

# Bus-Capable Optical Data Transmission DDL S 200

## Technical Description Ethernet



500 41 547

### 1 Safety Notices

#### 1.1 Safety standards

The DDL S 200 optical 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 DDL S 200 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 DDL S 200 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 300m) is required.
- Rotary transmission

#### 1.3 Working safety

**Attention Laser!**  
The DDL S 200 data transmission system is an infrared laser device of Laser Class 1 in accordance with EN 60825. Do not look directly at the laser beam at close range!

**Note**  
When used under reasonable conditions, devices of Laser Class 1 are safe. This even includes the use of optical instruments used for the direct observation of the laser beam. Acc. to EN 60825, the term "laser" also includes light emitting diodes (LED). The free-space data transmission system DDL S 200 uses an LED.

Observe the legal and local regulations applicable to the operation of laser units.

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

### 2 Technical Data

#### 2.1 General technical data

<b>Electrical data</b>	
Supply voltage Vin	18 ... 30 V DC
Current consumption without optics heating	approx. 200 mA with 24 V DC (no load at switching output)
Current consumption with optics heating	approx. 800 mA with 24 V DC (no load at switching output)
<b>Optical data</b>	
Sensing distance	0.2 ... 120 m (DDL S 200/120...) 0.2 ... 200 m (DDL S 200/200...) 0.2 ... 300 m (DDL S 200/300...)
Transmitter 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)
<b>Input/output</b>	
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
<b>Operating and display elements</b>	
Membrane buttons	change the operating mode
Individual LEDs	indicate voltage supply, operating mode, data traffic
LED strip	bar graph display of the receiving level
<b>Mechanical data</b>	
Housing	aluminium diecast; light inlet/outlet, glass
Weight	approx. 1200 g
Protection class	IP 65 acc. to EN 60529
<b>Environmental conditions</b>	
Operating temperature	-5 °C ... +50 °C without optics heating -30 °C ... +50 °C with optics heating (non-condensing)
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)

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### 2.2 Dimensioned drawing

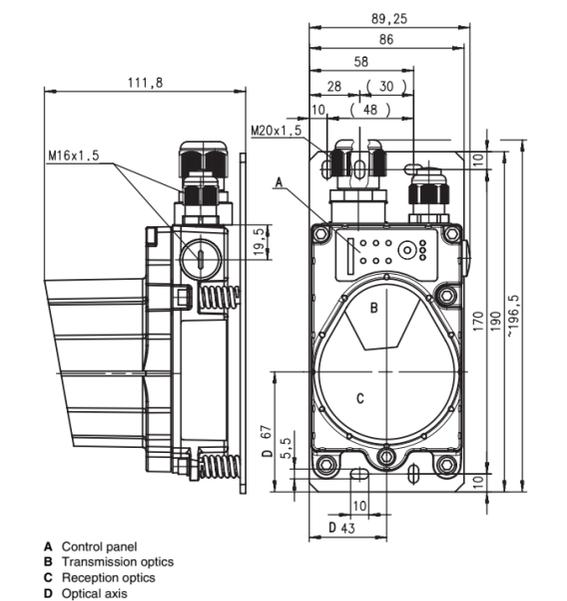


Figure 2.1: Dimensioned drawing of DDL S 200 Ethernet version for cable with RJ45 connector

### 3 Mounting / Installation (all device variants)

#### 3.1 Mounting and alignment

An optical data transmission system, consisting of 2 DDL S 200 devices, involves mounting each of the devices on mutually opposing, plane-parallel, flat and usually vertical walls with unobstructed view of the opposing DDL S 200.

Make certain that, at the minimum operating distance  $A_{min}$ , the optical axes of the devices are aligned with one another within  $\pm A_{min} \cdot 0.01$  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  $\pm 0.5^\circ$  to the optical axis! The horizontal and vertical adjustment angles of the fine alignment with the adjustment screws is  $\pm 6^\circ$  for each. The optical transmission path between the DDL S 200s 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 DDL S 200, 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 e.g. 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").

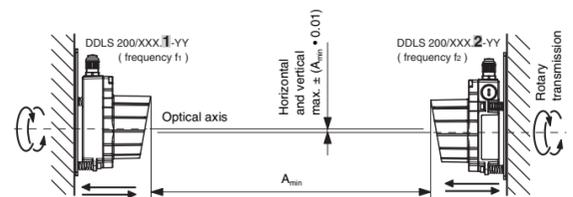


Figure 3.1: Mounting the devices

**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 DDL S 200 can be found in chapter 2.2.

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### 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 than 300mm (DDL S 200/120...) or 500mm (DDL S 200/200...) or 700mm (DDL S 200/300...).
- With arrangements using identical frequencies, the distance between two parallel transmission paths must be at least  $700 \text{ mm} + \tan(0.5^\circ) \times \text{sensing distance}$  (DDL S 200/300...), or  $500 \text{ mm} + \tan(0.5^\circ) \times \text{sensing distance}$  (DDL S 200/200...), or  $300 \text{ mm} + \tan(0.5^\circ) \times \text{sensing distance}$  (DDL S 200/120...).

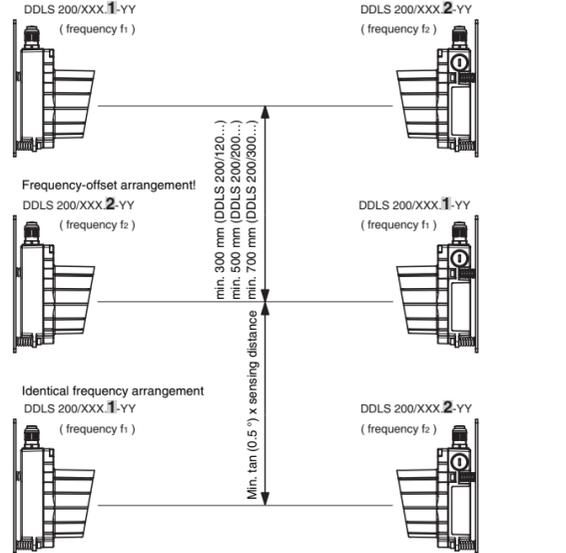


Figure 3.2: Arrangement of adjacent transmission systems

### 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 DDL S 200 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.

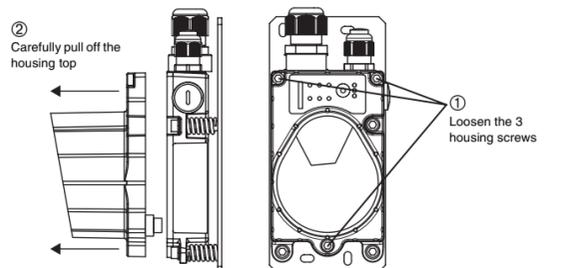


Figure 3.3: Removing the housing top

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

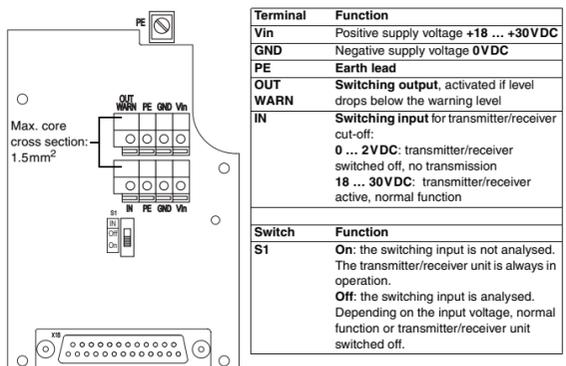


Figure 3.4: Positions of the general, non-bus-specific terminals and switches

#### 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 double 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 cross section 2.5mm<sup>2</sup>)

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. The housing seal is, in this way, ensured (Protection Class IP 65).

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

### 3.3.2 Switching input

The DDL S 200 is equipped with a switching input IN, via which the transmitter/receiver unit can be switched off, i.e. no infrared light is transmitted and at the bus terminals the corresponding bus bias level is present / the bus driver is high resistance.

**Input voltage:** 0 ... 2VDC: transmitter/receiver switched off, no transmission  
18 ... 30VDC: transmitter/receiver active, normal function

For easier operation, the switching input can be activated/deactivated via switch S1:

**Position S1:** On The switching input is not analysed. The transmitter/receiver unit is always in operation (internal preselection of the switching input with Vin).  
Off The switching input is analysed. Depending on the input voltage, normal function or transmitter/receiver unit switched off.

**Note!**  
When transmitter/receiver unit is switched off, the system behaves in the same way as in the event of a light beam interruption (see chapter 5.4 "Operation").

The switching input can be used, for example, during a corridor change to completely avoid interference effects from other sensors or the data transmission.

### 3.3.3 Switching output

The DDL S 200 is equipped with a switching output OUT WARN which is activated if the receiving level in the receiver drops.

**Output voltage:** 0 ... 2VDC: operating range  
Vin - 2VDC: warning or shutoff range

The switching output is protected against: short-circuit, surge current, surge voltage, overheating and transients.

**Note!**  
The DDL S 200 is still completely functional when the level of the receiving signal drops to the warning signal level. No performance reserve remains.

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### 4 Ethernet

The Ethernet model of the DDL S 200 has the following features:

- Supports 10Base-T and 100Base-TX (half and full duplex)
- Effective data transmission with 2Mbit/s full duplex
- Supports autopolarity and autonegotiation (Nway)
- Supports frames up to 1522 bytes in length
- The DDL S 200 for Ethernet does not occupy a MAC address
- Not dependent on specific protocol (transmits Ethernet/IP, Industrial Ethernet, ProfiNet, Modbus TCP/IP, ...)
- RJ45 connector, screwed cable gland provides protection class IP 65 (optional M12 connector version also available)
- Conversion of 10Base-T to 100Base-TX and vice versa is possible
- Increased network expandability owing to optical data transmission:
  - without optical data transmission = 100m
  - with optical data transmission = 2 x 100m + optical transmission path

**Attention!**  
Please observe the information in "Application Note: DDL S 200 with Ethernet"! (see www.leuze.de -> DOWNLOAD -> LOGISTICS PRODUCT UNIT)

#### 4.1 Electrical connection Ethernet

Electrical connection to Ethernet is realised using the RJ45 socket X1.

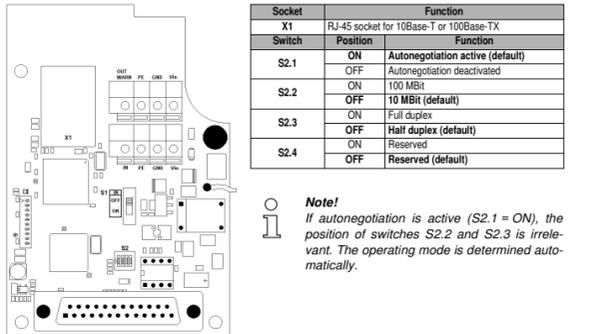


Figure 4.1: Connection circuit board of the Ethernet model

4.2 Device configuration Ethernet

4.2.1 Autonegotiation (Nway)

If the switch S2.1 of the DDLS 200 is set to ON (default), the device is in autonegotiation mode. This means that the DDLS 200 detects the transmission characteristics of the connected partner unit automatically (10Mbit or 100Mbit, full or half duplex) and adjusts itself accordingly.

If both devices are in autonegotiation mode, they adjust to the highest common denominator.

If a certain transmission type is to be required, the autonegotiation function must be deactivated (S2.1 = OFF). The transmission characteristics can then be set using the switches S2.2 and S2.3.

4.2.2 Transmission rate conversion

Through the use of an optical transmission system, the Ethernet is divided into two segments. Different transmission rates can be used in the physically separated segments. The DDLS 200s then functions as transmission rate converter. During transmission rate conversion, it must be ensured that the bandwidth of the segment with the lower transmission rate is adequate for processing the incoming data.

4.2.3 Signal delay

The typical delay of a message from a DDLS 200 to the opposing DDLS 200 is:

$$\text{number of bits in the telegram} \times (0.55\mu\text{s} + T_{\text{bit}}) + 60\mu\text{s}$$

1)  $T_{\text{bit}}$  for 10Base-T = 0.10µs,  $T_{\text{bit}}$  for 100Base-TX = 0.01µs

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

4.3.3 DDLS 200 between terminal/PLC and terminal/PLC

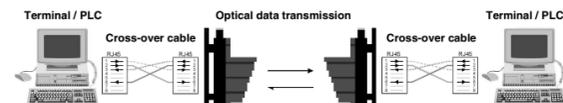


Figure 4.5: DDLS 200 between terminal/PLC and terminal/PLC

4.3.4 Assignment diagram for 1 : 1 cable and cross-over cable

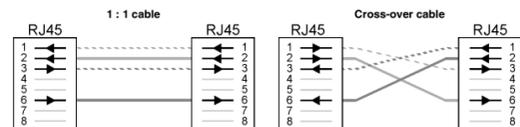


Figure 4.6: Assignment diagram for 1 : 1 cable and cross-over cable

4.4 LED Indicators Ethernet

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 Ethernet model also has the following indicators:

	LED PWR: green flashing	= operating indicator = transmitter /receiver unit switched off via switching input IN or hardware error
	LED LINK: green off	= no operating voltage = LINK OK
	LED Rx/Tx: green off	= no LINK present = data are being received by the bus. = data are being transmitted to the bus.
	LED 100: yellow off	= 100 MBit = 10 MBit
	LED FDX: yellow off	= full duplex (Full-Duplex) = half duplex
	LED BUF: yellow off	= internal buffer (Buffer) full, message rejected. = message not rejected.

Figure 4.8: Indicator/operating elements for the Ethernet model

5.2 Operating modes

The following table provides an overview of the DDLS 200 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, cut-off threshold on higher level	Active	Its own receiving level, display of the alignment quality of the opposing device
Adjust, ADJ LED illuminates	Adjustment operation, cut-off threshold on higher level	Separated	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 belonging to 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 DDLS 200 first performs a self-test. If the self-test is successfully completed, the PWR LED illuminates continuously and the DDLS 200 switches to the "Automatic" operating mode. If the connection to the opposing device exists, data can be transmitted immediately.

5.4 Operation

In running operation ("Automatic" operating mode) the DDLS 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 DDLS 200's glass optics is often the cause (see chapter 5.5 "Maintenance/Cleaning").

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

**Attention!**  
If, during operation of the DDLS 200, the light beam is interrupted or one of the two devices is switched voltage free, 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 DDLS 200 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.

5.5 Maintenance/Cleaning

The optical window of the DDLS 200 is to be cleaned monthly or as needed (warning output). To clean, use a soft cloth and a cleaning agent (standard glass cleaner).

**Attention!**  
Do not use solvents and cleaning agents containing acetone. Use of improper cleaning agents can damage the optical window.



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4.2.4 Network expansion

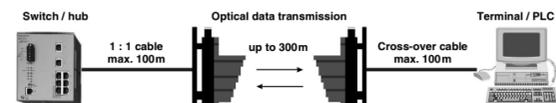


Figure 4.2: Network expansion

**Note!**  
The network expansion of the bus system can be increased through the use of the DDLS 200.

4.3 Wiring

4.3.1 DDLS 200 between switch/hub and terminal/PLC

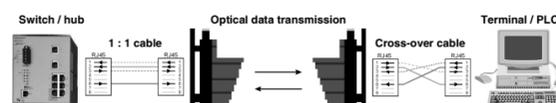


Figure 4.3: DDLS 200 between switch/hub and terminal/PLC

**Note!**  
Make sure that the 1 : 1 cable and cross-over cable are connected correctly. Do not plug the 1 : 1 cable to the switch/hub into the "Uplink" port.

4.3.2 DDLS 200 between switch/hub and switch/hub

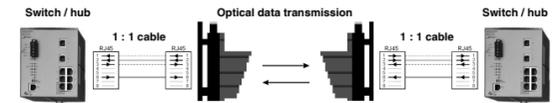


Figure 4.4: DDLS 200 between switch/hub and switch/hub

**Note!**  
Make sure that the 1 : 1 cable and cross-over cable are connected correctly. Do not plug the 1 : 1 cable to the switch/hub into the "Uplink" port.

4.3.5 Installing cable with RJ45 connector

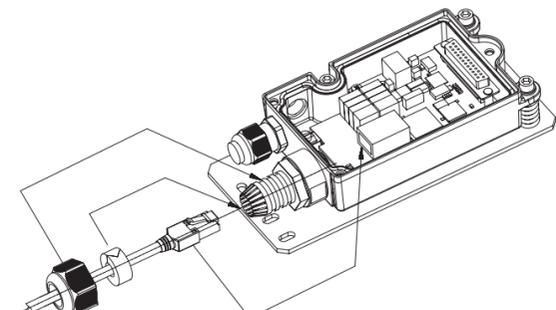


Figure 4.7: Installing cable with RJ45 connector

5 Commissioning / Operation (all device variants)

5.1 Indicator and operating elements

All DDLS 200 device models have the following indicator and operating elements:

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

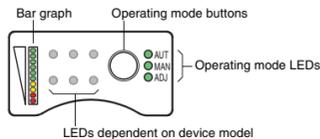


Figure 5.1: Indicator and operating elements common to all DDLS 200 device models

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") DDLS 200 (figure 5.2).

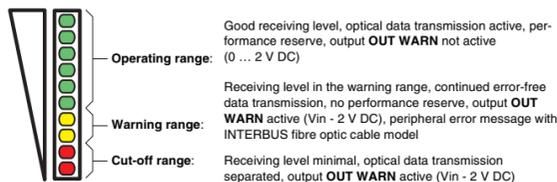


Figure 5.2: Meaning of the bar graph for displaying the receiving level

Operating mode LEDs

The three green LEDs AUT, MAN and ADJ indicate the current operating mode (see chapter 5.2 "Operating modes") of the DDLS 200.

- AUT: operating mode "Automatic"
- MAN: operating mode "Manual"
- ADJ: operating mode "Adjust"

Operating mode buttons

With the operating mode button, you can switch between the three operating modes "Automatic", "Manual" and "Adjust" (see chapter 5.2 "Operating modes").

If the PWR 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 (chapter 3.3.2).

If the PWR LED remains dark 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 DDLS 200s 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 with "alignment", the transmitter with the beam which is to be positioned as exactly as possible on the opposing receiver is always meant.

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

The DDLS 200 supports fast and easy fine adjustment. 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 DDLS 200 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.

6 Troubleshooting (Fax template, please enlarge!)

6.1 General causes of errors

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

6.2 Bus-specific causes of errors

General	<input type="checkbox"/> Check cables (see chapter 4.3) <input type="checkbox"/> Check settings
LINK - LED does not illuminate	<input type="checkbox"/> Check cables (see chapter 4.3) <input type="checkbox"/> Check settings (10/100 Mbit, half/full duplex) <input type="checkbox"/> If autonegotiation is active, deactivate autonegotiation and make settings manually
BUF - LED illuminates	<input type="checkbox"/> Check cables (see chapter 4.3) <input type="checkbox"/> Check bus load (see also information in "Application Note: DDLS200 with Ethernet option") <input type="checkbox"/> Bus load generally too high, check bus load

Your data:

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