Attn：Smiling
Mobile/WhatsApp/Wechat:+86 18050035902
E-mail: info@htechplc.com

PROCONTROL P
Transfer

Module and Application Description

Redundancy Control Module

Publication No.
D KWL 6328 93 E, Edition 03/97
Replacing D KWL 6328 93 E, Edition 01/95

88TR01/R1210

Application

In a PROCONTROL station, the redundancy control module is used for redundancy applications.

The redundancy control module

- recognizes redundancy−relevant disturbance signals issued by redundant modules of its own redundant station,
- monitors the proper functioning of the modules of its own redundant station,
- monitors the proper functioning of its own redundant station on the remote bus,
- monitors the redundant stations for identical configuration, and
- monitors its own essential module functions.

Whenever a redundancy−relevant monitoring function does respond, this module will − in conjunction with the redundancy control module of the other redundant station − effect a redundancy switchover.

When a station is used as a redundancy, the station's address may be within n = 1 to 121. In that case station address n+128 must not be used by any other station.

Features

The redundancy control module uses a standard interface with the PROCONTROL station bus. Connection with the redundant modules is established by the printed station−bus circuit board. Connection with the other redundancy control module is established through the partner interface on the lower edge−connector of the module as well as via the PROCONTROL bus.

By their parity bits, the telegrams received from the bus are checked by the module for fault−free transmission.

The telegrams sent from the module to the bus are provided with parity bits. This ensures fault−free transmission.

Disturbances in the module, disturbances in the redundant station, and the module state are indicated by light−emitting diodes (ST, SG, SR, DF, BE, AK) located on the module front.

The redundancy control module continuously scans the state of its redundant station. Should a disturbance occur in its own redundant station, the module will effect a switchover. In case the other redundant station is not fault−free, a switchover will not be made.

Design of the module

The module mainly consists of:

- Partner interface
- Switchover logic
- Station bus interface
- Processing section

Partner interface

Inside the partner interface, the signals from/to the redundancy control module of the other redundant station are adapted to the signal level inside the module.

Switchover logic

The switchover logic contains the control and monitoring logic for a redundancy switchover.

Station bus interface

Inside the station bus interface, the module signals are adapted to the station bus level. Mainly a parallel/serial conversion takes place.

Processing section

The module uses a microprocessor for processing the signals coming from the redundancy control module of the other redundant station and from the bus. Through a bus inside the module, this microprocessor cooperates with the following memory areas:

Contents	Storage medium
Operating program	EPROM
Address list of redundant modules	EEPROM
Current module input and output signals (shared memory)	RAM

The operating program allows the microprocessor to perform the operation of the module.

The address list of the redundant module locations is filed in the non−volatile EEPROM.

The ACTUAL values of the modules received by the redundancy control module are stored in the RAM.

The exchange of information between the module and the bus system takes place over the memory for module input and output signals. This memory is used for buffering the signals.

Addressing

General

Signal exchange between module and bus system takes place over the shared memory. This shared memory is used for buffering incoming telegrams that are to be received by the module as well as module−internal computed results which are to leave the module.

For this purpose, the shared memory is provided with send registers for telegrams to be transmitted and with receive registers for telegrams to be received. The information on the partner module is filed in the send registers. The telegrams received from the partner module and from the monitored modules of the module's own redundant station and of the redundant partner station are stored in the receive registers.

Address formation

The system and station address is set on the 88TK05 station−bus coupling module which transmits it to all modules belonging to the PROCONTROL station.

The fixed setting of the module address of the redundancy control module is **59**.

Designation rules and modes of operation

Redundancies A, B

The designations ”redundancy A”, ”redundancy B” refer to location. The following designation rules are to be adhered to:

If the redundant stations are located in two different cabinets, these cabinets have to be arranged next to each other. Seen from the front, the left cabinet shall always be designated as redundancy B, the right cabinet as redundancy A.

If the redundant stations are housed in one and the same cabinet, seen from the cabinet front, the upper redundant station shall always be designated as redundancy A, the lower redundant station as redundancy B.

Setting the redundancy mode

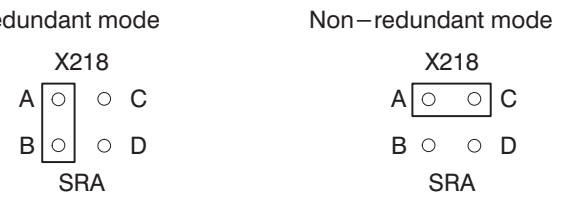
The PROCONTROL station is suitable for redundant as well as for non−redundant applications.

The desired mode of operation is set by means of plug−type jumpers on

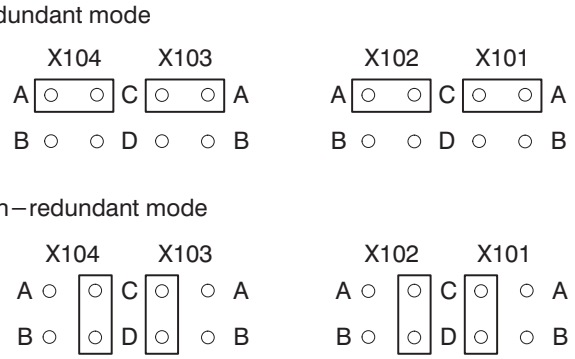
- Station−bus p.c.b. 89IL05 or 89IL07 respectively, and
- Connection p.c.b. 89IL06 for 88FT05 and 88TK05.

The setting points are accessible from the cabinet rear. Normally, the setting is done in the factory by the manufacturer.

Settings on all station−bus p.c.b.s, 89IL05, 89IL07, seen from the cabinet rear:



Settings on the 89IL06 connection p.c.b., seen from the cabinet rear:



Setting the privileged redundant station

A wired connection at the lower module connector (X21) of the redundancy control module of redundancy A between AZP (contact z08) and EPS (contact b12) is used to set the privileged redundant station. This connection is not used on the non−privileged redundant station.

Always set redundancy A to be the privileged redundant station and redundancy B to be the non−privileged one.

Determining a privileged station is important for the initialization phase (see also chap. on ”Sequence of functions”).

ACTIVE redundancy, PASSIVE redundancy, synchronous operation

The redundancy control module selects the ACTIVE redundancy station in accordance with fixed rules (see also chapter ”Function sequences”).

PASSIVE redundancy refers to the non−active redundant station.

The modules of the ACTIVE redundant station send their telegrams with station address n (n=1 through 121) to the remote bus.

The PASSIVE redundancy sends its diagnosis telegram and, for each module, the telegram having register address 0 with station address n+128 on the remote bus (sign−of−life telegram). The diagnosis telegrams are sent by station−bus coupling module 88TK05 and the redundancy control module.

The modules of the ACTIVE as well as the ones of the PASSIVE redundant station receive all telegrams from the remote bus.

Synchronous operation of both redundant stations is automatically ensured by the ACTIVE redundancy. For this purpose, in the event of any changes, the modules of the ACTIVE redundancy send their synchronous−operation information in event mode to their partner modules of the PASSIVE redundancy. In addition, the synchronous−operation information is transmitted cyclically in the background (per remote−bus cycle, for each redundant station). This function is being monitored (monitoring time 27 ... 41 min) and any failure is indicated (diagnosis message: ’Init. synchro−monitor. responded’; diagnosis register 246, bit 1).

Making changes in the user software

The redundancy control module monitors both redundant stations for identical software configuration. An activated light−emitting diode DF on the module front indicates that the software of both redundant stations is not identical. In that case, also a diagnosis message will be issued. The PASSIVE redundancy is not READY for take−over. The READY lamp of the PASSIVE redundancy is not on.

If only one redundant station is put into operation, the other redundant station needs to be adapted to the same status if it is to be activated later on.

When both redundancies are in operation, it is possible to make changes in user programs, e.g. structure lists or parameters, on the modules of both redundant stations by the PDDS/EDS. As a rule, first the ACTIVE and then the PASSIVE redundant station will be served. The service personnel does not need any special redundancy−related knowledge.

However, it is to be noted that redundancy switchover is inhibited for each module where the user program is being changed. For this purpose, the PDDS/EDS sends an instruction for setting the inhibition to the redundancy control module of the ACTIVE redundancy. A switchover inhibition (diagnosis register 246, bit 10) is set with the following PDDS/EDS interventions:

- Writing into a non−active RAM of a module belonging to the ACTIVE or PASSIVE redundancy
- Changing using the job memory in the ACTIVE or PASSIVE redundancy
- Activating programs on modules belonging to the ACTIVE or PASSIVE redundancy by means of commands UMS or SAV.

The PDDS/EDS knows which changes require a following sum−CRC−check or the sending of synchronous−operation telegrams and initiates the necessary transmission on the changed modules per instruction telegram. This ensures that a redundancy switchover is only possible if − as is the case with initialization (see chapter on ”Initialization”) − the PASSIVE redundancy is identical again with the ACTIVE redundancy and synchronous operation is achieved again.

After PDDS/EDS interventions have been completed, the switchover inhibition is reset by an instruction.

An activated inhibition is signalled by the ACTIVE redundancy control module through a flashing light−emitting diode BE.

After an inhibition is set, a monitoring time of approx. 3 min is started on the redundancy control module. If the PDDS/EDS does not cancel its inhibition within this time, the inhibition is cancelled by the redundancy control module, and in diagnosis register 246 bit 11 (diagnosis message: ”Blocking by EDS/PDDS expired”) will be set for approx. 16 sec (longer than 2 remote−bus cycles of 7.5 sec each).

Simultaneous access of several PDDS/EDS systems is admissible within one redundancy. Each new access will restart the monitoring time. A switchover is allowed only after the last PDDS/EDS has completed its activities.

Hardware changes

The redundancy control module monitors both redundant stations for identical hardware configuration.

Whenever the redundancy control module detects any hardware change in one of the redundant stations after initialization (see also chap. ”Function sequences”), it will respond as follows:

- Light−emitting diode SR of the redundancy concerned (ACTIVE, PASSIVE) is ON. A diagnosis message will be issued.
- Light−emitting diode DF is on in both redundancies. A diagnosis message will be issued.
- A hardware change in the ACTIVE redundancy causes a redundancy switchover to the PASSIVE redundancy provided it is in a READY state. Should that station not be READY, there will be no redundancy switchover.
- A hardware change in the PASSIVE redundancy renders this station not READY for a redundancy switchover.

Making hardware changes while a redundancy operation is activated should be avoided, since only a limited amount of redundancy functions would be available then. However, if such hardware changes are inevitable, follow the procedure described below. A distinction needs to made between the following two cases:

a) Removing a pair of modules

If a pair of modules needs to be removed from a redundancy station, follow the procedure below:

- Remove module from PASSIVE redundancy (light−emitting diode SR on the redundancy control module is illuminated; the PASSIVE redundancy is no longer in the READY state).
- Wait until the redundancy control module in the PASSIVE redundancy signals a discrepancy by an illuminated light−emitting diode DF.
- Remove the module from the ACTIVE redundancy.
- After the monitoring time has expired, the activated disturbance lamps and diagnosis messages are automatically deactivated.

b) Adding a pair of modules

If a pair of modules is to be added, follow the procedure below:

- Check whether the modules are of identical hardware status (type, version, change index) and software status (ident. no., P version).
- Plug module into the PASSIVE redundancy (light−emitting diode SR on the redundancy control module is illuminated; the PASSIVE redundancy is no longer in the READY state).
- Wait until the redundancy control module signals a discrepancy by an illuminated light−emitting diode DF.
- Plug module into the ACTIVE redundancy (light−emitting diode SR on the redundancy control module is illuminated).
- Make sure to provide for an identical software status on both modules (cf. chapter on ’Making changes in the user software’). As soon as an identical software status is detected, the redundancies will automatically start normal operation to the effect that the illuminated disturbance lights and diagnosis messages will be deactivated again.

Sequence of functions

Initialization

Initialization is effected when the redundancy control module is plugged in or when the voltage supply is connected. Initialization results in a defined module status. During the initialization phase, the disturbance light−emitting diodes ST and SG are on.

Initialization results in the following operating states:

- If both redundancies have been initialized at the same time, and both are found either fault−free or faulty, upon completion of the initialization phase one redundancy will be ACTIVE.
- If both redundancies have been initialized at the same time, and one of them is found faulty, upon completion of the initialization phase that station will be ACTIVE which is fault−free.
- If only one redundancy has been initialized, upon completion of the initialization phase this station will be PASSIVE in case the other redundant station is fault−free.
- If only one redundancy has been initialized, upon completion of the initialization phase this station will be ACTIVE in case the other redundant station is faulty.
- If only one redundancy has been initialized and both redundancies are faulty, upon completion of the initialization phase the additionally connected redundant station will be PASSIVE.
- If only one redundancy is present and is initialized, it will be ACTIVE.

A state of ”both redundancies PASSIVE” is prevented by the redundancy control module. A state of ”both redundancies ACTIVE” can be present during the initialization phase or a redundancy changeover (max. 5 msec) only. After completion of the initialization phase or a changeover, this state is prevented by the redundancy control module.

After the ACTIVE redundancy is identified, the following functions will be performed:

- Module−internal normalization.

  During this time, sending telegrams from the redundancy is inhibited.
- The partner interface of the redundancy control module is checked.
- The software status (firmware and user software) of the modules of both redundancies is assessed.

  This procedure requires 1 to 2 remote−bus cycles. The redundancy control modules use it to prepare their actual−value list for the software status of the modules and the equipment status.
- Synchronous operation of ACTIVE and PASSIVE redundancy is ensured. This procedure takes approx. 1 to 2 remote−bus cycles.

After synchronous operation has been established and the module software statuses have been compared (duration < 100 msec), initialization is completed.

When the module software statuses of both redundancies are identical, both redundancies are ready for operation. If they are not identical, the PASSIVE redundancy immediately enters the not READY state.

The lists of sum CRCs generated during initialization are used in normal operation for checking the identical structure of the two redundancies.

Normal operation

During normal operation, the redundancy control module monitors

- Redundancy−relevant disturbance messages of the modules in its own redundant station,
- Proper functioning of the modules in its own redundant station,
- Proper functioning of its own redundant station on the remote bus,
- Identical configuration of both redundant stations

  and
- Essential module functions of its own.

As soon as it recognizes a fault which is expected to lead to a redundancy switchover, it will control the switchover in cooperation with the redundancy control module of the other redundant station.

Redundancy switchover and related diagnosis messages

A redundancy switchover is effected whenever a redundancy−relevant fault is detected in the ACTIVE redundant station and the PASSIVE redundant station is in a READY state, i.e. is not faulty.

In case there is a condition requiring a redundancy switchover, first the active outputs are switched off and then the outputs of the PASSIVE modules in READY state are activated.

A redundancy switchover is effected (diagnosis message: 'Redundancy switchover executed'; diagnosis register 246, bit 0, in the PASSIVE redundancy):

– When the redundancy control module – via the SSG line of the station bus – recognizes a module signal in the presently ACTIVE redundant station.

  The SSG line is that line which is used by all modules of the manager's own station to indicate their proper functioning to their redundancy control module.

  Relevant diagnosis message: "Redundancy fault".

– If the redundancy control module in the ACTIVE station detects and signals a fault in its own firmware (check sum error).

  Relevant diagnosis message: "Checksum error detected".

– When the redundancy control module recognizes that an additional module has been plugged into the ACTIVE station.

  Relevant diagnosis message: "Station allocation different".

– When the redundancy control module recognizes that after initialization a module in the ACTIVE redundancy has either been removed or has stopped transmitting.

  Relevant diagnosis message: "Station allocation different".

– Whenever the redundancy control module recognizes that the ACTIVE redundant station no longer transmits signals to the remote bus.

  Relevant diagnosis message: "Transmit path fault".

– Whenever the redundancy control module recognizes that the ACTIVE redundant station does not receive any signals from the remote bus.

  Relevant diagnosis message: "Receive path fault".

– Whenever the redundancy control module recognizes that there is a fault present in its hardware for redundancy switchover. A hardware check is performed about every 5 min.

  Relevant diagnosis message: "Switchover hardware defective".

Redundancy READY and relevant diagnosis messages

If the PASSIVE redundant station is in a READY state, it is available for a switchover in case a redundancy−relevant fault has been detected in the ACTIVE redundant station.

The READY state is indicated by a light−emitting diode on the module front of the redundancy control module of the redundant station which is PASSIVE at the time.

The PASSIVE redundant station is not READY if a redundancy−relevant fault is present (see also description of the redundancy−relevant faults under "Redundancy switchover and relevant diagnosis messages", however, under the aspect that the disturbances described do occur in the PASSIVE redundant station).

The PASSIVE redundant station is also not in a READY state if one of the following conditions has been detected:

– When the redundancy control module detects that the partner interface is disturbed (checking at least once per remote−bus cycle).

  Relevant diagnosis message: "Partner connection fault".

– When the redundancy control module detects that the module user lists of the modules differ in both redundancies.

  Relevant diagnosis message: "Diff. module user lists A/B detected".

– When the redundancy control module detects that the firmware status (P number) of its partner module is not identical.

  Relevant diagnosis message: "Diff. module user lists A/B detected".

– When a switchover from ACTIVE to PASSIVE has been made. The status "not READY" does last approx. 60 sec.

Signal designations

Signals from or to the station bus

– SRA = Active redundancy output (issued to the SRA line of the station bus and from there to the modules of the redundant station)
– SSG = Module disturbance input (coming from the SSG line of the station bus, the line being activated in the case of redundancy-relevant faults)

Signals from the partner interface

Signals for redundancy switchover to the redundancy control module of the other redundant station:

– AZP = ”Partner available” message
– AT1 = ”Partner ACTIVE” control signal 1
– AT2 = ”Partner ACTIVE” control signal 2
– APP = ”Partner PASSIVE” control signal
– ASR = ”Redundancy switchover to partner” inhibited
– AAR = ”Redundancy ACTIVE” message to partner
– APR = ”Redundancy PASSIVE” message to partner

Signals for redundancy switchover from the redundancy control module of the other redundant station:

– EZP = ”Partner available” message
– ET1 = ”Partner ACTIVE” control signal 1
– ET2 = ”Partner ACTIVE” control signal 2
– EPP = ”Partner PASSIVE” control signal
– ESR = ”Redundancy switchover from partner” inhibited
– EAR = ”Redundancy ACTIVE” message from partner
– EPR = ”Redundancy PASSIVE” message from partner

Diagnosis bus from/to the redundancy control module of the other redundant station:

– AEP0 =
– AEP1 =
– AEP2 =
– AEP3 =
– AEP4 =
– AEP5 =
– AEP6 =
– AEP7 =

} Data lines

Status signals for the data of the diagnosis bus to the redundancy control module of the other redundant station:

– PSS0 = Processing active
– PSS1 = Ready to send synchronous–operation telegrams
– PSS2 = Reception monitoring did not respond
– PSS3 = Ready

Status signals for the data of the diagnosis bus from the redundancy control module of the other redundant station:

– EPS0 = Processing of partner active
– EPS1 = Partner ready to send synchronous–operation telegrams
– EPS2 = Reception monitoring of partner did not respond
– EPS3 = Partner ready

Operating mode signals

– ASP = Transmission inhibited (signal is sent to the 88TK05 station–bus coupling module)
– EPS = ”Privileged redundancy” input

Diagnosis and annunciation functions

Disturbance annunciations on the module

On the module front, red light−emitting diodes indicate:

– Disturbance	ST
– Module disturbance	SG
– Redundancy disturbance	SR
– Compared lists discrepancy	DF

Light−emitting diode ST annunciates all module disturbances and disturbances of data exchange with the module.

Light−emitting diode SG annunciates pure module disturbances.

Light−emitting diode SR annunciates all disturbances within that redundancy, including those which do not entail a redundancy switchover.

Light−emitting diode DF annunciates all discrepancies between the programs of the redundant modules of both stations.

Status annunciations on the module

On the module front, green light−emitting diodes indicate:

– Redundancy	READY	BE
– Switchover	INHIBITED	BE flashing
– Redundancy	ACTIVE	AK

Light−emitting diode BE indicates that the PASSIVE redundancy is READY for a redundancy switchover. In an active redundancy a flashing light−emitting diode BE indicates that switchover is inhibited by a PDDS/EDS intervention.

Light−emitting diode AK indicates that this redundancy is ACTIVE.

Disturbance annunciation signals to the annunciation system

The CDS control diagnosis system receives the disturbance signals of the redundancy control module over the bus.

Diagnosis

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

The module cyclically sends a telegram with the data stored in the diagnosis register (register 246).

The contents of the diagnosis register, the signals of the general disturbance line, the messages at the CDS and annunciations ST, SG, SR, DF, BE, AK are shown in Figure 1.

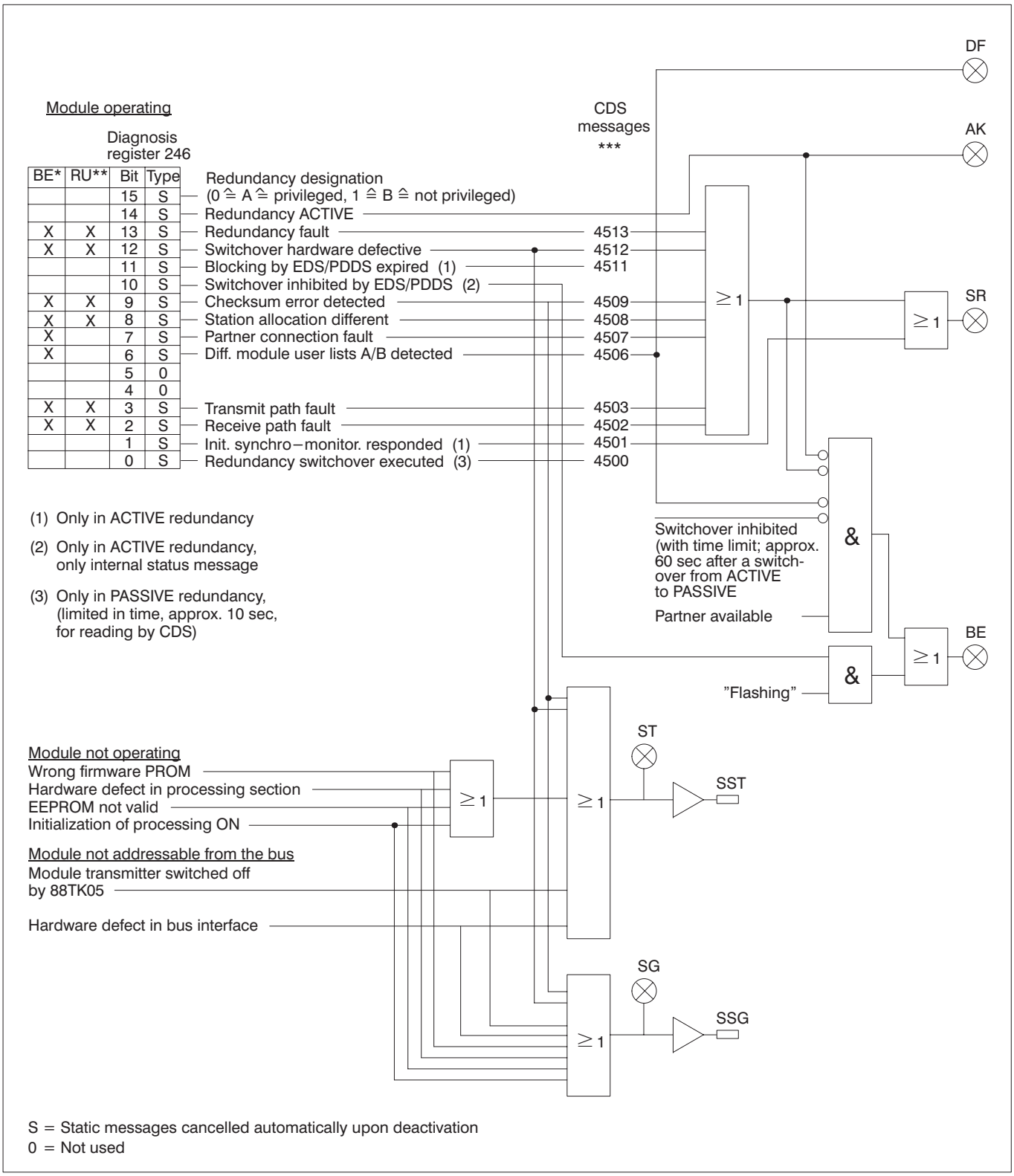


Figure 1: 88TR01/R1210 diagnosis messages

* BE = READY:
Signals marked X in this column in the PASSIVE redundancy will effect a not READY state for the PASSIVE station

** RU = redundancy switchover:
Signals marked X in this column in the ACTIVE redundancy will effect a redundancy switchover if the PASSIVE station is in a READY state.

*** For each message number, the control diagnosis system (CDS) provides a description containing among other information:

– Explanations on cause and effect of a certain disturbance
– Recommended remedies.

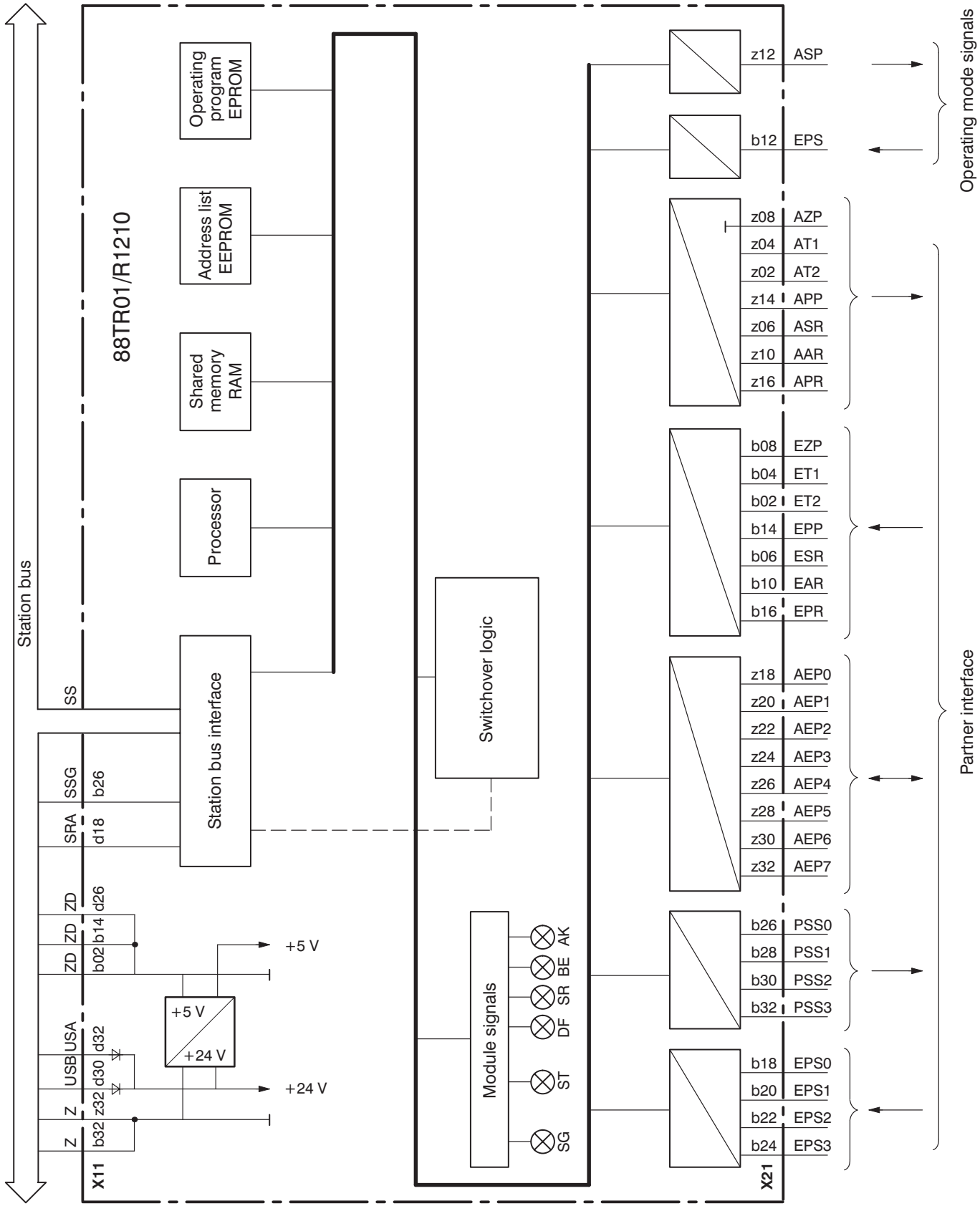
This ensures fast elimination of a disturbance.

Function diagram

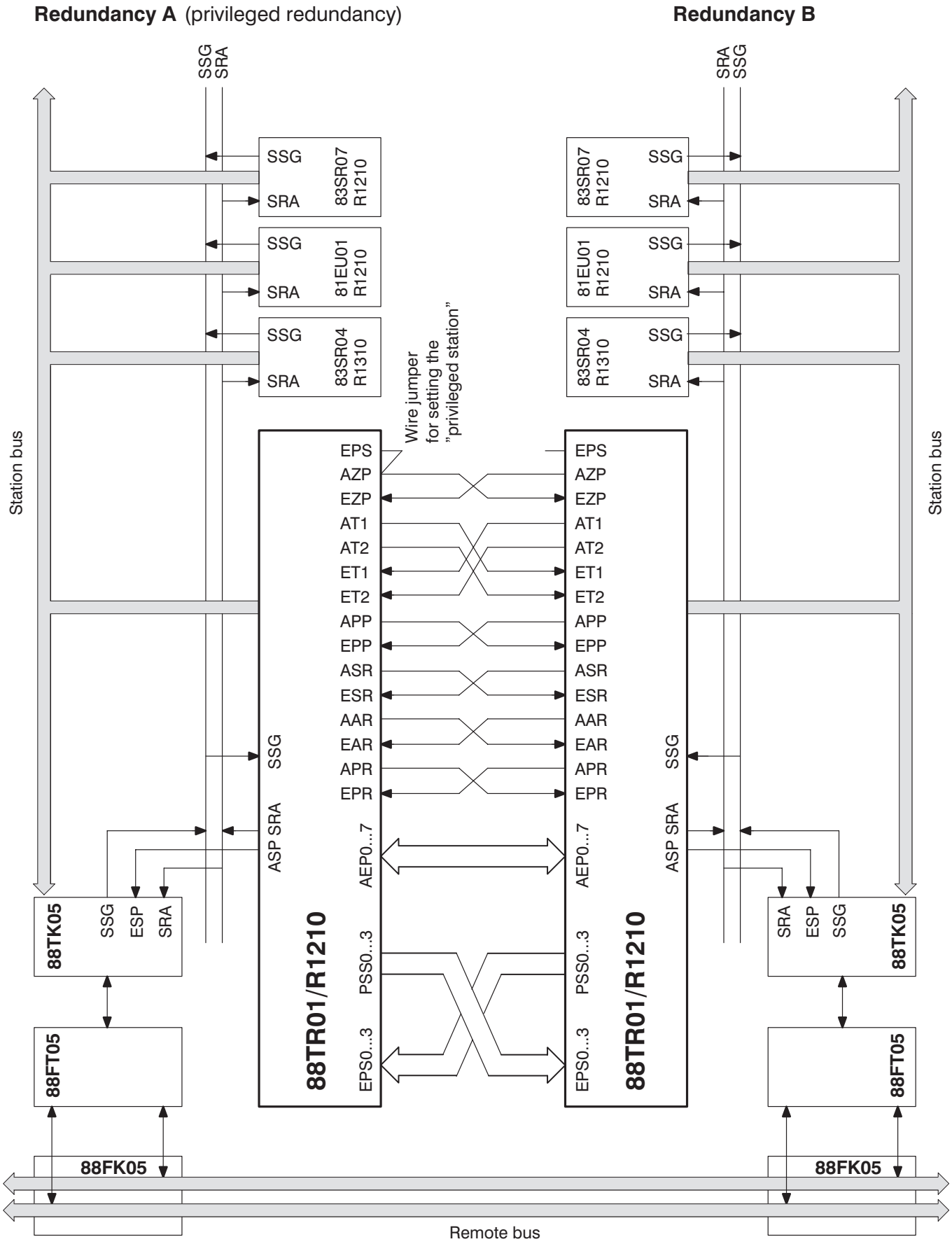
Connection designations

The printed circuit board includes connectors X11 and X21. Connector X11 contains standard interface SS with the station bus and input/output SSG, SRA for the redundancy switchover.

Connector X21 includes all inputs and outputs of the partner interface (connections to the redundant partner) and the operating mode signals.



Connection diagram for redundancy control modules in redundant stations



The operating mode settings on all 89IL05 station-bus p.c.b.s of the redundant station and on the 89IL06 connection p.c.b. need to be observed (see chapter "Control and operating modes").

Mechanical design

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

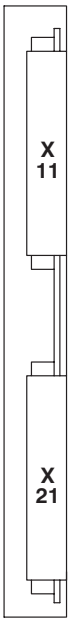
Connector: to DIN 41612

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

1 x for partner interfaces and
connecting operating mode signals,
32−pole, edge connector type F
(connector X21)

Weight: approx. 0.55 kg

View of connector side:

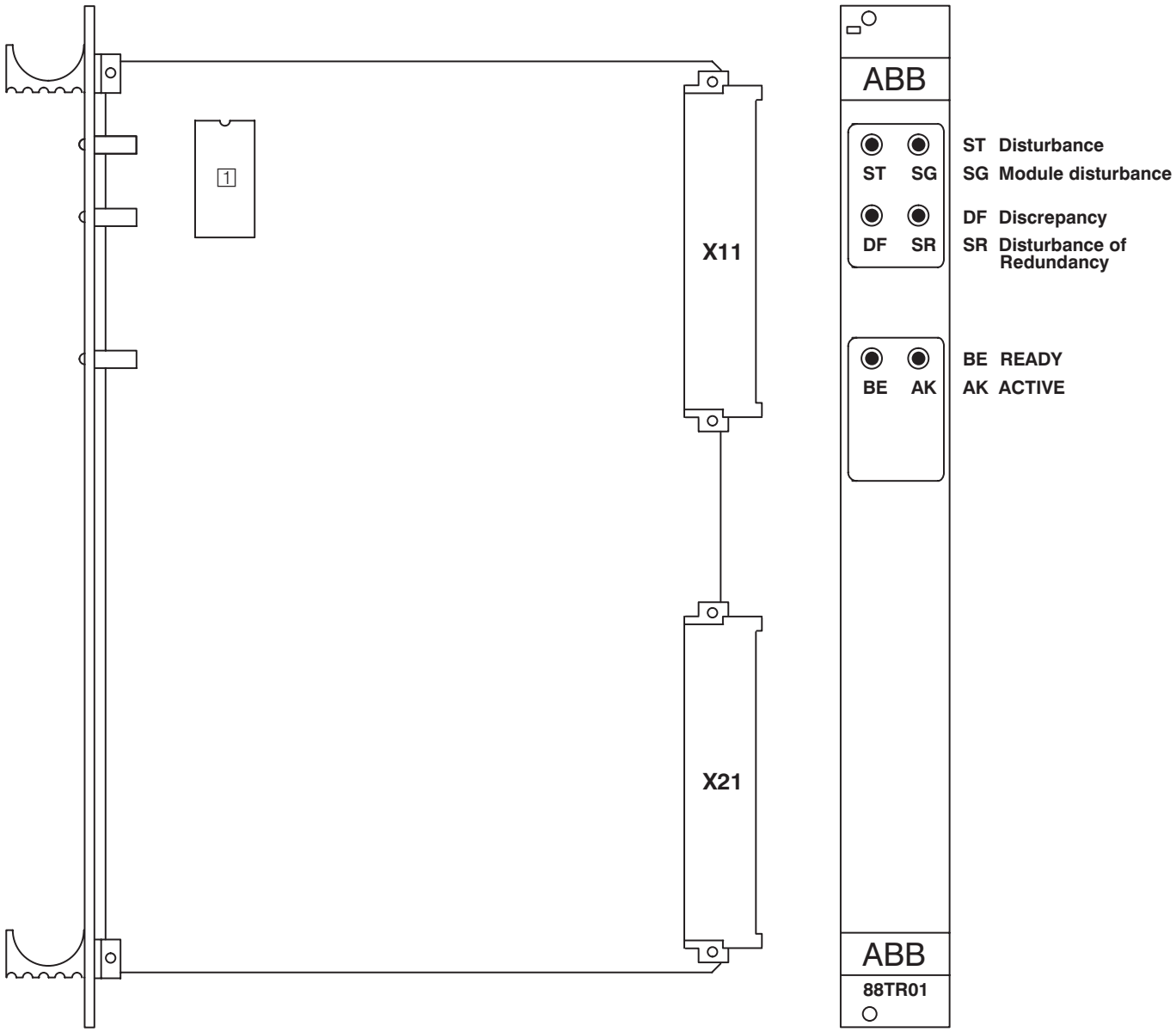


Contact assignments of connector X21

View of the contact side:

	b	*z*
02	ET2	AT2
04	ET1	AT1
06	ESR	ASR
08	EZP	AZP
10	EAR	AAR
12	EPS	ASP
14	EPP	APP
16	EPR	APR
18	EPS0	AEP0
20	EPS1	AEP1
22	EPS2	AEP2
24	EPS3	AEP3
26	PSS0	AEP4
28	PSS1	AEP5
30	PSS2	AEP6
32	PSS3	AEP7

Side view and view of module front



[1] EPROM programmed, order number: GJR2391141Pxxxx
xxxx = Position number indicating 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
Power consumption	IS = 150 mA
Power dissipation	PV = 3.6 W
Reference potential, partner interface	Z = 0 V
Reference potential, bus side	ZD = 0 V

Signal level

Signal exchange on the partner interface among the two redundancy control modules and for the operating mode signal takes place on 24 V levels:

Inputs:	0 signal	0 ... 3 V
	1 signal	11.2 ... 30 V
Outputs:	0 signal	0 ... 1 V
	1 signal	13.7 ... 30 V

Exceptions:

AZP signal	allocated inside the module to reference potential on the process side
EPS signal	5 V signal with resistor against 5 V

Switchover times

Activating the PASSIVE redundancy (from detecting a fault by the 88TR01, e.g. via the SSG line in the redundancy ACTIVE up to now, until setting the SRA line in the redundancy PASSIVE so far)	70 ... 280 msec

Noise immunity of inputs and outputs

ESD to IEC 801/2	8 kV against front panel
EMC to IEC 801/4	1 kV burst
Destruction acc. to IEC 801/5	1 kV against reference potential

ORDERING DATA

Order No. for entire module:	
Type designation: 88TR01/R1210	Order number: GJR2391100R1210

Technical data subject to change without notice!

Company: Joyoung International Trading Co.,Limited
Atten: Smiling
Mobile/WhatsApp/Wechat:+86 18050035902
E-mail: info@htechplc.com
Website: https://www.joyoungintl.com/