to the structure list (see Operating modes: RAM operation). The RAM with the external backup battery in which the parameters and historic values are also stored is here used as memory.

Structuring

During structuring, module inputs and outputs are allocated to the neutral inputs and outputs of the individual standard functions, or constants, parameters or outputs of other standard functions (calculated function results) are specified to the inputs of standard functions. Structuring is performed on the basis of the data supplied by the user in the form of a so–called structure list. These data can be taken from a function chart to be created beforehand.

The following limit values for the module should be observed when creating the function chart:

– max. no. of module inputs	255
– max. no. of module outputs	255
– max. no. of calcul. function results	255
– max. no. of timers	64
– max. no. of parameters	64
– max. no. of lines in the structure list	1512
– max. no. of limit values sets (module version R1145 only)	16
– Length of historic values list (bytes)	256
– Design of shared memory (see “Addressing”)	

One line means one entry on the PDDS or control system operator station. The proper procedure to be followed for structuring the standard functions is shown in the functional block descriptions.

Addressing

General

As already mentioned under “Processing”, the signal exchange between the module and the bus system takes place via a shared memory. Here, incoming telegrams to be received by the module and calculated function results which are to leave the module are buffered.

The shared memory has source registers for telegrams to be transmitted and sink registers for telegrams to be received. Register numbers 0 to 63 are defined as source registers and numbers 64 to 191 as sink registers.

The allocation of the module inputs and outputs to the shared memory registers is determined from the PDDS (programming, diagnostic and display device) or the control system operator station on the basis of data supplied by the user.

The user data are in the form of address lists.

Address list for module inputs

In the address list for module inputs, the source location address of the telegram to be received is allocated to each module input. The following data are for one module input:

Input	Address
EG1	1, 120, 54, 13, 7

where:
- 1st No. System no.
- 2nd No. Multi–purpose processing station no.
- 3rd No. Module no.
- 4th No. Register no.
- 5th No. Bit no.

When the address list is input from the control system operator station, the process–related KKS designation (Power plant designation system) can be given instead of the complete source location address.

In the case of module inputs which receive their signal directly from the analog input of the process interface or from the process operator station, special signs (V, 1 or L see Functional block catalogue) are used in place of the source address.

The address list for module inputs thus obtained is translated by the control system operator station or the PDDS into two module–internal lists, a bus address list and an allocation list for module inputs.

The bus address list contains the source location addresses of all telegrams which are to be received by the module.

Telegrams whose addresses are not included in the bus address list are ignored by the module. Received telegrams whose addresses are included in the bus address list are written to the sink registers of the shared memory.

In the allocation list, each module input is allocated the shared memory sink register number, and, in the case of binary values, also the bit position of the shared memory under which the telegram meant for it is stored.

However, the microprocessor does not work directly with the allocation list but rather with a duplicate which is stored in a random access memory.

Address list for module outputs

In the address list for module outputs, the complete source address is specified for each calculated function result that is to leave the module.

Output	Address
AG10	1, 110, 24, 28, 11

where:
- 1st No. System no.
- 2nd No. Multi–purpose processing station no.
- 3rd No. Module no.
- 4th No. Register no.
- 5th No. Bit no.

If several information items are transferred via one output of a standard function in the form of a standard telegram, (see Functional block description), the bit no. is not specified in the address list since this is already fixed in the standard telegram. The system, station and module addresses are the same for all module outputs. This information is not taken into account when the address list is input since it is otherwise specified to the module (see Formation of address) and is only of interest for computer–aided planning.

In this way, a module output allocation list is formed from the address list. In this allocation list, each module output is assigned a source register number and a bit number in the shared memory.

The allocation list has the following form:

Output	Address
AG10	28, 11

where: 1st No. Register no.
2nd No. Bit no.

Formation of adress

The system and station addresses are specified jointly for all modules in a multi–purpose processing station by means of a station–bus control module.

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

Limit value list

A limit value list is available in module version R1145 only.

The limit value list contains the sets of limit values for up to 16 sets of analog values. It is stored in the user PROM as part of the user program.

During operation, the module operates with a duplicate of this list in a RAM (same RAM as the parameter list). This enables changes at all times during operation by way of the process operator station or control system operator station. Any on–line change in a set of limit values is interpreted as simulation by the module.

Formation of event

The module is normally requested cyclically by the PROCONTROL system to transfer the data filed in the source registers of the shared memory.

If values change within the cycle time, this is treated as an “Event”.

The module recognizes the following occurrences as an event:

– Change of status in the case of binary values
– Change of an analog value by a permanently set threshold value of approx. 0.4 % and elapse of a time delay of 200 ms since the last transfer (cyclic or event).

If an event occurs, cyclic operation is interrupted and the new values are transferred to the bus with priority.

Diagnosis

The received telegrams and the formation of the telegrams to be sent as well as the internal signal processing are monitored in the processing section of the module for error–free operation (self–diagnosis).

In the event of a disturbance, the type of disturbance is filed in the diagnosis register and a disturbance annunciation is simultaneously sent to the PROCONTROL system. The module transfers a diagnosis telegram with the data stored in the diagnosis register after bus grant.

It is also possible to scan the current status of the module and the data at any time from the control system operator station or the 89PT01.

The diagnosis register can be called under the complete address. The diagnosis register has the register number 246 and the data type 0.

Disturbance bit

The telegrams supplied via the bus are partly provided with a fault flag on bit position 0. This fault flag is generated by the source module on the basis of plausibility checks and the dis–turbance bit is set to “1” in the event that specific disturbances are present (see Functional block descriptions).

In order to be able to detect errors during signal transfer, the module also incorporates a feature that monitors the input telegrams for cyclic renewal. If a signal has not been renewed within a certain time, (e.g. due to failure of the source module), bit 0 is set in the allocated sink register of the shared memory. In binary value telegrams, all the binary values are simultaneously set to “0”. In the case of analog values, the previous value is retained. By setting of the fault flag in analog values, the module is prevented from working with a historic value.

A set disturbance bit does not automatically involve a reaction in the sink module. If the disturbance bit of a telegram is to be evaluated, it must be allocated to an input of a standard function during structuring or to a module input during addressing.

External power supply to the RAM

The following means are available for external power supply to the RAM:

– Capacitor for short–term voltage failures
  (forms part of the module)
– For long–term power supply (module withdrawn), the battery pack 89NB02 can be plugged into the module front (connector X1).

Erasing of the RAM is possible by means of RAM erasing device 89PL01 which can be plugged into the module front (connector X1).

Important:

Battery backup for the RAM of the module is only effective in the event of a power failure if the battery pack 89NB02 is in place.

Command functions

Actuation by pushbuttons

The module is controlled from the operator’s console by pushbutton commands TZ, TO and TH. The internal processing of the pushbutton commands is determined by the standard function ASP.

Actuation by higher–level automatic system

A higher–level automatic system controls the module via the station–bus standard interface SS.

Protective commands

The logic combinations for release and protective commands are specified as required for the plant involved. Input signals are input via the station–bus standard interface.

Acknowledgement

Disturbance annunciations and discrepancy annunciations are acknowledged by pressing pushbutton TH.

Analog output

The position setpoint is output to electro–hydraulic, electro–pneumatic or motor–driven actuators via a hardware interface. This output can be reversed, during structuring, for adapting the position setpoint to the direction of action of the positioner.

Drive release

The output Drive release AF for the power electronics is automatically set to “1” when the initialization phase of the module has been completed and the operating–mode–dependent release is available from drive control function ASP. The output is permanently connected with the appropriate output of standard function ASP.

Annunciation functions

Annunciations to the operator's console

Three lamps can be connected to the operator's console via outputs LH, LA, and LM through a direct connection. The direct connection includes input BLS to which the appropriate flashing voltage is connected for the flashing disturbance light.

The kind of annunciation by steady light and flashing disturbance light is explained in the functional block description for ASP. It is independent of whether this function is implemented on the control room coupling module or on the control module itself.

Disturbance annunciations on the module

A light–emitting diode ST is provided at the front of the module. It is used to indicate module disturbances that are filed simultaneously in the diagnosis register.

The light–emitting diodes LH, LA, and LM are activated simultaneously with the corresponding annunciation lamps in the operator's console.

Disturbance annunciations to the alarm annunciation equipment

The alarm annunciation equipment or the facility for communication between the operator and the control system receive disturbance annunciations from the control module via the bus.

Generation of disturbance annunciations

The disturbance annunciations are generated by the microprocessor according to a program specification. The generation of disturbance annunciations is explained in the functional block descriptions.

Operating modes

Normal operation

In normal operation, signals arriving via the bus and the process and control room interface are processed according to the data in the structure list.

Depending on this, commands are output to the switchgear, and checkback signals identifying the process status are sent via the bus.

Simulation

The control system operator station permits constant values to be specified to the module for individual module input signals arriving from the transfer system during normal operation. In this case, the information specified in the allocation list for module inputs is overwritten in the allocation list duplicate by constants which are filed in a simulation list.

The inputs PRO Process signals and VOH Local manual control of the drive control function ASP cannot be simulated.

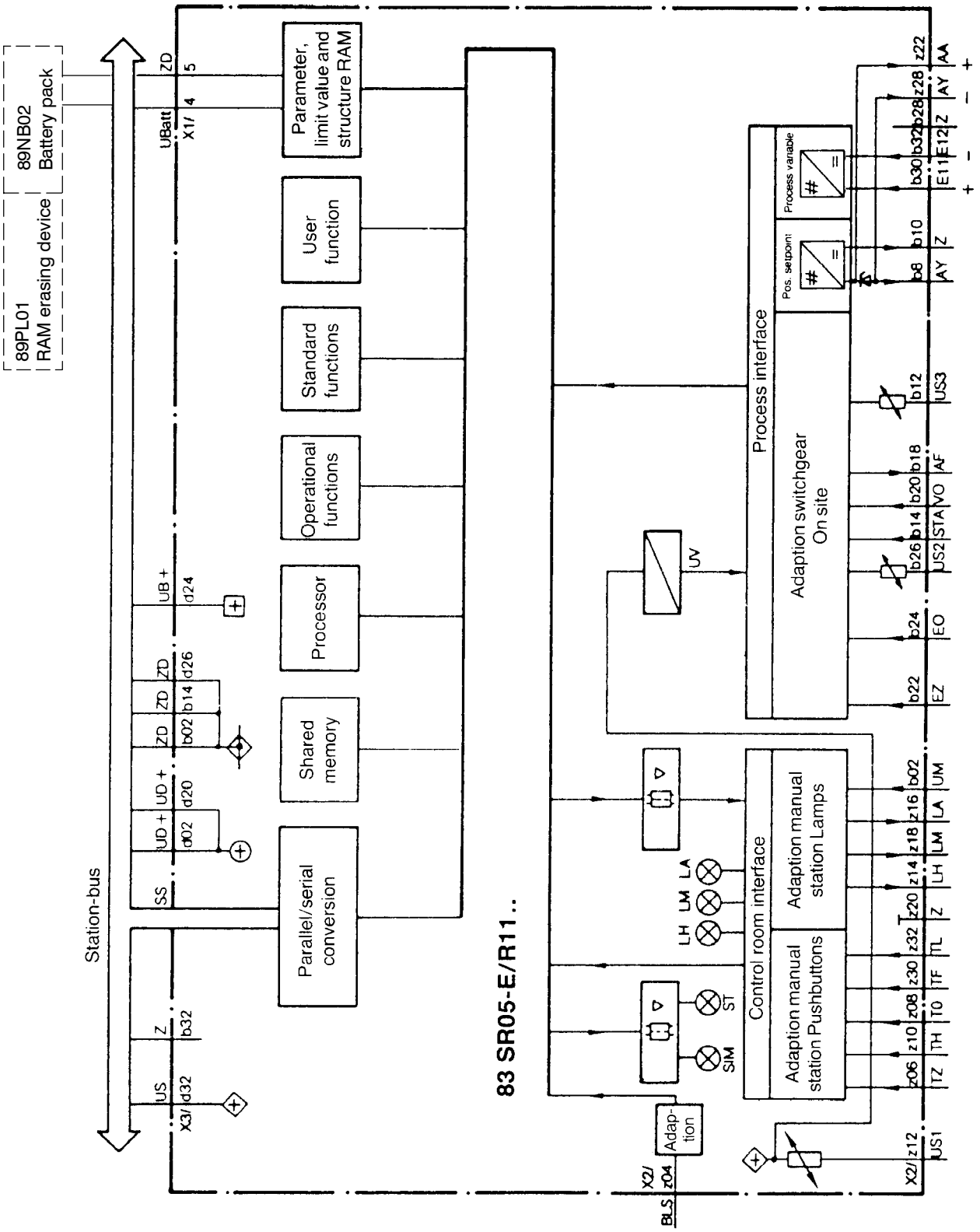
Simulation of signals or limit values is indicated at the front via the light–emitting diode SIM.

The light–emitting diode SIM is also set when a "1" signal is present at input VOH of a drive control function or at input S of a pushbutton selection function.

Operation with structure list on RAM memory

An instruction given via the control system operator station allows the structure list filed on the PROM to be duplicated onto the RAM with external power supply. The microprocessor of the control module can also be instructed to work with the RAM instead of the PROM. Modifications and amendments can then be made in the structure list via the control system operator station or the PDDS. The light–emitting diode SIM at the front of the module is also set in this operating mode.

Functional diagram



Mechanical design

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

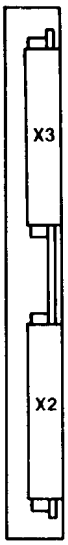
Connector: to DIN 41 612

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

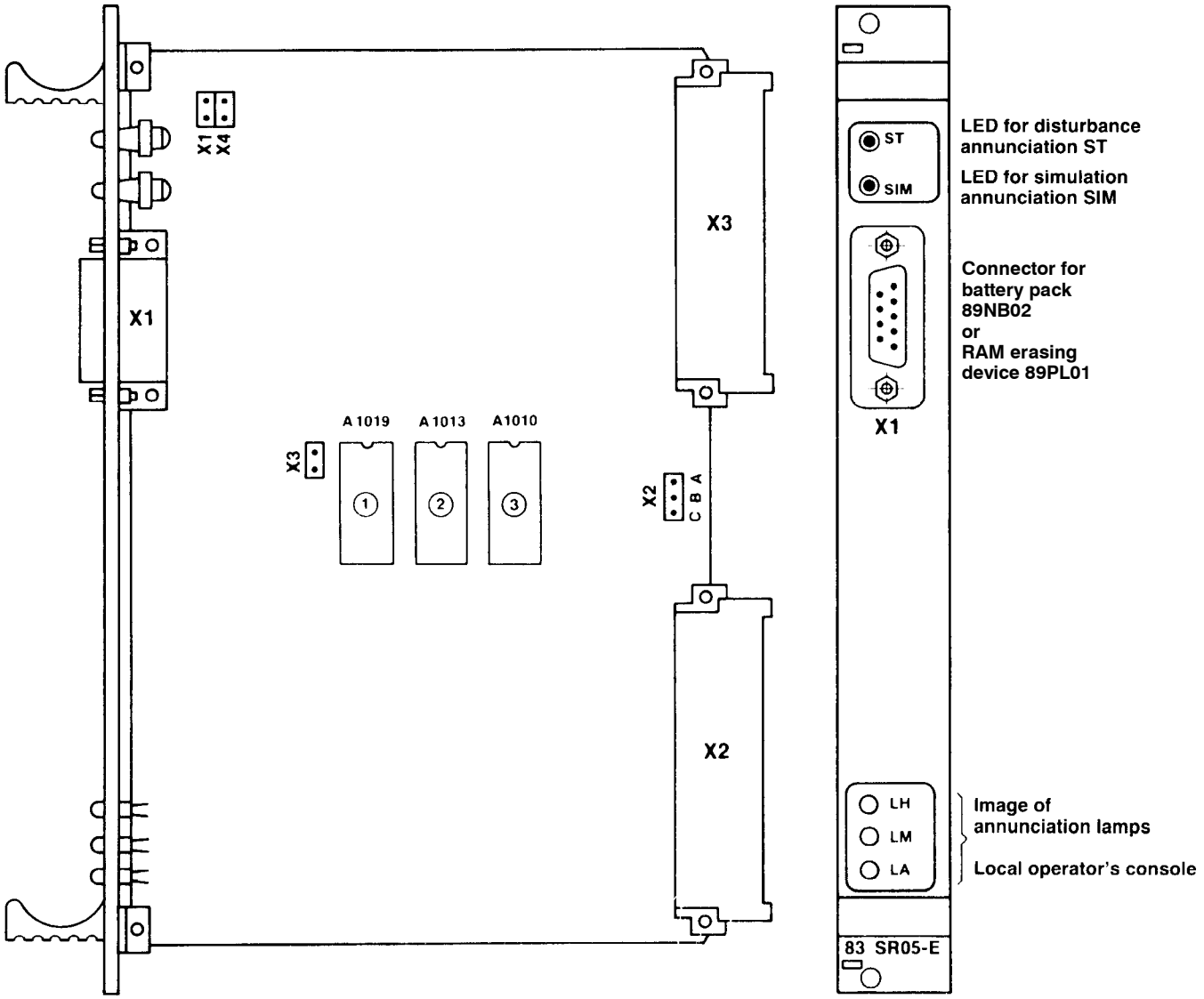
1 x for process connection,
32–pole, edge connector type F
(connector X2)

Weight: approx. 0.55 kg

View of connector side:



Positions of jumpers (as–delivered condition) and memory modules as well as the module's front panel



(1) Memory module user program A1019 (structure and addresses)

(2) Memory module basic program A1013

(3) Memory module basic program A1010

Notes:

User program:

An EPROM of type 2764 A is used as memory module for the user program.

Jumpers:

– jumpers X1 and X4 must always be plugged in
– jumper X2 must always be plugged in position B–C
– jumper X3 can be used to adjust the output current range:
  X3 plugged in: 0 – 20 mA; X3 not plugged in: 4 – 20 mA

Technical data

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

Power supply

Operating voltage process section	US = +24 V UM = +24 V
Operating voltage bus section	UD+ = + 5 V UB+ = +24 V
Reference potential process signals	Z = 0 V
Reference potential bus section	ZD = 0 V

Input values

Binary

BLS	– Flashing disturbance light	0.5 NL
EZ	– Process checkback signal CLOSED	5 mA at 48 V
E0	– Process checkback signal OPEN	5 mA at 48 V
STA	– Disturbance in switchgear	5 mA at 48 V
TZ	– Push button command CLOSED	1 NL
T0	– Push button command OPEN	1 NL
TF	– Push button command/Release	1 NL
TH	– Push button command MANUAL	1 NL
TL	– Push button command Lamp test	1 NL
VO	– Local intervention	5 mA at 48 V

Analog

E11	– Controlled variable X or any process variable	0 ... 20 mA
E12		RE = 100 Ohm

Output values

Binary		Loading capacity
AF	– Drive release for power controller	10 NL
LH	– Lamp for MANUAL	100 mA
LA	– Lamp for AUTOMATIC	100 mA
LM	– Annunciation lamp	100 mA

Analog

AY–Z	– Position setpoint	0/4 ... 20 mA Burden max. 500 Ohm
AA–AY	– Position setpoint display in control room	0/4 ... 20 mA Burden max. 100 Ohm

ORDERING DATA

Order No. for complete module:

Type designation: 83SR05–E/R11..
Order number: GJR2369900R11..

Order No. for plug–in memory modules:

Memory module	Position	Type	Order number
User program	A1019	2764A	GJTN160212P1
Basic program	A1013	27128	GJR2352502Pxxxx
Basic program	A1010	27128	GJR2352501Pxxxx

Pxxxx: Position number corresponding to appropriate revision.

Note on complete module:

The module is supplied with all blank PROMs for the basic and user programs under type designation 83SR05–E/R1100 with the order number GJR2369900R1100. The blank PROMs are not plugged in.

Note on single PROMs:

All programmed PROMs required for the basic program for the module and all blank PROMs for the user program are supplied under type designation 83SR05/R00xx; xx denotes the appropriate software version.

Technical data are subject to change without notice!

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