Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth
Bosch Group

Rexroth RD 500 Options

R911200241
Edition 07

Functional Description

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Options
RD500 Product Family

Type of Documentation
Functional Description

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Purpose of Documentation
The options for module slots 1 and 2 are described in this documentation.
They provide information about ...

- subsequent installation
- connecting-up
- parameterization and operation

of the option cards

Record of Revisions

Description	Release Date	Notes
DOK-RD500*-OPTIONS****-FK01-EN-P	01.2000	First edition
DOK-RD500*-OPTIONS****-FK02-EN-P	02.2001	Expansion
DOK-RD500*-OPTIONS****-FK03-EN-P	05.2002	Expansion (Sercos)
DOK-RD500*-OPTIONS****-FK05-EN-P	01.2003	Extracting RZP01.1-P1 Expansion RZP01.1-P2 Revision RZP01.1-G2
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DOK-RD500*-OPTIONS****-FK07-EN-P	12.2004	Extracting RZP01.1-G1 Expansion RZP01.1-T3

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List of contents

1 Installing options

1.1 Module slots

There are two module slots for accepting optional modules in the control module (SR17000 for the RD51, SR17002 for the RD52).

Selecting the module slot

Various cards/modules can be inserted in the module slots. Please observe the possibilities specified in the tables for installing the options.

Communications, option card – control card

The module slot, in which the option card is inserted, determines how the drive converter firmware addresses the interface. The communications between the control card and option card is realized via the process data interface. An option card in module slot 1 communicates with the control card via the SS2 process data interface, and at module slot 2, via the SS4 process data interface.

If the option card involves an interface, the bus-specific parameters and interface-specific parameters must always be set, depending on the selected module slot. More detailed information is provided in the descriptions of the interface cards.

Module slot 1 (connector X121)

The drive converter firmware treats the interface card as SS2 (serial interface 2).

Module slot 2 (connector X123)

The drive converter firmware treats the interface card as SS4 (serial interface 4).

Module slot 1

Option	RD 500 RD51	RD 500 RD52
CAN bus **C1**	Yes	Yes
Interbus S **B1**	Yes	Yes
Profibus DP **P2**	Yes	Yes
Incremental encoder emulation with resolver evaluation **G1**	-	Yes
Input for toothed-wheel encoder 1Vpp, TTL, sin/cos and incremental encoder emulation **G2**	-	Yes
Incremental encoder emulation **G3**	-	Yes
SynchroLink **L1**	-	Yes
Peer-to-peer coupling **L2**	Yes	Yes
Extended control terminal strip **T1**	-	-
Extended control terminal strip **T3**	-	-

Fig. 1-1: Options, module slot 1

Module slot 2

Option	RD 500 RD51	RD 500 RD52
CAN bus **C2**	Yes	Yes
Interbus S **B1**	Yes	Yes
Profibus DP **P2**	Yes	Yes
Incremental encoder emulation with resolver evaluation **G1**	-	Yes
Input for toothed-wheel encoder 1Vpp, TTL, sin/cos and incremental encoder emulation **G2**	-	Yes
Incremental encoder emulation **G3**	-	Yes
SynchroLink **L1**	-	Yes
Peer-to-peer coupling **L2**	Yes	Yes
Extended control terminal strip **T1**	Yes	Yes
Extended control terminal strip **T3**	Yes	Yes

Fig. 1-2: Options, module slot 2

Card combinations module slots

RD 500 RD51		RD 500 RD52	
Module slot 1	**Module slot 2**	**Module slot 1**	**Module slot 2**
NN	NN, T1, T3	NN	NN, T1, T3
C2	NN, L2, C2, B1, P2	C2	NN, L1, L2, G1, G2, G3, C2, B1, P2
B1	NN, L2, T1, T3, C2, B1, P2	B1	NN, L1, L2, G1, G2, G3, C2, B1, P2
P2	NN, L2, T1, T3, C2, B1, P2	P2	NN, L1, L2, G1, G2, G3, C2, B1, P2,NN, L2, T1, T3, C2, B1, P2
L2	NN, T1, T3	G1	NN, T1, T3, L1, L2
		G2	NN, T1, T3, L1, L2
		G3	NN, T1, T3, L1, L2
		L1	NN, T1, T3
		L2	NN, T1, T3

Fig. 1-3: Card combinations, module slots

1.2 Mechanical installation

Storage

The cards / modules must be stored in dry, clean rooms. The storage temperature must be between -25° C and +70° C.

Installation instructions for subsequent installation

If the drive converter is ordered with an option card, when the equipment is shipped, the card is already inserted in the unit. The option modules can be retrofitted to the drive converter by the customers themselves.

DANGER

Lethal shock as a result of live components at voltage levels exceeding 50V!

⇒ REFU drive units are operated at high voltage levels. Only qualified, trained personnel may carry-out any work.

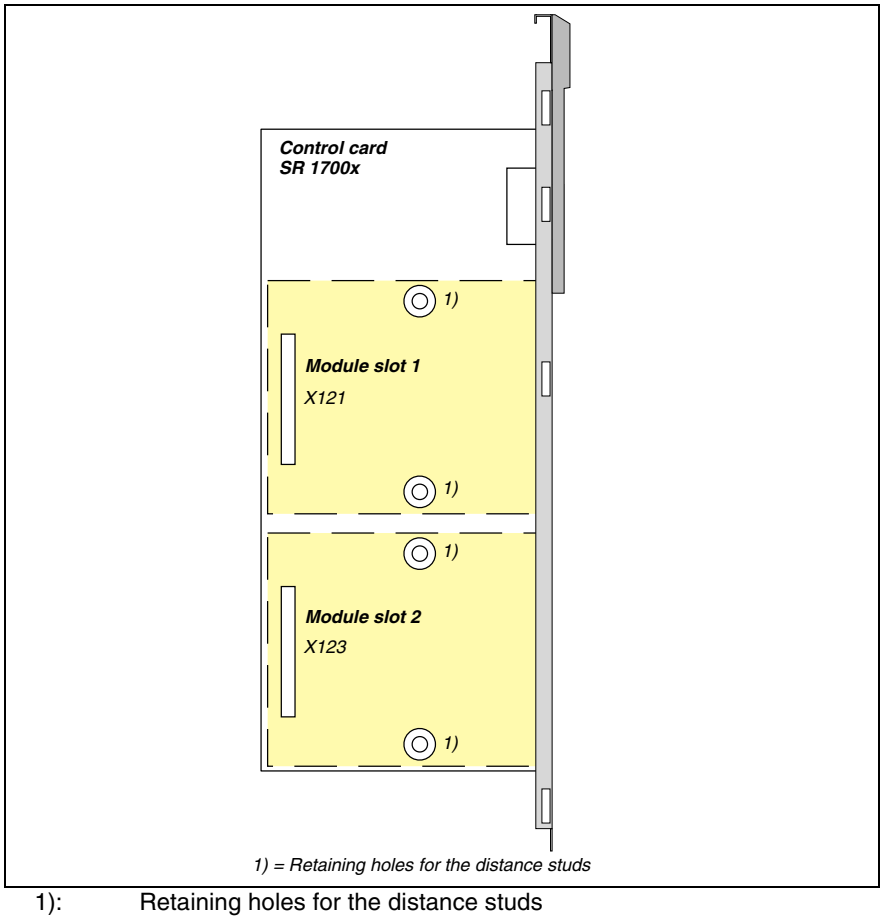
⇒ If this warning information is not observed, this can result in death, severe bodily injury or significant material damage.

⇒ The drive unit should be switched into a no voltage condition before work is carried-out. The drive unit has hazardous voltage levels up to 5 minutes after it has been powered-down as a result of the DC link capacitors. Before opening the drive unit, measure the voltage at the DC link terminals C and D using an appropriate measuring device to ensure that the voltage is less than 60 V.

⇒ The power and control terminals can be live (at a dangerous voltage level), even when the motor is stationary.

⇒ When working on the drive unit when it is open, it should be noted that live components (components at a dangerous voltage level) are exposed.

Installing option cards



1): Retaining holes for the distance studs

Fig. 1-4: Module slots

Removing the control card

1. Remove the front cover.
2. Remove the screw below on the mounting rack; also refer to the Section, Terminal layout diagram or Connection diagram in the appropriate description of the option card.

CAUTION

Components and devices which can be destroyed by electrostatic discharge (ESDS)!

⇒ The cards/modules contain components/devices which can be destroyed by electrostatic discharge. They can be easily destroyed if they are not carefully and professionally handled.

⇒ Please observe the generally valid ESDS measures, refer to Section 1.3.

3. Withdraw the complete mounting rack with the control card.
4. Remove the ribbon cable from X122 on the control card.

Installing the option card

5. Remove the sheet steel cover from the selected module slot. The sheet steel cover has breakaway points at the connection lugs. These can be broken off by bending them backwards and forwards several times. Alternatively, they can be bent inwards through 180°.
6. Mount the distance studs on the component side of the SR1700x card using the screws provided.
7. Insert the card at the module slot selected according to Fig. 1-3: Card combinations, module slots, and retain the card on the two distance studs using the M3 x 6 screws provided.

Inserting the control card

8. Re-insert the ribbon cable from the drive unit into connector X122 on the control card.
9. Install the complete mounting rack with the control card and the installed option card back into the drive converter.
10. Retain the mounting rack with the screw.
11. Re-attach the front cover.

CAUTION

Damage caused by incorrect installation!

⇒ Connectors X121 and X123 on the control card have no guide assembly. Take care to ensure that the connectors are correctly inserted in order to avoid erroneous functions and damage to the electronic/electrical components.

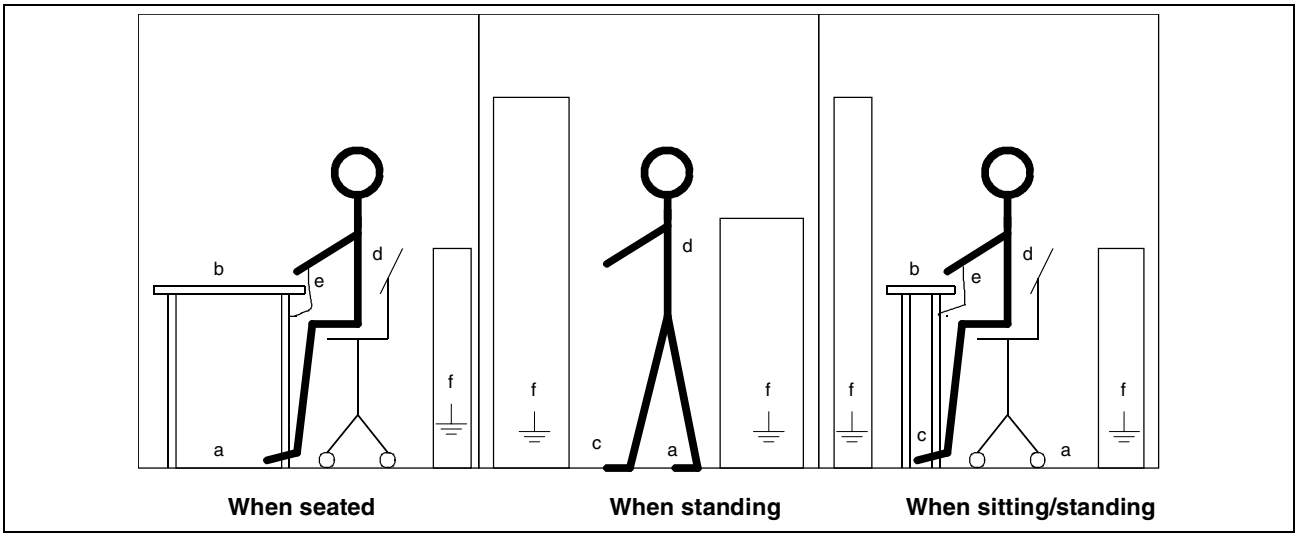
⇒ Also ensure that the ribbon cable between the drive unit and the control card has been correctly routed, i.e. it is not permissible that the cable comes into contact with sharp edges.

1.3 Cautionary measures when handling devices/components which can be destroyed by electrostatic discharge (ESDS)

The drive units contain components and parts which can be destroyed by electrostatic discharge. These components can be destroyed when not handled properly. Please observe the following when working with electronic modules and boards:

- Electronic modules and boards should only be touched if absolutely necessary.
- Before touching an electronic module/board, the human body must first be electrically discharged.
- Electronic modules/boards may not come into contact with highly-insulating materials e.g. plastic foils, insulating work surfaces, articles of clothing manufactured from man-made fiber.
- Electronic modules/boards may only be placed on conductive surfaces.
- The soldering iron tip must be grounded when carrying-out soldering work on electronic modules/boards.
- Electronic modules/boards and components may only be stored and shipped in conductive packaging (e.g. metalized plastic or metal containers).
- If the packaging is not conductive, electronic modules/boards must be wrapped in a conductive material. In this case, e.g. conductive foam rubber or household aluminum foil can be used.

The necessary ESDS protective measures are clearly shown in the following diagram:



a: Conductive floor
b: ESDS table
c: ESDS shoes
d: ESDS overall
e: ESDS bracelet
f: Grounding connection of the cabinets

Fig. 1-5: ESDS protective measures

2 RZP01.1-B1 Interbus S

2.1 General information on Interbus S, option module RZP01.1-B1

Interbus S is a sensor / actuator bus with an effective data transfer protocol and a fixed data transfer rate of 500 kbit/s.

It is mainly used for fast data transfer at the field level. Data transfer is cyclic. The connection uses a fast 5-conductor cable (RS 485, twisted, shielded). All of the protocols are transferred with a Hamming distance HD=4, which guarantees a high data transfer integrity.

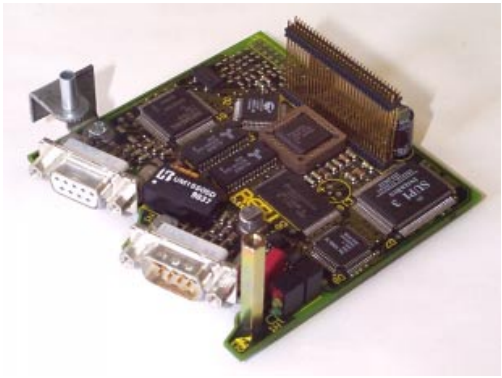


Fig. 2-1: View of the Interbus S card

Technical data

Order No. / version	RZP01.1-B1
Interface	RS 485
Protocol	Interbus S, conformance with DIN 19258 (or EN 50 254)
Baud rate	500 kbaud, fixed
Power supply	+5 V and +15 V on the control card
Size (length x width)	88 mm x 89 mm
Environmental Class	3K3 acc. to DIN IEC 721-3-3
Ambient temperature – in storage – during operation	 -25 °C ... 70 °C 0 °C ... 40 °C
Radio interference suppression level	A1 acc. to EN 55011
Noise immunity	EN 50082-2

General information on bus operation

Bus structure

The Interbus S bus has a ring-shift register topology. The conductors of the Interbus S ring system start and end at the bus controller. The ring is structured using a spatially distributed shift register from which, a multiple of 16 bits are combined in a module. 10 words, each 16 bits are handled on the option card. 9 of these words are used for cyclic I/O data (process data) and one word to program the drive converter. Programming is real-

ized using PMS (Peripheral Message Specification), which represents a sub-set of the Profibus FMS Standard. (MMS, Profibus Part 2)

Serial data flow in the summed frame of Interbus S

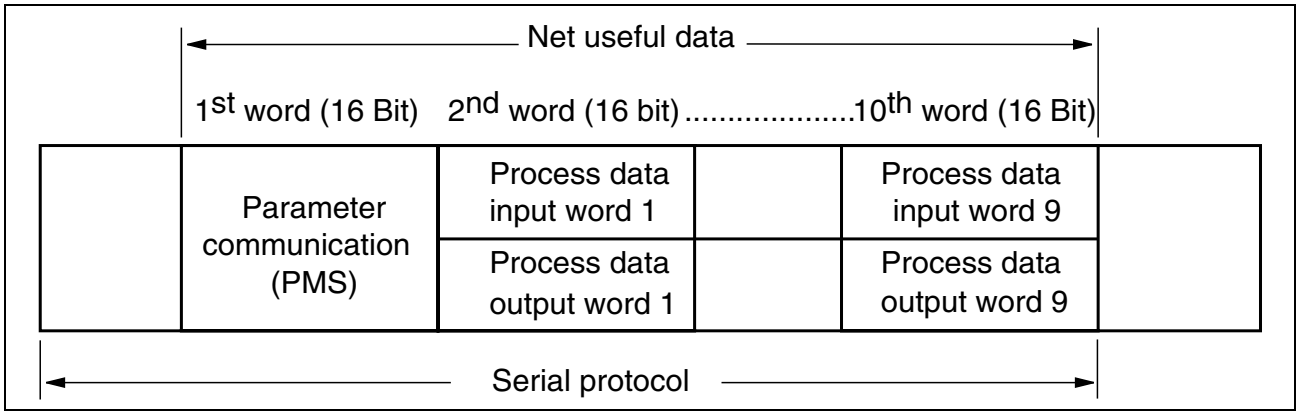


Fig. 2-2: Serial Interbus S protocol

At power-on, the individual 16-bit words are pre-assigned as follows:

1st data word: Communications acc. to PMS (the size of the input buffer is defined, for the Interbus S card IS11060, as 102 bytes)

2nd data word: Input data word = PZD 1
Output data word = PZD 1

3rd data word: Input data word = PZD 2
Output data word = PZD 2

2nd -10th data word: Can be freely parameterized

All of the parameters of the basic drive unit and Interbus S or DRIVECOM-specific parameters can be accessed via the communications.

Bus structure

The drive unit is operated on the remote bus of the Interbus S (as slave). A special connecting cable (Interbus S remote bus cable) via the front connector X40 (9-pin D-sub device connector) is used to connect the drive unit to the remote bus of Interbus S. Additional Interbus S nodes can be looped-into the remote bus branch via the front connector X41 (9-pin D-sub drive device socket). Bus termination (at connector X40) is not required as it is automatically generated on the card. It is not necessary to set a node address at the card or at the drive converter; the address is automatically assigned as a result of the bus topology.

Number of slaves

The maximum number of Interbus slaves (nodes) is limited to 512 devices.

DRIVECOM PROFILE drive technology

The DRIVECOM profile definition defines a standard, which does not define the bus, but instead, how the data is represented on the bus for specific applications. Using these definitions, devices with the same function can be addressed via a unified command set.

The DRIVECOM PROFILE can be requested from the Drivecom User Group e.V.

Data transfer via Interbus S

ID code PCB ID code = 0 x F3 (243 dec)

Process data

Process data are data which are transferred along the process data channel. This data is cyclically exchanged between the control and drive, whereby the cycle time is constant and only depends on the bus topology. The process data channel data can be mapped on the communication object (parameters). 9 words, each 16 bit are defined as process data on the option card.

Communication objects (parameters)

All of the basic drive parameters are supported, and in addition, several Interbus S-specific and several DRIVECOM-specific parameters. Data objects in the communications channel of the Interbus S can be individual variables, type BYTE (8 BIT), WORD (16 BIT) or LONG (32 BIT), or made up of arrays or records of the specified types. A data object is addressed via its number and an associated sub-index using the READ Request or WRITE Request utility. In this case, for single variables, the sub-index must be 0. For arrays or records, the complete object is addressed with sub-index = 0, and for a sub-index which is not equal to 0, a single element.

All parameter numbers of the basic drive have an offset of 5000 hex (e.g. number 1 becomes 5001 hex, number 100 becomes 5064 hex ...). This means that the objects, which address the parameters of the basic drive in the range from 5001 hex ... 53FF hex correspond to parameter Nos. 1 ... 1023. Parameters 5FFE hex and 5FFF hex support the process data channels of the basic drive (for SS2, refer to parameters P480.0 ... 9 with D1910...D1919 and for SI4, parameters 491.0 ... 9 with D1100 ... D1109).

Parameter numbers 6000 hex up to 605D hex are DRIVECOM parameters.

In the following text, process data, which are read by the controller, are designated PE data (actual values from the drive converter) and process data, which are written by the controller as PA data (setpoints).

Functional readiness of the Interbus S

The power supply of the Interbus S option is realized exclusively from the basic drive and cannot be externally fed-in. If the basic drive is in a no-current condition, then Interbus S is interrupted at this location. If an interruption is not desirable, then it is possible to maintain the Interbus S interface operational using option V (24 V electronics standby supply). The drive unit can also be coupled through a so-called bus terminal, which maintains bus operation (e.g. when replacing the drive unit).

2.2 Electrical installation

Terminal diagram

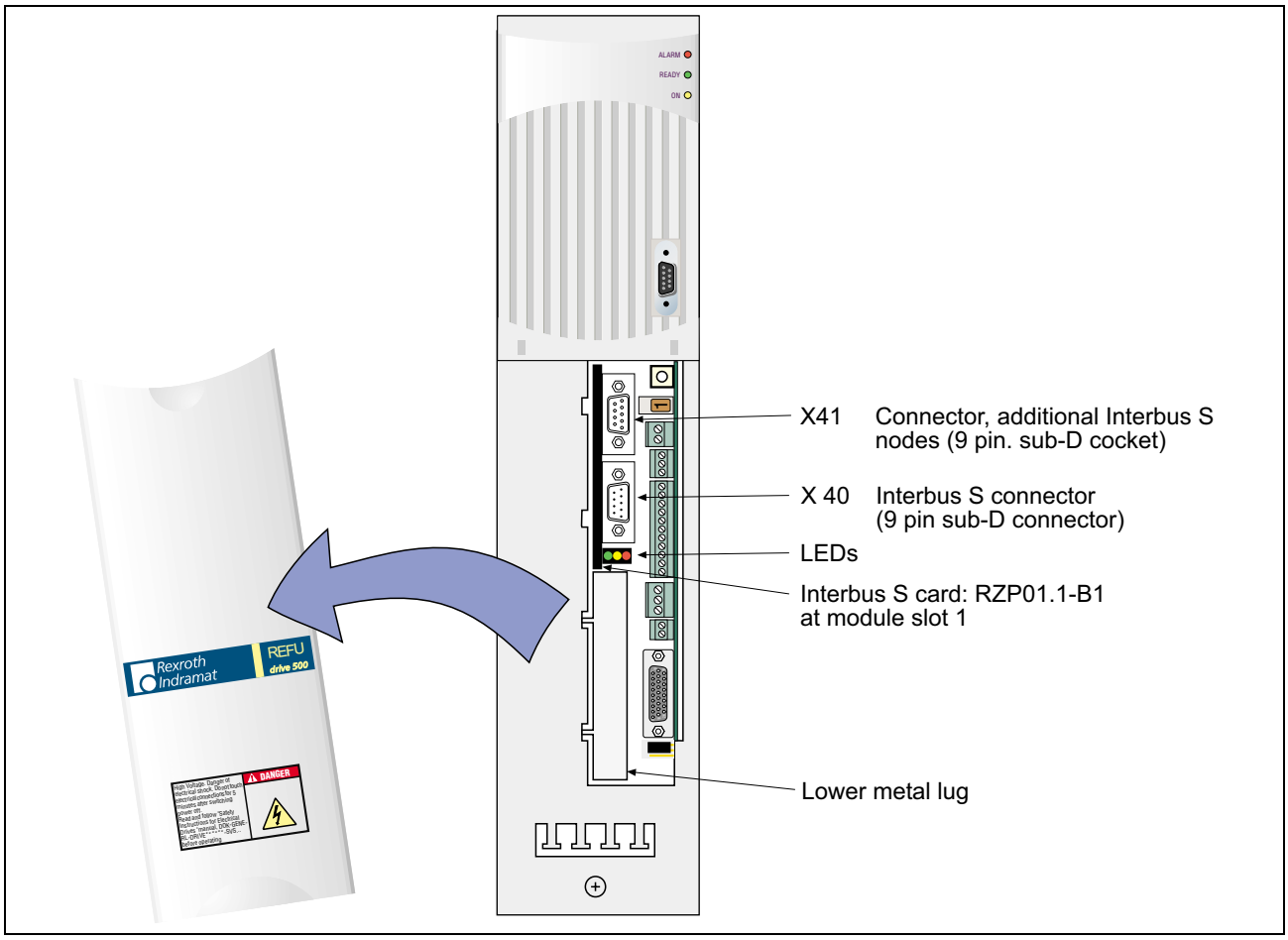


Fig. 2-3: Terminal layout diagram, Interbus S

LEDs

RED	Flashes, as long as the communications software is running correctly
YELLOW	Flashes, as long as data transfer to the basic drive unit is running correctly
GREEN	Flashes, as long as telegrams are being exchanged with the bus master

Connection assignment

Terminal	Designation	Terminal	Designation
X40	**Interbus S (connector)**	**X41**	**Interbus S (socket)**
1	Input A	1	Output A
2	Output A	2	Input A
3	GND Isolated	3	GND
4	-	4	-
5	-	5	+5 V
6	Input B	6	Output B
7	Output B	7	Input B
8	-	8	-
9	-	9	RBST
Shield	Via RC element	Shield	PE

The terminal X40/5 is connected to X40/9.

Cable length of the bus system

The RS 485 point-to-point data transfer permits a distance of 400 m between the two devices. Each node has an integrated repeater function which allows the INTERBUS system to be expanded up to 13 km. The bus termination is automatically set.

Recommended cable type

Characteristic impedance	135 .. 165	Ω
Capacitance per meter	<30	pF/m
Loop resistance	110	Ω/km
Conductor diameter	0.64	mm
Conductor cross-section	>0.34	mm^2

Bus cable shielding

The following measures must be made in order to ensure that Interbus S operates disturbance-free:

For the Interbus S bus cable, the shield in the bus connector does not have to be exposed. Shielding is realized when the bus cable is introduced into the drive unit housing at the chassis using cable ties. The shield connection is described in detail in the Instruction Manual of the appropriate device. When removing the insulation from the ends of the conductors, ensure that the solid copper core is not damaged.

Please ensure that the shield of every bus cable is connected to the drive unit housing and at the cabinet entry point!

Potential bonding

Please avoid potential differences (e.g. due to different line supply systems) between the drive units and the Interbus S master:

- Use the following potential bonding conductors:
  - 16 mm^2 Cu for potential bonding conductors up to 200 m long
  - 25 mm^2 Cu for potential bonding conductors over 200 m long
- Route the potential bonding conductors so that the lowest possible surface area is encompassed between the potential bonding conductor and signal conductor; i.e. they should be routed in parallel.
- Connect the potential bonding conductor to the grounding/protective conductor through the largest possible surface area.

Routing cables

Please observe the following information/instructions when routing cables:

- Do not route bus cables (signal cables) in parallel with power cables or maintain a clearance of > 20 cm between them.
- Route the signal cable and the associated potential bonding cables as close as possible together and keep them as short as possible.
- Route the power cables and signal cables in separate cable ducts.
- Connect the shields through the largest possible surface area.

2.3 Parameterization

Before commissioning the Interbus S interface, the interface parameters must be set as a function of the option slot and Interbus S-specific parameters. The parameters can be reached via the following menu:

PARAMETERIZATION
GUIDED PARAMETERIZATION
OPTIONS \ Interbus S
Slot 1 X121
Slot 2 X123

Setting the drive unit parameters for Interbus S operation

P. No.:	Name	Description / explanation selectable options	Setting example	Password loc. Prog.
0072	**Param. setting**	Defines which interfaces can be used to parameterize the unit 0 = operator panel, PC (RS232) 1 = bus SI1 [interface 1] (RS485) 2 = bus SI2 [interface 2] (module slot 1) 3 = bus SI4 [interface 4] (module slot 2) 4 = all buses, SIx 5 = bus SI6	**0**	**2** r/w off
0073	**Source ON / OFF**	Selects the source for the ON/OFF command (control word generation). A value of 1 must be set so that the Interbus card has the control authorization. 0 = operator panel + terminals 1 = SI (serial interface) + terminals 2 = terminals 3 = service interface	**1**	**2** r/w off
0074	**Source, control word 1**	**Recommendation for SI2 (option slot 1):** Use PZD 1 as control word. Enter D1910 into P0074 as parameter value. **Recommendation for SI4 (option slot 2)** Use PZD 1 as control word. Enter D1100 into P0074 as parameter value.	**D 1910**	**2** r/w off
0480.x	**Source SI2 PZD**	**Recommendation for SI2 (option slot 1):** Send the status word as PZD 1. In this case use the variable parameter source 0480.0. Set D1922 (status word) as parameter value.	**D 1800**	**2** r/w off
0491.x	**Source SI4 PZD**	**Note: Depending on the selected option slot, only parameter P0480.x or P0491.x has to be set.** **Recommendation for SI4 (option slot 2):** Send the status word as PZD 1. In this case use the variable parameter source P0491.0. Set D1922 (status word) as parameter value.	**D 1800**	**2** r/w off

Settings of the Interbus S-specific parameters

Parameter No.:	Name	Description / explanation selectable options	Factory setting Min ... max values	Password loc.
0518.00	**Commissioning monitoring function**	Process data channel monitoring 0 = no action 1 = fault 2 = inhibit voltage 3 = fast stop	**No action** 0 ... 3	**2**
0518.01	**Commissioning monitoring function**	Parameter channel monitoring 0 = no action 1 = fault 2 = inhibit voltage 3 = fast stop	**No action** 0 ... 3	**2**
0519.00	**Commissioning WD monitoring time**	Process data channel monitoring After the selected time has expired, the response, selected in P0518.00, is executed.	**65535 ms** 0 ... 65535 ms	**2**
0519.01	**Commissioning WD monitoring time**	Parameter channel monitoring After the selected time has expired, the response, selected in P0518.01, is executed.	**65535 ms** 0 ... 65535 ms	**2**
0520	**Commissioning register length**	Sets the register length in words (1 word corresponds to 16 bits). The value range for the register length is at least 2 words and a maximum of 10 words. The first word is always assigned PMS (Peripheral Message Specification), words 2 to 10 can be freely connected to process data; whereby data word 2 should be preferably assigned the control word (for input data) or the status word (for output data).	**3 words** 2 ... 10 words	**2**

Setting the interface parameters

Option slot 1 If the Interbus S card is inserted at option slot 1, the drive unit firmware addresses it as serial interface 2 (SI2). Parameters of SI2 must be set for interface operation.

P. No.:	Name	Description / explanation selectable options	Factory setting Min ... max values	Pass-word loc. Prog.
0509	SI2 functions	Sets the drive unit response type to warning / fault from the Interbus S interface. 0 = all active 1 = alarm off 2 = fault off 3 = inhibited	0 0 ... 3	2 r/w on
0526	SI2 RX monitoring	Sets the response type, if a valid telegram was not received after the monitoring time had expired (P0527). 0 = no action 1 = alarm 2 = fault	0 0 ... 2	2 r/w on
0527	SI2 monitoring time	Sets the monitoring time, in which a valid telegram must be received.	0.01 sec 0.01 ... 60.00 sec	2 r/w on

Option slot 2 If the Interbus S card is inserted at option slot 2, the drive unit firmware addresses it as serial interface 4 (SI4). Parameters of SI4 must be set for interface operation.

P. No.:	Name	Description / explanation selectable options	Factory setting Min ... max values	Pass-word loc. Prog.
0745	SI4 functions	Sets the drive unit response type to warning / fault from the Profibus interface. 0 = all active 1 = alarm off 2 = fault off 3 = inhibited	0 0 ... 3	2 r/w on
0746	SI4 RX monitoring	Sets the response type, if a valid telegram was not received after the monitoring time had expired (P0527). 0 = no action 1 = alarm 2 = fault	0 0 ... 2	2 r/w on
0747	SI4 monitoring time	Sets the monitoring time, in which a valid telegram must be received.	0.01 sec 0.01 ... 60.00 sec	2 r/w on

2.4 Interbus S operation

Overview of the communication objects which have been implemented

No. (HEX)	Parameter	Sub IND	Date type	Significance sub-parameters	Min. value	Max. value	r/w r
5001 ..... 53FF	Parameters of the basic drive unit with a constant offset of 5000 hex						
5FFE	REFU PZD 1 ... 6 corresponding to the actual values	1 2 3 4 5 6	S16 S16 S16 S16 S16 S16	Actual value, PZD 1 Actual value, PZD 2 Actual value, PZD 3 Actual value, PZD 4 Actual value, PZD 5 Actual value, PZD 6			r r r r r r
5FFF	REFU PZD 1 ... 6 setpoint	1 2 3 4 5 6	S16 S16 S16 S16 S16 S16	Setpoint, PZD 1 Setpoint, PZD 2 Setpoint, PZD 3 Setpoint, PZD 4 Setpoint, PZD 5 Setpoint, PZD 6			r/w r/w r/w r/w r/w r/w
6000	PE data description	1 2 3 4 5	U8 U16 U8 U16 U8	Process data length Index, word 1 Sub-index, word 1 Index, word 2 Sub-index, word 2	4	4	r/w r/w r/w r/w r/w
6001	PA data description	1 2 3 4 5	U8 U16 U8 U16 U8	Process data length Index, word 1 Sub-index, word 1 Index, word 2 Sub-index, word 2	4	4	r/w r/w r/w r/w r/w
6002	PA data enable		U16		0	65535	r/w
6003	PD Watchdog time		U16		200	65535	r/w
6004	PD Watchdog selection code		S16		0	3	r/w
6005	K Watchdog time		U16		200	65535	r/w
6006	PD Watchdog selection code		S16		0	3	r/w

Description, read-write objects (all numbers in hex)

5001...53FF Parameters 1 ... 1023 of the basic drive unit
Single parameter or array parameter.

5FFE Process data object SI2/SI4 actual values (PE data), sub-index 1...9
This object can be mapped on the process data

5FFF Process data object SI2/SI4 setpoints (PA data), sub-index 1...9
This object can be mapped on the process data

6000 PE data description

This parameter contains the data which define which process input data are mapped onto which communication objects.

Sub Ind	Significance	Data type	Value range (hex)
1	Length of the process data channel	Byte	04
2	Object No. PZD1 (status word)	Word	6041
3	Sub-index PZD1 (status word)	Byte	00
4	Occupied by object PZD1	Word	0000
5	Occupied by object PZD1	Byte	00
6	Object No. PZD2 (actual value)	Word	Refer to list
7	Sub-index PZD2 (actual value)	Byte	Refer to list
8	Occupied by object PZD2	Word	0000
9	Occupied by object PZD2	Byte	00

Permitted value pairs for sub-index 6 and 7, PE data description:

- Speed actual value (DRIVECOM) index 6: 6044, index 7: 00
- Percentage actual value (DRIVECOM) index 6: 6054, index 7: 00
- PZD2 for SI2/SI4 (basic drive) index 6: 5FFE, index 7: 02

6001 PA data description

This parameter contains the data which define which process output data are mapped onto which communication objects.

Sub Ind	Significance	Data type	Value range (hex)
1	Length of the process data channel	Byte	04
2	Object No. PZD1 (control word)	Word	6040
3	Sub-index PZD1 (control word)	Byte	00
4	Occupied by object PZD1	Word	0000
5	Occupied by object PZD1	Byte	00
6	Object No. PZD2 (setpoint)	Word	Refer to list
7	Sub-index PZD2 (setpoint)	Byte	Refer to list
8	Occupied by object PZD2	Word	0000
9	Occupied by object PZD2	Byte	00

Permitted value pairs for sub-index 6 and 7 PA data description:

- Speed setpoint (DRIVECOM) index 6: 6042, index 7: 00
- Percentage setpoint (DRIVECOM) index 6: 6052, index 7: 00
- PZD2 for SS2/SS4 (basic drive) index 6: 5FFF, index 7: 02

6002 PA data enable

In order to re-configure the process data, it is necessary that the link between the Interbus process data and the device parameters can be interrupted in a defined fashion. The ‘PA data enable’ parameter is used for this.

Permitted values:

0: All of the PA data are inhibited, no setpoints are processed

1: PZD 1 (control word) is enabled, PZD 2 (setpoints) is inhibited

4: PZD 2 (setpoints) is enabled, PZD 1 (control word) is inhibited

5: PZD 1 & PZD 2 (control word & setpoints) are enabled.

6003 PA data, Watchdog time

Watchdog time in ms bus monitoring for the process data.

The value 65535 stands for de-activate Watchdog.

6004 PA data Watchdog

Action which is to be executed if the Watchdog timer (6003 hex) has expired.

Permitted values:

0: No action

1: Fault initiated

2: Initiate device control command, power-off (OFF2)

3: Initiate device control command, fast stop (OFF3)

6005 Communications Watchdog time

Watchdog time in ms bus monitoring for communications.

The value 65535 stands for de-activate Watchdog.

6006 Communications Watchdog selection code

Action which is to be executed if the Watchdog timer (6005hex) has expired.

Permitted values:

0: No action

1: Fault initiated

2: Initiate device control command, power-off (OFF2)

3: Initiate device control command, fast stop (OFF3)

Control and status word diagrams

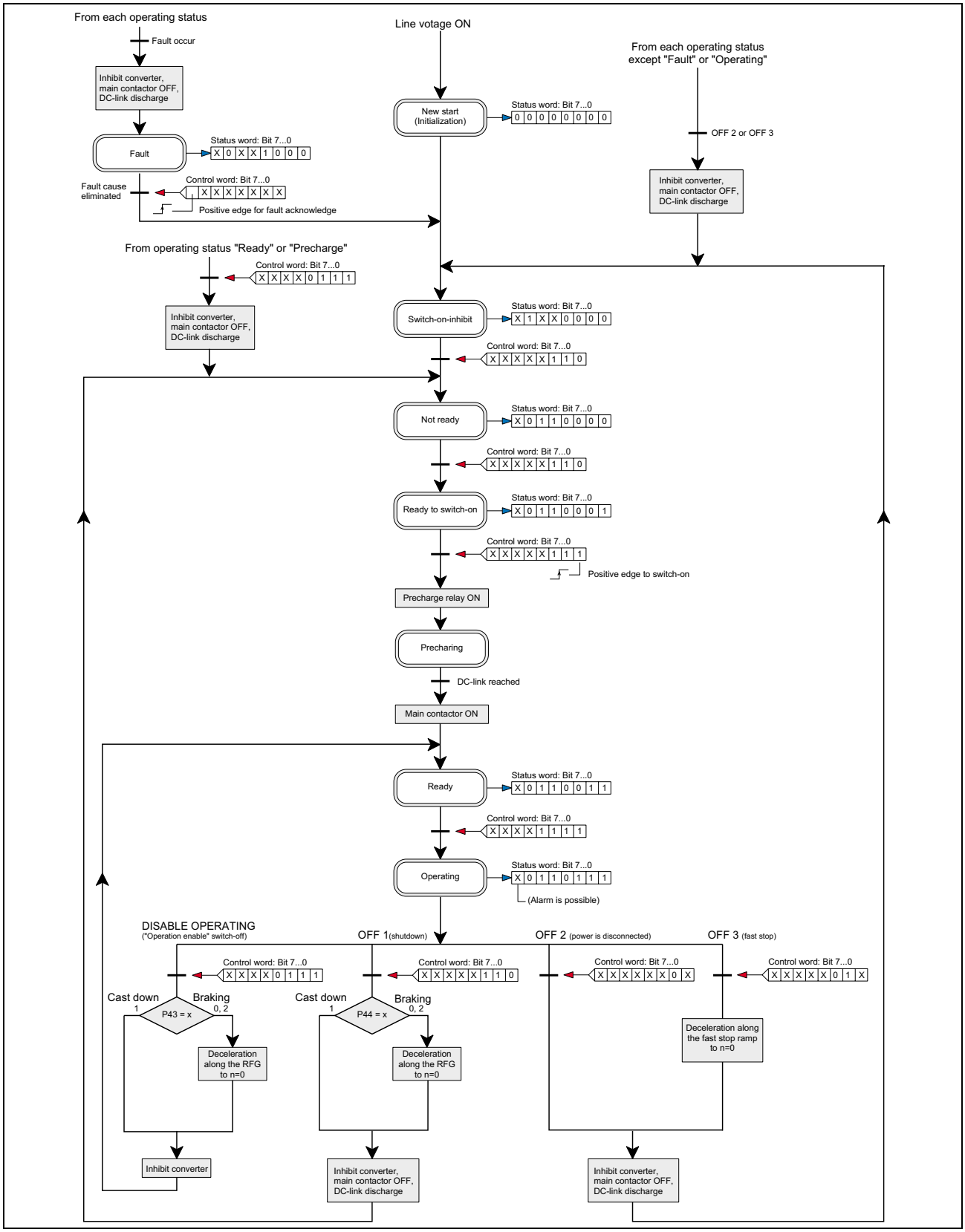


Fig. 2-4: Control and status word diagram, inverter

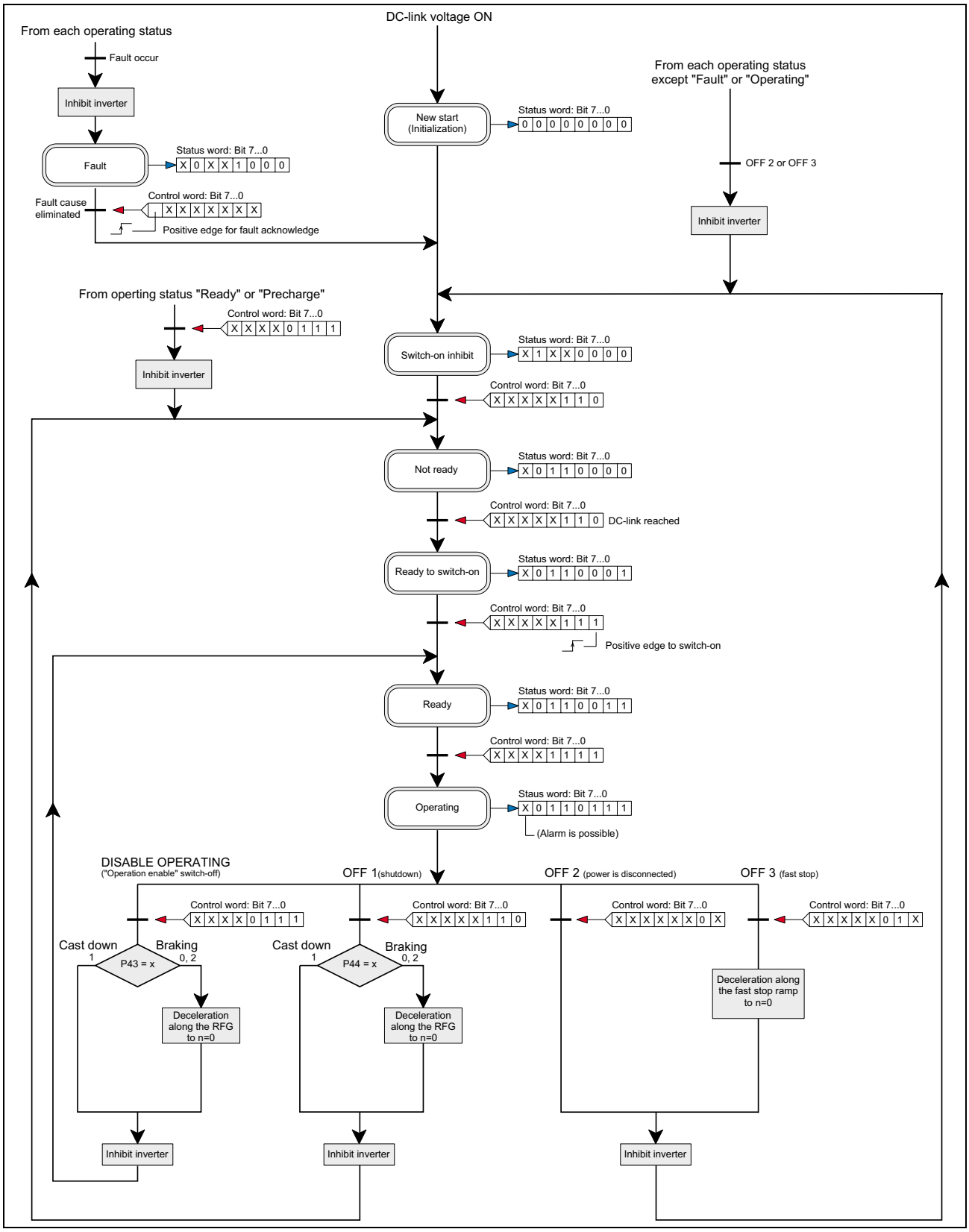


Fig. 2-5: Control and status word diagram, drive unit

Assignment of the control word bits

Bit	Value	Significance	Comments
0	1	On	Transition into the “Ready” status; DC link is charged, main contactor closed (if used).
	0	Off 1	Stop (back into the “Ready” status); deceleration along the RFG ramp * ; at n/f = 0 and I = 0 the power is disconnected; main contactor opened (if available). *or no-load coast down, refer to parameter 44
1	1	Operating condition	All “Off 2” commands are canceled
	0	Off 2	Power disconnected, pulses inhibited! The main contactor is then opened (if used) and the drive goes into the “Power-on inhibit” status; the motor coasts down
2	1	Operating condition	All “Off 3” commands are canceled
	0	Off 3	Fast stop; the drive decelerates along the fast ramp or current limit; at n/f = 0; inverter pulses are inhibited, the power is then disconnected (the contactor, if available is opened), and the drive goes into the “Power-on inhibit” status.
3	1	Operation enabled	Electronics and pulses enabled The inverter pulses are enabled and a field current is impressed. The drive then accelerates up to the setpoint along the RFG (ramp-function generator).
	0	Inhibit operation	Inverter pulses inhibited: The drive coasts down (RFG to zero) or brakes along the RFG ramp (refer to P0043) and goes into the “Ready” status (refer to control word, bit 2).
4	1	Operating condition	
	0	Inhibit RFG	The ramp-function generator output is set to 0. The main contactor remains closed, the drive unit is not isolated from the line supply.
5	0	Stop RFG	The setpoint, output from the RFG, is frozen.
	1	Enable RFG	
6	1	Enable setpoint	The value selected at the RFG input, is switched-in.
	0	Inhibit setpoint	The value selected at the input of the RFG is set to 0.
7	1	Acknowledge	The group signal is acknowledged for a positive edge; the drive unit is in a fault condition until the fault has been successfully removed and it then goes into the “Power-on inhibit” condition.
	0	No significance	

RFG: Ramp-function generator

Assignment of the status word bits

Bit	Value	Significance	Comments
0	1	Ready to power-up	The power supply is powered-up, the electronics initialized, the main contactor, if used, has dropped-out (opened), pulses inhibited.
	0	Not ready to power-up	
1	1	Ready	Ready; power connected to the drive unit, i.e. the main contactor is closed (if used). The DC link is charged; inverter pulses inhibited.
	0	Not ready	
2	1	Operation enabled	Electronics and pulses enabled. Enable inverter pulses: RD51: At Fmin, wait for delay time P0544 to expire. RD52: Wait for the field D1756 to be established. The RFG is then ramped-up to the setpoint.
	0	Operation inhibited	
3	1	Fault	Drive faulted and therefore not operational; it goes into the power-on inhibit condition after the fault has been removed and acknowledged if an “On” command is present. Fault numbers in fault memory P0040.x (the last fault can also be read-out via D1793).
	0	Fault-free	
4	1	No Off 2	
	0	Off 2	“Off 2” command present.
5	1	No Off 3	
	0	Off 3	“Off 3” command present.
6	1	Power-on inhibit	The drive can only be powered-up again by issuing an “Off 1” followed by an “On” command.
	0	No power-on inhibit	
7	1	Alarm	Drive still operational, alarm in alarm parameter P0039.
	0	No alarm	There is no alarm or the alarm has been withdrawn.
8	1		“f set in the tolerance range” (standard assignment)
9	1		Remote
10	1		“f set reached” (standard assignment)

Processing the Interbus S process data

The process data, received via the Interbus S, is converted in the drive unit into display parameters, which can be connected to the variable parameter sources in order to control the drive unit.

The drive unit sends its actual values as process data via the Interbus S; the variable parameter sources are connected in the D parameters, which are used as output for the SI2/SI4.

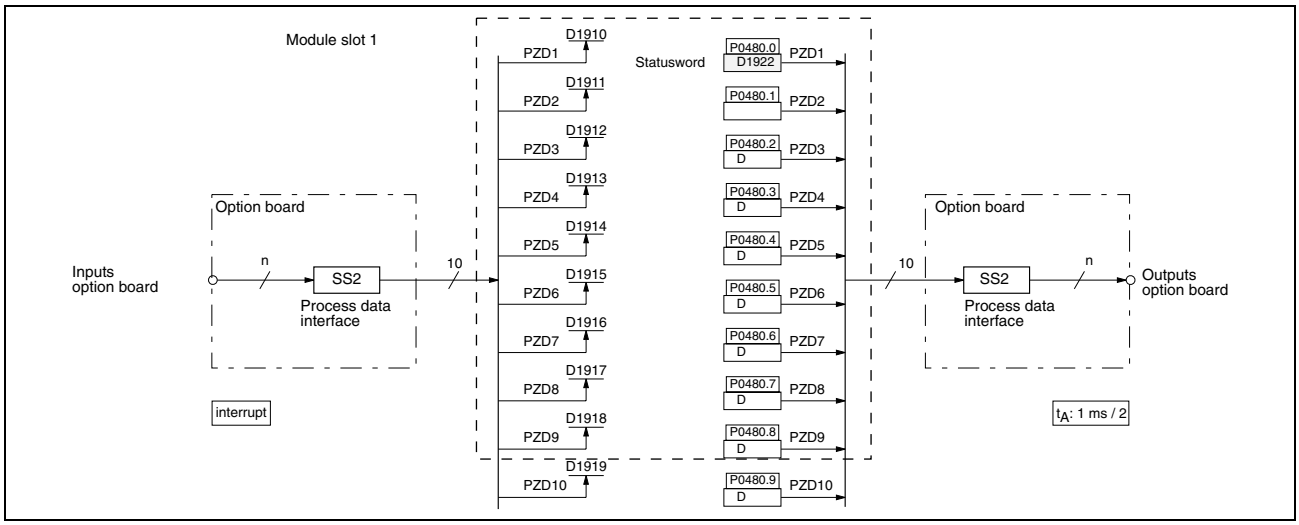


Fig. 2-6: Process data - interface SI2

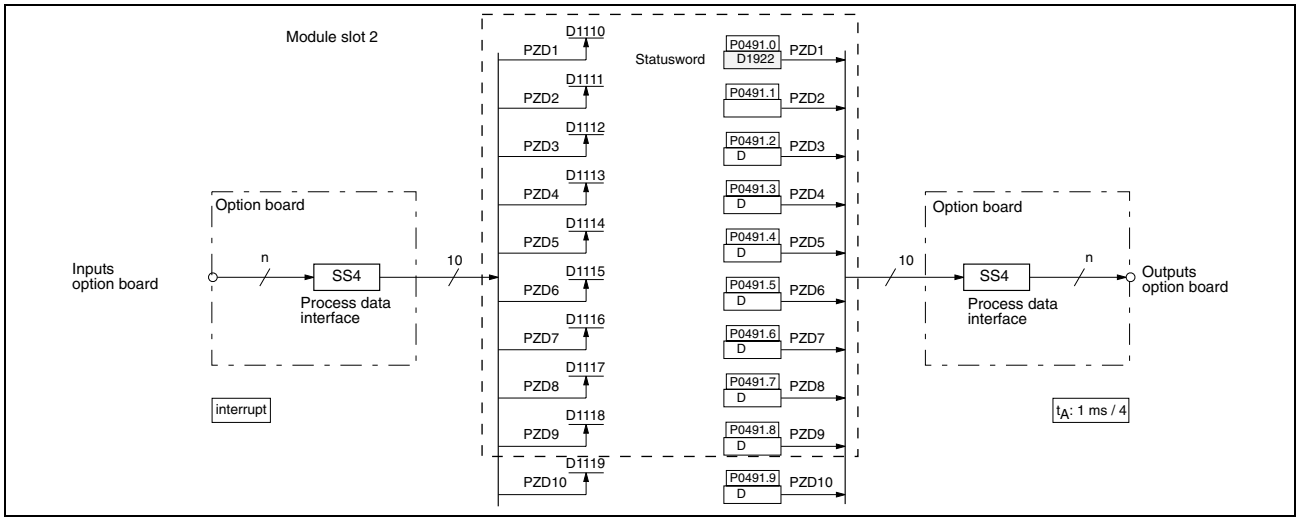


Fig. 2-7: Process data - interface SI4

3 RZP01.1-C2 - CANopen

3.1 General Information Regarding CANopen

Brief Information Regarding CANopen Bus Operation

Description of RZP01.1-C2

Communication module RZP01.1-C2 is a CANopen interface card for the RD500 device series. It supports profiles DS301 (basic profile) and DS401 (I/O profile). The interface card is designed for a temperature range of 0°C to 40°C.

The CANopen connection is electrically isolated from the rest of the module and from the SR1700x logic and control card; power is supplied by an integrated transformer.

The CANopen bus system

CANopen is based on the Controller Area Network (CAN) bus system. It is a multi-master system that works asynchronously and serially in half-duplex mode. Using the linear bus structure, short to medium connections (<500 meters, depending on the baud rate) can be made. The integrated hardware-side error detection and handling provides a high degree of transmission reliability. Bus arbitration of the telegrams occurs without destruction according to the CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) principle.

As opposed to other bus systems, CAN is structured according to information-oriented data transfer. Each piece of information has a priority.

The bus system is distinguished by high EMC characteristics despite a high transmission rate (up to 1 Mbit/s) as well as low connection costs. In addition, CAN allows hot swaps, i.e. removing or adding a node during operation.

A maximum of 127 logical nodes is permitted in the system; physically, however, the limit is currently at 64 nodes.

Standards and organizations

CAN follows the ISO 11898 international standard.

The CANopen communication profile is administered and maintained by the CAN in Automation (CiA) CAN organization.

The profile definitions permit devices to be exchanged relatively easily.

Communication objects

CANopen communication is implemented using Communication Objects (COB).

There are several types of these, such as:

- PDOs
- SDOs
- Special Function Objects
- NMT Objects

PDOs are process data objects; they are used for the fast transfer of real-time data.

SDOs are service data objects; they are required for parameterization, operation and observation.

Special function objects are, for example, synchronization, time-stamp or emergency objects.

NMT objects are network management functions. This includes logging a node into / out of the network (boot-up objects), error-control objects, etc.

Technical Data

Order No.	RZP01.1-C2
Protocol	CANopen acc. to DS301 and DS401 ISO 11898
Baud rate	125kBaud, 250kBaud, 500kBaud and 1Mbaud
Power supply	+5V and +15V, internal, from SR1700x
Size (length x width)	104 mm x 86 mm
Environmental class	3K3 according to DIN IEC 721-3-3
Ambient temperature - storage - operation	 -25°C - 70°C 0°C - 40°C
Noise suppression level	A1 acc. to EN 55011
Immunity to interference	EN50082-2

View of CB23904 Circuit Board

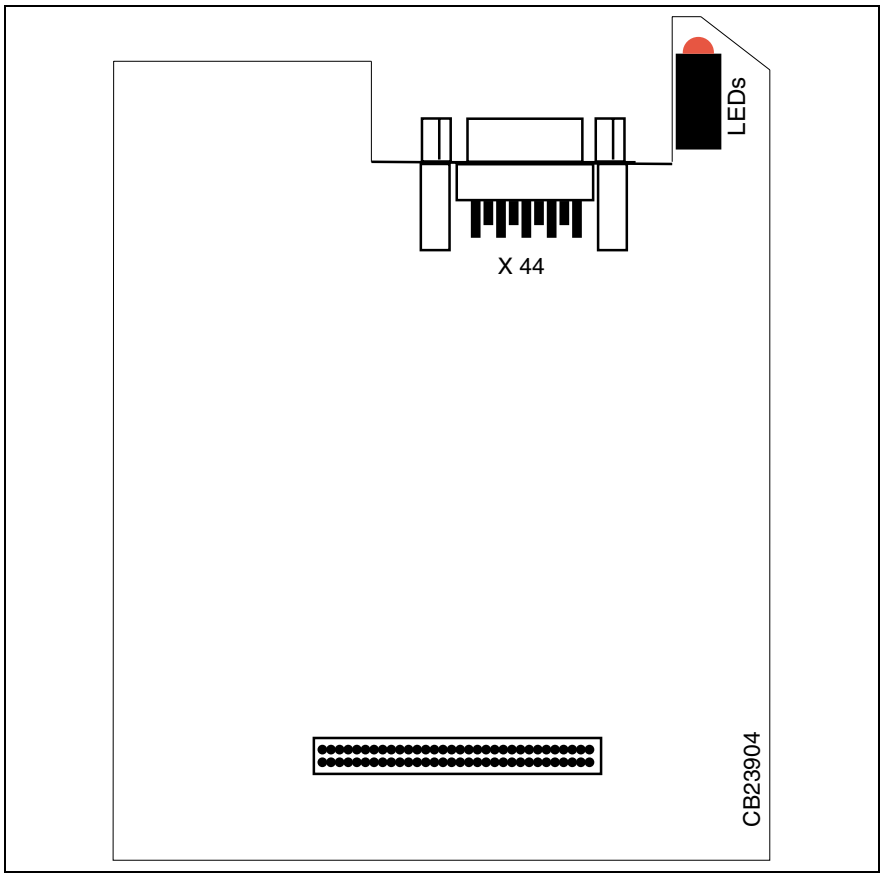


Fig. 3-1: Conductor board CB23904

3.2 Electrical Installation

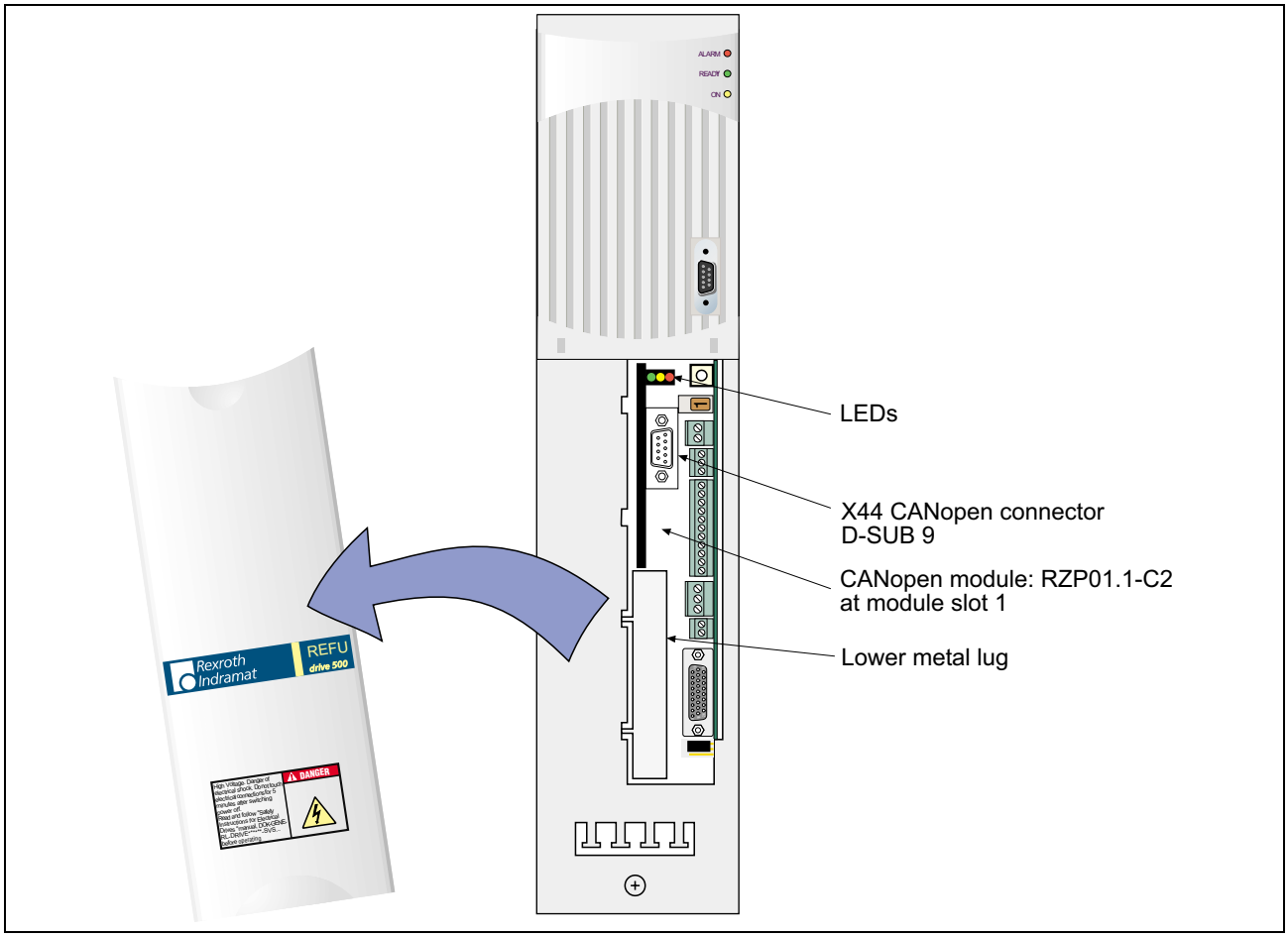


Fig. 3-2: Connection, front view

Cable Connection Plan

LEDs

RED:	Flashes as long as the communication software is working correctly
YELLOW:	Flashes as long as the data traffic between the option card and the basic card operates correctly
GREEN:	Flashes as long as telegrams are exchanged with other bus participants

Connection assignment

Pin	Designation
X44	**CANopen, 9-pin D-SUB**
1	-
2	CAN_L
3	CAN_GND
4	-
5	(CAN_SHLD)
6	-
7	CAN_H
8	-
9	-
S	PE

Connection to the bus system (CAN)

CANopen module RZP01.1-C2 is connected via X44 to the bus system (CAN). The CAN plug of the ERNI (http://www.erni.de) ERbic series is to be used as the field bus plug. The plug can be obtained from Bosch Rexroth:

Designation	Rexroth item No.	Type code
CAN plug (node)	10 70 919 029	B-BC CAN-SA009SW
CAN plug (terminator)	10 70 919 030	B-BC CAN-SA009GR

A low-capacity cable that is stranded in pairs is to be used as the field bus cable. One suitable possibility is type Lapp Unitronic Li2YCY (TP) 2x2x0.25, finely stranded (Lapp item No. 0031 371).

Detailed multilingual assembly instructions are included with each Erbic plug. The plug for a field bus terminator has five terminals, while that for a field bus node has ten terminals so that the cable can be looped to the next bus participant.

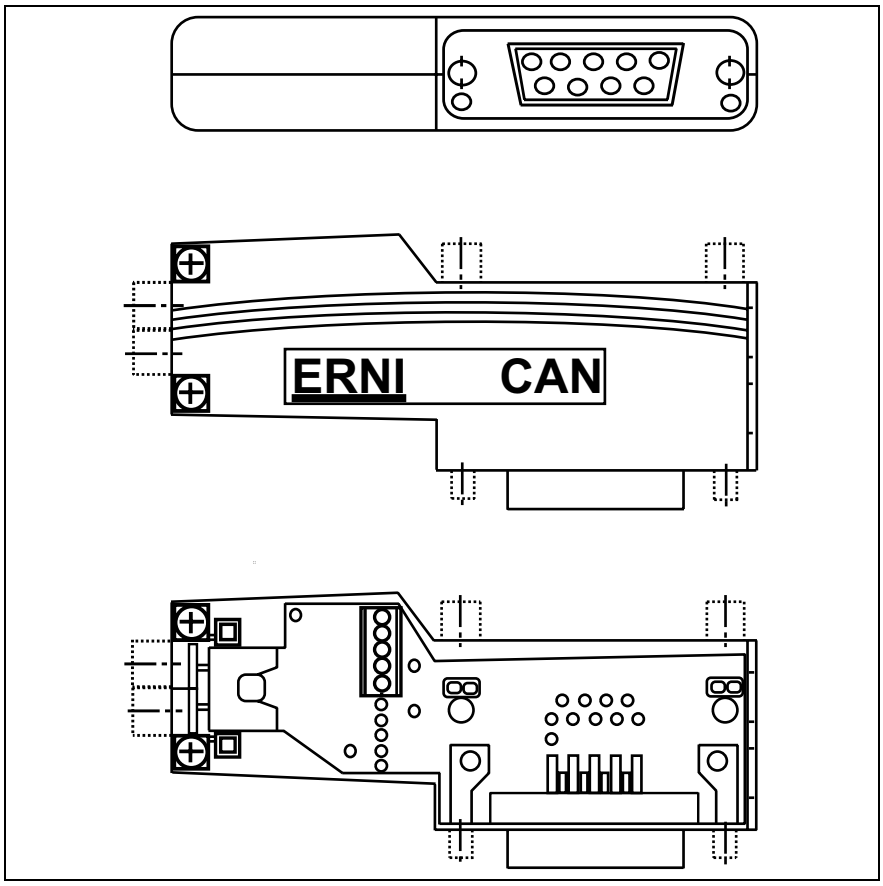


Abb. 3-3: CAN plug (node)

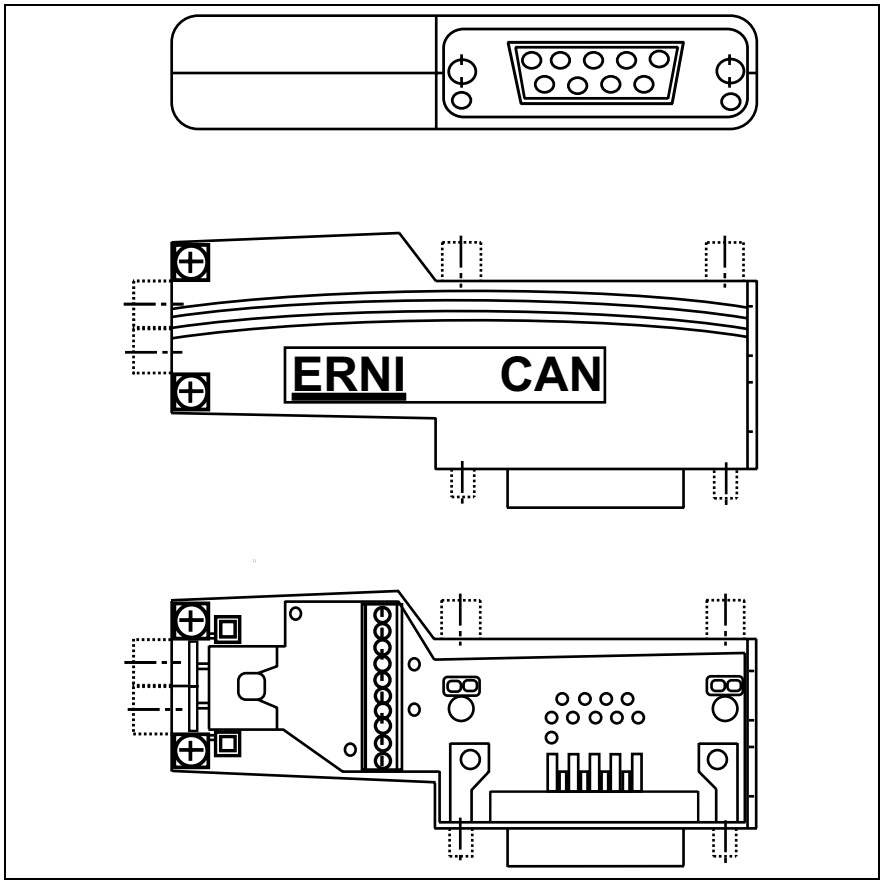


Abb. 3-4: CAN plug (terminator)

Bus Termination

For error-free operation, the CANopen bus line must be terminated with 120 Ohm resistors on both ends. Here, the bus line must be viewed as a linear bus line from the first to the last CANopen participant. The CANopen bus is thus terminated twice. Stubs have a negative effect, especially at high baud rates, and are thus not permitted.

CANopen option RZP01.1-C2 does not have a bus terminator resistor. The bus must be terminated in the field bus plug inserted on X44.

Line Lengths

The line length for CANopen bus lines depends on the baud rate selected. The possible line length is decreased at high baud rates. The values shown always apply for the entire bus line.

Baud rate	Line length
125 kBit/s	500 m
250 kBit/s	250 m
500 kBit/s	100 m
1 Mbit/s	25 m

Fig. 3-5: Line lengths

3.3 Parameter Value Assignment

Before commissioning the CANopen interface, the parameters for the interface must be set depending on the option slot. The parameters can be attained using the menu:

SET PARAMETERS
GUIDED PARAM.
OPTIONS
CANopen
Slot 1 X121
Slot 2 X123

Setting Converter Parameters for CANopen Operation

P. No.:	Name	Description / explanation of selectable options	Sample setting	Password of prog.
P0072	Param. setting specifies which interface may be used to set parameters	0 = User panel, PC(RS232) 1 = Bus SS1 (RS485) 2 = Bus SS2 (module slot 1) 3 = Bus SS4 (module slot 2) 4 = Buses SS1, SS2, SS4		r / w on
P0073	Source ON / OFF	Selection of the source for the ON/OFF command (control word generation). In order for the CANopen card to receive control authorization, the value must be set to 1 0 = user panel + terminals 1 = serial interface (SS) + terminals 2 = terminals 3 = service interface	1	2 r / w off
P0074	Source of control word 1	**Proposal for SS2 (option slot 1):** Use as control word PZD 1. Enter D1910 as the parameter value in P0074. **Proposal for SS4 (option slot 2):** Use as control word PZD 1. Enter D1100 as the parameter value in P0074.	D 1910	2 r / w off
P0480.x	Source of SS2 PZD	**Proposal for SS2 (option slot 1):** Send the status word as PZD 1. To do this, use the variable parameter source 0480.0. Set D1922 (status word) as the parameter value.	D 1922	2 r / w off
P0491.x	Source of SS4 PZD	Note: Depending on the selected option slot, only the corresponding parameter P0480.x or P0491.x must be set. **Proposal for SS4 (option slot 2):** Send the status word as PZD 1. To do this, use the variable parameter source P0491.0. Set D1922 (status word) as the parameter value.	D 1922	2 r / w off

Setting Interface Parameters

Slot 1 If the CANopen board is mounted on slot 1, it is addressed as serial interface 2 (SS2) by the converter firmware. The parameters of SS2 must be set for interface operation.

P. No.:	Name	Description / explanation of selectable options	Factory setting min / max values	Password of prog.
P0509	SS2 functions	Setting the type of reaction of the converter to a warning/malfunction from the CANopen interface. 0 = all active 1 = warning off 2 = fault off 3 = locked	0 0 - 3	2 r / w on

P. No.:	Name	Description / explanation of selectable options	Factory setting min / max values	Password of prog.
P0526	SS2 RX monitoring	Setting the type of reaction if no valid telegram was received after the monitoring time (P0527) has elapsed. 0 = no action 1 = warning 2 = fault	0 0 - 2	2 r / w on
P0527	SS2 monitoring time	Setting the monitoring time in which a valid telegram must be received.	0.01 sec 0.01 - 60.00 sec	2 r / w on

Fig. 3-6: Parameters for slot 1

Slot 2 If the CANopen board is mounted on slot 2, it is addressed as serial interface 4 (SS4) by the converter firmware. The parameters of SS4 must be set for interface operation.

P. No.:	Name	Description / explanation of selectable options	Factory setting min / max values	Password of prog.
P0745	SS4 functions	Setting the type of reaction of the converter to a warning/malfunction from the CANopen interface. 0 = all active 1 = warning off 2 = fault off 3 = locked	0 0 - 3	2 r / w on
P0746	SS4 RX monitoring	Setting the type of reaction if no valid telegram was received after the monitoring time (P0527) has elapsed. 0 = no action 1 = warning 2 = fault	0 0 - 2	2 r / w on
P0747	SS4 monitoring time	Setting the monitoring time in which a valid telegram must be received.	0.01 sec 0,01 - 60.00 sec	2 r / w on

Fig. 3-7: Parameters for slot 2

Setting CANopen-Specific Parameters on the Converter

Parameter number	Description	Min. value	Max. value	Std. value
P0714	CANopen Node ID	1	127	3
P0715	CANopen Baud Rate Value: 0 = Reserve 1 = Reserve 2 = Reserve 3 = Reserve 4 = 125 kBit/s 5 = 250 kBit/s 6 = 500 kBit/s 7 = 1 MBit/s	0	7	4
P0716.x x = 0 - 2	CANopen PDO Mode Value defined as in section **3.4** CANopen **Basic Profile DS301.** (see below)	0	255	253
P0717.x x = 0 - 2	CANopen Cycle Timer [ms]	0	255	0
P0718	CANopen Emergency Value: 0 = Off 1 = On	0	1	1
P0719	CANopen Bus off	0	255	0
P0720	CANopen Profile Value: 0 = Basic profile DS301 . 1 = I/O profile DS401	0	1	0

Fig. 3-8: CANopen parameters

Parameter P0716:

0 - 253	As in basic profile DS301
254	Timer-controlled cyclic transmission with the period duration that is set in parameter P0717
255	Asynchronous event-controlled transmission

Fig. 3-9: Parameter P0716

Parameter P0717:

0	PDO is blocked
1 -255	Cycle time = 1ms - 255ms

Fig. 3-10: Parameter P0717

Parameter P0718:

This parameter can be used to suppress (value = 0) or enable (value = 1) all emergency messages that can be generated by the RD 500 device.

Parameter P0719:

The reaction to status BUSOFF can be configured here:

0	after status BUSOFF occurs, no more attempts to participate in CAN bus data exchange are made
1 - 255	number of attempts made to participate in CAN bus data exchange after status BUSOFF occurs

Fig. 3-11: Parameter P0719

Parameter P0720:

Setting the CANopen profile

0	Basic profile DS301.
1	I/O profile DS401

Fig. 3-12: Parameter P0720

Note: If one of the following parameters is modified during CANopen communication (i.e. the CANopen node is in Operational mode), the note automatically reinitializes itself and then enters the Pre-Operational mode.
It must then be logged back onto the CANopen network master.

Affected parameters: P0714, P0715, P0716 and P0720

3.4 CANopen Basic Profile DS301.

Conditions

I/O profile DS301 has been activated by RD 500 parameter P0720 = 0 (see page 3-10 Parameter P0720:).

Setting CANopen-Specific Parameters using the CANopen Network

All CANopen profile parameters can be set only with the CANopen bus. For this, CAN configuration/commissioning tools are available on the market.

Using the CANopen network manager (CANopen master), the parameters of a node can also be set using SDO services before the node is enabled.

Generally, every entry in the object table can be addressed. See the Electronic Data Sheet (EDS file), in which every entry is described.

The Object Directory

The various areas of the object directory are defined as follows:

Index (hex)	Object
0000	Reserved
0001 – 001F	Static Data Types
0020 – 003F	Complex Data Types
0040 – 005F	Manufacturer-Specific Data Types
0060 – 007F	Device Profile-Specific Static Data Types
0080 – 009F	Device Profile-Specific Complex Data Types
00A0 – 0FFF	Reserved for further use
1000 – 1FFF	Communication Profile Area (DS301)
2000 – 5FFF	Manufacturer-Specific Profile Area (RD500)
6000 – 9FFF	Standardized Device Profile Area (e.g. DS401)
A000 – FFFF	Reserved for further use

Fig. 3-13: Object directory

Communication Profile Area entries

In the area between 0x1000 and 0x1FFF (Communication Profile Area), the following entries are supported:

Entry	Meaning
0x1000	Device type
0x1001	Error register
0x1004	Number of PDOs supported
0x1005	COB-ID SYNC message
0x1006	Communication cycle period
0x1007	Synchronous window length
0x1008	Manufacturer device name
0x1009	Hardware version
0x100A	Software version
0x100B	Node ID
0x100C	Guard time
0x100D	Lifetime factor
0x100E	Node guarding identifier
0x1014	COB ID emergency object
0x1200	1st server SDO parameter
0x1400	Receive PDO 1 parameter
0x1401	Receive PDO 2 parameter
0x1402	Receive PDO 3 parameter
0x1600	Receive PDO 1 mapping
0x1601	Receive PDO 2 mapping
0x1602	Receive PDO 3 mapping
0x1800	Transmit PDO 1 parameter
0x1801	Transmit PDO 2 parameter
0x1802	Transmit PDO 3 parameter
0x1A00	Transmit PDO 1 mapping
0x1A01	Transmit PDO 2 mapping
0x1A02	Transmit PDO 3 mapping

Fig. 3-14: Communication Profile Area

Manufacturer-Specific Profile Area (RD 500 entries)

Manufacturer-specific entries start at 0x2000.
RD500 parameter entries start at 0x2011.

RD500 parameter numbers are assigned to the object table as follows:

Note: Object directory entry = 0x2010 + RD parameter number

Example: Parameter 1 of RD500 is stored at location 0x2011 in the object table.

The first 6 entries from 0x2000 to 0x2006 are allocated for mirroring process data TxPZD1 to TxPZD10 and RxPZD1 to RxPZD10. It is thus possible to address the process data with SDO services.

If the RD parameters are indexed, these indexed parameters can be accessed with CANopen using subindices.

Example: RD parameters P0480.00 to P0480.09 are to be accessed. The corresponding entries in the object table can then be found under object 0x2010 + 480d = 0x21F0. Access using SDO service:

Index	Subindex	RD parameter
0x21F0	00	P0480.00
0x21F0	01	P0480.01
:	:	:
:	:	:
0x21F0	09	P0480.09

Description of object directory entries 0x2000 to 0x280F

	Index	Subindex	Meaning
RxPDO1	0x2000	0	Parameter description for RxPZD1-RxPZD4
		1	RxPZD1
		2	RxPZD2
		3	RxPZD3
		4	RxPZD4
RxPDO2	0x2001	0	Parameter description for RxPZD5-RxPZD8
		1	RxPZD5
		2	RxPZD6
		3	RxPZD7
		4	RxPZD8
RxPDO3	0x2002	0	Parameter description for RxPZD9-RxPZD10
		1	RxPZD9
		2	RxPZD10
		3	Dummy
		4	Dummy
TxPDO1	0x2004	0	Parameter description for TxPZD1-TxPZD4
		1	TxPZD1
		2	TxPZD2
		3	TxPZD3
		4	TxPZD4
TxPDO2	0x2005	0	Parameter description for TxPZD5-TxPZD8
		1	TxPZD5
		2	TxPZD6
		3	TxPZD7
		4	TxPZD8

	Index	Subindex	Meaning
TxPDO3	0x2006	0	Parameter description for TxPZD9-TxPZD10
		1	TxPZD9
		2	TxPZD10
		3	Dummy
		4	Dummy
	0x2011	0	RD parameter P0001 (0x2010 +1d)
	0x2012	0	RD parameter P0002 (0x2010 +2d)
	:	:	:
	:	:	:
	0x280F	0	RD parameter P2047 (0x2010 +2047d)

Fig. 3-15: Object directory entries 0x2000 to 0x2006 (Manufacturer-Specific Profile Area)

PDOs:

PDO mapping

Note: CANopen option RZP01.1-C2 does **not support dynamic mapping** of PDOs! The data content of the PDOs is fixed and cannot be reprogrammed by the CANopen master. The data content of the PDOs corresponds with the RD500 PZDs (process data). These, in turn, can be freely assigned so that the transfer possibilities are unlimited.

See also section “Editing Process Data”.

PDO COB identifier

A PDO COB identifier (11 bits wide) consists of a basic address and the node address (node ID). The node address is stored in RD device parameter P0714. As a rule, the identifiers can be freely assigned with entries 0x1400 to 0x1402 and 0x1800 to 0x1802 using the object table. By default, however, the PDOs are set according to the *Predefined Connection Set* as follows:

11-bit identifier:

Tx PDO No.	Basic address	+ Node address e.g.: note 3	= Resulting PDO COB identifier
1	0x180	3	0x183
2	0x280	3	0x283
3	0x380	3	0x383
4	0x480	3	0x483

Rx PDO No.	Basic address	+ Node address e.g.: note 3	= Resulting PDO COB identifier
1	0x200	3	0x203
2	0x300	3	0x303
3	0x400	3	0x403
4	0x500	3	0x503

PDO Structure:

The CANopen option permits up to three PDOs to be used for transmission and up to three PDOs to be used for reception.

Three PDOs correspond to 10 PZDs (process data) that are assigned as follows:

PDO	Word 1 (16 bits)	Word 2 (16 bits)	Word 3 (16 bits)	Word 4 (16 bits)
TxPDO1	TxPZD1	TxPZD2	TxPZD3	TxPZD4
TxPDO2	TxPZD5	TxPZD6	TxPZD7	TxPZD8
TxPDO3	TxPZD9	TxPZD10	reserved	reserved
RxPDO1	RxPZD1	RxPZD2	RxPZD3	RxPZD4
RxPDO2	RxPZD5	RxPZD6	RxPZD7	RxPZD8
RxPDO3	RxPZD9	RxPZD10	reserved	reserved

By default, only the first two TxPDOs and the first two RxPDOs are enabled. If you want to also use process data 9 and 10, i.e. PDO3, the CANopen master or a corresponding configuration tool must enable TxPDO3 and RxPDO3.

Enabling TxPDO3 and RxPDO3

Enabling is carried out according to the CANopen profile – when SDO services are used for writing, the uppermost bit in object directory index 1402, subindex 1 must be set to “0” for RxPDO3.
When index 1802, subindex 1 in the object directory is written, the uppermost bit must also be set to “0” to enable TxPDO3.

Communication modes

As a rule, the operating modes of the three TxPDOs can be separately set using RD parameter P0716.x. General rule:

Value x in P0716 or P0712	TxPDO
0	1
1	2
2	3

Note: Setting the operating mode of a PDOs affects one group of PZDs, as shown above.

Possible operating modes:

PDO mode	Value
0	Transmission is acyclic but synchronous, i.e. transmission occurs once and synchronously after an event
1-240	Transmission is cyclic and synchronous with every n^{th} sync object
241-251	Reserved
252	Transmission occurs once and synchronously on request (remote frame)
253	Transmission occurs once and asynchronously on request (remote frame)
254	Transmission occurs asynchronously per timer A timer value of 1ms to 255ms can be set A timer value of 0 means that the PDO is locked
255	Transmission occurs asynchronously (event-controlled)

The CANopen profile provides three different types of trigger modes:

- event-controlled or timer-controlled transmission
- transmission on request
- cyclic or acyclic synchronous transmission

Event-controlled or timer-controlled transmission

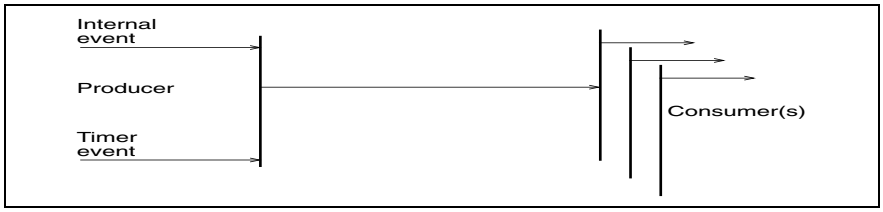


Fig. 3-16: Event-controlled or timer-controlled transmission

Timer-controlled transmission

Using RD parameter P0716.x "CANopen PDO mode", timer-controlled transmission can be set for a Tx PDO. To do this, the value 254 is selected. The index of parameter 716 stands for the selected PDO, i.e.: index 0 for PDO1, index 1 for PDO2 and index 2 for PDO3.

The cycle time is set in RD parameter P0717.x and can be selected from 1ms to 255ms in steps of one millisecond. Indices 0 to 2 again stand for PDOs 1 to 3, which can independently receive different cycle times. The value 0ms has a special status; it means that the corresponding PDO is not active, i.e. it shows no reactions to external influences (the PDO is locked).

Event-controlled transmission

If a PDO is to undergo event-controlled transmission, parameter P0716.x must be programmed with a value of 255.

If the data content of a PDO changes due to events in the device, this PDO is transmitted. The shortest time between two events must be approx. 1ms, i.e. events that occur within one millisecond are not detected for certain.

Note: A PDO affects a group of PZDs.

Example: PDO1 is to be transmitted with event control.

To do this, RD parameter P0716.0 is programmed to a value of 255.

PDO1 contains PZDs 1 to 4, whose values are as follows:

PZD1 = 0x1111, PZD2 = 0x2222, PZD3 = 0x3333 and PZD4 = 0x4444;

Now PZD3 changes to 0x3334.

PDO1, with PZD1 to PZD4 assigned, is transmitted...

Transmission on request

Using request telegrams (remote frames), every PDO can be specifically called. This can be used to determine the data content of a PDO, even if the PDO has not been modified.

For example, if a diagnosis device is connected during bus operation, all relevant PDOs can be called.

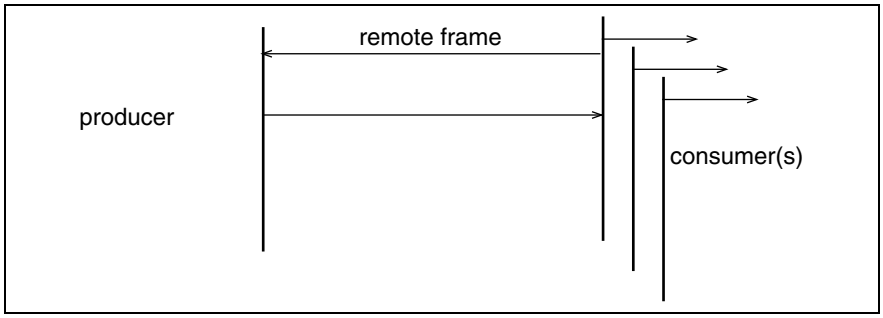


Fig. 3-17: Transmission on request

Cyclic or acyclic synchronous transmission

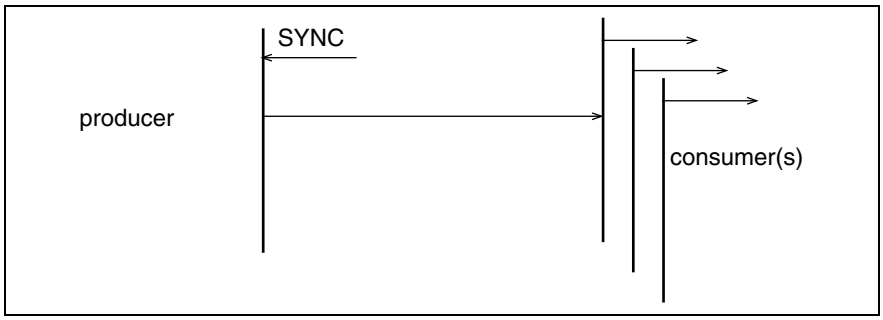


Fig. 3-18: Cyclic or acyclic synchronous transmission

The sync object (a short telegram with no user data and with a relatively high priority) can be used to synchronize the inputs and outputs of different devices. In addition, the update rates of different PDOs can be configured. With modes 1 to 240, data can be transferred cyclically and synchronous with every n^{th} sync object.

SDO Services

The SDO is a Service Data Object that is used for parameterization, operation and observation. Using the SDO, every entry in the object directory can be read and written.

The SDO COB identifier (11 bits wide) consists of a basic address and the node address (node ID). The node address is stored in device parameter P0714. The SDO COB identifier is set according to the Predefined Connection Set as follows:

11-bit identifier:

SDO	Basic address	+ Node address e.g.: note 3	= SDO COB identifier
TxSDO	0x580	3	0x583
RxSDO	0x600	3	0x603

Emergency Objects

The emergency object is used to inform other bus participants about internal device errors or other detected bus errors.

The standard COB identifier is at 0x80 + node address; the corresponding object entry is at 0x1014.

RD parameter P0718 can be used to suppress (value = 0) or enable (value = 1) all emergency messages that can be generated by the RD500 device.

Node Guarding / Life Guarding

The Node guarding and Life guarding options are supported on CANopen card RZP01.1-C2.

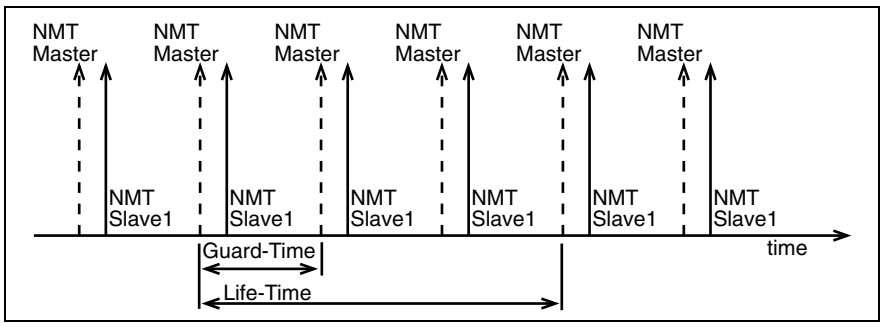


Fig. 3-19: Node guarding / Life guarding

Node guarding

Using the Node guarding monitoring function, a network master can detect if a slave fails.

In Node guarding, the master transmits a remote frame to the node to be monitored. Then the node transmits the corresponding reply telegram containing the status of the slave and a shifted toggle bit. If the master receives an unexpected reply, or none at all, the master assumes that the slave has failed.

The COB ID for the Node guarding message is entered at the 0x100E position in the object directory. The default value is at 0x700 + node address.

The corresponding object directory entry for the monitoring time is at 0x100C. The default value for the Node-guarding monitoring time is preset at one second.

Life guarding

The CANopen option can also detect the failure of the CANopen master if it hasn't transmitted any Node-guarding messages in the "Node lifetime". The Node lifetime is a multiple of the Node-guarding monitoring time (object directory entry 0x100C). The multiplier is entered at the 0x100D position in the object directory. A multiplier of 3 is entered as the default value, corresponding to a default time of three seconds.

If the Node-guarding monitoring time or the Lifetime multiplier is zero, the Node lifetime is not monitored (life-guarding is deactivated).

If the failure of the master is detected, the node returns to the “Pre-operational” status and transmits an emergency message.

Note: Monitoring is also active in node status “Stopped”.

CANopen Status Rules

Every node in the CANopen network works according to defined status rules. Only certain actions are permitted in each state.

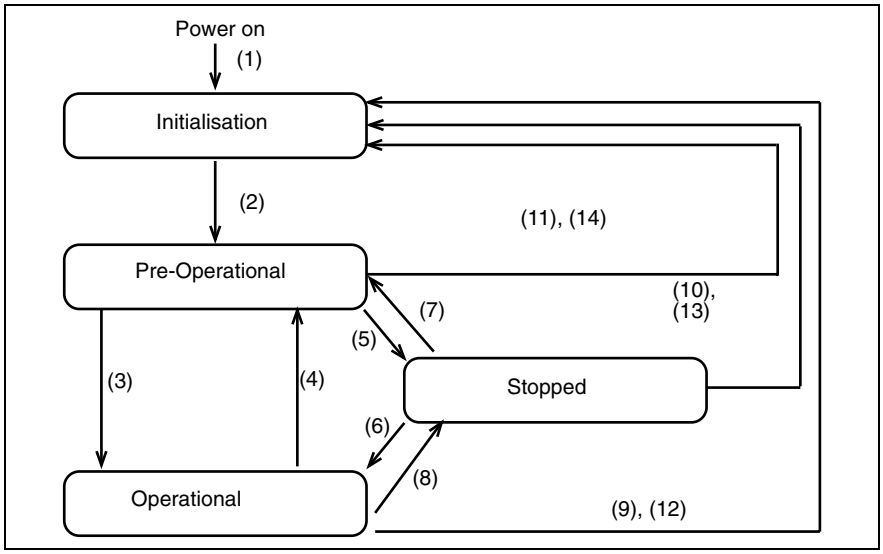


Fig. 3-20: Status rules

After the power is switched on, the “Initialization” status is attained. After initialization, the node automatically switches to the “Pre-operational” status. The node can now be configured using service data objects (SDOs). The process data objects (PDOs) are not yet evaluated in this status.

If the message “Start_Remote_Node” is now received, the node switches to the “Operational” status. Process data (PDOs) can be received as of now. If the node is in the “Stopped” status, only network messages can be received. The node can enter this status if the master requests it to do so.

(1)	After the device is switched on, the INITIALIZATION status is automatically attained
(2)	After initialization, the node automatically switches to the PRE-OPERATIONAL status
(3), (6)	Start_Remote_Node; node is enabled
(4), (7)	Enter_PRE_OPERATIONAL_STATE; PDOs are locked, SDOs remain active
(5), (8)	Stop_Remote_Node; PDOs and SDOs are locked, NMT messages remain active
(9), (10), (11)	Reset_Node; node is reinitialized with the startup default values
(12), (13), (14)	Reset_Communication; only communication parameters (0x1000 - 0x1FFF) are reset to the startup default values

3.5 CANopen I/O Profile DS401

Conditions

I/O profile DS401 has been activated by RD parameter P0720 = 1 (see page 3-10 Parameter P0720:).

General

The implementation of the I/O profile includes 32 digital inputs, 32 digital outputs, 8 analog inputs (16 bits wide) and 8 analog outputs (16 bits wide).

PDOs:

Process data objects (PDOs) are used for the fast transfer of real-time data. A PDO can contain up to four process data (PZDs).

PDO mapping

Note: CANopen option RZP01.1-C2 does not support dynamic mapping of PDOs! The data content of the PDOs is fixed and cannot be reprogrammed by the CANopen master. The data content of the PDOs corresponds with the RD500 PZDs (process data). These, in turn, can be freely assigned so that the transfer possibilities are unlimited.

See also section “Editing Process Data”.

PDO identifier

A PDO COB identifier (11 bits wide) consists of a basic address and the node address (node ID). The node address is stored in RD device parameter P0714. As a rule, the identifiers can be freely assigned with entries 0x1400 to 0x1403 and 0x1800 to 0x1803 using the object table. By default, however, the PDOs are set according to the *Predefined Connection Set* as follows:

11-bit identifier:

Tx PDO No.	Basic address	+ Node address e.g.: note 3	= PDO COB identifier
1	0x180	3	0x183
2	0x280	3	0x283
3	0x380	3	0x383
4	0x480	3	0x483

Rx PDO No.	Basic address	+ Node address e.g.: note 3	= PDO COB identifier
1	0x200	3	0x203
2	0x300	3	0x303
3	0x400	3	0x403
4	0x500	3	0x503

PDO structure

The CANopen option permits up to three PDOs to be used for transmission and up to three PDOs to be used for reception.

Three PDOs correspond to 10 PZDs (process data) that are assigned as follows:

PDO	Word 1 (16 bits)	Word 2 (16 bits)	Word 3 (16 bits)	Word 4 (16 bits)
TxPDO1	TxPZD1	TxPZD2	reserved	reserved
TxPDO2	TxPZD3	TxPZD4	TxPZD5	TxPZD6
TxPDO3	TxPZD7	TxPZD8	TxPZD9	TxPZD10
TxPDO4	reserved	reserved	reserved	reserved
RxPDO1	RxPZD1	RxPZD2	reserved	reserved
RxPDO2	RxPZD3	RxPZD4	RxPZD5	RxPZD6
RxPDO3	RxPZD7	RxPZD8	RxPZD9	RxPZD10
RxPDO4	reserved	reserved	reserved	reserved

TxPDO1 and RxPDO1 are assigned to the digital inputs and outputs, while TxPDOs 2 and 3 / RxPDOs 2 and 3 are assigned to the analog inputs and outputs.

By default, only the first two TxPDOs and the first two RxPDOs are enabled. This conforms to the Predefined Connection Set. If you want to also use process data 7 to 10, i.e. PDO3, the CANopen master or a corresponding configuration tool must enable TxPDO3 and RxPDO3.

Enabling TxPDO3 and RxPDO3

Enabling is carried out according to the CANopen profile – when SDO services are used for writing, the uppermost bit in object directory index 1402, subindex 1 must be set to “0” for RxPDO3.
When index 1802, subindex 1 in the object directory is written, the uppermost bit must also be set to “0” to enable TxPDO3.

Communication mode

The operating mode of the PDOs is specified to mode 255 (asynchronous event-controlled transmission) according to the selection of the I/O profile (DS401).

Supported Objects in the Object Directory

In the area between 0x6000 and 0x9FFF (Standardized Device Profile Area), the following entries are supported:

Entry	Meaning
0x6000	Read Input, 8-Bit
0x6002	Polarity Input, 8-Bit
0x6005	Digital Inputs, Global Interrupt Enable
0x6006	Input Interrupt Mask Any Change, 8-Bit
0x6007	Interrupt Mask Low to High, 8-Bit
0x6008	Interrupt Mask High to Low, 8-Bit
0x6200	Write Output, 8-Bit
0x6202	Change Polarity Output, 8-Bit
0x6206	Error Mode Output, 8-Bit
0x6207	Error Value Output, 8-Bit

Entry	Meaning
0x6401	Read Analog Input, 16-Bit
0x6403	Read Analog Input, Float
0x6411	Write Analog Output, 16-Bit
0x6413	Write Analog Output, Float
0x6420	Set Analog Input Range (reserved)
0x6421	Analog Input Interrupt Trigger Selection, 8-Bit
0x6422	Analog Input Interrupt Source, 32-Bit
0x6423	Analog Input Global Interrupt Enable
0x6424	Analog Input Interrupt Upper Limit, Integer
0x6425	Analog Input Interrupt Lower Limit, Integer
0x6426	Analog Input Interrupt Delta, Unsigned
0x6427	Analog Input Interrupt Negative Delta, unsigned
0x6428	Analog Input Interrupt Positive Delta, unsigned
0x642E	Analog Input Offset, Float
0x642F	Analog Input Scaling, Float
0x6441	Analog Output Offset, Float
0x6442	Analog Output Scaling, Float
0x6443	Analog Output Error Mode, 8-Bit
0x6444	Analog Output Error Value, Integer

Fig. 3-21: Standardized Profile Area

Digital Inputs

32 digital inputs are supported; these are permanently stored in TxPDO1 (PZD1 and PZD2). The polarity of each individual input can be switched. The interrupt for transmitting the PDOs can be separately switched on for each input. The trigger can be set for each modification of the input or only on the rising or falling flank.

The digital inputs can also be read from object directory entry 0x6000 using SDO access.

The 32 digital inputs are assigned as follows:

TxPZD	Digital inputs, bits
TxPZD1	15 - 00
TxPZD2	31 - 16

The objects are organized according to bytes; the input bits and the masks for switching the polarity and enabling the interrupt are arranged according to the following system:

Object IDx	Sdx	Digital inputs, bits
0x6000, 0x6002, 0x6006, 0x6007, 0x6008	1	07 - 00
	2	15 - 08
	3	23 - 16
	4	31 - 24

If a bit in object 0x6002 is set, the polarity of the associated input bit switches. If a bit in one of the three interrupt masks is set, the

corresponding flank is activated. The TxPDO transmission interrupt is enabled if bit 0 in object 0x6005 is set.

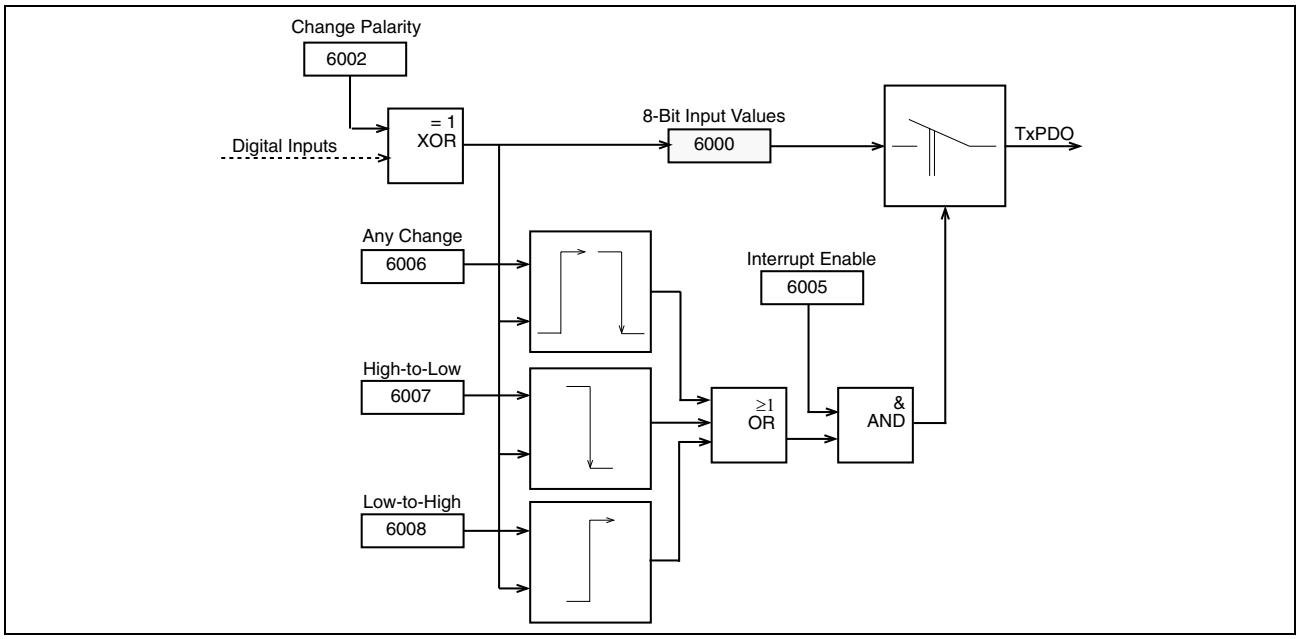


Fig. 3-22: Dataflow of a digital inlet

Digital Outputs

32 digital outputs are supported; these are permanently stored in RxPDO1 (PZD1 and PZD2). The polarity of each individual output can be switched.

If the device is faulty, it is possible to bring the digital outputs into a predefined setting. This predefined reaction can be entered in position 0x6206 or 0x6207 in the object directory using the CANopen master.

The digital outputs can also be reread from object directory entry 0x6000 using SDO access.

The 32 digital outputs are assigned as follows:

RxPZD	Digital outputs, bits
RxPZD1	15 - 00
RxPZD2	31 - 16

The objects are organized according to bytes; the input bits and the masks for switching the polarity and enabling the interrupt are arranged according to the following system:

Object IDx	Sdx	Digital outputs, bits
0x6200, 0x6202, 0x6206, 0x6207	1	07 - 00
	2	15 - 08
	3	23 - 16
	4	31 - 24

If a bit in object 0x6202 is set, the polarity of the associated output bit, or of the bit for a fault, switches. The polarity switches only after the next PDO is received. If a bit in object 0x6207 is set, the status of the corresponding bit is transferred from object 0x6207 in case of a fault (bit in RD status word D1922.3 or D1733 is set); if the bit is reset, the status that was last output is retained. A modification to objects 0x6206 or 0x6207 goes into effect only after the next fault event occurs.

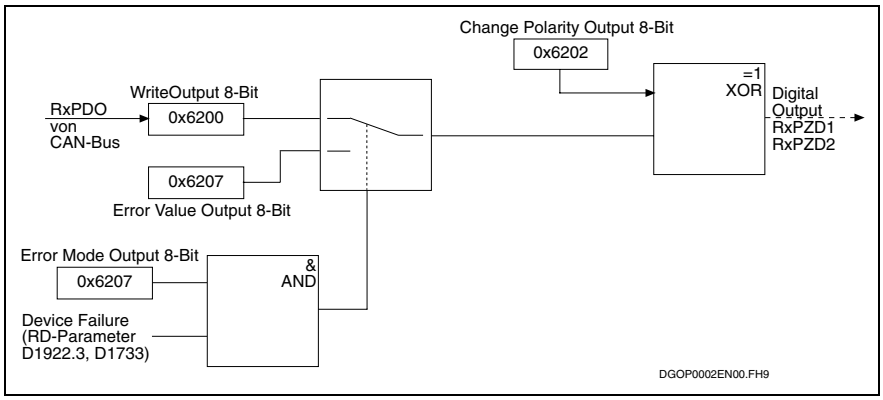


Fig. 3-23: Dataflow of a digital output

Analog Inputs

8 analog inputs are supported; these are permanently stored in TxPDO2 (PZD3 to PZD6) and TxPDO3 (PZD7 to PZD10). Each individual inlet can be defined with an amplification, an offset and an inlet value range. The interrupt for transmitting the PDOs can be separately switched on for each input. The trigger can be programmed to an upper limit and/or a lower limit. At the same time, a tolerance range that activates a trigger every time that the range is exceeded can be defined. However, it is also possible to activate a trigger in the positive and/or negative direction. For example, the trigger can be set differently in the positive direction than in the negative direction.

The analog inputs can also be read from object directory entry 0x6401 using SDO access.

The 8 analog inputs are assigned as follows:

TxPZD	Analog input
TxPZD3	1
TxPZD4	2
TxPZD5	3
TxPZD6	4
TxPZD7	5
TxPZD8	6
TxPZD9	7
TxPZD10	8

The objects for the input values, the input area, the offset, the scaling and the trigger settings are arranged according to the following system:

Object IDx	Sdx	Analog input
0x6401, 0x6403, 0x6420, 0x6421, 0x6423, 0x6424, 0x6425, 0x6426, 0x6427, 0x6428, 0x642E, 0x642F	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8

Using SDO services, the input values can be read from object 0x6401 as a 16-bit integer value or, alternatively, to object 0x6403 as a float value with positions behind the decimal point; the value is the same. The object for inlet area 0x6420 is implemented only for reasons of compatibility; it has no function.

The objects for offset 0x642E and scaling 0x642F of the input values are represented as float values; they are allocated to the corresponding input value according to the formula below:

$$(0x6403) = (\text{float})\text{input value} \times (0x642F) + (0x642E)$$
$$(0x6401) = (\text{int16})(0x6403)$$

After offset correction and scaling, the numerical value is written to object 0x6403; from there, it is written to object 0x6401 after an integer transformation.

Object 0x6423 is used to enable or block the transmission interrupts for all channels simultaneously. The TxPDO transmission interrupt is enabled if bit 0 in object 0x6423 is set.

Object 0x6421 can be used to set under which conditions a transmission interrupt is to be triggered for each channel:

Bit in 0x6421	Priority	Interrupt trigger if	Associated object for settings
0	1	Input above upper limit	0x6424
1	2	Input below lower limit	0x5425
2	4	Input changed by more than delta	0x6426
3	8	Input reduced by more than negative delta	0x6427
4	16	Input increased by more than positive delta	0x6428
7 - 5	-	reserved	-

Several trigger conditions can also be combined by adding the priorities. If one of the selected conditions occurs, a trigger is activated.

Object 0x6422 can be used to read out which analog input has triggered an interrupt. A bit is reserved in object 0x6422, subindex 1 for each analog input; this is set if it has caused a trigger event.

Bit 0 is reserved for analog input 1, bit 1 for analog input 2, and so on for the remaining bits. The object is reset after it has been read out using a PDO or SDO service.

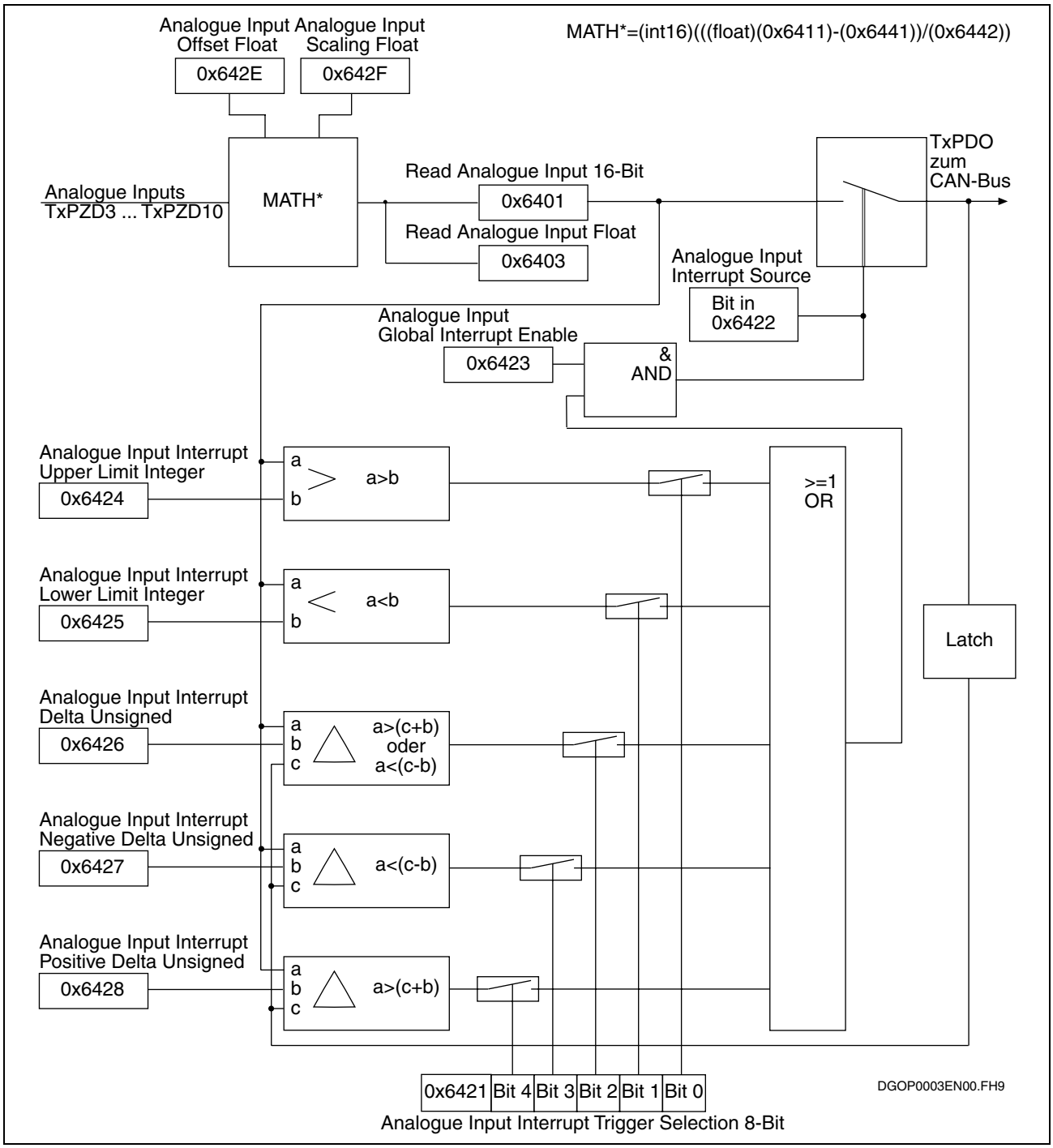


Fig. 3-24: Dataflow of an analog inlet

Analog Outputs

8 analog outputs are supported; these are permanently stored in RxPDO2 (PZD3 to PZD6) and RxPDO3 (PZD7 to PZD10). Each individual output can be provided with an amplification and an offset.

If the device is faulty, it is possible to bring the analog outputs into a predefined setting. This predefined reaction can be entered in position 0x6443 or 0x6444 in the object directory using the CANopen master.

The analog outputs can also be reread from object directory entry 0x6411 using SDO access.

The analog outputs are assigned as follows:

RxPZD	Analog output
RxPZD3	1
RxPZD4	2
RxPZD5	3
RxPZD6	4
RxPZD7	5
RxPZD8	6
RxPZD9	7
RxPZD10	8

The objects for the output values, the offset, the scaling and the trigger settings are arranged according to the following system:

Object IDx	Sdx	Analog output
0x6411, 0x6413, 0x6441, 0x6442, 0x6443, 0x6444	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8

Using SDO services, the output values can be read from object 0x6411 as a 16-bit integer value or, alternatively, to object 0x6413 as a float value with positions behind the decimal point; the value is the same.

The objects for offset 0x6441 and scaling 0x6442 of the output values are represented as float values; they are allocated to the corresponding output value according to the formula below:

$$\text{Intermediate value} = ((\text{float})(0x6411) - (0x6441))/(0x6442)$$
$$\text{output value} = (\text{int16})\text{Intermediate value}$$

The numerical value is written to the analog output (associated RxPZD) after the offset correction and scaling.

A modification to objects 0x6441 and 0x6442 goes into effect only after the next PDO is received.

If the value in object 0x6443 is 1, the value of object 0x6444 is adopted in case of a fault (bit in RD status word D1922.3 or D1733 is set); if the value in object 0x6443 is 1, the analog value that was last output is retained. A modification to objects 0x6443 or 0x6444 goes into effect only after the next fault event occurs.

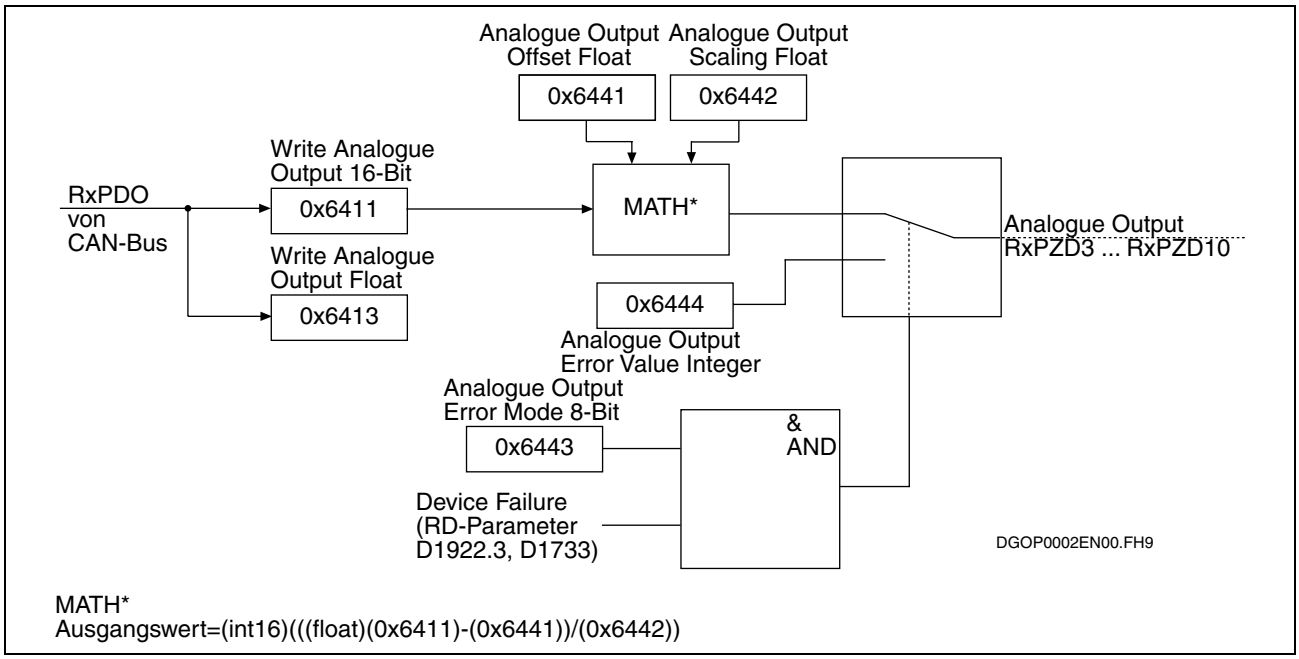


Fig. 3-25: Dataflow of an analog output

3.6 Electronic Data Sheet (EDS)

Entries in the EDS File

The EDS file contains a complete description of all the parameters of the CANopen node (RD500 device) that can be reached using the CANopen network. This does not necessarily mean all the device parameters – see menu item BASIC parameters or ALL parameters in EDS Generator. Only the parameters that are described in this file can be reached using the object directory.

The EDS file can be divided into three groups:

- the informative part (creation date, program version, etc.)
- the device-specific part (manufacturer, baud rates, slave type, etc.)
- and the object table with its default values (parameter implementation, etc.)

Manufacturer-specific entries

Manufacturer-specific entries start at 2000hex in the object directory. RD500 parameter numbers are assigned to the object table as follows:

Note: Object directory entry = 0x2010 + RD parameter number

Example: Parameter 1 of RD500 is stored at location 0x2011 in the object table.

The first 16 entries from 0x2000 to 0x200F are allocated for mirroring process data TxPZD1 to TxPZD10 and RxPZD1 to RxPZD10. It is thus possible to address the process data with SDO services.

Automatic Generation of EDS File for CANopen

Via the Internet, you can download the program (EDS Generator) for generating your own EDS file.

File name: REFU0469.zip

Address: http://www.boschrexroth.com

Contents of the ZIP file:

- EDS-GEN.EXE Program
- Setup.bat Standard installation from A: to C:\REFU\EDSGEN\
- Readme.txt Installation notes (this text file)
- \EDSGEN\static.dat Program data to generate the EDS

EDS Generator

1. Copy the contents of this file to any directory on the hard disk, preferentially C:\REFU\EDSGEN*.*
   Note: The subdirectory absolutely must be included. Program “setup.bat” does this for you.
2. Start the EDS-GEN.EXE program (Win9X, WinNT).
3. Select the fastest possible transfer speed permitted by your system environment (e.g. 57600 Baud as the fastest transfer rate of the RD500 device). To do this, set device parameter P0499 to the desired baud rate. In menu item “Device connection \ configuration” of the EDS Generator, set the same baud rate. Menu item “Timeout multiplier” multiplies the timeout period in 25ms steps. “No timeout” means that the reply is expected immediately within the reply delay time, according to the USS protocol specification. This is the fastest connection with the converter – see if the hardware configuration of your PC permits it. When the “AUTO” button is pressed, the PC looks for the connection on its own.
4. Make a connection with the RD500 device, i.e. RS232 serial communication via the COM interface and service interface X11 of the RD500. Please use a standard RS232 extension cable or the original RD cable with item number 0013456.
5. To test the connection, select menu item “Device connection \ Connection test”.
6. Now generate the EDS file by activating menu item “Make EDS”. You are now requested to enter the size, type and language of the EDS file that is to be generated. If BASIC PARAMETERS is selected, only the most important parameters required to operate and monitor the converter are generated. The language of the EDS parameter descriptions can be set by selecting either English or German. The progress bar shows the current processing status. Generation can take from approx. 10 minutes to half an hour.
7. When the procedure is complete, the automatically generated name of the EDS file is displayed. This contains the firmware version. The file is located on the same path as the program.

Note: Files with the same name in this directory are overwritten without a query being issued.

If you have any questions, consult our Customer Service department or call our telephone hotline:

Telephone Hotline: +49-(0)7123-969-200

Please provide our Customer Service department with files EDS-LOG.LOG and EDS-ERROR.LOG so that an error analysis may be carried out.

4 RZP01.1-G1/G3 Incremental encoder emulation

4.1 General information on pulse encoder emulation RZP01.1-G1/G3

The RZP01.1-G1/G3 option is used to evaluate an incremental pulse encoder (rotary encoder input X48) and to emulate a pulse encoder (encoder output X49).

The encoder input supports pulse encoders with TTL or RS422 signal level and can be used as second encoder for position or speed synchronization.

The encoder output emulates a pulse encoder with RS422 signal level and optionally emulates

- the encoder input (X48)
- or the pulse encoder input of the base card SR17002 (X18)

Option G1 additionally contains a converter, which emulates a pulse encoder from the signals of a SR17002 (X18) resolver.

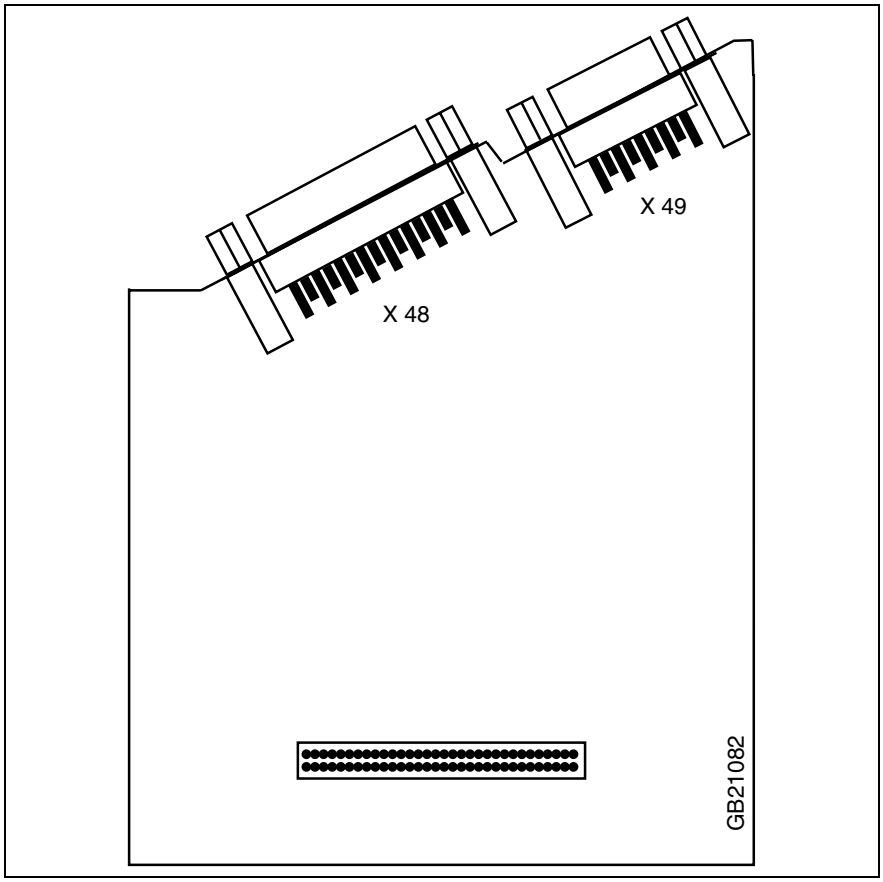


Fig. 4-1: Layout diagram of the GB21082 module

Technical data

Order No. / version	RZP01.1-G1/RZP01.1-G3
Power supply for the card	+ 5V and +15V internal from the control card
Size	100 x 89 mm
Environmental Class	3K3 acc. to DIN IEC 721-3-3
Ambient temperature – during storage – in operation	 -25°C ... 70°C 0°C ... 40°C
Radio interference suppression level	A1 acc. to EN 55011
Noise immunity	EN50082-2
Encoder input (X48)	TTL pulse encoder
Encoder power supply	+5V max 300mA (when sensor conductors are connected) closed-loop controlled; +10V max 300mA (when the sensor conductors are jumpered)
Signal inputs A+ / A-, B+ / B- and R+ / R-	Differential inputs RS422 signal level
Input resistance	120 Ohm
Max. input signal level w.r.t. ground	+/- 10V
Max. common mode signal	+/- 10V
Max. input frequency	300 kHz
Encoder output (X49)	
Signal pairs A+/A-, B+/B-, R+/R-	RS422 driver

Fig. 4-2: Technical data

4.2 Electrical installation

Installation diagram

The options G1 and G3 can be inserted at module slot 1 or 2. The connections are visible after the front cover has been removed

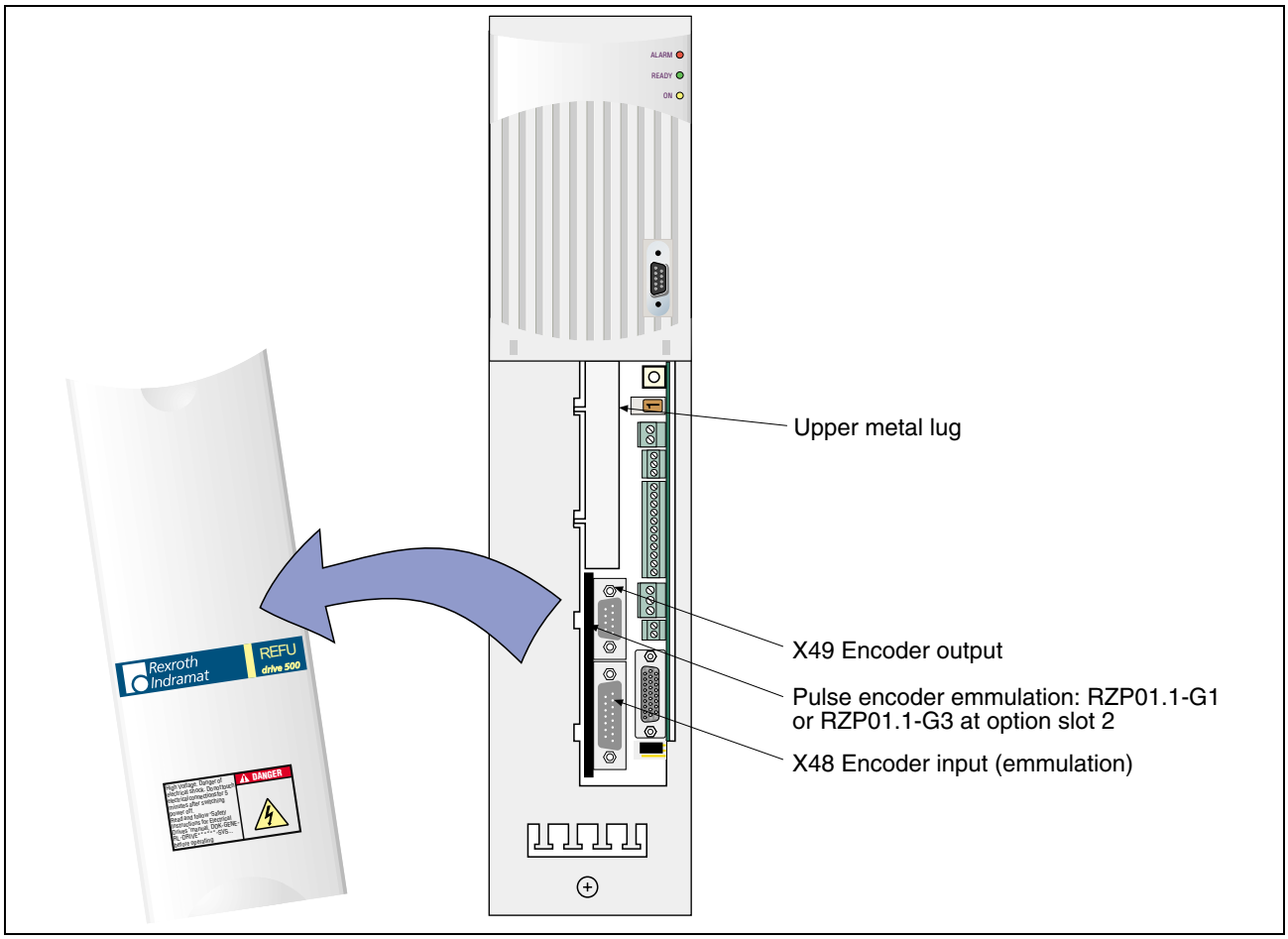


Fig. 4-3: Connector layout diagram, option G1/3 at module slot 2

Connector assignment

Connector X48 Encoder input 15-pin sub-D plug connector		
Pin No.	**Signal designation**	**Description**
1	P5V sense	Sensor conductor +5V
2	OV sense	Sensor conductor, ground
3	R-	Zero signal (inverted)
4	R+	Zero signal (direct)
5	B-	Neg. signal track B
6	B+	Pos. signal track B
7	A+	Pos. signal track A
8	A-	Neg. signal track A
9		Not assigned
10	0V	Ground or reference potential
11		Not assigned
12	5V (* 10V)	Power supply, max. 300mA, (* 10V, if pins 1 and 2 are jumpered)
13		Not assigned
14	0V	Ground or reference potential
15		Not assigned

Fig. 4-4: Connector assignment X48

Connector X49 Encoder output 9-pin sub-D plug connector		
Pin No.	**Signal designation**	**Description**
1	B+	Pos. signal track B
2	B-	Neg. signal track B
3	R+	Zero signal direct
4	R-	Zero signal inverted
5	A-	Neg. signal track A
6	-	Not assigned
7	-	Not assigned
8	0V	Ground or reference potential
9	A+	Pos. signal track A

Fig. 4-5: Connector assignment X49

4.3 Hardware description

Input circuit

All of the 3 signals of the encoder input (A, B, R) are implemented according to the following principle. Differential signals according to the RS422 Standard are expected.

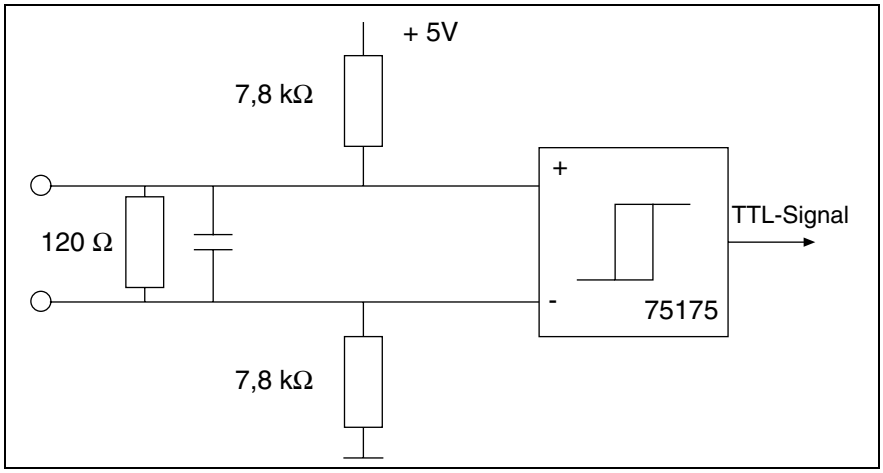


Fig. 4-6: Input circuit

The input circuit is not floating, however, however the input circuit can process common-mode signals of +/-10 V. The maximum input frequency is approx. 300 kHz; this corresponds, for an encoder with 1024 pulses, a speed of approx. 17500 rpm.

Output circuit

The encoder output (X49) supplies signals A, B and R and the associated inverted signals. The RS422 drivers supply a differential voltage signal level of min. 2.5 V for a 120 Ohm load. The outputs are short-circuit proof.

Encoder power supply

The power supply at X48 (pin10-pin12) supplies max. 300 mA and has an internal current limiting function. The nominal voltage is 5 V. However, it can also be adapted for encoders with a 7-12 V power supply.

For longer encoder cables, we additionally recommend that 2 sense conductors are used in the encoder cable. These are connected, at the encoder side, with the +5 V and 0 V power supply conductors. The power supply regulates the output voltage so that there is precisely 5.0 V between pin 1 (+5V sensor) and pin 2 (0V sensor). This means that the voltage drop along the power supply conductors can be compensated. The regulator can generate a max. voltage of approx. 10 V (pin12 to pin10), which means, that for very long cables, the supply conductors should have a 0.5 mm^2 cross-section.

For encoders with a recommended power supply of 7-12 V, a voltage of approx. 10 V can be forced by connecting pins 1 and 2 (sensor conductors) at the connector on the drive converter side.

4.4 Parameterization

Checking the card identification

As for all option cards for REFUdrive units, these log-on in the basic drive converter firmware under the following parameters

- 1021.0 (slot 1) and
- 1022.0 (slot 2) with a card identification.
- Identification for G1: 21
- Identification for G3: 23

The encoder option G1/G3 does not have its own firmware, which is the reason that parameters 102x.1 .. 102x.3 indicate a zero.

Setting the encoder type

Parameter No.	Name	Description or value range	Factory setting
P134	Encoder emulation	From encoder SR17002 = 0 pulse encoder GB21082 = 1	0
P637	Select, supplementary function	The evaluation of the supplementary encoder is activated using the following settings IGR 2 active = 2 IGR 2 + position controller = 3	Everything de-activated = 0
P0638	IGR2 pulse number	100 ... 8000	1024
P0639	Offset, pos.act.value	-180.00° ... +1799.99°	0
P0640	IGR2 reset zero sync	0..2047 connectable input to reset the angular referencing via zero pulse	1700
D1985	Angle IGR 2, raw	-200.00% ... +199.99% display parameter: Angular signal before referencing normalization 100% => 90°	-
D1986	Angle IGR 2	-200.00% ... + 199.99% display parameter: Angular signal after offset and referencing, normalization 100% => 90°	-
D1987	nact 2	-200.00% ... +199.99% the speed display refers to the speed normalization set in P0390	-

Fig. 4-7: Parameter list

Function diagram, encoder evaluation

The following function module is processed in time sector 4T0 (directly before the closed-loop position controller), and is activated by appropriately setting parameter P0637.

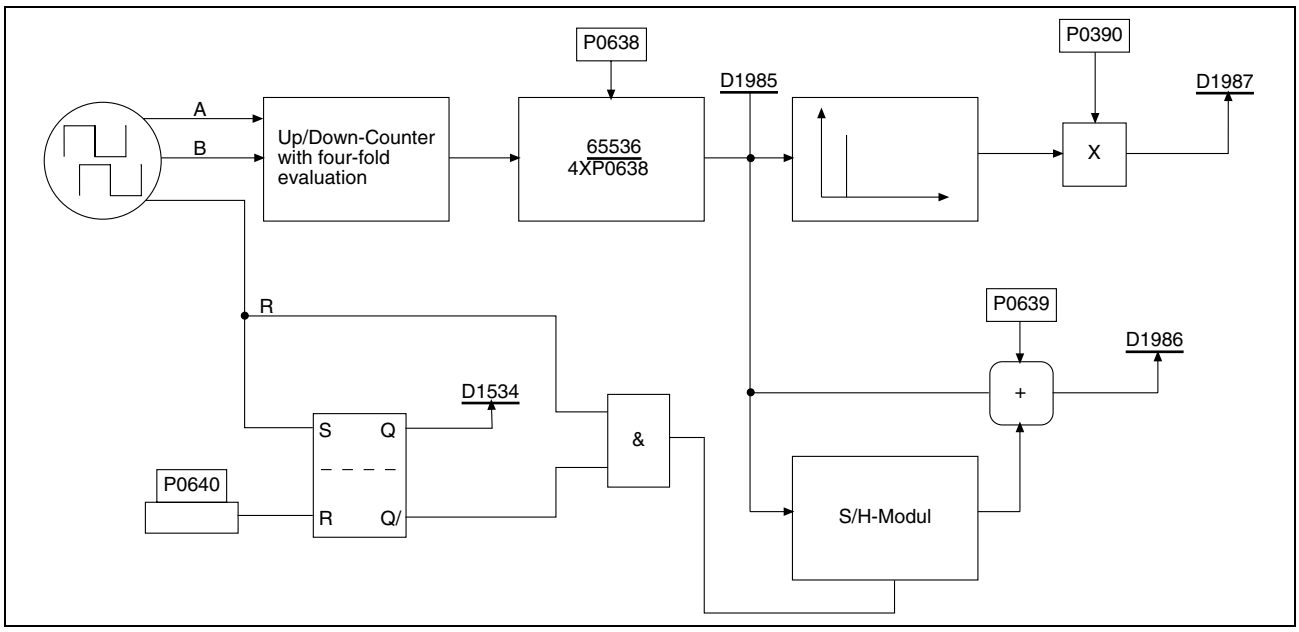


Fig. 4-8: Function diagram, encoder evaluation G1/G3

4.5 Applications

Master setpoint from an external encoder

The speed is evaluated according to the pulse counting method (without interpolation). The speed actual value (D1986) also does not include a low-pass filter which means that this signal has a relatively coarse resolution. If D1986 is to be used as speed setpoint, we recommend that this signal is filtered through a PT1 element. The time constant must be adapted to the application (dynamic response).

Application, electronic shaft

The encoder angle D1987 can be directly used as setpoint for the position controller (P0648) or can be routed via the electronic gear (P0642), so that D1988 is used as position controller setpoint. The position controller processes 32-bit quantities, however the G2 angle only has a 16-bit word size, which means that parameter P0794 (evaluation position difference) should be set to 1 at the position controller (= factor 1/65536).

Looping the master setpoint signal

Output X49 can be configured with P0134, so that the encoder input signals are directly routed to the output driver. This allows almost instantaneous (no delay) signal looping.

Pulse encoder emulation of the resolver

The option version G1 additionally has a resolver-pulse encoder converter. This emulates an incremental encoder with 1024 pulses from the modulated sinusoidal signals of a resolver. In this case, the resolver must be connected via X18 of the base card, encoder selection P0130 = resolver and P0134 = encoder from SR17002.

Note: The converter always generates 1024 pulses + 1 zero pulse for each resolver period. This means that for 4 or 6-pole resolvers, either 2048 or 3072 pulses are generated each shaft revolution and either 2 or 3 zero pulse marks. This means that a 2-pole resolver is required in order to evaluate the zero pulse.

5 Input 1Vss Gear-Type Encoder and Incremental Encoder Emulation RZP01.1-G2

5.1 General

The RZP01.1-G2 option is used to evaluate a rotary encoder (rotary encoder input X48) and to emulate a pulse encoder (encoder output X49).

The encoder input supports the following encoder types:

- Pulse encoder (TTL / RS422 level)
- Sine-cosine encoder (signal level of 1Vss)
- Absolute value encoder with RS485 interface (Hiperface)
- Absolute value encoder with SSI interface

These encoders can be used as primary encoders (motor shaft) or as secondary encoders for position or speed synchronization.

When a sine-cosine encoder is used, the signal asymmetries (offset and amplitude differences) can be automatically compensated; the input is suitable for direct connection to a gear-type encoder (magneto-resistire encoder).

The encoder output X49 emulates a pulse encoder

- with RS422 signal level
- with any number of lines to a maximum of 8192 lines per rotation
- source encoder selectable from the option card G2 (X48) or SR (X18)

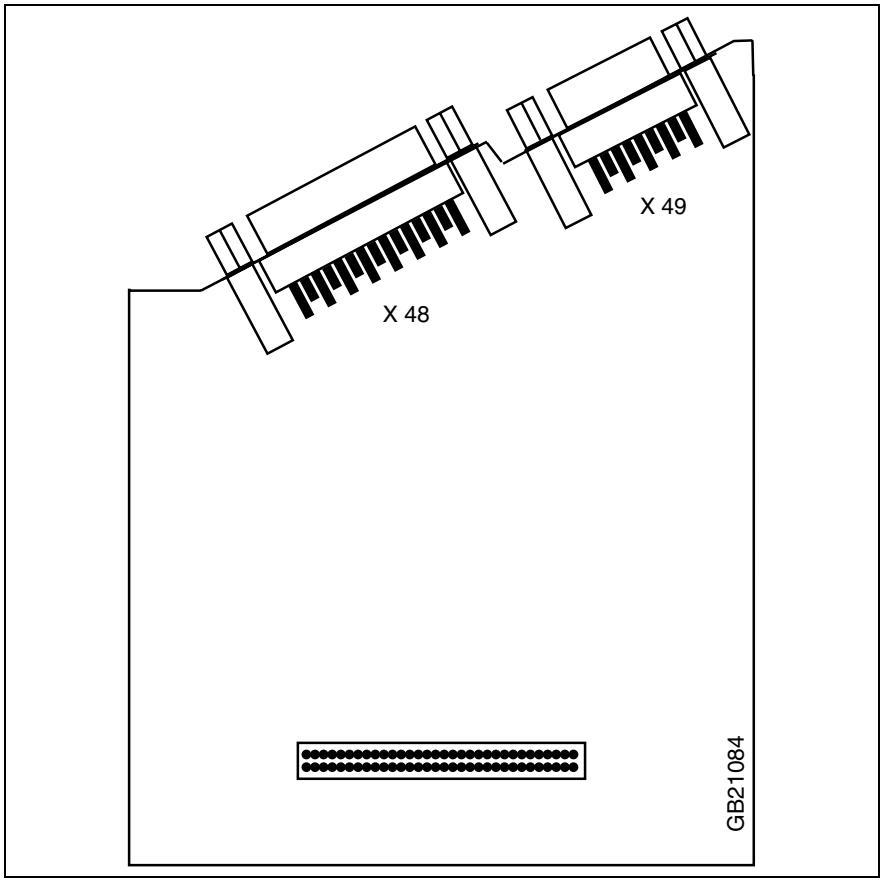


Fig. 5-1: Layout of GB21084 module

Technical Data

Order No. / version	**RZP01.1-G2**
Power supply card	+ 5 V and +15 V, internal, from the logic and control card
Size	100 x 89 mm
Environmental class	3K3 according to DIN IEC 721-3-3
Ambient temperature – storage – operation	 -13.00°F ... 158.00°F ... 32.00°F 104.00°F
Degree of radio interference suppression	A1 acc. to EN 55011
Immunity to interference	EN50082-2
Encoder input (X48)	TTL pulse encoder or SinCos encoder
Encoder power supply	+5 V max. 300 mA (when sensor cables are attached), regulated; +10 V max. 300 mA (via sensor cable jumpers)
Signal inputs A+ / A-, B+ / B-	Differential inputs, RS422 level or 1Vss
Input resistance	120 Ω
Max. input level against GND	+/- 20 V
Max. input frequency	300 kHz
Amplitude (A+ - A-) (SinCos encoder)	0,5 V_{ss} ... 1.3 V_{ss} ...
Permitted offset (SinCos encoder)	+/- 250 mV, but no more than 50% of the amplitude
Signal input R+ / R-	
Input resistance	120 Ω
Max. input level against GND	+/- 15V
Switching threshold (R+ / R-)	+/- 20 V
Interface for multiturn encoder	Synchronous / asynchronous serial interface
Signal pair Data+ / Data-	RS485 transceiver, 120Ω termination
Signal pair CLK +/ CLK-	RS422 driver
Max. cable length	100 m
Encoder output (X49)	
Signal pairs A+/A-, B+/B-, R+/R-	RS422 driver
Max. output frequency A/B	300 kHz
Validity of the zero pulse	Operating mode 1:1 – up to 300kHz, Operating mode 1:n – up to 60kHz signal A/B frequency

Fig. 5-2: Technical data

5.2 Electrical Installation

Installation Plan

Option G2 can be attached to either module slot 1 or 2. The connections are visible after the front cover has been removed.

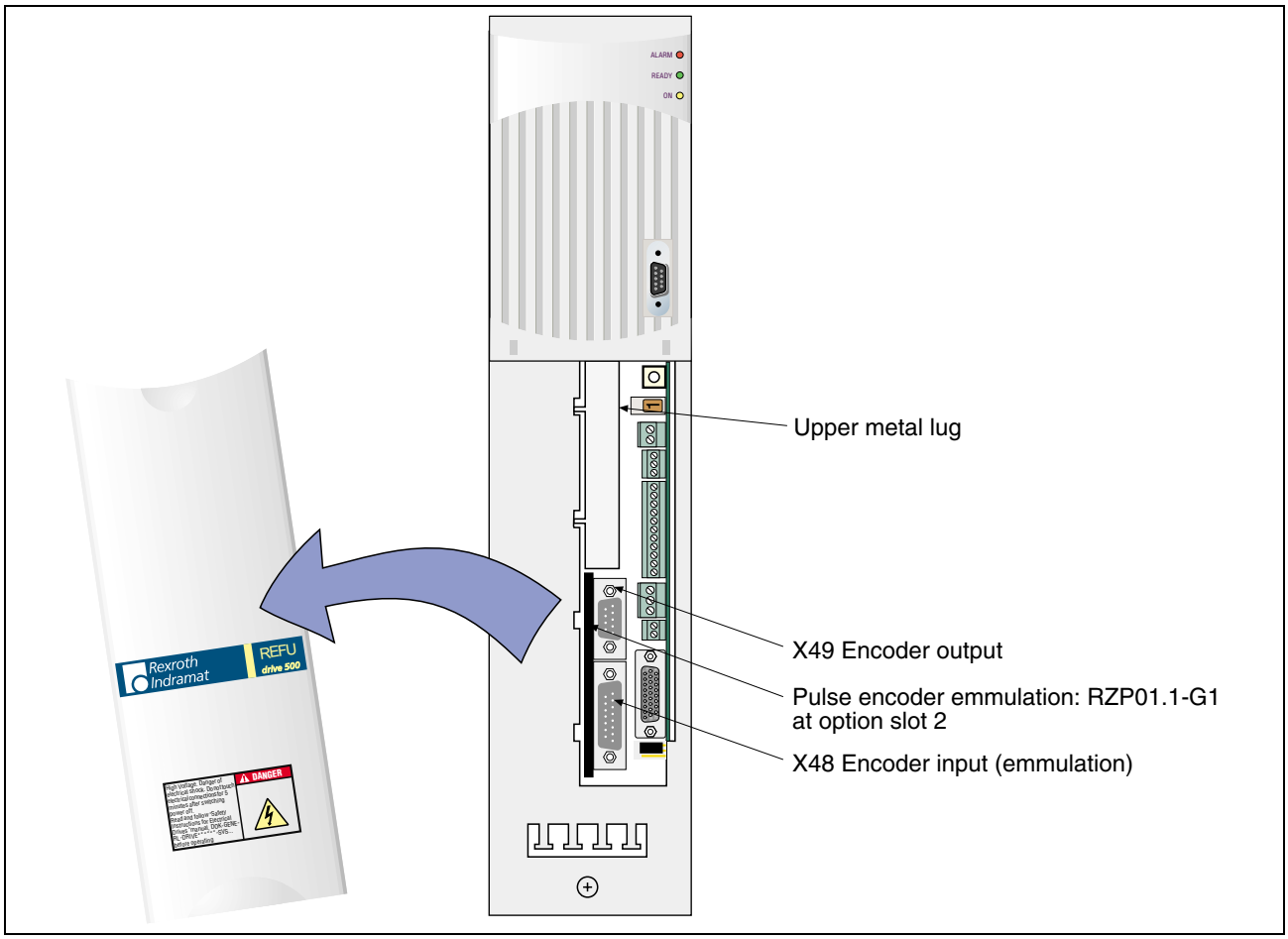


Fig. 5-3: Plug layout for option G2 on module slot 2

Connection Allocation

Connection Allocation Plug X48 Encoder input Sub-D pin, 15 pins		
Pin No.	**Signal designation**	**Description**
1	P5V Sense	Sensor cable +5V
2	OV Sense	Sensor cable for ground
3	R-	Zero signal (inverted)
4	R+	Zero signal (direct)
5	B- (Cos-)	Neg. signal track B or cosine
6	B+ (Cos+)	Pos. signal track B or cosine
7	A+ (Sin+)	Pos. signal track A or sine
8	A- (Sin-)	Neg. signal track A or sine
9	Data +	Pos. data cable of the ser. interface
10	OV	Ground or reference potential
11	CLK+	Pos. timing circuit of the ser. interface
12	5V (* 10V)	Power supply max. 300mA, (* 10V if pins 1 and 2 are bridged)
13	CLK-	Neg. timing circuit of the ser. interface
14	0V	Ground or reference potential
15	Data -	Neg. data cable of the ser. interface

Fig. 5-4: Connection allocation for X48

Plug X49 Encoder output Sub-D pin, 9 pins		
Pin No.	**Signal designation**	**Description**
1	B+	Pos. signal track B
2	B-	Neg. signal track B
3	R+	Zero signal (direct)
4	R-	Zero signal (inverted)
5	A-	Neg. signal track A
6	-	free
7	-	free
8	0V	Ground or reference potential
9	A+	Pos. signal track A

Fig. 5-5: Connection allocation for X49

5.3 Overview of Parameters

Checking Card ID

As is the case for all option cards for RD 500 devices, these cards report in the basic device firmware under the parameters P1021.0 at slot 1, or under parameters P1022.0 at slot 2 with a card ID.

- ID for G2: 22

The firmware version of the option card is visible in the following indices of parameters P102x.1 .. P102x.3.

Settings of the RZP01.1-G2 Option Card

Encoder input (X48)

Parameter No.	Name	Description or value range	Factory setting
P0420	G2 encoder type	Sine/cosine encoder = 0 Incremental encoder = 1 Hiperface encoder = 2 SSI encoder standard = 3 SSI encoder and SinCos = 4 SSI encoder and rectangle = 5	Sine/cosine encoder
P0421	G2 encoder number of lines	1 ... 8192	256
P0422	G2 compensation mode	Switched off = 0 Auto offset = 1 Auto offset + amplitude = 2	Auto offset + amplitude
P0430	Enable zero referencing G2	D0 .... D2048	D1700
P0431	Reset zero referencing	D0 .... D2048	D1700
P0432	Absolute position offset	-1000000.00 .... 10000000.00	0.00
P0450	Gear counter	-8192 ... 8192	1
P0451	Gear denominator	1 ... 8192	1

Fig. 5-6: Parameters for encoder input X48

Encoder Output (X49)

Parameter No.	Name	Description or value range	Factory setting
P0423	G2 source emulation	Deactivated = 0 Encoder SR 1:1 = 1 Encoder G2 1:1 = 2 Encoder SR 1:n = 3 Encoder G2 1:n = 4	Encoder G2 1:1 = 2
P0424	G2 emulation number of lines	1 ... 8192	256

Fig. 5-7: Parameters for encoder emulation output X49

Hiperface absolute encoder evaluation

Parameter No.	Name	Description or value range	Factory setting
P0425	Baud rate serial interface (Hiperface)	0 = 600 Bd 1 = 1200 Bd 2 = 2400 Bd 3 = 4800 Bd 4 = 9600 Bd 5 = 19200 Bd 6 = 38400 Bd	9600Bd = 4
P0426	Set position	-16383 ... -16383 - +16383 rotations The position-setting procedure is started with bit 31	0

Fig. 5-8: Parameters for evaluation of Hiperface

Evaluation of SSI absolute encoder

Parameter No.	Name	Description or value range	Factory setting
P0452	No. of bits resolution	0 25	13 bits
P0453	No. of bits rotation	0 25	0 bits
P0454	SSI Baud rate	0 = 62.5 kBd 1 = 100 kBd 2 = 120 kBd 3 = 220 kBd 4 = 360 kBd 5 = 570 kBd 6 = 750 kBd 7 = 810 kBd 8 = 1 MBd 9 = 1.5 MBd	570kBd = 5
P0455	SSI coding	0 = Gray code 1 = binary code	Gray code = 0

Fig. 5-9: Parameter for evaluation of SSI encoder

Diagnosis Parameters

Parameter No.	Name	Description or value range	Factory setting
P0428	G2 debug address 1	0 ... 65536	11
P0429	G2 debug address 2	0 ... 65536	0

Fig. 5-10: Parameters for diagnosis of encoder interface

Process Data Interface

The RZP01.1-G2 is attached using process data interface SS2 or SS4. Depending on in which module slot the printed circuit board is inserted, information is transferred to D1910 ... D1919 or to D1101 ... D1109, as shown in the following table.

Signal	D parameter when G2 is on module slot 1 (SS2)	D parameter when G2 is on module slot 2 (SS4)	Comment
Angle, (Hi word)	D1910	D1100	0 ... 0xffff -> 0 ... 360 degrees
Angle, (Lo word)	D1911	D1101	Fine resolution of the angle
Rotational speed	D1912	D1102	Normalization acc. to P0390
Zero impulse	D1913	D1103	Bit 0
Encoder error message	D1914	D1104	Bit 0 (Error monitoring signal) OK = 0 Error = 1
Diagnosis value 1	D1915	D1105	see P0428
Diagnosis value 2	D1916	D1106	see P0429
Normalized actual position (Hi word)	D1917	D1107	Normalization acc. to P0780
Normalized actual position (Lo word)	D1918	D1108	Normalization acc. to P0780

Fig. 5-11: Allocation of process data

5.4 Description of Functions

Principle of Offset and Amplitude Compensation

When the compensation mode (P0422) is selected, the encoder signals are symmetrized automatically. This procedure starts when the shaft starts to turn. By determining the minima and maxima of the sine and cosine signal, the zero point offset (offset error) and the size variation of sine and cosine (amplitude error) can be determined. The control algorithm for error compensation is always active; therefore, temperature- and speed-dependent effects can be compensated during operation.

Encoder Output X49 for Incremental Encoder Emulation

The incremental encoder signal tracks A, B and R of the G2 encoder emulation are located on encoder output X49. Encoder emulation of the encoder connected to the G2 encoder input (X48) as well as of the encoder connected to the SR encoder input (X18) is possible. The encoder signals can be evaluated both as TTL and as RS422 levels. The following possible emulation's can be selected.

Value in P0423	Allocation	Comment
0	Deactivated	No encoder emulation, constant output level
1	SR 1:1	Direct emulation (number of input lines = number of output lines) via the hardware driver of the encoder connected to the SR (X18). Only SinCos and incremental encoders can be emulated.
2	G2 1:1	Direct emulation (number of input lines = number of output lines) via the hardware driver of the encoder connected to the G2 (X48).
3	SR 1:n	Emulation of any encoder with any number of lines of the encoder connected to the SR (X18).
4	G2 1:n	Emulation with any number of lines of the encoder connected to the G2 (X48).

Fig. 5-12: Encoder emulation selection

Direct Emulation

The encoder output mirrors the signals of the encoder input in a prepared form as pulses (TTL / RS422 level). The path of the signal goes via the operation amplifier, the comparator and the line driver; therefore, there is no appreciable signal delay. The output signal is issued correctly even if dynamic modifications to the speed of the encoder are made.

The setting of the value in P0424 “Emulation number of lines” is irrelevant here.

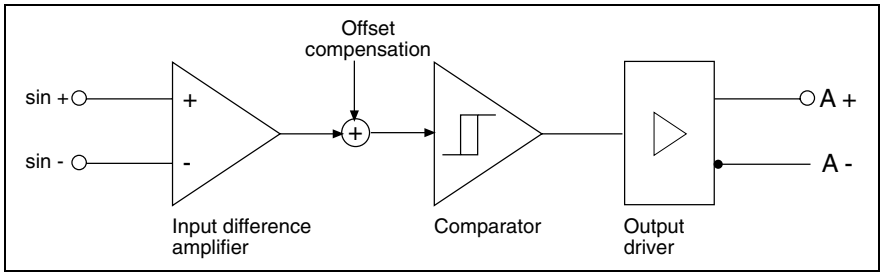


Fig. 5-13: Principle of encoder input -> encoder output signal path

Direct Emulation for “G2 1:1”

If option G2 1:1 is selected, the automatic offset compensation of the G2 can also be used. Offset compensation, which can be selected using P0422, affects the pulse widths of the incremental signals on plug X49. This is useful, for example, in the speed evaluation of an external unit. The following illustration shows this in more detail.

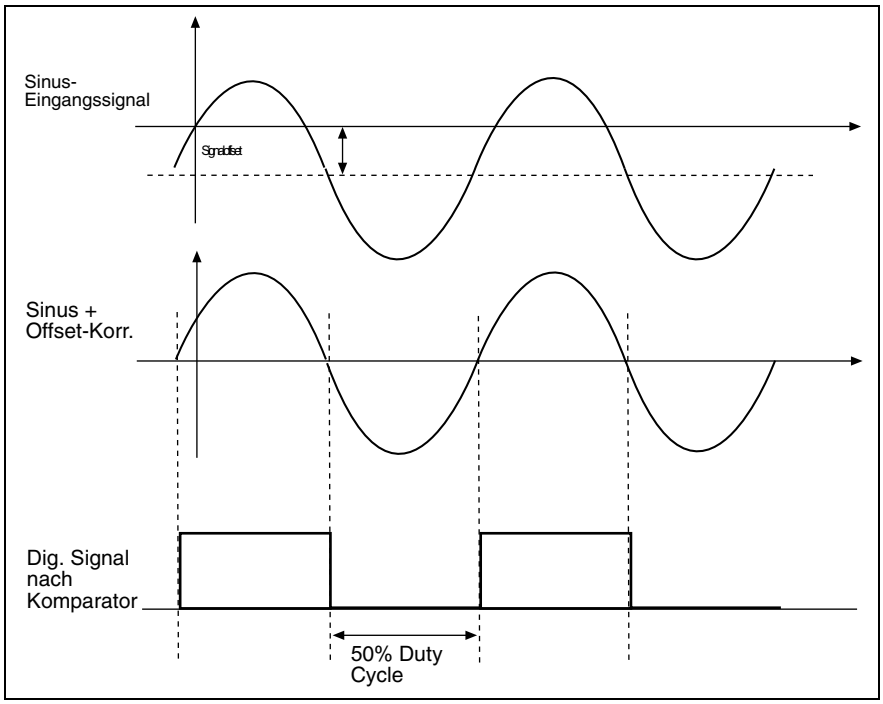


Fig. 5-14: Preparation of the encoder output signals

The zero impulse signal – if the encoder has one – has no offset compensation; the input amplifier is directly followed by the comparator and the output driver.

Direct Emulation for “SR 1:1”

When “SR 1:1“ is selected, a SinCos or incremental encoder must be connected to the SR. The zero impulse signal can only be generated if the encoder connected to the SR creates a zero pulse.

Note: If “SR 1:1” is selected, the zero impulse signal is inverted!

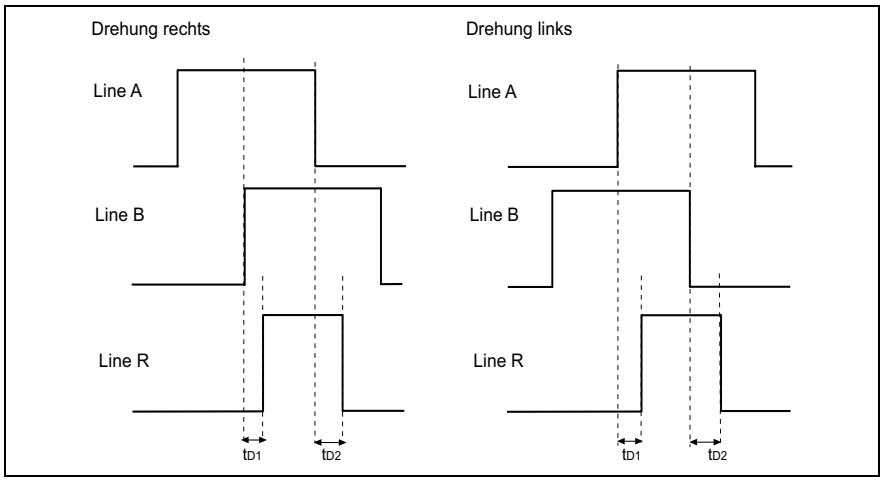
Any Emulation “SR 1:n” or “G2 1:n”

In the case of any form of emulation, the number or pulses to be emulated can be set using parameter P0424. If option “SR 1:n” is selected, the PZD1 channel (P480.0 when the option card is connected to interface SS2 or P491.0 for the SS4) must be connected with D1890.

For option “G2 1:n”, no process data channels need be connected.

The zero impulse of the encoder emulation is a 90° pulse; it is valid with the increasing edge. When the zero pulse has an increasing edge, this means that both the A track and the B track of the emulation are on High level.

Note: The emulated zero pulse is not synchronous to the zero position of the source encoder; it is generated regardless of whether the source encoder has a zero impulse or not.



t_{D1}: Delay of zero pulse, increasing edge
t_{D2}: Delay of zero pulse, decreasing edge

Fig. 5-15: Zero pulse of encoder emulation

Note: The zero impulse is generated only at a number of encoder emulation lines of 2^n (n = 0, 1, 2, 4 - 13). 13).

Diagnosis Interface

For commissioning or troubleshooting, diagnoses can be carried out quickly using parameters P0428 and P0429 as well as the oscilloscope function of the REFUwin software tool.

Procedure: With P0428 / P0429, the following table is used to decide which signal is indicated on the allocated D parameter (D1915, D1916 for SS2 or D1105/D1106 for SS4). In the oscilloscope function of the REFUwin software tool, the selected signals can be recorded in two channels. All process signals of the RZP01.1-G2, including diagnosis values, are updated in control cycle T0.

Value in P0428 / P0429	Signal allocation	Comment
0	Zero	Debug mode off
1	Sine	Maximum amplitude +/-50%
2	Cosine	Maximum amplitude +/-50%
3	SinCos amount	$(\sin^2 + \cos^2)/65536$
4	Offset sine	
5	Offset cosine	
6	Amplitude correction, sine signal	Nominally 100%
7	Following error, encoder emulation	Delay to input signal at 4x the number of pulses
8	Absolute encoder, rotation	Range: -32768 to 32767 32767
9	Absolute encoder, angle	0 ... 0 - FFFFhex = 360°
10	Absolute encoder type	8-bit hex value from specifications for Hiperface encoder
11	Encoder error status	Refer to Abb. 5-17
12 ... 65535	-	For internal use only

Fig. 5-16: Allocation of debug parameters

If “Malfunction of encoder G2” occurs, the cause of the error can be viewed in detail in diagnosis value No. 11 “Encoder error status”. Bits 8 to 12 are used to represent any errors that may be reported by a Hiperface encoder.

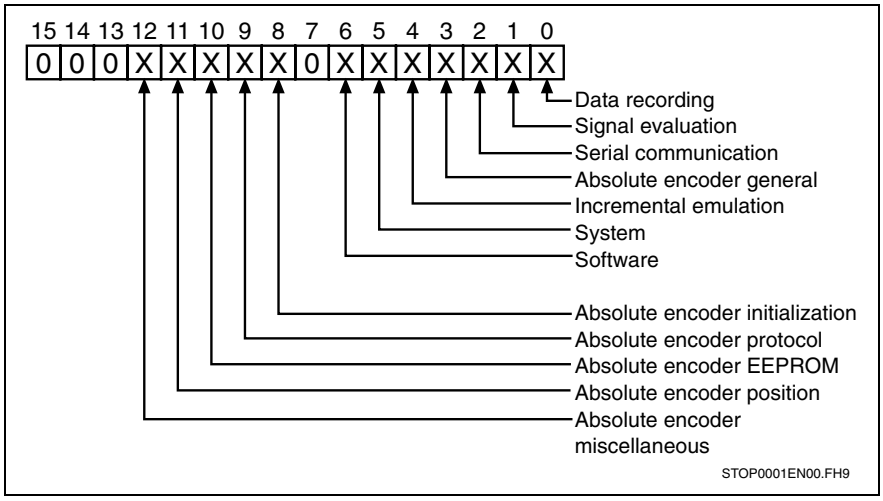


Abb. 5-17:G2 error status

Description of error bits and their possible causes:

Bit	Name	Description
0	Data recording	Error in analog signal recording (signal amplitude)
1	Signal evaluation	Discrepancy between analog signal and absolute encoder information
2	Serial communication	Error in communication on RZP01.1-G2 side

3	Absolute encoder, general	Error in the absolute encoder determined by RZP01.1-G2.
4	Incremental emulation	Signal input frequency too high (300kHz)
5	System	Error detected in the hardware
6	Software	Unexpected entry
8	Initialization	Internal initialization error of absolute encoder
9	Protocol	Reception error on absolute encoder side
10	Data	Error during data access to absolute encoder
11	Position	Error in absolute position recording
12	Miscellaneous	Error determined in the power or temperature monitor of the absolute encoder

Fig. 5-18: Description of error bit

Evaluation of Absolute Encoders with Stegmann Hiperface Encoders

The Stegmann HIPERFACE® (High Performance Interface) contains two data interfaces. These are a real-time data channel as a sine/cosine interface and a serial data channel for the absolute position information. Furthermore, the following information is evaluated using the serial data channel:

- encoder status information concerning any errors detected by the encoder
- encoder type information for determining the encoder number of lines and the absolute position information (multiturn / single-turn).

The encoder types recognized by the firmware are listed in Fig. 5-19:

Hiperface encoder tpyes. If the encoder type is recognized by the option card, this automatically adopts the corresponding number of encoder lines. If the encoder type is not known to option card RZP01.1-G2, the number of lines specified by P0421 is used.

Type	Type ID		Resolution	No. of periods / rotation	Number of rotations	Comment
	Single-turn	Multiturn				
SINCOS® SKS/M 36	32hex	37hex	4096 inc. / rot	128	4096	
SINCOS® SCS/M 60/70	02hex	07hex	16384 inc. / rot	512	4096	
SINCOS® SHS 170	02hex	-	16384 inc. / rot	512	-	Single-turn only
SINCOS® SRS/M 50/60	22hex	27hex	32768 inc. / rot	1024	4096	
SINCOS® - KIT	22hex	27hex	32768 inc. / rot	1024	4096	
SINCOS® SRS 660	22hex	-	32768 inc. / rot	1024	-	Single-turn only

Fig. 5-19: Hiperface encoder tpyes

The absolute position information of the encoder is used to compensate the angle information during the initialization of the option card; these are transferred to the SR via process data channels PZD1 and PZD2 (D1100/1101 or D1910/1911). This ensures that the correct angle information that is required to operate, for example, a synchronous machine is always present. This compensation also occurs for the normalized absolute position of option card G2, which leads to display parameter D1508. This value can be used as an actual value input for position control. Display parameter D1510 indicates the absolute position as a physical unit.

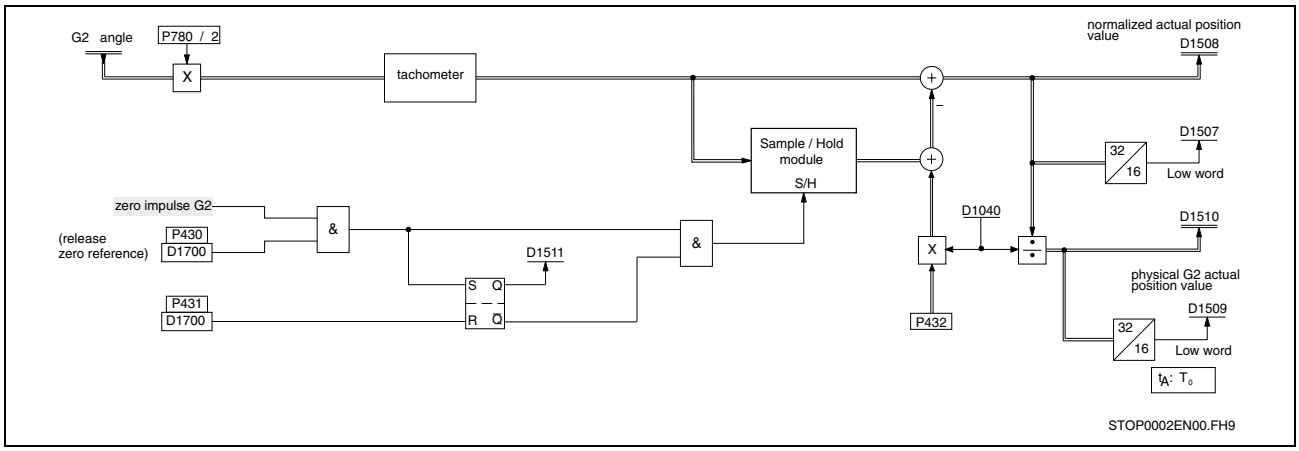


Fig. 5-20: Normalized G2 actual position value

Possible Settings

In order to adapt to ambient conditions, it is possible to set the baud rate of the serial communication between 600 Baud and 38400 Baud.

The absolute position can be set using parameter P0426 and permanently stored in the encoder. This setting is required only during commissioning or when modifying a system; it is designed for using the encoder system for position control.

Evaluation of Absolute Encoder with SSI Encoder Interface

Single-turn and multi-turn variants of an SSI encoder (synchronous serial interface) can be used. Additionally, combined encoders with additional sine/co-sine or rectangle signal can be evaluated. In case of encoders with these additional incremental tracks, the SSI interface is evaluated for position of the starting angle and the absolute position information in parameter D1508 at the start of initialization. Then, the incremental tracks are used for further capture of data. Accordingly, evaluation of the SSI signals only occurs during initialization.

Note: SSI encoders without incremental track are not suitable as motor encoders.

In most cases, SSI data are transmitted in Gray-code process, but they can also be evaluated in binary format.

Any errors recognized in the SSI data transmission are recorded and signaled as errors of option card G2 to the control card. The reaction to an encoder error can be set.

The following list is an overview of the supported encoder manufacturers and of the encoders tested with option card G2.

Manufacturer	Type	Resolutions in bits Rotations / resolutions	Comments	Encoder cable
Sick AG (Stegmann)	ATM60 (AG 626)	12/13	Programmable, binary/gray	IKS5021 IKS5022
Heidenhain	ROQ 425	12/13	Additionally, 512 sinus/cosine periods	IKS5023 IKS5024 Version for 5Volt supply
TR Elektronik	HE 65S	12/13	11-27 Volt supply voltage (G2 max. 10Volt)	IKS5021 IKS5022
TR Elektronik	CE65M-SSI	12/12	Additional sinus/cosine periods	
Thalheim	ATD 3S B14 Y 1	12/13		
IVO	G1P2H	12/13	Hollow-shaft encoder with additional rectangle signal interface	
Hengstler	RA-58M	12/12		IKS5021 IKS5022
Hengstler	Acuro	12/13	Additionally, 2048 sine/cosine periods or rectangular; programmable	

Fig. 5-21: Overview of SSI encoders

Error Evaluation and Reactions

When the encoder connected to G2 is used as a motor encoder with P0130 = external encoder and P0145 = 1100/1910, the reaction to an encoder error can be set with parameter P0047 “Encoder monitoring”. When the G2 encoder is used as a secondary encoder, the reaction to an encoder error can be parameterized through the parameters P0509 “S2 function” or P0745 “SS4 function”, depending on the respective slot. There are the following options:

- no reaction
- warning “Encoder error G2”
- malfunction “Encoder error G2”

Firmware Compatibility

Use of encoder emulation with any number of lines and of absolute encoder evaluation is possible as of G2 firmware version FWC-GB2108-400-02VRS-01 and only in connection with SR firmware as of version FWC-SR1700-200-06VRS-xx. RZP01.1-G2 firmware FWC-GB2108-400-01VRS-01 functions with all SR firmware versions.

RZP01.1 G2 firmware	SR firmware	Limitation to functioning
FWC-GB2108-400-01V01-NN	FWC-SR1700-200-04VRS-xx FWC-SR1700-200-05VRS-xx FWC-SR1700-200-06VRS-xx	No encoder emulation and absolute encoder evaluation
FWC-GB2108-400-01T02-NN to FWC-GB2108-400-01T04-NN	FWC-SR1700-200-04VRS-xx FWC-SR1700-200-05VRS-xx FWC-SR1700-200-06VRS-xx	Restricted scope of functions : “SR 1:n” encoder emulation possible. See the description in the additional documentation.
FWC-GB2108-400-02VRS-NN	FWC-SR1700-200-06VRS-xx	Evaluation of Hiperface and incremental encoder emulation
FWC-GB2108-400-03VRS-NN	from FWC-SR1700-200-06V39	SSI evaluation, evaluation of Hiperface and incremental encoder emulation

Fig. 5-22: Firmware limitations, RZP01.1-G2

5.5 Commissioning and Use

Overview of RZP01.1-G2 Operating Modes

Operating mode of G2 encoder input X48	Parameters for motor control	Parameters for position control
X48 as motor encoder (1st encoder)	P0130 = 5 “external from P0145” P0145 = corresponding module pos. P0189 if “encoder optimization run” is desired	D1890 – “mechanical angle” D2014 – “normalized actual pos. val.”
X48 as position encoder (2nd encoder)	P0130 = 0 - 4 (encoder from X18 or w/o encoder)	D1100 – “angle encoder G2” D1508 – “normalized G2 actual position value” D1510 – “physical G2 actual position value”
X48 as speed encoder (2nd encoder)	P0130 = 0 - 4 (encoder from X18 or w/o encoder)	D1102 – “speed encoder G2”

Fig. 5-23: Operating modes of G2 encoder input X48

Operating mode of G2 incremental encoder output X49	Parameters for incremental encoder emulation	Comment
SR 1:1	P0423 = 1	Zero pulse inverted!
G2 1:1	P0423 = 2	-
SR 1:n	P0423 = 3 P0424 = 1...8192 RZP01.1-G2 on module slot 1: P0480.0 = D1890 RZP01.1-G2 on module slot 2: P491.0 = D1890	Zero pulse is generated only for 2^n line graduation.
G2 1:n	P0423 = 4 P0424 = 1...8192	Zero pulse is generated only for 2^n line graduation.

Fig. 5-24: Operating modes of G2 encoder output X49

RZP01.1-G2 Encoder Input X48 as Motor Encoder (1st Encoder)

For use as a motor encoder, the following parameter settings must be made.

- P0130 = external from P0145
- P0145 = D1910 if RZP01.1-G2 is on module slot 1,
  P0145 = D1100 if RZP01.1-G2 is on module slot 2
- and encoder settings in P042ff

This configuration results in the transfer of the entire angle information (32 bits) via P0145 to D parameter D1890 (mechanical angle encoder). From this, differentiation and filtering is used to determine the speed, leading to the familiar parameter D1873.

Neither display parameter D1102 or D1912 (G2 speed) nor the encoder error message (D1104/D1904) needs to be switched

Using parameter P0189 = 3 “Encoder optimization run”, parameter 133.x “Encoder delta-phi” can be automatically compensated. When a sine/cosine or incremental encoder is selected using P0420 and a synchronous machine is present, the encoder optimization run occurs at every start. When a Hiperface encoder or an SSI encoder with incremental track is used, the encoder optimation run occurs only when “Encoder optimization” mode is selected with P0189 = 3.

Zero impulse synchronization for position controlling occurs in the same manner as in the use of encoder input X18 (logic and control card). D parameter “Zero impulse” (D1913 or D1103) is entered in parameter P0622. The information “Zero pulse detected” is visible in D1780.

RZP01.1-G2 Encoder Input X48 as 2nd Encoder

When the G2 encoder input is used as a second encoder, several possibilities are available. The normalized actual position value of the G2 – D1508 – can be switched directly to the position controller. Actual position value D1508 is normalized using parameter P0780 “Increments/motor rotation”. In this way, the actual position value is normalized to the same unit as nominal position value D2012.

Following is an example for setting the parameters for position controlling with a second encoder.

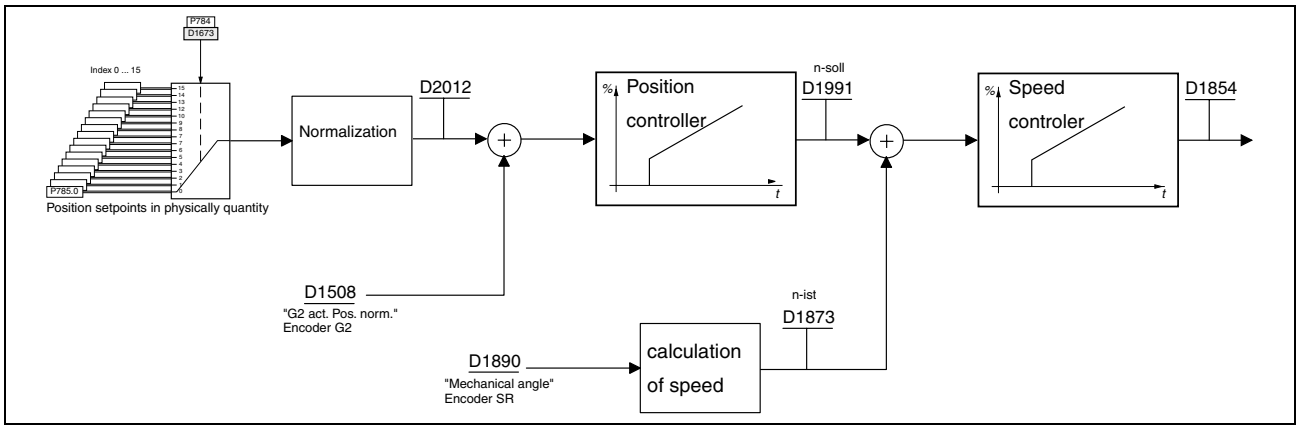


Fig. 5-25: Position controlling with 2nd encoder

In the same manner, actual speed value D1102 (D1912) can serve as a nominal value and be switched depending on the application. The angle information in D1100 (D1912) can also be used as a nominal position controller value, e.g. for the application of an electrical shaft.

The zero impulse is synchronized in the manner described in Section RZP01.1-G2 Encoder Input X48 as Motor Encoder (1st Encoder).

Encoder Output X49 for Incremental Encoder Emulation

When commissioning the encoder emulation, pay heed to the following when using the encoder input signal from the SR (X18):

- when using any emulation, parameter P0423 = “SR 1:n“”, process data channel PZD1 must be connected to the G2 with D1890 “Mechanical angle”.

Settings for Stegmann Hiperface Encoders

Since the Stegmann Hiperface protocol initializes itself on its own, there are no commissioning regulations to be heeded for this device type. When the Hiperface encoder is selected in the case of an unconnected or defective encoder, an encoder error is displayed.

In the case of encoder types that are unknown to the card, the number of encoder lines must be set in P0421. Known encoder types are listed under Fig. 5-19:Hiperface encoder tpyes.

The debug interface can be used to read out the determined encoder type and the determined position information from the encoder.

Setting the Baud Rate and Serial Communication

Parameter P0425 can be used to set the baud rate of the serial encoder interface. Note that, in order to set up communication, a baud rate scan is carried out; subsequently, the device switches to the set baud rate. This means that a connection can always be set up with the encoder – regardless of the baud rate set in P0425 and as long as the line connection is working properly. If any communication errors occur, the option card reports an encoder error (see Abb. 5-17).

Note: The serial connection set-up is independent of the baud rate preset in P0425! Connection errors are not caused by an incorrectly set baud rate.

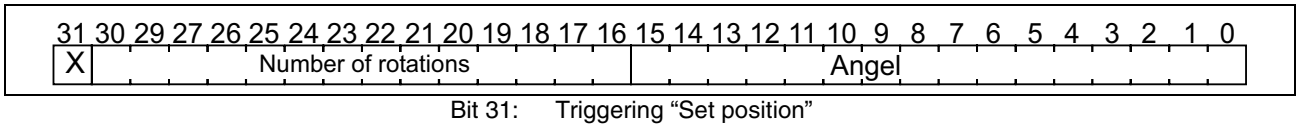
Setting the Current Position

Parameter P0426 can be used to permanently change the current position of the Hiperface encoder. For this, the encoder shaft absolutely must be idle! If the position is to be set and the encoder is not idle, the position information is not modified and the option card reports an encoder error. The uppermost bit of P0426 is used to trigger the action “Set position”. The “Set position” word is entered in “Number of rotations” and “Angle” with a resolution of 65535 increments per rotation of the encoder shaft.

Example:

Entry 8000 0000hex means setting position zero.

Entry 8001 0000hex means setting the position to one rotation of the encoder.



Bit 31: Triggering “Set position”

Fig. 5-26: P0426 “Set position”

SSI Interface Settings

To set an SSI encoder, the encoder type is selected in P0420. For setting all SSI encoders (P0420 = 3, 4 or 5), the following parameters must be set:

- in P0452, enter the resolution in bits per encoder rotation. Normally, the information on encoder resolution is printed on the type label of the encoder. As a default value for an SSI encoder, a resolution of 13 bit per rotation is defined for an SSI encoder.
- In P0453, enter the bit number of the maximum number of rotations the encoder can evaluate. For a single-turn encoder, enter the value ‘zero’. As a standard, a multi-turn encoder has 25 bits (12 bits rotations and 13 bits resolution) for the SSI interface.
- The SSI Baud rate can be set in P0454. Here, take the encoder specification into consideration as not all SSI encoders cover all the range of Baud rates that can be set. Together with the bit number of P0452 and P0453 to be captured, the set Baud rate defines the sample rate of the encoder. In this connection, also note the following maximum cable lengths.

Max. cable length	Baud rate	Sample rate for 25 bit multi-turn	Sample rate for 13 bit single-turn
-	1.00 MBaud	16 kHz	20 kHz
13.67 yd	810.00 kBaud	15 kHz	19 kHz
27.34 yd	750.00 kBaud	14 kHz	18 kHz
54.68 yd	570.00 kBaud	12 kHz	17 kHz
109.36 yd	360.00 kBaud	9 kHz	13 kHz
218.72 yd	220.00 kBaud	6 kHz	10 kHz
437.45 yd	120.00 kBaud	4 kHz	6 kHz
546.81 yd	100.00 kBaud	3 kHz	5 kHz
-	62.5 kBaud	2 kHz	3 kHz

Fig. 5-27: Maximum cable length

- For a binary-coded encoder, the coding type of data transmission can be changed in P0455. By default, SSI encoders are carried out in Gray-code.

When an SSI encoder with an additional sine/cosine interface (P0420 = 4) or rectangular interface (P0420 = 5) is connected, the number of encoder lines or the sine-cosine periods must be entered additionally in P0421.

If there are faulty settings in a parameter, the encoder angle cannot be captured correctly. Also in case of selection of an SSI encoder with additional incremental tracks, only one SSI encoder with P0420 = 3 should be selected first to check the set bit numbers in P0452/P0453. After checking for the correctly captured angle by turning the encoder shaft by one rotation, P0420 can be set to one SSI encoder with incremental track.

Note: The correct SSI encoder setting can be checked by turning the encoder shaft by one rotation and monitoring the G2 encoder angle in D1910 or D1100.

5.6 Encoder cable

Several prefabricated encoder cables are available to connect an encoder to option card RZP01.1-G2:

Encoder	Encoder input (X48)	Encoder output (X49)
ERN 387 e. g., Indramat ADP motor	IKS 5015 IKS 5016 (AMP)	
Woelke gear-type encoder	IKS 5015	
TTL	IKS 5011	
Hiperface encoder (12-pin circular connector)	IKS 5019 IKS 5020 (AMP)	
SSI encoder (12-pin circular connector, Stegmann assignment)	RKG 5021 RKG 5022 (AMP)	
SSI encoder (17-pin circular connector, Heidenhain assignment)	RKG 5023 RKG 5024 (AMP)	
Pulse encoder replica		IKS 5012

AMP: Angular motor plug

Fig. 5-28: Cable selection

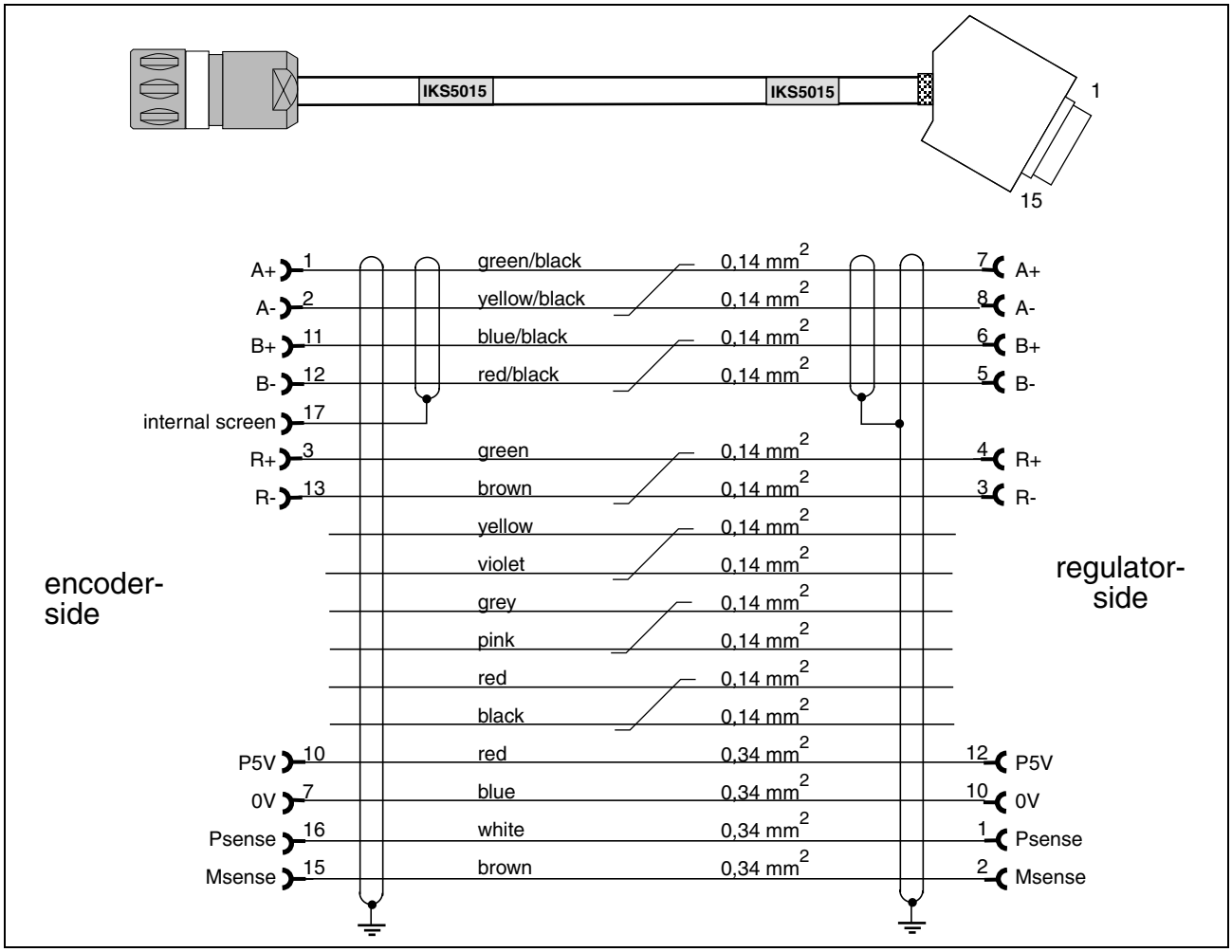


Fig. 5-29: Encoder cable IKS 5015

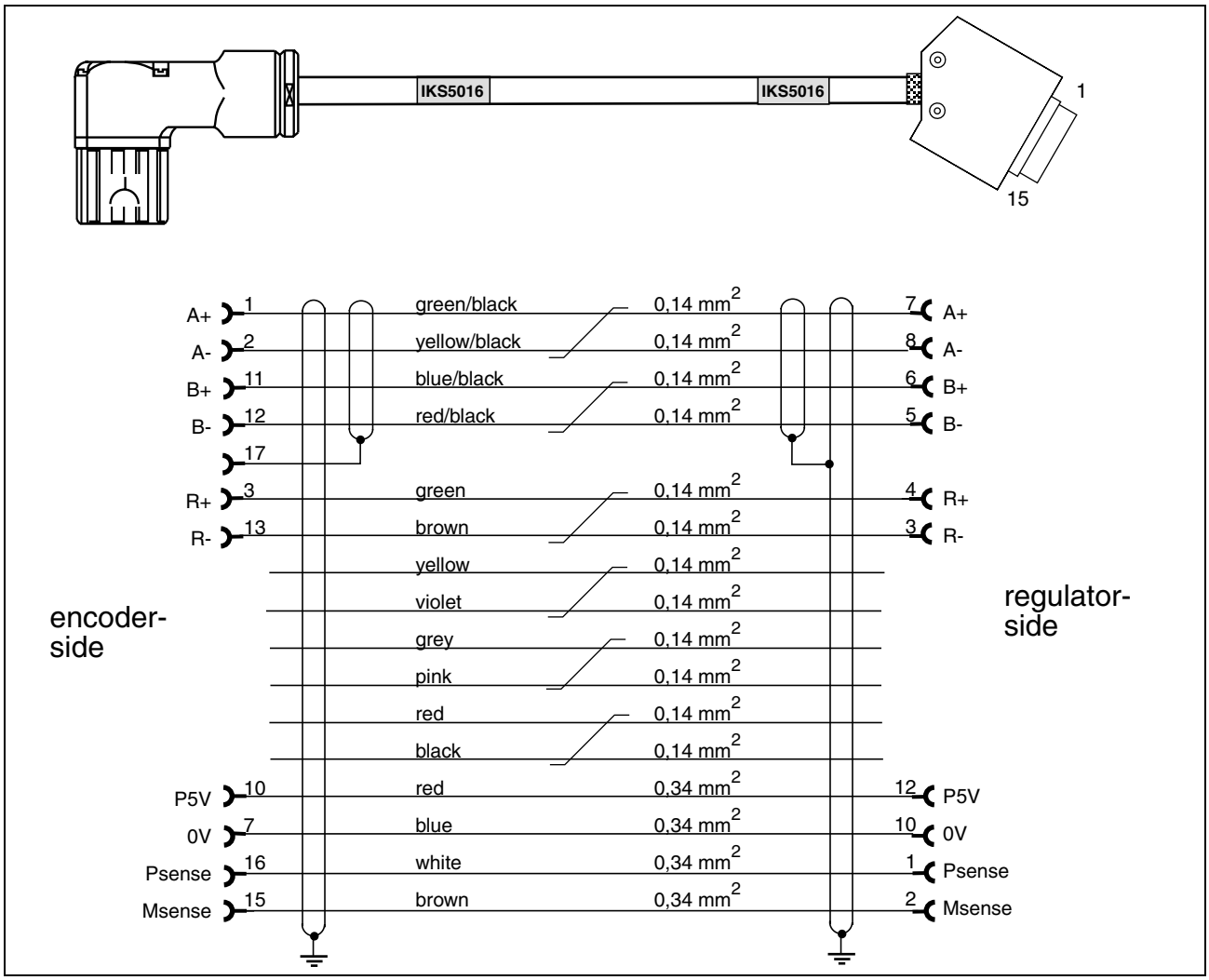


Fig. 5-30: Encoder cable IKS 5016

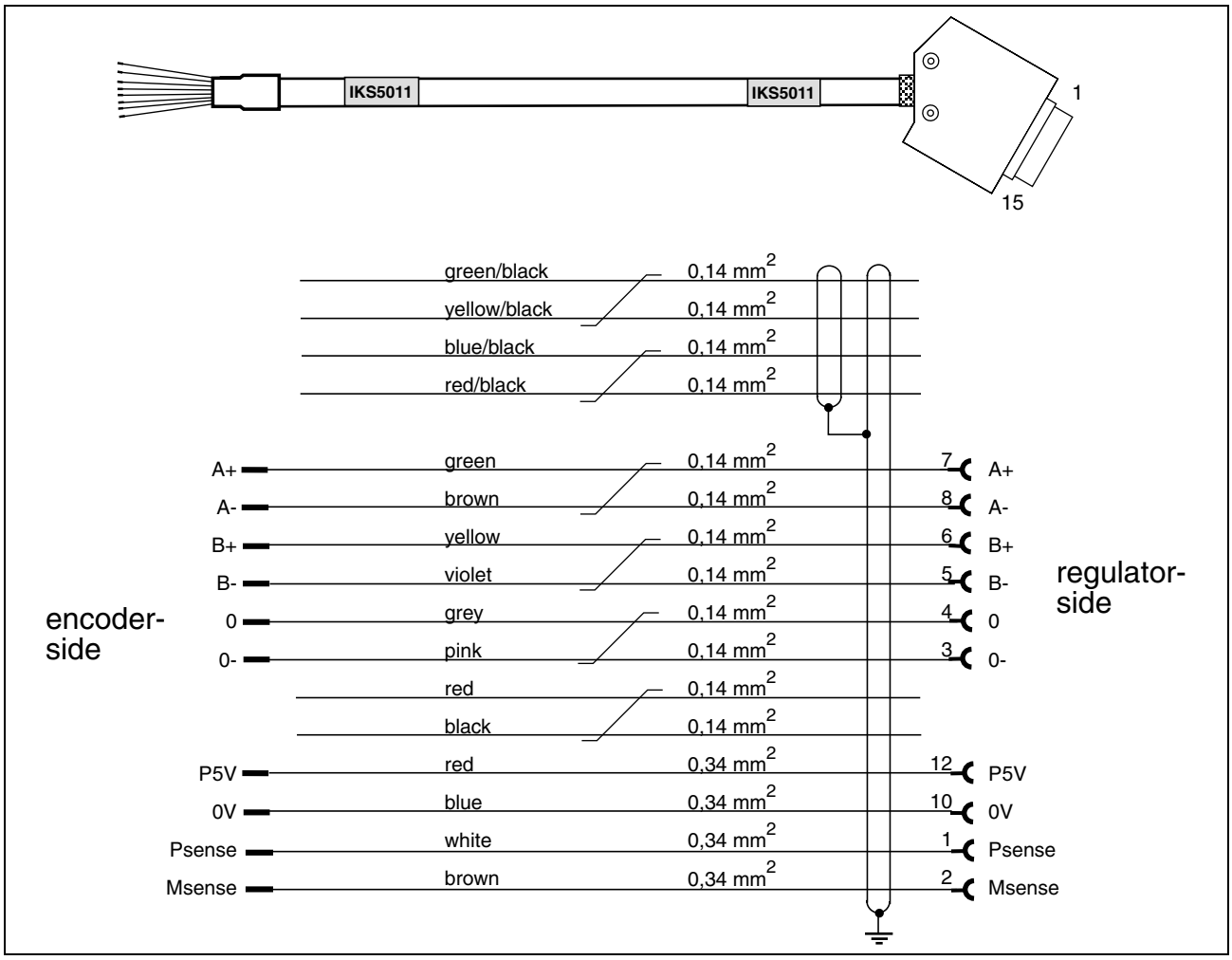


Fig. 5-31: Encoder cable IKS 5011

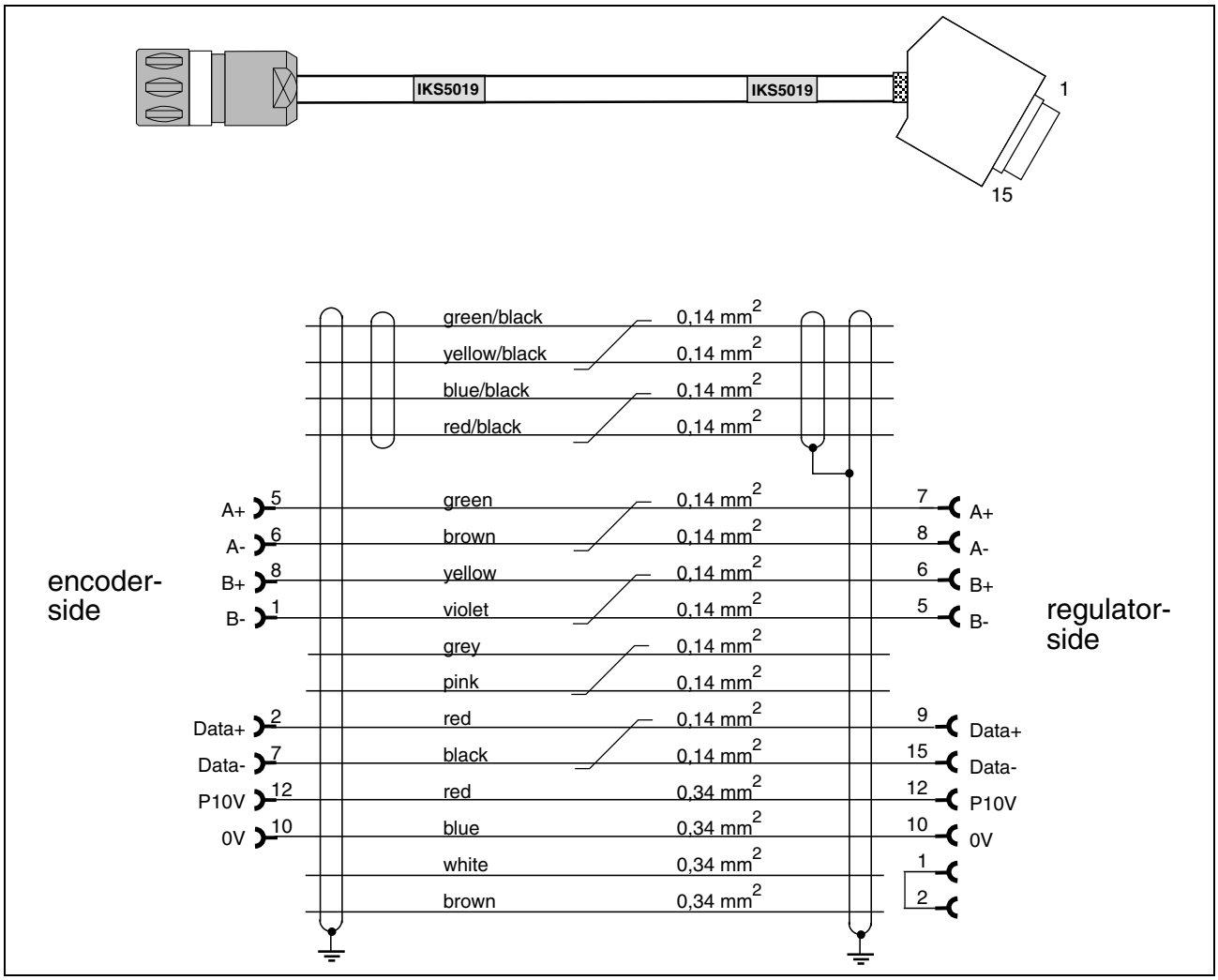


Fig. 5-32: Encoder cable IKS 5019

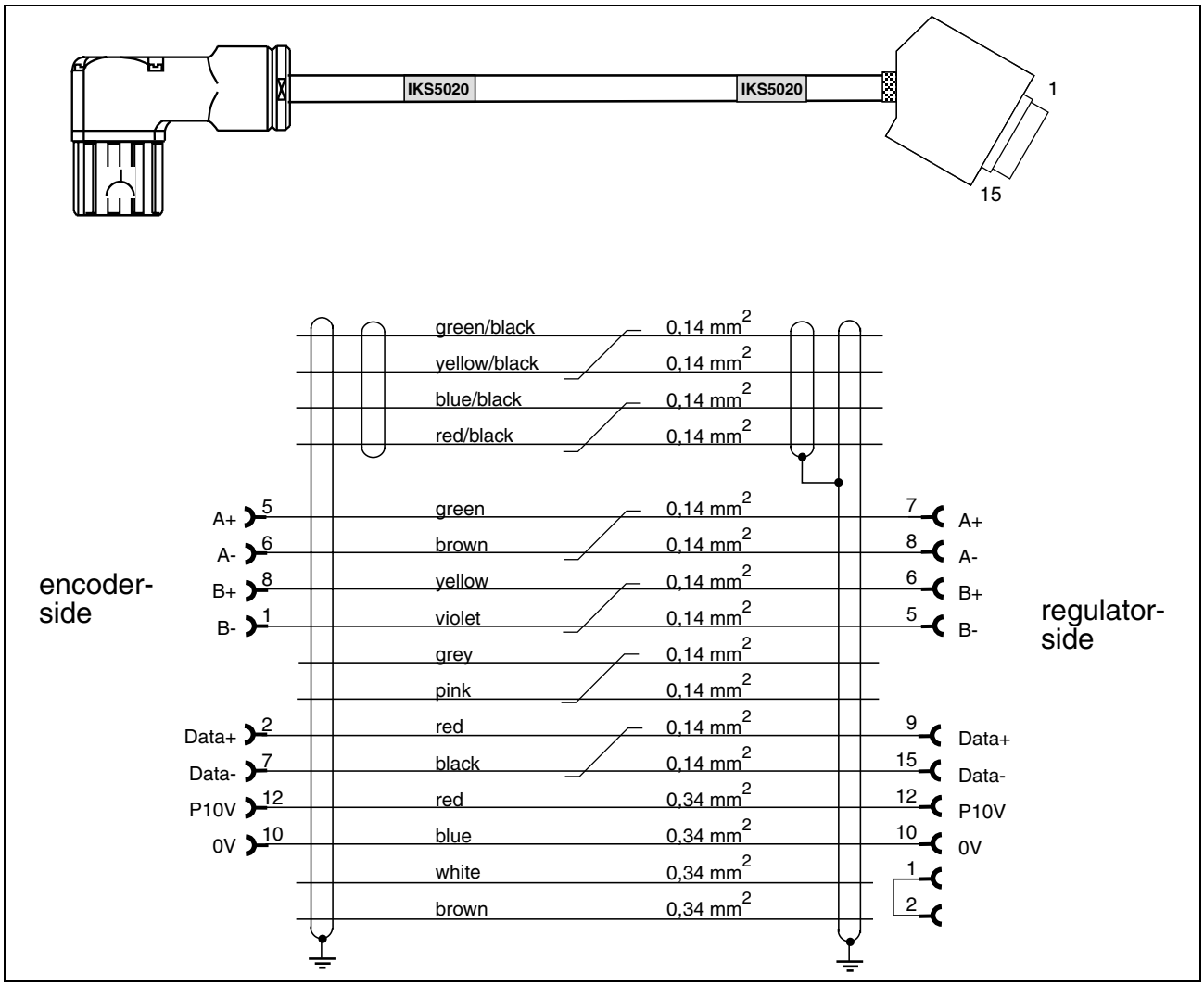


Fig. 5-33: Encoder cable IKS 5020

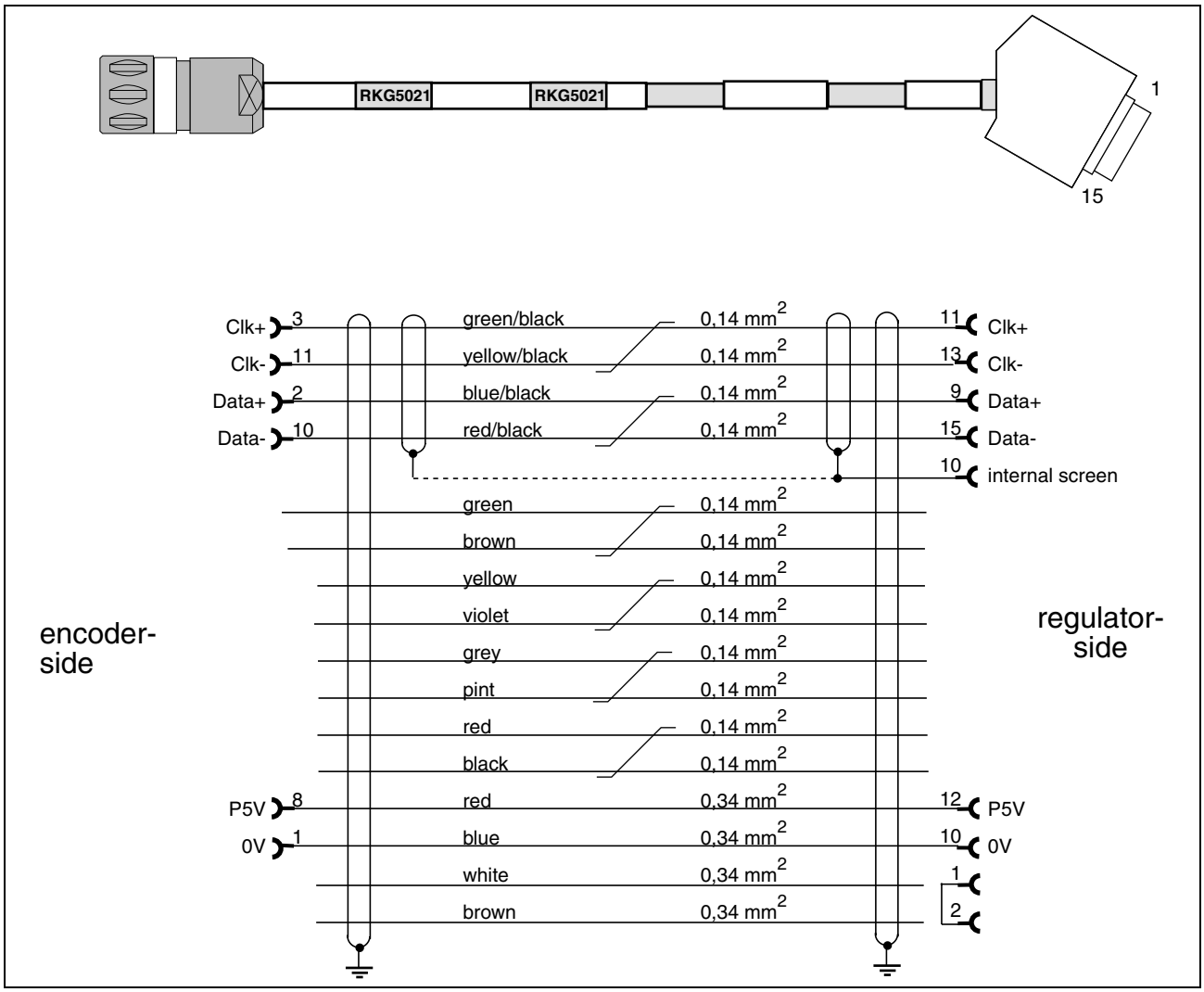


Fig. 5-34: Encoder cable RKG 5021

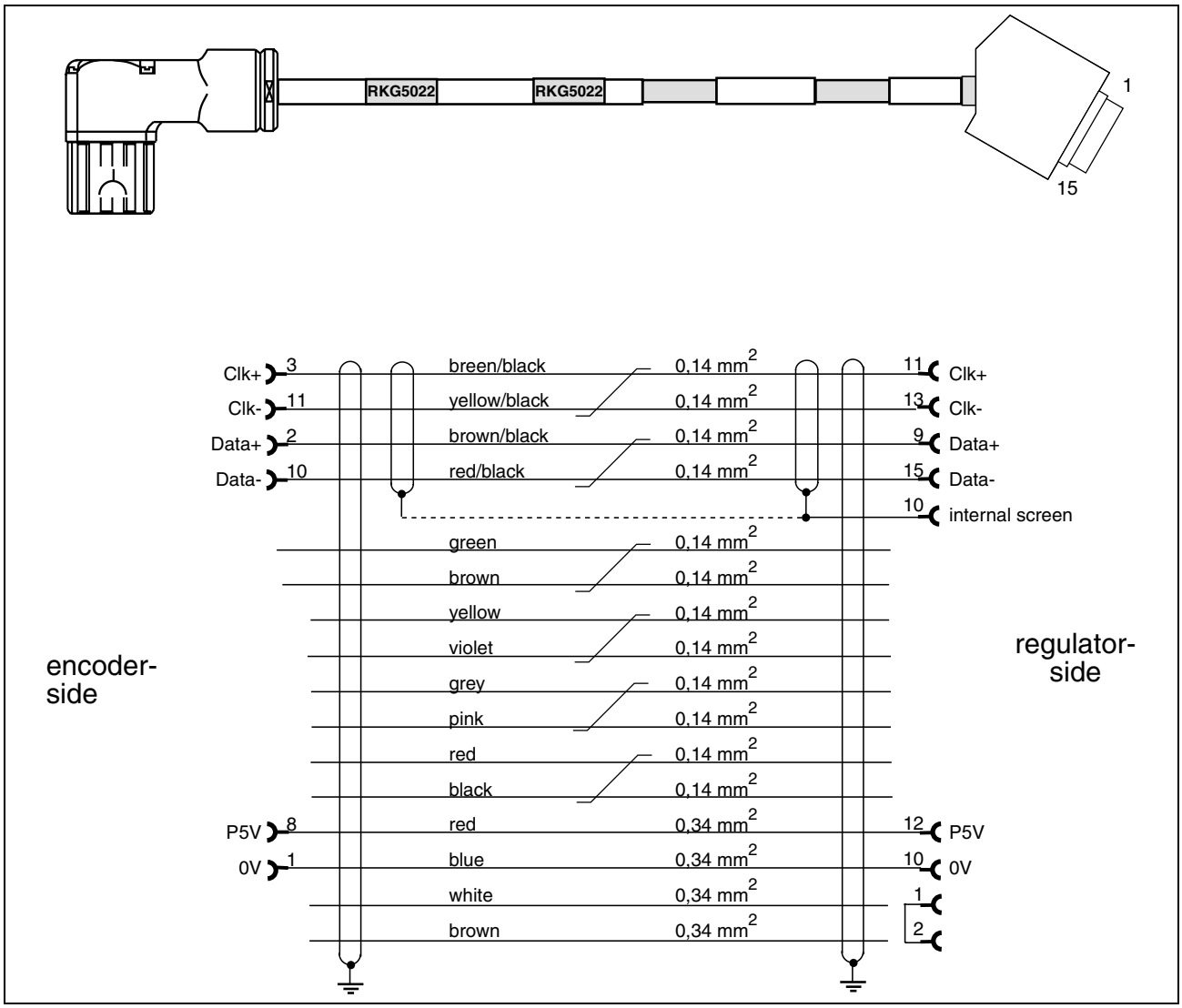


Fig. 5-35: Encoder cable RGK 5022

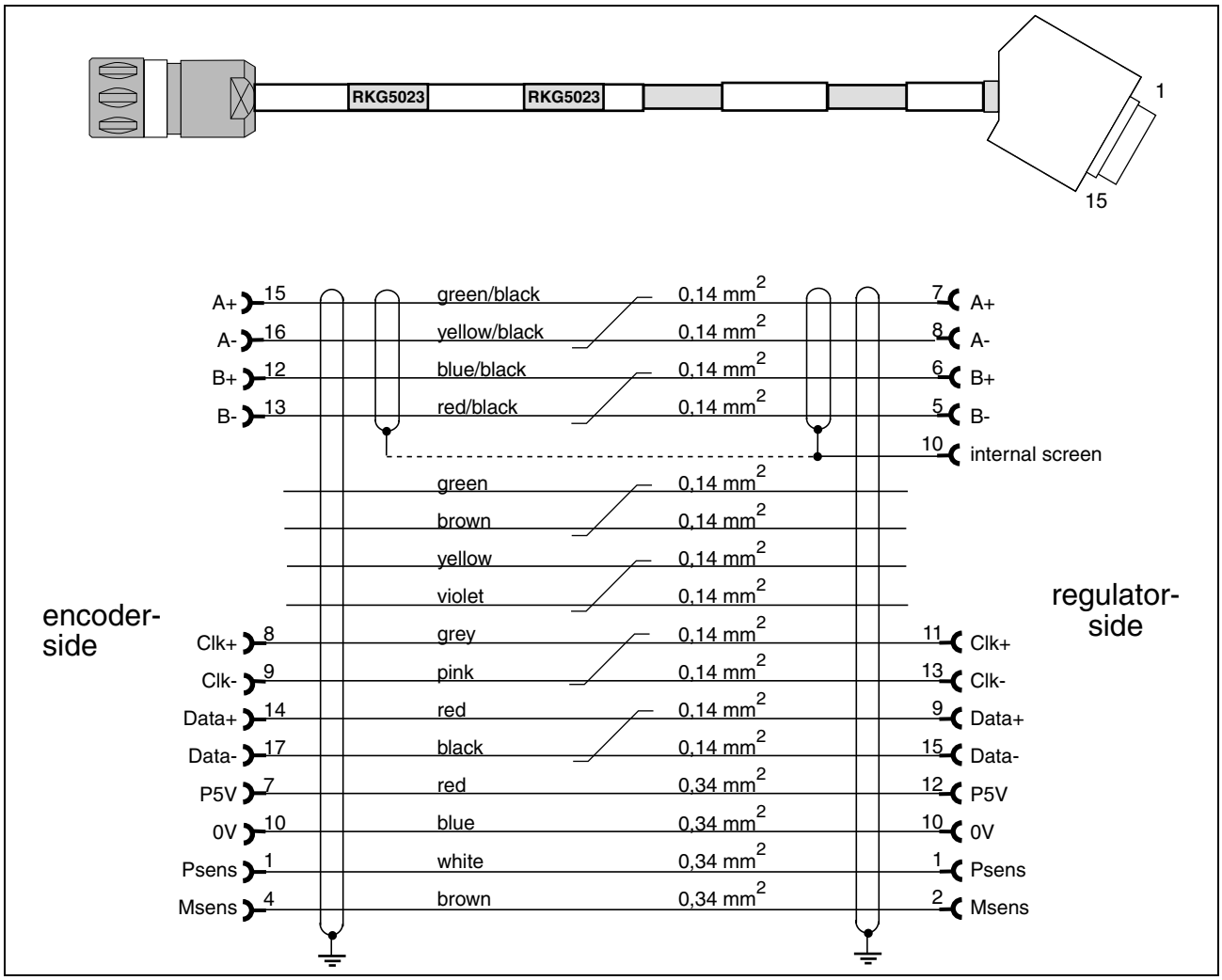


Fig. 5-36: Encoder cable RGK 5023

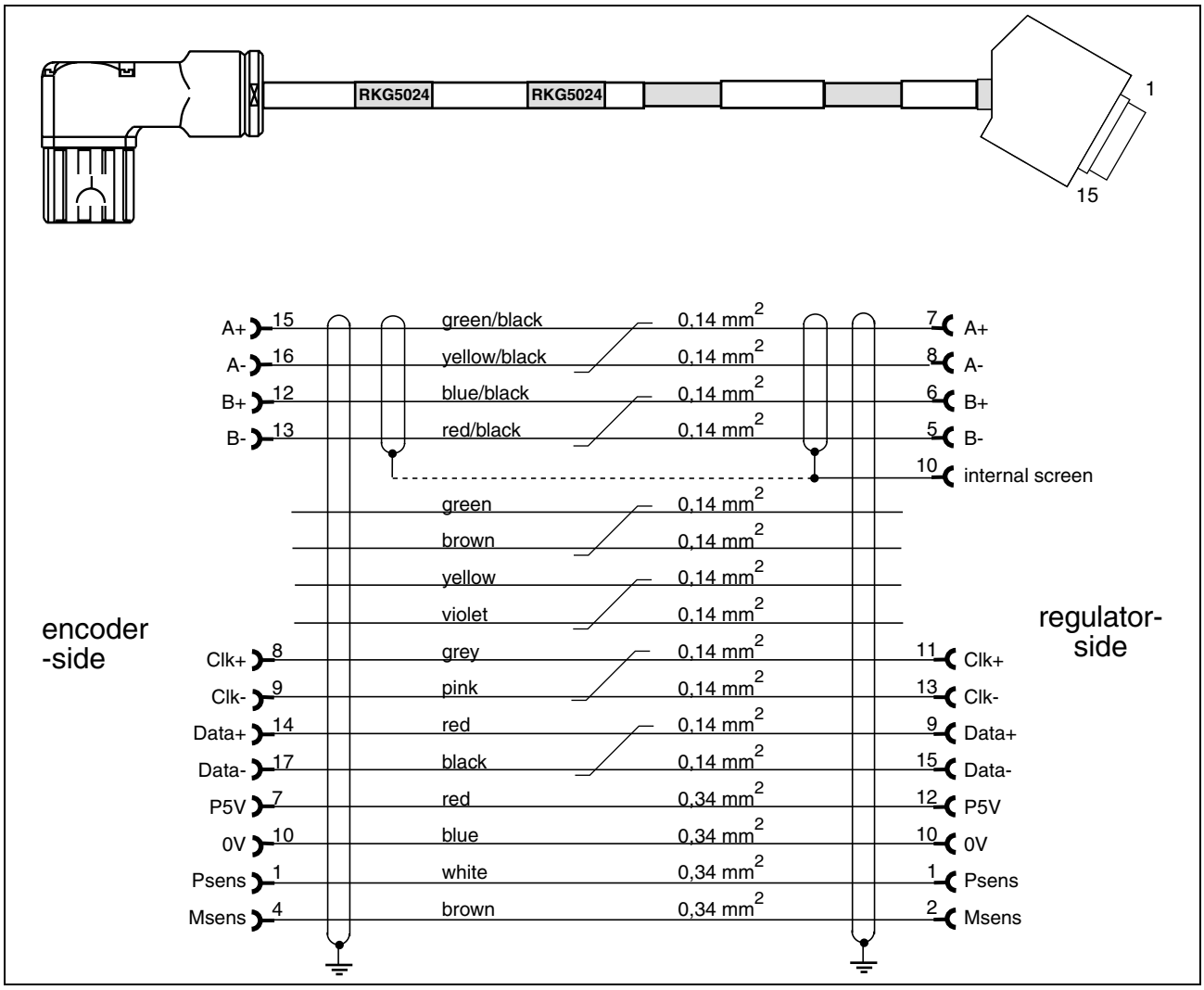


Fig. 5-37: Encoder cable RGK 5024

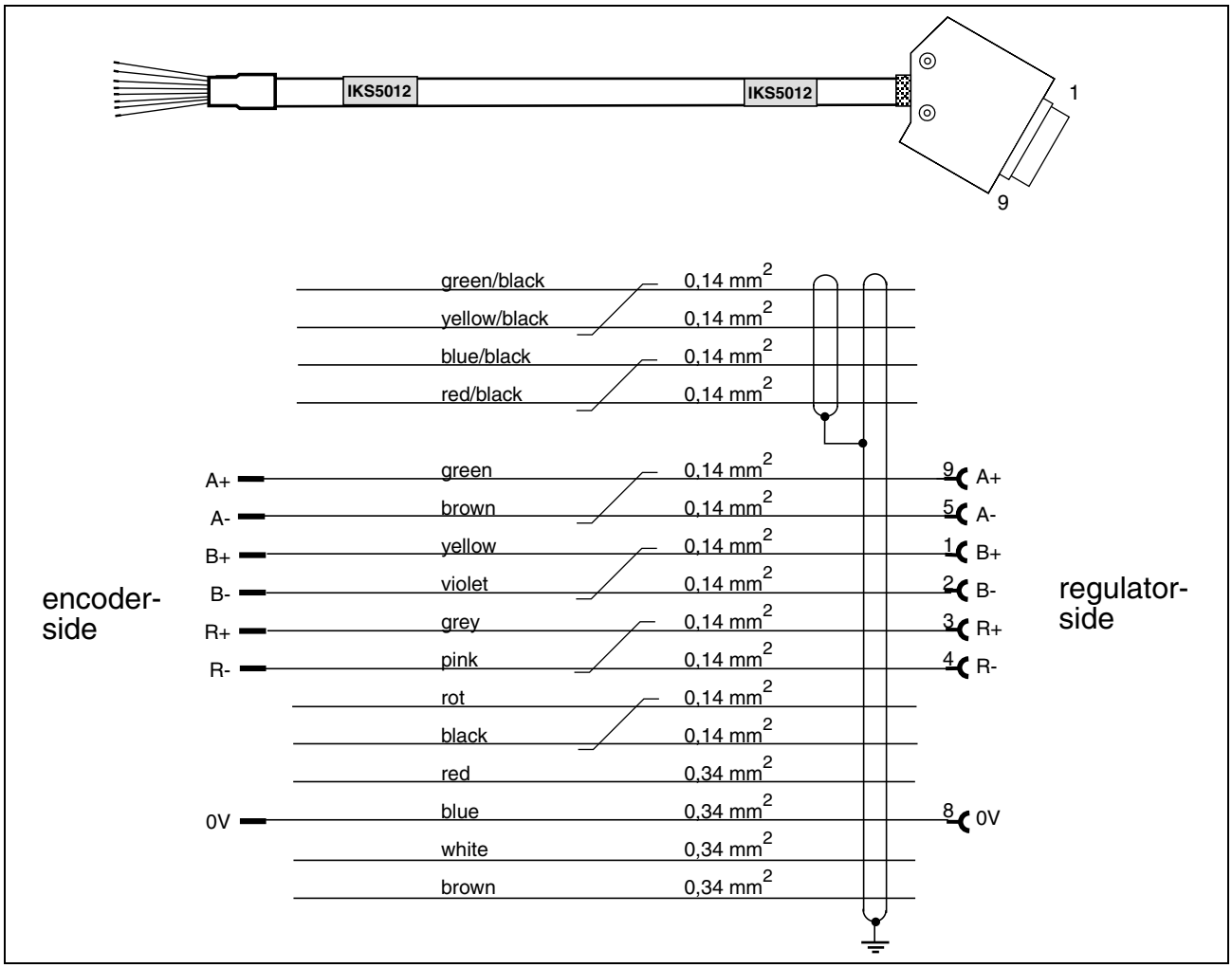


Fig. 5-38: Encoder cable IKS 5012 (pulse encoder replica X49)

6 RZP01.1-L1 SynchroLink

6.1 General information on SynchroLink

Technical data

Order No.:	RZP01.1-L1
External power supply	24V DC –15/+20%, max. ripple 5% corresponding to VDE 0411/500
Size (length x width)	107mm x 87mm
Environmental Class	3K3 acc. to DIN IEC 721-3-3
Ambient temperature – during storage – in operation	 -25°C ... +70°C 0°C ... +40°C
Radio interference suppression level	A1 acc. to EN 55011
Noise immunity	EN 50082-2

Fig. 6-1: Technical data

View of the SL21058 control card

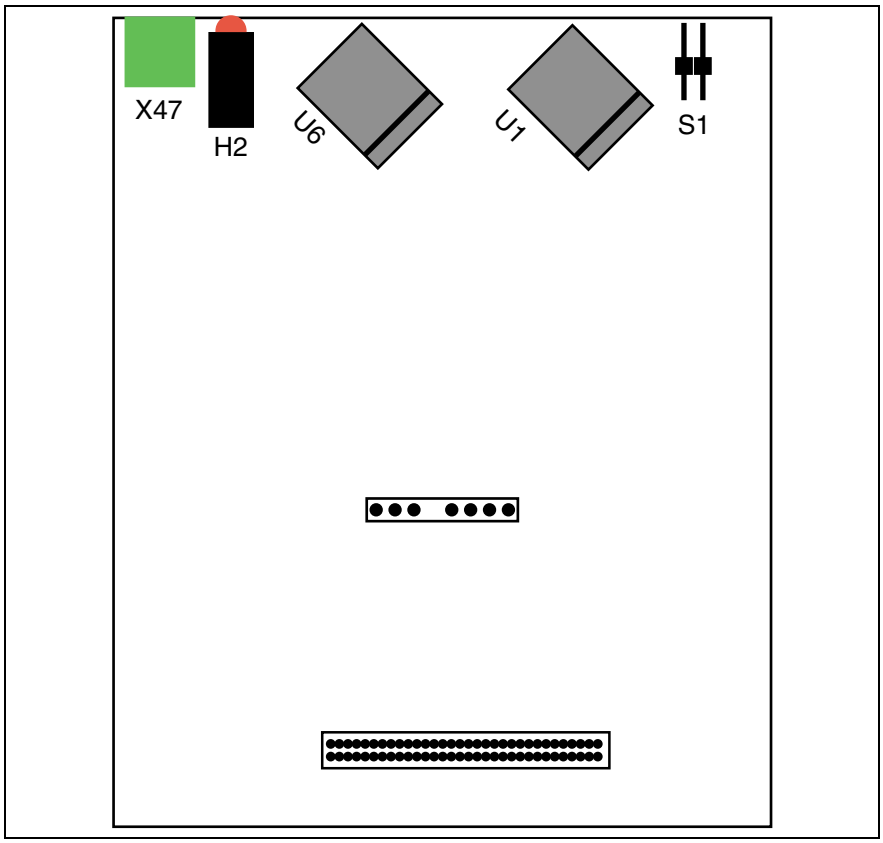


Fig. 6-2: SL21058 control card

6.2 Prerequisites for using SynchroLink

Unit series

From the REFU DRIVE 500 series, only the RD52 can be equipped with SynchroLink (RZP01.1-L1).

Version SR17002 08 SP 08 (May 1998) or higher of the control card must be used.

Firmware versions

The basic card supports the SynchroLink function from firmware version FVC 04VRS onwards.

The actual FPGA firmware of the SynchroLink option can be read-out from parameter P1021.x or P1022.x.

Unit settings

The SynchroLink card is automatically identified and supported on the two option slots X121 and X123. No special configurations have to be made.

Note: It is not permissible to insert 2 SynchroLink cards.

SynchroLink settings

The number of nodes is limited to 16.

6.3 Electrical installation

Installation diagram

The RZP01.1-L1 option can either be inserted at module slot 1 or 2. The connections are visible after the front cover has been removed.

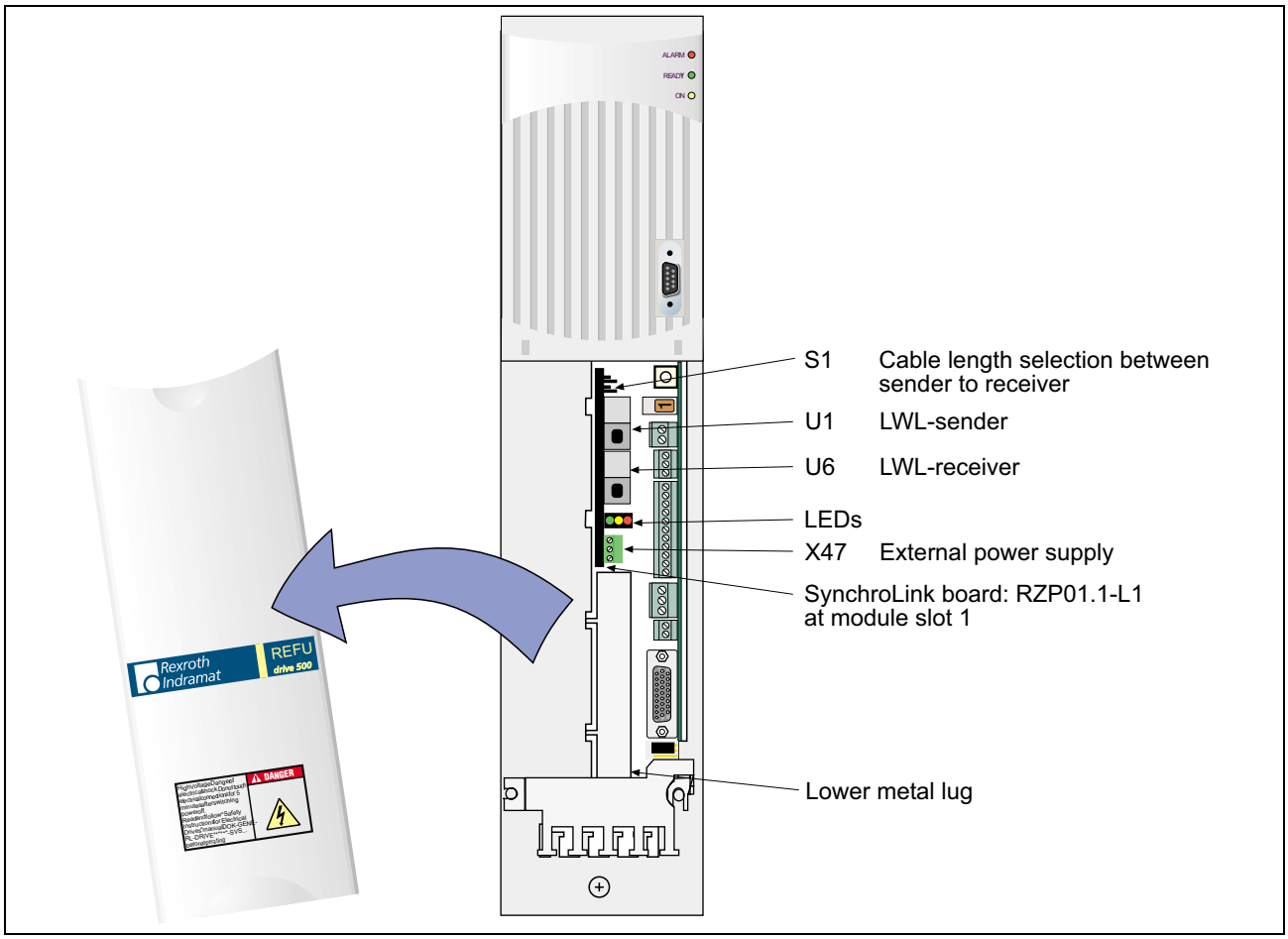


Fig. 6-3: Connector layout diagram, option RZP01.1-L1

Connection assignment

External power supply

The external power supply is connected at X47.

It should have a 24V output voltage and provide a minimum 5W output.

Pin number	Description
X47.1	24V DC –15%/+20% acc. to EN 61131-2
X47.2	0V (ground)

Fig. 6-4: X47 pin assignment, SynchroLink

Bus operation

- If the basic drive unit is in a no-current condition and does not have an external power supply, then the fiber-optic cable bus is ‘isolated’ at this location.
- Data transfer along the bus can be maintained using the external X47 power supply. However, it should be noted that for this node the fiber-optic cable bus is seen as being ‘short-circuited’. The failed node then behaves as if it was programmed in the ‘unsync broadcast’ SynchroLink mode.

Ground connection

The external power supply is not electrically isolated.

Pin 2 of X47 is the digital device ground!

This is the reason that it must be checked whether several SynchroLink options can be connected together at the same external power supply (-> equalization currents).

We recommend that electrically isolated connections are used, especially for drive units with a high output.

Note: If the supplementary P24V standby function is used instead of the external power supply at X47, the SynchroLink card remains fully functional.

Significance of the LEDs:

Drive status: Ready / operation

Green LED	Flashes for data transfer with the SynchroLink bus
Yellow LED	Flashes as long as the SR is synchronized (slave mode) Is dark, if the SR is not synchronized, or is in the unsync mode
Red LED	Flashes for a data transfer error Dark when running error-free

Fig. 6-5: Drive status, ready/operation, SynchroLink

Drive status: Initialization

Green LED	Remains dark
Yellow LED	Remains dark
Red LED	Remains dark

Fig. 6-6: Drive status initialization, SynchroLink

Drive status: No-current condition, SynchroLink with external power supply

Green LED	Bright
Yellow LED	Bright
Red LED	Bright

Fig. 6-7: Device status

Fiber-optic cable

U6	Fiber-optic cable receiver
U1	Fiber-optic cable sender

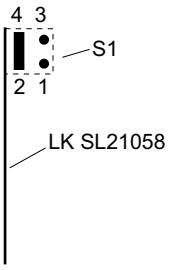
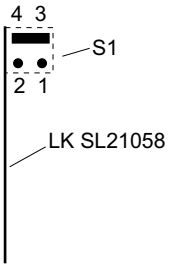
S1

The cable length is always from one SynchroLink card to the other, i.e. from one fiber-optic cable sender to a fiber-optic cable receiver.

The factory setting of jumper S1 at the front of the SynchroLink (SL21058) is defined for a cable length of between 0.2 to 10 meters (jumper between S1.2 and S1.4).

For >10 to 30 meters, the jumper must be set to pins S1.3 and S1.4; for >30 to 50 meters, the jumper must be set to pins S1.1 and S1.2.

Note: Under no circumstances can a jumper setting be used which does not match the actual cable length, as otherwise the fiber-optic cable receiver will be either over-controlled or under-controlled.

Jumper setting	Cable length
	0.2 ... 10 m Factory setting
	>10 ... 30 m

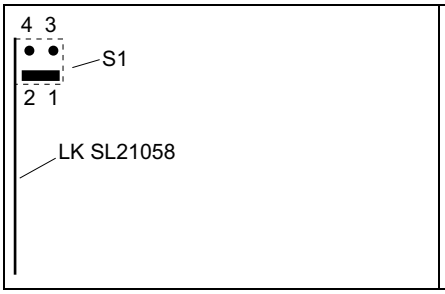
	>30 ... 50 m

Fig. 6-8: Jumper settings

Accessories

There are pre-assembled fiber-optic cables with different lengths for the SynchroLink connection.

Fiber-optic cable	Order No.:
0.3 m	0014126
1.0 m	0011950
2.5 m	0014127
3.0 m	0014308
4.0 m	0014402
5.0 m	0015299
10.0 m	0017241

Fig. 6-9: Fiber-optic cable Order No.

6.4 Data transfer with SynchroLink

Synchronizing AC drives

The main function of SynchroLink is to synchronize AC drives with one another. This allows the time sectors T0 of all drives to be synchronized with one another and the control loops can be closed in the fastest time sector.

The highest requirements placed on an electronic shaft can be implemented.

- Angular synchronism
- Speed synchronism
- Electronic gear

Fast distributed drive structures are extremely simply implemented using SynchroLink and at a favorable price. It is no longer necessary to directly transfer encoder signals.

The fiber-optic cable connection

The data transfer is realized using fiber-optic cables. This has the advantage that it is insensitive to EMC noise, reduces EMC emission and also electrically isolates the devices being connected.

The number of nodes is limited to 16.

Fast and reliable data transfer

Process data (PZD) can be quickly and reliably transferred in the highest closed-loop control time sector T0 = 1/Fpuls with a baud rate of 10Mbit/s and an appropriate protocol frame.

3 protocols are generated within T0. One telegram is used to transfer synchronous information and two telegrams are used for data transfer. A data telegram can accept 5 pieces of process data whose contents are protected using a data security code. Data transfer takes approx. 10µs.

Both of these data telegrams can be operated separately from one another in different modes.

Data transfer of a SynchroLink coupling

The example describes data transfer of 10 pieces of process data between drives in time sector T0 (example f_p = 10 kHz).

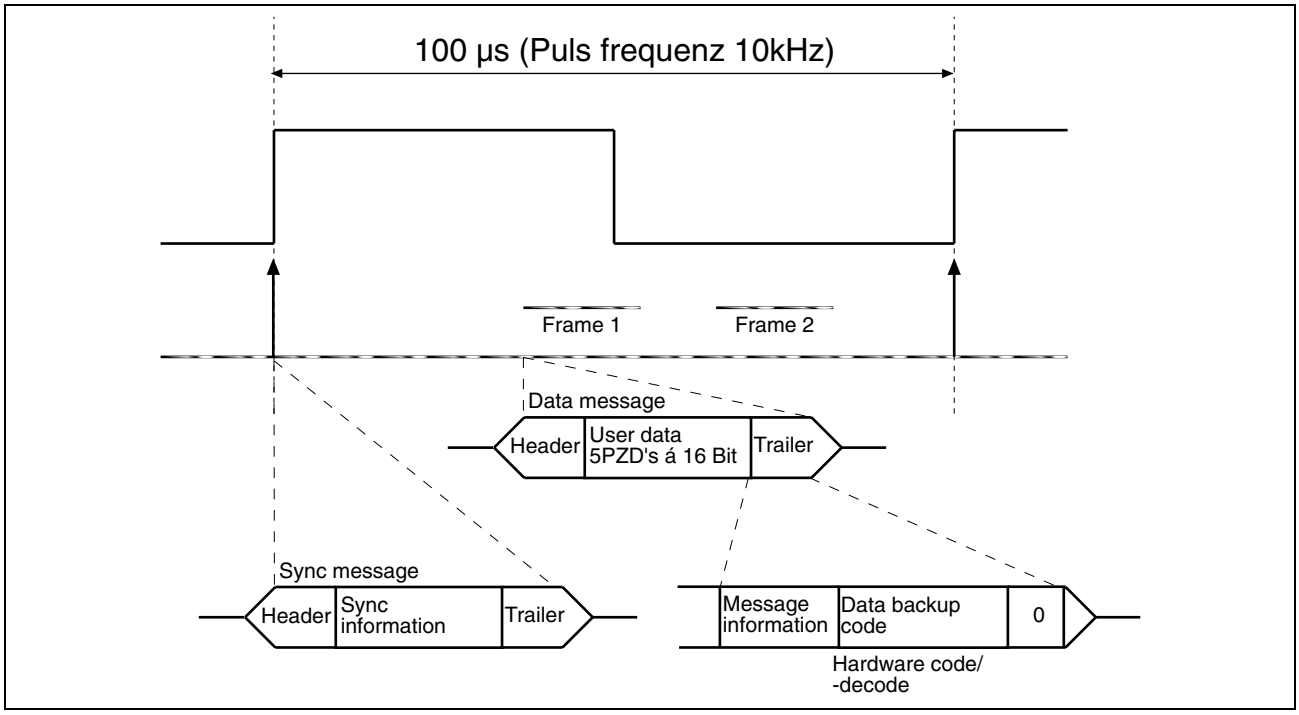


Fig. 6-10: Data transfer of a SynchroLink coupling

The SynchroLink interface (SS7) provides 10 pieces of process data (16 bit). A maximum of 8 such PZDs can be combined in groups of two. A maximum of 4 PZDs is then obtained each with 32 bit and 2 PZDs with 16 bit.

6.5 Parameters which are used:

Parameter P0496

The SynchroLink interface can be monitored together with parameter P0497. The ‘Rx monitoring mode’ is set here (also refer to 6.6, Interface description SS7:).

Parameter P0497

Here, the ‘Rx monitoring time’ is set, in which time at least one data transfer must have been taken place via SynchroLink, otherwise the action, which is activated in P0496, is executed (also refer to 6.6, Interface description SS7:).

Parameter P0498

The SynchroLink coupling mode is set using parameter P0498.

Parameter	Value	Description
P0498	0	Master, peer to peer
	1	Master, change mode
	2	Slave, peer to peer
	3	Slave, change mode
	4	Slave broadcast
	5	Unsync peer to peer
	6	Unsync broadcast

Fig. 6-11: P0498 SynchroLink

Parameters P0493.00 .. 09

The process data to send on the SS7 (SynchroLink) are defined using parameters P0493.00 .. 09 (also refer to 6.6, Interface description SS7:).

Parameters D1130 .. D1139

The display parameters D1130 to D1139 accept the received process data via SS7 (SynchroLink) (also refer to 6.6, Interface description SS7:).

Parameters D1531, D1532, D1533

These three display parameters map the status of the LEDs on the SynchroLink option.

D1531 ‘RxD active’ indicates whether data transfer via SynchroLink is active. The display parameter is updated in 16T0 (refer to green LED).

D1532 ‘Drive in synchronism’ includes status information as to whether the drive has synchronized to the synchronization master. The update is realized in 16T0 (refer to yellow LED).

D1533 ‘Data transfer error’ indicates whether data transfer via SynchroLink is erroneous. D1533 is set at each telegram error and indicates this status for a minimum of 100 ms (refer to red LED).

Parameter D1021 and D1022

If the SynchroLink card is inserted at module slot 1 (X121), the SynchroLink firmware version can be read-out via parameter D1021. The same is also true for module slot 2 (X123) with parameter D1022.

Parameter	Index	Description	Example value
D1021	0	Card code for SynchroLink	18
	1	Code for the drive series	500
	2	Firmware module	1
	3	Firmware version	1
	4	Firmware release	1
	5	Status information	n.n.

Fig. 6-12: Parameter D1021 and D1022 SynchroLink

6.6 Interface description SS7:

The interface structure:

A max. of 10 pieces of process data can be exchanged with other RD52 drives in time sector T0 using interface SS7.

Various drive pulse frequencies can be mixed in the ‘de-synchronized’ mode.

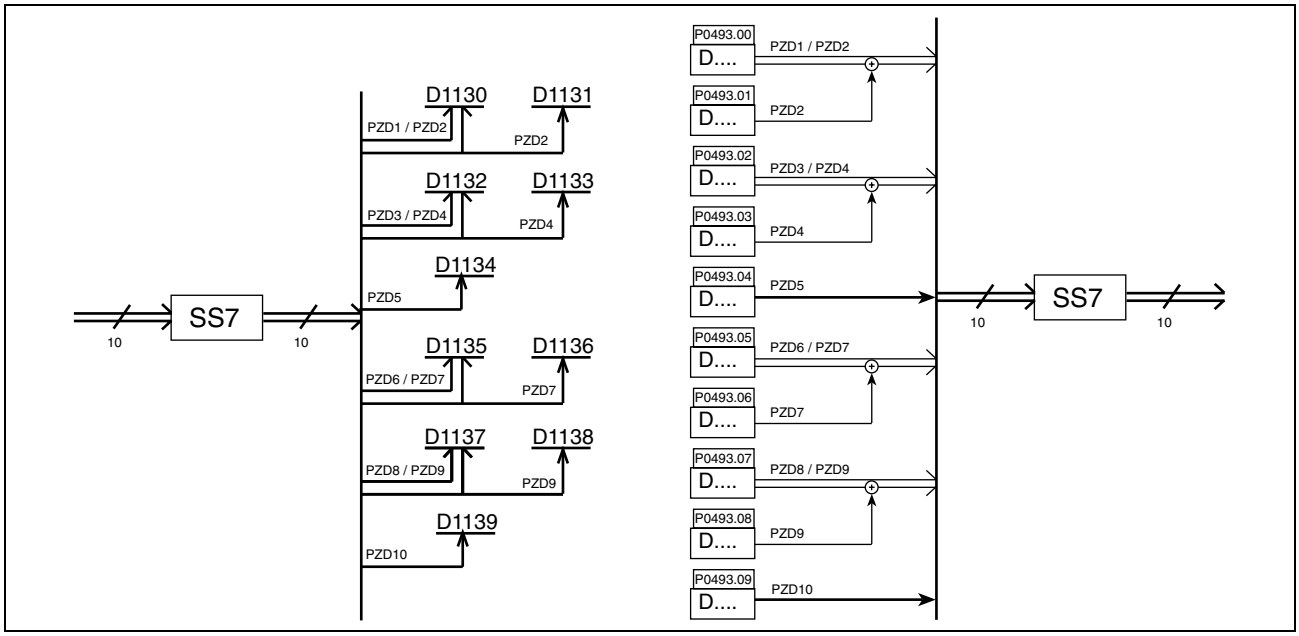


Fig. 6-13: Interface structure, SS7 SynchroLink

10 pieces of process data, 16 bit data can be transferred. It is possible to combine process data to form 32-bit data. A maximum of 4 32 bit process data and 2 - 16 bit process data can be configured.

P0493.0 is interpreted as 32-bit value by writing the D parameter ‘D1800’ into P0493.1. For all other configurations of P0493.1, two independent 16-bit values are configured (the low word of P0493.0 is then cut-off).

The same is true for the process data pairs:

P0493.2 and P0493.3 (with possibly D1800 in P0493.3)

P0493.5 and P0493.6 (with possibly D1800 in P0493.6)

P0493.7 and P0493.8 (with possibly D1800 in P0493.8)

Parameters P0493.4 and P0493.9 are permanently set to a data width of 16 bit.

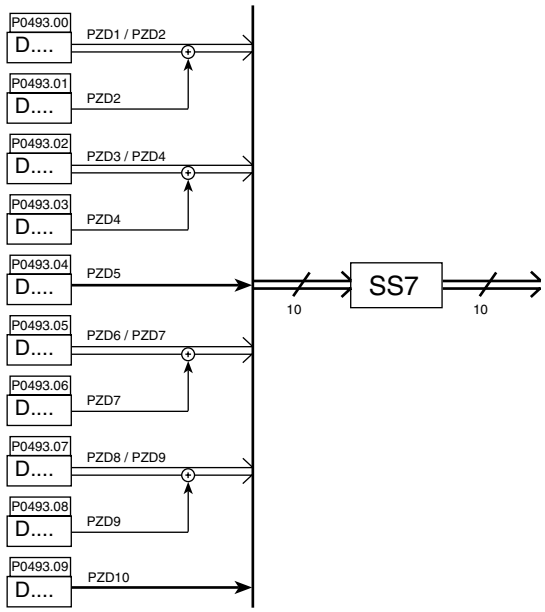


Fig. 6-14: Parameter P0493.X

Parameters D1130, D1132, D1135 and D1137 are interpreted as 32-bit value if a link is generated to a 32-bit source parameter. For a link to a 16-bit source parameter, the high word is always used.

(refer to the example below)

D1131, D1133, D1134, D1136, D1138 and D1139 are always interpreted as 16-bit value.

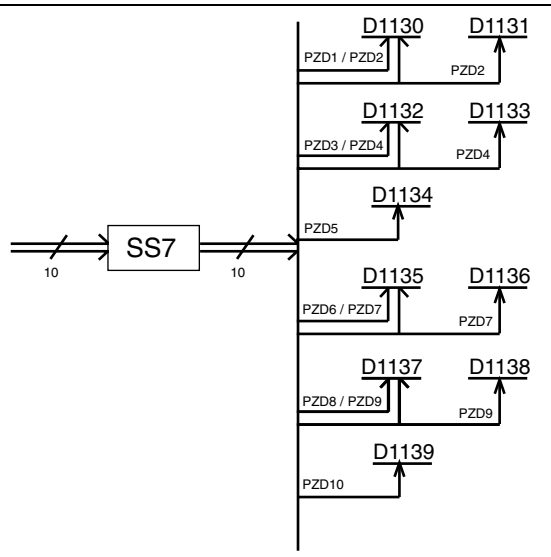


Fig. 6-15: Parameters D1130 ... D1139 SynchroLink

Interface monitoring

The SynchroLink interface is monitored using parameters P0496 and P0497. For this purpose, the ‘Rx monitoring time’ can be set in 1 ms steps in P0497. The shortest monitoring time is a millisecond and the longest monitoring time is 60 seconds.

If data transfer is not detected in the selected time, then the action, activated in P0496, is executed. P0496 (‘Rx monitoring mode’) provides five different actions:

No action	Monitoring is not active
Warning	The drive outputs a warning
Fault	The drive outputs a fault
Warning & Clear-Data	A warning is output and parameters D1130 to D1139 are set to 0x0000.
Fault & Clear-Data	A fault is output and parameters D1130 to D1139 are set to 0x0000.

Fig. 6-16: Interface monitoring, SynchroLink

Example of data transfer:

When sending, PZD1 should be transferred as 32-bit value; PZD3, PZD4 and PZD5 as 16-bit value.

Furthermore when receiving, PZD1 should be interpreted as 32-bit value, PZD3, PZD4 and PZD5 as 16-bit value.

Sending	In order that PZD1 (P493.0) is recognized as 32-bit value, D1800 must be written into P493.1. The other PZDs are automatically recognized as 16-bit value.
Receive	In order that PZD1 (D1130) is used as 32-bit value, it must be logically-combined with a 32-bit source parameter. In order that PZD3 (D1132) is recognized as 16-bit value, it must be logically-combined with a 16-bit source parameter. PZD4 (D1133) and PZD5 (D1134) are already defined as 16-bit data. Info: In D1131, are the lower 16-bits of the 32-bit value from D1130.

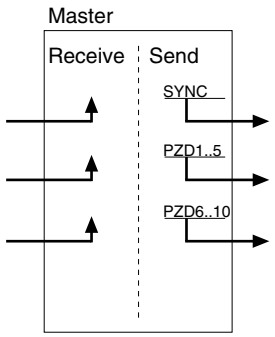
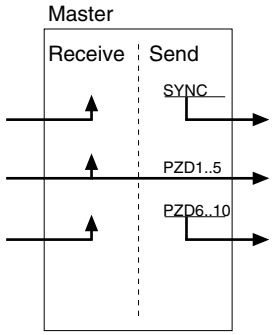
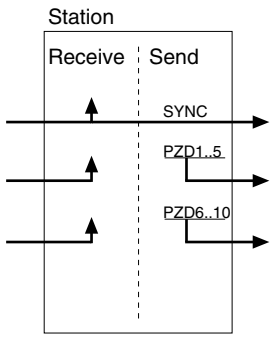
Fig. 6-17: Example of a SynchroLink data transfer

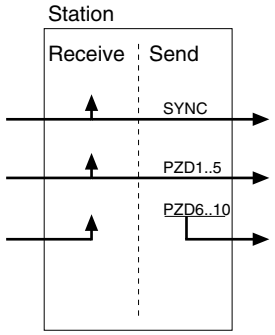
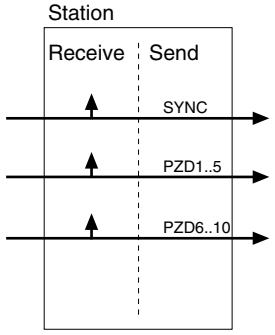
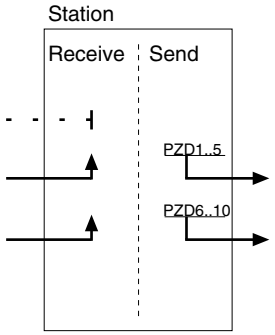
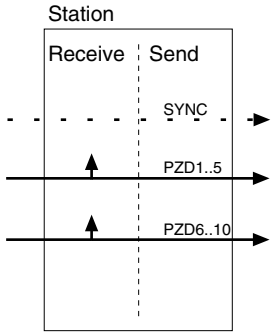
6.7 SynchroLink mode selection:

Prerequisites

In synchronized operation, the pulse frequency of all of the nodes (stations) must be set to the same value (parameter P0026).

Module description

Mode selection (P0498)	Description	Graphic representation
Master, peer-to-peer	Synchronization: This device has the master function to synchronize the fiber-optic cable ring bus. Only one master may be defined in the system. Process data processing: The received PZDs 1 to 10 (D1130 to D1139) are replaced by their own PZDs 1 .. 10 (P0493.0 to P0493.9).	
Master, change mode	Synchronization: This device has the master function to synchronize the fiber-optic cable ring bus. Only one master may be defined in the system. Process data processing: The received PZDs 1 to 5 (D1130 to D1134) are only read and transferred unchanged. PZDs 1 ..5 of the SS7 interface (P0493.0 to P0493.4) have no effect. The received PZDs 6.. 10 (D1135 to D1139) are replaced by their own PZDs 6 .. 10 (P0493.5 to P0493.9).	
Slave, peer-to-peer	Synchronization: This device synchronizes itself to the device defined as master. Process data processing: The received PZDs 1 to 10 (D1130 to D1139) are replaced by their own PZDs 1 .. 10 (P0493.0 to P0493.9).	

Slave, change mode	Synchronization: This device synchronizes itself to the device defined as master. Process data processing: The received PZDs 1 to 5 (D1130 to D1134) are only read and transferred unchanged. PZDs 1 ..5 of the SS7 interface (P0493.0 to P0493.4) have no effect. The received PZDs 6.. 10 (D1135 to D1139) are replaced by their own PZDs 6 .. 10 (P0493.5 to P0493.9).	
Slave, broadcast	Synchronization: This device synchronizes itself to the device defined as master. Process data processing: The received PZDs 1 to 10 (D1130 to D1139) are only read and transferred unchanged. PZDs 1 .. 10 of the SS7 interface (P0493.0 to P0493.9) have no effect.	
Unsync., peer-to-peer	Synchronization: This device does not synchronize itself. It runs non-synchronously to bus data transfer. **This mode may not be selected in a synchronized system**. Process data processing: The received PZDs 1 to 10 (D1130 to D1139) are replaced by their own PZDs 1 .. 10 (P0493.0 to P0493.9).	
Unsync., broadcast	Synchronization: This device does not synchronize itself. It runs non-synchronously to bus data transfer. Process data processing: The received PZDs 1 to 10 (D1130 to D1139) are only read and transferred unchanged. PZDs 1 .. 10 of the SS7 interface (P0493.0 to P0493.9) have no effect.	

6.8 System example

Example 1:

Synchronized operation, where each node (station) sends its own output data to the next node (station) (synchronized peer-to-peer mode).

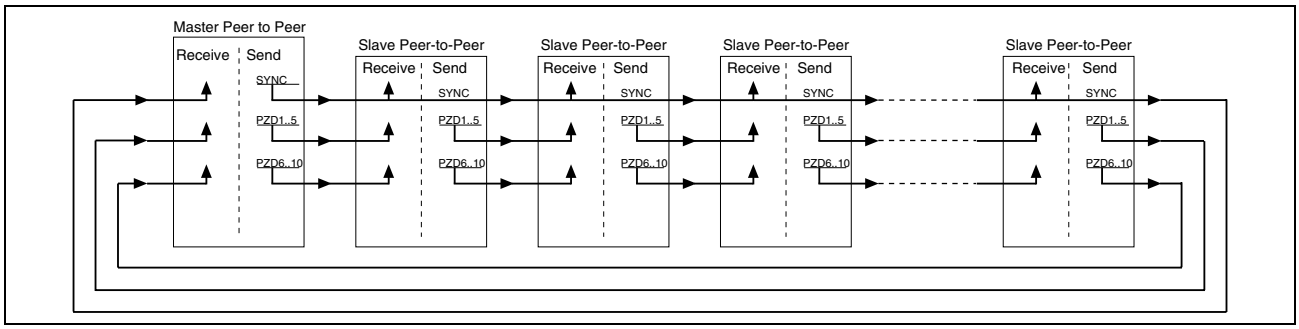


Fig. 6-18: Synchronized peer-to-peer mode

Example 2:

Synchronized operation, where each slave processes the output data of the master, however without sending any output data (synchronized broadcast mode).

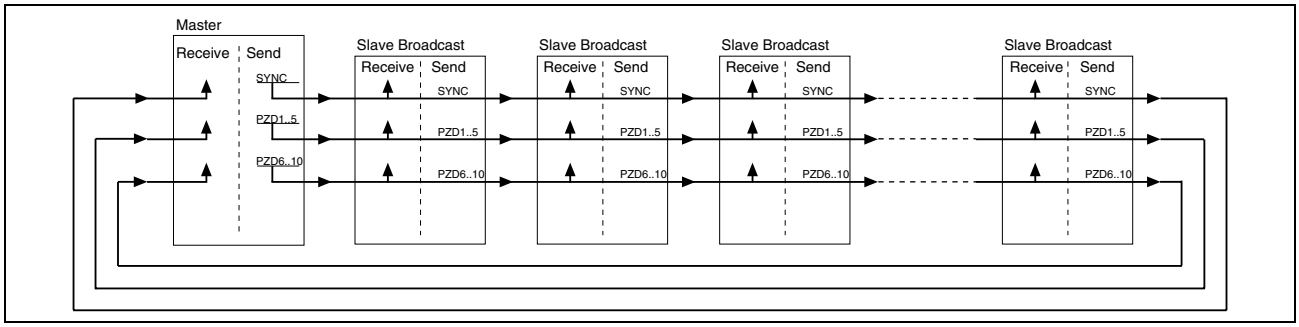


Fig. 6-19: Synchronized broadcast mode

Example 3:

Synchronized operation, where each slave processes the output data PZD1 to PZD5 of the master and sends output data PZD6 to PZD10 to its next node (synchronized change mode).

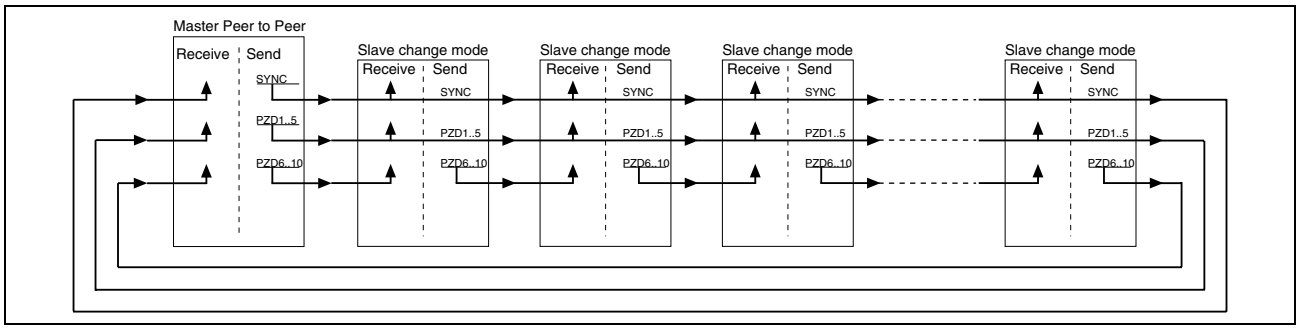


Fig. 6-20: Synchronized change mode

Example 4:

Non-synchronized operation, where each node sends its own output data to the next node (non-synchronized peer-to-peer mode).

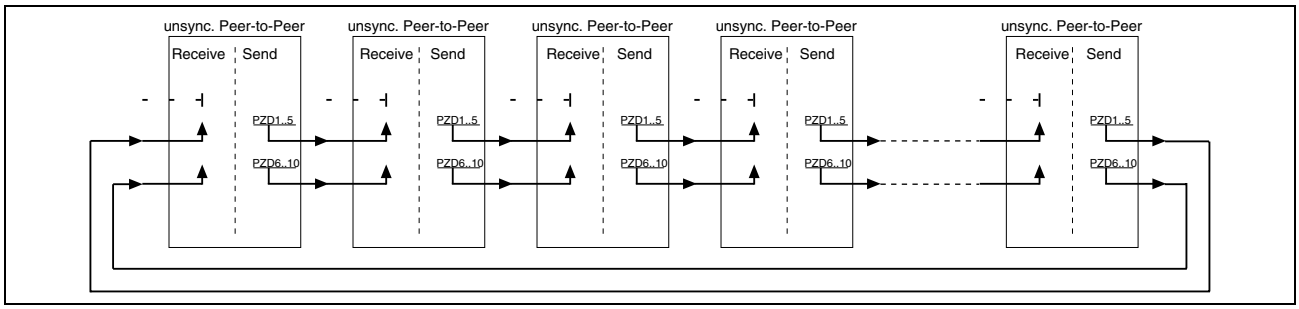


Fig. 6-21: Non-synchronized peer-to-peer mode

Example 5:

Non-synchronized mixed operation, where the individual node either sends its own output data to the next node or only receives data but does not send any output data (non-synchronized mixed operation).

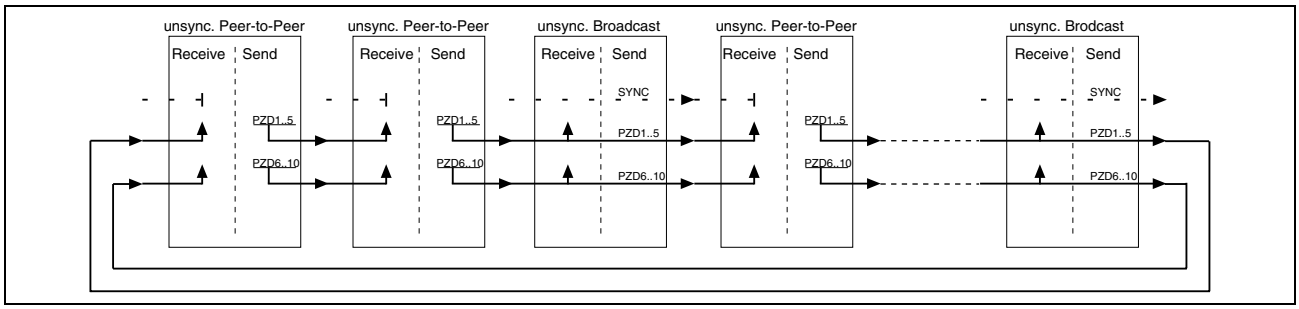


Fig. 6-22: Non-synchronized mixed operation

Example 6:

This example is mainly a theoretical configuration and has no practical significance. However, it clearly shows the flexibility of the modules.

The slave, which runs in this synchronous system in the 'non-synchronized broadcast' mode does not have to have the same pulse frequency as the other slaves. This means that the devices run in the synchronous fiber-optic cable ring bus, e.g. with 5kHz, while the non-synchronized device can operate with 8kHz.

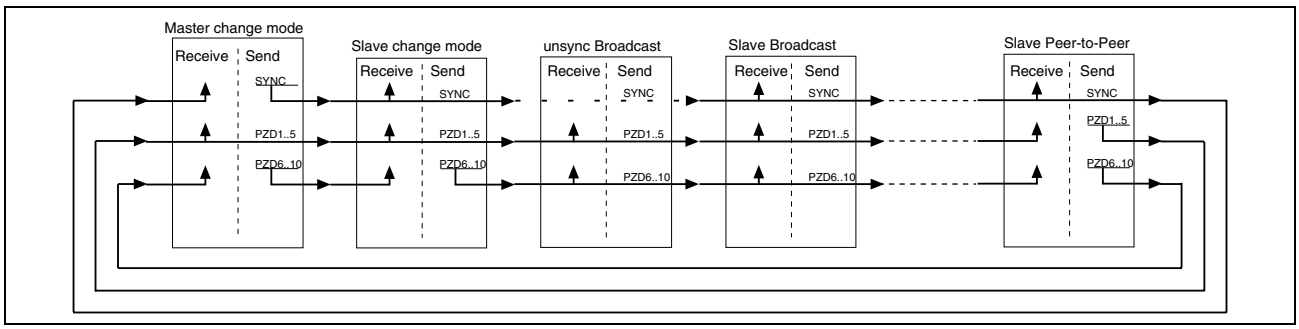


Fig. 6-23: Mixed operation

7 RZP01.1-L2 Peer-to-peer coupling

7.1 General information on the peer-to-peer coupling

Function of the peer-to-peer coupling

The peer-to-peer coupling is used to establish a fast, digital setpoint cascade. Fiber-optic cables are used as the data transfer medium in order to guarantee fast and disturbance-free data transfer. Each drive sends up to 5 process data words (this can be set from one word up to 5 words) to the next drive in the cascade. A dedicated controller guarantees the shortest data processing time. The number of drives in the cascade is not limited. Branches in the drive cascade can be realized using two outputs.

For REFUdrive 500 – RD51, the system clock cycle of all drive units in a setpoint cascade can be synchronized via the peer-to-peer coupling; refer to the parameterization of the synchronized operation.

For REFUdrive 500 – RD52, the peer-to-peer coupling can only be realized de-synchronized. We recommend the SynchroLink RZP01.1-L1 option for drive unit synchronization in RD52.

The 1st drive of a setpoint cascade can be connected to an automation unit (PLC) either via the standard serial interface RS485 or an optional fieldbus interface, e.g. Profibus DP.

Mapping the peer-to-peer coupling

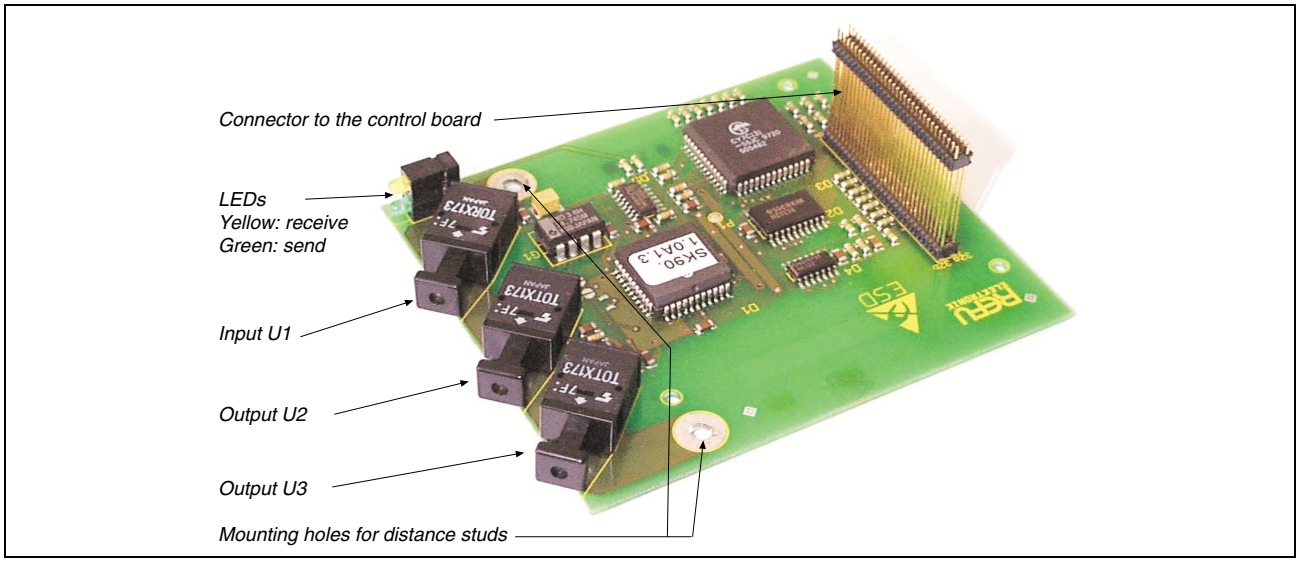


Fig. 7-1: View, peer-to-peer coupling

Technical data

Order No.	RZP01.1-L2
Protocol	Internal protocol refer to Page 7-10
Baud rate	9.6 kbaud, 19.2 kbaud, 38.4 kbaud, 76.8 kbaud, 115.2 kbaud, 230.4 kbaud.
Power supply	+5V and +15V internal from the control card
Size (length x width)	100 x 87 mm
Environmental Class	3K3 acc. to DIN IEC 721-3-3
Ambient temperature – during storage – in operation	 -25°C ... +70°C 0°C ... +40°C
Radio interference suppression level	A1 acc. to EN 55011
Noise immunity	EN 50082-2

Fig. 7-2: Technical data

Accessories

There are pre-configured fiber-optic cables for the peer-to-peer coupling; they are available in various lengths.

length	**Type code**	**Order number**
0.3	IKO 0004/000.3	201217
1.0	IKO 0004/001.0	201218

Abb. 7-3: Fiber-optic cable, Order No.

7.2 Electrical installation

Connection diagram

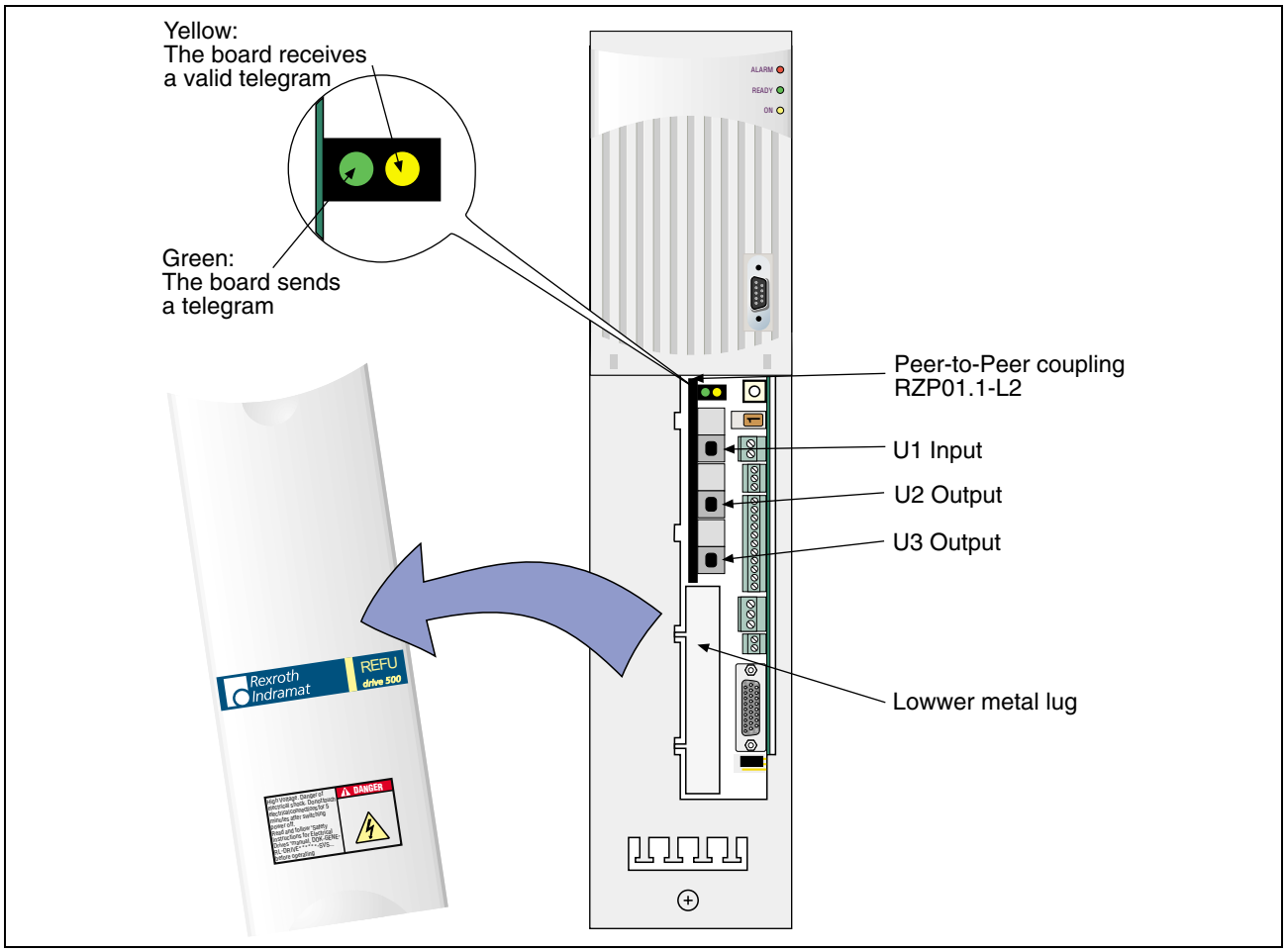


Fig. 7-4: Connection diagram, peer-to-peer coupling

Connection assignment

Connection	Designation	Function
U1	Input	The process data is received from the previous drive.
U2	Output	Sends its own process data.
U3	Output	Sends process data. Output U3 is, depending on the setting of P507, internally connected to input U1 or output U2. In the first case, the process data, received via U1 are sent instantaneously (no delay) via U3. In the second case, their own process data are simultaneously sent via U2 and U3.

Fig. 7-5: Connections, peer-to-peer coupling, description

Connection example of a setpoint cascade

The connection between drives can be simply established using pre-assembled fiber-optic cables which can be plugged-in. The two ends of the fiber-optic cable are the same and the signal direction is bi-directional. This means that the cable ends can be interchanged. The only thing that has to be observed is that the output of a drive (U2 or U3) is connected to input (U1) of the following drive. The fiber-optic cable length between two drives may not exceed 10 meters.

A branch in the setpoint cascade is realized in the example below. Drive 3 calculates a new setpoint for the branch to drive 4, e.g. from the received process data and its own measured values.

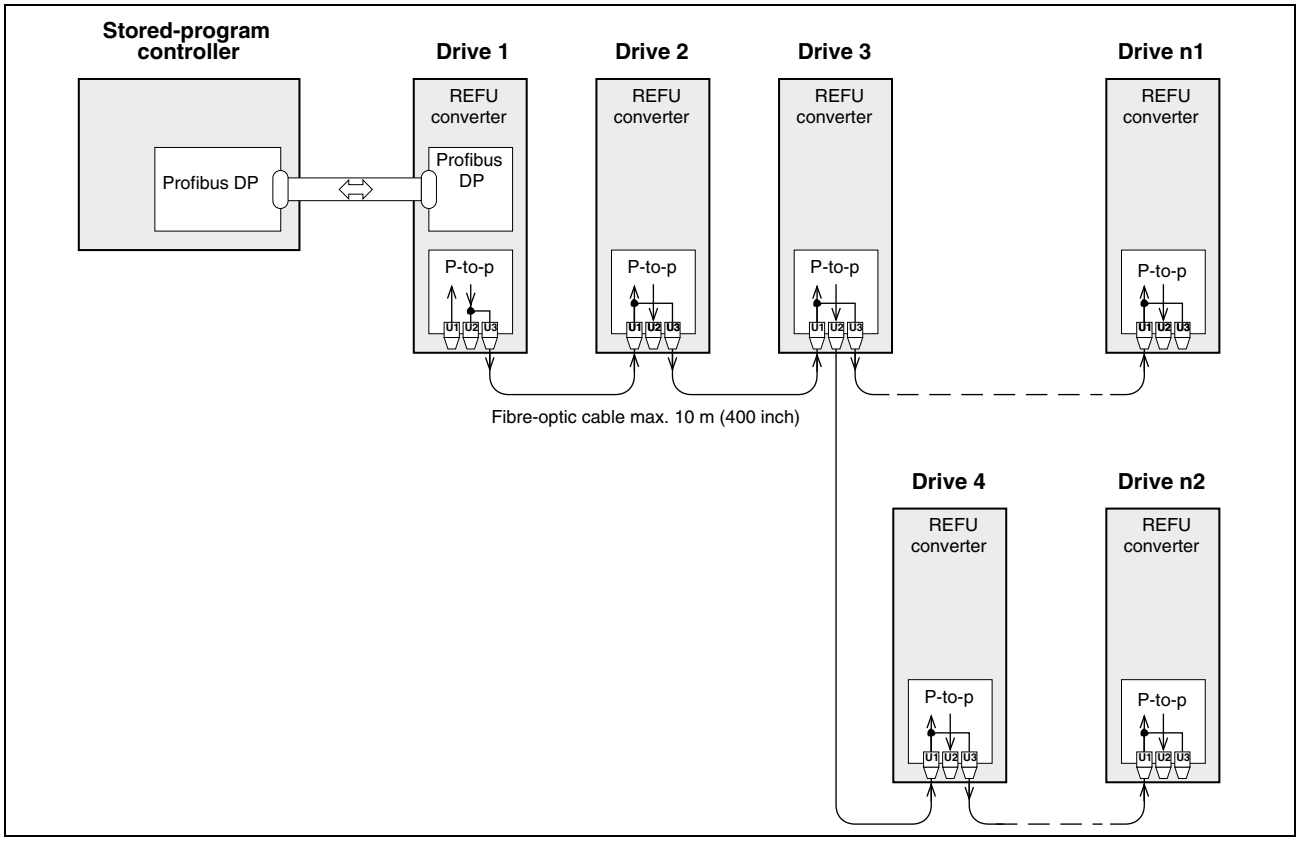


Fig. 7-6: Connection example, setpoint cascade with branch

Synchronized operation for RD51 via the peer-to-peer card

For RD51, the system clock cycle of all drive units in a cascade can be synchronized via the peer-to-peer coupling (from firmware SR501-1-5-1). The master is the first drive unit in the setpoint cascade, all of the other drive units in the cascade are slaves. The master outputs the 1 ms clock cycle to synchronize the drive units. A connection must be established between output U2 and input U1 on the peer-to-peer card of the master via a fiber-optic cable. At the same time, the master sends protocols in a 1 ms clock cycle to the slaves and to itself via the two outputs U2 and U3 (to itself via the link between U2 and U1). All of the drive units in the cascade derive their internal system clock cycle from the cyclically received protocols.

The master may not immediately process the setpoints output from the control computer, but must first send them via the peer-to-peer coupling and then receive them again via the fiber-optic cable coupling between U2 and U1. This means that the setpoints in the master and in all of the slave

drive units become effective and are processed in the processor at the same time.

For synchronized operation, a baud rate and a protocol must be selected which results in a telegram run time of <0.7 ms; refer to Protocol run times", Page 7-10. We recommend that the fastest baud rate of 230400 baud is set.

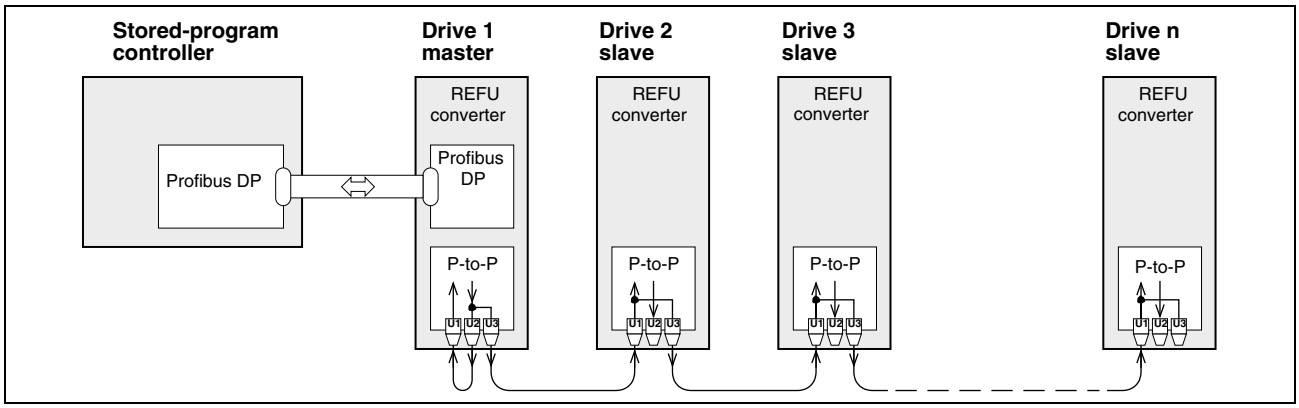


Fig. 7-7: Connection example, peer-to-peer coupling synchronized operation

Parameterizing synchronized operation

P. No.	Name	Setting	Description / explanation
Master drive unit			
0507	Peer-to-peer operating mode	Output U3 = U2 = master	The two outputs U2 and U3 are internally connected. The drive unit is the master and sends the process data in a 1 ms clock cycle. At the master, a connection must be established between output U2 and input U1 using a fiber-optic cable.
0508	Synchronous operation	Ext. peer-to-peer	The drive unit generates its system clock cycle from the received protocols (time clock cycle = 1ms). The master synchronizes itself via the U2 – U1 fiber-optic cable connection.
Slave drive unit			
0507	Peer-to-peer operating mode	Output U3 = input U1	Output U3 is internally connected to input U1. The slave receives the protocols from the master via input U1 and transfers them instantaneously to the next slave via output U3.
0508	Synchronous operation	Ext. peer-to-peer	The drive unit generates its system clock cycle from the received protocols (clock cycle = 1ms). This synchronizes it to the master.

Fig. 7-8: Parameterizing synchronized operation

Assembling fiber-optic cables

The fiber-optic cables used are APF cables from Toshiba with connector housings using a clamping system. They are pre-assembled in standard lengths, refer to “Accessories”, Page 7-2.

If you wish to assemble a fiber-optic cable with a particular length, or if you wish to shorten an existing cable, proceed as follows:

1. Release the clamping device using a small screwdriver.
2. Shorten the APF cable to the required length.
3. Use an insulation stripping tool to remove approx. 2 cm of sheath from the APF cable taking care that the fiber-optic cable is not damaged.
4. Insert the cable into the connector housing; the core must extend through the front of the connector.
5. Re-insert the clamping device into the connector housing.
6. Using a sharp knife, cut the core which projects beyond the housing of the APF cable vertically at the connector.
7. Using grain size 600 sandpaper, finish the core and then polish it with a polishing foil.

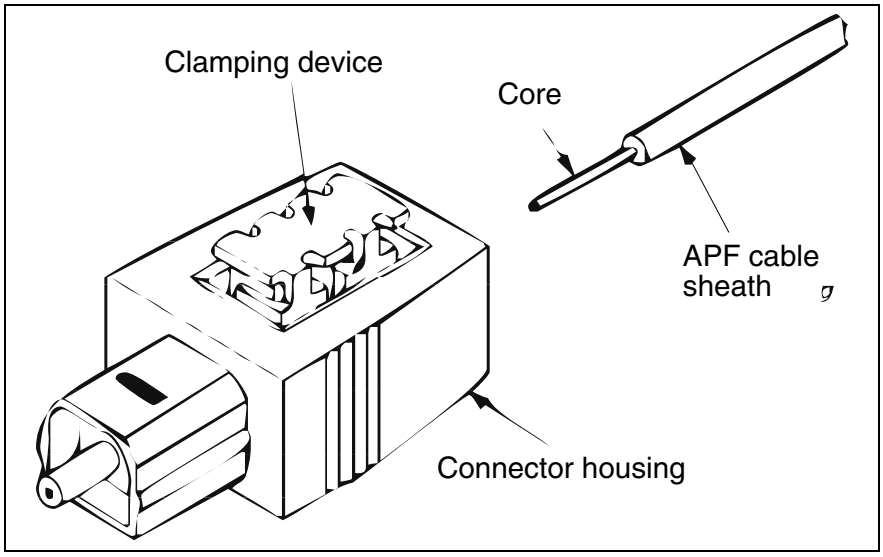


Fig. 7-9: Assembling fiber-optic cables

7.3 Parameterization

Before commissioning the peer-to-peer coupling, the parameters for the interface must be set, depending on the module slot and peer-to-peer specific parameters. The parameters can be accessed via the following menu:

PARAMETERIZATION / Prompted Parameterization / Options / Slot 1 X121

Setting the peer-to-peer specific parameters

Parameter No.:	Name	Description / explanation selectable options	Factory setting min ... max values	Password prog.
0507	Peer-to-peer mode	Two settings are simultaneously made using the selectable options. The internal connection from output U3 is linked to the system clock cycle generation. 0 = output U3 = output U2; output U2 and output U3 are connected on the hardware side on the peer-to-peer card. 1 = output U3 = input U1; input U1 and output U3 are connected on the hardware side on the peer-to-peer card. 2 = output U3=U2=master; output U2 and output U3 are connected on the hardware side on the peer-to-peer card. The drive unit is the master and sends the process data in a 1 ms clock cycle to synchronize all of the drive units in the setpoint cascade (only RD51).	0 RD51 0 ... 2 RD52 0 and 1	2 r/w off
0508	Synchronous operation	Synchronized operation using the peer-to-peer coupling, only for RD51! 0 = non-synchronized The system clock cycle is internally generated in the drive unit 1 = ext. peer-to-peer The system clock cycle is derived fr. the protocols received in the 1 ms clock cycle via the peer-to-peer coupling. All of the drive units in the setpoint cascade operate in the synchronized mode.	0 0 ... 1	1 r/w off
0510	Peer-to-peer protocol	6 = peer-to-peer 1 word 7 = peer-to-peer 2 words 8 = peer-to-peer 3 words 9 = peer-to-peer 4 words 10 = peer-to-peer 5 words	3 6 ... 10	2 r/w on
0511	Peer-to-peer baud rate	3 = 9600 baud 4 = 19200 baud 5 = 38400 baud 6 = 76800 baud 7 = 115200 baud 8 = 230400 baud	8 3 ... 8	2 r/w on

Setting the interface parameters

Module slot 1

If the peer-to-peer coupling is inserted at module slot 1, the drive unit firmware addresses it as serial interface SS2. For interface operation, the parameters of SS2 must be set.

Parameter No.:	Name	Description / explanation selectable options	Factory setting min ... max values	Password prog.
0526	SS2 RX monitoring	Sets the response time if a valid telegram was not received after the monitoring time has expired (P0527). 0 = no action 1 = warning 2 = fault	0 0 ... 2	2 r/w on
0527	SS2 monitoring time	Sets the monitoring time in which a valid telegram must be received.	0.01 sec 0.01 ... 60.00 sec	2 r/w on

Module slot 2

If the peer-to-peer coupling is inserted at module slot 2, the drive unit firmware addresses it as serial interface SS4. For interface operation, the parameters of SS4 must be set.

Parameter No.:	Name	Description / explanation selectable options	Factory setting min ... max values	Password prog.
0746	SS4 RX monitoring	Sets the response time if a valid telegram was not received after the monitoring time has expired (P0527). 0 = no action 1 = warning 2 = fault	0 0 ... 2	2 r/w on
0747	SS4 monitoring time	Sets the monitoring time in which a valid telegram must be received.	0.01 sec 0.01 ... 60.00 sec	2 r/w on

Controlling the drive unit in peer-to-peer operation

It is not possible to parameterize the drive unit using the peer-to-peer coupling as for the fieldbus interfaces. However, all of the control functions of the control word, e.g. powering-up the drive unit, can be executed. The master drive unit in the setpoint cascade sends the control word as process data word 1; refer to Section “Send and receive process data”, Page 7-10. In the slaves, the control word, received via the peer-to-peer coupling, is connected in P0074, refer to the table below.

Parameter No.:	Name	Description / explanation selectable options	Setting example	Password prog.
0073	Source ON / OFF	Selects the source for the ON/OFF command (control word generation). The value must be set to 1 so that the peer-to-peer card has the control authorization. 0 = operator panel + terminals 1 = bus SSx (serial interface) + terminals 2 = terminals 3 = service interface	1	2 r/w off
0074	Source, control word 1	**Recommendation for the peer-to-peer coupling at option slot 1:** Use PZD 1 as control word. Enter D1910 into P0074 as parameter value. **Recommendation for the peer-to-peer coupling at option slot 2:** Use PZD 1 as control word. Enter D1110 into P0074 as parameter value.	1910 or 1100	2 r/w off

7.4 Commissioning

1. Connect all of the drive units in the setpoint cascade via the fiber-optic cable; refer to the Section, Connection example of a setpoint cascade on Page 7-4.
2. Set the parameters for the peer-to-peer mode and for the interface depending on the module slot used; refer to Section “Parameterization”, Page 7-6.
3. Connect the process data (D parameters) for the peer-to-peer communications, depending on your requirement, to variable parameter sources; refer to the Section “Send and receive process data”, Page 7-10. Detailed information about working with the software is provided in the instructions associated with the firmware.

7.5 Peer-to-peer communications

Peer-to-peer protocol

The net data in the peer-to-peer protocol can be set to between 1 and 5 words using P0510.

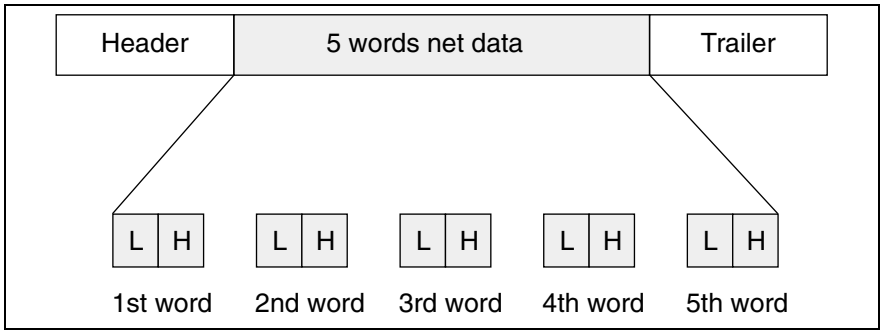


Fig. 7-10: Peer-to-peer protocol

Protocol run times

The protocol run time depends on the selected baud rate (P0511) and the number of words in the peer-to-peer protocol (P0510). For synchronized operation, for RD51, only the settings in the cells marked with * may be used due to the required protocol run time of < 0.7 ms.

Baud rate	5 words	4 words	3 words	2 words	1 word
9 600	16.0 ms	13.7 ms	10.3 ms	8.00 ms	5.70 ms
19 200	8.0 ms	6.8 ms	5.10 ms	4.00 ms	2.80 ms
38 400	4.0 ms	3.4 ms	2.60 ms	2.00 ms	1.40 ms
76 800	2.0 ms	1.7 ms	1.30 ms	1.00 ms	0.70 ms
115 200	1.3 ms	1.1 ms	0.83 ms	0.70 ms	*0.46 ms
230 400	0.7 ms	*0.6 ms	*0.45 ms	*0.35 ms	*0.25 ms

Fig. 7-11: Protocol run times, peer-to-peer coupling

Send and receive process data

The process data received via the serial protocol of the peer-to-peer coupling are changed-over to the process data channels of SS2, and are then available in the drive unit as D parameters. In order to further process the data, the D parameters must be connected to a variable parameter source.

The drive unit sends its actual values as process data via the peer-to-peer coupling, by connecting D parameters to the variable parameter sources, which serve as output for interface SS2.

Peer-to-peer card at module slot 1

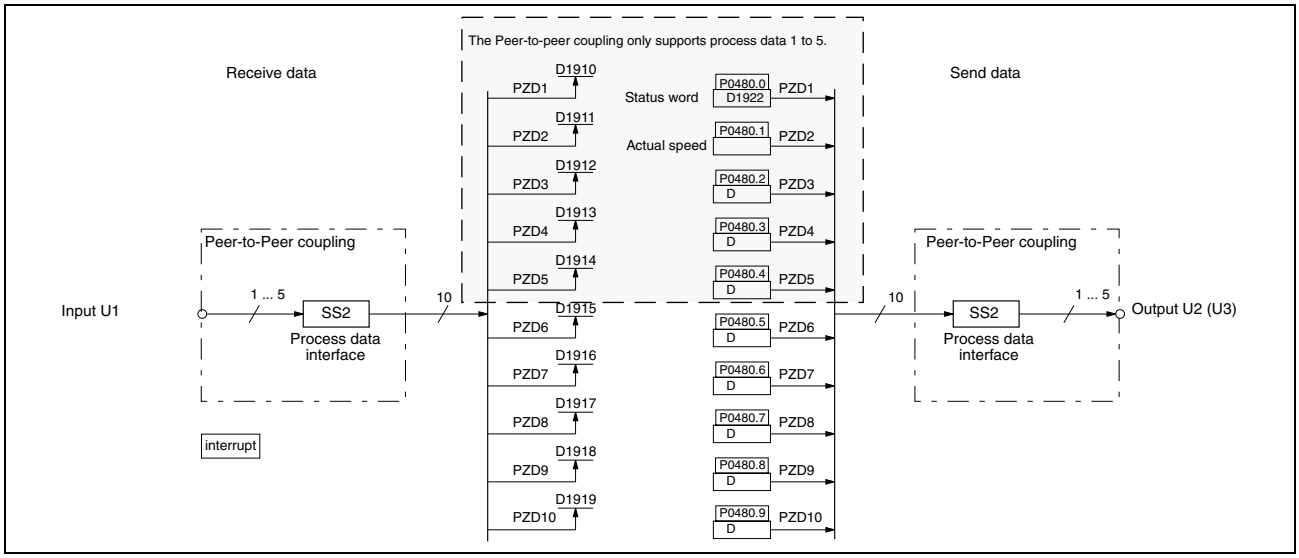


Fig. 7-12: Process data, interface SS2

8 RZP01.1-P2 Profibus DP

8.1 General Information Regarding Profibus DP

Communication module RZP01.1-P2 is the Profibus DP connection for all of the converters of the REFUdrive 500 series. It permits the converter to be coupled to superordinate automation computers.

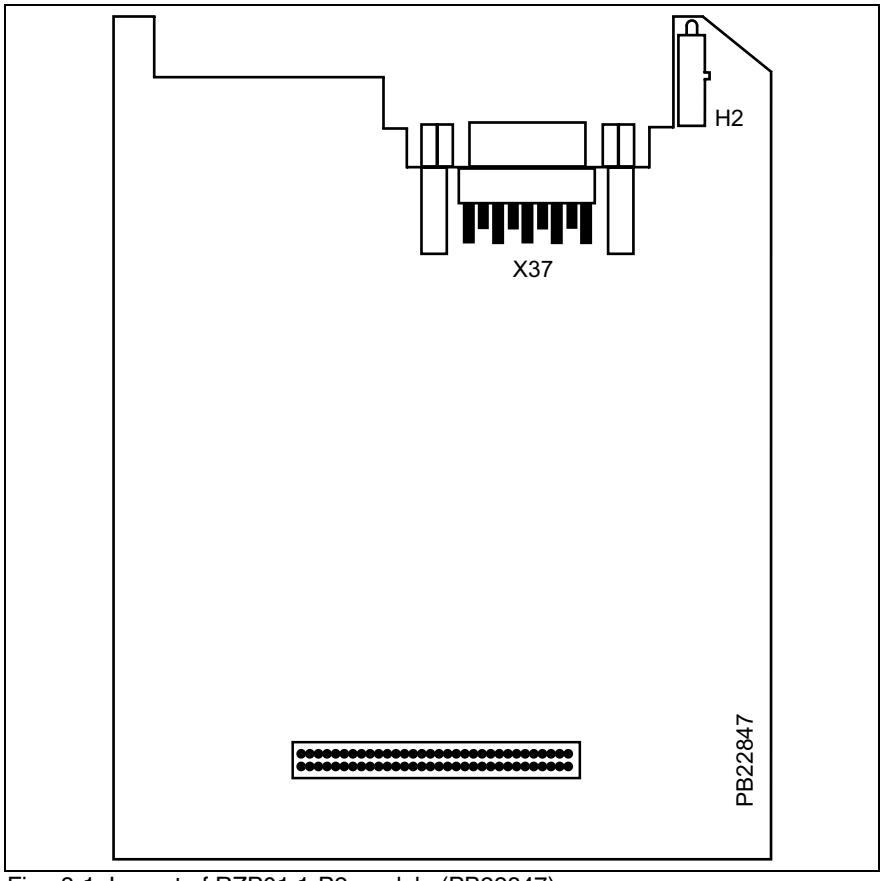


Fig.: 8-1: Layout of RZP01.1-P2 module (PB22847)

Technical Data

Order No.	**RZP01.1-P2**
Interface	RS485
Protocol	Profibus DP-conformal (see EN 50170, Volume 2 / DIN 19245, Parts 1 and 3)
Baud rate	9.6 kBit / s - 12 Mbit / s
Power supply	+ 5V and +15V, internal, from the logic and control card
Size (length x width)	111.5 mm x 87 mm
Environmental class, storage	1K3 according to EN 60721-3-1 – 5° C to + 45° C
Environmental class, transport	2K3 according to EN 60721-3-2 -25° C to +70° C
Environmental class, operation	3K3 according to EN 60721-3-3 +5° C to +40° C

Order No.	RZP01.1-P2
Noise suppression level	A1 acc. to EN 55011
Immunity to interference	EN 50082-2

General Information Regarding Bus Operation

PROFIBUS DP

Profibus DP is used for fast data exchange in the field level. Mainly cyclic data traffic takes place. The connection is implemented with a fast two-wire line (RS 485, twisted, shielded). All protocols are transferred with the Hamming distance HD = 4, ensuring a high transmission reliability. The device master data file (REFU0469.GSD) provides the converter characteristics regarding functions and bus parameters to the planning tools and the bus commissioning / bus configuration tools.

Number of Slaves

Up to 32 stations can be connected to one bus segment (masters or slaves). The beginning and the end of the segment must be terminated with a bus termination. When more than 32 stations are in operation, repeaters must be used. Overall, a maximum of 126 participants is possible.

DIN Basics

PROFIBUS-DP is legally established as a standard design in DIN 19245, Part 3. Data are exchanged with the converters according to the conventions of VDI/VDE guideline 3689 “Profibus Profile – Drives with Variable Speeds”. The guideline specifies the user data structure for the drives; these are used by a master to access the drive slaves. The user data structure is divided into two areas which can be transferred in every telegram:

- process data, i.e. control words and nominal values or status information and actual values; and
- parameter area to read/write parameter values, e.g. reading out malfunctions, as well as reading out information regarding characteristics of a parameter, such as reading out the minimum / maximum limits, etc.

The structure of the user data is designated as parameter process data objects (PPO) in Profibus profile “Drives with Variable Speeds” (VDI/VDE guideline 3689). There are five PPO types: user data without a parameter area with two- or six-word process data, or user data with a parameter area and two-, six- or ten-word process data.

The converter is addressed by the PROFIBUS DP master with PPO types 1 to 5.

The process data are processed with the highest priority and in the shortest time slices. The process data are used to guide the drive in the automation network, e.g. switching on/off, specifying nominal values, etc.

Using the parameter area, the user has random access to all the parameters located in the converter via the bus system. For example: reading out detailed diagnostic information, error messages, etc. In this manner, additional information for visualizing the drive can be called from a superordinate system, e.g. from a PC, without affecting the performance of the process data transfer.

Data Transfer Structure

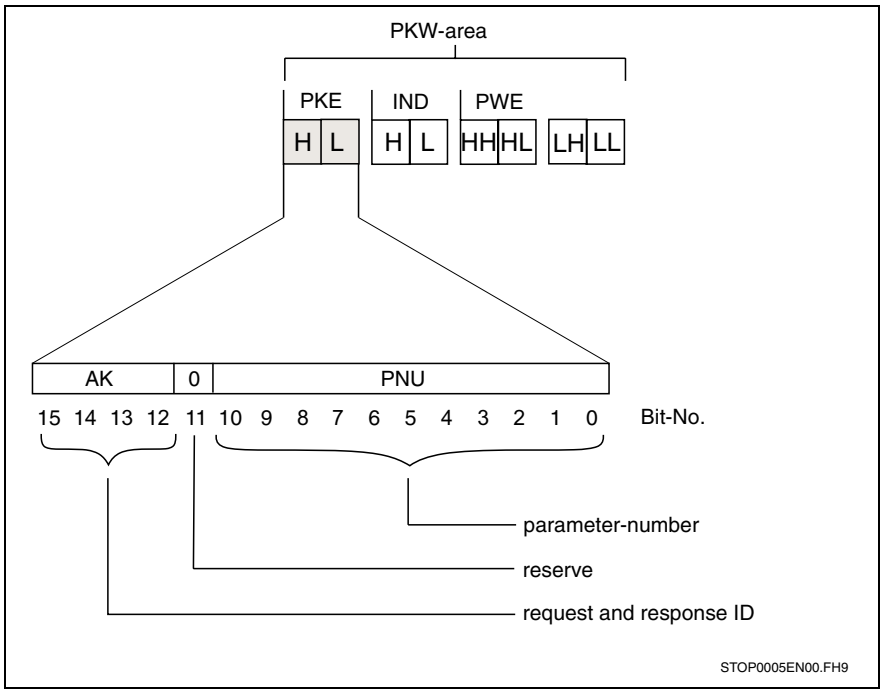


Fig.: 8-2 PKW area

Controlling and Operating the Converter Using Profibus DP

In the process data area, all the information is transferred that is required to guide a speed-controlled drive in the network of a technical process. Control information (control words) and nominal values are given to the converter by the PROFIBUS DP master. Information regarding the status of the converter (status words) and actual values are transferred in the opposite direction.

Communication module RZP01.1-P2 transfers the received process data in the dual-port RAM on the logic and control card.

The LEDs on the front side of the card are a fast way of providing the user with information about the current status of the RZP01.1-P2.

8.2 Electrical Installation

Cable Connection Plan

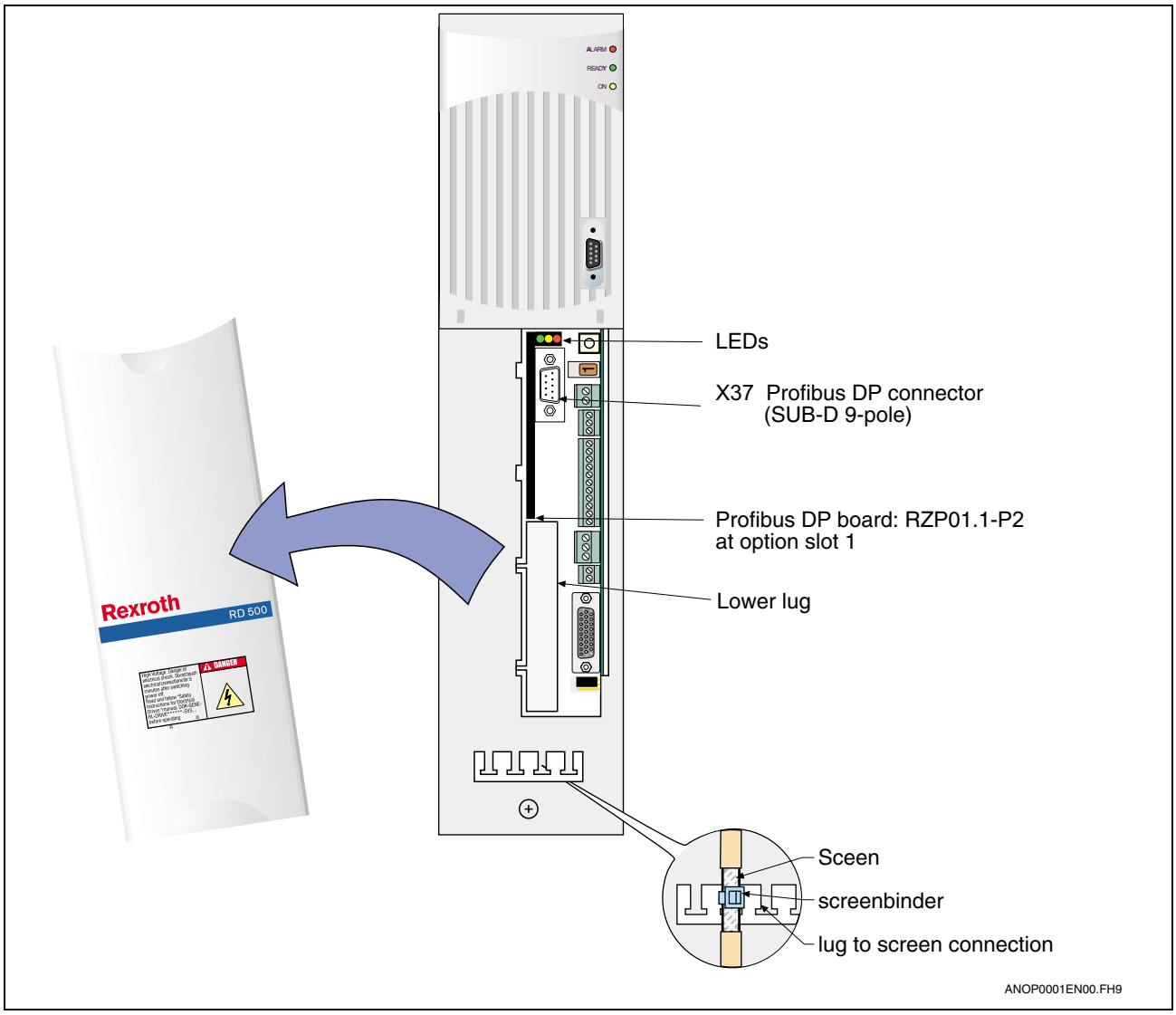


Fig.: 8-3 Profibus cable connection layout plan

LEDs

RED Flashes as long as the communication software is working correctly

YELLOW Flashes as long as the data traffic between the option card and the basic card operates correctly

GREEN Flashes as long as telegrams are exchanged with the bus master

Connection Assignment

Terminal	Designation
X37	Profibus DP
1	Bus ground
2	-
3	B cable: Rx / Tx + potential-separated

Terminal	Designation
4	Repeater control
5	Bus ground
6	+5V
7	-
8	A cable: Rx / Tx - potential-separated
9	-
S	PE

Fig.: 8-4 X37 terminal assignment

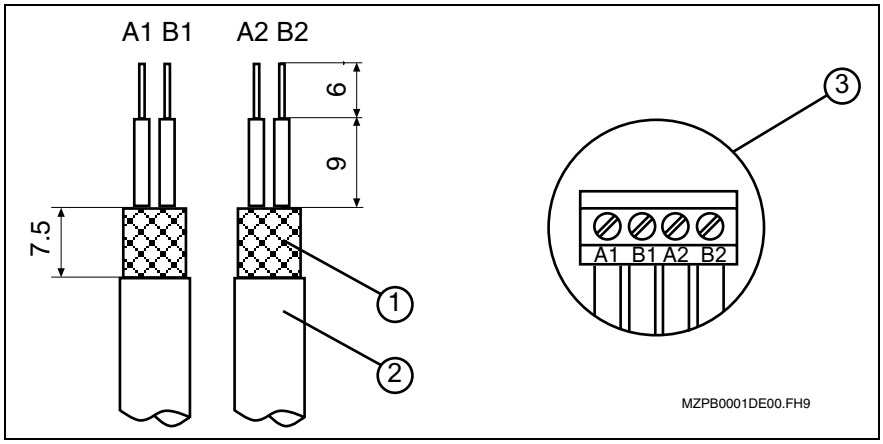
Connection Types to the Bus System (RS - 485)

Profibus option card RZP01.1-P2 is connected via X37 to the bus system (RS - 485). Profibus plug INS 0704 / K01 (item No. 200667) is available as an accessory.

Assembly Types of the Bus Lines

The SIEMENS-SINEC-L2 bus line (6XV1830-0AH10) can be used as the bus line; this is ideally suited for the Profibus plug mentioned above. Detailed multi-language assembly instructions are included with every Profibus plug.

Assembly Type

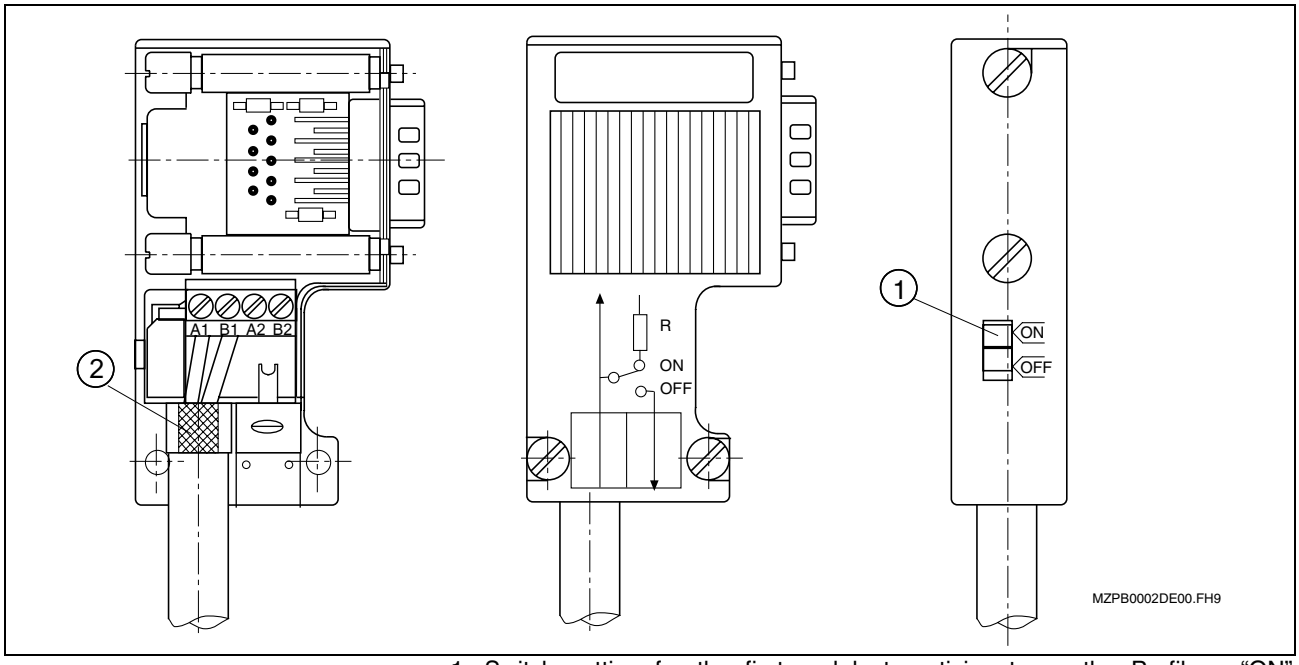


1: Cable shield
2: Bus cable, e.g. 6XV1 830-OEH10
3: Screw terminal block on plug PCB for bus cable connection

Fig.: 8-5 Bus connection plug 1

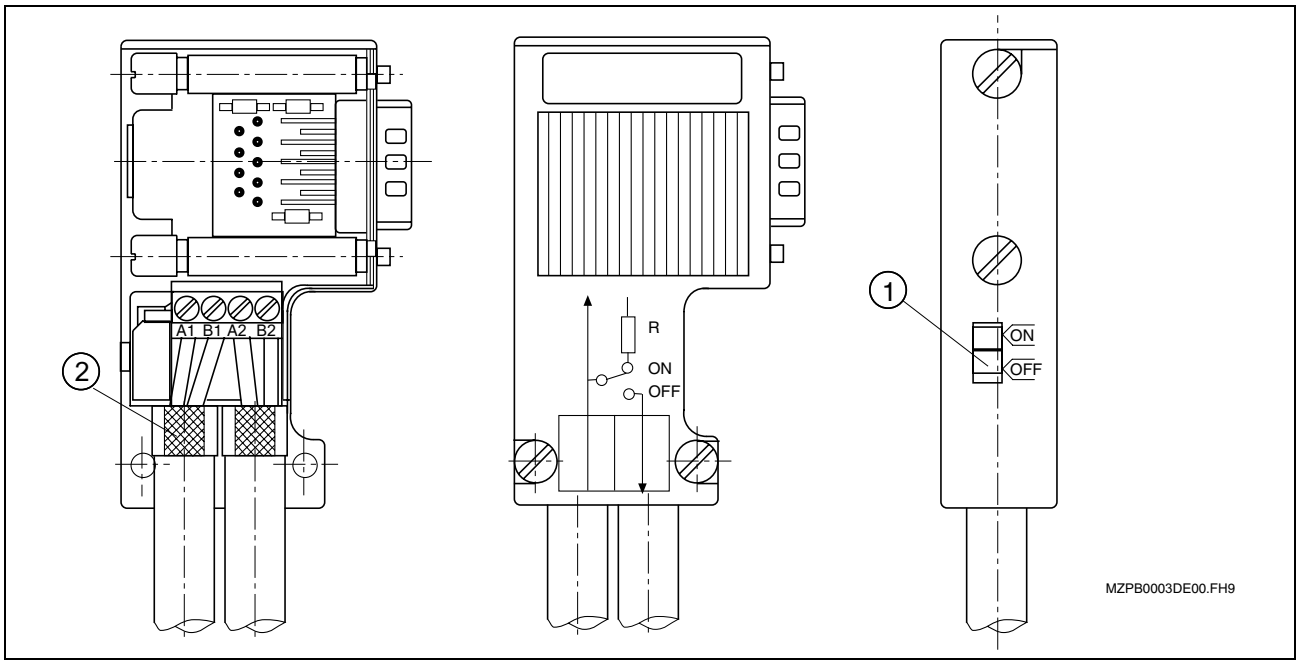
1. Strip the insulation off the cable.
2. Guide the green and red wires into the screw terminal block. (A1, B1 or A“, B2; recommendation; A = green, B = red)
3. Press the cable sleeve between the two clamping fins.
4. Screw the green and red wires into the screw terminal.

Profibus Plug INS 0704 / K01



1: Switch setting for the first and last participants on the Profibus: “ON” (terminating resistor switched on)
2: The cable shield must lie directly on the metal guide
Fig.: 8-6 Bus connection plug 2

Bus connection for the first and last participants on the Profibus. The cable must always be connected on the left side (see plug ID A1, B1)



1: Switch setting for all additional participants on the Profibus. “OFF” (terminating resistor switched off)
2: The cable shield must lie directly on the metal guide
Fig.: 8-7 Bus connection plug 3

Bus connection for all additional participants on the Profibus. The cable entry must always be connected on the left side (A1, B1) The cable continuation must always be connected on the right side (A2, B2)

Note: If the switch is set to “ON”, the Profibus is separated from the other participants at this point (e.g. for servicing).

Proposed Switching Configuration

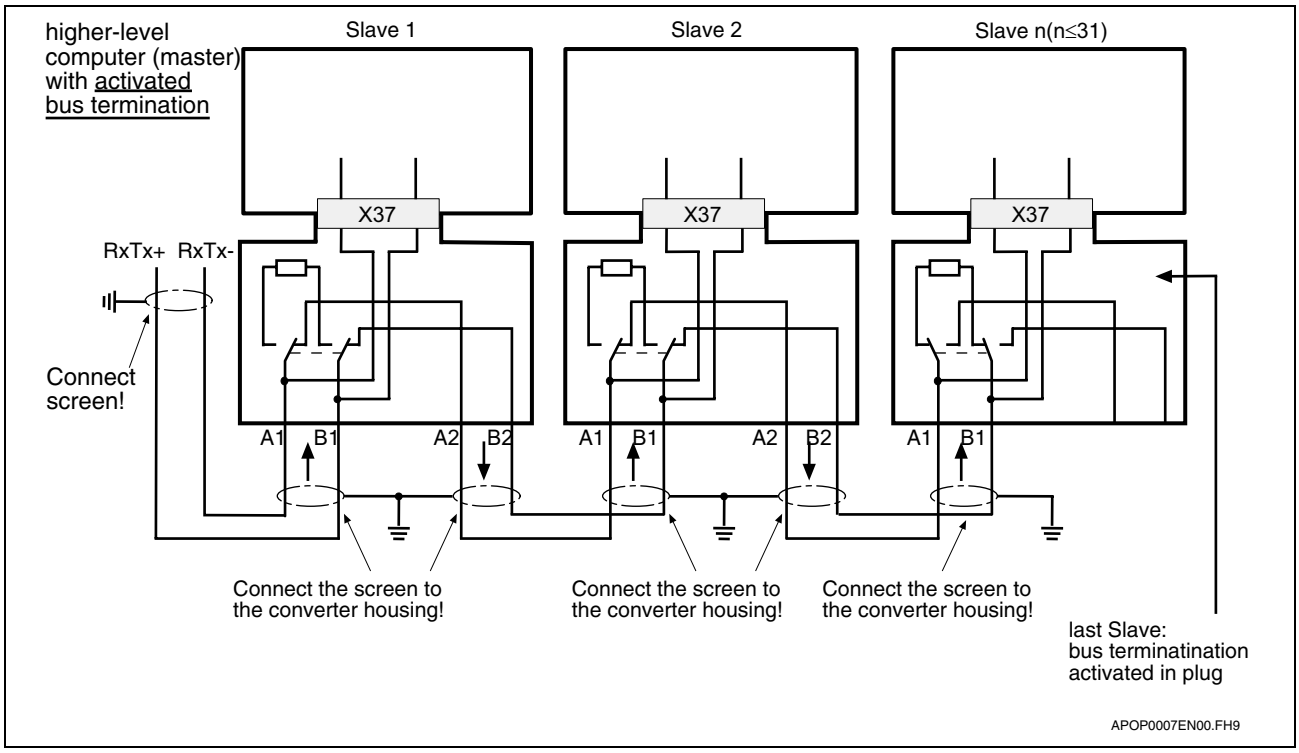


Fig.:8-8 Profibus connection, proposed switching configuration

Bus Termination

For error-free operation, the Profibus line must be terminated with resistors on both ends. Here, the bus line must be viewed as one bus line from the first to the last Profibus participant. The Profibus is thus terminated twice.

In the first bus participant (e.g. master) and the last bus participant (slave), the bus terminating resistors must be switched on. In the Profibus plug mentioned above, it is not possible to accidentally switch on three or more terminating resistors: the bus is either terminated with one resistor (R on) or is looped to the next bus participant (R off); the switch settings are impressed in the plug housing.

Note: Please ensure that you switch on the bus termination only for the first bus participant (e.g. control computer) and the last bus participant (e.g. RZP01.1-P2)!

Using Repeaters

By using repeaters, a line segment can be lengthened. With repeaters, the bus can be extended to 126 stations. The control signal is placed on X37 on PIN 4 (PIN name: "CNTR - P") and works with TTL levels.

It is recommended that no more than 3 repeaters be switched in series.

Stubs

Stubs are possible with limitations: they should be avoided at baud rates of 187.5 kBit/s and higher; they are no longer permitted at baud rates of 1.5 Mbit/s and higher. Stubs cannot be generated with the plug mentioned above.

Line Length of the Bus System

The line length of the bus line (between Profibus cards or between automation computers and Profibus cards) depends on the baud rate used and on the cable type (and cable connection) used. The possible line length is decreased at high baud rates. By using repeaters, a line segment can be lengthened.

Transfer rate in kBits/s	Max. line length of a segment in meters
9.6	1200
19.2	1200
45.45	1200
93.75	1200
187.5	1000
500	400
1500	200
3000	100
6000	100
12,000	100

Fig.:8-9 Line length, Profibus DP

The data in the table refer to the cable type mentioned below.

Recommended Cable Type

Characteristic impedance	135 - 165	Ω
Capacitance per unit length	< 30	pF / m
Loop resistance	110	Ω / km
Wire diameter	0.64	mm
Wire cross-section	> 0.34	mm²

Fig.:8-10 Recommended cable type, Profibus DP

EMC Measures

To ensure fault-free Profibus DP operation, the following measures are absolutely required:

- The bus lines must be twisted and shielded and are to be laid out so that they are separated from the power cables, at a minimum distance of 20 cm.
- The shield must be generously applied on both sides, i.e. the shield of the bus line is to be applied on both ends on the converter housing between 2 converters. The same is true for the shield of the bus line between the Profibus DP master and the converter.
- Crossings of bus and power cables are to be laid out at an angle of 90°.

Where the bus line enters the converter housing, the shield must be attached to the chassis using cable ties. Handling of the shield connection is explained in detail in the operating instructions of the corresponding device. When removing the insulation of the wire ends, please make sure that the massive copper wire is not nicked in the process.

Please ensure that the shield of each bus line lies on a surface both at the cabinet entry and on the converter housing!

Potential Equalization

Please avoid differences in potential (e.g. due to different power supplies) between the converters and the PROFIBUS DP master:

- Use potential equalization lines:
  - 16 mm² Cu for potential equalization lines up to 200 m length
  - 25 mm² Cu for potential equalization lines above 200 m length
- Lay out potential equalization lines in such a way that as small an area as possible is enclosed between the potential equalization conductor and the signal lines.
- Connect the potential equalization conductor with the ground electrode / protective conductor over a large area.

Line Layout

Please note the following instructions for laying out lines:

- Do not lay out the bus cable (signal cable) parallel and next to power cables; maintain a minimum spacing of 20 cm.
- Lay out signal cables and the associated potential equalization lines with as small a spacing as possible between them and over the shortest path possible.
- Lay out power cables and signal cables in separate cable ducts.
- Lay out shields smoothly.

Note: For the shield connection, refer to Fig.: 8-3 Profibus cable connection layout plan

8.3 Setting Parameters

Before commissioning the Profibus interface, the parameters for the interface, depending on the option slot, and the Profibus-specific parameters must be set. The parameters can be attained using the menu:

SET PARAMETERS
\GUIDED PARAM.
\OPTIONS
\PROFIBUS
\Module slot 1 X121
\Module slot 2 X123

Setting Converter Parameters for Profibus Operation

Parameter. No.	Name	Description / explanation of selectable options	Sample setting	Password prog.
0073	Source ON / OFF	Selection of the source for the ON/OFF command (control word generation). For the Profibus card to receive control authorization, the value must be set to 1	1	2
		0 = control panel + terminals 1 = serial interface (SS) + terminals 2 = terminals 3 = service interface		r / w off
0074	Source of control word		D1910	2
		Proposal for SS2 (module slot 1): Use PZD 1as the control word; enter D1910 as the parameter value in P0074. Proposal for SS4 (module slot 2): Use PZD 1 as the control word; enter D1100 as the parameter value in P0074.		r / w off
0480.x	Source of SS2 PZD		D1800	
		Proposal for SS2 (module slot 1): Send the status word as PZD 1. To do this, use the variable parameter source P0480.0. Set D1922 (status word) as the parameter value.		r / w off
0491.x	Source of SS4 PZD	**Note:** Depending on the selected module slot, only the corresponding parameter P0480.x or P0491.x must be set.	D1800	2
		Proposal for SS4 (module slot 2): Send the status word as PZD 1. To do this, use the variable parameter source P0491.0. Set D1922 (status word) as the parameter value.		r / w off

Fig.:8-11 Converter parameters for Profibus operation

Setting Profibus - Specific Parameters

P. No.:	Name	Description / explanation of selectable options	Factory setting min - max values	Pass-word prog.
0522.X	PB baud rate	X = 0: data refer to SS2 X = 1: data refer to SS4		2
		9600 baud 19,200 baud 45,450 baud 93,750 baud 187,500 baud 500,000 baud 1.5 Mbaud 3 Mbaud 6 Mbaud 12 Mbaud		read
0523	PB address	Setting the slave address	9	2
			3 - 124	r / w on
0524	PB CLR-DATA	Behavior in case of Clear Data	0	2
		0 = no action 1 = malfunction	0 / 1	r / w on
0525.X	PB PPO-TYP	X = 0: data refer to SS2 X = 1: data refer to SS4		2
		PPO type 1, 4 / 2 words PPO type 2, 4 / 6 words PPO type 3, 0 / 2 words PPO type 4, 0 / 6 words PPO type 5, 4 / 10 words		read

Fig.:8-12: Setting Profibus-specific parameters

Setting Interface Parameters

Module slot 1 If the Profibus board is mounted on module slot 1, it is addressed as serial interface 2 (SS2) by the converter firmware. The parameters of SS2 must be set for interface operation.

P. No.:	Name	Description/explanation of selectable options	Factory setting min - max values	Password prog.
0509	SS2 functions	Setting the type of reaction of the converter to a warning/malfunction from the Profibus interface.	0	2
		0 = all active 1 = warning off 2 = malfunction off 3 = blocked	0 - 3	r / w on
0526	SS2 RX monitoring	Setting the type of reaction if no valid telegram was received after the monitoring time (P0527) has elapsed.	0	2
		0 = no action 1 = warning 2 = malfunction	0 - 2	r / w on
0527	SS2 monitoring time	Setting the monitoring time in which a valid telegram must be received.	0.01 sec	2
			0.01 - 60.00 sec	r / w on

Fig.:8-13: Setting SS2 interface parameters, Profibus DP

Module slot 2 If the Profibus board is mounted on module slot 2, it is addressed as serial interface 4 (SS4) by the converter firmware. The parameters of SS4 must be set for interface operation.

P. No.:	Name	Description / explanation of selectable options	Factory setting min - max values	Password prog.
0745	SS4 functions	Setting the type of reaction of the converter to a warning/malfunction from the Profibus interface.	0	2
		0 = all active 1 = warning off 2 = malfunction off 3 = blocked	0 - 3	r / w on
0746	SS4 RX monitoring	Setting the type of reaction if no valid telegram was received after the monitoring time (P0747) has elapsed.	0	2
		0 = no action 1 = warning 2 = malfunction	0 - 2	r / w on
0747	SS4 monitoring time	Setting the monitoring time in which a valid telegram must be received.	0.01 sec	2
			0.01 - 60.00 sec	r / w on

Fig.:8-14: Setting SS4 interface parameters, Profibus DP

8.4 Profibus Operation

Device Master Data File “REFU0469.GSD”

The available functions of the device and the possible bus parameters, such as the baud rate, PPO type, time monitors, etc. are described in the so-called 'REFU0469.GSD' file. This DMD (Device Master Data) file has a specified format and can be used by the user for automatic bus configuration. In addition, the consistency of the entire bus system can already be checked in the design phase.

This file provides a simple plug-and-play configuration.

The REFU0469.GSD file can be downloaded from the Indramat home page http://www.boschrexroth.com. It is shown below:

```
;               (c) 1999 REFU Elektronik
;
; PROFIBUS DP          Device master file
;
; Author:                    Thomas Moegle
; Creation date:             27.01.1999
; Modifications:             --.--.----
;
; General information:       ----
; ===================================
;
;
#PROFIBUS_DP
;
; Manufacturer name
Vendor_Name = "REFU Elektronik"
;
; Manufacturer’s designation of the DP device
Model_Name = "REFUdrive 500 (RZP01.1-P2)"
;
; Version level of the DP device
Revision = "01"
;
; Protocol ID of the DP device
;    0: Profibus-DP
;    16-255 Manufacturer-specific
Protocol_Ident = 0
;
;  DP device type
;    0: DP slave
;    1: DP master, class 1
Station_Type = 0
;
;  no mixed FMS/DP device
FMS_supp = 0
;
; Hardware release of the DP device
Hardware_Release = "RZP01.1-P2 02 SP02"
;
; Software release of the DP device
Software_Release = "PB500.01"
;
;  9.6 kBaud is supported
9.6_supp = 1
;
;  19.2 kBaud is supported
19.2_supp = 1
;
;  45.45 kBaud is supported
45.45_supp = 1
;
;  93.75 kBaud is supported
93.75_supp = 1
;
;  187.5 kBaud is supported
187.5_supp = 1
;
;  500 kBaud is supported
500_supp = 1
;
;  1.5 Mbaud is supported
1.5M_supp = 1
;
;  3 Mbaud is supported
3M_supp = 1
;
;  6 Mbaud is supported
6M_supp = 1
;
;  12 Mbaud is supported
12M_supp = 1
MaxTsdr_9.6   = 60
MaxTsdr_19.2  = 60
MaxTsdr_45.45 = 250
MaxTsdr_93.75 = 60
MaxTsdr_187.5 = 60
MaxTsdr_500   = 100
MaxTsdr_1.5M  = 150
MaxTsdr_3M    = 250
MaxTsdr_6M    = 450
MaxTsdr_12M   = 800
;
Redundancy = 0
;
;  CNTR-P is designed as TTL signal
Repeater_Ctrl_Sig = 2
;
;  24V not connected
24V_Pins = 0
;
Implementation_Typ = "SPC3"
;
;  ID number
Ident_Number = 0x0469
;
;  Freeze mode is supported
Freeze_Mode_supp = 1
;
;  Sync mode is supported
Sync_Mode_supp = 1
;
;  Automatic baud rate detection is supported
Auto_Baud_supp = 1
;
;  The slave address can not be set by the
master
Set_Slave_Add_supp = 0
;
;  Min. spacing between 2 DDLM_Data_Exchange
calls
Min_Slave_Intervall = 30
;
; Module ID
Modular_Station = 1
Max_Module      = 4
Max_Input_len   = 20
Max_Output_len  = 20
Max_Data_len    = 20
;
Module = "PPO 1" 0xF3, 0xF1
EndModule
Module = "PPO 2" 0xF3, 0xF3, 0xF1
EndModule
Module = "PPO 3" 0x00, 0xF1
EndModule
Module = "PPO 4" 0x00, 0xF3, 0xF1
EndModule
Module = "PPO 5" 0xF3, 0xF9
EndModule

```

ID Number

Each bus participant (slave) on the Profibus DP must have an ID number so that it can be uniquely identified on the bus. For the REFUdrive 500 device series, the ID number is:

0469 hex

The master uses this ID number to provide the reference to the device master data (DMD) file. User data are transferred only if the ID number, together with the correct bus address, are recognized by the master.

Configuration

To create a connection between the master and the slave (RZP01.1-P2), the master must first send the configuration bytes for the set PPO type.

Possible PPO settings:

	Number of configuration bytes			
PPO type	**1 byte long**	**2 bytes long**	**3 bytes long**	**4 bytes long**
PPO1	-	F3, F1	-	-
PPO2	-	F3, F5	F3, F3, F1	-
PPO3	F1	00, F1	-	-
PPO4	F5	00, F5	00, F3, F1	-
PPO 5	-	F3, F9	-	F3, F3, F3, F1

Fig.:8-15 PPO settings for Profibus DP

The baud rate and the PPO type used are automatically detected by the device and are shown in parameters P0522 and P0525.

Data Transfer with Profibus

The structure of the user data is designated as **P**arameter **P**rocess data **O**bjects (PPO) in Profibus profile “Drives with Variable Speeds”. This defines five PPO types for data transfer:

PPO type 1 4 / 2 words (4 words in PKW area / 2 words in PZD area)
PPO type 2 4 / 6 words (4 words in PKW area / 6 words in PZD area)
PPO type 3 0 / 2 words (no word in PKW area / 2 words in PZD area)
PPO type 4 0 / 6 words (no word in PKW area / 6 words in PZD area)
PPO type 5 4 / 10 words (4 words in PKW area / 10 words in PZD area)

Process Data Control

As opposed to the description of the USS protocol, bit 10 of the control word for the Profibus DP has the special function “Release of process data”.

Bit 10 = 0 ⇐ freeze process data
Bit 10 = 1 ⇐ process data valid

Guide via Interface (Bit 10 in Control Word)

For correct operation when guiding via the PROFIBUS DP interface, it is required that process datum PZD1 be permanently allocated for incoming and outgoing protocols (PPO types).

This means:

- in order to be able to evaluate the control word, it must be ensured that parameter P0074 (source of control word 1) is linked with parameter D1910 or D1100 (SS2 / SS4).
- in order to transfer the status word, parameter P0480.0 or P0491.0 (SS2 / SS4) must also be linked with parameter D1922.

Note: In the control word, bit 10 has the function “Guiding from PLC”.

Value “1” When guiding via the interface, this means that the received process data are valid and are accepted.

Value “0” No guiding via the interface; the received process data are invalid and are not accepted. The process data that were last received remain active, i.e. the last status is “frozen”.

USS Protocol

Control word, status word

The superordinate automation computer predefines the control word and evaluates the status word. The bit functions of the control and status words are specified by the VDI / VDE 3689 guideline for bits 0 to 10; bits 11 to 15 can be freely allocated.

In the REFUdrive 500 device series, control and status word bits 0 to 7 have been allocated in agreement with the guideline. Bits 8 to 15 can be freely allocated; see the function plan for “Control word 1” and “Status word 1”.

In the illustration below, the control / status word is transferred as PZD1 according to the proposed allocation.

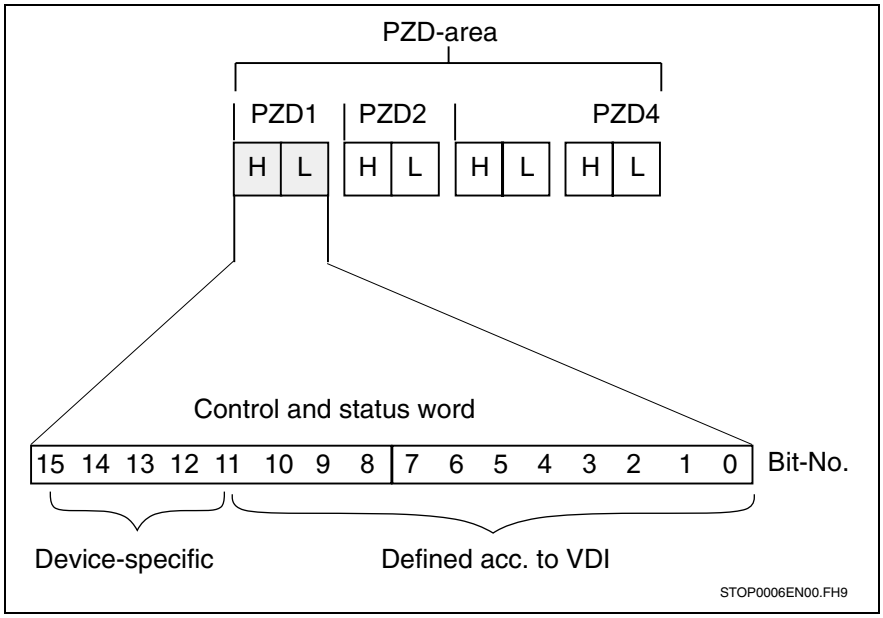


Fig.:8-16 Profibus PZD area

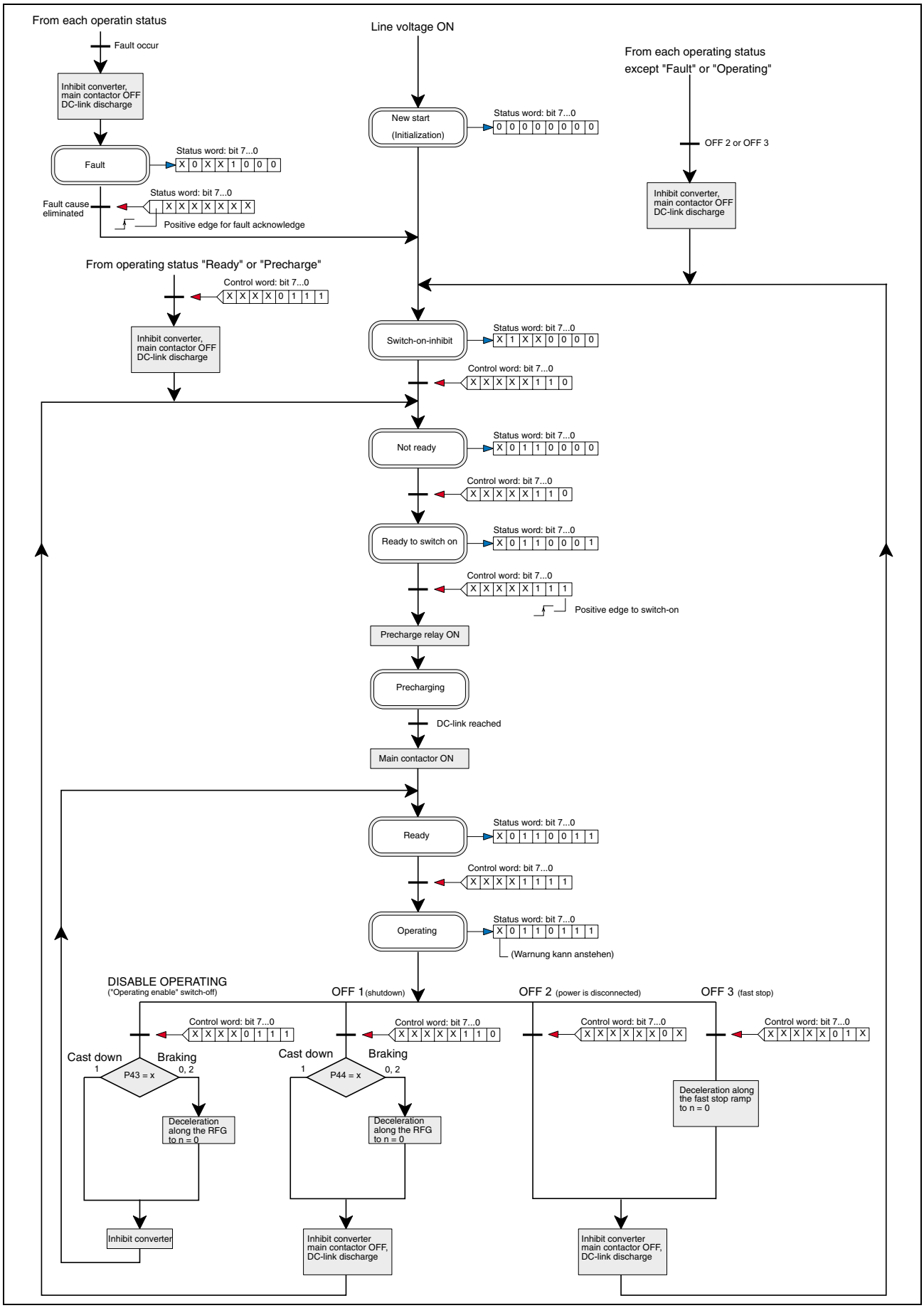


Fig.:8-17 Control and status word diagram for converters

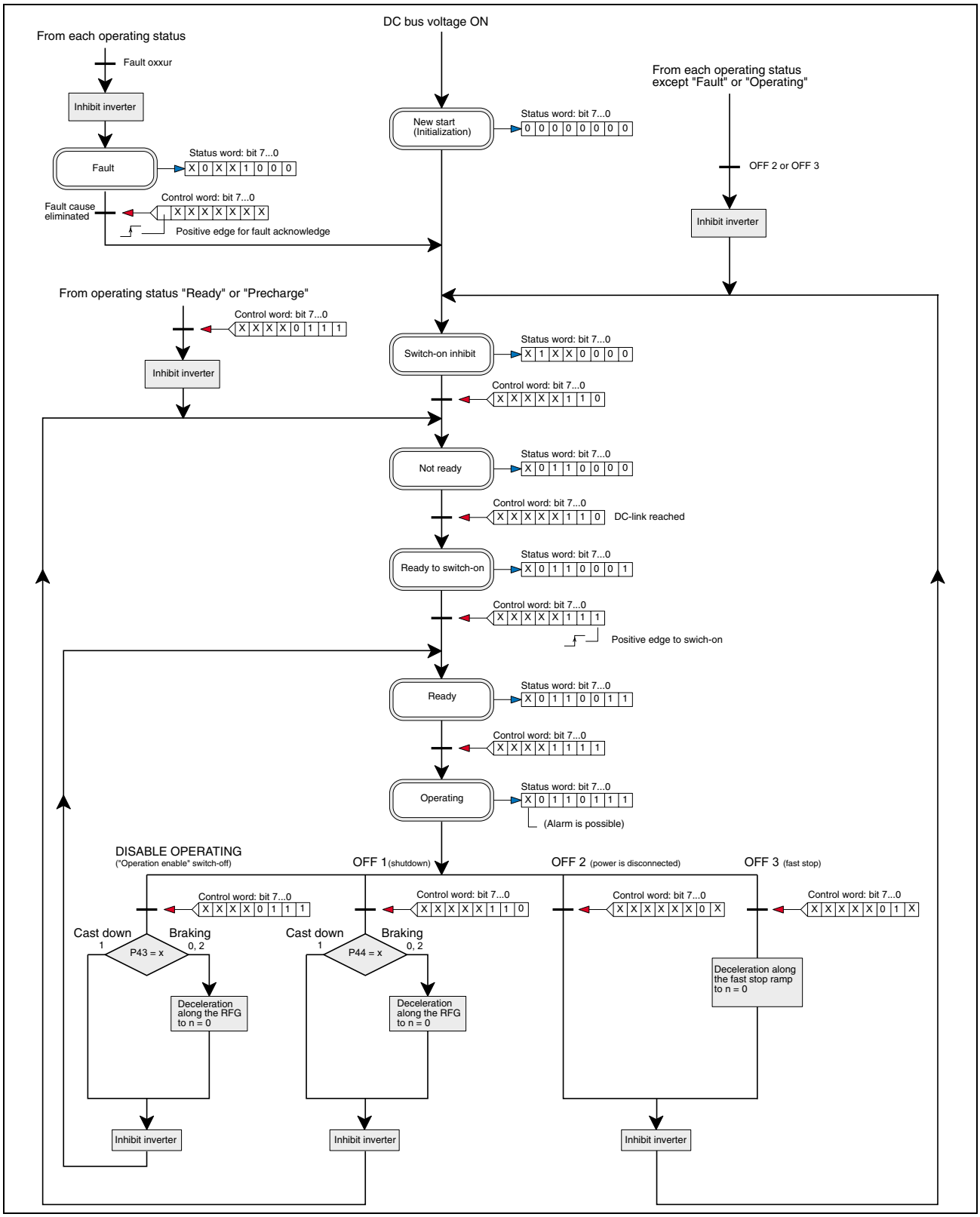


Fig.:8-18 Control and status word diagram for inverters

Assignment of Control Word Bits

Bit	Value	Meaning	Comment
0	1	On	Transition to the “Ready for operation” status; intermediate circuit is loaded, master contactor on (if present).
	0	Off 1	Stop (back to the “Ready to be switched on” status); shut down to the RFG ramp*; power release if n/f = 0 and I = 0 ; master contactor off (if present). * or run-empty – see parameter P0044
1	1	Operational requirement	All “Off 2” commands are lifted
	0	Off 2	Power release, block impulses! Then switch the master contactor off (if present) and go to the “Switch-on block” status; the motor slows to a stop.
2	1	Operational requirement	All “Off 3” commands are lifted
	0	Off 3	Quick stop; shut down to the quick-stop ramp or current limit; at n/f = 0, block WR impulses, then release power (contactor off if present) and go to the “Switch-on block” status.
3	1	Release operation	Release of electronics and impulses Release WR impulses and impress the field current. Then drive the RFG to the pending nominal value.
	0	Block operation	Block WR impulses: Drive slows to stop (RFG at zero) or braking operation to the RFG ramp (see P0043) and goes to the “Ready for operation” status (see control word, bit 2).
4	1	Operational requirement	
	0	Block RFG	The ramp function encoder output is set to 0. The main contactor remains on; the power converter is not disconnected from the power supply.
5	0	Stop RFG	Freezing of the nominal value currently predefined by the RFGG.
	1	Release RFG	
6	1	Release nominal value	The selected value at the input of the RFG is switched on.
	0	Block nominal value	The selected value at the input of the RFG is set to 0.
7	1	Acknowledge	The collective message is acknowledged when the flank is positive; the current converter is in the malfunction mode until the error has been successfully eliminated and then goes to “Switch-on block”.
	0	no meaning	

Fig.:8-19 Assignment of control word bits, Profibus DP

Assignment of Status Word Bits

Bit	Value	Meaning	Comment
0	1	Ready to be switched on	Power supply is switched on, electronics are initialized, main contactor (if present) dropped out, impulses blocked
	0	Not ready to be switched on	
1	1	Ready for operation	Ready for operation; current at current converter, i.e. main contactor on (if present). Intermediate circuit is loaded; WR impulses blocked.
	0	Not ready for operation	
2	1	Operation released	Release of electronics and impulses. Release WR impulses: RD51: for F_{min} wait for time P544. RD52: wait for field buildup D1756. Then the HLG drives to the pending nominal value.
	0	Operation blocked	
3	1	Malfunction	Drive malfunctioning and thus not in operation; goes to switch-on block after successful error elimination and acknowledgement when “On” command is pending. Error numbers in malfunction memory P 0040.x (the last malfunction can also be read out using D1793).
	0	No malfunction	
4	1	No Off 2	
	0	Off 2	“Off 2” command pending.
5	1	No Off 3	
	0	Off 3	“Off 3” command pending.
6	1	Switch-on block	Restart only using “Off 1” and subsequent “On” command
	0	No switch-on block	
7	1	Warning	Drive remains in operation, warning in warning parameter P0039.
	0	No warning	No warning is pending / warning has been rescinded.
8	1		“Nominal f in range of tolerance” (standard assignment)
9	1		Remote
10	1		“Nominal f attained” (standard assignment)

Fig.:8-20 Assignment of status word bits, Profibus DP

Parameter ID, PID Word

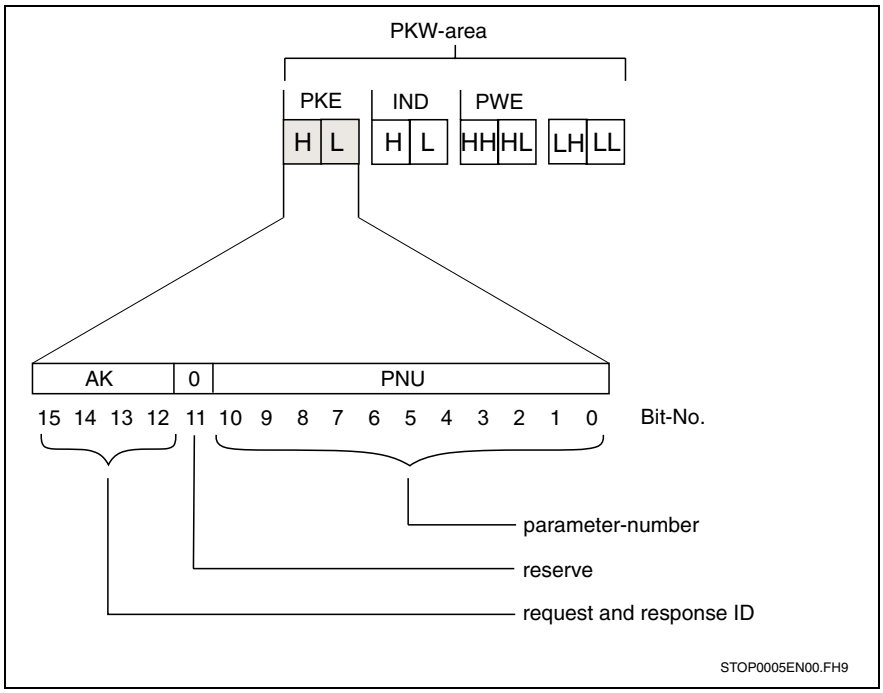


Fig.:8-21 Parameter ID, PKE word

Request and response ID (AK)

In request IDs, the requests that are sent by the master to the slave are coded. The slave processes the request and formulates the corresponding answer; this is then also coded and sent back to the master as an answer ID.

The request and response IDs are defined in such a manner that an request / response is uniquely identified by the parameter ID (PID = AID + PNU). Certain orders/answers are also defined by the index word IND (see “Index word”).

Parameter Number (PNU)

The parameter number is contained in bits 0 to 10. You can find the parameters, arranged according to increasing PNUs, in the parameter list of the corresponding firmware of the device.

The functions of most of the parameters can be seen in the function plans.

Request ID Function

AID Bit No. 15 14 13 12	Function master to slave	Description
0 0 0 0	No request	No request
0 0 0 1	Request PWE	Requests a parameter value (PWE). (16 or 32 bits)
0 0 1 0	Modify PWE (word)	Writes a parameter value (PWE) in word size (16 bits)
0 0 1 1	Modify PWE (double-word)	Writes a parameter value (PWE) in double-word size (32 bits)
0 1 1 0	Request PWE (array)	Reads a parameter value from an array. The position within the array from which the value is to be read can be seen in IND Example: If IND = 4, the PWE that is located in the 5th element of the array is transferred. (16 or 32 bits)
0 1 1 1	Modify PWE (array word)	Writes a parameter value (PWE) in word size to a certain position in an array. (as for reading) (16 bits)
1 0 0 0	Modify PWE (array double-word)	Writes a parameter value (PWE) in double-word size to a certain position in an array. (as for ID 0111) (32 bits)
1 0 0 1	Request number of array elements	Reads the number of elements of an array

The standard password level is 3
16 bit parameter values are in word 4 of the net data
32 bit parameter values are in words 3 and 4 of the net data

Fig.:8-22: request ID function, Profibus DP

Response ID Function

AID Bit No. 15 14 13 12	Function master to slave	Description
0 0 0 0	No response	No response
0 0 0 1	Transfer PWE (word)	Transfers a parameter value (PWE) as a word (16 bits)
0 0 1 0	Transfer PWE (double-word)	Transfers a parameter value (PWE) as a double-word (32 bits)
0 1 0 0	Transfer PWE (array word)	Transfers a parameter value from the element given in IND + 1 within an array (16 bits)
0 1 0 1	Transfer PWE (array double-word)	As ID 0100, only the PWE is in double-word size (32 bits).
0 1 1 0	Transfer number of array elements	Transfers the number of elements of a field.
0 1 1 1	Order cannot be executed (with error number)	The order cannot be executed by the slave. Reason: see the error number.
1 0 0 0	No PKW operating sovereignty	Parameter values may only be read, not modified, on the interface on which this protocol is running.

Fig.:8-23 Response ID function, Profibus DP

Relationship between Request and Response

AID Bit No. 15 14 13 12	Request ID function master to slave	AID Bit No. 15 14 13 12	Response ID function slave to master
0 0 0 0	No Request	0 0 0 0	No Request
0 0 0 1	Request PWE	0 0 0 1	Transfer PWE (word)
		0 0 1 0	Transfer PWE (double-word)
0 0 1 0	Modify PWE (word)	0 0 0 1	Transfer PWE (word)
0 0 1 1	Modify PWE (double-word)	0 0 1 0	Transfer PWE (double-word)
0 1 1 0	Request PWE (array)	0 1 0 0	Transfer PWE (array word)
		0 1 0 1	Transfer PWE (array double-word)
0 1 1 1	Modify PWE (array word)	0 1 0 0	Transfer PWE (array word)
1 0 0 0	Modify PWE (array double-word)	0 1 0 1	Transfer PWE (array double-word)
		0 1 1 1	Order cannot be executed
		1 0 0 0	No operating sovereignty

Fig.:8-24: Relationship between Request and Response, Profibus DP

Error ID	Description
0	Invalid parameter No.
1	Parameter cannot be modified
2	Min. / max. limitation
3	Incorrect index value
4	No array
5	Incorrect data type
101	Unknown order
102	Data conflict between parameter X and parameter Y Parameter P1019 can be used to read out the two conflict parameters: P1019.0 = parameter X P1019.1 = parameter Y
103	Writing possible only with WR block
104	Password level too low
105	Writing possible only in configuration mode
106	Internal interface buffer is full, order must be repeated

Fig.:8-25: Error IDs, Profibus DP

Index Word (IND)

The index word is defined only for Request / Response where values are to be written to / read from an array (one-dimensional field).

In all other cases, the index word is included in the telegram as a "zero word", i.e. all bits are set to logical 0.

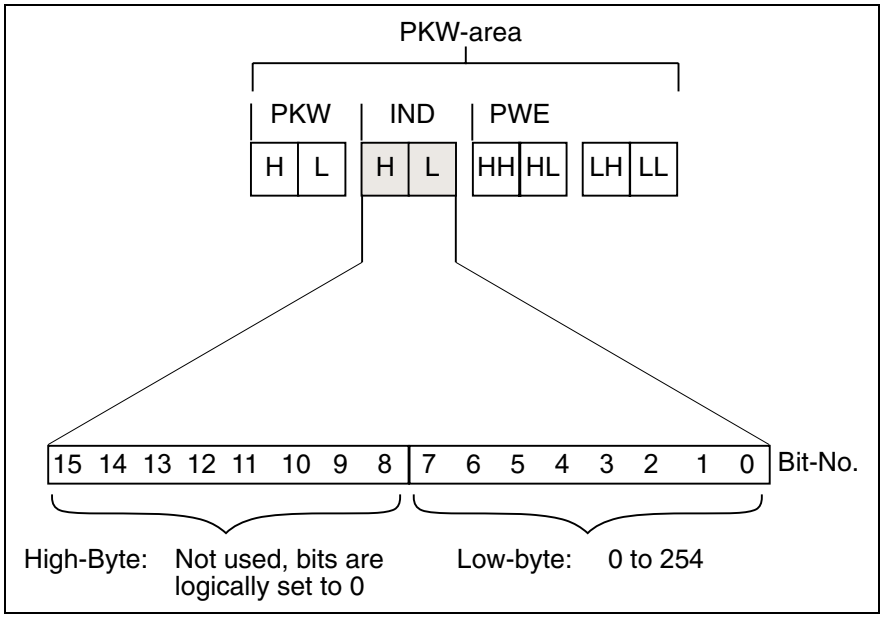


Fig.:8-26 Index word in PKW area, Profibus DP

Request with Index Word (IND)

PID		IND	
AID Bit No. 15 14 13 12	**Function master to slave**	**Low byte**	**Function**
0 1 1 0	Request PWE (array)	y (< = 254)	Read the parameter value of the “y +1”th element of the array
0 1 1 1	Modify PWE (array word)	y (< = 254)	Write the PWE in word size to the “y + 1”th element in the array
1 0 0 0	Modify PWE (array double-word)	y (< = 254)	Write the PWE in double-word size to the “y + 1”th element in the array

Fig.:8-27 Request with index word (IND), Profibus DP

Response with Index Word (IND)

PID		IND	
AID Bit No. 15 14 13 12	**Function master to slave**	**Low byte**	**Function**
0 1 0 0	Transfer PWE (array word)	y (< = 254)	Transfer the PWE that is in the “y +1”th element of the array
0 1 0 1	Transfer PWE (array double-word)	y (< = 254)	Write the PWE in double-word size to the “y + 1”th element in the array
1 0 0 0	Modify PWE (array double-word)	y (< = 254)	Write the PWE in double-word size to the “y + 1”th element in the array

Fig.:8-28 Response with index word (IND), Profibus DP

Functions FREEZE / UNFREEZE

Freeze Function

The freeze function is supported. When the freeze command arrives, the current status data of the converter are frozen, i.e. the PROFIBUS DP master cannot request current data from the converter during the freeze command. This function is used to synchronize the input data of various slaves.

Unfreeze Function

The unfreeze function is supported. When the 'UNFREEZE' command arrives, freezing of the converter data is lifted and the current status data can be requested again.

Functions SYNC / UNSYNC

Sync Function

The SYNC function is supported. When the SYNC command arrives, the data that were received last are accepted. The data that are subsequently sent are not executed until the next SYNC command is received.

In this way, different data can be accepted by several slaves at the same time. This function is used to synchronize the output data of various slaves.

Unsync Function

The UNSYNC function is supported. The “UNSYNC” command deactivates the “SYNC” command.

Function “PB Clear-Data”

If the Profibus master sends the “CLEAR DATA” command, the nominal values in the process data channel are set to zero. This also resets bit 10 in the control word (Guiding AG) and the last control status is frozen.

Parameter P0524 “PB CLEAR Data” can be used to define the reaction of the converter to this command.

Case 1: Setting parameters with the value “No malfunction”

The converter runs with the valid data that were last sent until a new valid protocol with the value ONE in bit 10 of the control word arrives.

Case 2: Setting parameters with the value “Malfunction”

When the “CLEAR DATA” command arrives, a timer starts in the converter; this switches the converter off with a malfunction message (“Malfunction SSx function”) after the timeout period elapses.

The timeout period corresponds to the Watchdog period, whose parameters were set by the master when the connection was made. If no timeout was given while setting the parameters of the converter, a default value of 10 seconds is used for this function.

A shutdown due to a malfunction also occurs if the data buffers are deleted due to incorrectly set parameters when the connection was made (transitions ABORT 4 - 10 in the PROFIBUS DP status diagram.

If a valid protocol (with bit 10 in the control word equal to ONE) arrives before the timeout period elapses, the timer is switched off and the converter continues to run normally.

Processing Profibus Process Data

The process data received using the Profibus are transformed into display parameters in the converter; these can be freely switched into the variable parameter sources to control the device.

The converter sends its actual values as process data via the Profibus; the variable parameter sources that serve as the output for SS2 / SS4 are switched in the D parameter.

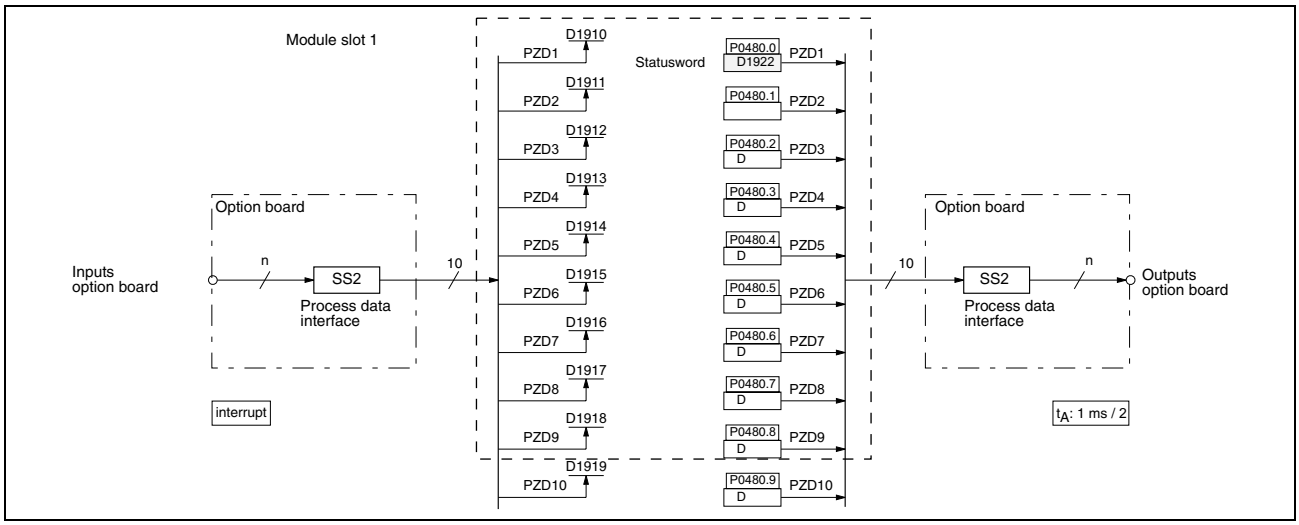


Fig.:8-29 Process data interface SS2

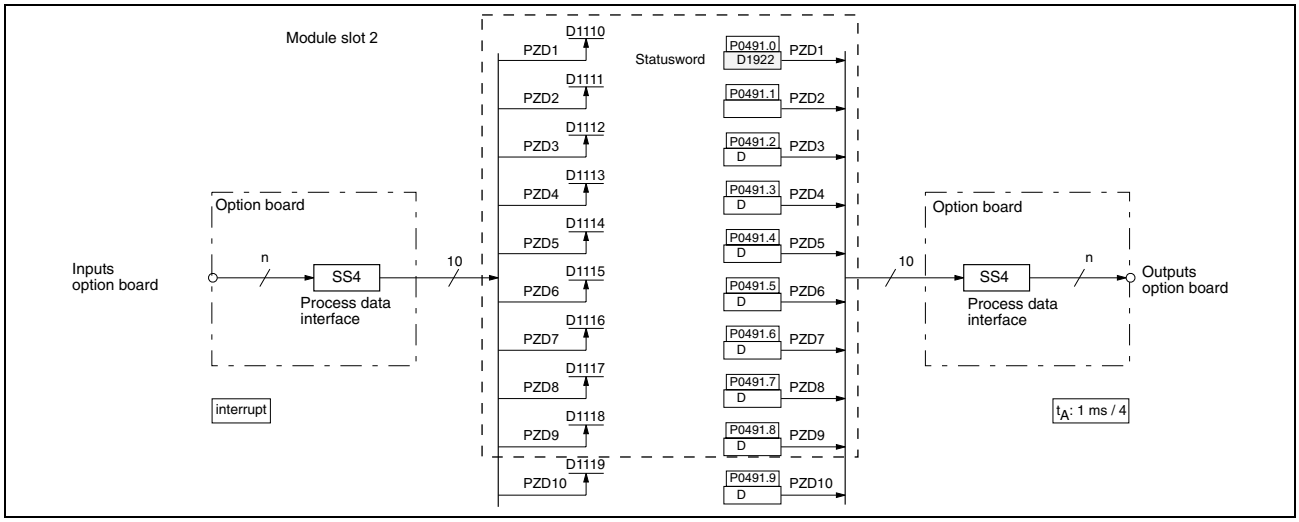


Fig.:8-30 Process data interface SS4

9 RZP01.1-S1 SERCOS-Interface

9.1 General Information on the SERCOS Interface

With the RZP01.1-S1 optional assembly, you get a SERCOS interface slave with the following devices: REFUdrive 500 RD51, RD52 and RS51. This is based on the Sercos Version 1.02 update 98.1 according to IEC61491.

Technical Specifications

Order No.	RZP01.1-S1
Power supply	internal
Size (length and width)	113 x 87 mm
Environmental class of storage	1K3 according to EN 60721-3-1 –5 °C to +45 °C
Environmental class of transport	2K3 according to EN 60721-3-2 -25 °C to +70 °C
Environmental class in operation	3K3 according to EN 60721-3-3 +5 °C to +40 °C
Radio interference level	A1 according to EN 55011
Immunity to radio interference ESD	Test level 2 according to EN 61000-4-2 with the synthetic cover mounted
Immunity to radio interference Burst	Test level 4 according to EN 61000-4-4

Fig. 9-1: Technical Specifications of RZP01.1-S1

View of the SC22243 PCB

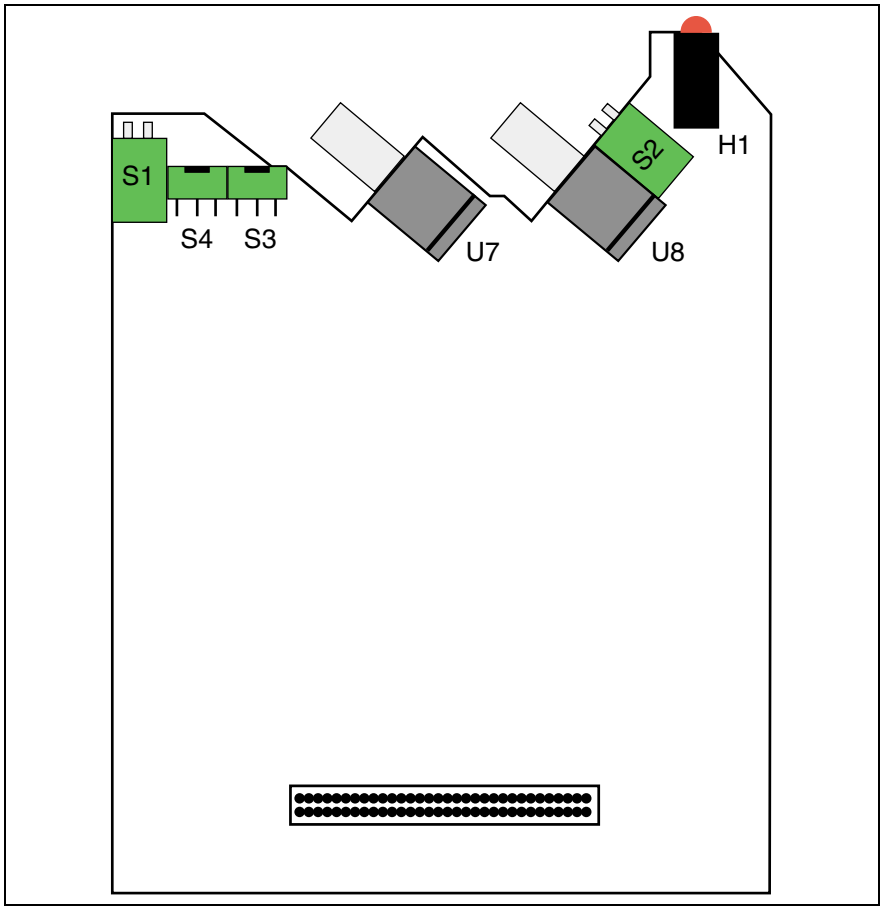


Fig. 9-2: SC22243

9.2 Requirements for Operating SERCOS - Interface

PCB	Hardware	Firmware
SC22243	SC22243 03SP03, layout 00 or higher	FWC-SC2224-300-01VRS or higher
SR17000 for RD51	SR17000 07SP07 or higher	FWC-SR1700-000-04VRS or higher
SR17000.2 for RS51	SR17000.2 03SP03 or higher	FWC-SR1700-000-04VRS or higher
SR17002 for RD52	SR17002 08SP08 or higher	FWC-SR1700-200-05VRS or higher

9.3 Electrical Installation

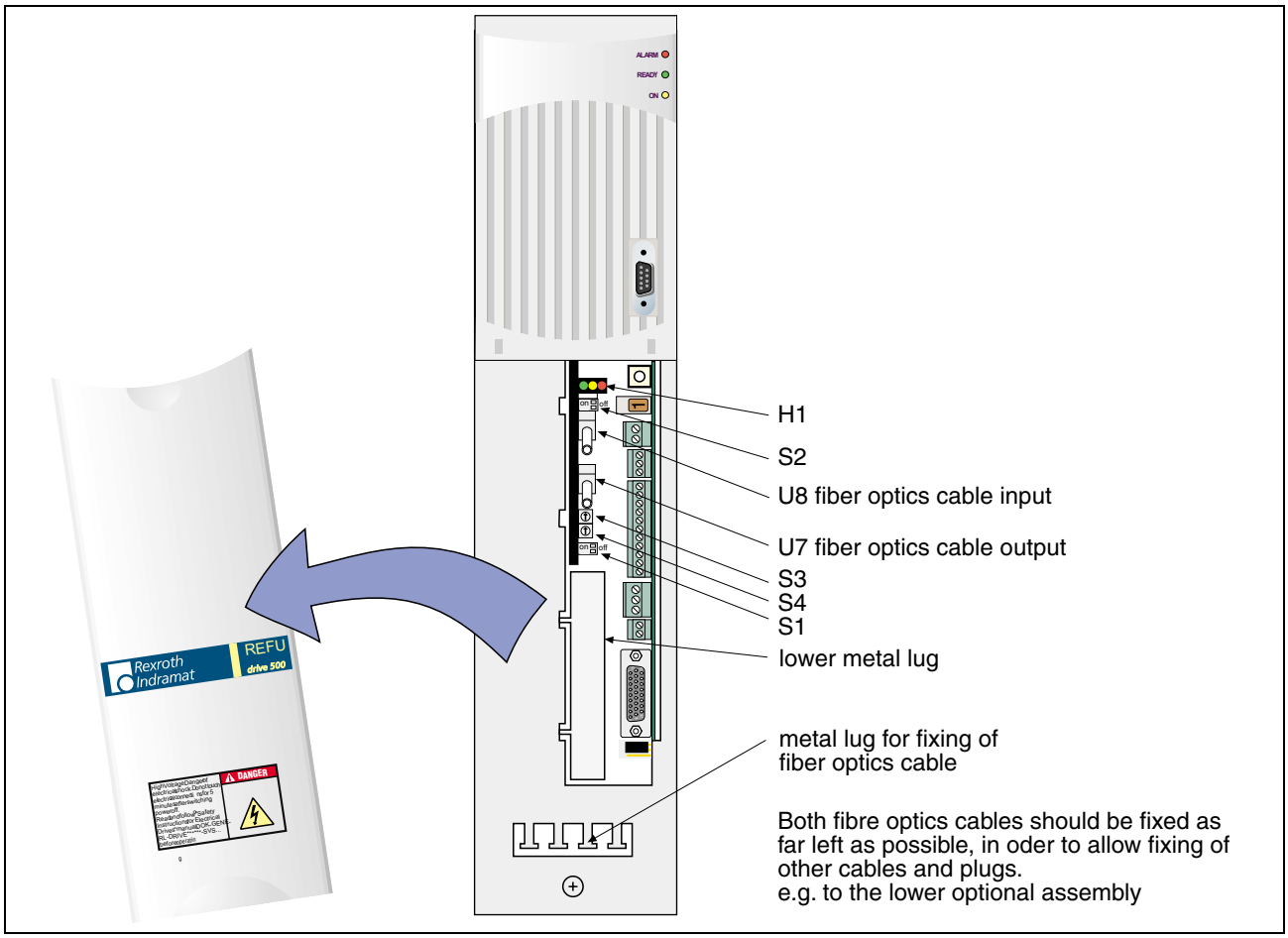


Fig. 9-3: Plug Position Plan of RZP01.1-S1 Option

Note: When laying the fiber optics cable, make sure to observe the minimum bending radius stipulated by the manufacturer (typically 50 mm). The fiber optics cable must be mechanically fixed to the metal lugs.

Note: After assembling the fiber optics cable onto the cable transmitter and the cable receiver by tightening the union nut (e.g. using the fiber optics cable FSMS socket wrench, order no. 260 285) and, when required, the rubber cover plugs (refer also to the „Handling the Fiber Optics Cable“ manual)), the synthetic cover on the front panel of the REFUdrive 500 must be reattached.

Control elements

Control element	Description	Display or Setting Possibility		Cause and/or Effect
H1 triple LED red/yellow/green	status display	bright red permanent light		No light signal at the receiver, incorrect baud rate, extreme distortion
		dim red permanent light		bad reception signal: reception level is too weak or heavy distortion due to high reception level
		yellow permanent light (approx. 5 sec)		Initialization of the SERCOS option board
		yellow permanent light (approx. 45 sec)		Update of the parameter information on the option board (only once, when the options board or basic board firmware has been changed)
		yellow flashing light		Operation
		green LED is off		Communication phase 0 or 1
		green LED is permanently on		Communication phase 2 (configuration phase) or 3
		green LED flashes		Communication phase 4 (operating phase)
S2 double DIL switch	transmission brightness	Switch S2.2 (bottom)	Switch S2.1 (top)	transmission brightness
		On	On	Very high, > 45m or fiber glass
		On	Off	High, 30 – 45 m
		Off	On	Medium, 15 – 30 m
		Off	Off	Low, 0 – 15 m
U8 fiber optics cable receiver	Rx			
U7 fiber optics cable transmitter	Tx			
S3 rotary coded switch	address high 0 ... 9	Decimal more significant settings can be made		Address settings 1 to 99 can be made
S4 rotary coded switch	address low 0 ... 9	Decimal less significant settings can be made		
S1 double DIL switch	baud rate	Schalter S1.2 (unten)	Schalter S1.1 (oben)	baud rate
		On	On	No function
		On	Off	No function
		Off	On	4 MBaud
		Off	Off	2 MBaud

Note: The same baud rate must be set for all slaves within the fiber optics cable bus.

9.4 General Information on the SERCOS Protocol

Real Time Control and Status Bits

In the SERCOS control and status word, 2 control and 2 status bits are transmitted cyclically. Within the SERCOS implementation in the REFUdrive 500, these real-time bits are passed on to the REFUdrive control board (SR) and are available there as binary Refu – P – parameters and can be switched through from there. To understand the wiring or the concrete parameterization there, please consult, e.g. the REFUdrive 500 manual: Function plans and parameter lists, function descriptions for firmware.

Real-time status bit	Bit in SERCOS status word of the drive	Is transmitted to the options board in the bit of the RD500-status word P1922	Is configured in:	Function plan
1	6	13	P0076.13	Status word 1
2	7	14	P0076.14	Status word 1

Real-time status bits

Real-time status bit	Bit in SERCOS control word of the drive	Is transmitted to the basic board in the bit of the RD500-control word P1922	Appears in:	Function plan
1	6	8	D1768	Control word 1
2	7	9	D1769	Control word 1

Real-time control bits

Note: The SERCOS control word can be read out in S-0-0135. The SERCOS status word can be read out in S-0-0134.

Telegram Type

The standard, default telegram type (S-0-0015 Telegram type parameter) is 2 „speed control“. Thereby, only the nominal speed value S-0-0036 is transmitted in MDT and the actual speed value S-0-0040 is transmitted in AT. (See also the parameters for data scaling S-0-0044, S-0-0045 and S-0-0046).

An additional supported standard telegram is 5 „position and speed data“. Here, positional information (S-0-0051, S-0-0053 and S-0-0047) are also transmitted in addition to the nominal and actual speed values. However, this information is not evaluated by the drive.

The following parameters are available for application telegram type 7 (contained in the IDN lists S-0-0187 (for the AT) and S-0-0188 (for the MDT)):

AT: Content of S-0-0187

If parameters from here are used in the AT, then they must be entered into the parameter S-0-0016 configuration list of the AT.

Parameter	Name	Description
S-0-0040	Velocity feedback value, 4 bytes	With data scaling S-0-0044 to S-0-0046
S-0-0051	Position feedback value 1	Dummy parameter
S-0-0053	Position feedback value 2	Dummy parameter
S-0-0084	Torque feedback value	Dummy parameter
S-0-0144	Signal status word	Currently, only bits 0, 1, 5 and 6 are supported
P-0-2060	Feedback configurable 1, 2 byte	With Refu standard data scaling ± 15 bits
P-0-2061	Feedback configurable 2, 2 byte	With Refu standard data scaling ± 15 bits
P-0-2062	Feedback configurable 3, 2 byte	With Refu standard data scaling ± 15 bits
P-0-2063	Feedback configurable 4, 2 byte	With Refu standard data scaling ± 15 bits
P-0-2064	Feedback configurable 5, 2 byte	With Refu standard data scaling ± 15 bits
P-0-2065	Feedback configurable 6, 4 byte	With Refu standard data scaling ± 31 bits

TB. 9-4: Content of S-0-0187

MDT: Content of S-0-0188

If parameters from here are used in the MDT, then they must be entered into the parameter S-0-0024 configuration list of the MDT.

Parameter	Name	Description
S-0-0036	Velocity command value, 4 bytes	With data scaling S-0-0044 to S-0-0046
S-0-0047	Position command value	Dummy parameter
S-0-0080	Torque command value, bipolar	Dummy parameter
S-0-0092	Bipolar torque limit value	Dummy parameter
P-0-2050	Setpoint configurable 1, 2 byte	With Refu standard data scaling ± 15 bits
P-0-2051	Setpoint configurable 2, 2 byte	With Refu standard data scaling ± 15 bits
P-0-2052	Setpoint configurable 3, 2 byte	With Refu standard data scaling ± 15 bits
P-0-2053	Setpoint configurable 4, 2 byte	With Refu standard data scaling ± 15 bits
P-0-2054	Setpoint configurable 5, 2 byte	With Refu standard data scaling ± 15 bits
P-0-2055	Setpoint configurable 6, 4 byte	With Refu standard data scaling ± 31 bits

TB. 9-5: Content of S-0-0188

In this way, all Refu-Parameters can be made available for cyclic transfer in MDT- and AT-telegram. Every parameter of REFUdrive be configured here.

The following connections exist:

IDN	Appears in the REFUdrive as	Comment
P-0-2050 Setpoint configurable 1	D1912	
P-0-2051 Setpoint configurable 2	D1913	
P-0-2052 Setpoint configurable 3	D1914	
P-0-2053 Setpoint configurable 4	D1915	
P-0-2054 Setpoint configurable 5	D1916	
P-0-2055 Setpoint configurable 6	D1917 and D1918	32 bits

IDN	Is created in the REFUdrive in	Comment
P-0-2060 Feedback configurable 1	P0480.2	
P-0-2061 Feedback configurable 2	P0480.3	
P-0-2062 Feedback configurable 3	P0480.4	
P-0-2063 Feedback configurable 4	P0480.5	
P-0-2064 Feedback configurable 5	P0480.6	
P-0-2065 Feedback configurable 6	P0480.7 and P0480.8	32 bits

Note: Only one SERCOS options board may be inserted into the device.

Function plan

Function plan of process data interface SI2 when operated with the SERCOS interface.

Processing of the inputs of the options board

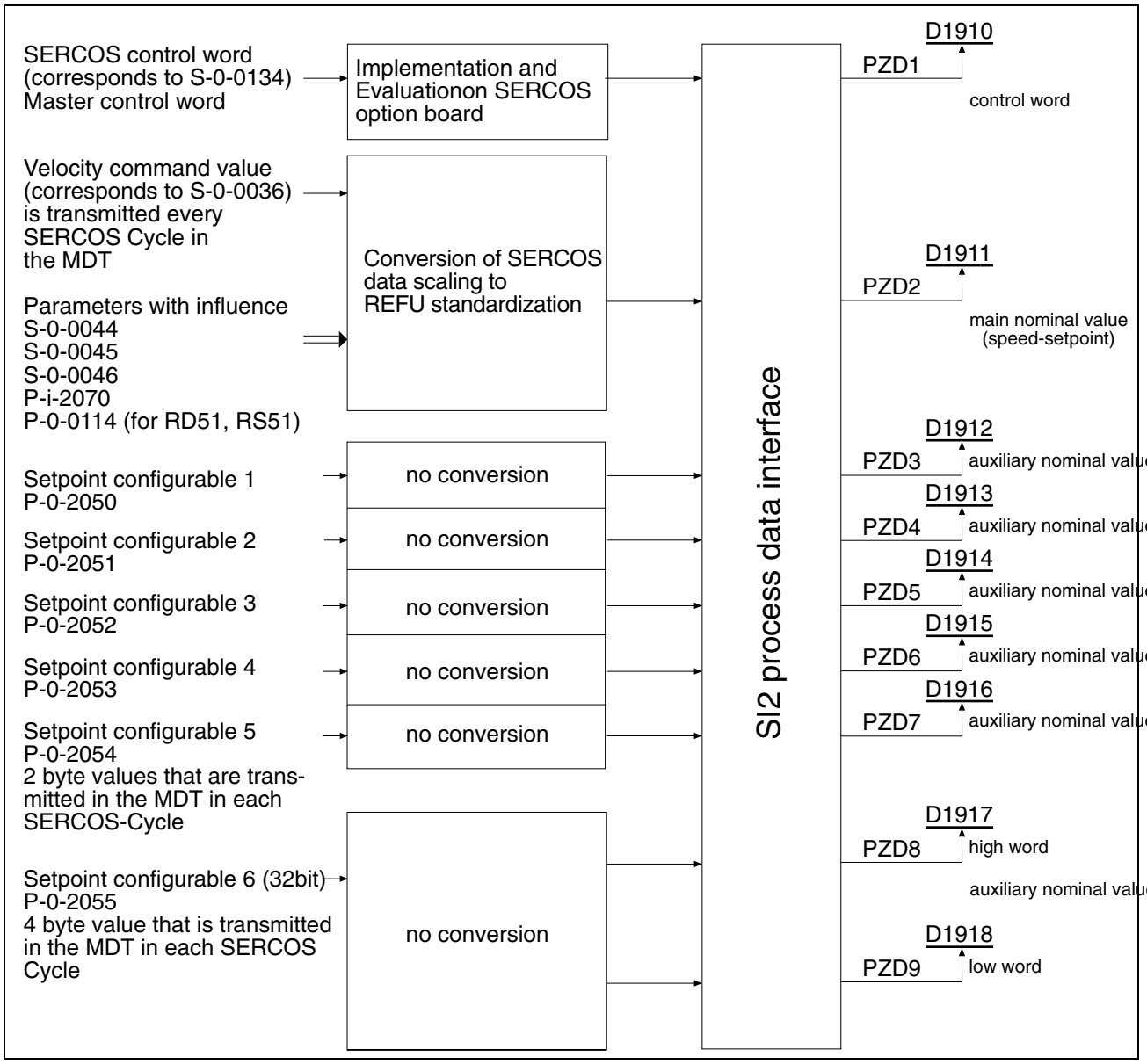


Fig. 9-6: Input SI2 of Process Data Interface with SERCOS

Signal Flow to the Outputs of the Options Board

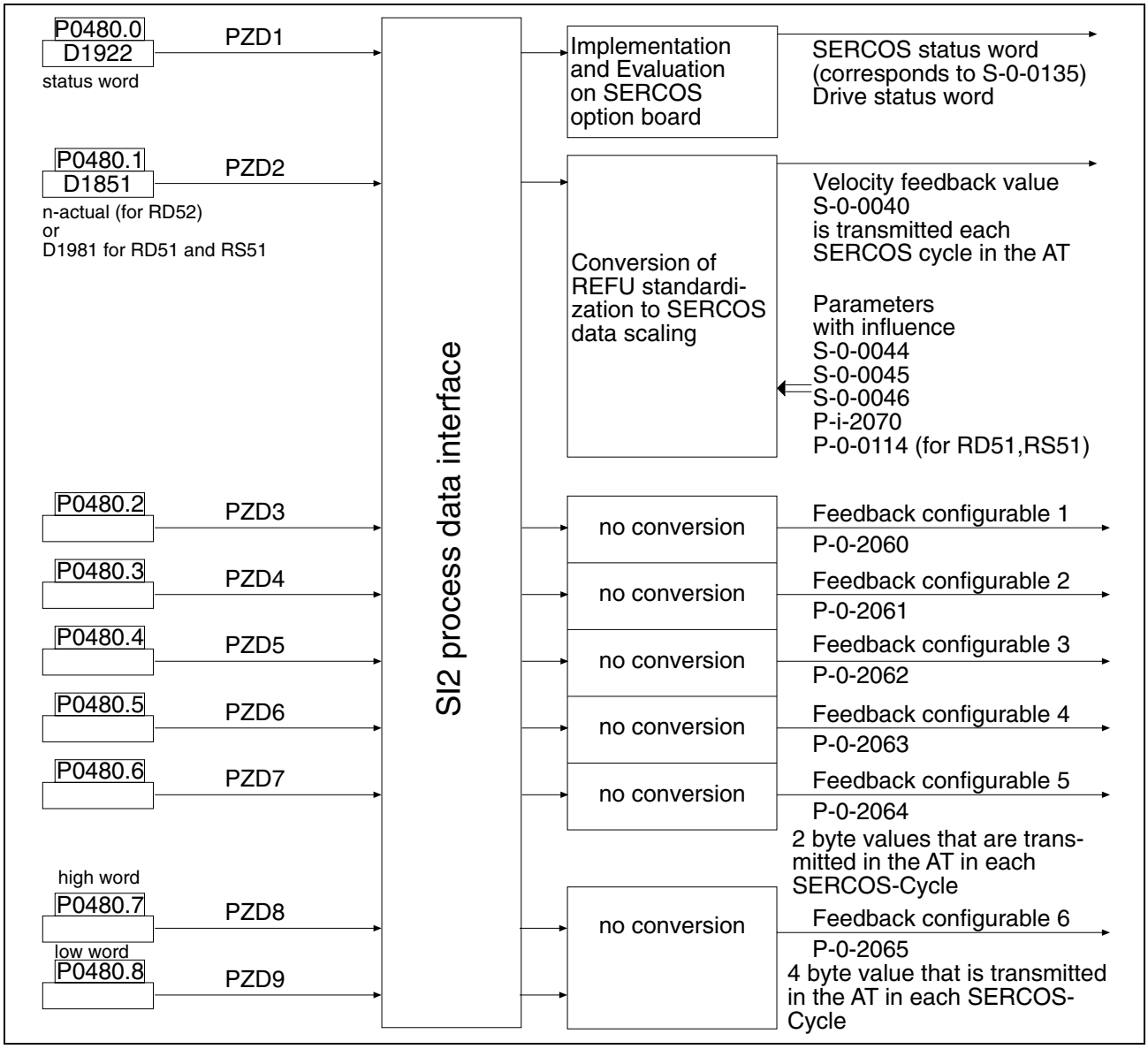


Fig. 9-7: Output SI2 of Process Data Interface with SERCOS

Examples for Transmitting Parameters via the SI2 Interface

- Cyclic transmission of a torque limit value via SERCOS in the MDT

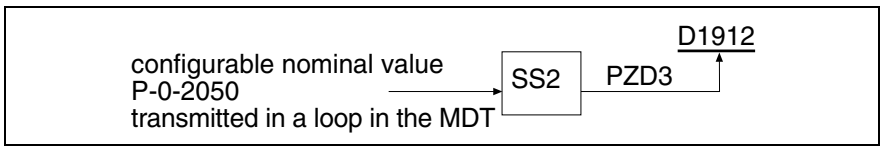


Fig. 9-8: Example of the Transmission of a Torque Limit Value

The values D1868 and D1869 as well as D1912 are percentage-standardized .

This means that for a torque limitation to ±100 %, a value of 16384 must be entered in P-0-2050 (=D1912). (Refer also to chapter 9.13 Documentation on Data Types N2 and N4).

- Transmitting the torque-forming motor current i_{sq} via SERCOS to the master.

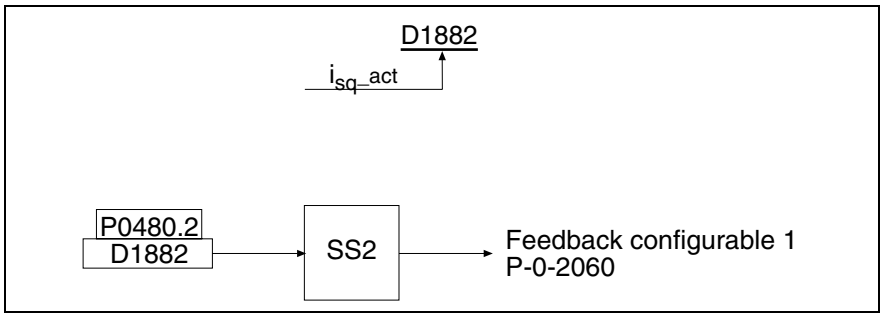


Fig. 9-9: Example for Transmitting the Torque-forming motor current

If, for instance, the torque-forming current is 100%, then the value 16384 is transmitted via P-0-2060. (Refer also to chapter 9.13 Documentation on Data Types N2 and N4).

A conversion to current in amperes would then be possible via the normalize current parameter P0374 (P-0-0374).

9.5 Parameterization

General Preliminary Remarks for Basic Devices RD51 and RS51

A difference is made between basic and free parameterization for devices RD51 and RS51. The basic parameterization allows for a simple and easily understandable setup of the drive (input of engine data, plug assignments, function on/off, etc.). For operation with SERCOS, operation with the basic parameterization is not possible. For this reason, you must switch over to free parameterization.

Setting the free parameterization

When putting into operation, parameter P0071 “Load Factory Settings” is set to the value 2. This then sets all parameters to their standard values. Parameter P0064, “Parameterization Level” indicates that the free parameterization level is active (value of P0064 = 1)

Loading the Factory Settings with SERCOS Functions

For all basic devices RD51, RS51 and RD52, the parameters required for running with SERCOS can either be set individually as described in the next section or “semi-automatic” factory settings can be made.

Setting the “Standard Values with SERCOS”:

When putting into operation, parameter P0071 “Load Factory Settings” is set to the value 4. All parameters are thereby set to standard values and the parameters required for operating with SERCOS are also set.

For RD51 and RS51: Value = 4 = “free standard value and SERCOS”

For RD52: Value = 4 = “standard value and SERCOS”

For device RD52, setting the “standard value with SERCOS” also has an effect on the parameters required for the function “spindle positioning” (Refer to chapter 9.17 Spindle positioning).

Setting the Parameters for Operation with SERCOS

The following parameters must be specially set to allow for correct operation.

They can either be written in phase 2 by the SERCOS master, via the control panel or via a serial interface.

Parameter	Name	Value	Description
P0064	Parameterization level	1	Only for RD51, RS51 free parameterization level
P0043	Inhibit operation	1	Inverter off, coast down
P0050.0	Source of control word KL	e.g. 1719	Digital input, to switch on power. Recommended for RD51 and RS51 Digital input 6, this is the value 1719
		e.g. 1717	Digital input, to switch on power. Recommended for RD52: Digital input 4, this is the value 1717
P0050.1 to P0050.6	Source of control word KL	1701	Constant logical 1
P0050.7	Source of control word KL	1700	Constant logical 0
P0072	Source of Parameterization	4 NEVER CHANGE!	All busses, so that the basic board (SR17000 or SR17002) can be configured by the SERCOS interface. P0072 is automatically set after a power-on during the initialization process of the basic board and must not be changed after this.

Parameter	Name	Value	Description
P0073 or P0073.0	Source on/off	1	From an Serial Interface and terminals
P0076.8	Source of statusword 1bit	1567 for RD52	reports the signal “in position” (necessary for the spindle positioning function)
		RD51, RS51: no change	
P0076.11	Source of statusword 1bit	1756 for RD52	Field current reached (if P0189 is at U/f operation, then: value = 1701)
		RD51, RS51: no change	Does not have to be adjusted for RD51 and RS51
P0076.12	Source of statusword 1bit	1709 for RD52	Speed < n_min
		1701 for RD51, RS51	For RD51 and RS51, this should be at 1701
P0093	Fault quit delay	0	
P0298	Source of Speed-Control parameter set 2	D1672 for RD52	So that the selection of Kp2, Tn2 is available for parameter set 1. Only required when different parameter sets are required. See S-0-0216.
			Does not have to be adjusted for RD51 and RS51.
P0390	Speed normalization	For RD52 NEVER CHANGE!	Is set by the SERCOS interface board depending on S-0-0044, S-0-0045, S-0-0046, P-i-2070 and P-0-0114 (for RD51 and RS51). Is changed as soon as communication phase 2 is reached for the first time after switching on the drive.
	Frequency normalization	For RD51, RS51 NEVER CHANGE!	
P0391	Hysteresis N<Nmin	Only for RD52	Set suitably, e.g.: Standard = 10.00%
P0392	Threshold N<Nmin	Only for RD52	Set suitably, e.g.: Standard = 1.00%

Parameter	Name	Value	Description
P0074	Source of control word 1	1910	PZD1 of SI2
P0263 or P0263.0	Source of main set point	1911	PZD2 of SI2
P0480.0	PZD1 of SI2	1922	Status word
P0480.1	PZD2 of SI2	1851 for RD 52	n_{act}
		1981 for RD 51	f_{act} before standardization
		1981 for RS 51	f_{act} before standardization
P0526	SI2 Rx watchdog	2	Fault
P0527	SI2 Rx timeout	0.1 sec	

The most important SERCOS Parameters

Note: If you do not want to make the following settings using SERCOS then the drive parameters indicated in the P-Parameter column must be set accordingly (e.g. using the control panel or RefuWin).

S Parameter	Description	P Parameter
S-0-0015	Telegram type parameter (value 2, 5 or 7)	P1324
S-0-0016	Configuration list of AT (only required when S-0-0015 = 7)	P1325, the first index no longer contained in the telegram must be set to 0!
S-0-0024	Configuration list of MDT (only required when S-0-0015 = 7)	P1326, the first index no longer contained in the telegram must be set to 0!
S-0-0044	Velocity data scaling type: normal value is: 2, this is the default data scaling (1 LSB corresponds to 10^{-4} 1/min)	P1332
S-0-0045	Velocity data scaling factor: normal value is: 1.	P1333
S-0-0046	Velocity data scaling exponent: normal value is: -4.	P1334
S-0-0091	Bipolar velocity limit value, parameter set 0 must be set to a meaningful value that is not equal to zero.	P1339.0
S-1-0091	Bipolar velocity limit value, parameter set 1 must be set to a meaningful value that is not equal to zero. S-1-0091 must then also be set if only parameter set 0 is used!	P1339.1
S-0-0154	Set spindle positioning parameter to the value 0000 0010b (RD52 only)	P1346
P-0-2070	RD500 standardization speed parameter set 0 must be set to a suitable value. Set the maximum speed used in the system for parameter set 0. For more information, refer to the parameter description of P-0-2070.	P1360.0
P-1-2070	RD500 standardization speed parameter set 1 must be set to a suitable value. Set the maximum speed used in the system for parameter set 1. For more information, refer to the parameter description of P-1-2070. This parameter must also be set if only parameter set 0 is used!	P1360.1

To conclude this configuration, the command S-0-0264, “Backup working memory” must be set.

Using parameters S-0-0095 and (after the commands S-0-0127 and S-0-0128) S-0-0021 and S-0-0022 you can recognize which parameters include an incorrect value or which parameters pose a data conflict.

Changed Speed Normalization

Parameters P0390.0 and P0390.1 (SERCOS: P-0-0390) are suitably set by the options board when operating with SERCOS from phase 2 onwards and must not be subsequently changed. It is important to note that the speed normalization has now been changed and may have an effect on other characteristics that have already been set in the drive.

Particular attention should be given to the following parameters and changes should be made as required:

- speed controller Kp and Tn (only for RD52: P0335 to P0338).
- negative and positive speed limitation value (P0303 and P0304)
- f-min and f-max (only for RD51 and RS51: P0179 and P0180)
- Check switch-off threshold Nmax (only for RD52: P0395)
- and other parameters

9.6 List of the supported Commands

IDN	Command	Comment
S-0-0099	Reset Class 1 diagnostic	
S-0-0127	CP_3 transition check	
S-0-0128	CP_4 transition check	
S-0-0152	Position spindle procedure command	Is only supported in RD52
S-0-0216	Switch parameter set procedure command	
S-0-0264	Backup working memory procedure command	Stores the temporarily transmitted values in the EEprom of the basic board. S and P parameters are stored.

9.7 Description of the Parameters

Parameter: S-0-0001 NC cycle time

Length: 2 bytes
Minimal value: 1000
Maximal value: 65000
Unit: µsec

This value is not processed by the option board

Parameter: S-0-0002 Communication cycle time

Length: 2 bytes
Minimal value: 1000
Maximal value: 65000
Unit: µsec

The communication cycle time states the time interval in which data is transmitted in a cycle. This value must be transmitted to the slave in phase 2 and is valid from phase 3. The minimum time is 1000 µsec or a multiple of this.

Parameter: S-0-0003 Shortest AT transmission starting time

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: µsec

The maximal time that the slave requires between the end of the master synchronization telegram MST and the first drive telegram AT transmitted after this. This time is determined by the ASIC and is 12 µsec.

Parameter: S-0-0004 Transmit/receive transition time

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: µsec

The maximal time that the slave requires between transmitting its own drive telegram and receiving the master data telegram. This time is determined by the ASIC and is 0 µsec.

Parameter: S-0-0005 Minimum feedback processing time

Length: 2 bytes

Minimal value: 500

Maximal value: 500

Unit: µsec

Not supported by the drive.

Parameter: S-0-0006 AT transmission starting time

Length: 2 bytes

Minimal value: = t_{1min}

Maximal value: = t_{Scyc}

Unit: µsec

This time determines when the slave must transmit its drive telegram after completion of the MST. The value is calculated by the master and is transmitted to the slave in phase 2. T1 is then effective in phase 3 and 4.

Parameter: S-0-0007 Feedback acquisition capture point (t_4)

Length: 2 bytes

Minimal value: = 0

Maximal value: = t_{Scyc}

Unit: µsec

Is written by the master; the value is not further processed by the option board.

Parameter: S-0-0008 Command value valid time (t_3)

Length: 2 bytes

Minimal value: = 0

Maximal value: = t_{Scyc}

Unit: µsec

Is written by the master; the value is not further processed by the option board.

Parameter: S-0-0009 Position of data record in MDT

Length: 2 bytes

Minimal value: = 1 (one drive)

Maximal value: = 65531

Unit: -

Specified in bytes. Here, the slave is informed of the location within the master telegram that contains data relevant for the slave. The slave is informed in phase 2 and this then applies in phases 3 and 4.

Parameter: S-0-0010 Length of MDT

Length: 2 bytes

Minimal value: = 4 (one drive)

Maximal value: = 65534 (number of bytes of 254 drives)

Unit: Byte

Specified in bytes. This length contains the data records of all drives participating on the bus, including the control word and the service-information value. The slave is informed in phase 2 and this then applies in phases 3 and 4.

Example: If standard telegram 2 is used (transmission of nominal and actual speed values) then 4 bytes are used for the cyclical transmission (nominal and actual speed values are 32 bit values), 2 bytes are used for the control word and 2 bytes for the service channel. If only one SERCOS slave RD500 is connected to the bus then S-0-0010 is transmitted with the value 8.

Parameter: S-0-0011 Class 1 diagnostic

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

Only bit 15 “Manufacturer-specific errors” is supported. If an error occurs on the basic device, then bit 15 is set.

Parameter: S-0-0012 Class 2 diagnostic

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

This parameter is not supported.

Parameter: S-0-0013 Class 3 diagnostic

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

Reports status conditions.

The following bits are used:

Bit 0: $(n_{nom} - n_{window}) <= n_{act} <= (n_{nom} + n_{window})$

Bit 1: $|n_{act}| <= n_{standstill}$

Bit 5: $|n_{nom}| >= n_{limit}$

Bit 6: Spindle is in position (only for RD52)

Bits that are not mentioned are currently not supported (=0).

The following applies:

n_{nom} = S-0-0036 nominal speed value (Velocity command value)

n_{act} = S-0-0040 actual speed value (Velocity feedback value)

n_{window} = S-0-0157 velocity window

$n_{standstill}$ = S-0-0124 standstill window

n_{limit} = S-i-0091 bipolar velocity limit value

Parameter: S-0-0014 Interface status

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

This parameter is not supported.

Parameter: S-0-0015 Telegram type parameter

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

In SERCOS-implementation for RD500, standard telegrams 2 and 5 as well as application telegram 7 are supported.

This value of S-0-0015 is transmitted by the master to the slave in phase 2 and is valid from phase 3.

Standard telegram 2 means that the cyclic data of the master data telegram (MDT) only contains the velocity command value (32 bit) parameter S-0-0036. The cyclic data of the drive telegram (AT) only contains the velocity feedback value (32 bit) parameter S-0-0040. Standard telegram 5 is the same as telegram type 2, but contains additional position values that are not evaluated (dummy).

Telegram type 7 means that the data to be cyclically transmitted can be configured by the user. To do this, the identification numbers contained in IDN lists S-0-0187 and S-0-0188 can be configured into IDN lists S-0-0016 and S-0-0024 and written to the drive. The drive thereby configures these parameters in the cyclical telegrams.

Parameter: S-0-0016 Configuration list of AT

Length: Variable (2 bytes)

Minimal value: -

Maximal value: -

Unit: -

This list contains the IDNs whose operating data are transmitted cyclically in the configurable part of the AT. In case of application telegram (S-0-0015 = 7) this list is written by the master in CP2.

Example: In case of the standard telegram S-0-0015 = 2, this list only contains the parameter S-0-0040 (velocity feedback value).

Parameter: S-0-0017 IDN-list of all operation data

Length: Variable (2 bytes)

Minimal value: -

Maximal value: -

Unit: -

This list contains all S - and P - parameters supported by this implementation of SERCOS.

Note: This ID number list has the following length for the REFUdrive:

RD51: 986 entries

RS51: 1033 entries

RD52: 1278 entries

For future functional expansions the length of this list should be reserved big enough inside the control system.

Suggestion: list-length of 1600 entries

Parameter: S-0-0018 IDN-list of all operation data for CP2

Length: Variable (2 bytes)

Minimal value: -

Maximal value: -

Unit: -

The ID numbers of all operation data needed for CP2 are stored in this IDN-list and must be processed before switching over into communication phase 3 (CP3).

Parameter: S-0-0019 IDN-list of all operation data for CP3

Length: Variable (2 bytes)

Minimal value: -

Maximal value: -

Unit: -

The ID numbers of all operation data needed for CP3 are stored in this IDN list and must be processed before switching over into communication phase 4 (CP4).

Parameter: S-0-0021 IDN-list of invalid operation data for CP2

Length: Variable (2 bytes)

Minimal value: -

Maximal value: -

Unit: -

Here, the drive delivers those ID numbers that have been recognized as invalid during a switch-over command from CP2 to CP3 (S-0-0127).

Parameter: S-0-0022 IDN-list of invalid operation data for CP3

Length: Variable (2 bytes)

Minimal value: -

Maximal value: -

Unit: -

Here, the drive delivers those ID numbers that have been recognized as invalid during a switch-over command from CP3 to CP4 (S-0-0128).

Parameter: S-0-0024 Configuration list of MDT

Length: Variable (2 bytes)

Minimal value: -

Maximal value: -

Unit: -

This list contains the IDNs whose operating data are transmitted cyclically in the configurable part of the MDT. In case of application telegram (S-0-0015 = 7) this list is written by the master in CP2.

Example: In case of the standard telegram S-0-0015 = 2, this list only contains the parameter S-0-0036 (velocity command value).

Parameter: S-0-0025 IDN-list of all procedure commands

Length: Variable (2 bytes)

Minimal value: -

Maximal value: -

Unit: -

All ID numbers of commands that exist in the drive are stored in this IDN list.

Parameter: S-0-0028 MST error counter

Length: 2 bytes

Minimal value: = 0

Maximal value: = 65535

Unit: -

The MST error counter counts all invalid MSTs in communication phases 3 and 4. If more than two consecutive MSTs break down then any subsequent MST faults are no longer counted. The MST error counter counts to a maximum of 2^{16} –1. In case of a seriously interrupted transmission, the MST error counter therefore has the value 65535 after a long interruption time.

Parameter: S-0-0028 MDT error counter

Length: 2 bytes

Minimal value: = 0

Maximal value: = 65535

Unit: -

The MDT error counter counts all invalid MDTs in communication phase 4. If more than two consecutive MDTs break down then any subsequent MDT faults are no longer counted. The MDT error counter counts to a maximum of 2^{16} –1. In case of a seriously interrupted transmission, the MDT error counter therefore has the value 65535 after a long interruption time.

Parameter: S-0-0030 Manufacturer version

Length: Variable 1 byte (text)

Minimal value: -

Maximal value: -

Unit: -

Displays the firmware version of the REFUdrive and of the SERCOS option-assembly.

Example: FWC-SR1700-200-05V18-MS/SC2224-300-01V20.

Parameter: S-0-0032 Primary operation mode

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

The operating mode set in this parameter is activated in the drive when the main operating mode is selected in the control word of the MDT.

The parameter is not evaluated by the option board.

It is assumed that the operating mode is „velocity control“.

Parameter: S-0-0033 Secondary operation mode 1

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

The operating mode set in this parameter is activated in the drive when secondary operation mode 1 is selected in the control word of the MDT.

The parameter is not evaluated by the option board.

It is assumed that the operating mode is „velocity control“.

Parameter: S-0-0034 Secondary operation mode 2

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

The operating mode set in this parameter is activated in the drive when secondary operation mode 2 is selected in the control word of the MDT.

The parameter is not evaluated by the option board.

It is assumed that the operating mode is „velocity control“.

Parameter: S-0-0035 Secondary operation mode 3

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

The operating mode set in this parameter is activated in the drive when secondary operation mode 3 is selected in the control word of the MDT.

The parameter is not evaluated by the option board.

It is assumed that the operating mode is „velocity control“.

Parameter: S-0-0036 Velocity command value

Length: 4 bytes

Minimal value: -

Maximal value: -

Unit: rpm

In the velocity control of the drive, the command values are transmitted by the control system to the drive in the time pattern of the SERCOS cycle time.

Note: The limitation imposed by parameters S-0-0044, S-0-0045 and S-0-0046 as well as by „standardization“ by P-i-2070 should be observed.

Parameter: S-0-0040 Velocity feedback value

Length: 4 bytes

Minimal value: -

Maximal value: -

Unit: rpm

The actual speed value is transmitted by the drive to the control system to allow the speed to be displayed by the control system.

Note: The limitation imposed by parameters S-0-0044, S-0-0045 and S-0-0046 as well as by „standardization“ by P-i-2070 should be observed.

Parameter: S-0-0042 Homing acceleration (Dummy)

Length: 4 bytes
Minimal value:
Maximal value:
Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0043 Velocity polarity parameter

Length: 2 bytes
Minimal value: 0
Maximal value: 0
Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0044 Velocity data scaling type

Length: 2 bytes
Minimal value: 2
Maximal value: 10
Unit:

Only the values 2 or 10 are allowed. 2 is the default data scaling 1 LSB = 10^{-4} rpm; 10 is the parameter data scaling using S-0-0045 and S-0-0046.

The following always applies: Rotational data scaling, unit rpm, data related to the motor shaft.

Note: Bit 6 may be set but is not supported, i.e. no difference is made between the data relation at the load or at the motor shaft.

Parameter: S-0-0045 Velocity data scaling factor

Length: 2 bytes
Minimal value: 1
Maximal value: 9
Unit:

Values can be between 1 and 9.

Parameter: S-0-0046 Velocity data scaling exponent

Length: 2 bytes
Minimal value: -4
Maximal value: 0
Unit:

Values can be between -4 and 0.

Parameter: S-0-0047 Position command value (Dummy)

Length: 4 bytes

Minimal value: -2^{31}

Maximal value: $2^{31}-1$

Unit: m

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0051 Position feedback value 1 (Dummy)

Length: 4 bytes

Minimal value: -2^{31}

Maximal value: $2^{31}-1$

Unit: m

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0053 Position feedback value 2 (Dummy)

Length: 4 bytes

Minimal value: -2^{31}

Maximal value: $2^{31}-1$

Unit: m

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0055 Position polarity parameters (Dummy)

Length: 2 bytes

Minimal value: 0

Maximal value: 65535

Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0057 Position window (Dummy)

Length: 4 bytes

Minimal value: 0

Maximal value: $+2^{31}-1$

Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0080 Torque command value (Dummy)

Length: 2 bytes

Minimal value: -2^{15}

Maximal value: $2^{15}-1$

Unit: Nm

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0084 Torque feedback value (Dummy)

Length: 2 bytes

Minimal value: -2^{15}

Maximal value: $2^{15}-1$

Unit: Nm

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0086 Torque data scaling type (Dummy)

Length: 2 bytes

Minimal value:

Maximal value:

Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0088 Receive to receive recovery time (TMTSY)

Length: 2 bytes

Minimal value: 0

Maximal value: 0

Unit: µsec

Maximal time that the slave requires between a received MDT and the next MST. Fixed value: 0 µsec. Can be read by the master from phase 2.

Parameter: S-0-0089 MDT transmission starting time (T2)

Length: 2 bytes

Minimal value: = 0

Maximal value: = t_{Scyc}

Unit: µsec

The MDT transmission starting time determines when the master shall send its MDT during CP3 and CP4, following the MST. This parameter is transferred by the master to the slave during CP2 and becomes active during CP3.

Parameter: S-0-0090 Command value proceeding time (TMTSG)

Length: 2 bytes

Minimal value:

Maximal value:

Unit: µsec

The times required by the slave to make command values available for a drive after receipt of a MDT. This time is read by the master during CP2 in

order to calculate correctly the command value valid time T3 (IDN0008). The command value proceeding time depends on the telegram type.

Parameter: S-0-0091 Bipolar velocity limit value

Length: 4 bytes

Minimal value: = 0

Maximal value: = 2^{31} - 1

Unit: rpm

If the velocity command value exceeds this value then the value transmitted to the basic board is limited. The report „n_{nom} > n_{limit}“ in S-0-0013 and S-0-0144 is supported.

Note: Parameter S-0-0091 is valid for parameter set 0.
Parameter S-1-0091 is valid for parameter set 1.

Parameter: S-1-0091 Bipolar velocity limit value

Length: 4 bytes

Minimal value: = 0

Maximal value: = +2^{31} - 1

Unit: rpm

If the velocity command value exceeds this value then the value transmitted to the basic board is limited. The report „n_{nom} > n_{limit}“ in S-0-0013 and S-0-0144 is supported.

Note: Parameter S-0-0091 is valid for parameter set 0.
Parameter S-1-0091 is valid for parameter set 1.

Parameter: S-0-0092 Bipolar torque limit value (Dummy)

Length: 2 bytes

Minimal value: = 0

Maximal value: = +2^{15} - 1

Unit: Nm

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0095 Diagnostic message

Length: Variable 1 byte (text)

Minimal value: -

Maximal value: -

Unit: -

The drive operating condition that is currently relevant is transmitted in the diagnostic message. The diagnostic messages are generated as a text in the drive and are stored in the operating data of this IDN.

Parameter: S-0-0096 Slave arrangement (SLKN)

Length: 2 bytes

Minimal value: 1

Maximal value: 254

Unit: -

The implementation of the SERCOS Interface for RD500 only allows for one drive for each bus address. It therefore follows that this parameter only contains its own drive address in each of the high and the low bytes (this is set by rotary coded switches S3 and S4). The drive address can be in the range between 1 and 99. The master can request this parameter from communication phase 2.

Parameter: S-0-0099 Reset class 1 diagnostic

Length: 2 bytes

Minimal value:

Maximal value:

Unit:

If the slave receives this command and if there are no more errors then Class 1 diagnostic is reset.

Parameter: S-0-0100 Velocity loop proportional gain Pset 0 (Dummy)

Length: 2 bytes

Minimal value: 0

Maximal value: 65535

Unit: -

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

It is intended for parameter set 0.

Parameter: S-1-0100 Velocity loop proportional gain PSet 1 (Dummy)

Length: 2 bytes

Minimal value: 0

Maximal value: 65535

Unit: -

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

It is intended for parameter set 1.

Parameter: S-0-0101 Velocity loop integral action time PSet 0 (Dummy)

Length: 2 bytes

Minimal value: 0

Maximal value: 65535

Unit: -

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used. It is intended for parameter set 0.

Parameter: S-1-0101 Velocity loop integral action time PSet 1 (Dummy)

Length: 2 bytes

Minimal value: 0

Maximal value: 65535

Unit: -

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used. It is intended for parameter set 1.

Parameter: S-0-0104 Position loop Kv-factor (Dummy)

Length: 2 bytes

Minimal value: 0

Maximal value: 65536

Unit: -

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0121 Input revolutions of load gear (Dummy)

Length: 4 bytes

Minimal value: = 1

Maximal value: = 1

Unit: -

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used. The value is fixed as „1“.

Parameter: S-0-0122 Output revolutions of load gear (Dummy)

Length: 4 bytes

Minimal value: = 1

Maximal value: = 1

Unit: -

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used. The value is fixed as „1“.

Parameter: S-0-0124 Standstill window

Length: 4 bytes

Minimal value: = 0

Maximal value: $= +2^{31} -1$

Unit: rpm

The standstill window describes the amount of deviation of the velocity from 0. If the velocity feedback value is within the standstill window the drive sets the message $n_{act} = 0$ in signal status word S-0-0144 and in the Class 3 diagnostic S-0-0013.

Parameter: S-0-0127 CP3 transition check

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

Using this command, the slave checks whether it has all information required to switch correctly into phase 3. The command is completed without an error when the slave can keep to the programmed timeslot values and can generate the desired telegram.

Parameter: S-0-0128 CP4 transition check

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

Using this command, the slave checks whether it has all information required to switch correctly into phase 4. The command is completed without an error when the slave is ready to do this.

Parameter: S-0-0129 Manufacturer class 1 diagnostic

Length: 2 bytes
Minimal value:
Maximal value:
Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0134 Master control word

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

Using this, you can display the master control word via the service channel on the screen of the control system (this is a useful help when putting into operation and during troubleshooting).

Parameter: S-0-0135 Drive status word

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

Using this, you can display the drive status via the service channel on the screen of the control system (this is a useful help when putting into operation and during troubleshooting).

Parameter: S-0-0138 Bipolar acceleration limit value (Dummy)

Length: 4 bytes
Minimal value:
Maximal value:
Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0140 Controller type

Length: Variable 1 byte (text)

Minimal value: -

Maximal value: -

Unit: -

Contains the type code of the drive in as much as the values can be read out from the drive parameters.

Example: RD52.1-4B-005-x-xx-FW

Parameter: S-0-0141 Motor type

Length: Variable 1 byte (text)

Minimal value: -

Maximal value: -

Unit: -

The operating data of the motor type contains the fixed text “REFU Motor”.

Parameter: S-0-0142 Application type

Length: Variable 1 byte (text)

Minimal value: -

Maximal value: -

Unit: -

The operating data contains the type of usage of the drive (e.g. main spindle drive, Rotary Axis).

When first switching on the drive, this parameter contains the text “REFU main spindle”. This text can be over-written as required and replaced by a text specific to the application (max. 40 characters).

Note: This text is stored in an EEPROM on the option board and is therefore not accessible via the basic board. We recommend that you fill the new text with blanks until it is longer than the old, previously stored text.

Parameter: S-0-0143 SYSTEM interface version

Length: Variable 1 byte (text)

Minimal value: -

Maximal value: -

Unit: -

Contains the fixed text string: "V 01.02 "

Parameter: S-0-0144 Signal status word

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

Signals can be transmitted in real time from the drives to the control system using the signal status word. To do this, the signal status word

must be integrated into the AT as cyclic data. The assignment of the bits in the signal status word is fixed in the SERCOS-implementation for REFUdrive.

The following bits are reserved:

Bit 0: $(n_{nom} - n_{window}) <= n_{act} <= (n_{nom} + n_{window})$

Bit 1: $|nact| <= nstandstill$

Bit 5: $|n_{nom}| >= n_{limit}$

Bit 6: Spindle is in position (only for RD52)

Bits that are not mentioned are currently not supported (=0).

The following applies:

n_{nom} = S-0-0036 Nominal speed value (Velocity command value)

n_{act} = S-0-0040 Actual speed value (Velocity feedback value)

n_{window} = S-0-0157 Velocity window

$n_{standstill}$ = S-0-0124 Standstill window

n_{limit} = S-i-0091 speed limit value, bipolar

Parameter: S-0-0147 Homing parameter (Dummy)

Length: 2 bytes

Minimal value:

Maximal value:

Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0152 Position spindle procedure command

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

On activating the command, the drive switches to drive-internal positioning control. While the command is active, changes to the cyclical command values are ignored. As long as the spindle is not yet in position, it runs at Spindle positioning speed S-0-0222. Additionally, the spindle angle position (IDN 00153) is driven into absolute position via the spindle positioning parameter (IDN 00154). When the selected value is reached, the message "In Position" (IDN 00336) is set by the drive. Bits in S-0-0013 and S-0-0144 are also set. As long as the command is active, the drive maintains the control of the position and accepts every new setpoint setting (IDN 00153) via the service channel. If the control system resets the command then the drive switches back to velocity control.

The parameter is only of significance for RD52.

Parameter: S-0-0153 Spindle angle position

Length: 4 bytes

Minimal value: $= -2^{31}$

Maximal value: $= +2^{31} -1$

Unit: -

The spindle angle position is based on the reference point and is only active with the "Position spindle procedure command" (IDN 00152).

The parameter is only of significance for RD52.

Parameter: S-0-0154 Spindle positioning parameter

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

When the "Position spindle procedure command" is active and the nominal speed value is 0 then the direction of rotation for reaching the spindle angle position can be preset here. If the nominal speed value does not equal 0 then the current direction of rotation is maintained for reaching the spindle angle position.

Construction of the spindle positioning parameter:

Bit 0-1: 1 x – shortest path (x = 0 or 1)

Bit 2: 0 – spindle angle position (IDN 00153)

Bit 3: 0 – motor encoder

The parameter is only of significance for RD52.

Parameter: S-0-0157 Velocity window

Length: 4 bytes

Minimal value: 0

Maximal value: $2^{31}-1$

Unit: rpm

If the velocity feedback value is around the velocity command value within the velocity window then bit 1 is set in Signal status word (S-0-0144) and in Class 3 diagnostic (S-0-0013).

Parameter: S-0-0160 Acceleration data scaling type (Dummy)

Length: 2 bytes

Minimal value:

Maximal value:

Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0169 Probe control parameter (Dummy)

Length: 2 bytes

Minimal value:

Maximal value:

Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0182 Manufacturer class 3 diagnostic (Dummy)

Length: 2 bytes
Minimal value:
Maximal value:
Unit:

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: S-0-0185 Length of the configurable data record in the AT

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

In the operation data of this IDN, the drive indicates the maximum length in bytes which can be processed in the configurable data record of the AT.

Parameter: S-0-0186 Length of the configurable data record in the MDT

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

In the operation data of this IDN, the drive indicates the maximum length in bytes which can be processed in the configurable data record of the MDT.

Parameter: S-0-0187 IDN-list of the configurable data in the AT

Length: Variable 2 bytes (IDNn)
Minimal value: -
Maximal value: -
Unit: -

This list contains those IDNs whose operation data can be delivered by the drive cyclically as feedback values in the AT. If the application telegram (S-0-0015 = 7) is used, then the IDNs contained in it can be written into S-0-0016. Refer to table TB. 9-4: Content of S-0-0187 In Chapter 9.4.

Parameter: S-0-0188 IDN-list of the configurable data in the MDT

Length: Variable 2 bytes (IDNn)
Minimal value: -
Maximal value: -
Unit: -

This list contains those IDNs whose operation data can be delivered by the drive cyclically as command values in the MDT. If the application telegram (S-0-0015 = 7) is used, then the IDNs contained in it can be written into S-0-0024. Refer to table TB. 9-5: Content of S-0-0188 In Chapter 9.4.

Parameter: S-0-0192 IDN-list of backup operation data

Length: Variable, 2 bytes (IDNn)

Minimal value: -

Maximal value: -

Unit: -

IDN´s of all S - and P – parameters, which have to be loaded in the drive in order to guarantee correct operation, are stored in this IDN-list. The master uses this list to generate a backup copy of the drive parameters.

Important: IDN S-0-0269 Storage mode. It is fixed at 1, e.g. temporarily store data. This means that data that is stored in the parameters contained in S-0-0192 and that are transmitted to the drive are only stored temporarily and are only written into the EEprom of the basic board when “Backup working memory procedure command” S-0-0264 is set..

Note: This ID number list has the following length for the REFUdrive:

RD51: 410 entries

RS51: 444 entries

RD52: 644 entries

For future functional expansions the length of this list should be reserved big enough inside the control system.

Suggestion: list-length of 1000 entries.

Parameter: S-0-0216 Switch parameter set procedure command

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

Parameter sets can be switched over using this command. The drive switches over to the parameter set that is programmed in the “Parameter set preselection” (IDN 00217). This command can only be executed when the inverter is off, i.e. when the corresponding bits are reset in the control word.

Note: On changing the parameter set, the corresponding value is written to parameter P0070 (P-0-0070).

Parameter set preselection S-0-0217 = 0: P-0-0070 = 1700

= 1: P-0-0070 = 1701

Parameter: S-0-0217 Parameter set preselection

Length: 2 bytes

Minimal value: 0

Maximal value: 1

Unit: -

The parameter set in the drive is selected via the parameter set preselection. The „Switch parameter set procedure command“ (IDN 00216) is used to switch parameter sets.

Parameter sets 0 and 1 are supported.

Value: 0 – parameter set 0

1 – parameter set 1

Parameter: S-0-0219 IDN-list parameter set

Length: variable 2 byte (IDN list)

Minimal value: -

Maximal value: -

Unit: -

This IDN list contains all IDNs whose parameter sets can be switched over. If their IDN is smaller than 32767 or larger than 34816 then this parameter also exists in parameter set 1. (Example: S-0-0091, S-1-0091, P-0-2070, P-1-2070)

If the ID number is in the range between 32768 and 34815 (i.e. within P-0-0000 and P-0-2047) then the value of the second parameter set is shown in the second list element.

Parameter: S-0-0222 Spindle positioning speed

Length: 4 bytes

Minimal value: ≥ 0

Maximal value: $\leq +2^{31} -1$

Unit: rpm

The "Position spindle procedure command” (IDN 00152) accelerates or decelerates to the Spindle positioning speed If the drive receives the "Position spindle procedure command" when at standstill then it accelerates to the Spindle positioning speed.

The parameter is only of significance for RD52.

Parameter: S-0-0254 Actual parameter set

Length: 2 bytes

Minimal value: 0

Maximal value: 1

Unit: -

This parameter stores the currently active parameter set in the drive. If a parameter set is to be switched, it is important, that the next consecutive parameter set has been updated into the parameter set preselection (IDN 00217) before setting the Switch parameter set procedure command.

Value: 0 – parameter set 0 is active

1 – parameter set 1 is active

Parameter: S-0-0264 Backup working memory procedure command

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

When the master sets the „Backup working memory procedure command”, all data necessary for operation (see „IDN List of the Operating Data to be Stored“ IDN 00192) is transferred from the drives „active memory“ into its „non-volatile memory“.

Attention: This command overwrites previously stored parameters.

Parameter: S-0-0265 Language selection

Length: 2 bytes

Minimal value: 0

Maximal value: 1

Unit: -

You can choose between either English or German language.

Value: 0 – German

1 – English

Parameter: S-0-0269 Storage mode

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

The „Storage mode“ indicates that in RefuDrive 500 all data transmitted via the service channel is stored temporarily (e.g. in RAM, working memory). Refer also to **Parameter: S-0-0264 Backup working memory procedure command**

Bit 0: 1 – store data temporarily

Parameter: S-0-0336 Status “In position”

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

With this parameter, an IDN is set for the message "In Position".

Construction of the "In Position" message:

Bit 0: 0 – position not (yet) reached

1 – position reached

The parameter only exists for RD52.

Note: This information is generated from the REFUdrive basic device RD52, Parameter P1567 (P-0-1567) and transmitted from there via the status word (P1922, P-0-1922), bit 8 to the option board. To do this, parameter P0076.8 (ninth list element of P-0-0076) must have the value 1567. For more information on this, refer to the REFUdrive 52 manual, Functional Diagrams and Parameter Lists, for Firmware 05VRS. Parameters S-0-0305, S-0-0307, S-0-0047 and S-0-0057 are not supported.

Parameter: S-0-0390 Diagnostic number

Length: 2 bytes

Minimal value: = 0

Maximal value: = 2^{16} -1

Unit: -

During a fault of the basic device, the number of the fault is indicated here. This corresponds to the parameter P-0-1793 of the basic device.

Parameter: S-0-0403 Position feedback value status (Dummy)

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

This parameter is not supported. It can be read and written via the SERCOS service channel but the value is not used.

Parameter: P-0-2048 Block configuration SERCOS on

Length: 2 bytes
Minimal value: 0
Maximal value: 1
Unit: -

This parameter is not supported.

Parameter: P-0-2049 Block configuration SERCOS off

Length: 2 bytes
Minimal value: 0
Maximal value: 1
Unit: -

This parameter is not supported.

Parameter: P-0-2050 Setpoint configurable 1

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

With Refu standard data scaling ± 15 bits

Parameter: P-0-2051 Setpoint configurable 2

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

With Refu standard data scaling ± 15 bits

Parameter: P-0-2052 Setpoint configurable 3

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

With Refu standard data scaling ± 15 bits

Parameter: P-0-2053 Setpoint configurable 4

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

With Refu standard data scaling ± 15 bits

Parameter: P-0-2054 Setpoint configurable 5

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

With Refu standard data scaling ± 15 bits

Parameter: P-0-2055 Setpoint configurable 6

Length: 4 bytes
Minimal value: -
Maximal value: -
Unit: -

With Refu standard data scaling ± 31 bits

Parameter: P-0-2060 Feedback configurable 1

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

With Refu standard data scaling ± 15 bits

Parameter: P-0-2061 Feedback configurable 2

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

With Refu standard data scaling ± 15 bits

Parameter: P-0-2062 Feedback configurable 3

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

With Refu standard data scaling ± 15 bits

Parameter: P-0-2063 Feedback configurable 4

Length: 2 bytes
Minimal value: -
Maximal value: -
Unit: -

With Refu standard data scaling ± 15 bits

Parameter: P-0-2064 Feedback configurable 5

Length: 2 bytes

Minimal value: -

Maximal value: -

Unit: -

With Refu standard data scaling ± 15 bits

Parameter: P-0-2065 Feedback configurable 6

Length: 4 bytes

Minimal value: -

Maximal value: -

Unit: -

With Refu standard data scaling ± 31 bits

Parameter: P-i-2070 RD500 normalization Speed parameter set i

Length: Variable 2 bytes (IDNn)

Minimal value: >=0

Maximal value: $<=+2^{31}-1$

Unit: rpm

Parameters P-0-2070 and P-1-2070 are available for parameter sets 0 and 1. In the following, they are combined and termed as P-i-2070. This parameter “P-i-2070 RD500 normalization speed parameter set i” is used to adjust the different ways of displaying velocity / speed data under SERCOS and REFUdrive.

Differences in the speed data:

Protocol	SERCOS	REFUdrive
Data width	32 bits	16 bits
Normalization is as follows:	1 LSB = a x 10^b rpm	100 % = P0390
Parameters that always apply:	S-0-0044 Data scaling type S-0-0045 Data scaling factor (a) S-0-0046 Data scaling exponent (b)	P0390 Normalization speed
Data transmission	As above, i.e. 1 LSB = a x 10^b rpm	100 % = 16384

LSB: Least Significant Bit

To solve the normalization problem with a good rate of accuracy and with sufficient resolution while at the same time reducing the online computer time to a minimum, the P-i-2070 parameter has been introduced.

P-i-2070 must be parameterized to suit the motor in order to obtain a suitable normalization, speed accuracy and resolution. The value to be inserted orients itself to the maximal allowed or actually occurring speed of the motor in this application.

Example: A spindle has a maximum speed of 18000.0000 rpm. This range is also fully used on the system. For P-i-2070, you now select a value that is a „little“ higher, e.g. 18100.0000. (data scaling factors S-0-0044 to S-0-0046 apply!!).

Note: Parameter S-i-0091 has nothing to do with P-i-2070.

S-i-0091 is used in limiting the velocity command value.

Note: When switching on the drive (power-on) or on changes to S-0-0044, S-0-0045, S-0-0046 or P-i-2070, parameter P0390.i is written from the SERCOS option assembly onto the basic board SR. For RefuDrive RD51 and RS51 the parameter P-0-0114 (P0114) Pole pair number is also relevant.

For this reason, P0390 must not be changed by other sources or at other locations (control panel, REFUwin, ...) as otherwise the conversion of the weighted SERCOS velocity data to the normalized percentile Refu nominal and actual speed values is no longer correct.

Note: Both P-0-2070 and P-1-2070 must be set to suitable values. If you only use parameter set 0 then it is best to set P-1-2070 to the same value as P-0-2070.

Parameter: P-0-2080 Set parameter for operation procedure command

Length: 2 bytes

Minimal value:

Maximal value:

Unit:

Sets the parameters of the basic device required for operation with SERCOS, depending on the basic unit. These parameters are described in chapter 9.5 Parameterization This command can be used when setting a drive into operation for the first time. It can only be written in phase 2.

Important note: These settings are standard values that can or must be optimized afterwards.

Parameter: P-0-2081 Set parameter for spindle positioning command

Length: 2 bytes

Minimal value:

Maximal value:

Unit:

Sets the parameters required at the RD52 basic device for the spindle positioning procedure command. These parameters are described in chapter 9.17 Spindle positioning.

Note: These settings are standard values that can or must be optimized afterwards.

9.8 Refu – P Parameter

All Refu parameters from P-0-0000 (P0000) to P-0-2047 (P2047) (refer to documentation REFUdrive Function Plans and Parameter Lists) are also available to the user with the elements belonging to SERCOS (name, IDN, attribute, min. and max. values, unit and data (the data can be read by the user and, when not read-only, can also be edited by the user).
With the REFUdrive, a distinction is made between offline and online, whereby offline means that the parameter can only be written when the

inverter is switched off. SERCOS does not recognize this difference. For this reason, all of these parameters have the attribute „Can only be changed in Phase 2“. Refu online parameters are „Changeable in Phase 4“.

P-Parameters with index

There are indexed parameters in the REFUdrive. As this term or mechanism does not exist under SERCOS, all Refu parameters with index are mapped into SERCOS list parameters.

Example:

Refu: Parameter P0050.x, Index Length 7 (i.e. 0 to 7) Name: „Source Control word KL”

P0050.0 = 1714

P0050.1 = 1701

P0050.2 = 1701

P0050.3 = 1701

P0050.4 = 1701

P0050.5 = 1701

P0050.6 = 1701

P0050.7 = 1700

SERCOS List with 2-byte data, length of list: 8 , IDN: P-0-0050, Name: „Source Control word KL”

Transmitted by SERCOS: Actual Length in Bytes, Max. Length in Bytes, Data.

Example: 16, 16, 1714, 1701, 1701, 1701, 1701, 1701, 1701, 1700

The **first** element has the value 1714. Under Refu, this is the index **0.**

The **second** element has the value 1701. Under Refu, this is the index **1.**

etc.

P-Parameters for the SERCOS - interface

The following parameters are used for settings and diagnostics. These parameters (read-only) can be seen in the basic device.

Parameter	Name	Comment
P1322	SC address	Shows the current SERCOS bus address of the drive. It is set on the options board using rotary coded switches S3 and S4.
P1323	SC baud rate	Shows the current baud rate and is set on the options board by switch S1.
P1520	SC phase	Displays the current SERCOS phase
P1521	SC cycle time	Shows the value of the S-0-0002 parameter
P1522	SC control word	Shows the value of the S-0-0134 parameter
P1523	SC status word	Shows the value of the S-0-0135 parameter
P1524	SC brightness	Shows the currently set transmitter brightness. It is set on the options board using switch S2.

9.9 Data storage

The IDN-list of the S-0-0192 backup operation data contains all S - and P - parameters of the „REFUdrive 500 with SERCOS-Interface“, that must be stored securely against a power failure.

Loading the data of all parameters contained in S-0-0192 into the control system allows the complete configuration to be restored for example during service operations.

All S (SERCOS-standard) and P (product-specific) parameters described in 9.7 Description of the Parameters and that are implemented on the option board and that are stored at a power failure are kept in the EEprom of the basic board (SR17000 or SR17002).

The following table contains those SERCOS parameters that are only relevant for the option „SERCOS Implementation in RD500“.

They are available via the SERCOS optical bus under the following ID numbers (IDN).

In the REFUdrive, they can be addressed via the parameter number in the REFUdrive P-Number column and can be read and edited at the control panel or by using REFUwin.

Note: If these parameters are changed via SERCOS then they are immediately visible under the corresponding REFUdrive P-Number.

If these parameters are changed via the control panel or REFUwin then they are only available via SERCOS after the next power-on or phase transition to phase 2.

Reminder: Do not forget to store all parameters after loading the parameters in the drive (using the S-0-0264 command)!

IDN	Name (Name in REFUdrive)	Is only valid for:	REFUdrive P-Number
S-0-0015	Telegram type parameter (S15 telegram type)	RD51, RS51, RD52	P1324
S-0-0016	Configuration list of AT (S16 config. list AT)	RD51, RS51, RD52	P1325 Index 0 ... 9
S-0-0024	Configuration list of MDT (S24 config. list MDT)	RD51, RS51, RD52	P1326 Index 0 ... 9
S-0-0032	Primary operating mode (S32 main oper. mode)	RD51, RS51, RD52	P1327
S-0-0033	Secondary operation mode 1 (S33 aux oper.mode 1)	RD51, RS51, RD52	P1328
S-0-0034	Secondary operation mode 2 (S34 aux oper.mode 2)	RD51, RS51, RD52	P1329
S-0-0035	Secondary operation mode 3 (S35 aux oper.mode 3)	RD51, RS51, RD52	P1330
S-0-0043	Velocity polarity parameter (S43 speed polarit.)	RD51, RS51, RD52	P1331
S-0-0044	Velocity data scaling type (S44 veloc.scal type)	RD51, RS51, RD52	P1332
S-0-0045	Velocity data scaling factor (S45 veloc.scal fact)	RD51, RS51, RD52	P1333
S-0-0046	Velocity data scaling exponent	RD51, RS51, RD52	P1334

IDN	Name (Name in REFUdrive)	Is only valid for:	REFUdrive P-Number
	(S46 veloc.scal exp.)		
S-0-0055	Position polaritiy parameter (S55 posit. polarity)	RD52	P1335
S-0-0057	Positioning window (S57 positioning window)	RD52	P1336
S-0-0085	Torque polaritiy parameter (S85 torque polaritiy)	RD52	P1337
S-0-0086	Torque/force data scaling type (S86 torq.scal type)	RD52	P1338
S-0-0091, S-1-0091	Bipolar velocity limit value 0 Bipolar velocity limit value 1 (S91 veloc limit bip)	RD51, RS51, RD52	P1339, Index 0 ... 1
S-0-0092	Bipolar torque limit value (S92 torque limit bip) .	RD52	P1340
S-0-0093	Torque/force data scaling factor (S93 torquescal fact)	RD52	P1341
S-0-0094	Torque/force data scaling exponent (S94 torque scal exp)	RD52	P1342
S-0-0103	Modulo value (is not supported) (S103 modulo value)	RD52	P1343
S-0-0124	Standstill window (S124 standstil wind)	RD51, RS51, RD52	P1344
S-0-0153	Spindle angle position (S153 spindle angle)	RD52	P1345
S-0-0154	Spindle positioning parameter (S154 spindleposMode)	RD52	P1346
S-0-0157	Velocity window (S157 speed window)	RD51, RS51, RD52	P1347
S-0-0222	Spindle positioning speed (S222 position.speed)	RD52	P1348
S-0-0265	Language selection (S265 language sel.)	RD51, RS51, RD52	P1349
P-0-2070, P-1-2070	RD500 Normalization speed parameter set 0 RD500 Normalization speed parameter set 1 (Sercos Max. speed)	RD51, RS51, RD52	P1360, Index 0 ... 1

9.10 Special treatment of some parameters under SERCOS

Certain Refu parameters have a special meaning under SERCOS, i.e. they are treated in a special way by the SERCOS board.

An example of this is the Refu parameter P0390.i.:

For reasons of:

- SERCOS own data scaling of the speed information (nominal and actual speed values)
- 16 bit resolution of the speed controller
- percentile standardization typical to the Refu, and
- computing times

the parameter P0390 must be generated in a special way from SERCOS parameters (S-0-0044, S-0-0045, S-0-0046, P-i-2070) (after power-on, in phase 2).

For this reason, the P0390 parameter must not be subsequently changed. A change via the control panel or via REFUwin should no longer be possible.

When the SERCOS board is plugged in then the parameter P0390.i is write-protected.

The following parameters are also treated specially by SERCOS:

Parameter	Name	Comment
P0008	EEprom program cycles	Is generated in the S-0-0264 command
P0010	Display language	To switch over the language of all parameters, both S-0-0265 as well as P0010 (P-0-0010) must be suitably set. For S-0-0265, the following applies: 0 – German 1 = English For P-0-0010, the following applies: 0 – English 1 = German When writing from S-0-0265, P-0-0010 is generated accordingly.
P0390	Frequency normalize (RD51, RS51)	Value can not be changed by SERCOS.
	Speed normalize (RD52)	
P0072	Source parameter	Is fixed at value 4 = all interfaces
P0000	Firmware FWC-	Is displayed as an ASCII value with 16-bit word width. Refer also to Parameter: S-0-0030 Manufacturer version
P0028	Operating hours	Can not be changed
P0029	Operating minutes	Can not be changed
P0040	Fault memory	Can not be changed
P0041	Fault time hours	Can not be changed
P0042	Fault time minutes	Can not be changed
P0435.0	Fixed value for D1860	Only for RD52 Do not use for other applications! Is used to transmit the spindle positioning speed from the SERCOS option board to the basic board.
P0435.2	Fixed value for D1967	Only for RD52 Do not use for other applications! Is used to transmit the spindle angle position from the SERCOS option board to the basic board.
P1848	n regulator Kp	Is converted on the option board in such a way that the date transmitted via SERCOS corresponds to the value on the control panel
P1870	Cooler temperature, power section	Is converted on the option board in such a way that the date transmitted via SERCOS corresponds to the value on the control panel
P1872	Motor temperature, linearized	Is converted on the option board in such a way that the date transmitted via SERCOS corresponds to the value on the control panel
P1796	St. LT:S 1P W12 P	not visible via SERCOS
P1798	Dig. output relay 321	not visible via SERCOS
P1799	Dig In 54321	not visible via SERCOS

9.11 Rights

Both the control panel, REFUwin and the SERCOS master can read, write and change parameters.

If a parameter is changed using the control panel or by REFUwin at a control system with the SERCOS interface, then a parameter upload should be subsequently done in order to ensure that data consistency is maintained.

Recommended operation:

Putting into operation: REFUwin

Fault remedy: Control panel
SERCOS Master

Operation: SERCOS Master

9.12 Fault Remedy (Troubleshooting)

Error Message	Cause	Remedy
Yellow LED does not light up	Options board without power or defective	
Yellow LED lights permanently for approx. 45 sec after power-on	Once-only initialization	Please wait
Red LED lights up brightly	Light bus not closed	Fiber optic cable is defective, bent or not correctly screwed on; when appropriate, use the LWL-FSMA socket wrench, Order No.: 260 285
	Received light level is much too high or much too weak	Adjust transmission brightness of preceeding transmitter in SERCOS bus.
	Incorrect baud rate	Check baud rate (using S1)
Red LED lights weakly or flickers	Light bus not closed	Fiber optic cable is defective, bent or not correctly screwed on; when appropriate, use the LWL-FSMA socket wrench, Order No.: 260 285
	Received light level is much too high or much too weak	Adjust transmission brightness of preceeding transmitter in SERCOS bus.
	Incorrect baud rate	Check baud rate (using S1)
All LEDs light permanently	Options board is in reset condition	Switch the drive off from power and then switch back on
SS2 or SS4 timeout	Incorrect parameterization	Check the parameters P0526, P0527 or P0746 and P0747

9.13 Documentation on Data Types N2 and N4

(Profibus) data types N2 and N4 are used in the REFUdrive device. These are 16 and 32 bit parameters, marked with a „percentage“ sign.

This means that the number range of $\pm 2^{15}$ is mapped to ±200.00 % (for 16 bit) and $\pm 2^{31}$ is mapped to ±200.00000 % (for 32 bit). All process-relevant data is therefore shown on the control panel and in REFUwin as a „percentage“ and with „2 digits (for 16bit) after the decimal point“, but the data is transmitted via the interface (and this also includes the SERCOS interface) as $\pm 2^{15}$ (or $\pm 2^{31}$).

Example:

% Value in the REFUdrive	Number via SERCOS (or another interface)	Hex equivalent
+199,99 %	32767	7FFF

+100,00 %	16384	4000
0 %	0	0
-1,00 %	-163	FF5D
-100,00 %	-16384	C000
-200,00 %	-32768	8000

9.14 Information on operation with DriveTop

The “setpoint generator” implemented on the SERCANS board is used for putting the drive into operation. After all settings have been done and communication phase 4 has been switched on, the setpoint generator can now be started.

First, the setpoint generator must be “configured” using “setpoint generator box” – “setpoint box selection” and then the operating mode “xxx speed control” must be selected.

Then, in the “setpoint generator box” – “setpoint generator box settings” window, the drive is enabled and the motor is switched on with “Start” (or ”Jog” and “Jog +” or “Jog –“).

The speed is adjusted using the parameters Y-0-0062, rotary speed or Y-0-0063, jog speed.

Y-0-0044 setpoint generator enable = 00000000 00000001 (automatically done by setpoint generator)

Y-0-0045 setpoint generator operating mode axis structure 1 = 01010001 00000001 (automatically done by setpoint generator)

9.15 Known Limitations

a) setpoint generator together with DriveTop

The setpoint generator on the SERCANS board with DriveTop only works with the following limitations regarding the Sercos cycle time S-0-0002:

Basic devices RD51 and RS51:

F-pulse in kHz (P-0-0026)	**2**	**4**	**6**	**8**	**10**	**12**
S-0-0002 >= (in usec)	2000	2000	2000	2000	2000	No function

Basic device RD52:

F-pulse in kHz (P-0-0026)	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
S-0-0002 >= (in usec)	5000	4000	3000	2000	2000	2000	2000	3000	3000	3000	3000

When used with other control systems than DriveTop, no limitations have as yet been observed.

b) With basic device RefuSpeed RS51, only the setting 0 = brake operation is possible for parameter P-0-0043 (P0043). This means that the option of selecting the inverter off, coast down via the corresponding bit in the Sercos control word is not available.

c) For basic devices RD51 and RS51, there is no SERCOS interface on selecting the TEST operation (refer here to the documentation of devices RD51 or RS51).

9.16 Block-parametrization

To download an entire data record to a drive, we recommend that you use block-parametrization.

Parameter P1018 (P-0-1018) Blockparametrization is used here. Manually entering the parameter at the beginning and at the end of a data record ensures that no warning or error messages appear and that a functioning data record is also completely downloaded.

To do this, the block-parametrization is “opened” at the beginning by transmitting the value 1. On conclusion, the block-parametrization is “closed” by transmitting the value 0.

9.17 Spindle positioning

a) Requirements

Refu drive RD52 (with Firmware version FWC-SR1700-200-05V17 or later) and SERCOS Option Board on slot 1 (with Firmware FWC-SC2224-300-01V16 or later).

Before putting the spindle positioning function into operation, all parameters that are required for operation with SERCOS must already be correctly set. This means that operation in phase 4 with speed control is a basic requirement.

Furthermore, a rotary position transducer that delivers a zero pulse must be connected to the motor.

A simple way of carrying out the following configuration is, in phase 2, to execute the command P-0-2081 “Set Parameter for Spindle Positioning Command”. All of the following settings listed are then carried out. (do not forget command S-0-0264 on completion!).

b) configuration for spindle positioning

The resolution is set for the position information in the drive:

Parameter	Name	Value	Description
P-0-0780 (P0780)	resolution/motor-turn	22	2exp 32 increments

Enter ramps active in positioning mode:

Parameter	Name	Value	Description
P-0-0280, second list element (or P0280.1)	Ramp up time	1.0 sec	Active in positioning mode
P-0-0281, second list element (or P0281.1)	Ramp down time	1.0 sec	

Now enter the basic setting of the speed control parameters. These values are very “soft” settings of the speed and position control during spindle positioning. They must be subsequently optimized.

Parameter	Name	Value	Description
P-0-0335 (P0335)	Speed controller G1	1.0	Active for speed control; optimize!

Parameter	Name	Value	Description
P-0-0336 (P0336)	Speed controller T1	50 msec	
P-0-0337 (P0337)	Speed controller G2	1.0	Active for position control; optimize!
P-0-0338 (P0338)	Speed controller T2	50 msec	
P-0-0654 (P0654)	Position controller Gain	1.0	Active for position control; optimize!

Setting the parameters for the spindle positioning:

Parameter	Name	Value	Description
P-0-0156, third list element (or P0156.2)	MFB source 1	D 1991	
P-0-0157, third list element (or P0157.2)	MFB source 2	D 1834	
P-0-0158, third list element (or P0158.2)	MFB function 1	1	Subtraction
P-0-0159, third list element (or P0159.2)	MFB function 2	1	Absolute value
P-0-0269 (or P0269)	Source, jog setpoint value 3	D 1860	
P-0-0270 (or P0270)	Source, enable jog 3	D 1770	
P-0-0271 (or P0271)	Source ramp up generator 2	D 1770	
P-0-0298 (or P0298)	Selection speed controller 2	D 1612	
P-0-0300 (or P0300)	Source, additional setpoint 4	D 1991	
P-0-0301 (or P0301)	Selection addition. setpoint 4	D 1613	
P-0-0317 (or P0317)	Source 1, Multiplier 1	D 1860	
P-0-0318 (or P0318)	Source 2, Multiplier 1	D 2001	
P-0-0367 (or P0367)	Fix value torque limit 1	199.99%	
P-0-0370 (or P0370)	Fix value torque limit 2	-199.99%	
P-0-0396 (or P0396)	Source x1 comparator 1	D 1895	
P-0-0397 (or P0397)	Hysteresis x1:xs1	0.1%	
P-0-0398 (or P0398)	Fix value xs1 comparator 1	0.1%	
P-0-0406 (or P0406)	Source x0 positive input	D 1897	Actual speed value
P-0-0407 (or P0407)	Source x0 negative input	D 1860	Positioning speed
P-0-0408 (or P0408)	Hysteresis x0:xs0	0.1%	
P-0-0409 (or P0409)	Fix value xs0	0.2%	
P-0-0460 (or P0460)	Source digital output 1	D 1768	
P-0-0572 (or P0572)	Source AND ramp up enable	D 1613	
P-0-0576 (or P0576)	Source synchronous reset	D 1626	
P-0-0583, first list element (or P0583.0)	Source input 0 gate	D 1748	
P-0-0583, sixth list element (or P583.5)	Source input 0 gate	D 1770	
P-0-0584, first list element (or P584.0)	Source input 1 gate	D 1780	
P-0-0584, second list element (or P 584.1)	Source input 1 gate	D 1610	
P-0-0585, first list element (or P585.0)	Source input 2 gate	D 1757	
P-0-0585, second list element (or P 585.1)	Source input 2 gate	D 1650	
P-0-0586, first list element (or P586.0)	Function gate	14	triple AND
P-0-0586, second list element (or P 586.1)	Function gate	3	RS-Flipflop
P-0-0586, sixth list element (or P586.5)	Function gate	22	Inverter and NAND
P-0-0587, fourth list element (or P587.3)	Source timer module	D 1770	

Parameter	Name	Value	Description
P-0-0588, fourth list element (or P588.3)	Timer module mode	2	pulse
P-0-0589, fourth list element (or P589.3)	Timer module time 1	1	0.01 sec
P-0-0637 (or P0637)	Enable auxiliary function	1	position control active!
P-0-0647 (or P0647)	Source additional setpoint position control	D 1967	comes from P0435.2
P-0-0648 (or P0648)	Source setpoint position control	D 1800	
P-0-0649 (or P0649)	Source position feedback	D 2014	
P-0-0656 (or P0656)	Source position control enable	D 1701	
P-0-0657 (or P0657)	Source position control positive limit	D 1860	
P-0-0658 (or P0658)	Source position control negative limit	D 1831	
P-0-0788 (or P0788)	Enable reset position	D 1757	
P-0-0793 (or P0793)	linear part of square-root	0.5%	optimize!
P-0-0794 (or P0794)	weighting position error	1	1/65536

After completing the configuration, the command S-0-0264 must be started to ensure data safety.

Parameter S-0-0153 sets the spindle angle position (value range 0.0000 to 360.0000 degrees)

Parameter S-0-0222 sets the spindle positioning speed (value range the same as for other speed data)

The Position spindle procedure command is started by S-0-0152.

Note: Parameters P0435.0 and P0435.2 are used by the spindle positioning function and are therefore not available to other applications. The spindle positioning speed is transmitted in P0435.0 (as a percentage, related to P0390.0) The angle position (high word) is transmitted in the resolution +/- 199.99 percent in P0435.2.

10 Extended control terminal strip RZP01.1-T1

10.1 General information on the extended control terminal strip

The extended control terminal strip RZP01.1-T1 offers the following functionality over the control terminal strip

- 4 floating digital inputs
- 4 relay outputs (2 NO contacts, 2 changeover contacts)
- 2 floating analog current outputs (9-bit resolution / max. 500 Ω)
- 1 differential high-ohmic analog input (current/voltage, 10-bit resolution)

The extended control terminal strip KL RZP01.1-T1 is intended for installation in module slot 2. The basic parameterization (only for RD51) supports the extended control terminal strip at **module slot 2**.

Technical data

Order No.	RZP01.1-T1
Power supply	+5 V and +15 V internal from the control card
Size (length x width)	100 x 87 mm (3.94 x 3.43 inch)
Environmental Class	3K3 acc. to DIN IEC 721-3-3
Ambient temperature – during storage – in operation	 -25 °C ... +70 °C 0 °C ... +40 °C
Radio interference suppression level	A1 acc. to EN 55011
Noise immunity	EN 50082-2
Relay outputs	
Max. switching voltage	30 V AC/DC
Max. switching current	2 A
Max. switching power	65.5 VA, 60 W
Min. load	10 µA at 10 mV DC
Digital inputs (floating)	
Voltage input	0 ... 35 V
Input resistance	Ri ≈ 3 kΩ
H signal	+13 V ... +35 V
L signal	-3 V ... +5 V or open-circuit terminal
Analog outputs	
Current outputs	0...20 mA or 4...20 mA, can be parameterized
Max. load resistance	500 Ω
Resolution	9 bit

Analog input (can either be parameterized as current or voltage input), non-floating	
Current input	0...20 mA or 4...20 mA, can be parameterized
Input resistance	R_e = ~ 150 Ω
Current resolution 0...20 mA	10 bit
Min. load	10 µA at 10 mV DC
Voltage input	-10 V...+10 V
Input resistance	R_e = ~ 45 kΩ
Voltage resolution	±9 bit

10.2 Electrical installation

The optional extended control terminal strip is inserted at module slot 2. The connections are visible after the front cover has been removed.

Terminal diagram

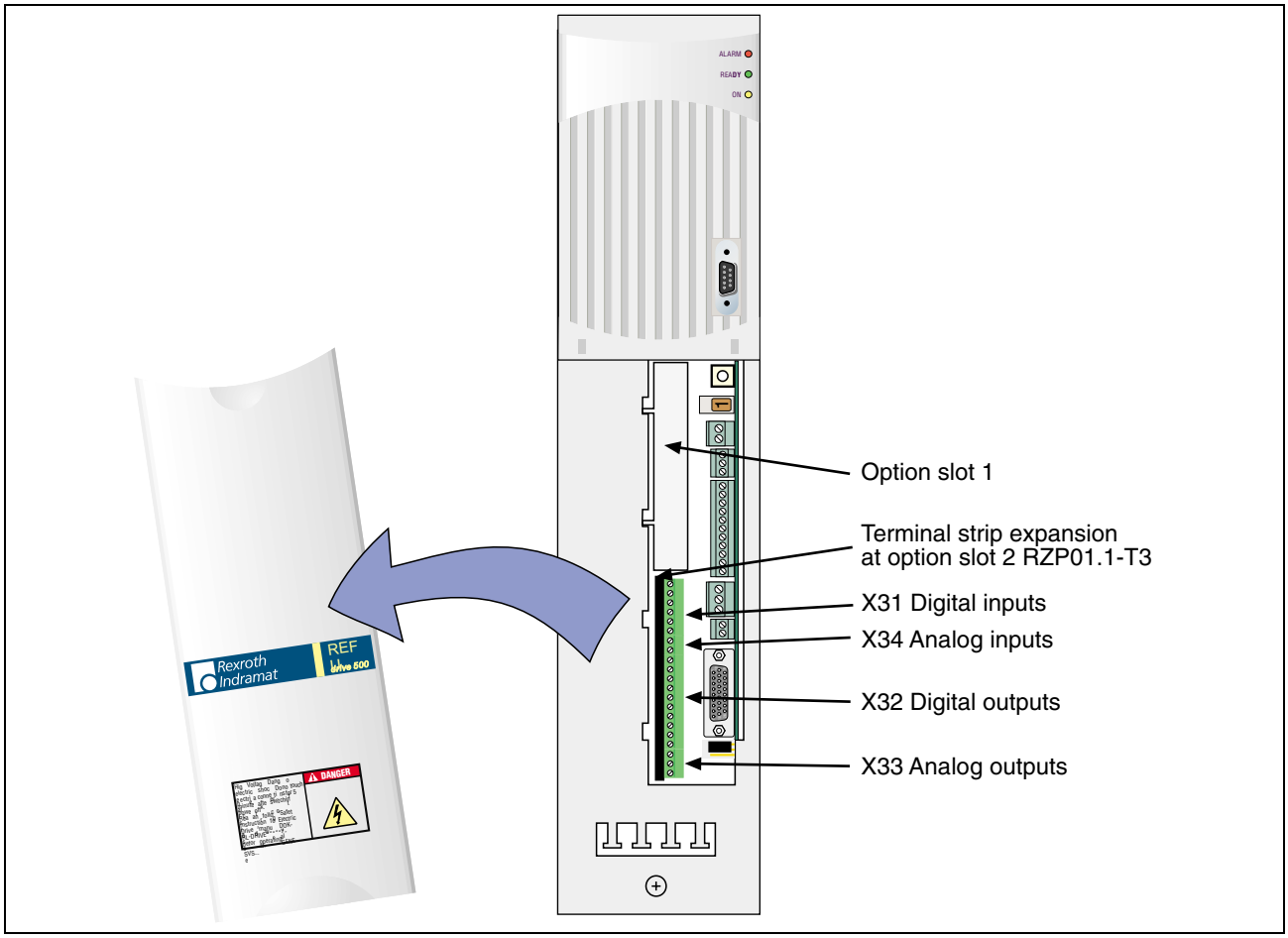


Fig. 10-1: Terminal layout diagram, extended control terminal strip

Connection assignment

Terminal	Comment
X31	Digital inputs
1	Ground, internal unit
2	Digital input 1
3	Digital input 2
4	Digital input 3
5	Digital input 4
6	Digital input, REFERENCE
X32	Relay outputs
1	Relay 1 NO contact (default “open”)
2	Relay 1
3	Relay 2 NO contact (default “open”)
4	Relay 2
5	Relay 3 changeover contact (default “closed”)
6	Relay 3 center contact
7	Relay 3 changeover contact (default “open”)
8	Relay 4 changeover contact (default “closed”)
9	Relay 4 center contact
10	Relay 4 changeover contact (default “open”)
X33	Analog outputs
1	Analog output 1
2	Analog output 2
3	Analog output, REFERENCE
X34	Analog input
1	Analog input A -
2	Analog input A+

Connection circuit diagram

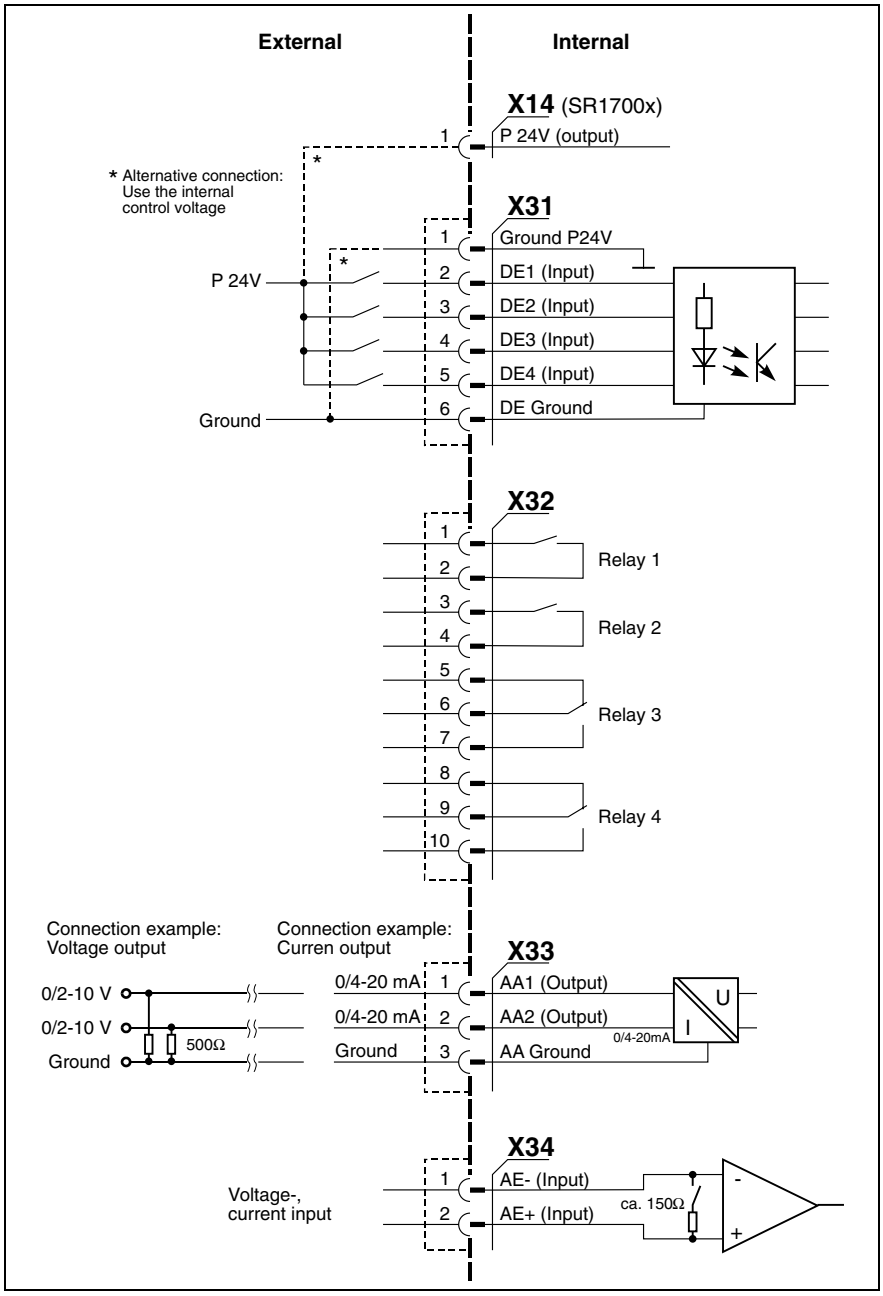


Fig. 10-2: Connection circuit-diagram

10.3 Parameterization

Basic parameterization for RD51

The user can use pre-defined parameters (refer to the Instruction Manual). These can either be accessed via the numerical list or as follows via the menu:

PARAMETERIZATION\PROMPTED PARAM.\OPTIONS\TERMINAL STRIP

Setting the specific parameters for the extended control terminal strip

P. No.:	Name	Description / explanation, selectable options	Factory setting min ... max values	Passw. Prog.
0882	Option, dig. input1		I no function	1
		Digital input 0 = **I** no function (**I**=input) 1 = **I** operating enable 2 = **I** not alarm ext. 3 = **I** not fault ext. 4 = **I** fault reset 5 = **I** fmin select 6 = **I** direct. rotat. 7 = **I** not volt. disc. 8 = **I** not parking 9 = **I** RFG park 10 = **I** RFG up stop 11 = **I** motp. faster 12 = **I** motp. slower 13 = **I** WLM sensit. up 14 = **I** WLM sensit. down 15 = **I** WLM sensit. StrtStp 16 = **I** inhib. touch mess 17 = **I** inhib. load limit 20 = **I** setp. mem. bit4 21 = **I** TEST/NORMAL 22 = **I** setp. mem. bit0 23 = **I** setp. mem. bit1 24 = **I** setp. mem. bit2 25 = **I** setp. mem. bit3 26 = **I** param. set bit0 27 = **I** param. set bit1 28 = **I** param. set bit2 29 = **I** param. set bit3 30 = **I** param. set bit4	0 ... 69	r/w off

P. No.:	Name	Description / explanation, selectable options	Factory setting min ... max values	Passw. Prog.
		31 = **IN** operating enable (**IN** = input for NORMAL) 32 = **IN** not alarm ext. 33 = **IN** not fault ext. 34 = **IN** fault reset 35 = **IN** fmin select 36 = **IN** direct. rotat. 37 = **IN** no volt. disc. 38 = **IN** not fast stop 39 = **IN** RFG parking 40 = **IN** RFG up stop 41 = **IN** motp. faster 42 = **IN** motp. slower 43 = **IN** WLM sensit. up 44 = **IN** WLM sensit. down 45 = **IN** WLM sensit. StrtStp 46 = **IN** inhib.touch mess 47 = **IN** inhib. load limit 51 = **IT** operating enable (**IT**=input for TEST) 52 = **IT** not alarm ext. 53 = **IT** not fault ext. 54 = **IT** fault reset 55 = **IT** fmin select 56 = **IT** direct. rotat. 57 = **IT** not volt. disc 58 = **IT** not fast stop 59 = **IT** RFG parking 60 = **IT** RFG up stop 61 = **IT** motp. faster 62 = **IT** motp. slower 63 = **IT** WLM sensit. up 64 = **IT** WLM sensit. down 65 = **IT** WLM sensit. StrtStp 16 = **IT** inhib.touch mess 17 = **IT** inhib. load limit		
0883	Option, dig.input2	As for parameter P0882, from value 0 to 69.	I no function 0 ... 69	1 r/w off
0884	Option, dig.input3	As for parameter P0882, from value 0 to 69.	I no function 0 ... 69	1 r/w off
0885	Option, dig.input4	As for parameter P0882, from value 0 to 69.	I no function 0 ... 69	1 r/w off

P. No.:	Name	Description / explanation, selectable options	Factory setting min ... max values	Passw. Prog.
0886	Option, relay 1	70 = **O** no function (**O**=output) 71 = **O** ready to switch-on 72 = **O** st.: Ready to switch-on 73 = **O** ready 74 = **O** st.: Ready 75 = **O** run 76 = **O** not fault 77 = **O** switch-on inhibit 78 = **O** no alarm 79 = **O** motor rotates 1 (on & (< x.x sec) | (i > x.xx %)) 80 = **O** motor rotates 2 (on & (fact > fmin) & (i > x.xx %)) 81 = **O** direct. cw 82 = **O** current limiting 83 = **O** not mot. warning temp 84 = **O** not mot. overtemp 85 = **O** RFG up 86 = **O** RFG down 87 = **O** RFG reached 88 = **O** setpoint reached 89 = **O** setpoint in tolerance 90 = **O** fmin limiting 91 = **O** fmax limiting 92 = **O** TEST selected 93 = **O** control line contactor 94 = **O** f act <= f min 95 = **O** WLM spark signal 96 = **O** WLM load limit 97 = **O** mech. brake open	O no function 70 ... 99	1 r/w off
0887	Option, relay 2	As for parameter P0886, from value 70 to 99.	O no function 70 ... 99	1 r/w off
0888	Option, relay 3	As for parameter P0886, from value 70 to 99.	O no function 70 ... 99	1 r/w off
0889	Option, relay 4	As for parameter P0886, from value 70 to 99.	O no function 70 ... 99	1 r/w off
0891	Option, analog output 1	0 = no function 1 = fact output, frequency 2 = Iact output, current 3 = Isq torque generating 4 = Vact output, voltage 5 = Pact output, power 6 = Pactive active power	No function 0 ... 6	1 r/w off
0892	Option, analog output 2	As for parameter P0891.	No function 0 ... 6	1 r/w off
0221.XX	Filter time	XX = 01 for module slot 1 XX = 02 for module slot 2	0 ms 0 ... 10000 ms	1 r/w off

P. No.:	Name	Description / explanation, selectable options	Factory setting min ... max values	Passw. Prog.
0741.XX	Signal, output block	XX = 00 for module slot 1 XX = 01 for module slot 2 0 = direct 1 = absolute value 2 = inverted 3 = absolute value inverted	Absolute value 0 ... 3	1 r/w on
0742.XX	Output block, normal	Normalization of the output block XX = 00 for module slot 1 XX = 01 for module slot 2	100 % 6.26 ... 200.00 %	1 r/w on
0743.XX	Output block	XX = 00 for module slot 1 XX = 01 for module slot 2 0 = 0 ... ±100% 1 = +20 ... +100%	0 ... ±100% 0 / 1	1 r/w on
0744.XX	Output block, offset	**Is only displayed, if** P0891 **or** P0892 **has a function.** XX = 00 for option, analog output 1 XX = 01 for option, analog output 2	0.00 % -100.00 ... 100.00 %	1 r/w on

Free parameterization

The operator can access all of the parameters (refer to the function charts and parameter lists of the appropriate unit).

Communications is established between the “Control card” and the option card via the process data. The extended control terminal strip can only be inserted at module slot 2.

The inputs of the extended control terminal strip are converted on the process data channels, and are available as D parameter.

The firmware addresses an option card at slot 2 as interface SS4.

	Module slot 2	
Option input	**Process data channel**	**D parameters**
Digital input 1	PZD1 from SS4	D1100
Digital input 2	PZD2 from SS4	D1101
Digital input 3	PZD3 from SS4	D1102
Digital input 4	PZD4 from SS4	D1103
Analog input		D1806

Fig. 10-3: Digital inputs, analog input

Signals are connected to the digital and analog outputs, by connecting the appropriate D parameter to the variable parameter sources at the interface output.

	Module slot 2	
Option output	**Process data channel**	**Var. parameter source**
Relay output 1	PZD1 from SS4	P0491.0
Relay output 2	PZD2 from SS4	P0491.1
Relay output 3	PZD3 from SS4	P0491.2
Relay output 4	PZD4 from SS4	P0491.3
Analog output 1	PZD5 from SS4	P0491.4
Analog output 2	PZD6 from SS4	P0491.5

Fig. 10-4: Relay outputs

11 Extended control terminal strip RZP01.1-T3

11.1 General information on the extended control terminal strip

The extended control terminal strip RZP01.1-T3 offers the following functionality over the control terminal strip

- 4 floating digital outputs
- 2 floating analog current outputs (9-bit resolution / max. 500 Ω). From version KL24815SP02 selectable via switch as analog voltage outputs.
- differential analog input at a considerably high electrical resistance (current/voltage, 10-bit resolution)

The extended control terminal strip KL24815. RZP01.1-T3 is intended for installation in module slot 2. The basic parameterization (only for RD51) supports the extended control terminal strip at **module slot 2**.

Technical data

Order No.	RZP01.1-T3
Power supply	+5 V and +15 V internal from the control card
Size (length x width)	100 x 87 mm (3.94 x 3.43 inch)
Environmental Class	3K3 acc. to DIN IEC 721-3-3
Ambient temperature – during storage – in operation	 -25 °C ... +70 °C 0 °C ... +40 °C
Radio interference suppression level	A1 acc. to EN 55011
Noise immunity	EN 50082-2
Digital outputs (floating)	
Voltage input	18 ..-. 31 V DC
Maximum output current per output	0,5 A
Maximum total output current	1 A
H signal rate	24 V external – (0,4 Ω ∗output current) e.g. 24 V – (0,4 Ω ∗ 0,5 A) =23,8 V
L signal rate	Must not exceed 1,5 V at a load resistance ≥ 10 MΩ

Digital-inputs (floating)	
Input voltage	0..... 35 V
Input resistance	R_j ≈3KΩ
H – signal rate	+13 V ... +35 V
L – signal rate	-3 V ... +5 V or open terminal
Analog outputs KL24815SP01	
Current outputs	0 ... 20 mA respectively 4 ... 20 mA suitable for parameterization
Maximum load resistance	500 Ω
resolution	9 Bit
Analog outputs KL24815SP02	
Current outputs	0 ... 20 mA respectively 4 ... 20 mA suitable for parameterization
Voltage outputs to be switched via S1	0 ... 10 V respectively 2 ... 10 V suitable for parameterization
Analog input (can either be parameterized as current or voltage input), non-floating	
Current input	0...20 mA or 4...20 mA, suitable for parameterization
Input resistance	R_e = ~ 150 Ω
Current resolution 0...20 mA	10 bit
Min. load	10 µA at 10 mV DC
Voltage input	-10 V...+10 V
Input resistance	R_e = ~ 45 kΩ
Voltage resolution	±9 bit

11.2 Electrical installation

The optional extended control terminal strip is inserted at module slot 2. The connections are visible after the front cover has been removed.

Terminal diagram

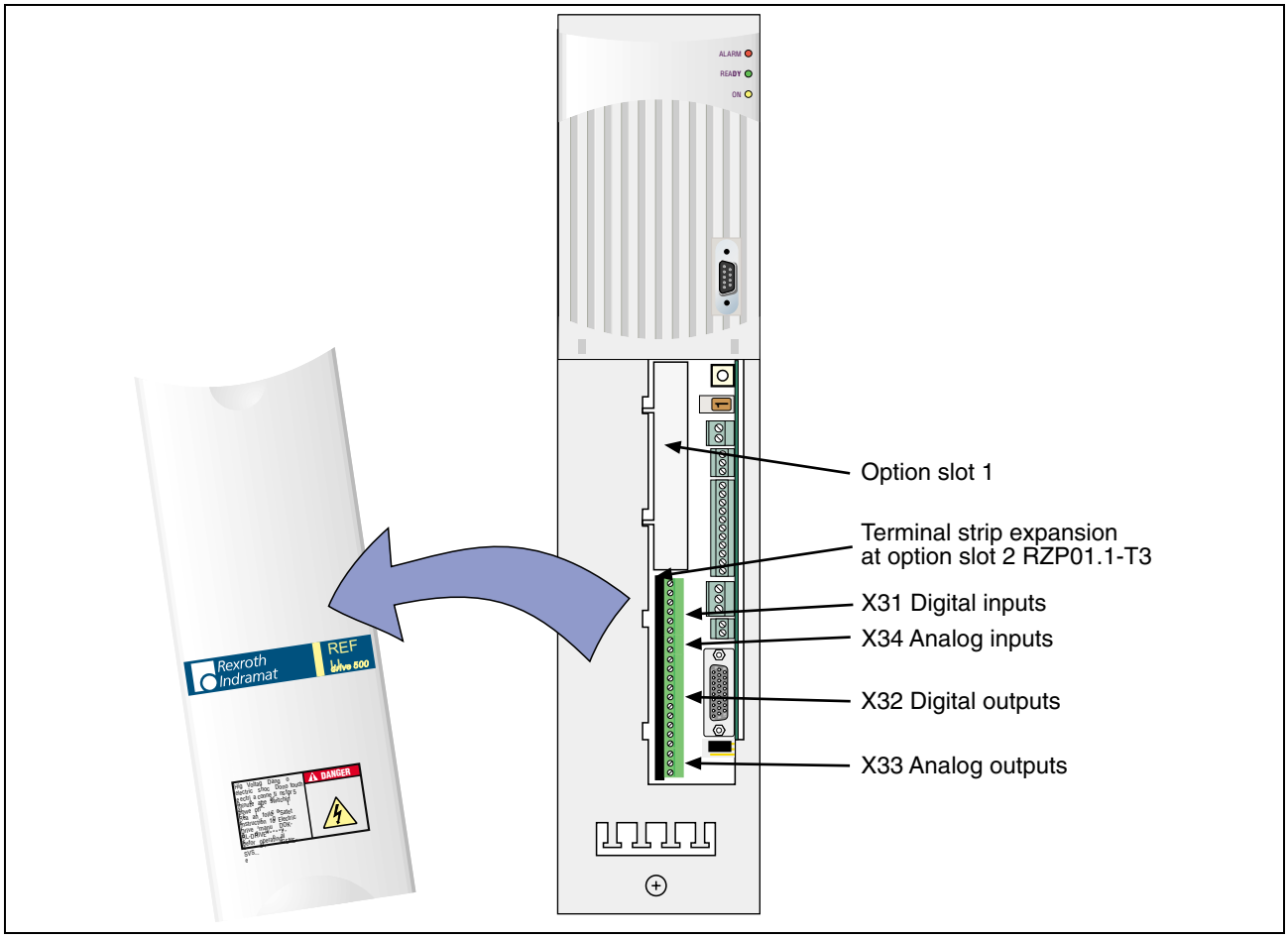


Fig. 11-1: Terminal layout diagram, extended control terminal strip

Connection assignment

Terminal	Comment
X31	**Digital inputs**
1	Ground, internal unit
2	Digital input 1
3	Digital input 2
4	Digital input 3
5	Digital input 4
6	Digital input, REFERENCE
X 32	**Digital outputs**
1	24 V DC external
2	0 V external
3	Digital output 1
4	Digital output 2
5	0 V external
6	0 V external
7	Digital output 3
8	Digital output 4
X33	**Analog outputs**
1	Analog output 1
2	Analog output 2
3	Analog output, REFERENCE
X34	**Analog input**
1	Analog input A -
2	Analog input A+
S1.1	Switch for analog output 1
On	Voltage output
Off	Current output
S1.2	Switch for analog output 2
On	Voltage output
Off	Current output

The 4 digital outputs are floating in relation to the electronic control devices, but have the same potential mutually.

The voltage difference between 0 V external and protective conductor must not exceed 30 V DC.

The digital outputs are resistant to short cuts and moreover cannot become subject of overheating.

Connection circuit diagram

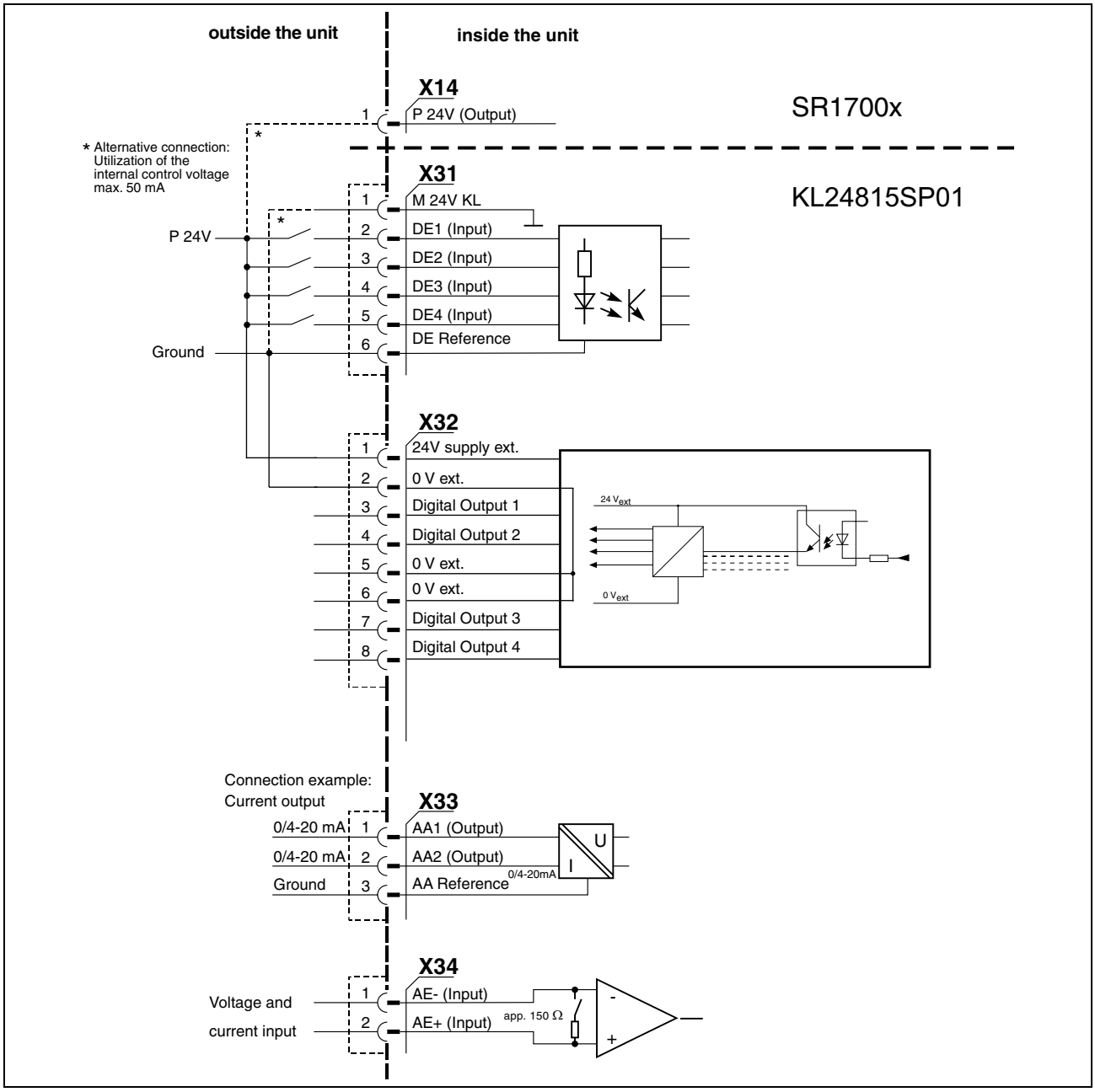


Abb. 11-2:Connection circuit-diagram KL24815SP01

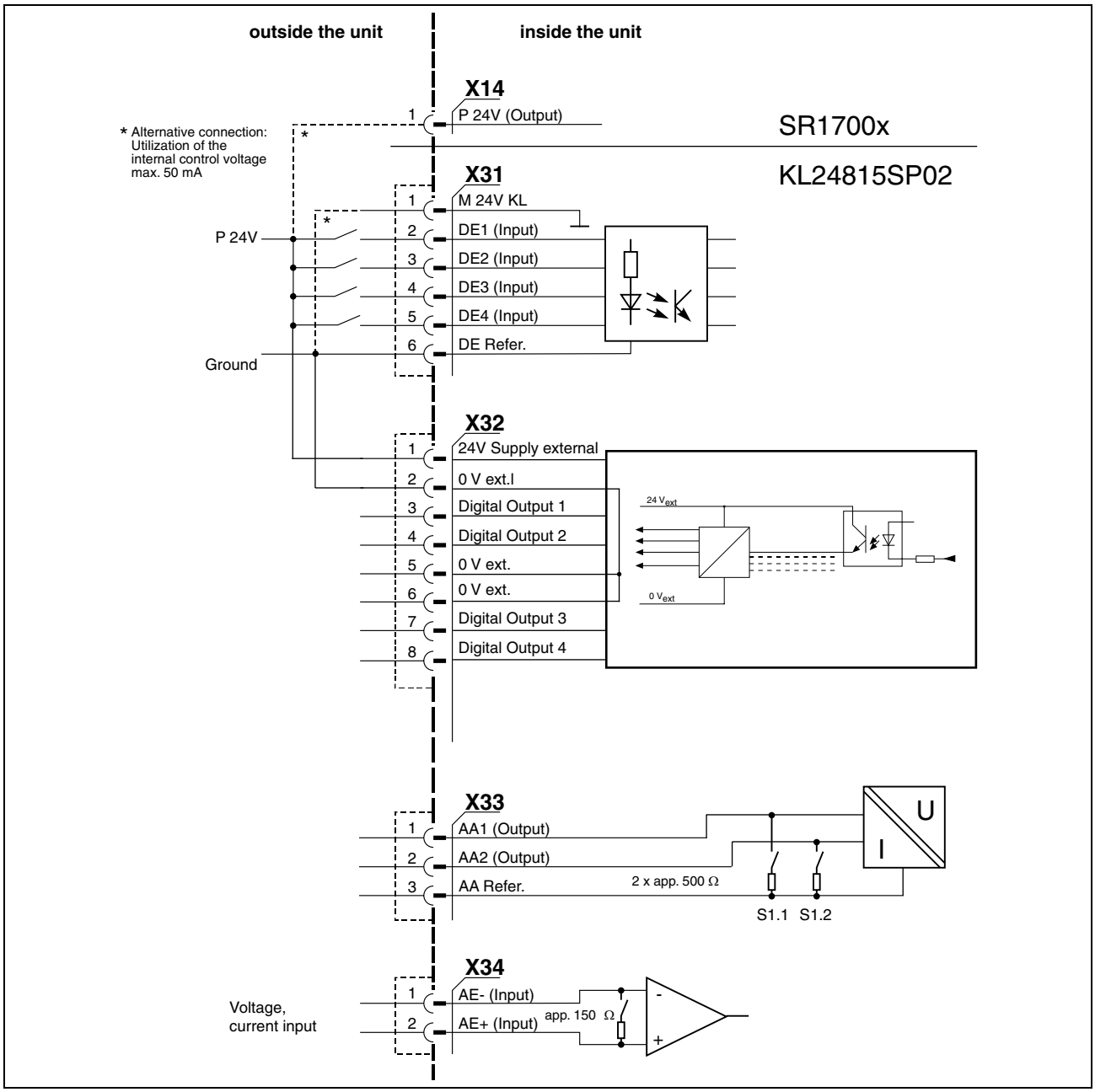


Fig. 11-3: Connection circuit-diagram KL24815SP02

11.3 Parameterization

Basic parameterization for RD51

The user can use pre-defined parameters (refer to the Instruction Manual). These can either be accessed via the numerical list or as follows via the menu:

PARAMETERIZATION\PROMPTED PARAM.\OPTIONS\TERMINAL STRIP

Setting the specific parameters for the extended control terminal strip

P. No.:	Name	Description / explanation, selectable options	Factory setting min ... max values	Passw. Prog.
0882	Option, dig. input1		I no function	1
		Digital input 0 = **I** no function (**I**=input) 1 = **I** operating enable 2 = **I** not alarm ext. 3 = **I** not fault ext. 4 = **I** fault reset 5 = **I** fmin select 6 = **I** direct. rotat. 7 = **I** not volt. disc. 8 = **I** not parking 9 = **I** RFG park 10 = **I** RFG up stop 11 = **I** motp. faster 12 = **I** motp. slower 13 = **I** WLM sensit. up 14 = **I** WLM sensit. down 15 = **I** WLM sensit. StrtStp 16 = **I** inhib. touch mess 17 = **I** inhib. load limit 20 = **I** setp. mem. bit4 21 = **I** TEST/NORMAL 22 = **I** setp. mem. bit0 23 = **I** setp. mem. bit1 24 = **I** setp. mem. bit2 25 = **I** setp. mem. bit3 26 = **I** param. set bit0 27 = **I** param. set bit1 28 = **I** param. set bit2 29 = **I** param. set bit3 30 = **I** param. set bit4	0 ... 69	r/w off

P. No.:	Name	Description / explanation, selectable options	Factory setting min ... max values	Passw. Prog.
		31 = **IN** operating enable (**IN** = input for NORMAL) 32 = **IN** not alarm ext. 33 = **IN** not fault ext. 34 = **IN** fault reset 35 = **IN** fmin select 36 = **IN** direct. rotat. 37 = **IN** no volt. disc. 38 = **IN** not fast stop 39 = **IN** RFG parking 40 = **IN** RFG up stop 41 = **IN** motp. faster 42 = **IN** motp. slower 43 = **IN** WLM sensit. up 44 = **IN** WLM sensit. down 45 = **IN** WLM sensit. StrtStp 46 = **IN** inhib.touch mess 47 = **IN** inhib. load limit 51 = **IT** operating enable (**IT**=input for TEST) 52 = **IT** not alarm ext. 53 = **IT** not fault ext. 54 = **IT** fault reset 55 = **IT** fmin select 56 = **IT** direct. rotat. 57 = **IT** not volt. disc 58 = **IT** not fast stop 59 = **IT** RFG parking 60 = **IT** RFG up stop 61 = **IT** motp. faster 62 = **IT** motp. slower 63 = **IT** WLM sensit. up 64 = **IT** WLM sensit. down 65 = **IT** WLM sensit. StrtStp 16 = **IT** inhib.touch mess 17 = **IT** inhib. load limit		
0883	Option, dig.input2	As for parameter P0882, from value 0 to 69.	I no function 0 ... 69	1 r/w off
0884	Option, dig.input3	As for parameter P0882, from value 0 to 69.	I no function 0 ... 69	1 r/w off
0885	Option, dig.input4		I no function	1
		As for parameter P0882, from value 0 to 69.	0 ... 69	r/w off

P. No.:	Name	Description / explanation, selectable options	Factory setting min ... max values	Passw. Prog.
0886	Option relais 1	Digital output 1 70 = **O** no function (**O**=output) 71 = **O** ready to switch-on 72 = **O** st.: Ready to switch-on 73 = **O** ready 74 = **O** st.: Ready 75 = **O** run 76 = **O** not fault 77 = **O** switch-on inhibit 78 = **O** no alarm 79 = **O** motor rotates 1 (on & (< x.x sec) | (i > x.xx %)) 80 = **O** motor rotates 2 (on & (fact > fmin) & (i > x.xx %)) 81 = **O** direct. cw 82 = **O** current limiting 83 = **O** not mot. warning temp 84 = **O** not mot. overtemp 85 = **O** RFG up 86 = **O** RFG down 87 = **O** RFG reached 88 = **O** setpoint reached 89 = **O** setpoint in tolerance 90 = **O** fmin limiting 91 = **O** fmax limiting 92 = **O** TEST selected 93 = **O** control line contactor 94 = **O** f act <= f min 95 = **O** WLM spark signal 96 = **O** WLM load limit 97 = **O** mech. brake open	O no function 70 ... 99	1 r/w off
0887	Option, relay 2	Digital output 2 As for parameter P0886, from value 70 to 99.	O no function 70... 99	1 r/w off
0888	Option, relay 3	Digital output 3 As for parameter P0886, from value 70 to 99.	O no function 70 ... 99	1 r/w off
0889	Option, relay 4	Digital output 4 As for parameter P0886, from value 70 to 99.	O no function 70 ... 99	1 r/w off
0891	Option, analog output 1	0 = no function 1 = fact output, frequency 2 = Iact output, current 3 = Isq torque generating 4 = Vact output, voltage 5 = Pact output, power 6 = Pact active power	No function 0 ... 6	1 r/w off
0892	Option, analog output 2	As for parameter P0891.	No function 0 ... 6	1 r/w off
0221.XX	Filter time	XX = 00 for module slot 1 XX = 01 for module slot 2	0 ms 0 ... 10000 ms	1 r/w off

P. No.:	Name	Description / explanation, selectable options	Factory setting min ... max values	Passw. Prog.
0741.XX	Signal, output block	XX = 00 for module slot 1 XX = 01 for module slot 2 0 = direct 1 = absolute value 2 = inverted 3 = absolute value inverted	Absolute value 0 ... 3	1 r/w on
0742.XX	Output block, normal	Normalization of the output block XX = 00 for module slot 1 XX = 01 for module slot 2	100 % 6.26 ... 200.00 %	1 r/w on
0743.XX	Output block	XX = 00 for module slot 1 XX = 01 for module slot 2 0 = 0 ... ±100% 1 = +20 ... +100%	0 ... ±100% 0 / 1	1 r/w on
0744.XX	Output block, offset	**Is only displayed, if** P0891 **or** P0892 **has a function.** XX = 00 for option, analog output 1 XX = 01 for option, analog output 2	0.00 % -100.00 ... 100.00 %	1 r/w on

Free parameterization

The operator can access all of the parameters (refer to the function charts and parameter lists of the appropriate unit).

Communications is established between the “Control card” and the option card via the process data. The extended control terminal strip can only be inserted at module slot 2.

The inputs of the extended control terminal strip are converted on the process data channels, and are available as D parameter.

The firmware addresses an option card at slot 2 as interface SS4.

	Module slot 2	
Option input	**Process data channel**	**D parameters**
Digital input 1	PZD1 from SS4	D1100
Digital input 2	PZD2 from SS4	D1101
Digital input 3	PZD3 from SS4	D1102
Digital input 4	PZD4 from SS4	D1103
Analog input		D1806

Fig. 11-3: Digital inputs, analog input

Signals are connected to the digital and analog outputs, by connecting the appropriate D parameter to the variable parameter sources at the interface output.

	Module slot 2	
Option output	**Process data channel**	**Var. parameter source**
Digital output 1	PZD1 from SS4	P0491.0
Digital output 2	PZD2 from SS4	P0491.1
Digital output 3	PZD3 from SS4	P0491.2
Digital output 4	PZD4 from SS4	P0491.3
Analog output 1	PZD5 from SS4	P0491.4
Analog output 2	PZD6 from SS4	P0491.5

Fig. 11-4: Digital outputs

The digital outputs number 1 and 2 are designed as current outputs at a capacity of 4 ... 20 mA . All units from version KL24815SP02 on will carry a double switch on the board which allows the user to alter between current and voltage output.

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13 Service & Support

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  über Service Call Entry Center Mo-Fr 07:00-18:00
  - via Service Call Entry Center Mo-Fr 7:00 am - 6:00 pm
- per Fax - by fax: **+49 (0) 9352 40 49 41**
- per e-Mail - by e-mail: **service.svc@boschrexroth.de**

13.2 Service-Hotline

Außerhalb der Helpdesk-Zeiten ist der Service direkt ansprechbar unter

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*) Data in the present documentation may have become obsolete since printing.

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2. Angaben auf dem Typenschild der betreffenden Produkte, insbesondere Typenschlüssel und Seriennummern.
3. Tel.-/Faxnummern und e-Mail-Adresse, unter denen Sie für Rückfragen zu erreichen sind.

For quick and efficient help, please have the following information ready:

1. Detailed description of the failure and circumstances.
2. Information on the type plate of the affected products, especially type codes and serial numbers.
3. Your phone/fax numbers and e-mail address, so we can contact you in case of questions.

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