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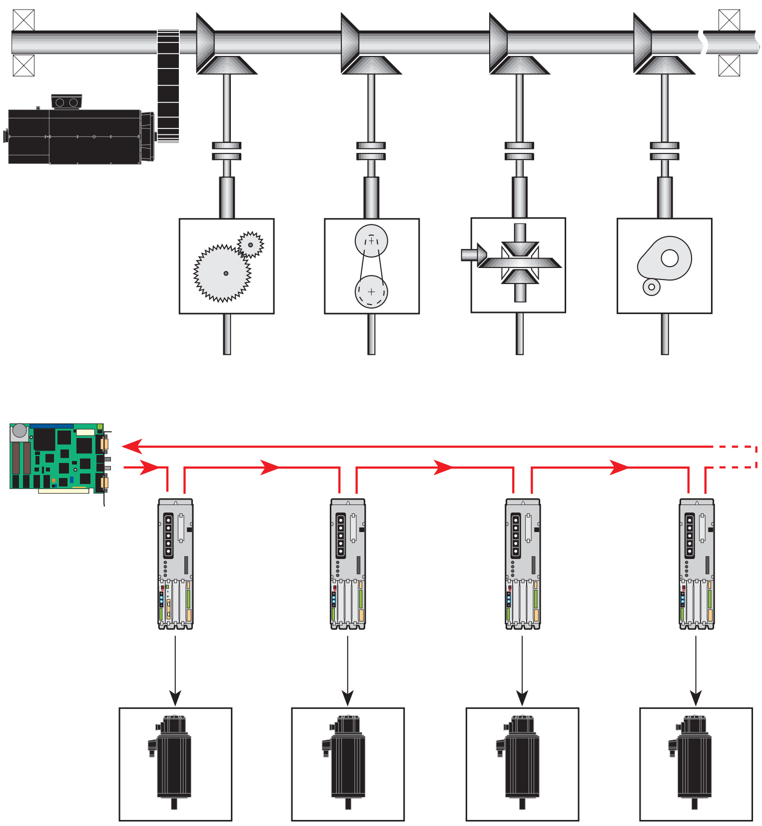

SYNAX

Decentralized System for the Synchronization of Machine Axes

Project Planning

DOK-SYNAX*-SY*-04VRS**-PRJ1-EN-P

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The purpose of this documentation This documentation assists
- in the selection of units and hardware components and
- in the basic control cabinet construction

Editing sequence

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Contents

1 Determining Drive and System Configurations

1.1 General

SYNAX systems are made up of up to 40 digital intelligent drives of the DIAX03 drive family, one CLC-D or CLC-P plugin control, one LWL connection between these components meeting SERCOS interface standards (IEC 1491) as well as a number of optional plugin cards for the digital intelligent drives (also see section 1 of the Functional Description).

All DIAX03 drive controllers are suited for operating rotary and linear motors belonging to the MDD product line, MKD, 2AD, 1MB, MBW, LAR, LAF and LSF.

A number of plugin cards are available for the drive controllers that enable an optimum adaptation to the respective drive and control tasks.

The plugin cards functionally assigned to the CLC control are addressed directly by it via the SERCOS interface. The digital intelligent drives thus fill a two-fold purpose. In addition to their intelligent drive functions, they also serve as a decentralized unit rack for the control-related plugin cards (see Fig. 1-2).

Additionally, there are plugin modules directly connected to the CLC-D which can only be used in the CCD box.

Only configured drive controllers are delivered for logistical reasons. In other words, basic units or individuals cards are only available for servicing.

Note: The SYNAX system is adapted to the hardware on the machine in two steps:

- First, the drive concept in terms of motor is determined this includes drive amplifiers and linear scale (as part of the basic drive configuration).
- Then, CLC control functions and plugin cards allocated to the CLC control are determined.

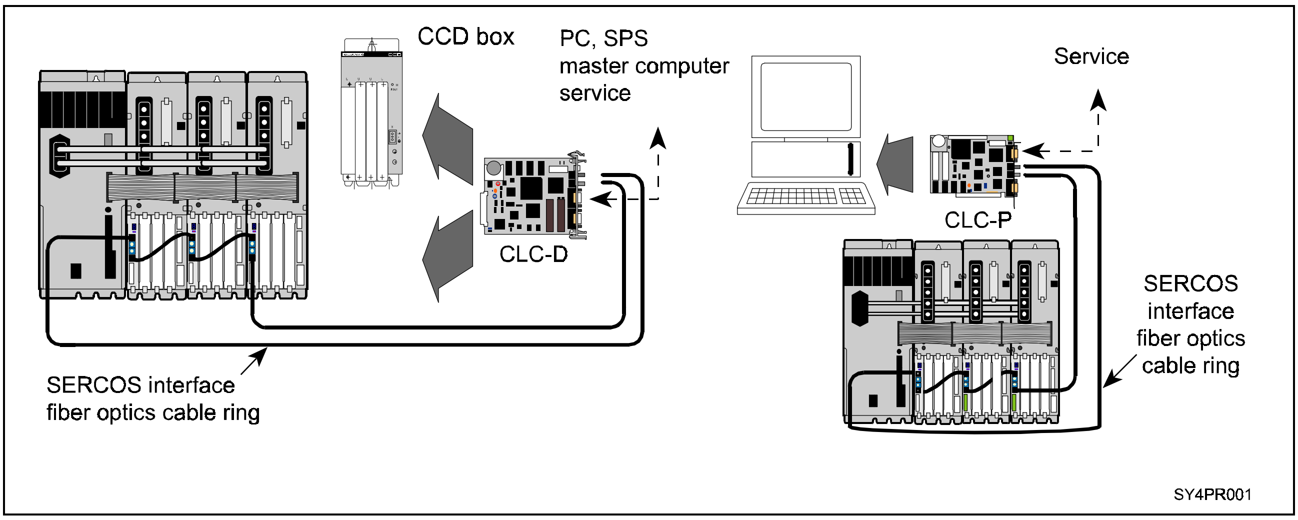


Fig. 1-1: CLC configurations

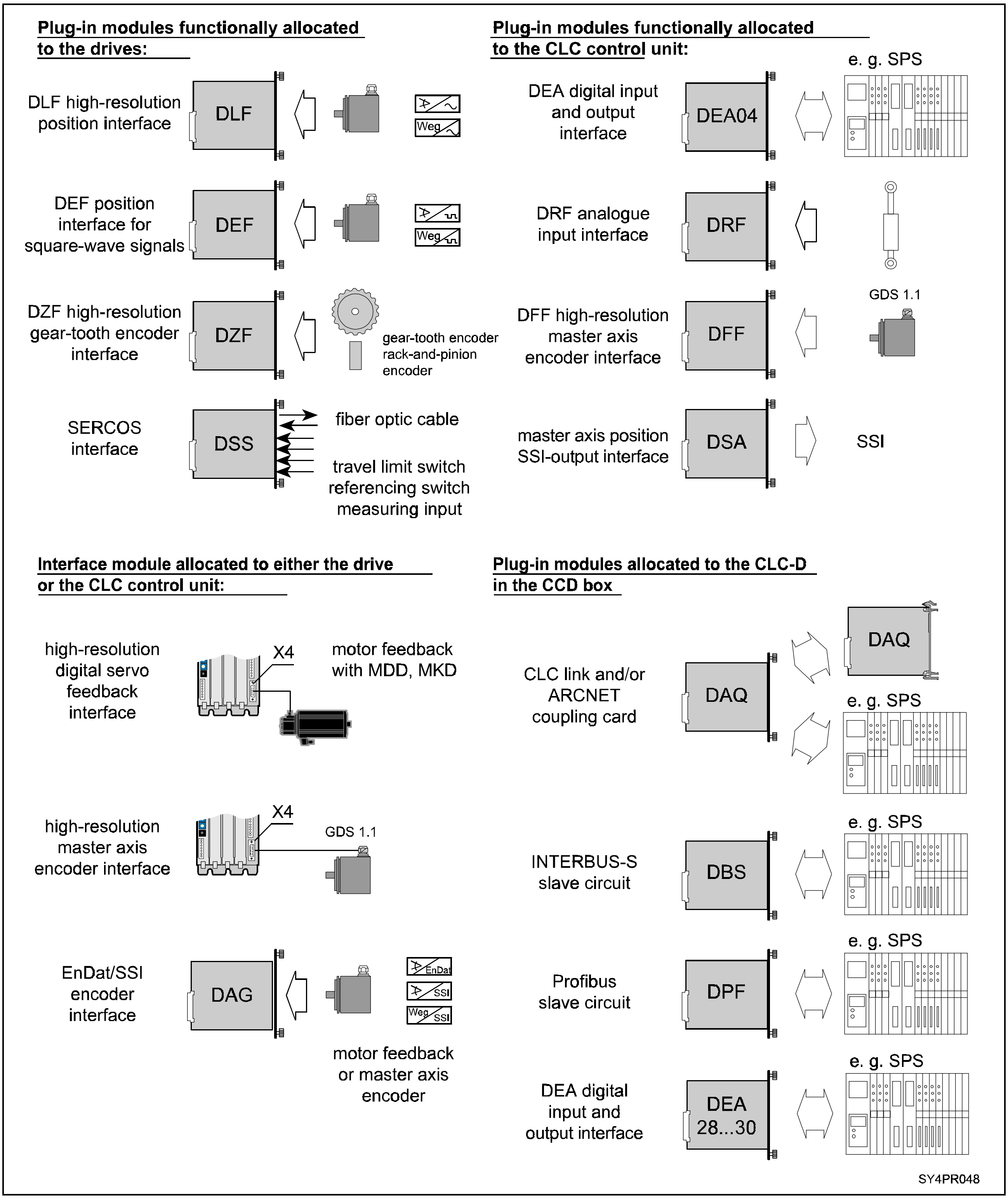


Fig. 1-2: Functional allocation of the plugin module relating to drives and CLC plugin controls with SYNAX systems configurations

2 Determining basic drive configuration

2.1 Procedure

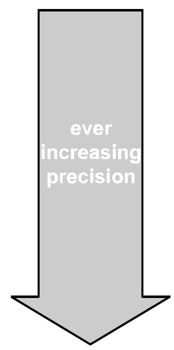
The drive configuration choices (motor, drive amplifier, drive-related plugin cards) conform with the power requirements and the precision requirements of the respective drive task.

The following procedure is recommended.

a) Definition of precision requirements

A differentiation is made between absolute and relative precision (repetitive precision) as well as scale resolution. It depends primarily on the mechanical transmission elements and the quality of the mounting location of the linear scale.

Motor type	Motor
Motor with gearbox and resolver as motor feedback	MKD
Motor with gearbox and DSF as motor feedback	MDD 2AD
Motor with gearbox and external encoder mounted loadside (direct position detection)	MKD MDD 2AD
Conventional motor as direct drive and encoder loadside	MKD MDD 2AD
Mounted motor and loadside encoder	1MB MBW



SY4PR002

Fig. 2-1: Selection table for precision

b) Selecting the suitable motor/controller combinations

The selection lists must be used. The following figure offers a rough orientation.

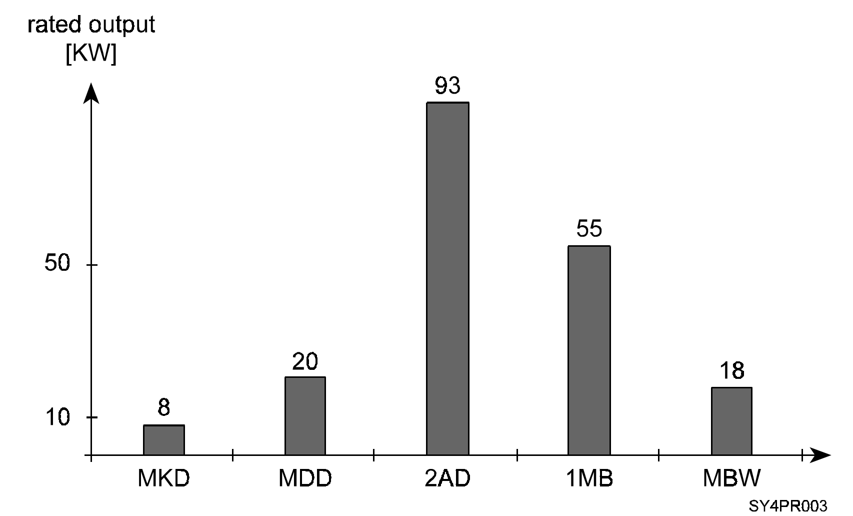


Fig. 2-2: Power range of different lines of motors

Once motor type and encoder arrangement are decided on, a suitable basic drive configuration is selected using the subsections below.

2.2 Rotary axes

Drive with step-down gear and indirect position detection

Features:

- Precision is determined with gear error (generally four angle minutes)
- encoder is integrated into motor
- motor encoder with singleturn or multiturn absolute encoder

Usable motors:

- MDD
- MKD
- 2AD (only with digital servo feedback)

Basic drive configuration BE12:

MDD, MKD, 2AD with DSF:

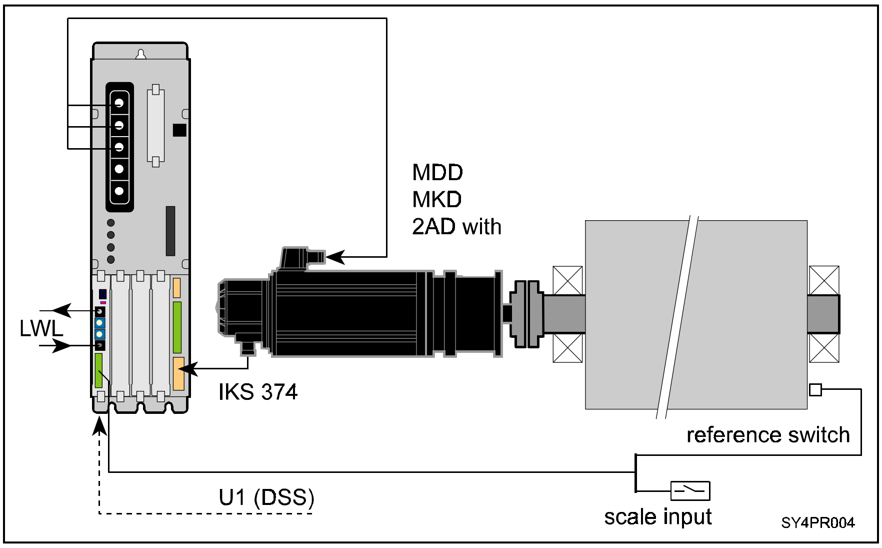


Fig. 2-3: Drive with step-down gears and indirect position detection

Drive with step-down gears and direct incremental position detection

Feature:

- Precision determined by gear error (generally four angle minutes)
- encoder is integrated into motor
- motor encoder single-turn encoder
- load angle directly detected via incremental, external encoder
- gear error is statically compensated

Usable motors:

- MDD
- MKD
- 2AD (only with digital servo feedback)

Basic drive configuration BE32:

MDD, MKD, 2AD:

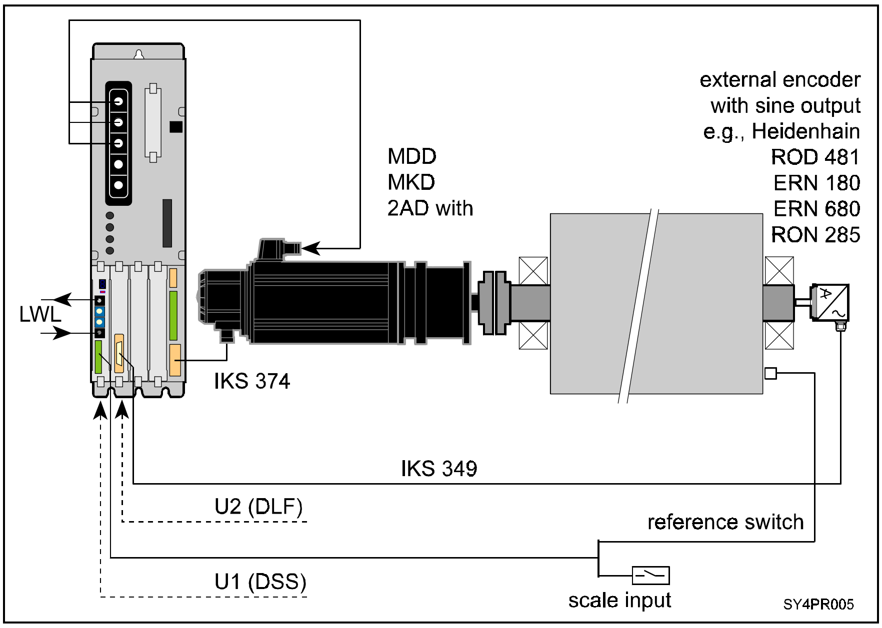


Fig. 2-4: Drive with step-down gear and direct incremental position detection

Drive with step-down gear and direct absolute position detection

Feature:

- Precision is determined by gear error
  (generally four angle minutes)
- encoder is integrated into motor
- motor encoder multiturn absolute encoder
- load angle detected via absolute, external encoder directly
- gear error statically compensated

Usable motors:

- MDD
- MKD
- 2AD (only with digital servo feedback)

Basic drive configuration BE04:

MDD, MKD, 2AD:

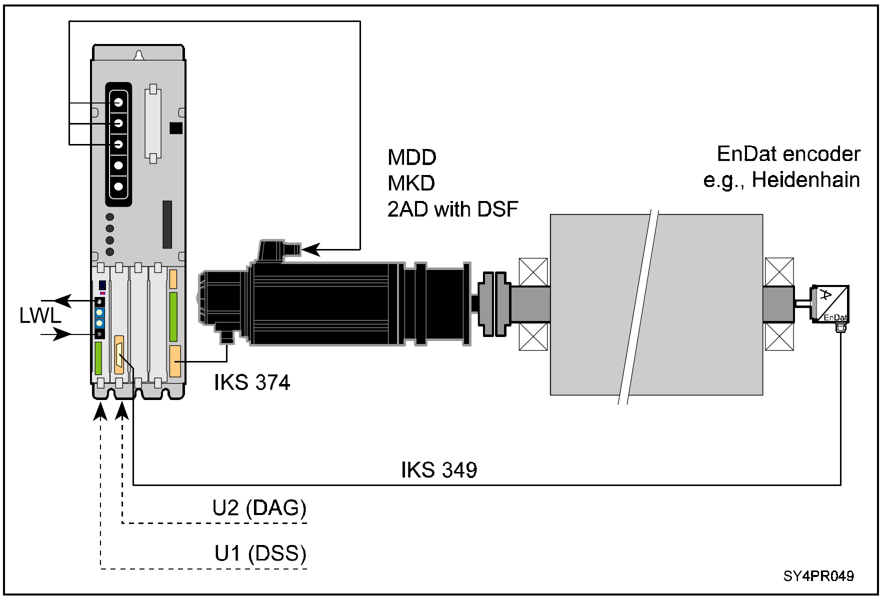


Fig. 2-5: Drive with step-down gear and direct absolute position detection

Drive with indirect position detection

Features:

- no gear between motor and cylinder
- high level of precision an be achieved
- encoder is integrated into motor

Usable motors:

- 1MB

Basic drive configuration BE37:

1MB:

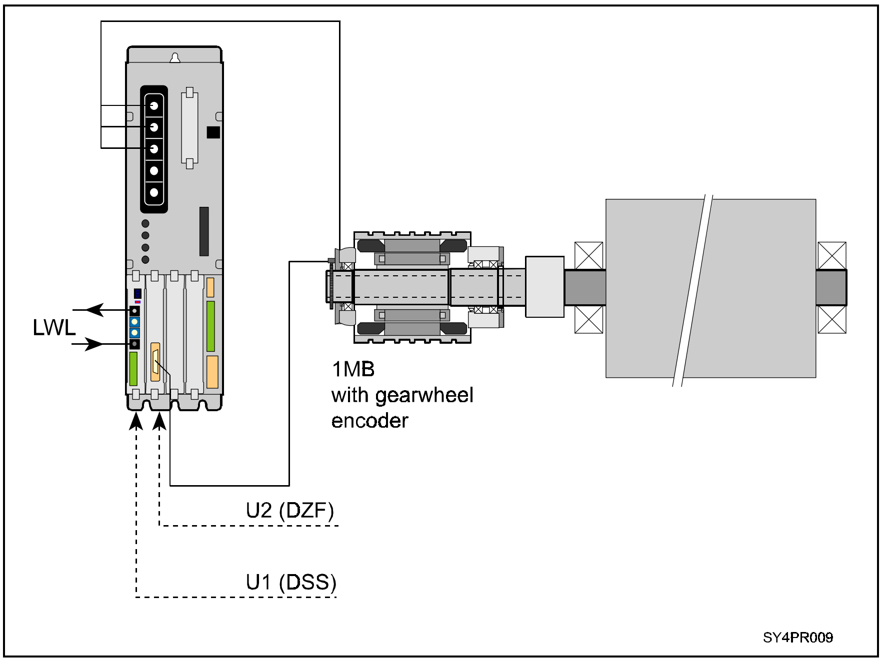


Fig. 2-6: Drive with 1MB motor with indirect position detection

Drive with direct incremental position detection

Features:

- no gear between motor and cylinder
- high level of precision can be achieved
- load angle determined via incremental external encoder directly
- gear error statically compensated
- **With MDD and MKD motors:**
  - motor encoder for commutation is needed
  - absolute position detection via motor encoder
- **With MBW, 1MB and 2AD motors:**
  - no separate motor encoder
  - no absolute position detection
- **With MBW and 1MB motors:**
  - rigid coupling between motor and cylinder, resulting in highest level of static and dynamic stiffness

Usable motors:

- MBW (without motor encoder)
- 1MB (without motor encoder)
- 2AD (without motor encoder)
- MDD (only in connection with motor encoder)
- MKD (only in connection with motor encoder)

Basic drive configuration BE32:

MBW, 2AD, 1MB:

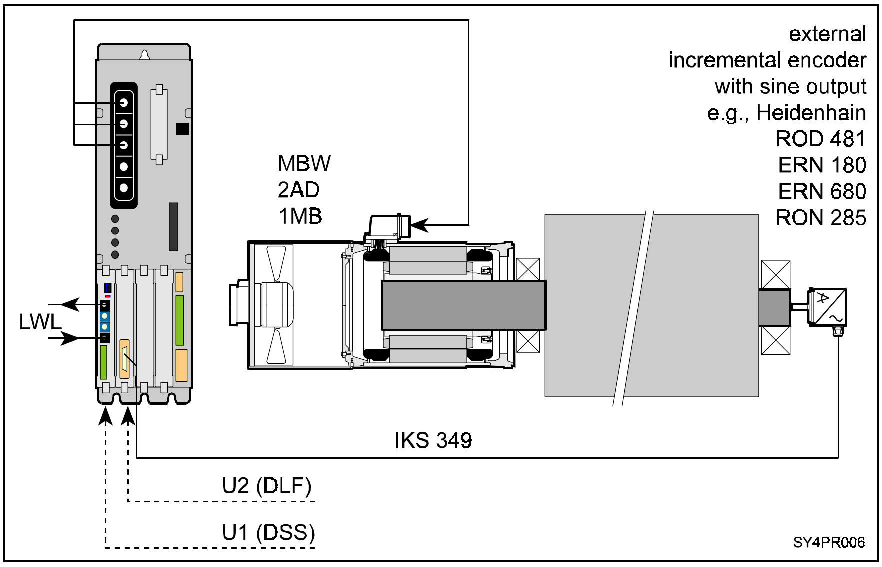


Fig. 2-7: Drive with MBW, 2AD or 1MB motor with direct incremental position detection

Basic drive configuration BE32:

MDD, MKD:

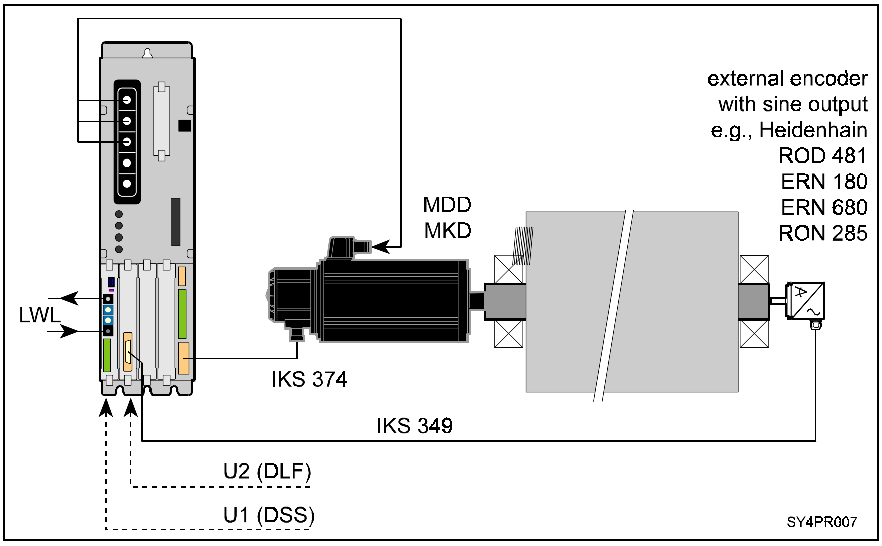


Fig. 2-8: Drive with MDD or MKD motor with direct incremental position detection

Drive with direct absolute position detection

Features:

- no gear between motor and cylinder
- high level of precision an be achieved
- load angle detected via absolute, external encoder directly
- gear error statically compensated
- **With MDD and MKD motors:**
  - motor encoder for commutation is needed
  - absolute position detection via external encoder
- **With MBW, 1MB and 2AD motors:**
  - no separate motor encoder
  - absolute position detection
- **With MBW and 1MB motors:**
  - rigid coupling between motor and cylinder, meaning highest level of static and dynamic stiffness

Usable motors:

- MBW (without motor encoder)
- 1MB (without motor encoder)
- 2AD (without motor encoder)
- MDD (only in connection with motor encoder)
- MKD (only in connection with motor encoder)

Basic drive configuration BE04:

MBW, 2AD, 1MB:

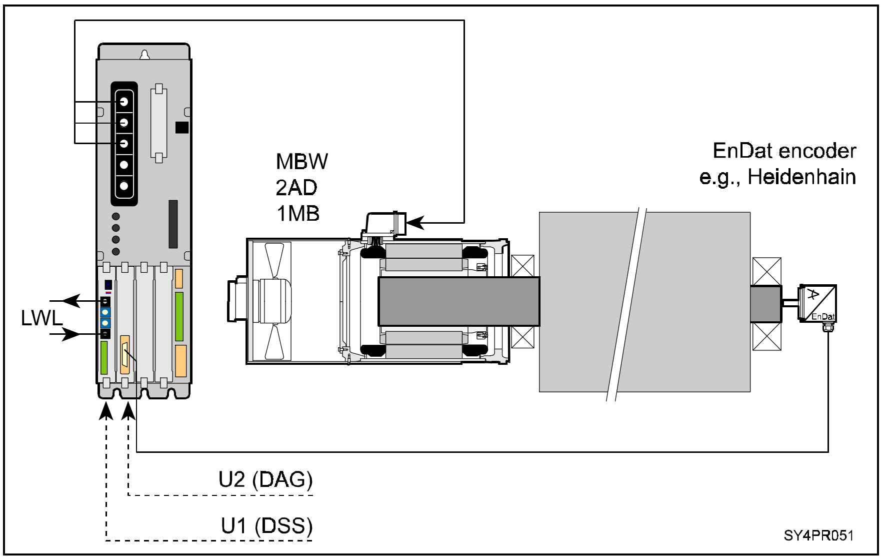


Fig. 2-9: Drive with MBW, 2AD or 1MB motor with direct absolute position detection

Basic drive configuration BE32:

MDD, MKD:

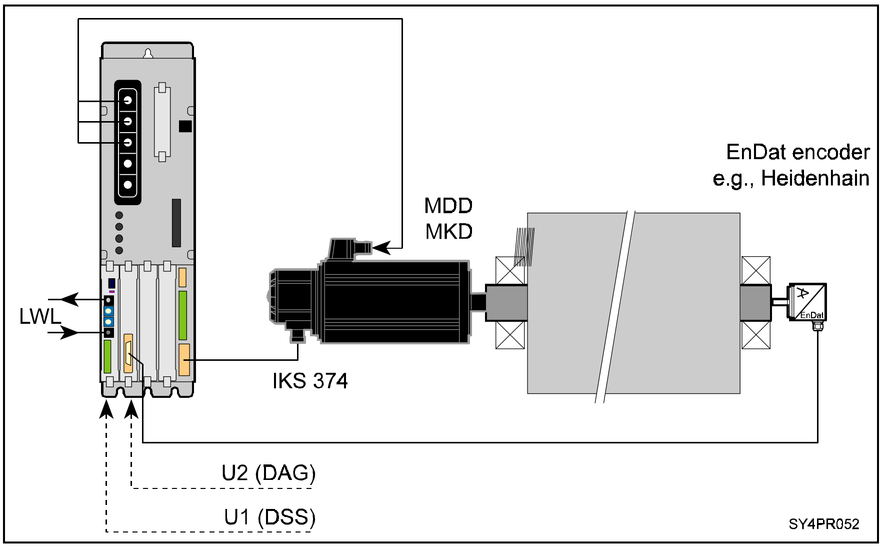


Fig. 2-10: Drive with MDD or MKD motor with direct absolute position detection

2.3 Linear axes

Drive with indirect position detection

Features:

- accuracy determined by spindle and gear errors
- encoder is integrated into motor
- motor encoder either with singleturn or multiturn absolute encoder

Usable motors:

- MDD
- MKD
- 2AD with DSF
- 1MB with gearwheel encoder

Basic drive configuration BE12:

MDD, MKD, 2AD with DSF

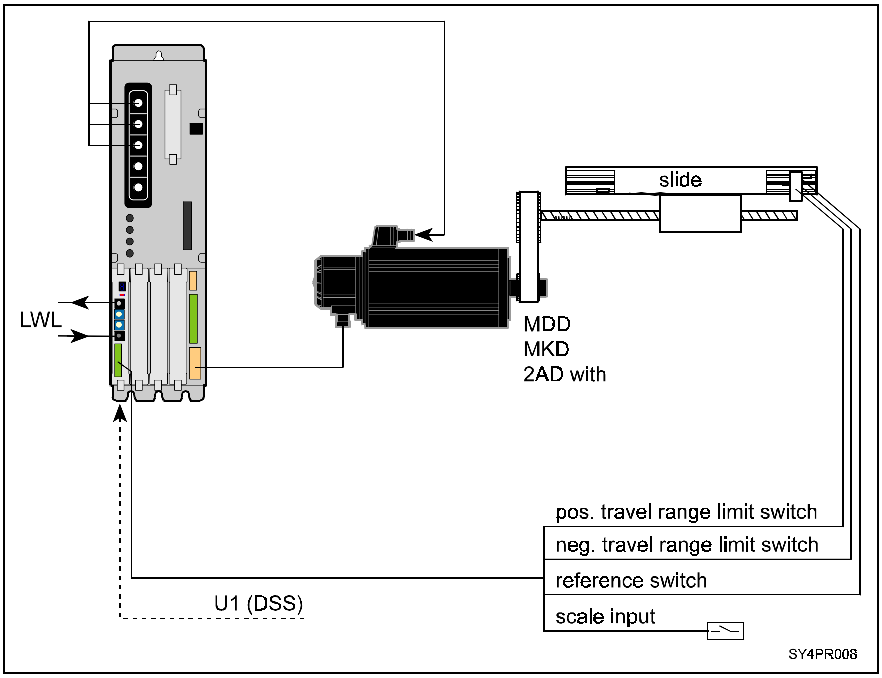


Fig. 2-11: Drive with MDD, MKD or 2AD motor with DSF and indirect position detection

Drive with direct incremental position detection

Features:

- motor encoder with either singleturn or multiturn absolute encoder
- load position detected via incremental, external encoder directly
- gear error statically compensated

Usable motors:

- MDD
- MKD
- 2AD with DSF

Basic drive configuration BE32:

MDD, MKD, 2AD with DSF

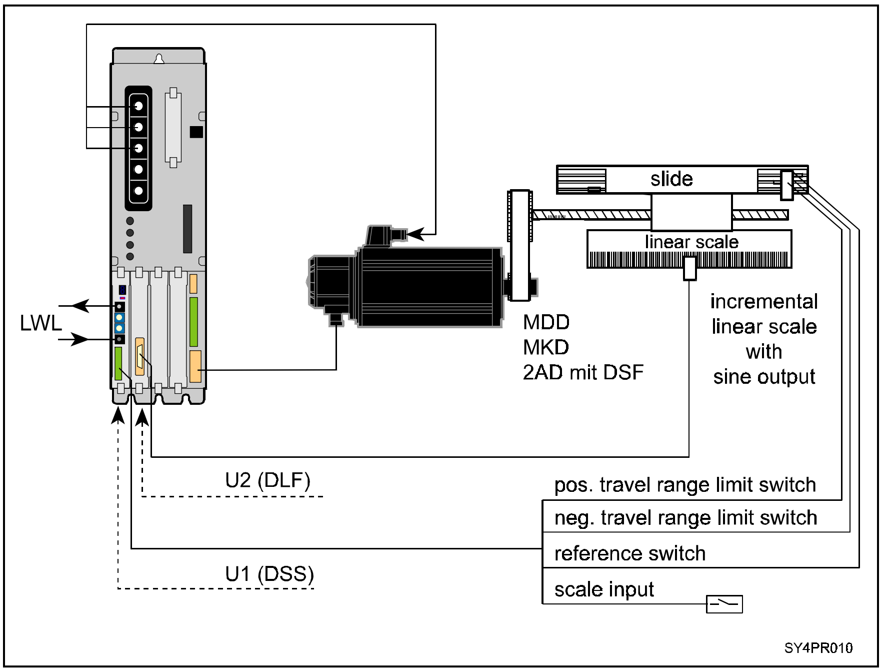


Fig. 2-12: Drive with MDD, MKD or 2AD with DSF motor with direct incremental position detection

Drive with direct absolute position detection

Features:

- gearwheel encoder als motor encoder
- load position detected via absolute, external encoder directly
- gear error statically compensated

Usable motors:

- 2AD with gearwheel encoder
- 1MB with gearwheel encoder

Basic drive configuration BE04:

1MB:

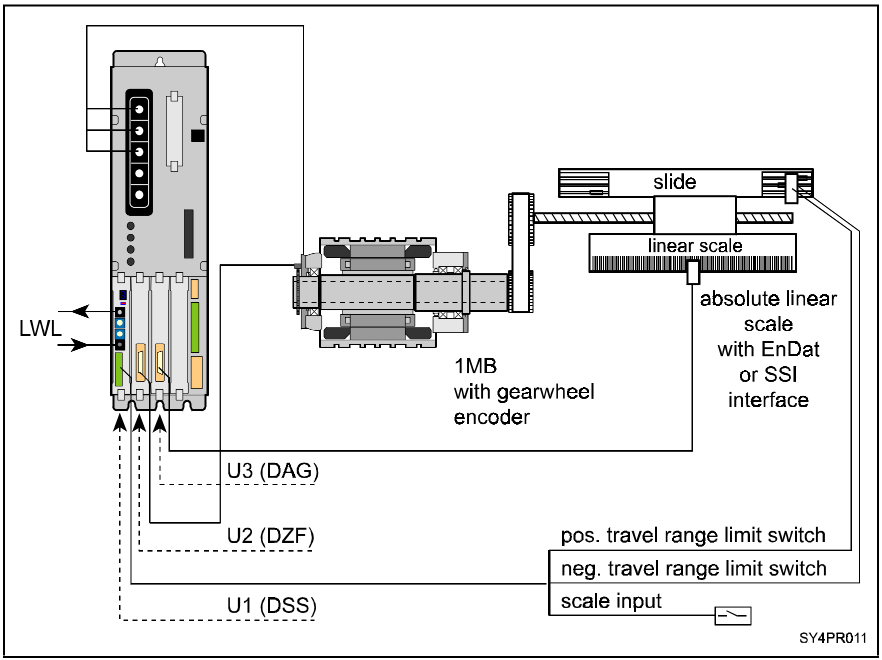


Fig. 2-13: Drive with 1MB motor with gearwheel encoder with direct absolute position detection

Drive with linear motor and incremental position detection

Features:

- incremental position detection via external linear scale with sinusoidal output
- Direct Drive
- highest possible degree of static and dynamic precision
- high achievable acceleration of up to 100 m/s²

Usable motors:

- LAF
- LAR

Basic drive configuration BE32:

LAR, LAF:

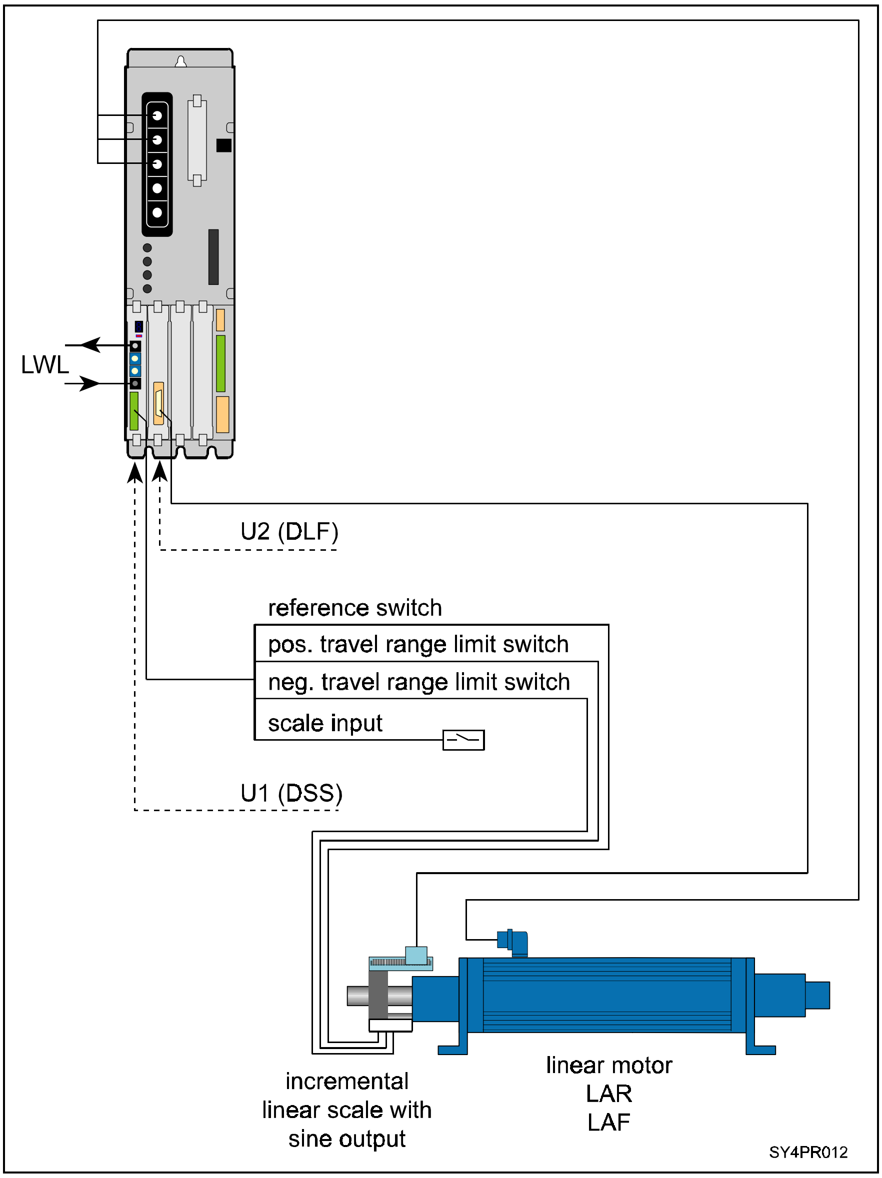


Fig. 2-14: Drive with linear motor LAR or LAF and incremental position detection

Drive with linear motor and absolute position detection

Features:

- absolute position detection via external linear scale with EnDat interface
- DirectDrive
- highest possible degree of static and dynamic precision
- high achievable acceleration of up to 100 m/s²

Usable motors:

- LAF
- LAR

Basic drive configuration BE04:

LAR, LAF:

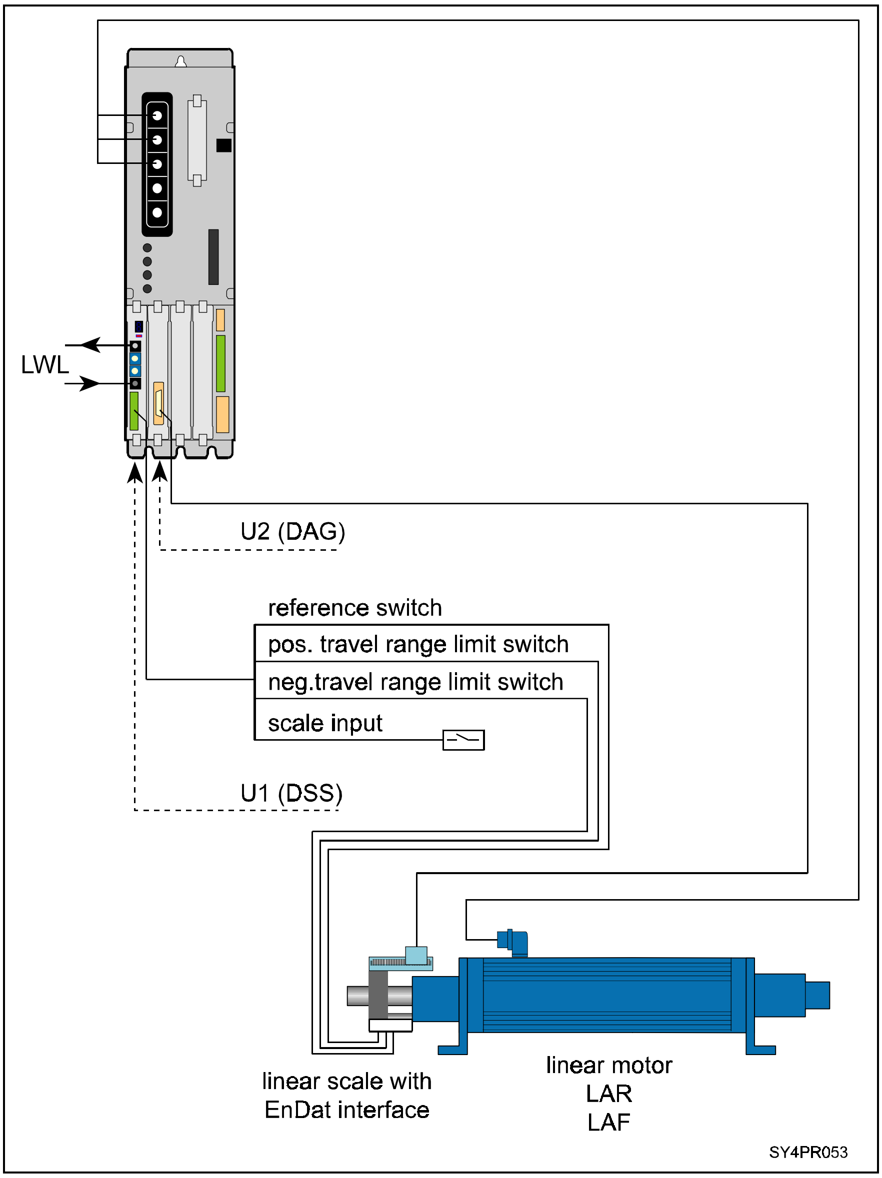


Fig. 2-15: Drive with linear motor LAR or LAF and absolute position detection

3 Determining the control-related plugin cards

3.1 Determining the control card

Control card CLC

The CLC control card supports drive control. Hereinafter it will be called *CLC*. The connection between control and drives is via the fiber optic cable bus SERCOS interface. Up to 40 following drives can be assigned to one CLC.

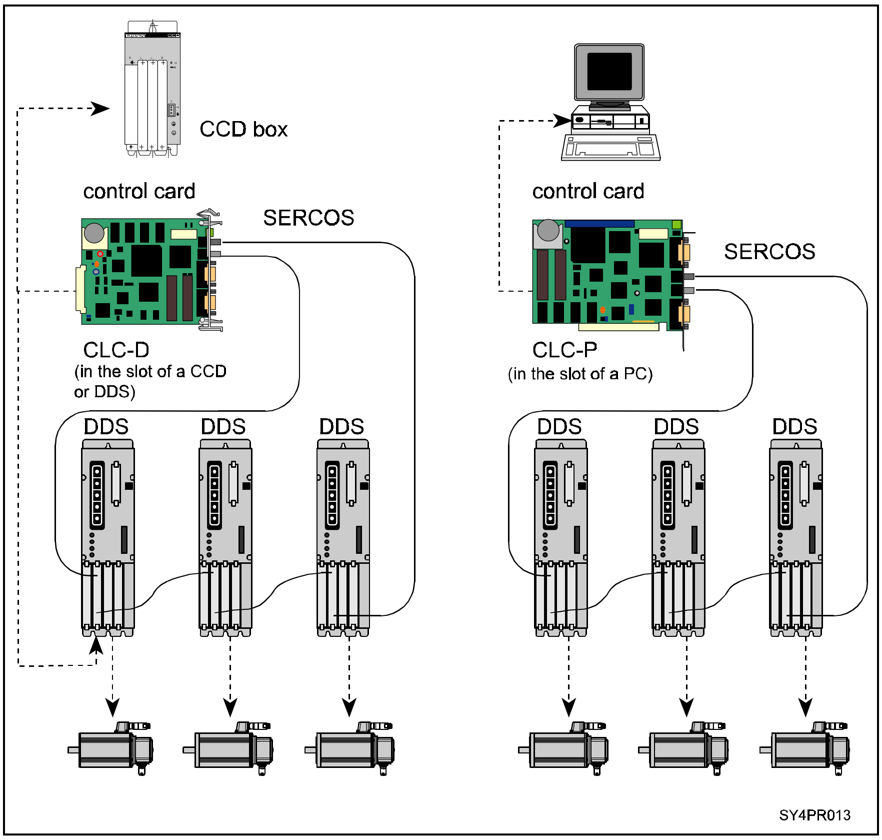


Fig. 3-1: Control card CLC-D/CLC-P

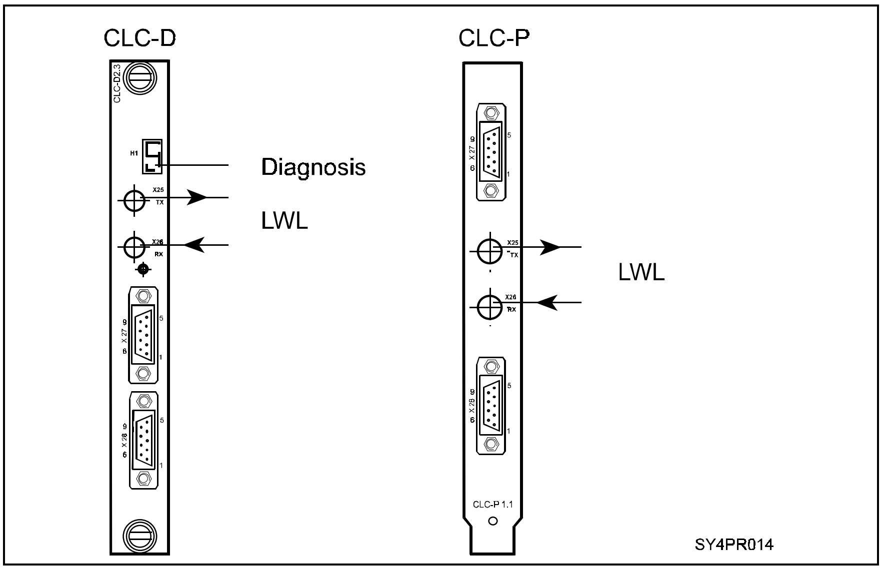


Fig. 3-2: Front panel of control cards CLC-D/CLC-P

The CLC is available in the following versions:

CLC-D

The CLC-D is inserted into a slot in one of the drive controllers which is only its power source. In addition to the LWL connections, the CLC-D also has two serial interfaces (RS 232) that can be used for the following functions:

- SynTop for startup
- user communication (e.g., 3964R)
- pattern data transmission

The CLC-D has a 7-segment display for displaying states.

CLC-P

The CLC-P has been designed to be inserted into a PC slot. It can access all the system parameters via the PC bus (ISA). With this arrangement, it is possible to implement an operator interface on the PC.

A terminal or PC for setups and servicing can be mounted via one of the serial interfaces (RS 232).

3.2 CLC link and ARCNet circuit

The CLC-D control card can be connected to a CLC link and an ARCNet via a DAQ coupler card DAQ.

The DAQ card is a plugin card developed for the CLC-D card.

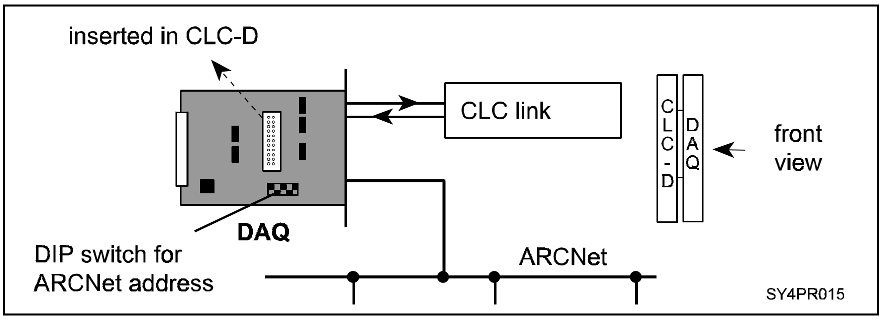


Fig. 3-3: ARCNet coupler card DAQ

3.3 CLC link and determining parallel I/Os

A parallel I/O DEA04 card can be inserted into every drive controller (DDS).

Binary signals can be exchanged with this card between the CLC and a SPC. The voltage level equals 24 volts. The inputs and outputs are opto-decoupled.

Fifteen inputs (the 16th input monitors the 24 V power source) and 16 outputs are available. The 16th input can be used as a watchdog or a regular output.

The signals applied to this I/O are transmitted via the SERCOS LWL ring to the CLC.

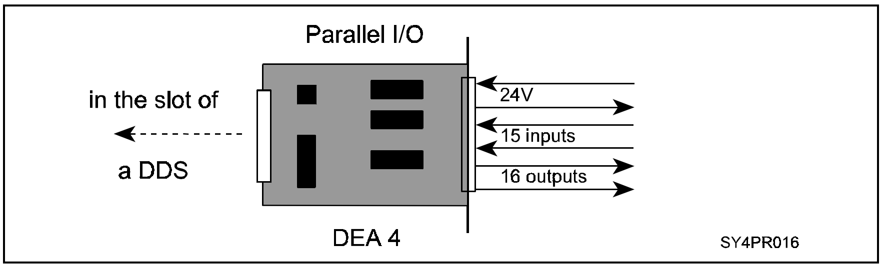


Fig. 3-4: Parallel I/O card DEA4

Parallel I/O card DEA28, DEA29 and DEA30 have 32 inputs and 24 outputs. They are intended for use in the CCD box. The parallel I/O cards DEA28, DEA29 and DEA30 are plugin cards for the CLC-D.

The signals applied to this I/O are transmitted directly via connector X3, located on the side, to the CLC-D.

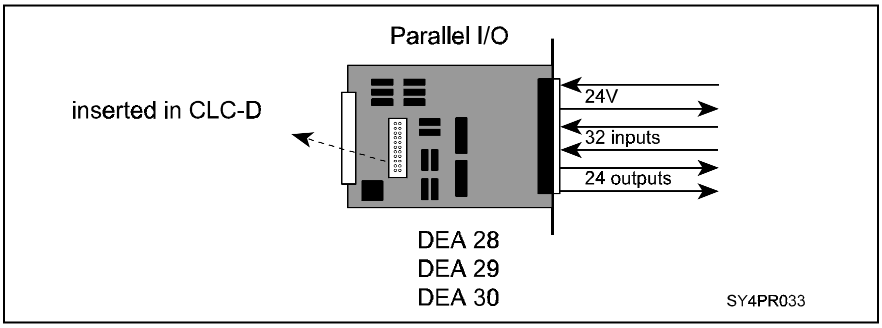


Fig. 3-5: Parallel I/O cards DEA28, DEA29 and DEA30

3.4 Determining the master axis

If a following axis of an electronic gearbox must reference a real master axis, then the high-resolution master axis encoder GDS (singleturn encoder) is mounted .

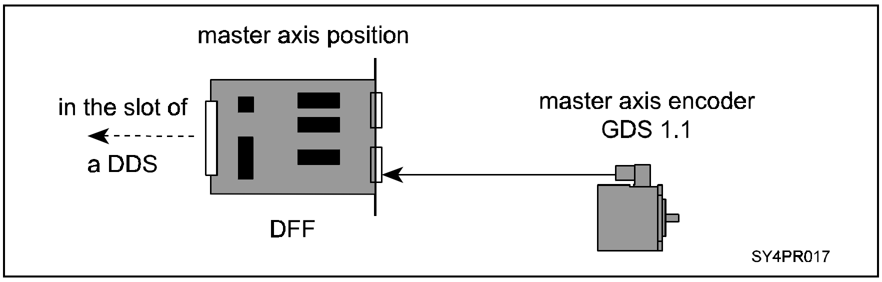


Fig. 3-6: GDS master axis encoder with master axis encoder interface DFF

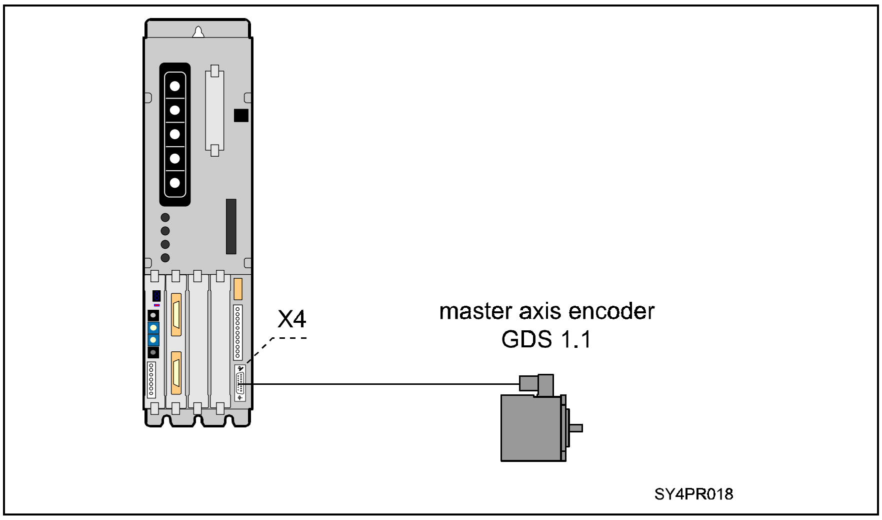


Fig. 3-7:GDS master axis encoder with DSF interface X4

The master axis encoder is mounted via master axis encoder interface DFF or via the DSF interface on the DDS (connector X4) to the drive amplifier. It processes the signals coming from the master axis encoder (GDS) and transmits this master axis position via SERCOS to the CLC.

Alternately, a real master axis can be mounted via an EnDat/SSI encoder.

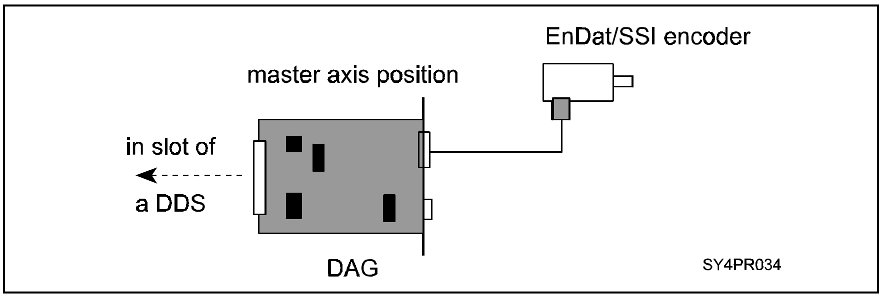


Fig. 3-8: EnDat and SSI encoder interface

3.5 Determining analog inputs

Two analog signals per drive can be detected via the analog interface DRF.

Analog signals are read by the drive and transmitted via the SERCOS LWL ring to the CLC. The CLC processes and allocates the analog signals (e.g., actual values of the tension control).

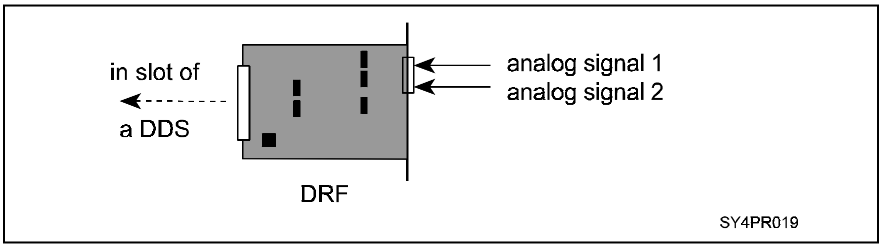


Fig. 3-9: Analog interface DRF

3.6 Master axis position output

The master axis position in SSI format can be generated via the master axis position SSI output interface DSA.

The DSA card can be placed in any drive in the ring for this purpose.

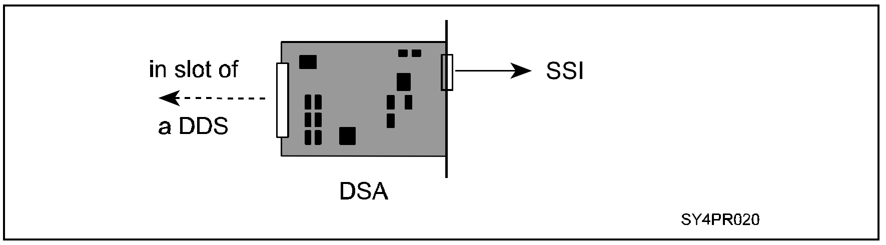


Fig. 3-10: Master axis position SSI output encoder interface

3.7 Determining a field bus

If a connection to a field bus system is required, then a field bus slave circuit can be used.

Plugin card DBS3 can be used for an interbus-S slave connection.

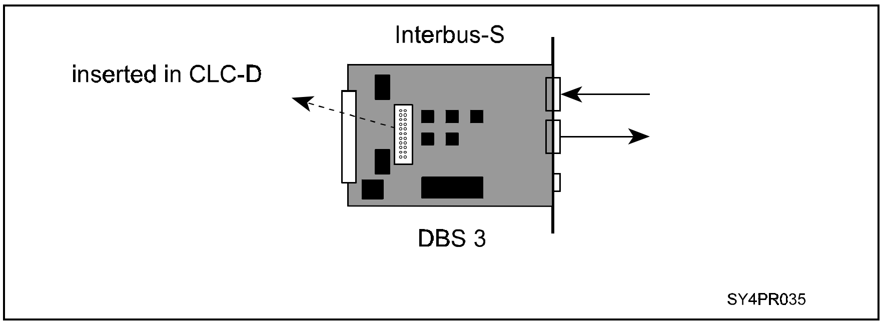


Fig. 3-11: Interbus-S slave connection

Plugin card DPF5 is used for a Profibus slave connection .

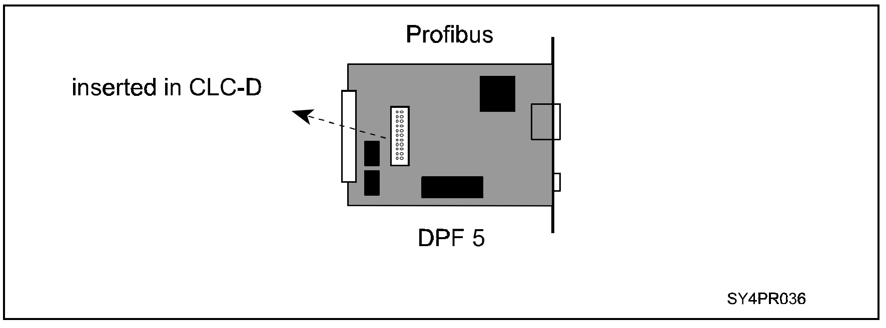


Fig. 3-12: Profibus slave connection

4 Determining the Drive Configurations

4.1 General information

The control-related plugin cards are now distributed to the free slots in the basic configuration. The final drive configuration is thereby fixed.

Possible configurations are listed below.

The DDS03.2 controller is limited in its configuration to a DDS card plus one additional card.

4.2 Drive configurations based on the basic configuration BE12

Configuration designation:	CLC-D 02.3	DAG 01.2	DAQ 02.1	DEA 04.2	DEF 01.1	DFF 01.1	DLF 01.1	DRF 01.1	DSA 01.1	DZF 02.1 (DZF03.1)
BE05-03-FW	X		X					X		
BE06-01-FW				X				X		
BE09-01-FW						X				
BE10-01-FW				X					X	
BE11-02-FW	X			X		X				
BE12-01-FW										
BE13-01-FW				X		X		X		
BE14-02-FW	X			X				X		
BE15-01-FW						X		X		
BE16-02-FW	X					X				
BE17-02-FW	X		X			X				
BE18-02-FW	X							X		
BE23-01-FW				X						
BE24-02-FW	X			X						
BE25-01-FW				X		X			X	
BE30-01-FW				X		X				
BE31-01-FW								X		
BE40-01-FW				X				X	X	
BE41-02-FW	X									
BE42-03-FW	X		X							
BE43-02-FW	X		X	X						
BE44-02-FW	X					X		X		
BE45-01-FW		X								
BE46-02-FW	X			X					X	
BE47-01-FW						X			X	
BE48-01-FW						X		X	X	

BE49-02-FW	X					X			X	
BE50-01-FW								X	X	
BE51-03-FW	X							X	X	
BE52-02-FW	X								X	
BE53-02-FW	X		X						X	
BE54-01-FW									X	
BE74-02-FW		X		X						
BE75-02-FW	X	X		X						
BE76-01-FW					X					
BE77-00-FW	X			X	X					
BE78-00-FW				X	X					
BE81-00-FW	X				X					

Fig. 4-1: Drive configurations built up on the basic configuration BE12

4.3 Drive configurations based on the basic configuration BE32

Configuration designation:	**CLC-D 02.3**	**DAG 01.2**	**DAQ 02.1**	**DEA 04.2**	**DEF 01.1**	**DFF 01.1**	**DLF 01.1**	**DRF 01.1**	**DSA 01.1**	**DZF 02.1** **(DZF03.1)**
BE07-03-FW	X		X				X			
BE08-01-FW						X	X			
BE20-02-FW	X					X	X			
BE21-02-FW	X						X			
BE28-01-FW				X		X	X			
BE32-01-FW							X			
BE33-01-FW				X			X			
BE34-02-FW	X			X			X			
BE55-01-FW				X			X		X	
BE57-01-FW						X	X		X	
BE61-02-FW	X						X		X	
BE62-01-FW							X		X	

Fig. 4-2: Drive configurations based on basic configuration BE32

4.4 Drive configurations based on basic configuration BE37

Configuration designation:	CLC-D 02.3	DAG 01.2	DAQ 02.1	DEA 04.2	DEF 01.1	DFF 01.1	DLF 01.1	DRF 01.1	DSA 01.1	DZF 02.1 (DZF03.1)
BE01-02-FW	X					X				X
BE22-01-FW				X		X				X
BE27-01-FW						X				X
BE29-02-FW	X									X
BE35-02-FW	X		X							X
BE37-01-FW										X
BE38-01-FW				X						X
BE39-02-FW	X			X						X
BE63-01-FW				X					X	X
BE65-01-FW						X			X	X
BE69-02-FW	X								X	X
BE70-01-FW									X	X
BE79-01-FW										(X)
BE80-01-FW				X						(X)

Fig. 4-3: Drive configurations based on basic configuration BE37

4.5 Drive configurations based on basic configuration BE04

Configuration designation:	CLC-D 02.3	DAG 01.2	DAQ 02.1	DEA 04.2	DEF 01.1	DFF 01.1	DLF 01.1	DRF 01.1	DSA 01.1	DZF 02.1 (DZF03.1)
BE02-02-FW		X				X				X
BE03-02-FW		X		X						X
BE04-02-FW		X								X
BE71-03-FW	X	X								X
BE72-02-FW		X							X	X

Fig. 4-4: Drive configurations based on basic configuration BE04

4.6 Example

The rotary press and folding machine of the plant as per Fig. 1-2 of the Functional Description should be equipped with a SYNAX system.

The following equipment is needed for all three drives and is always based on both precision and power requirements:

Axis	Drive controller	Motor
Stanzzylinder	DDS2.2-W100	MDD
Gegenzylinder	DDS2.2-W100	MDD
Falzantrieb	DDS2.2-W200	MDD

Fig. 4-5: Drive equipment

The results are, as per section 2, the basic drive configuration BE12-01. The selection of the control-related plugin module follows the guidelines in section 3. The CLC-D with ARCNET double card DAQ is used as the plugin card.

A DEA card is used for the safety control signals.

A DFF card is needed for the master axis circuit.

The drive configuration follows the guidelines in section 4. The slots of the drive amplifier in the printing cyclinder are during the course of the configuration tasks also filled.

This results in the following drive configuration (see Fig. 4-7):

Axis	Configuration
stamping machine	BE43 (with DEA04, CLC-D02 und DAQ02)
return-motion machine	BE31 (with DFF01)
folding drive	BE12

Fig. 4-6: Drive configuration

For checking the reliability of the resulting drive configuration and for determining the relevant configuration number, see the table on page 4-1 ff.

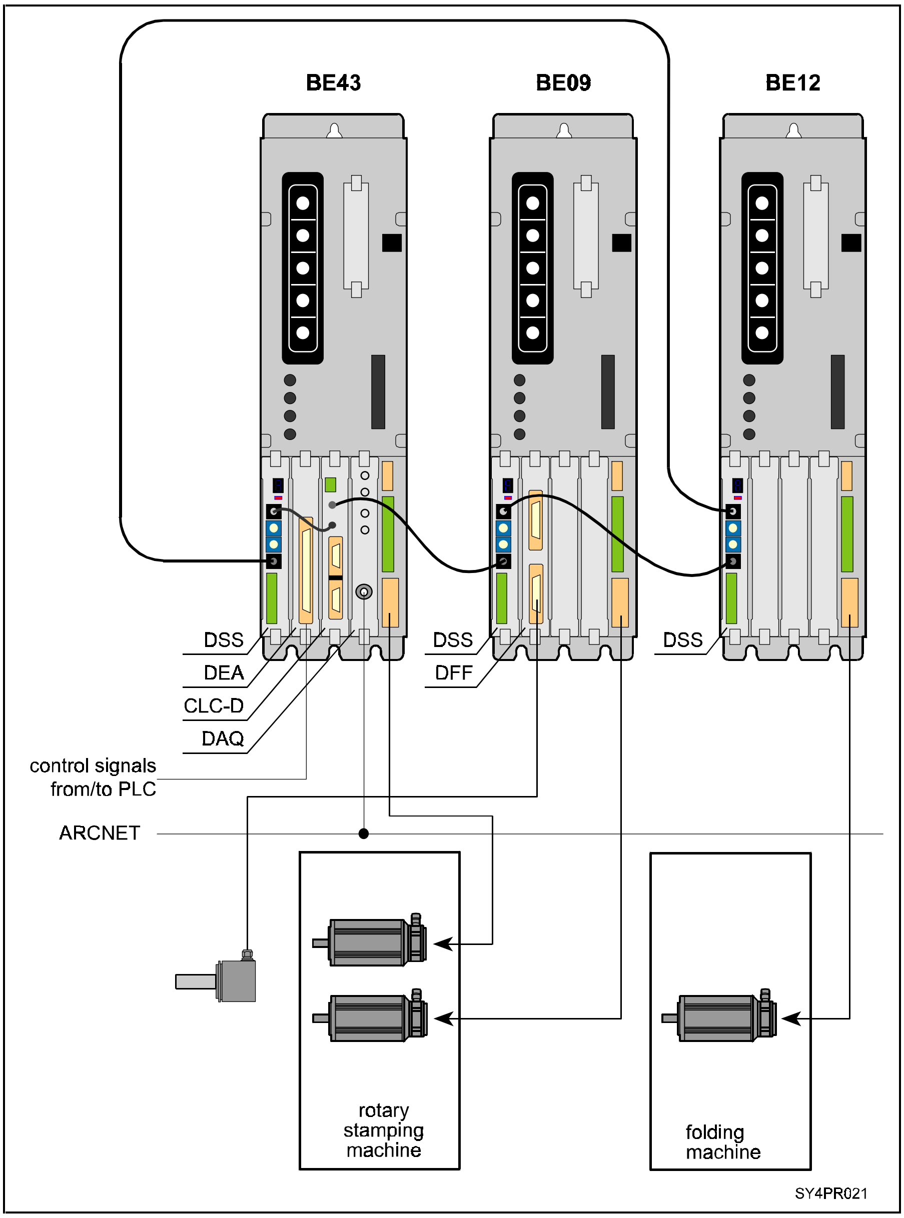


Fig. 4-7: System configuration for equipping SYNAX in plant as per Fig. 1.02 of the Functional Description.

How to order the drive controller

Item	1	Drive controller DDS2.2-W100-BE43-..-FW
Item	1.1	Relevant firmware FWA-DIAX03-SY1-02VRS
Item	2	Drive controller DDS2.2-W100-BE09-..-FW
Item	2.1	Relevant firmware FWA-DIAX03-ELS-03VRS
Item	3	Drive controller DDS2.2-W200-BE12-..-FW
Item	3.1	Relevant firmware FWA-DIAX03-ELS-03VRS

5 CCD-Box Configurations

5.1 Drive configurations with CCD-Box

The CLC-D can be used in a drive or a CCD-box. When used with the CCD-box, the CLC-D can be combined with DEA28, DEA29, DEA30, DBS, DPF and DAQ.

Configuration designation	CLC-D 02.3	DAQ 02.1	DBS 03.1	DEA 28.1	DEA 29.1	DEA 30.1	DPF 05.1
KE00-01							
KE01-01-FW	X						
KE02-01-FW	X			X			
KE03-01-FW	X			X	X		
KE04-01-FW	X			X	X	X	
KE05-01-FW	X		X				
KE06-01-FW	X		X	X			
KE07-01-FW	X		X	X	X		
KE08-01-FW	X						X
KE09-01-FW	X			X			X
KE10-01-FW	X			X	X		X
KE11-01-FW	X	X					
KE12-01-FW	X	X		X			
KE13-01-FW	X	X		X	X		
KE14-01-FW	X	X	X				
KE15-01-FW	X	X	X	X			
KE16-01-FW	X	X					X
KE17-01-FW	X	X		X			X

Fig. 5-1: Selecting the configuration when using the CCD-box

6 Fiber Optic Cable (LWL)

6.1 Data transmission via fiber optic cable

Optical transmission ring structure

The connection between the control (CLC) and the digital drives is conducted with help of fiber optic cable s (LWL).

SERCOS interface (IEC 1491)

A ring structure as per SERCOS interface (IEC 1491) is used.

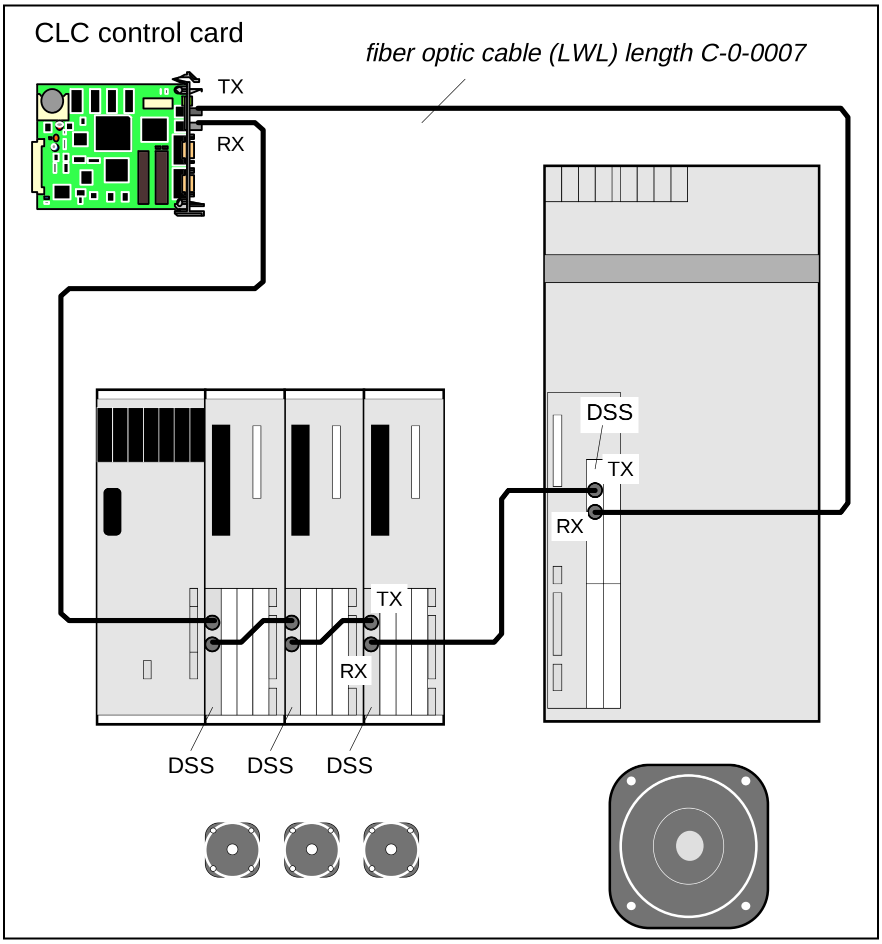


Fig. 6-1: Ring structure

The ring starts and ends at the control. The optical output of the control is connected with the optical input of the first drive. Its output is connected to the input of the next drive and so on. The output of the final drive is connected to the input of the control.

Drive address

Each drive is assigned its own drive address. It can be selected independently of the position within the fiber optic cable ring. The drive address is set at the communications board (e.g., DSS 2.1) using a rotary switch.

Constructing the transmission path

A transmission path starts at a transmitter output and ends at a receiver input.

fiber optic cable isolating points

The transmission path is made up of fiber optic cables and fiber optic cable leadthroughs. These serve as, for example, coupling units for wall leadthroughs.

FSMA standard (IEC 874-2)

The plugin connectors correspond to FSMA standards (IEC 874-2).

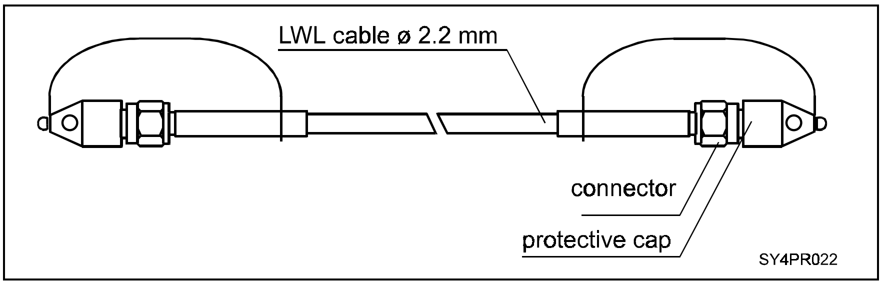


Fig. 6-2: Structure of a transmission path

Types of fiber optic cables

Plastic fiber optic cables can be used for transmission stretches up to 50 m and glass fiber optic cables for lengths up to 500 m.

There are three different types of fiber optic cables:

Plastic fiber optic cable 2.2 mm

Plastic fiber optic cables for internal control cabinet use with a diameter of 2.2 mm.

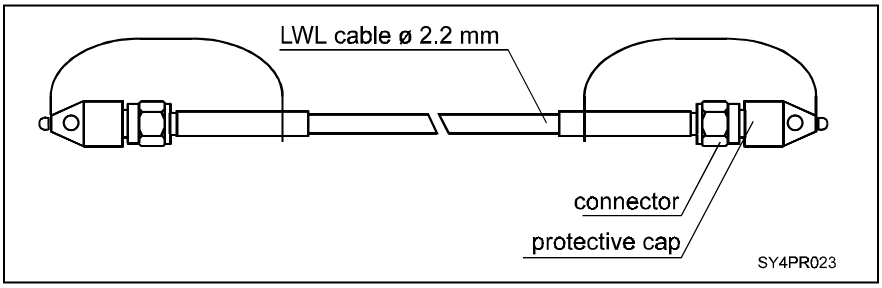


Fig. 6-3: Plastic fiber optic cable 2.2 mm (IKO 982)

Plastic fiber optic cable 6 mm

Plastic fiber optic cables for internal and external control cabinet use with reinforced casings. The diameter of this fiber optic cable equals 6 mm.

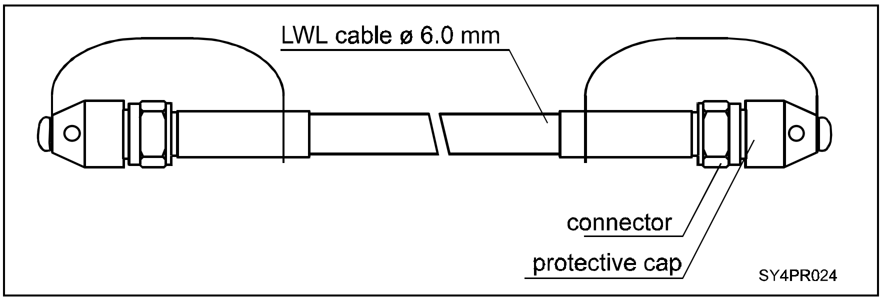


Fig. 6-4: Plastic fiber optic cable 6 mm (IKO 984)

Glass fiber optic cable 3 mm

Glass fiber optic cable for internal and external control cabinet use with reinforced casing. The diameter of this fiber optic cable equals 3 mm.

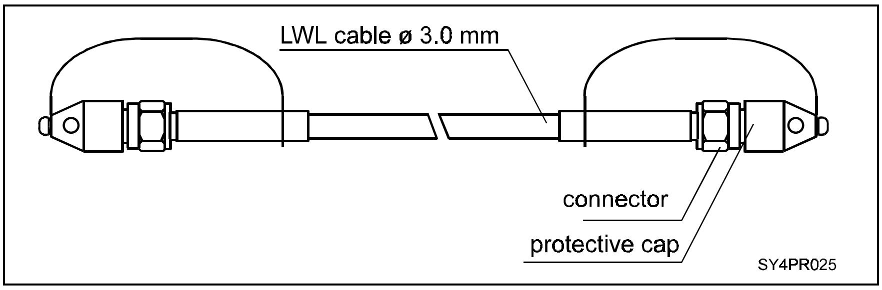


Fig. 6-5: Glass fiber optic cable 3 mm (IKO 001)

Order information

Type of fiber optic cable	Part number
plastic LWL, 2.2 mm	IKO 982/xx
plastic LWL, 6 mm	IKO 984/xx
glass LWL, 3 mm	IKO 001/xx

Fig. 6-6: Part numbers of fiber optic cable types (xx: lengths in meters)

fiber optic cable accessories

Accessories of the fiber optic cables are:

- fiber optic cable leadthroughs
- wrench for FSMA connector

Fig. 6-7: fiber optic cable leadthroughs

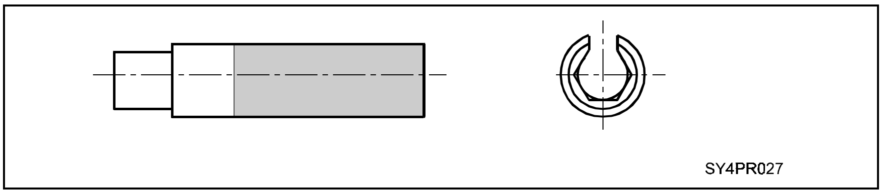


Fig. 6-8: Wrench for FSMA connector

Name	Order identification
LWL leadthrough	PLUGIN-LWL DF
wrench LWL FSMA	TOOL WRENCH LWL-FSMA

Fig. 6-9: fiber optic cable accessories

6.2 Project planning notes

General notes

Note the following when planning the project:

The length of the transmission path

The length of the transmission path is limited. Isolating points decrease the maximum length of a fiber optic cable stretch.

Mixing fiber optic cable types

Between transmitter and receiver either only plastic fiber optic cables (IKO 982 or IKO 984) only glass fiber optic cables (IKO 001) may be used. There may be no change from plastic to glass or vice versa at isolating points.

Mechanical limits

The mechanical limit values of fiber optic cables (e.g., bend radii, tension, cross tension, alternate bends) must be maintained.

Thermal limit values

Thermal limit values of the fiber optic cables may not be exceeded.

Maximum lengths of the fiber optic cables

LWL type	Without isolating point	1 isolating point	2 isolating points
plastic LWLs	50 m	40 m	30 m
glass LWLs	500 m	400 m	300 m

Fig. 6-10: Maximum fiber optic cable lengths

Technical data of available fiber optic cables

	IKO 982	IKO 984	IKO 001
Outer casing	polyamide (PA)	polyurethane (PUR)	polyurethane (PUR)
Outer diameter	2.2 mm ± 0,07 mm	6.0 mm ± 0,2 mm	3.0 mm ± 0.xx mm
Bend radius	> 50 mm	> 80 mm	> 16 mm
Bend radius in cable trailing install.	--	> 100 mm	--
Tension resistance - short-term	150 N	150 N	330 N
Tension resistance - continuous	100 N	100 N	245 N
Cross tension resistance	450 N/cm	450 N/cm	1000 N/cm
Alternating bend endurance	> 8,000 Cycles ± 90°	> 100,000 Cycles ± 90°	> 10,000 Cycles ± 90°
Temperature range - storage	-40 °C .. +85 °C	-20 °C .. +80 °C	-40 °C .. +85 °C
Temperature range - operations	-40 °C .. +85 °C	-20 °C .. +80 °C	-40 °C .. +85 °C
Core diameter of optic cable	1000 µm	1000 µm	200 µm
Specific opt. damping	< 250 dB/km	< 250 dB/km	< 8 dB/km

Fig. 6-11: fiber optic cable technical data

General safety guidelines

DANGER

High-energy light
Risk of blindness and eye injury
⇒ Do not look into the light (transmitter output or fiber optic cable end)

CAUTION

Error during mounting or when handling
fiber optic cable components could be mechanically damaged
⇒ Do not screw fiber optic cable connector in too tightly

CAUTION

Error during mounting or when handling
fiber optic cable could be damaged
⇒ Mechanical limit values must be maintained

Handling

Connecting the fiber optic cables

Connections transmitter side

fiber optic cables are connected as follows at the transmitter
X25 (CLC-D) or
TX (CLC-P) or
X10 (DSS 2.1 in DIAX03 or DIAX04 and ECODRIVE).

Connections receiver side

fiber optic cables are connected as follows at the receiver
X26 (CLC-D) or
RX (CLC-P) or
X11 (DSS 2.1 in DIAX03 or DIAX04 and ECODRIVE).

Storage

When storing the fiber optic cables, please note that

- the protective caps must be in place
- the mechanical limit values are maintained
- the thermal limit values are maintained

Routing and mounting

When routing and mounting the fiber optic cables, please note that the specific load data do not damage the fiber optic cables.

Bend radius

The minimum bend radius may not be exceeded (e.g., when routing around corners).

Cross pressure

The maximum cross stress may not be exceeded (e.g., when routing around corners). In cable channels, please note that the fiber optic cable is not subjected to excessive cross stress. This can be caused, for example, by the weight of power cables.

Routing over shrap edges or pointy, uneven surfaces must be avoided. Any cuts or mechanical damage could cause interference.

Do not twist fiber optic cable

Avoid twisting the fiber optic cable when routing. There may be no tension in the final position of the fiber optic cable.

6.3 Setups

Preparations

The correct connection of the fiber optic cable should be checked before hand. Is the transmiter output (TX) connected to a receiver input (RX)?

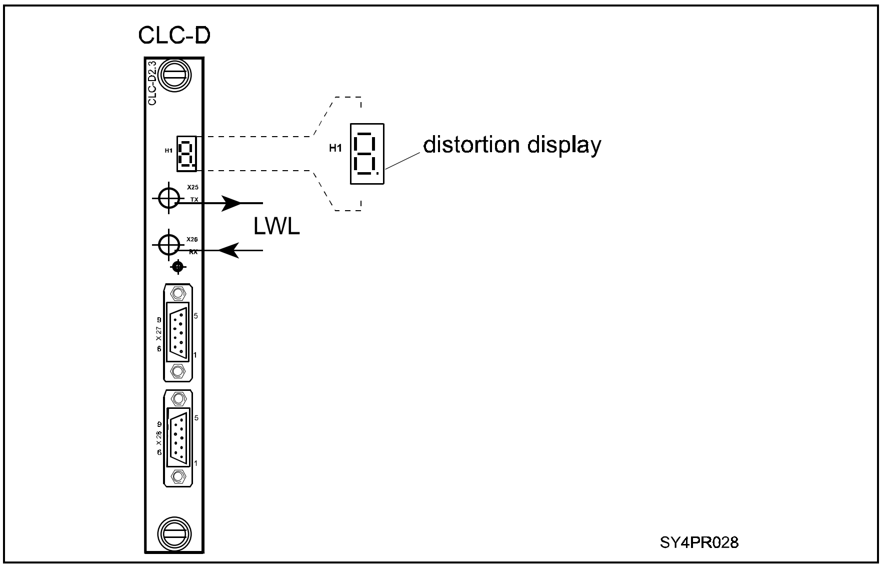


Fig. 6-12: Connections - CLC-D

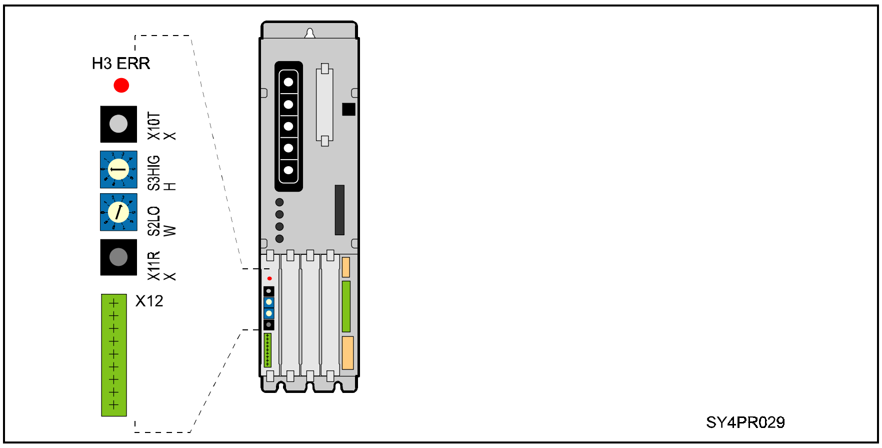


Fig. 6-13: Connections - DSS 2.1 (DIAX03)

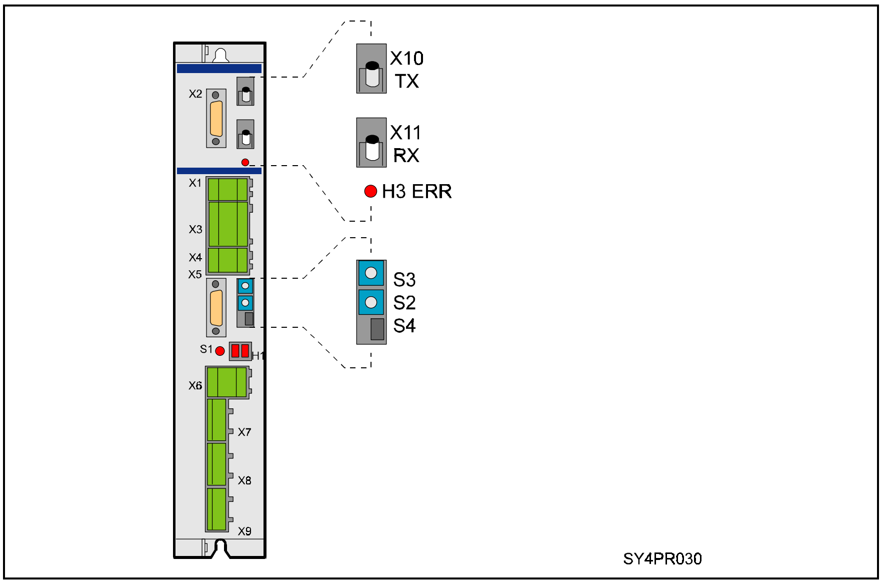


Fig. 6-14: Connections - DKC02.1 (ECODRIVE)

Setting drive address

A drive address is set at every drive (see Fig. 6-13 or Fig. 6-14). It must be absolutely clear in each SYNAX ring. There may not be two drives with the same address. Permitted addresses lie within the range of [1..40].

The machine can now be switched on.

Check warp display

The next step is to check whether there is a sufficient optical level at each participant, in other words, make sure that the receiver is neither over or under controlled.

Warp display may neither light up or glow!

Generally, the warp display is dark (see Fig. 6-12, Fig. 6-13 or Fig. 6-14: LED H3 ERR). If it lights up, then the transmission path "ahead of" the participant must be checked.

Control - starting with the transmitter output of the control - in signal direction, the warp display of the drive (see Fig. 6-13 or Fig. 6-14).

The warp display of the CLC is the decimal point of the 7-segment display H4 (CLC-D 2.3 on up, see Fig. 6-12). The warp display on the drives is the LED "H3 ERR".

Check warp display in "light direction"

First check the first drive in the ring. If its warp display is dark, then proceed to the next drive. This procedure is followed until the final drive and then the CLC is checked.

If one of the displays is not dark, then the following must be checked:

- has the transmission path been correctly set?
- has the output power of the previous drive in the ring been correctly set?
- is the fiber optic cable to the previous drive defective?

See section 6.4 for checking transmission rates and output power.

6.4 Clearing errors

Communications errors are signalled via the following diagnoses:

Dis-play	C-0-0048 Error number	C-0-0047 Diagnostics text	C-0-0046 Diagnostics info
01	01	"SERCOS interface - ring break"	10000h
02	02	"SERCOS interface - no drive connected"	10000h
05	05	"SERCOS interface - double drive telegram failure"	n = address
06	06	"Fiber optic ring ring not closed"	10000h
07	07	"drive addresses not correct (see C-0-0002, C-0-0086)"	10000h

Fig. 6-15: Error messages generated by communications errors

The causes could be:

- incorrectly set drive addresses
- incorrectly parametrized parameters C-0-0002 or C-0-0086
- incorrectly set transmission rates
- incorrectly set output power
- defective fiber optic cable

Use of warp display

A warp display (see Fig. 6-13: "H3 ERR" or Fig. 6-14: "H3 ERR") lights up in the following cases:

- incorrectly set transmission rate
- incorrectly set output power
- defective fiber optic cable

If a warp display does light up, then check:

Checking the transmisison rate

The transmission rate must be checked at the CLC and the respective drive (see Fig. 6-16).

Checing output power

Output power must be checked at the CLC and the physical predecessors of the relevant drive (see Fig. 6-16).

Checking the fiber optic cable

Check the fiber optic cable from the physical predecessor to the relevant drive.

Setting the transmission rate

The transmission rate set is 2 MBit/s. This is set at the time of delivery for both CLC and the drives so that generally speaking nothing has to be set here.

CLC

The transmission rate is set on the CLC in parameter "SERCOS interface - configuration" (C-0-0038). The contents of this parameter must equal ‘0000000000000000’.

DIAX03, DIAX04 (DSS 2.1)

The transmission rate is set with help of switch S4 on the communications board DSS 2.1. For a transmission rate of 2 MBit/s the switch must be set to 'OFF'.

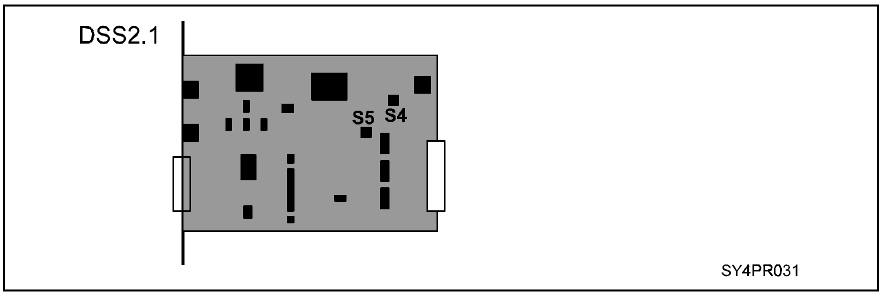


Fig. 6-16: DIP switch of the DSS 2.1 (DIAX03, DIAX04)

ECODRIVE (DKC02.1)

The transmission rate is set with the help of switch S4/1 on the front panel. For a transmission rate of 2 MBit/s the switch must be set to 'OFF' (=in front).

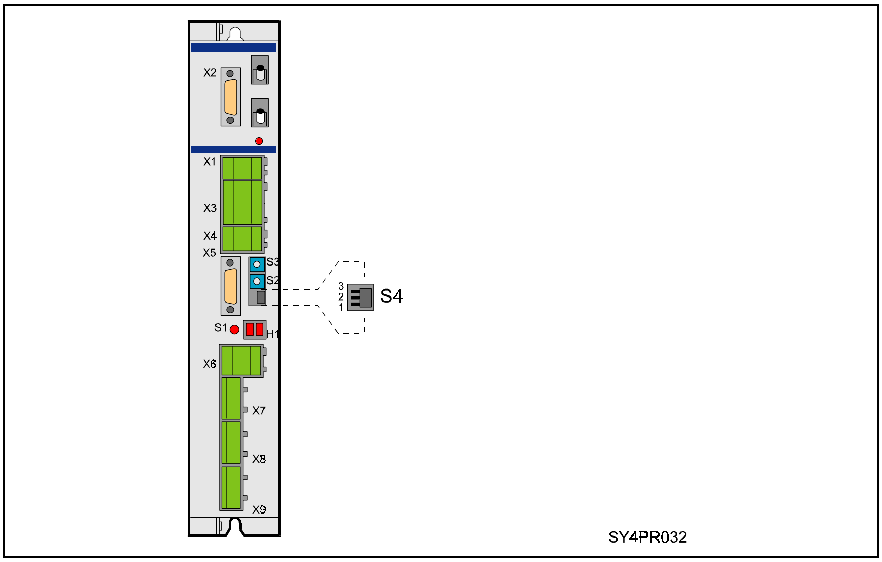


Fig. 6-17: DIP switch of the DKC02.1 (ECODRIVE)

Setting the optic output power

CLC

The output power of the CLC is parametrized using the parameters "fiber optic cable (LWL) length" (C-0-0007). If plastic fiber optic cables are used, then the length of the fiber optic cable connected to the transmission output is set here. With glass fiber optic cables, a length of 50.0 m must be set here.

DIAX03, DIAX04 (DSS 2.1)

Output power is set via switches S5A and S5B on the DSS 2.1 card (see Fig. 6-16).

ECODRIVE (DKC02.1)

Output power is set via switches S4/2 and S4/3 on the front panel (see Fig. 6-17).

If plastic fiber optic cables are used then see Fig. 6-18. If glass fiber optic cables are used then see Fig. 6-19.

LWL lengths	0 .. 15 m	15 m ..30 m	30 m .. 50 m
DIAX03, DIAX04	S5A = OFF S5B = OFF	S5A = ON S5B = OFF	S5A = ON S5B = ON
DKC02.1	S4/2 = OFF S4/3 = OFF	S4/2 = ON S4/3 = OFF	S4/2 = ON S4/3 = ON

Fig. 6-18: Setting the output power with plastic fiber optic cables

LWL lengths	0 .. 500 m
DIAX03, DIAX04	S5A = ON / S5B = ON
DKC02.1	S4/2 = ON / S4/3 = ON

Fig. 6-19: Setting the output power with glass fiber optic cables

Checking the fiber optic cables

If both transmission rates and output power have been correctly set, (see section 6.4) and communications still will not function, then it is possible that the fiber optic cable has a defect. In this case, the warp display will also light up.

The cause of a defective fiber optic cable can be damage or poor manufacture (e.g., connector mounting).

A defective fiber optic cable can possibly be recognized by the fact that at the end of the fiber optic cable hardly any light is visible or the optical fiber has been "pulled in backwards" into the connetor. Check the face of the connector. Other fiber optic cable checks cannot be conducted without the appropriate tools.

The only remedial action is the exchange of the defective fiber optic cable.

7 CLC Link

7.1 General Information

Several CLC controls can be combined to create one CLC link with which following axes can be allocated to different master axes.

This combining of CLC controls is accomplished with the help of CLC plugin card *DAQ*. All DAQ boards are connected with a fiber optic cable (LWL) ring thereby creating the CLC link.

Communications within the CLC link implements, as does the SYNAX ring, an LWL ring.

Simple and double ring

The CLC link can be mounted via either a simple or double LWL ring.

Plugin card DAQ

The DAQ02 board supports not only double but single rings as well.

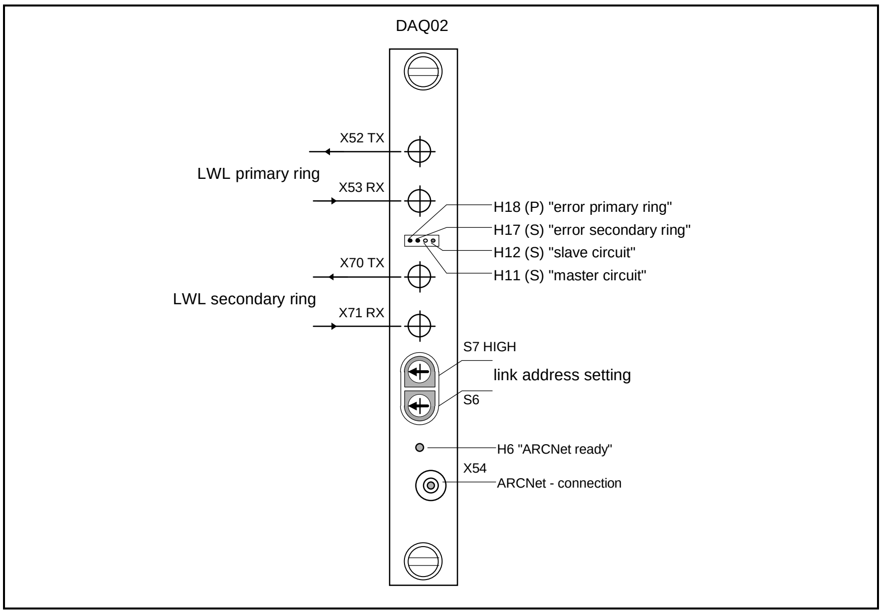


Fig. 7-1: Front view of plugin card DAQ02

Max. 32 CLCs in a link

Up to 32 CLC controls can be combined to one CLC link.

Link addresses

Each link participant receives a link address. The link address is set via address switches S6 and S7 on the DAQ.

The link address must lie within a range of 1 to 32.

7.2 CLC link with simple ring

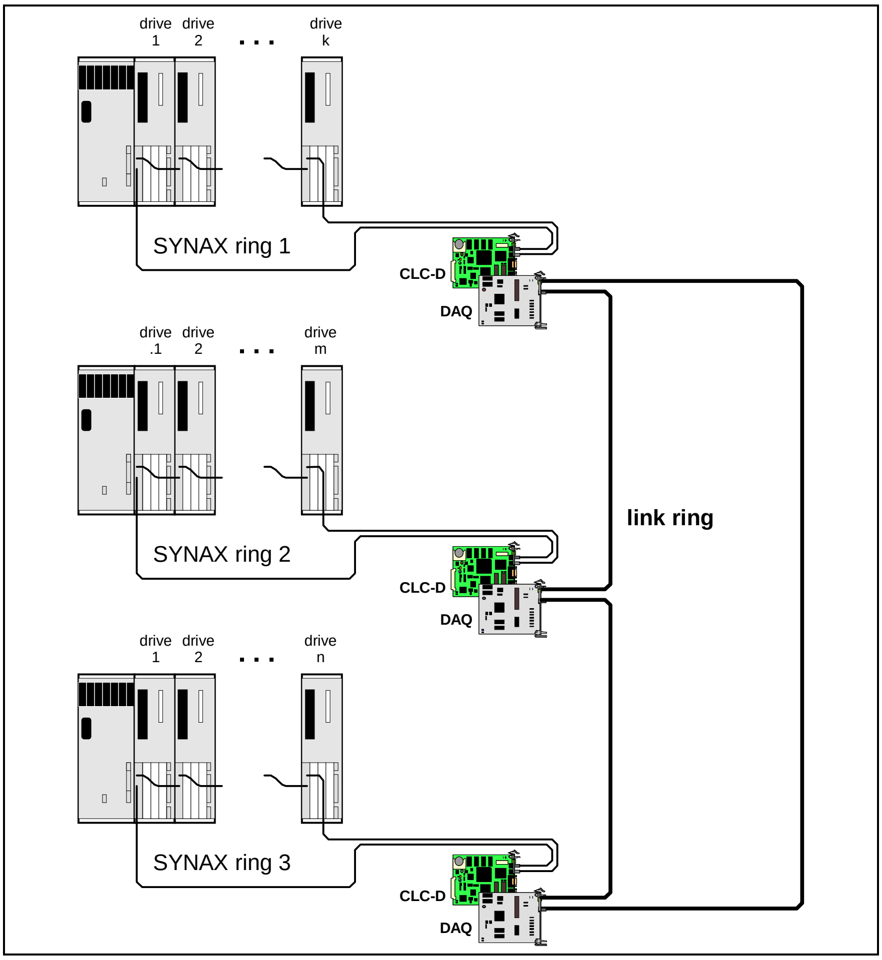


Fig. 7-2: CLC link with simple ring

Simple ring: primary ring

A simple ring only uses the primary ring. The secondary ring is not cabled.

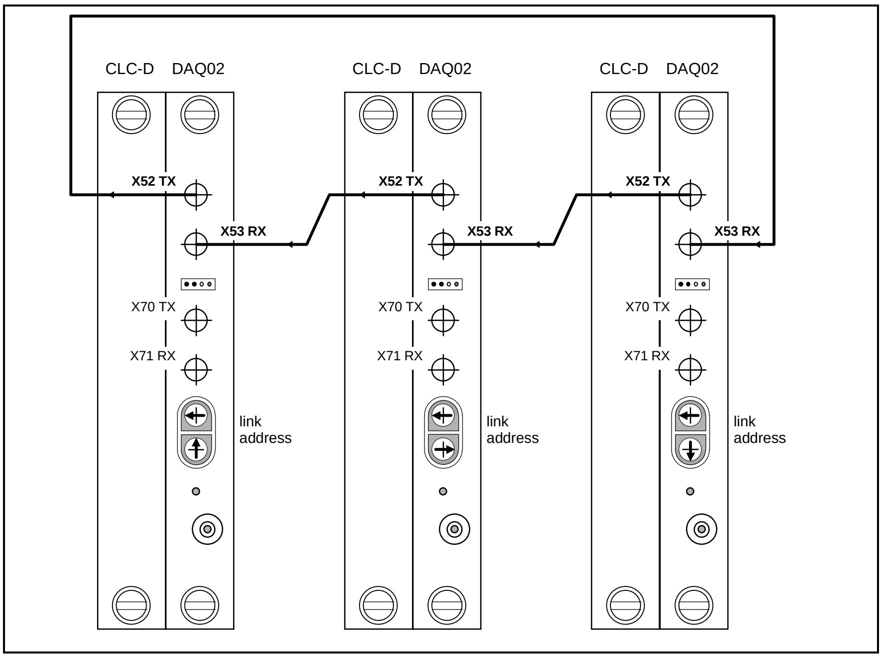


Fig. 7-3: LWL link in a single ring

7.3 CLC link with double ring

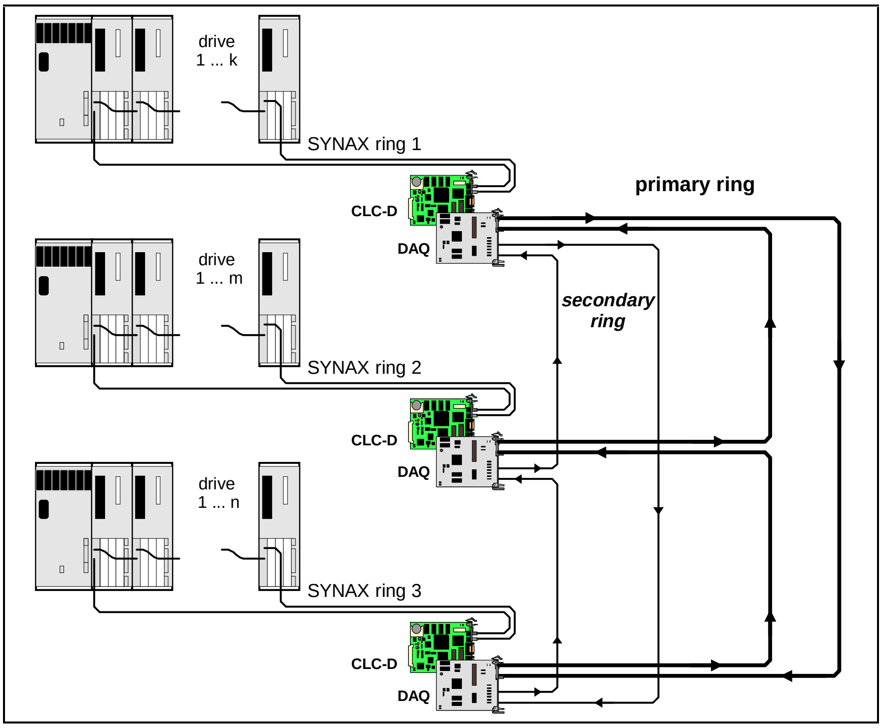


Fig. 7-4: CLC link with double ring

Primary ring, secondary ring

The primary ring is generally used for communication. The secondary ring only transmits diagnostics signals.

Note: The secondary ring must be connected - as shown - in a counter direction.

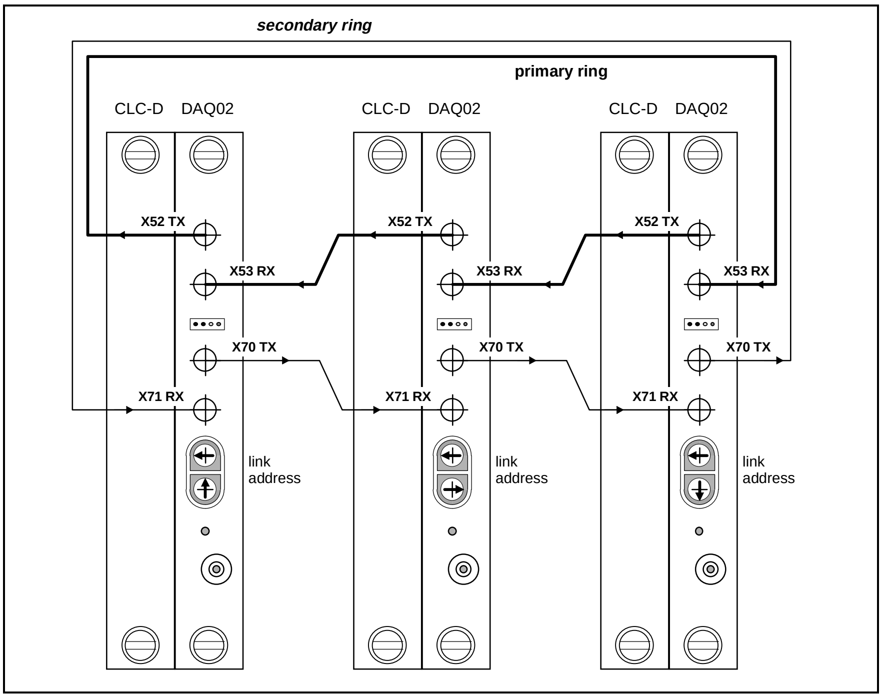


Fig. 7-5: LWL connections in a double ring

7.4 Configuration example with CCD

With an eye towards increased machine availability, CLC control cards can be arranged with DAQ plugin cards in their own minirack (CCD).

This offers a good functional overview and makes servicing faster and easier.

The miniracks are equipped with their own 24 V electronic storage and can, as with the master system, be USV supported.

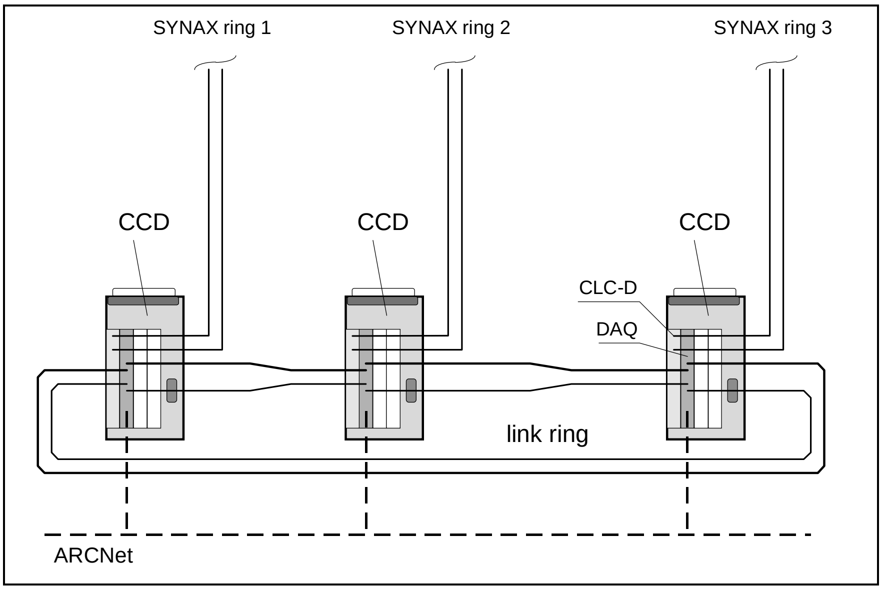


Fig. 7-6: Double ring configuration with CCD

8 Battery

8.1 The CLC battery

There is a 3 voltage round cell of the "RENATA CR2477N 3V" on the CLC-D and CLC-P. This battery is the backup for the RAM on the CLC until control voltage is applied.

Note: The C and A parameters of the CLC are on this RAM. These parameters will be lost if the battery fails!

This is the reason why it is fundamentally important to secure the parameters.

Indramat order designation for the CLC battery: BATTERY 3V LI/MN 02 round cell

Battery service life

The battery, at the time the CLC is delivered, has a capacity of at least 75% of its total.

When reaching a level of 10 % the total capacity of the CLC battery is then empty.

The service life of the battery depends on the way the CLC is operated and can be estimated as per the following table.

Ambient temperature	3 shift Workload	2 shift Workload	1 shift Workload	Storage without control voltage
25° C	4 Years	4 Years	4 Years	3 Years
35° C	4 Years	3 Years	2 Years	1.5 Years
45° C	3 Years	2 Years	1.2 Years	0.8 Years

Fig. 8-1: Battery service life

Note: At the end of this time, the battery of the CLC is empty and must be replaced.

Replacing the battery

After the battery is removed, the parameters stored on the CLC will be retained for at least one minute.

The battery must be replaced as follows:

1. keep new battery handy
2. switch plant off
3. pull CLC card
4. pull old battery out
5. insert new battery **no more than one minute later**

9 Attachment

9.1 Dimensional sheets, terminal diagrams

CCD box

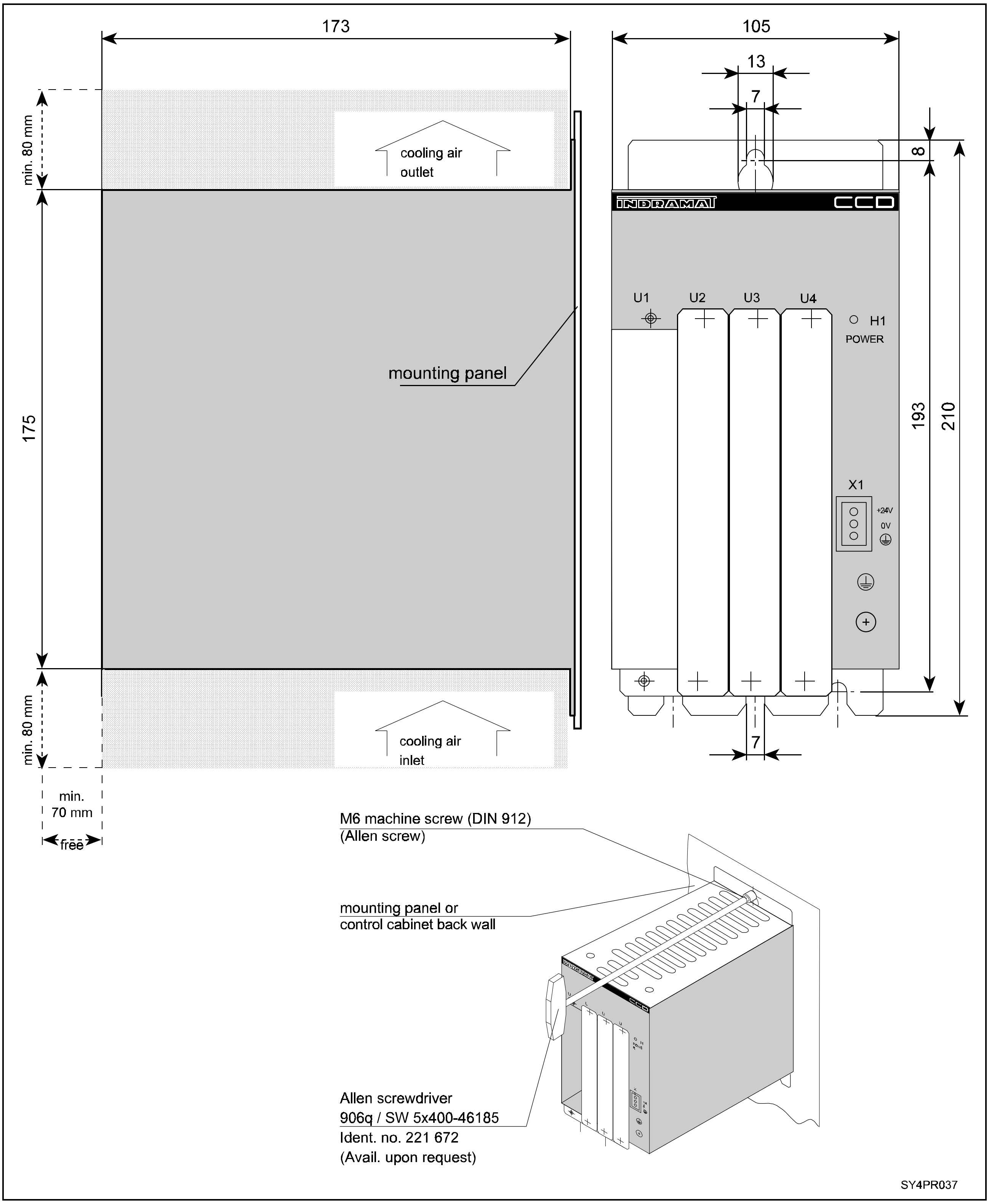


Fig. 9-1: Terminal diagram CCD box

Power connector X4

Distribution voltage is typically U_{in} = 24V.

Min./max. values for U_{in}/I_{in} with the maximum number of modules mounted:

	Minimum	Typical	Maximum	Unit
U_{in}	18	24	32	V
	⇓	⇓	⇓	⇓
I_{in}	1.2	1	0.8	A

Fig. 9-2: Min/Max values for U_{in}/I_{in}

Note: The actual current I_{in} depends on the number of inserted plugin modules in U1 - U4.

Control card CLC-D02.3M

Terminal diagram CLC-D02.3M

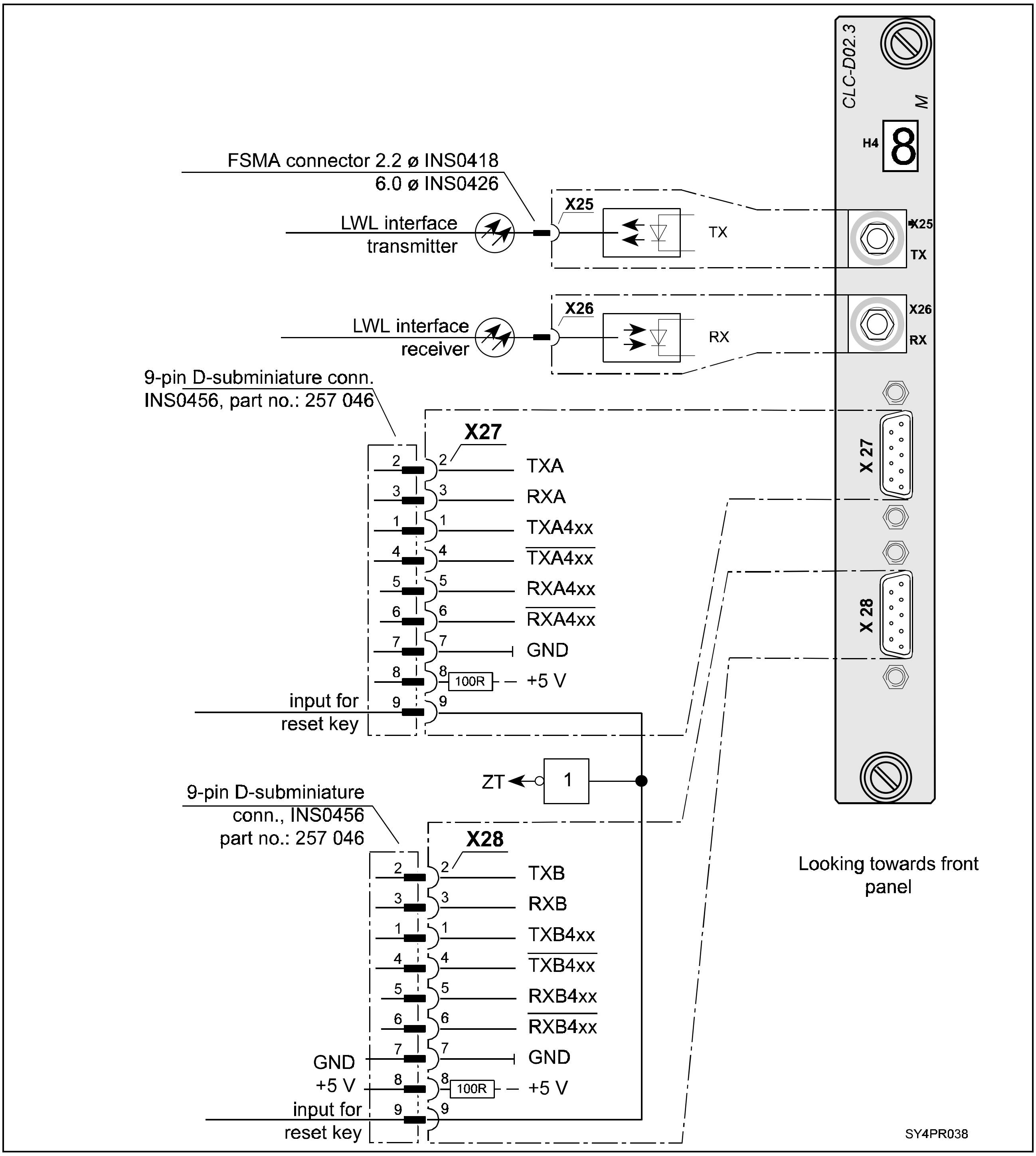


Fig. 9-3: Terminal diagram CLC-D02.3M

Dimensional sheet CLC-D02.3M

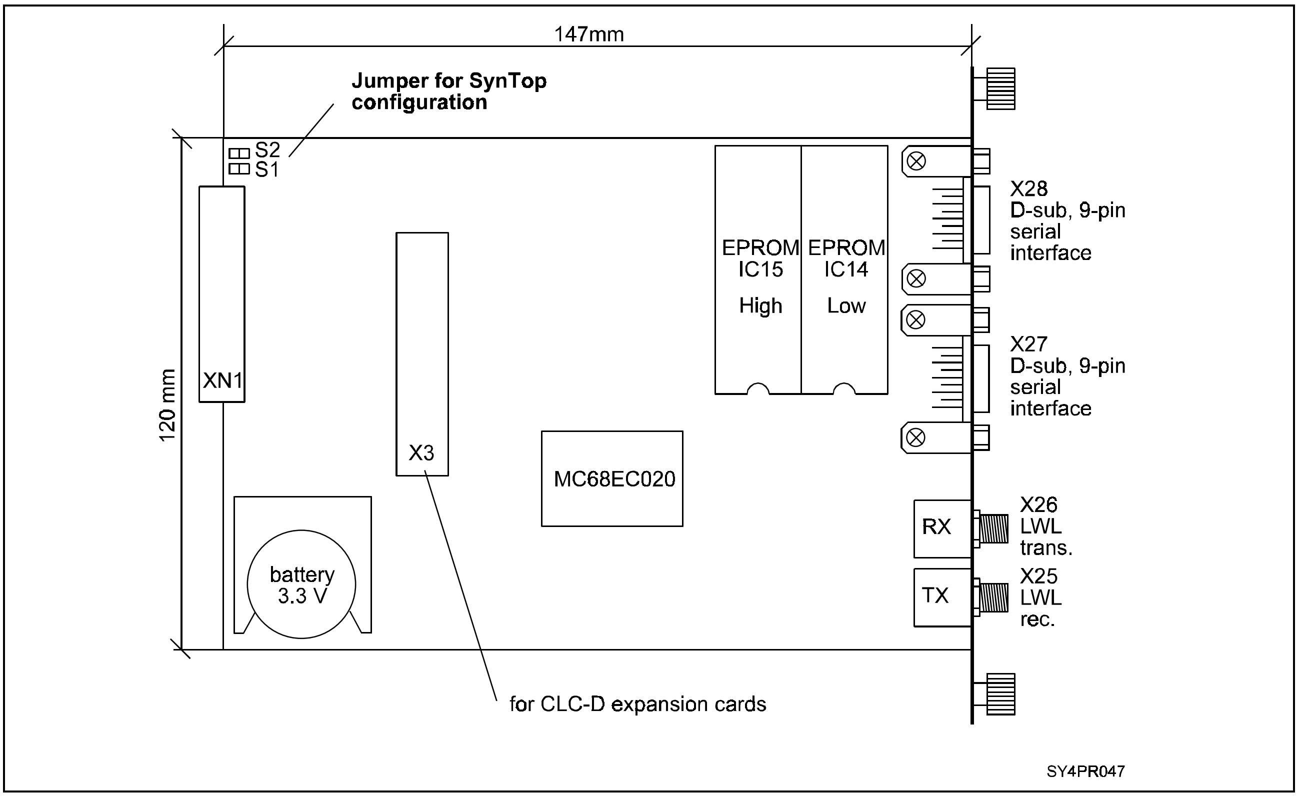


Fig. 9-4: Dimensional sheet CLC-D02.3M

PC plugin card CLC-P01.1

Terminal diagram CLC-P01.1

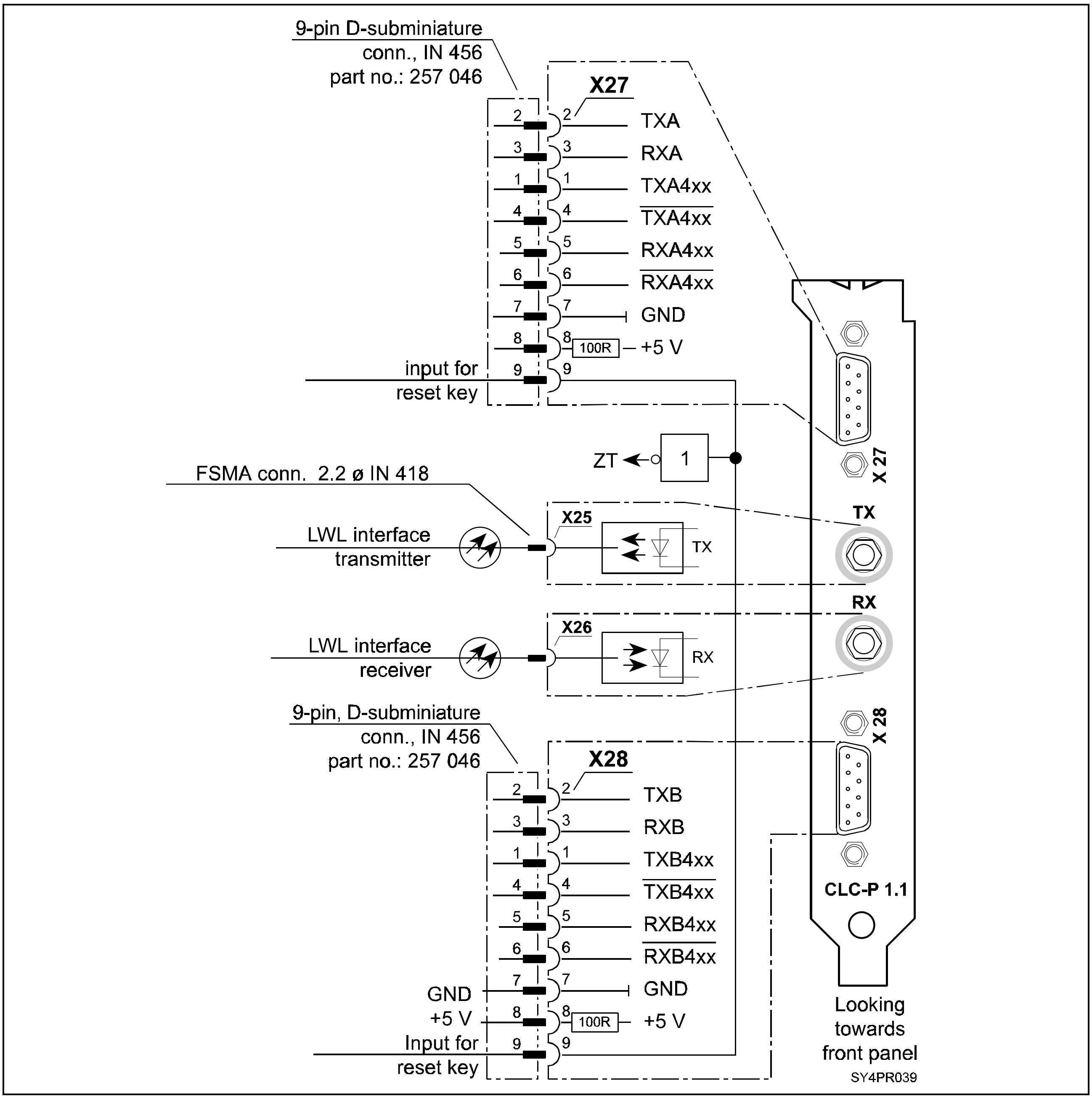


Fig. 9-5: Terminal diagram CLC-P01.1

Dimensional sheet CLC-P01.1

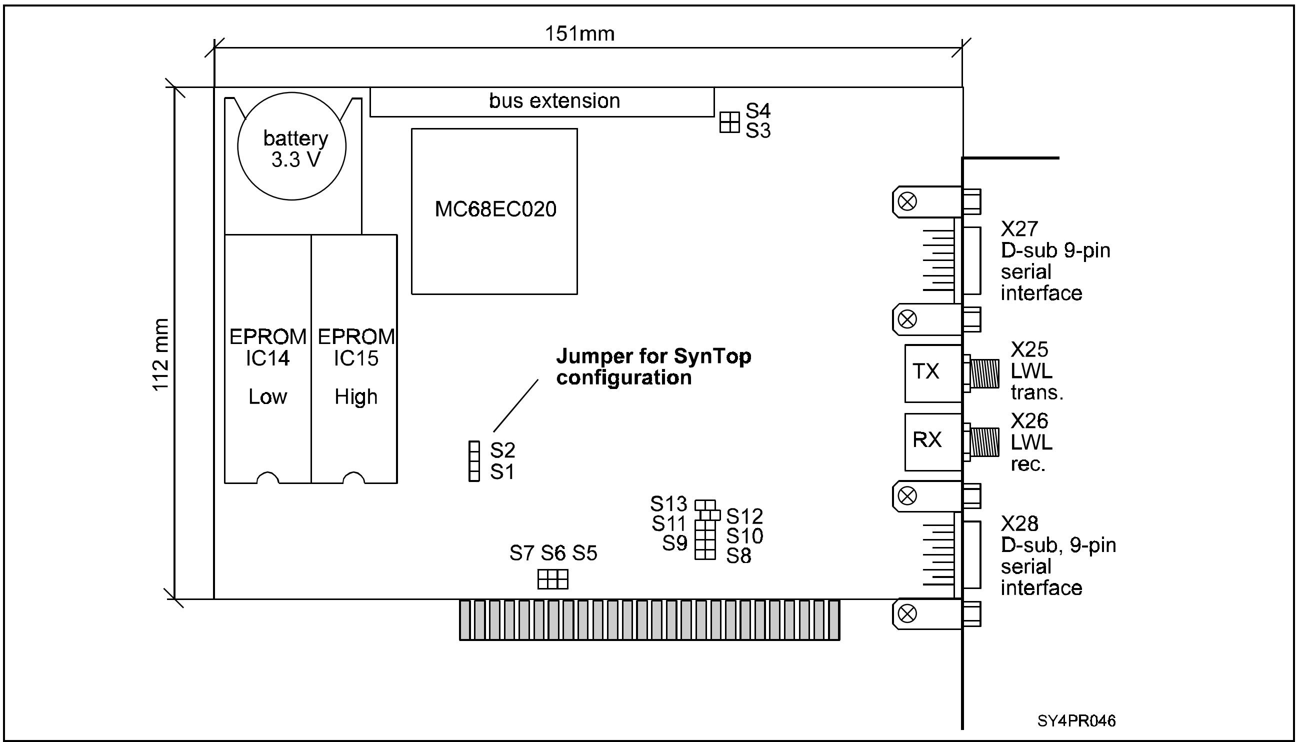


Fig. 9-6: Dimensional sheet CLC-P01.1

Input / output interface DEA

DEA04.2M, DEA05.2M, DEA06.2M

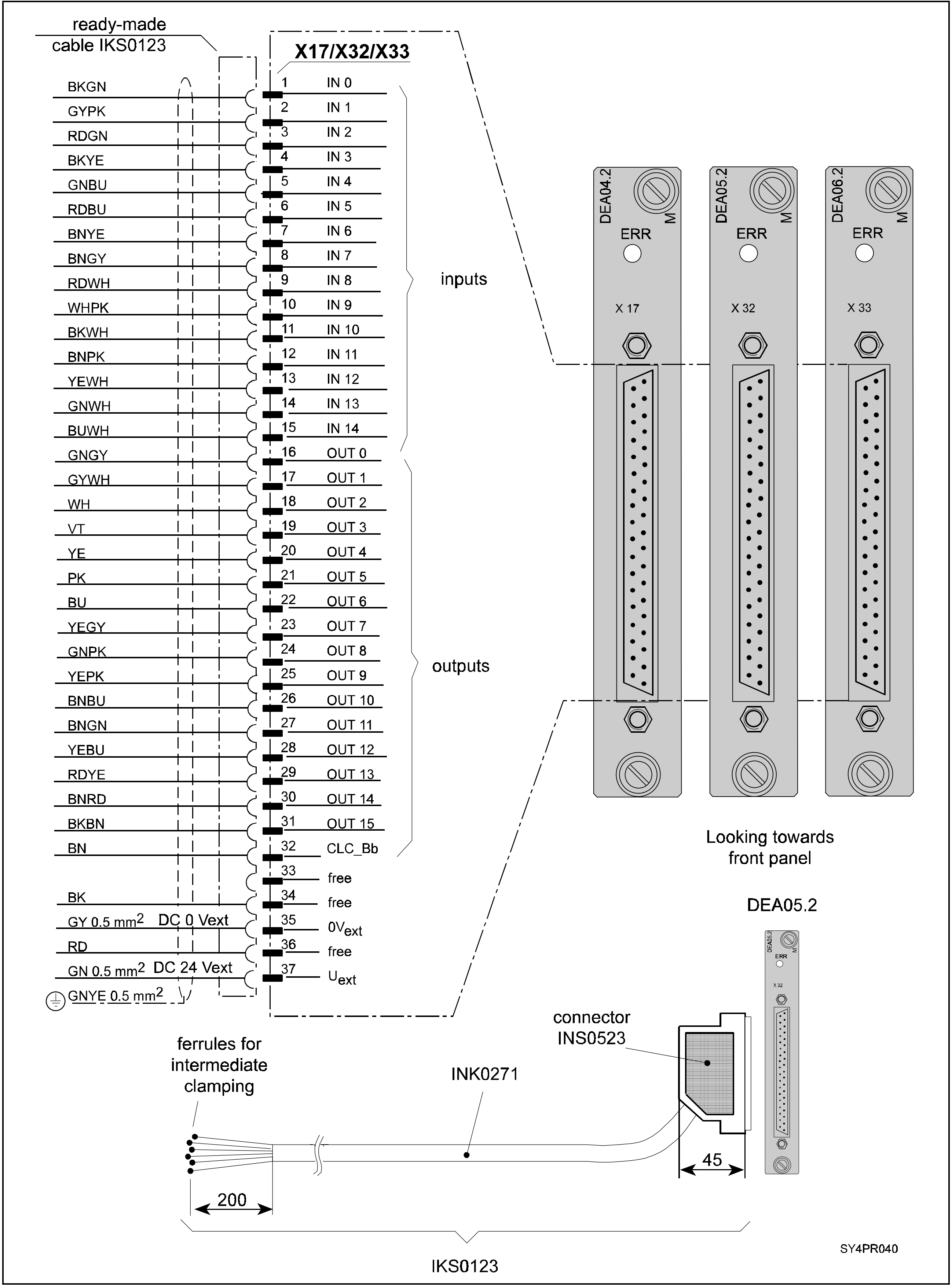


Fig. 9-7: Terminal diagram DEA04.2M, DEA05.2M, DEA06.2M

DEA28.1M, DEA29.1M, DEA30.1M

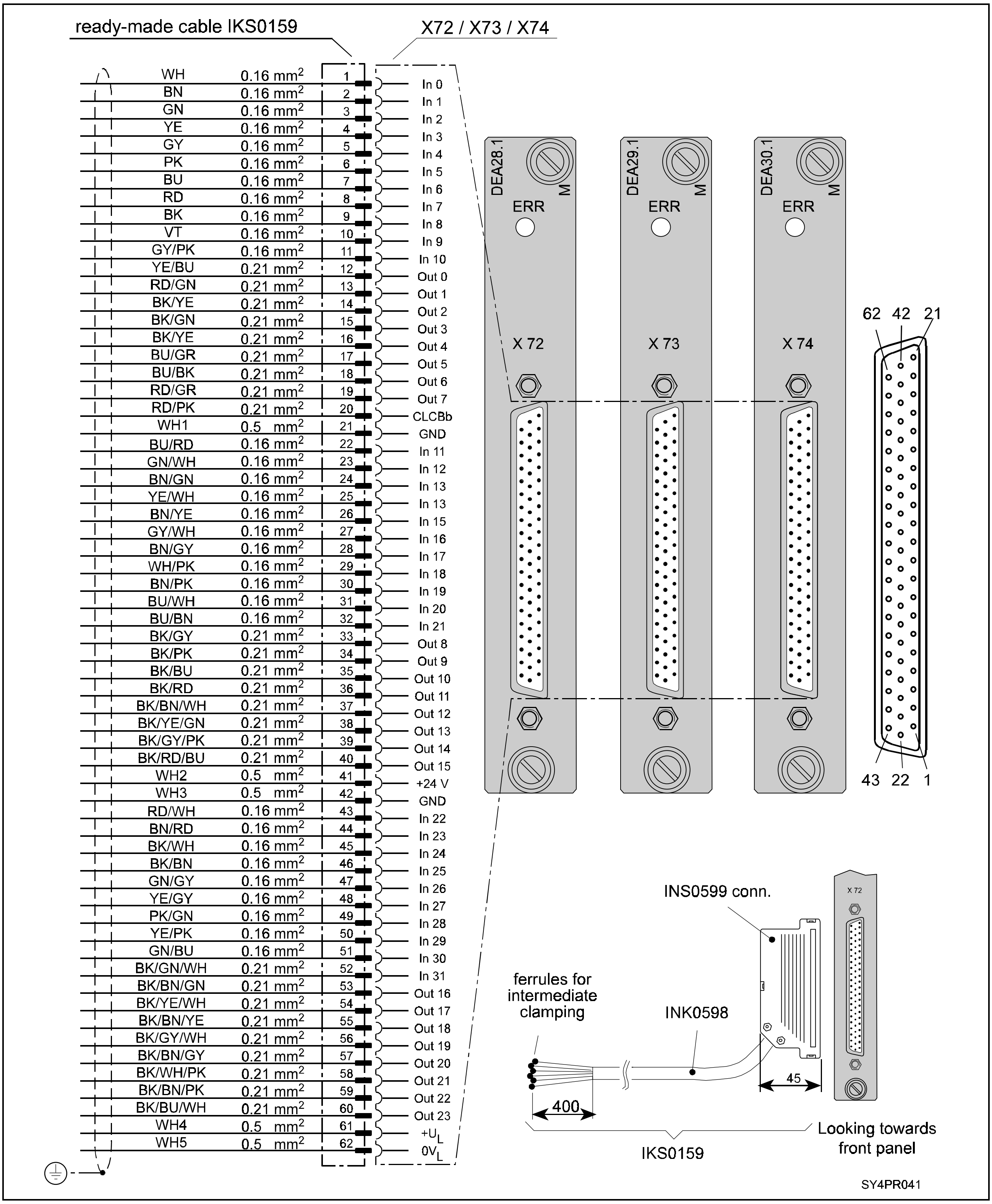


Fig. 9-8: Terminal diagram DEA28.1M, DEA29.1M, DEA30.1M

ARCNet - CLC link DAQ02.1M

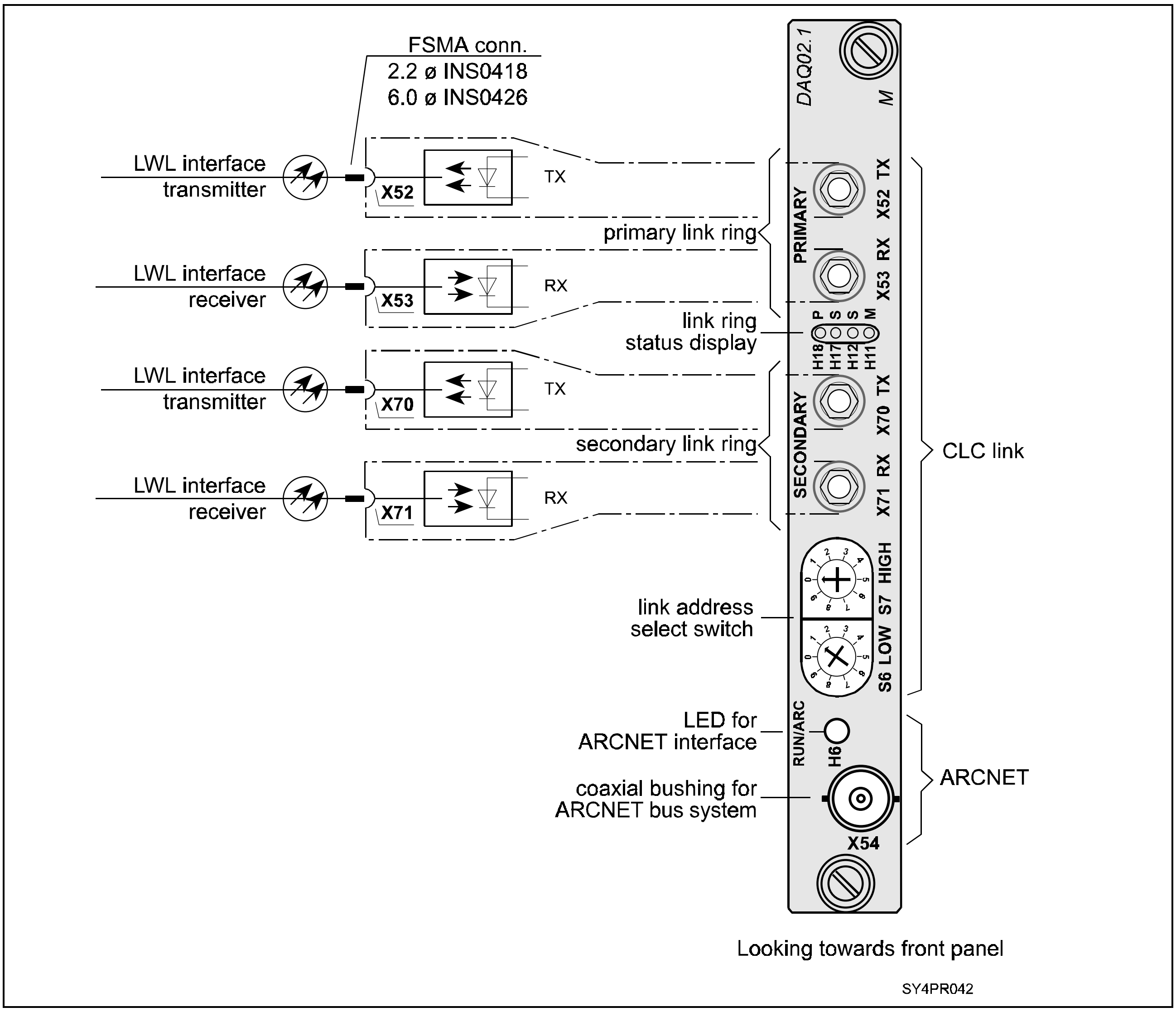


Fig. 9-9: Terminal diagram DAQ02.1M

Interbus-S slave board DBS03.1M

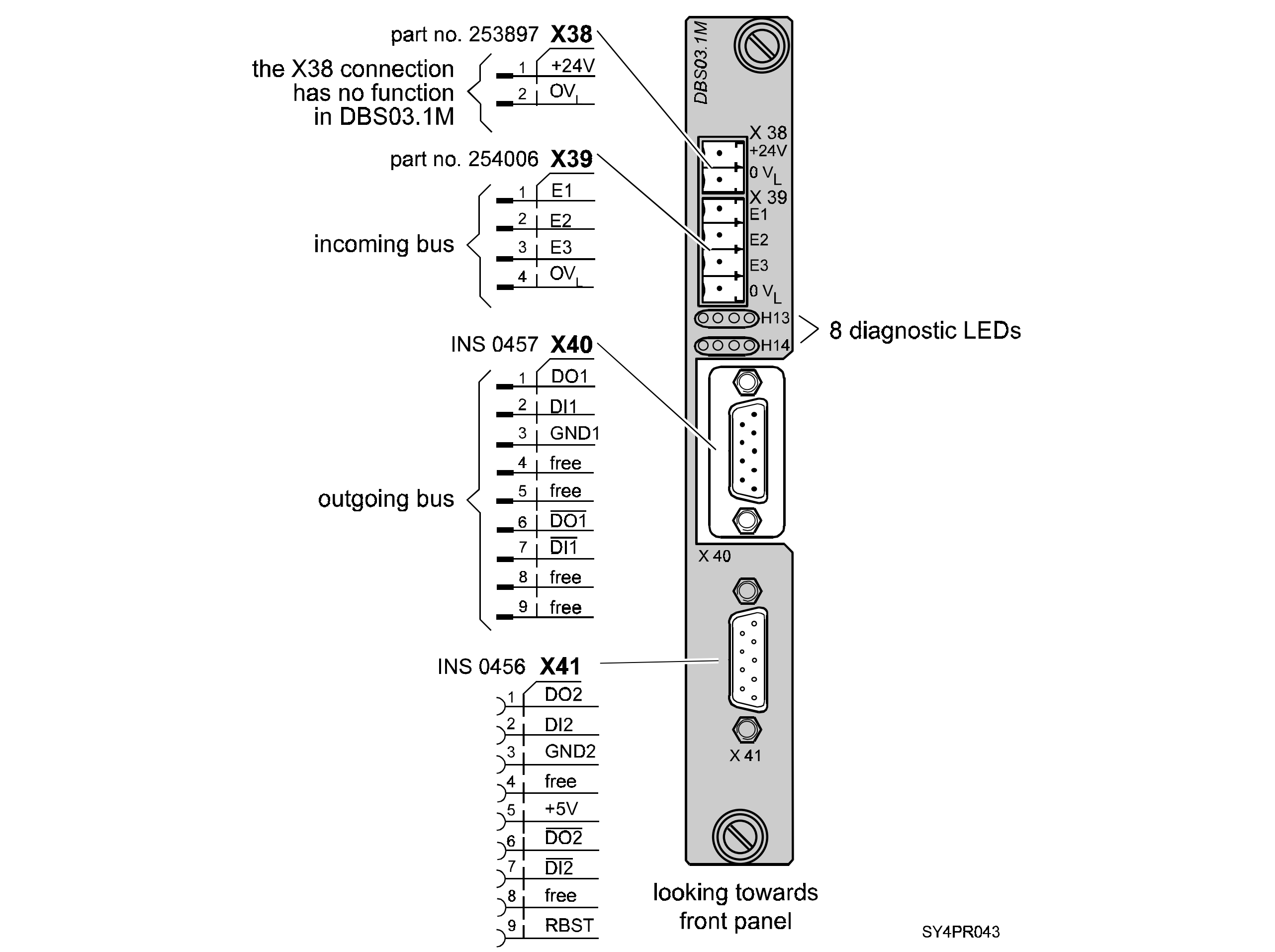


Fig. 9-10: Terminal diagram DBS03.1M

Profibus-DP combi slave board DPF05.1M

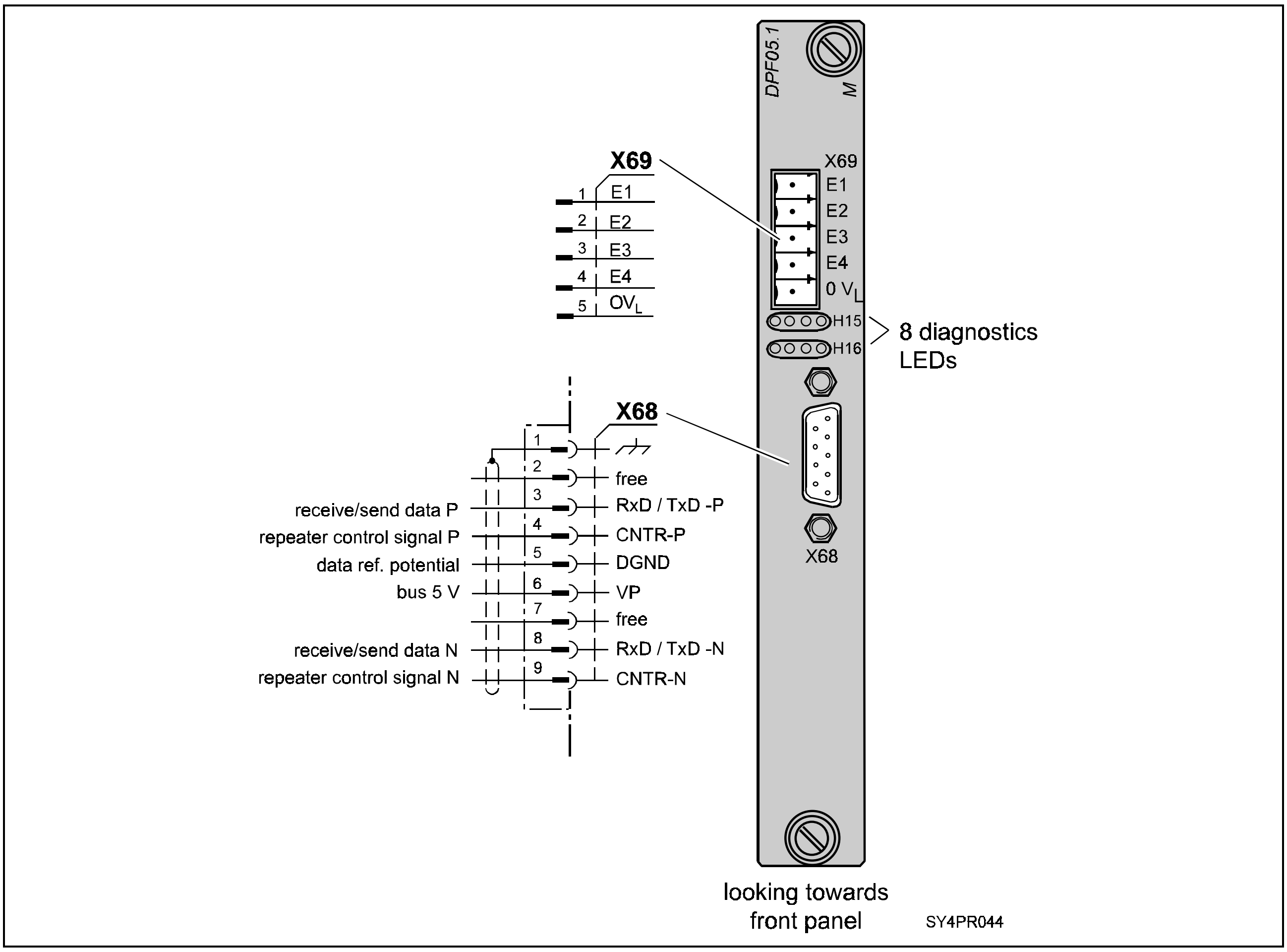


Fig. 9-11: Terminal diagram DPF05.1M

Analogsignal interface DRF01.1M

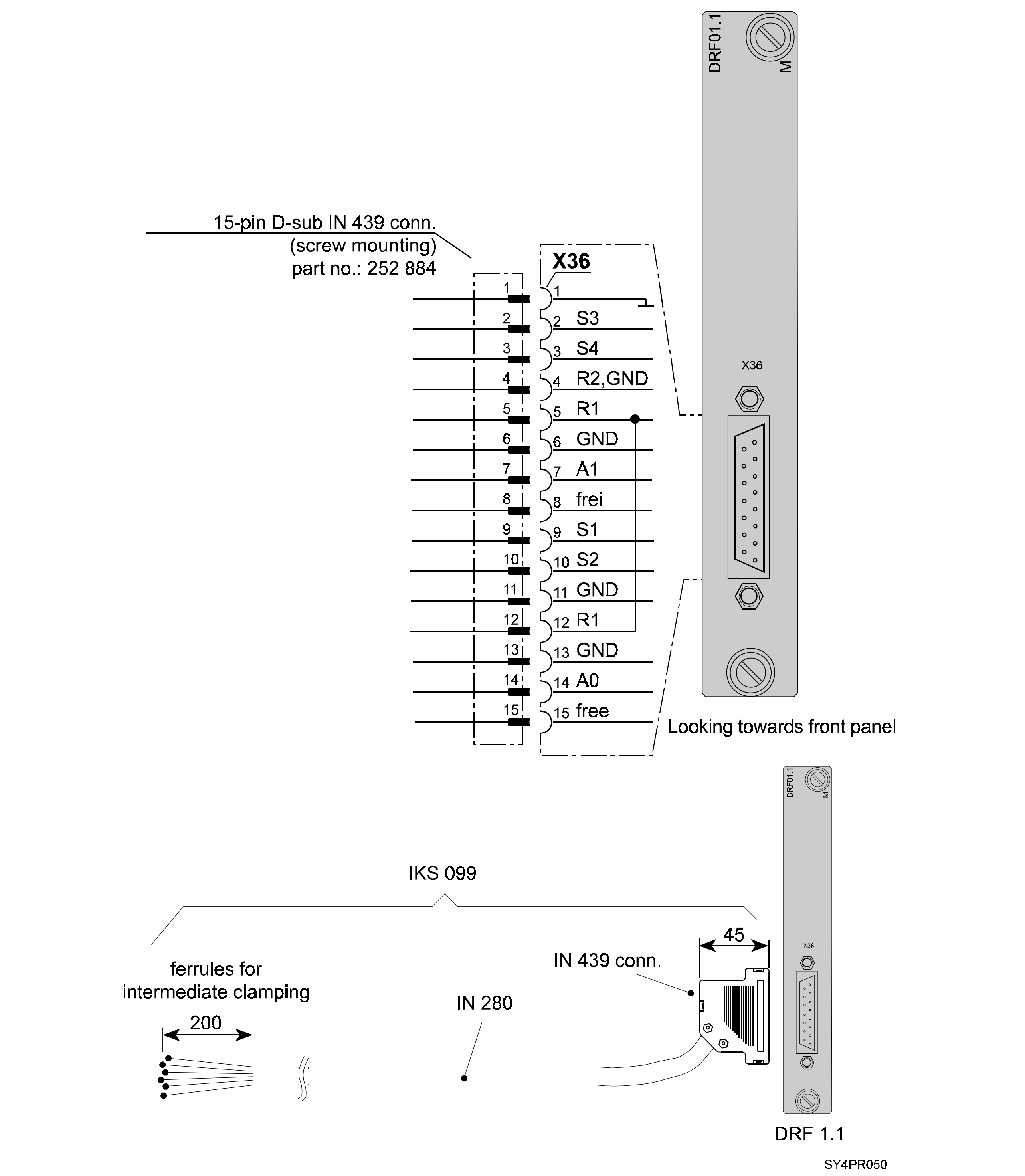


Fig. 9-12: Terminal diagram DRF01.1M

Absolute encoder emulator DSA01.1M

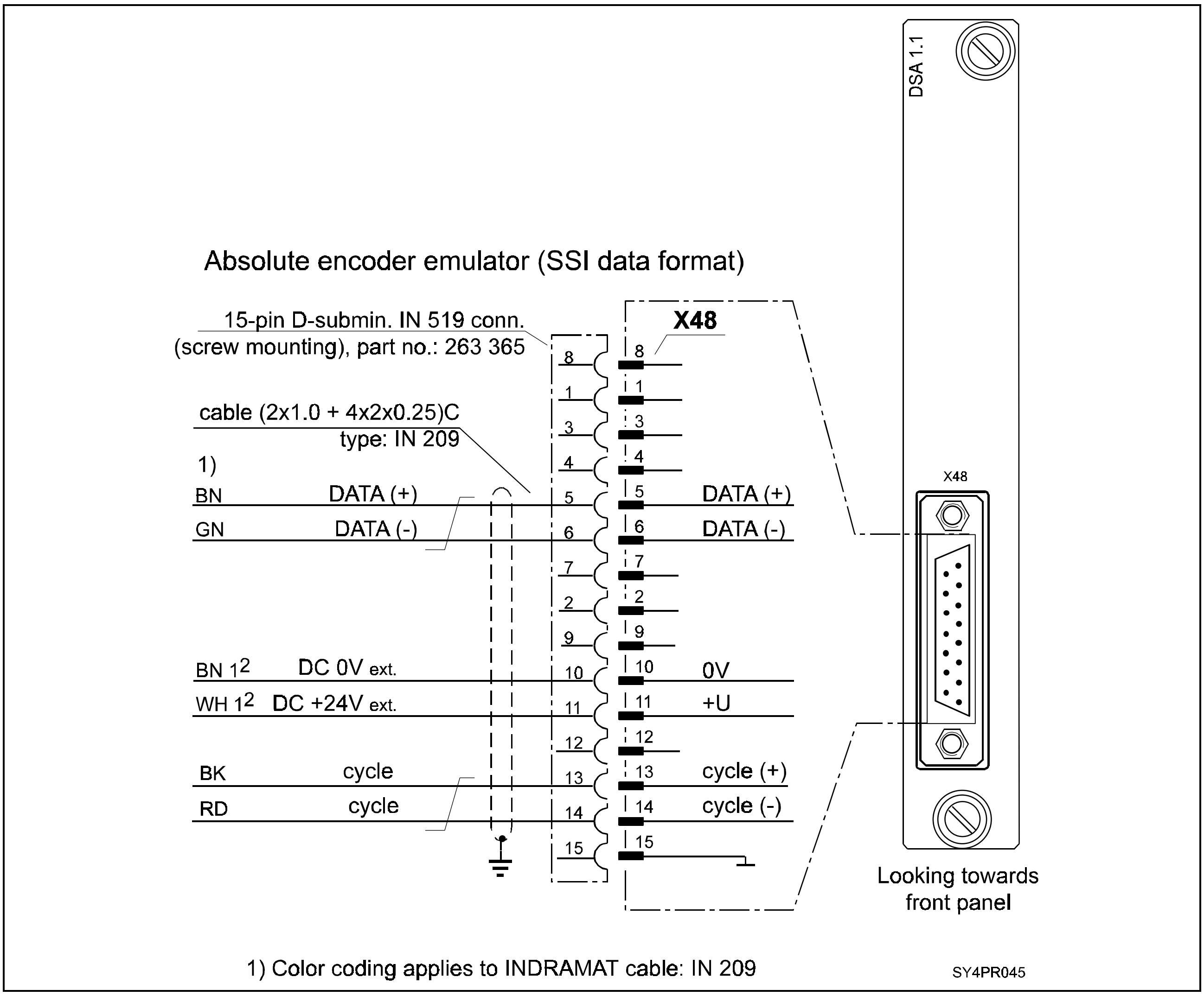


Fig. 9-13: Terminal diagram DSA01.1M

Supplementary documentation

This document contains dimensional sheets and terminal diagrams of plugin module relating to SYNAX.

Supplementary documentation:

"Plugin modules for DIAX03" (DOK-DIAX03-PLUG*IN*MOD-PRJ1-EN-P)

10 Glossary

1MB

AC kit motor with water cooling for integration in spindles (inductance principles).

2AD

AC motors in power range of approx. 3.5 - 93 KW (inductance principle).

Absolute encoder

Encoders that supply an absolute position over several rotations (e.g., 4096).

ARCNet

Serial communication system (coaxial line).
If used with printing machines, for example.

CCD

Housing for CLC-D + daughter boards

CLC

Families of control cards with SERCOS interface. Available are CLC-P and CLC-D. Various software packages are available (here SYNAX).

CLC link

With the help of a SERCOS interface ring, up to 32 CLC-D controls can be connected. Master axis positions are synchronously distributed to all CLC-D's for this purpose.

CLC-D02

Plugin control for DIAX03 drives and CCD box.

CLC-D03

Plugin control for CCD box with external battery (requires two slots).

CLC-P01

PC plugin control with ISA bus.

CLC-P02

PC plugin control with PC/104 bus.

DAG

SSI- EnDat encoder interface

DAQ

CLC link and/or ARCNet connection - CLC-D daughter board.

DBS

INTERBUS-S slave connection - CLC-D daughter board.

DEA

Digital 24V I/Os- CLC-D daughter board or plugin module for digital drives.

DFF

High resolution master axis encoder interface - plugin module for digital drives.

DIAX03

Controller family with an output width of 1 ... 100kW. (DDS02.2 / DDS03.2 / DKR02.1 / DKR03.1 / DKR04.1)

DIAX03 controller

Controller with uniform functions and a output band width of 1... 100kW. (DDS02.2 / DDS03.2 / DKR02.1 / DKR03.1 / DKR04.1)

DLF

High resolution sinusoidal encoder interface - plugin module for digital drives.

DPF

Profibus slave connetion - CLC daughter board.

DRF

Analog input interface - plugin module for digital drives.

DSA

Master axis position with SSI signals - plugin module for digital drives.

DSS

SERCOS interface - plugin module for digital drives.

DZF

High resolution gear/tooth interface - plugin module for digital drives.

GDS

Master axis encoder.

I/O logic

Simply logic with e.g. AND, OR, NOT allocations with which simply I/O allocations are executed.
The I/O logic is generated as a text file and translated. The results of this translation procedure are loaded into the CLC-D. A return to the original is not possible.

LAF

AC linear motor - flat construction (inductance principle).

LAR

AC linear motor - round construction (inductance principle).

LSF

AC linear motor - flat construction (synchronous principle)

LWL

Fiber optic cable, e.g., for SERCOS interface

Master axis encoder

The master axis encoder is a high resolution digital path scale system with 1048580 (=2^20) increments. This encoder is absolute over one revolution.

MBW

AC mounting motor with hollow shaft for printing cylinders (inductance principle).

MDD

AC motor with digital servo feedback synchronous principle)

MKD

AC motor with resolver feedback (synchronous principle)

Multi-Turn

Encoder, that supplies an absolute position over several revolutions (e.g. 4096).

Select lists

Documentation used to determine, for a specific application, a specific motor/controller combination.

SERCOS interface

Internationally standardized digital interface (IEC1491) for communications between control and drives in numerically controlled drives.

Single-Turn

Encoder, that supplies an absolute position over a single revolution.

SSI

Synchronous serial interface. Interface for encoder systems with serial transmissions of digital actual values.

SYNAX

Decentralized System for the Synchronization of Machine Axes, made up of SYNAX firmware, SynTop software, CLC control, DIAX03 and ECODRIVE drives.

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Directory of Customer Service Locations

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