DeviceNet/ CANopen

BETRIEBSANLEITUNG/OPERATING INSTRUCTION

Optische Datenübertragung
Optical Data Transmission System
ISD 300

SICK

1 Safety Notices

1.1 Safety standards

The optical ISD 300 data transmission system was developed, manufactured and tested in accordance with applicable safety standards. It corresponds to the state of the art.

1.2 Intended use

The ISD 300 optical data transmission system has been designed and developed for the optical transmission of data in the infrared range.

Attention!
The protection of personnel and the device cannot be guaranteed if the device is operated in a manner not corresponding to its intended use.

Areas of application

The ISD 300 is suitable for the following areas of application:

- Automated high-bay warehouses
- Stationary data transmission between buildings
- Anywhere, where data transmission to and from stationary or moving objects (visual contact) over relatively long distances (up to 200 m) is required.

1.3 Working safely

Laser Class 1!
The ISD 300 data transmission system is a class 1 infrared laser device in accordance with EN 60825. Do not look directly at the beam at close range!

Attention!
Access and changes to the device, except where expressly described in this operating manual, are not authorised.

1.4 Organisational measures

Documentation

All entries in this operating instruction must be heeded, in particular those in the sections „Safety Notices“ and „Commissioning“. Keep this operating instruction in a safe place. It should be accessible at all times.

Safety regulations

Observe the locally applicable legal regulations and the rules of the employers' liability insurance association.

Qualified personnel

Mounting, commissioning and maintenance of the device may only be carried out by qualified personnel.

Work on electrical installations may only be carried out by qualified electricians.

Repair

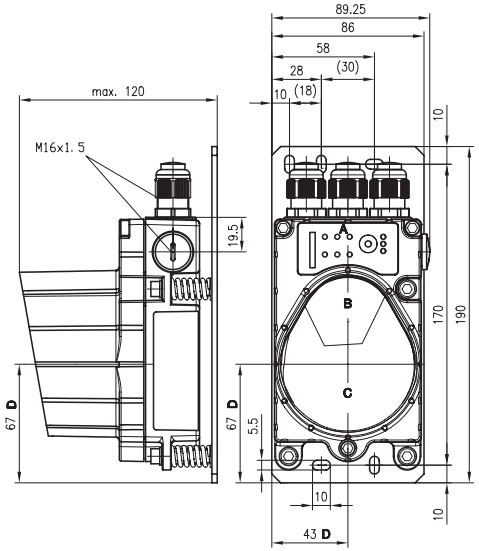
Repairs must only be carried out by the manufacturer or an authorised representative.

2 Technical Data

2.1 General technical data

	ISD 300-5211	ISD 300-5212
Part No.	6 027 231	6 027 232
Electrical data		
Supply voltage Vin	18 … 30 V DC	
Current consumption	approx. 200 mA with 24 V DC (no load at switching output)	
Optical data		
Sensing distance	0.2 … 200 m	
Transmission diode	infrared light, wavelength 880 nm	
Opening angle	± 0.5 ° to optical axis	
Ambient light	> 10000 Lux acc. to EN 60947-5-2 (2000)	
Laser safety class	1 acc. to EN 60825-1 (2001)	
Input/output		
Input	0 … 2 V DC: transmitter/receiver deactivated 18 … 30 V DC: transmitter/receiver activated	
Output	0 … 2 V DC: normal operation Vin - 2 V DC: limited performance reserve output current max. 100 mA, short-circuit proof, protected against surge voltage, transients and overheating	
Operating and display elements		
Membrane buttons	change the operating mode	
Individual LEDs	indicate voltage supply, operating mode, data traffic	
LED strip	bar graph display of the receiving level	
Mechanical data		
Housing	aluminium diecast; light inlet/outlet, glass	
Weight	approx. 1200 g	
Protection class	IP 65 acc. to EN 60529	
Environmental conditions		
Operating temperature	-5 °C … +50 °C	
Storage temperature	-30°C … +70°C	
Air humidity	max. 90% rel. humidity, non-condensing	
Vibrations	acc. to EN 60068-2-6	
Noise	acc. to EN 60068-2-64	
Shock	acc. to EN 60068-2-27 and EN 60068-2-29	
EMC	acc. to EN 61326 (1998) + A1 (1999)	

2.2 Dimensioned drawing

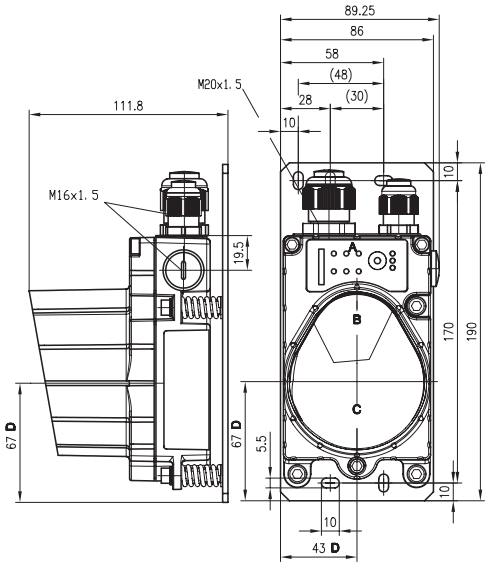


Permissible cables:

M16 x 1.5:
round cable Ø 5 … 10 mm

A control panel
B transmission optics
C reception optics
D optical axis

Bild 2.1: Dimensioned drawing ISD 300 for **copper cable**



Permissible cables:

M16 x 1.5:
round cable Ø 5 … 10 mm

M20 x 1.5:
round cable Ø 7 … 12 mm

A control panel
B transmission optics
C reception optics
D optical axis

Bild 2.2: Dimensioned drawing ISD 300 for **fibre optic cable**

3 Mounting / Installation (all device variants)

3.1 Mounting and alignment

An optical data transmission system, consisting of 2 ISD 300 devices, involves mounting each of the devices on mutually opposing, plane-parallel, flat and usually vertical walls with unobstructed view of the opposing ISD 300.

Make certain that, at the minimum operating distance A_{min} the optical axes of the devices are aligned with one another within $\pm A_{min} \bullet 0.01$ to ensure that the transmission/reception beams of the two devices lie within the opening angle. This also applies for rotary transmission.

Note

The opening angle (angle of radiation) of the optics is ± 0.5 ° to the optical axis! The horizontal and vertical adjustment angles of the fine alignment with the adjustment screws is ± 6 ° for each. The optical transmission path between the ISD 300 should not be interrupted. If interruptions cannot be avoided, be sure to read the notice in chapter 5.4.
Therefore, pay close attention when selecting a suitable mounting location!

Attention!

When laying out a mobile arrangement for a ISD 300, pay particular attention that the alignment of the devices relative to one another remains unchanged over the transmission path. The transmission can be interrupted by jolts, vibrations or inclination of the mobile device due to irregularities in the floor or path.
Ensure adequate track stability.

Mount each device with 4 screws ∅ 5 mm using 4 of the 5 fastening holes in the mounting plate of the device (see chapter 2.2 “Dimensioned drawing”).

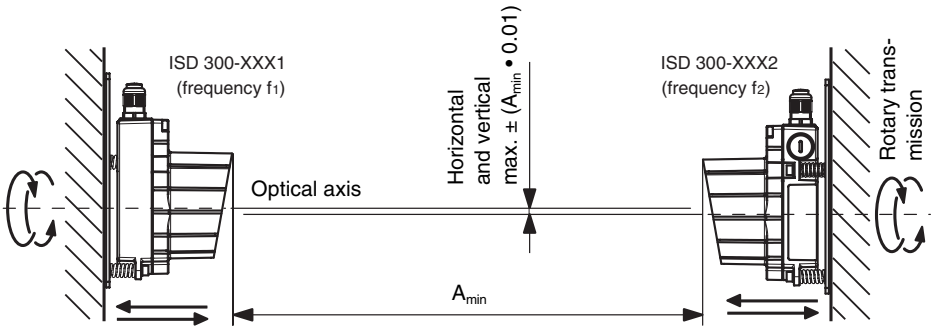


Bild 3.1: Mounting the devices

Note

The fine alignment of the transmission system is performed during commissioning (see chapter 5.3.2 “Fine adjustment”). The position of the optical axis of the ISD 300 can be found in chapter 2.2.

3.2 Arrangement of adjacent transmission systems

To prevent mutual interference of adjacent transmission systems, the following measures should be taken in addition to exact alignment:

- With a frequency-offset arrangement, the distance between two parallel transmission paths must not be less 500 mm.
- With arrangements using identical frequencies, the distance between two parallel transmission paths must be at least **500 mm + tan (0.5°) x sensing distance**.

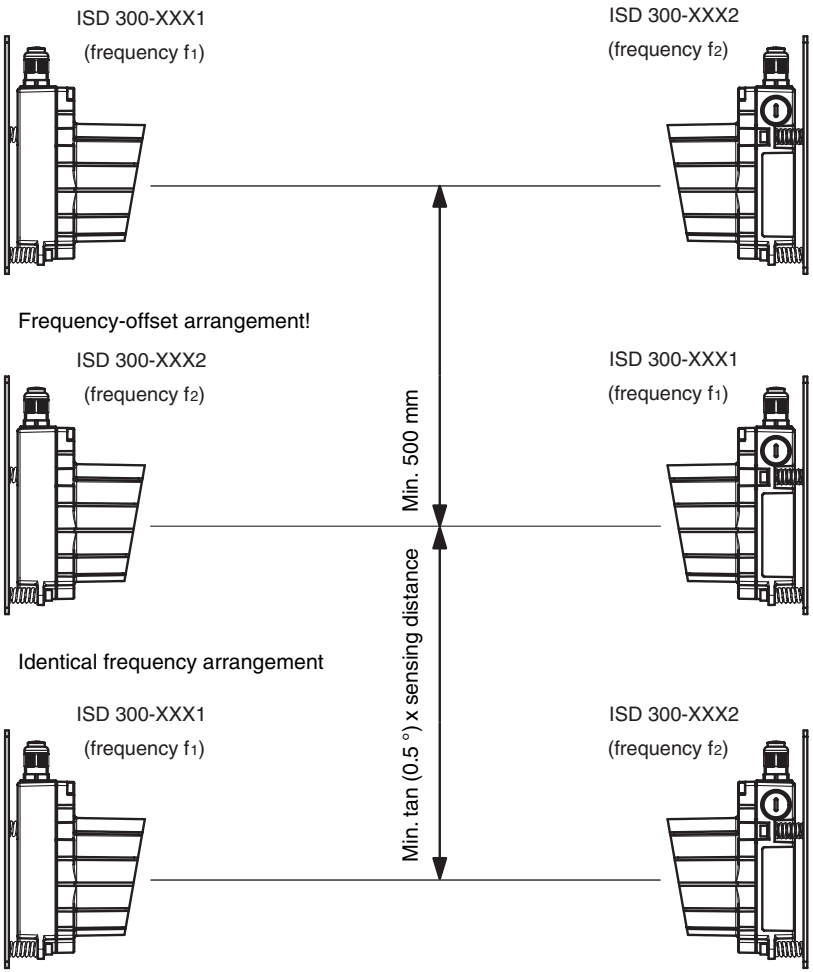


Bild 3.2: Arrangement of adjacent transmission systems

3.3 Electrical connection

Attention!
Connection of the device and maintenance work while under voltage must only be carried out by a qualified electrician.

If faults cannot be corrected, the device should be removed from operation and protected against possible use.

Before connecting the device, be sure that the supply voltage agrees with the value printed on the nameplate.

The power supply unit used to power the ISD 300 must have protected electrical separation by way of a safety transformer with double insulation according to EN 60742 (equivalent IEC 60742).

Be sure that the earthing conductor is connected correctly. Error-free operation is guaranteed only when the device is properly earthed.

Described in this section is the electrical connection of the supply voltage, the input and the output. These connections and their functions are identical for all device variants.

The connection of the respective bus system is described in the following chapters.

To establish the electrical connections, you must first remove the red housing top with the optics. To do this, loosen the three housing hex screws. The housing top is now only electrically connected to the base by means of a connector. Carefully pull the housing top straight forward without skewing.

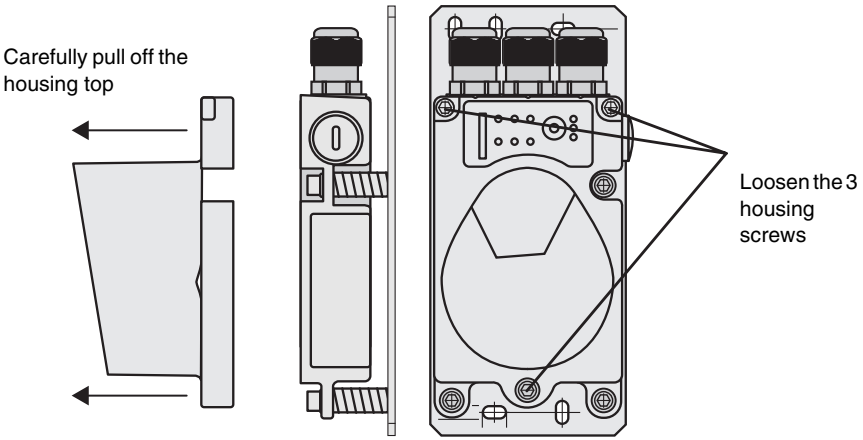
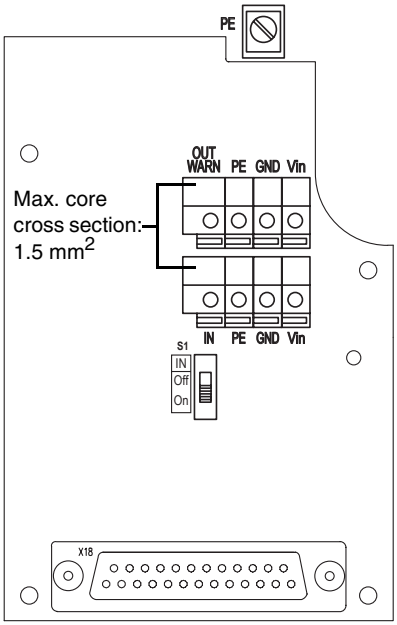


Bild 3.3: Removing the housing top

The connection compartment in the housing base with the screwed cable glands is now freely accessible.



Terminal	Function
Vin	Positive supply voltage **+18 … +30 V DC**
GND	Negative supply voltage **0 V DC**
PE	**Earth lead**
OUT **WARN**	**Switching output**, activated if level drops below the warning level
IN	**Switching input** for transmitter/receiver cut-off: **0 … 2 V DC**: transmitter/receiver switched off, no transmission **18 … 30 V DC**: transmitter/receiver active, normal function

Switch	Function
S1	**On**: the switching input is not analysed. The transmitter/receiver unit is always in operation. **Off**: the switching input is analysed. Depending on the input voltage, normal function or transmitter/receiver unit switched off.

Bild 3.4: Positions of the general, non-bus-specific terminals and switches

3.3.1 Supply voltage

Connect the supply voltage, including the earth lead, to the spring terminals labelled **Vin**, **GND** and **PE** (see figure 3.4).

Note
The connection terminals Vin, GND and PE are provided twice to simplify wiring through the supply voltage to other devices.

The earth lead can alternatively be connected at the screw terminal in the housing base (max. core diameter 2.5 mm^2)

If you would like to wire through the supply voltage, you should replace the filler plugs on the right side of the housing base with an M16 x 1.5 screwed cable gland and guide the continuing supply voltage cable through this gland. In this way the housing seal is ensured (Protection Class IP 65).

The housing top can be removed and replaced while under voltage.

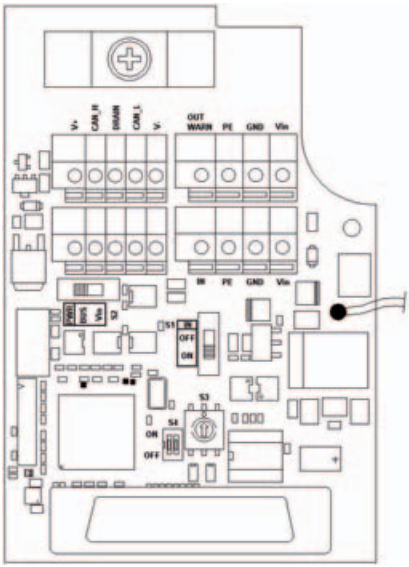
4 DeviceNet / CANopen

The DeviceNet/CANopen model of the ISD 300 has the following features:

- The ISD 300 can transmit both DeviceNet as well as CANopen protocols
- Electrically isolated interface
- The ISD 300 does not occupy an address
- Can simultaneously process 11-bit and 29-bit identifiers
- 8 baud rates can be set (10k, 20k, 50k, 125k, 250k, 500k, 800k, 1M)
- Baud rate conversion possible

4.1 Electrical connection DeviceNet / CANopen

The electrical connection to DeviceNet / CANopen is made at terminals V-, CAN_L, DRAIN, CAN_H, V+. The terminals are available as double connectors for wiring through the bus.



No.	Terminal	Cable colour	Function	
1	**V-**	black	neg. supply (CAN ground reference)	
2	**CAN_L**	blue	bus signal (LOW)	
3	**DRAIN**	transparent	shield	
4	**CAN_H**	white	bus signal (HIGH)	
5	**V+**	red	pos. supply	
Switch		**position**	**Function**	
S2		BUS	bus transceivers are supplied via the bus cable (V- and V+ lines)	
		Vin **default**	bus transceivers are supplied via internal DC/DC converters	
S3		0 **default**	125kBit baud rate	CANopen/DeviceNet
		1	250kBit baud rate	CANopen/DeviceNet
		2	500kBit baud rate	CANopen/DeviceNet
		3	10kBit baud rate	CANopen
		4	20kBit baud rate	CANopen
		5	50kBit baud rate	CANopen
		6	800kBit baud rate	CANopen
		7	1000kBit baud rate	CANopen
		8	reserved	
		9	reserved	
S4.1		ON	sorting memory is active	
		OFF **default**	sorting memory is deactivated (FIFO)	
S4.2		ON / OFF	reserved	

Bild 4.1: DeviceNet / CANopen, connection-board variant

Attention!
The maximum permissible current which may pass over terminals V+ / V- is 3A; the maximum permissible voltage is 25 V (11 … 25 V)!

4.1.1 Bus transceiver and device supplied via separate power connection

- Switch S2 = Vin
- Bus electrically insulated (isolated node)
- CAN_GND must be connected to V-

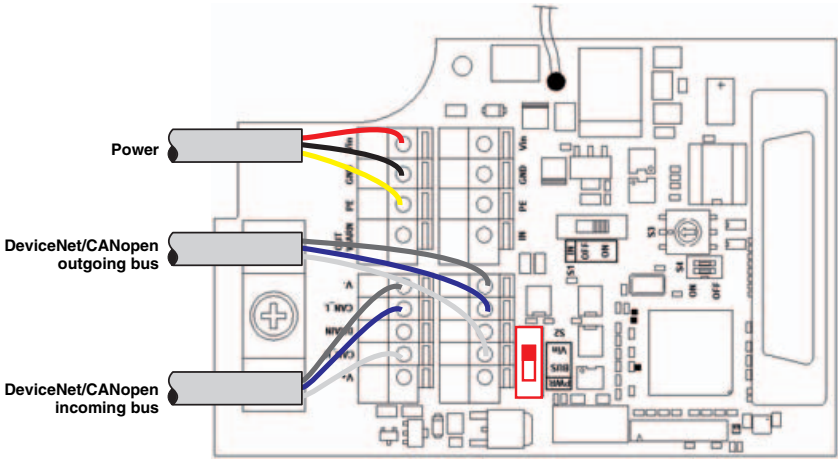


Bild 4.2: Bus transceiver and device supplied via separate power connection

4.1.2 Supply: bus transceiver via bus cable, device via separate power line

- Switch S2 = BUS
- Bus electrically insulated (isolated node)

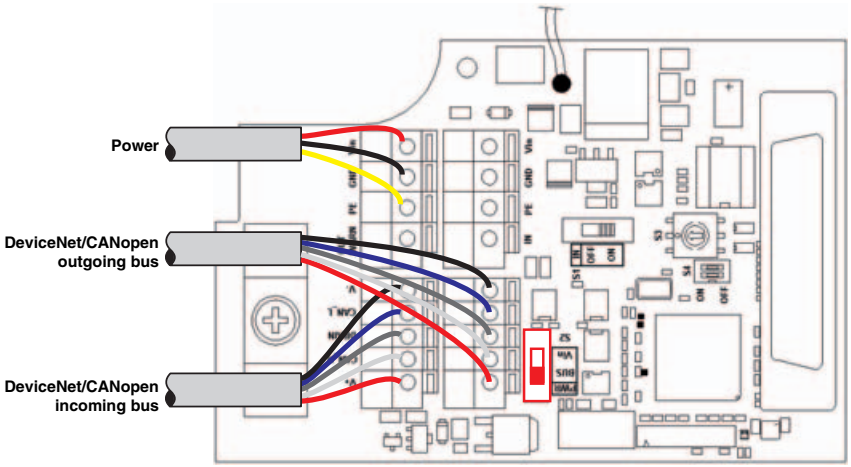


Bild 4.3: Bus transceiver supplied via bus cable, device supplied via separate power line

4.1.3 Bus transceiver and device supplied via bus cable

- Switch S2 = BUS
- Bus not electrically insulated (non-isolated node)

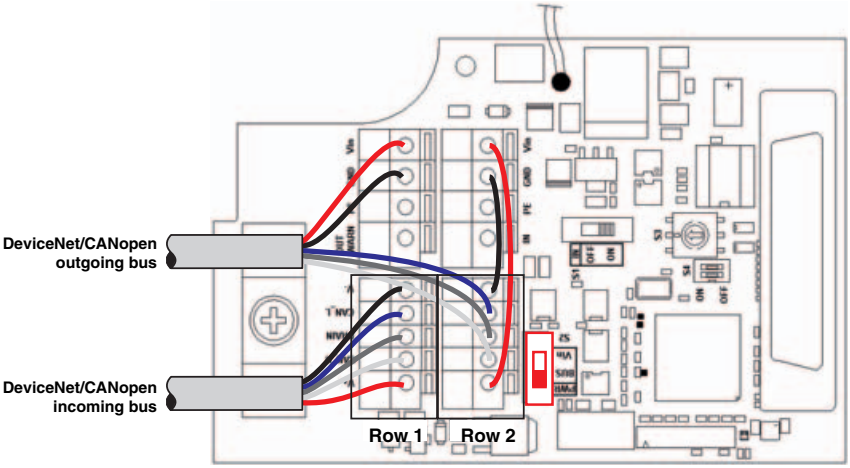


Bild 4.4: Bus transceiver and device supplied via bus cable

Incoming bus cable		Outgoing bus cable	
Cable	**Terminal**	**Cable**	**Terminal**
V- (black)	V- (row 1)	V- (black)	GND
CAN_L (blue)	CAN_L (row 1)	CAN_L (blue)	CAN_L (row 2)
DRAIN (transparent)	DRAIN (row 1)	DRAIN (transparent)	DRAIN (row 2)
CAN_H (white)	CAN_H (row 1)	CAN_H (white)	CAN_H (row 2)
V+ (red)	V+ (row 1)	V+ (red)	Vin
Bridge between Vin and V+ (row 2)			
Bridge between GND and V- (row 2)			

Tabelle 4.1: Connection table

Note!
In order for this interface connection to be conformant with the DeviceNet Ground concept, the load on the switching output and/or the source at the switching input must be potential free.

Note!
If the complete device is operated using the supply in the bus cable, it must be ensured that the voltage is at least 18 V.

Note!
The total current of the device is the device current plus the current drawn at the switching output.

4.2 Device configuration DeviceNet / CANopen

4.2.1 Baud rate conversion

Through the use of an optical transmission system, the bus is divided into two segments. Different baud rates can be used in the physically separated segments. The ISD 300s then function as baud rate converters. During baud rate conversion, it must be ensured that the bandwidth of the segment with the lower baud rate is adequate for processing the incoming data.

4.2.2 Sorting (switch S4.1)

With the aid of switch S4.1, sorting of the internal memory can be activated and deactivated. If sorting is deactivated (switch S4.1 = OFF), CAN frames are handled according to the FIFO principle (First-In-First-Out).

If sorting is active (switch S4.1 = ON), CAN frames are sorted according to their priority. The messages with the highest priority in memory are processed first.

4.2.3 Signal delay

The typical delay of a message from one optical data transmitter to the opposing optical data transmitter is (calculated with 10% stuffing bits):

Number of bits in the telegram x 1.1 x (0.5µs + TBit) + 45µs

Note!
The maximum delay is dependent on various factors (bus loading, history, message priority, ...).

Attention!
Due to the delay of the messages, it is possible, for example, that the initialisation time (starting up the system) increases with CANopen.

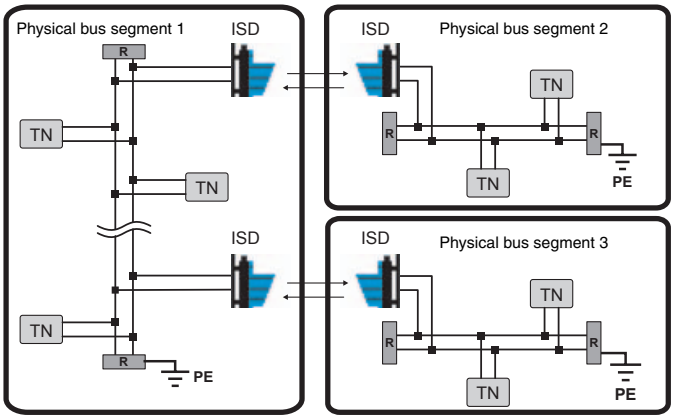
4.2.4 Bus lengths as a function of the baud rate

Switch position S3	Baud rate	max. cable length per bus segment	Interface
0	125kBit	500m	CANopen / DeviceNet
1	250kBit	250m	CANopen / DeviceNet
2	500kBit	100m	CANopen / DeviceNet
3	10kBit	5000m	CANopen
4	20kBit	2500m	CANopen
5	50kBit	1000m	CANopen
6	800kBit	50m	CANopen
7	1000kBit	30m	CANopen

Note!
The mechanical expansion of the bus system can be increased through the use of the ISD 300.

4.3 Wiring

- The ends of the bus lines must be terminated between CAN_L and CAN_H for each physical bus segment (see Figure 4.5 R).
- The ground reference CAN_GND must only be connected to earth potential (PE) at one place on a physical bus segment (see Figure 4.5).



TN = bus subscriber

Bild 4.5: DeviceNet / CANopen wiring

4.3.1 Termination

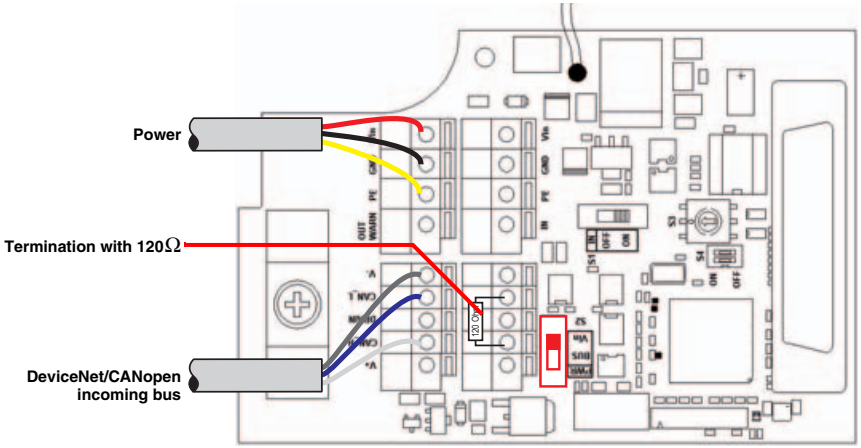
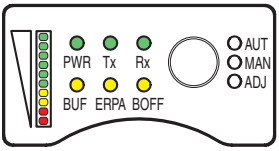


Bild 4.6: Termination in the unit.

A 120Ω resistor is connected standard between terminals CAN_L and CAN_H. If the device is not the last subscriber of the bus segment, the resistor must be removed and the outgoing bus cable connected to the terminal strip.

4.4 DeviceNet/CANopen LED indicators

In addition to the indicator and operating elements present in all device models (bar graph, buttons, LEDs AUT, MAN, ADJ; see chapter 5.1 “Indicator and operating elements”), the DeviceNet/CANopen model also has the following indicators:



LED **PWR**:	green	=	operating indicator
	green flashing	=	transmitter /receiver unit switched off via switching input **IN** or hardware error
	off	=	no operating voltage
LED **Tx**:	green	=	data are being transmitted to the bus
	green flashing	=	with baud rates set to very low values, or with low bus traffic, the LEDs **Tx** and **Rx** flicker.
	off	=	no data are being transmitted to the bus
LED **Rx**:	green	=	data are being received by the bus
	green flashing	=	with baud rates set to very low values, or with low bus traffic, the LEDs **Tx** and **Rx** flicker.
	off	=	no data on the reception line
LED **BUF**:	yellow	=	**buf**fer load: >70%
	yellow flashing	=	**buf**fer load: 30% … 70%
	off	=	**buf**fer load: <30%
LED **ERPA**:	yellow	=	ISD 300 is in “**Er**ror **Pa**ssive” state, full communication functionality, however in the event of an error, a passive error flag is sent (see also “BOSCH CAN Specification 2.0”). **Measures**: - check termination, wiring, baud rate
	off	=	ISD 300 is in “Error Active” state, full communication functionality, however in the event of an error, an active error flag is sent, normal state
LED **BOFF**:	yellow	=	ISD 300 in “**B**us**Off**” state, does **not** reattempt to participate in bus traffic ⇒ **manual intervention necessary** **Measures**: - check termination, wiring, baud rate - power OFF/ON of the device supply or bus supply
	yellow flashing	=	ISD 300 in the “**B**us**Off**” state, but does reattempt to participate in bus traffic
	off	=	ISD 300 not in the “**B**us**Off**” state, normal state

Bild 4.7: Indicator/operating elements of the DeviceNet/CANopen model

5 Commissioning / Operation (all device models)

5.1 Indicator and operating elements

All ISD 300 device models have the following indicator and operating elements:

- Bar graph with 10 LEDs
- Operating mode LEDs AUT, MAN, ADJ
- Operating mode buttons

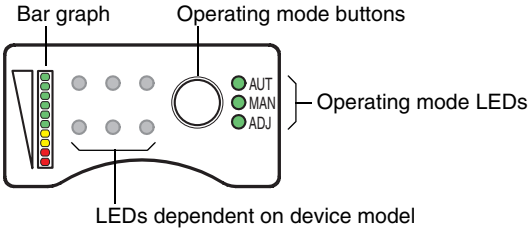
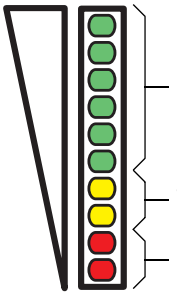


Bild 5.1: Indicator and operating elements common to all ISD 300 device models

Bar graph

The bar graph displays the quality of the received signal (receiving level) at its own (operating modes “Automatic” and “Manual”) or opposing (operating mode “Adjust”) ISD 300 (figure 5.2).



Operating range: Good receiving level, optical data transmission active, performance reserve, output **OUT WARN** not active (0 … 2 V DC)

Warning range: Receiving level in the warning range, continued error-free data transmission, no performance reserve, output **OUT WARN** active (Vin - 2 V DC), peripheral error message with INTERBUS fibre optic cable model

Cut-off range: Receiving level minimal, optical data transmission separated, output **OUT WARN** active (Vin - 2 V DC)

Bild 5.2: Meaning of the bar graph for displaying the receiving level

Operating mode LEDs

The three green LEDs **AUT**, **MAN** and **ADJ** indicate the current operating mode (see chapter 5.2 “Operating modes”) of the ISD 300.

- **AUT**: operating mode “Automatic”
- **MAN**: operating mode “Manual”
- **ADJ**: operating mode “Adjust”

Operating mode buttons

You can switch between the three operating modes “Automatic”, “Manual” and “Adjust” (see chapter 5.2 “Operating modes”) with the operating mode button.

5.2 Operating modes

The following table provides an overview of the ISD 300 operating modes.

Operating mode	Description	Optical data transmission	Bar graph assignment
Automatic, **AUT** LED illuminates	Normal operation	Active	Its own receiving level, display of the alignment quality of the opposing device
Manual, **MAN** LED illuminates	Adjustment operation, higher cut-off threshold	Active	Its own receiving level, display of the alignment quality of the opposing device
Adjust, **ADJ** LED illuminates	Adjustment operation, higher cut-off threshold	Stopped	Receiving level of the opposing device, display of the alignment quality of own device

Changing the operating mode

AUT –> MAN Press the operating mode button for more than 2 seconds.
Only the device on which the button was pressed switches to the “Manual” operating mode (**MAN** LED illuminates).

MAN –> ADJ Press the operating mode button on one of the two devices.
Both devices switch to the “Adjust” operating mode (both **ADJ** LEDs illuminate) when both were previously in the “Manual” operating mode.

ADJ –> MAN Press the operating mode button on one of the two devices.
Both devices switch to the “Manual” operating mode (both **MAN** LEDs illuminate).

MAN –> AUT Press the operating mode button for more than 2 seconds.
Only the device on which the button was pressed switches to the “Automatic” operating mode (**AUT** LED illuminates).

Note!
To switch to the “Adjust” (ADJ) operating mode, both devices in a transmission path must first be in the “Manual” (MAN) operating mode. It is not possible to switch directly from the “Automatic” to the “Adjust” operating mode or vice versa.

5.3 Initial commissioning

5.3.1 Switch on device / function check

After applying the operating voltage, the ISD 300 first performs a self-test. If the self-test is successfully completed, the **PWR** or **UL** LED illuminates continuously and the ISD 300 switches to the “Automatic” operating mode. If the connection to the opposing device exists, data can be transmitted immediately.

If the **PWR** or **UL** LED flashes after switching on, there are two possible causes: either a hardware error has occurred or the transmitter/receiver unit has switched off via the switching input **IN**.

If the **PWR** or **UL** LED remains off after switching on, there is either no voltage supply present (check connections and voltage) or a hardware error has occurred.

5.3.2 Fine adjustment

If you have mounted and switched on the two ISD 300s of a given optical transmission path and they are both in the “Automatic” operating mode, you can perform the fine adjustment of the devices relative to one another with the aid of the three alignment screws.

Note!
Note that “alignment” refers to the transmitter beam being positioned as accurately as possible on the opposing receiver.

At the maximum sensing distance, the bar graph does not show end-scale deflection even with optimal alignment!

The ISD 300 is fast and easy to adjust finely. The **optimisation of the alignment** between the two devices of one transmission path can be performed **by just one person**. Use the following descriptive steps as a set of numbered instructions:

1. Both devices are located close to one another (> 1 m). Ideally, the bar graphs of both devices display maximum end-scale deflection.
2. Switch both devices to “Manual” (**MAN**) by pressing the button for a relatively long time (> 2 s). Data transmission remains active, only the internal cut-off threshold is changed to the warning threshold (yellow LEDs).
3. While in the “Manual” operating mode, move until data transmission of the ISD 300 is interrupted. The devices are not yet optimally aligned with one another.
4. Briefly press the button to switch both devices to the “Adjust” operating mode (**ADJ**). Data transmission remains interrupted.
5. The devices can now be individually aligned. The result of the alignment can be read directly in the bar graph.
6. When both devices are aligned, briefly pressing the button on one of the devices is enough to switch both back to the “Manual” operating mode (**MAN**). Data transmission is again active; the vehicle can continue its path. If data transmission is interrupted again, repeat steps 3 through 6.
7. If the data transmission and the alignment are OK through the end of the path of motion, switch both devices back to the “Automatic” (**AUT**) operating mode by pressing the button for a relatively long time (> 2 s). The optical data transceiver is now ready for operation.

5.4 Operation

In running operation (“Automatic” operating mode) the ISD operates maintenance-free. Only the glass optics need to be cleaned occasionally in the event of soiling. This can be checked by analysing the switching output **OUT WARN** (with the INTERBUS fibre optic cable model, a peripheral error message is also available). If the output is set, soiling of the ISD 300’s glass optics is often the cause (see chapter 6 “Maintenance”).

It must still be ensured that the light beam is not interrupted at any time.

Attention!
If, during operation of the ISD 300, the light beam is interrupted or one of the two devices is switched off, the effect of the interruption on the entire network is equivalent to the interruption of a data line!

In the event of an interruption (light beam interruption or switched voltage-free), the ISD 300 switches off the network to a non-interacting state. The system reactions in the event of an interruption are to be defined together with the supplier of the PLC.

6 Maintenance

Generally, the ISD 300 does not require maintenance.

Care during operation:
It is advisable to clean the transmitter and receiver lenses (optical interface) and housing (heat dissipation) at regular intervals (especially in extreme industrial conditions with dust or humidity).
To do so, use a soft, lint-free cloth with a mild water-soluble detergent, if necessary.

7 Troubleshooting (Fax template, please enlarge!)

7.1 General causes of errors

General	❑ Check alignment, tension spring elements of the adjustment plate ❑ Clean inlet/outlet glass ❑ Check wiring ❑ Check shield ❑ Eliminate possible interfering light sources
PWR - LED does not illuminate	❑ Check device supply
PWR - LED flashes	❑ Check wiring of switching input and/or switch position S1
ADJ - LED flashes	❑ Select the same operating mode (AUT or MAN or ADJ) on **both** devices ❑ Path not optimally aligned, check alignment ❑ Check device pairing (a path consists of one device which uses frequency f1 and one which uses frequency f2)

7.2 Bus-specific causes of errors

General	❑ Check wiring ❑ Check settings
BUF - LED flashes/ illuminates	❑ Check wiring ❑ Incorrect baud rate set, check baud rate switch S3 ❑ Wrong or missing termination, check termination ❑ No further subscribers connected to the bus, check bus arrangement ❑ Errors on the bus segment, check with analyser ❑ Messages are not sorted, a low priority message cannot be sent (bottleneck effect), check switch position S4.1 ❑ Bus load generally too high, check bus load
ERPA - LED illuminates	❑ Check wiring ❑ Wrong or missing termination, check termination ❑ Incorrect baud rate set, check baud rate switch S3 ❑ No further subscribers connected to the bus, check bus arrangement ❑ Errors on the bus segment, check with analyser
BOFF - LED flashes/illuminates	❑ Check wiring ❑ Switch S2 set to “BUS” and no supply connected to bus terminals V+ and V-, check switch position S2 ❑ Supply at V+, V- below specification, measure voltage ❑ Defect on device

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