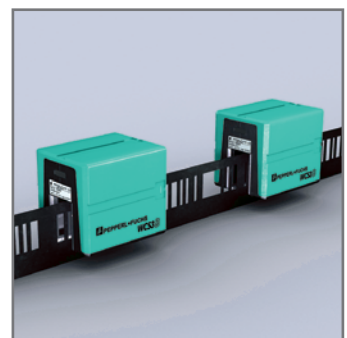
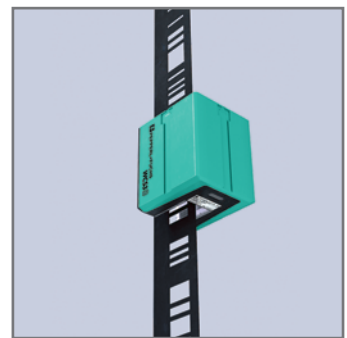
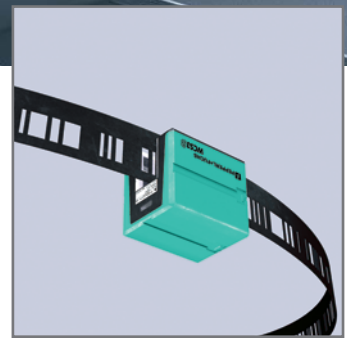


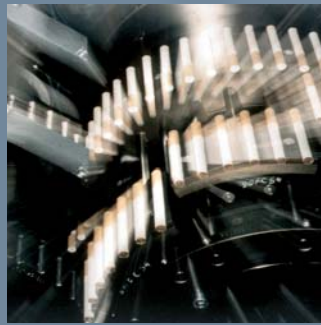
POSITION ENCODING SYSTEM WCS



THE SUCESS STORY OF PEPPERL+FUCHS

- 1945** Walter Pepperl and Ludwig Fuchs lay the foundation of Pepperl+Fuchs:
The opening of a radio repair shop
- 1948** Manufacture of transformers
- 1958** Development and production of the first inductive proximity switch
- 1973** The first foreign subsidiary is formed in England
- 1979** Pepperl+Fuchs commences production in Singapore
- 1988** Michael Fuchs and Claus Michael take over the management of the
company and Pepperl+Fuchs becomes a limited liability company
- 1991** Split into Factory Automation and Process Automation divisions, new product
group level control through a company acquisition
- 1996** The purchase of another company establishes the encoder business
- 1997** New production facilities open at Veszprem/Hungary
- 2000** Expansion of the Factory Automation activities with the purchase of Visolux
GmbH and the Microswitch and Photoswitch interests from Honeywell;
at the same time the Process Automation sector is expanded by the takeover
of ELCON
- 2000** Start of manufacture at Bintan/Indonesia
- 2003** Takeover of the purge and pressurization systems from Bebcu Industries EPS
in the USA
- 2004** New Data Matrix Code product range obtained through the acquisition
of Omnitron AG and the Position Encoding System, also due to an
acquisition
- 2005** Expansion of the Systems & Solutions business area within the Process
Automation division aided by the acquisition of EXTEC
- 2006** “Acquisition of the Intrinsic Safety Instrumentation (ISB) business from
Cooper Crouse-Hinds and the Separator Alarm System (SAS) business
from OJ Electronics in order to extend its Process Automation product
range; takeover of VMT Bildverarbeitungssysteme and integration into
the Factory Automation business unit.”

Pepperl+Fuchs will continue this policy of growth.



One company, two divisions

PRODUCT AREAS FACTORY AUTOMATION

- Binary and analog sensors in various technologies
 - Inductive and capacitive sensors
 - Magnetic sensors
 - Ultrasonic sensors
 - Photoelectric sensors
 - Vision sensors
- Incremental and absolute value rotary encoders
- Counters and secondary switching devices
- RFID Identification systems
- Data Matrix Identification systems
- AS-Interface
- WCS



BRANCHES FACTORY AUTOMATION

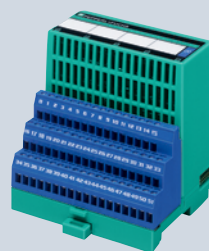
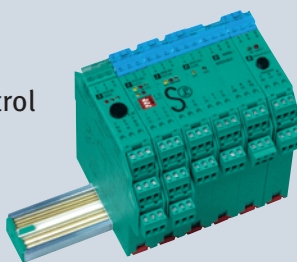
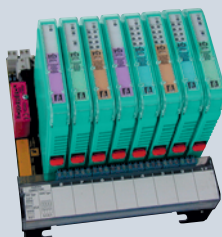
- Machine & Plant Engineering
- Print, Paper and Finishing
- Material Handling
- Packaging Industry
- Automotive Industry
- Doors, Gates and Elevators
- Chemical Apparatus
- Commercial vehicles
- Textile Machines





PRODUCT AREAS PROCESS AUTOMATION

- Signal conditioners
- Intrinsically safe interface components
- Remote process interface
- Intrinsically safe fieldbus solutions
- Level control sensors
- Operating systems for hazardous areas
- Purge/Pressurization enclosure systems
- Process measuring and control systems engineering at the interface level
- Ex-protection training

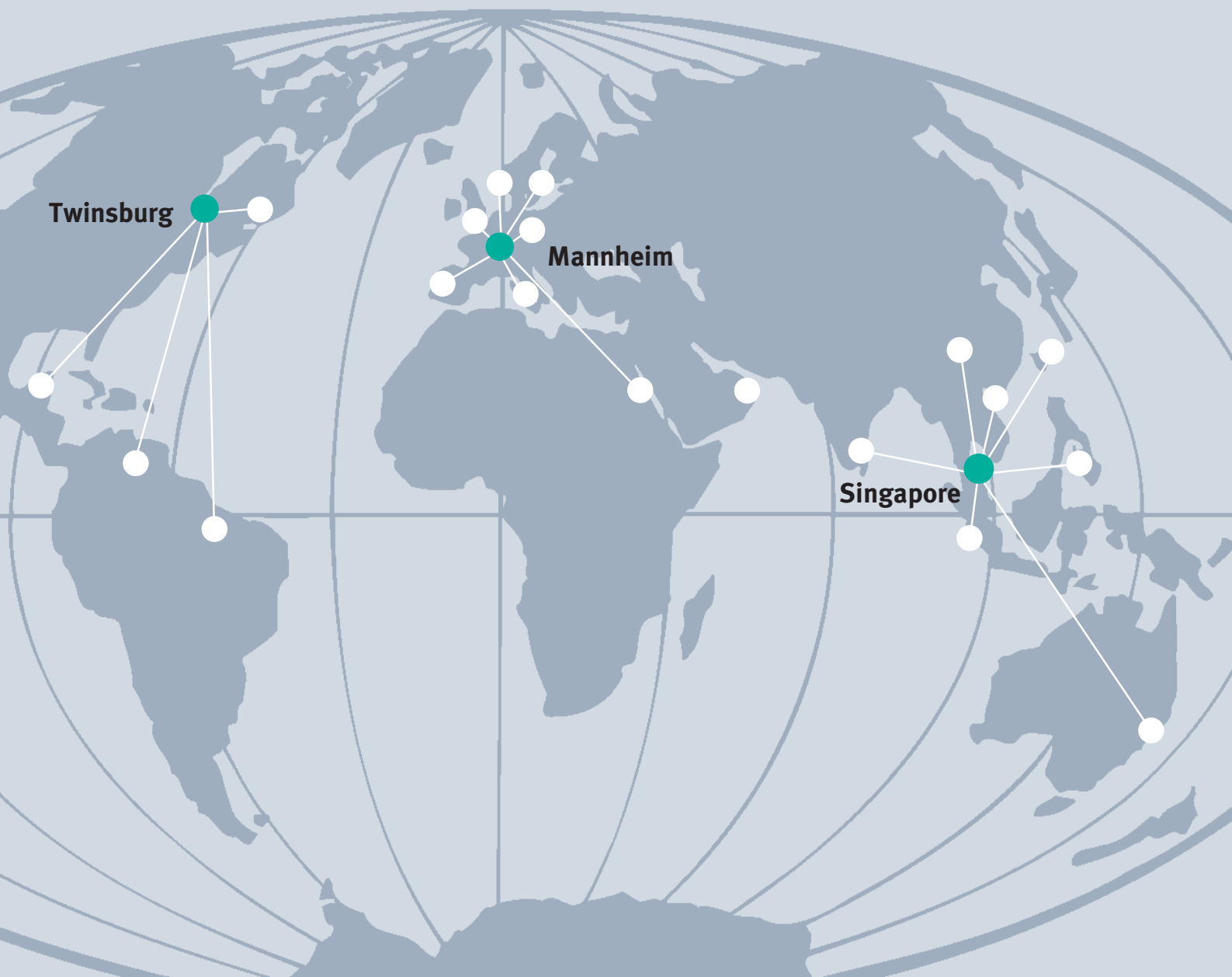


BRANCHES PROCESS AUTOMATION

- Chemical Industry, Pharmaceuticals
- Oil, Gas and Petrochemical Industry
- Industrial and communal waste water technology
- Energy Production
- Engineering consultant for Process Automation



WORLDWIDE PRESENCE



WE ARE RIGHT THERE – WHERE OUR CUSTOMERS ARE...

The three centers of excellence are the focal points of the global presence of Pepperl+Fuchs



Mannheim

Mannheim is the traditional headquarters of Pepperl+Fuchs and the center of excellence focusing on engineering. More than 800 specialists support the activities of this principal Pepperl+Fuchs location.



Twinsburg

Since 1983, Twinsburg/Ohio has been the headquarters for the American market. 250 employees on site develop specific solutions for the American customers of Pepperl+Fuchs.



Singapore

More than 700 employees are engaged in the Singapore center of excellence of Pepperl+Fuchs. Since 1979, all activities associated with the Asiatic economic area have been controlled from Singapore. This region is becoming of increasing importance due to the growth market in China.

We create markets

The global presence of Pepperl+Fuchs:

- Technology centers with their own development groups in Berlin, Tuttlingen and Sulbiate/Italy offer customers specific solutions. Furthermore the locations operate highly flexible production in small batch sizes.
- The production facilities in Hungary and Indonesia are equipped for series production in large quantities.
- The worldwide sales network guarantees that we are close to our customers and enforces Pepperl+Fuchs to react swiftly and competently to customer requirements. You are in need of contact addresses of our sales partners?

Please try the internet at www.pepperl-fuchs.com/company/presence.



Fields of application of the WCS

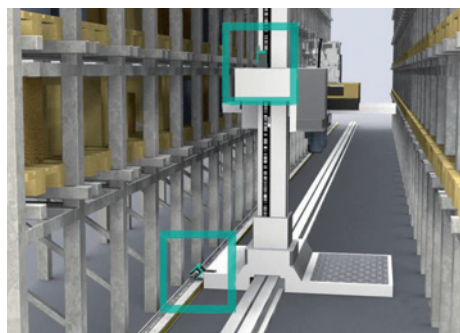
The WCS can be used wherever material handling equipment has to be controlled highly precisely down to the very millimeter. The functional principle of the WCS permits use in various applications, such as

- Interruption of the code rail (aisle change, points)
- Applications in curves and circuits
- Use of several vehicles behind each other.

Due to the larger tolerances of the reading head relative to the code rail, the WCS3 system can be used in most applications. In some cases, however, it is of advantage to use the WCS2 in combination with the aluminium profile system (page 18 et seqq.).

Below please find some examples from the vast range of applications possible:

Shelf handling units (high-bay warehouses)

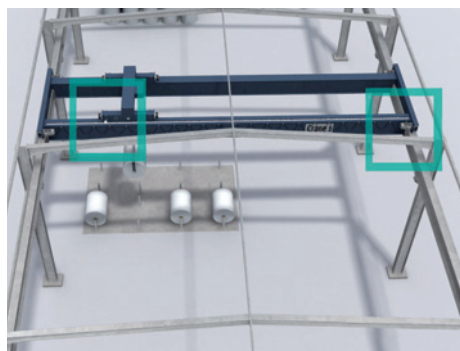


Bogies, lifting gear and transversing carriages are positioned with one reading head each. Independent of the length of the code rail, the positioning is always absolutely reproducible. In case of new high-bay warehouses we recommend the use of the WCS3 system.

For retrofitting elder warehouses, it may be advantages to use WCS2 in combination with the aluminium profile system:

- Easy subsequent installation.
- High mechanical tolerances between measuring system and vehicle is possible.
- Decoupling of travel vibrations.

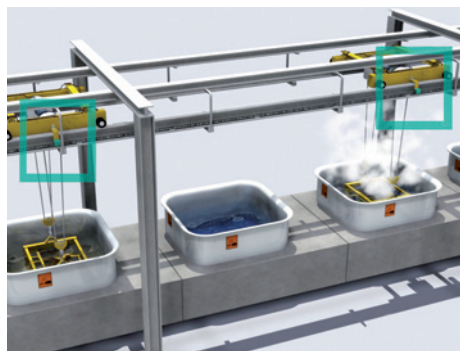
Automatic cranes



Automatically operated cranes are a typical application for the WCS2 in combination with the aluminium profile system. A reading head is used to position the crane for the crane and trolley travel. The guide trolley guarantees the ideal position of the reading head relative to the code rail in every position, and decouples potential vibrations of the craneway.

Cleaning brushes for the code rails can be attached to the guide trolley as an optional feature. Thus, the WCS2 can also be used in very dusty environments, such as cement works or casting workshops.

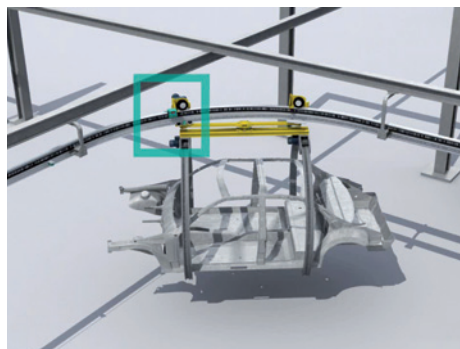
Galvanising plants



One or several vehicles behind each other on a straight travel. The vehicles transport the goods to be electroplated to the corresponding bath automatically. On account of the high and adaptable luminous power of the reading heads, the travel code system WCS has proved excellent performance also under difficult conditions.

Apart from the WCS3 system, the WCS2 with an aluminium profile system, which can be supplied with a powder coating as well, can be used as well.

Overhead conveyors

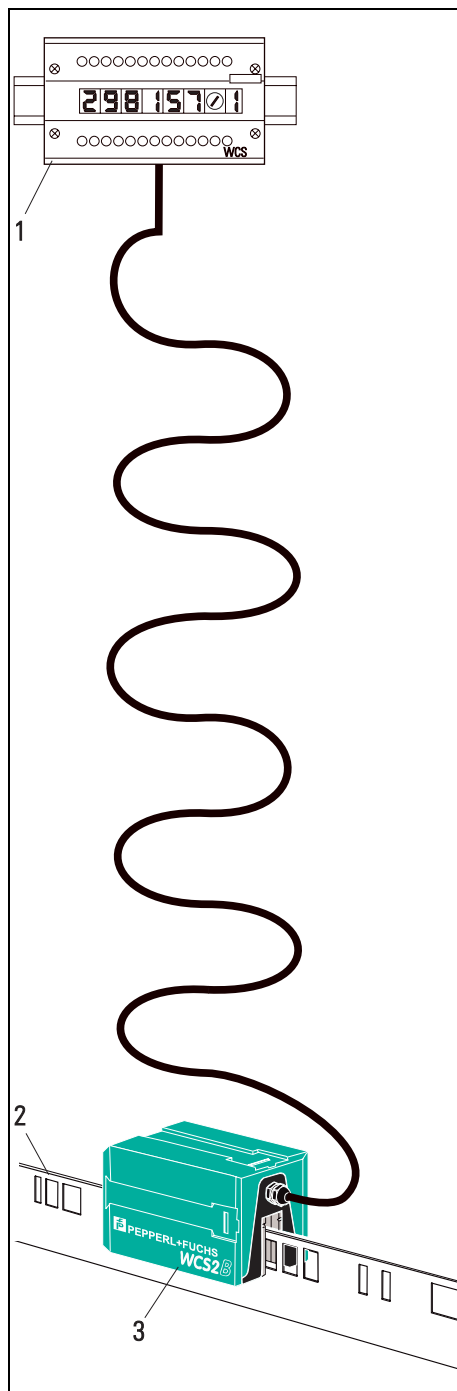


Many vehicles have to be positioned on a belt line - the WCS system offers itself as a solution. Branch lines (points) and bends can be set up. The WCS3 is especially suited for this task.

After a power failure, the current position of the vehicle is transferred to the control without delay without the vehicle having to be moved for the purpose.

The WCS can also be employed for longer travels than 314 meters. We will be pleased to help you find a solution for your special application. Please get in touch with us.

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Characteristics of the WCS

- Absolute Position Encoding System
- Optoelectronic principle (infrared range)
- Tried-and-tested and tough
- Maintenance-friendly
- No reference points necessary
- No calibration or adjustment necessary
- Not sensitive to power cuts
- Positioning with millimetre accuracy and absolute reproducibility
- Determination of position values in real time and independent of temperature fluctuations
- Reliable reading up to a velocity of 12.5 m/sec
- High resolution = ± 0.4 mm
- Variable reading distance: 0.1 m ... 327 m
- Encoding system also suitable for use in bends down to 0.5 m radius
- Varied areas of application, e. g. storage and retrieval machines, traversing carriages, electric overhead conveyors, galvanising plants, automatic and rotary cranes and lifts
- Various systems available for installing the code rail
- Connection to any control equipment possible, directly or via interface module
- Facilities available for connection to many field bus systems
- Support during commissioning and maintenance from extensive system diagnosis facilities
- Extreme reliability in operation thanks to continuous self-diagnosis
- Prewarning of dirt accumulation
- Optional space heating for ambient temperatures down to -40 °C
- Optional digital output of variable limit overspeed

Description of function

The WCS position encoding system comprises in the main two components: the code rail, which is the information carrier for the absolute code, and the reading head which scans the code rail optoelectronically.

The **code rail** is installed parallel to the runway of the vehicle and thus assigns a clear position to each point on the runway. It is possible to install the code rail only where positioning is required. The system permits the to be installed in bends and branches to be constructed. The code rails are manufactured individually for each order and is supplied in a bundle. Unless ordered otherwise, the code rail always begins with a position value of 0. The maximum length of the code rail is 327 m (WCS2) or 314.5 m (WCS3). Numerous fitting aids are available for speedy installation of the code rail.

The code rail is scanned with a U-shaped **reading head**. The reading head detects a new position value every 0.833 mm (WCS2) or 0.8 mm (WCS3). After being placed onto the code rail, the reading head calculates the position value without reference points and value delay. Scanning the code rail is reproducible, reliable and independent of temperature fluctuations even at very high velocities. The positional value can be transmitted directly from the reading head to the control via a serial RS 485 interface or an SSI interface.

Various interface modules are available for connection to standard interfaces, such as:

- Parallel
- SSI
- Profibus DP
- DeviceNet
- CANopen
- Ethernet
- Interbus-S
- ProfiNet
- Modbus-RTU

Up to four reading heads can be connected simultaneously to all the interface modules apart from the SSI interface.

	WCS2B	WCS3B
y-axis	±5 mm	±15,5 mm
z-axis	±5 mm	±14 mm
Resolution	±0,42 mm (1200 pos/m)	±0,40 mm (1250 pos/m)
V _{max}	12.5 pF/m	12.5 pF/m

Table 1

WCS reading head

The housing of the reading head is made of tough plastic (protection class IP54). The mounting plate for attaching the reading head are part of the supply.

On the inside of the reading head there are easily replaceable, transparent plastic liners to protect the reading area from dirt and damage (Fig. 2 and Fig. 3 on page 11). There are identification notches on these liners. These serve to set the zero point for vertical play (z-axis) on the reading head. The reference point is the top edge of the code rail. The reading head can move around the reference point within the specified tolerances (see Table 1):

If the height play (z-axis) is exceeded, the reading head signals "OUT" (reading head outside of the code rail) to the control. The tolerances for lateral play (y-axis) are given by the width of the gap in the reading head.

The positions are reliably detected in both vertical ($\alpha: \pm 10^\circ$) and horizontal ($\beta: \pm 5^\circ$) inclined positions, and in bends down to a minimum of 500 mm. If positional value cannot be detected, e. g. because the optical elements are soiled, the reading head transmits a clear error code.

WCS2B/WCS3B

The reading heads were revised on the basis of the well-tried types WCS2A and WCS3A. The new type series was given the designation "B", WCS2B and WCS3B. With the new black and green housing, the new reading heads integrate well into the design of the Pepperl+Fuchs sensors. The electric connection of the reading heads WCS2B and WCS3B is established exclusively by M12 plug connectors. A wide range of connecting sockets and pre-confectioned cables are available for these M12 plug connectors. The hardware and software for devices with SSI interfaces have been revised. Compared to the previous models, it is also new that the current speed can be transmitted to the control by the serial interface apart from the positional value. Compared to the previous type WCS3A, a significant modification in the WCS3B reading heads is that the gap width has been enlarged at identical external dimensions. Due to the free space between the reading head and the code rail which has been increased by 25 per cent, the potential mechanical tolerances in the applications are compensated automatically by the reading head. In addition to the previously integrated interfaces, the CANopen interface is now offered for the WCS3B reading head as well.

Replacement of previous reading head types by WCS2B/WCS3B reading heads

The replacement of a reading head of type WCS2 or WCS2A by a WCS2B or a WCS3 or WCS3A by a WCS3B is possible. The important factor is that the type code is identical, such as LS221. If the reading head to be replaced has no M12 plug connection, the electrical connection had to be adapted to the M12 plug connection of the WCS2B/3B reading head. The manufacturer recommends the modification of the socket on the data cable present. The M12 cable socket required can be obtained from Pepperl+Fuchs as an accessory. If the modification of the plug connection on the data cable is not possible or desirable, corresponding adapter cables can be supplied.

An overview of the recommended M12 cable sockets and adapter cables is rendered in section "Data cables and accessories" on page 48 et seqq.

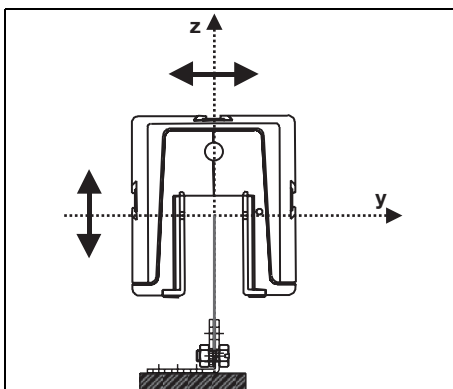


Fig. 1a
Reading head play

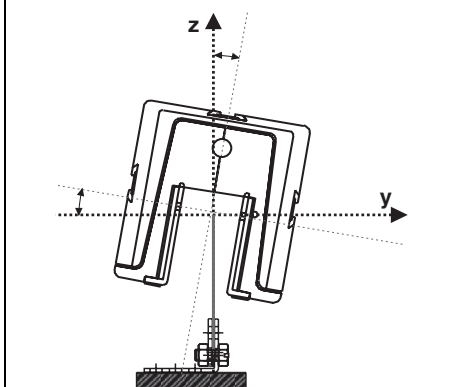
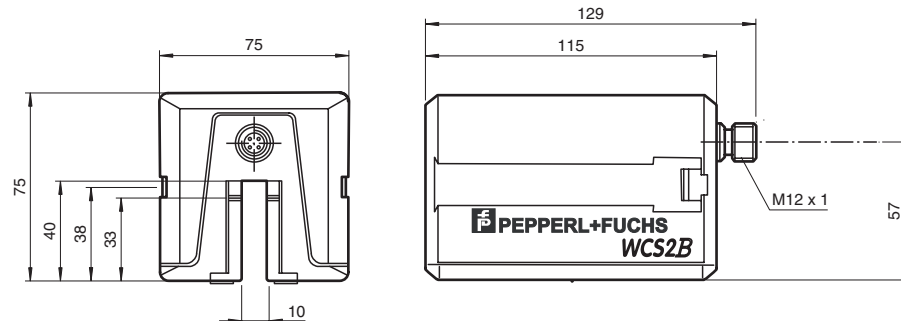


Fig. 1b
Inclined position

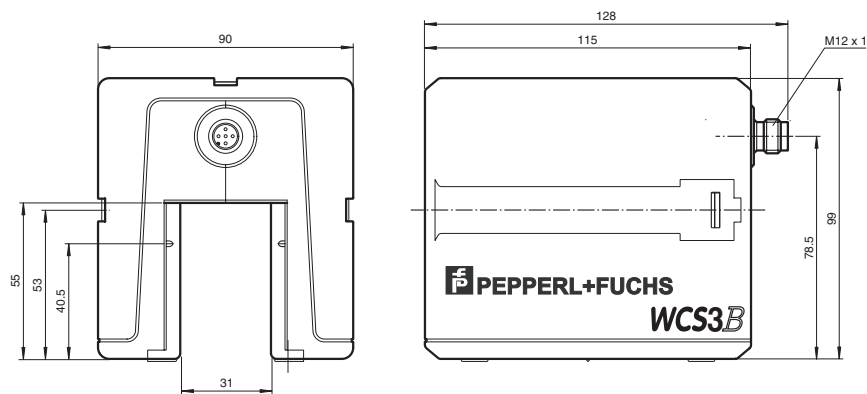
WCS2B reading head

Fig. 2



WCS3B Reading Head

Fig. 3

**Position of code rail with respect to reading head**

Electric connection plug must point towards ascending positional values!

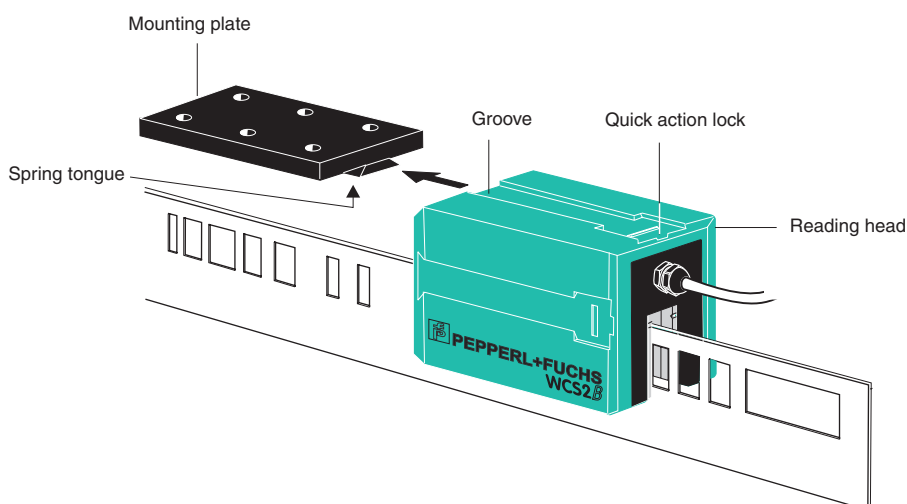
Installation of reading head

The reading head is generally fitted to the vehicle. However it is also possible to install the reading head in a stationary position and attach a section of code rail to the vehicle (vehicle identification).

A special mounting plate is part of the supply of the reading head. This is attached to the vehicle. If the WCS2 is used with the aluminium profile system and guide trolley, the mounting plate is already integrated into the guide trolley. There are dovetail guides with a quick-action lock on three sides of the reading head housing. Using one of these guides as required, the reading head is snapped into place on the guide bar. Using one of these guides as required, the reading head is snapped into place on the guide bar. Thanks to this quick-action lock, the reading head can be installed very simply without any adjustment, and replaced quickly if required.

The reading head can be installed in any position. It is tough and will function reliably even in a rugged industrial environment. The reading head is not vulnerable to external light sources. During plant project work, it is recommended to ensure that no strong sunlight directly enters the reading head gap.

To ensure long-term fault-free functioning, we recommend ensuring during installation that the gap in the reading head is protected from dirt and any vapours. The reading head must be fitted so that the electric connector plug points in direction of the ascending positional values on the code rail.

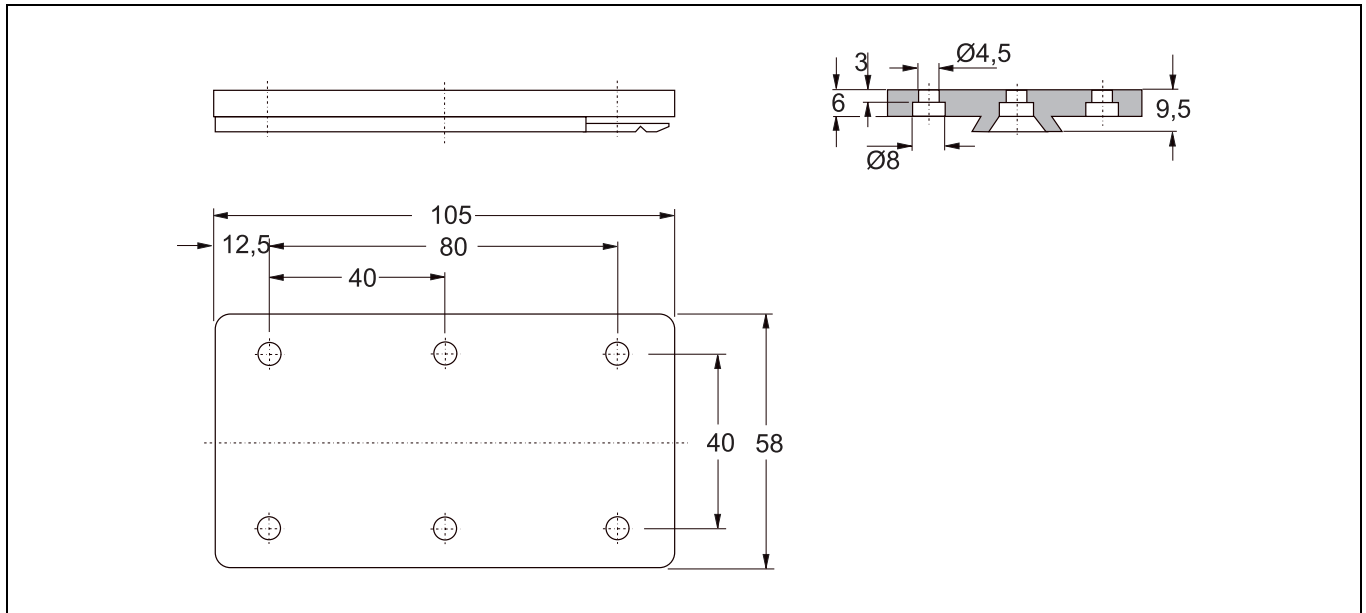


Mounting plate

The mounting plate is attached to the vehicle with M4 screws. When designing the system, we recommend providing oblong holes to enable the position of the mounting plate and thus the reading head to be corrected. For installation, the dovetail groove of the reading head pushed over the bar on the mounting plate until the spring tongue snaps into place.. To remove

the reading head, the spring tongue is released by turning slightly with a screwdriver and the reading head pushed out of the guide.

The mounting plate is for all reading head types identical.



Replacement of plastic liners

The plastic liners of the reading head can be replaced quickly if they are damaged or soiled. Unscrew the two cross-head screws on each liner and pull off the liner. Fit in reverse order. The cross-head screws must be tightened with a max. torque of 0.5 Nm. It is recommended to always replace both liners and also replace the seal.

The plastic liners are available as a spare part.

WCS2B reading head:
2 plastic liners with seal: WCS2-PL2

WCS3B reading head:
2 plastic liners with seal: WCS3B-PL2

Code rail

The code rail, which carries the absolute code, differs for the WCS2 and the WCS3 and thus cannot be interchanged between the two systems. In the case of the WCS3, the height of the code rail is always 70 mm, for the WCS2 the code rail can be supplied 55 mm or 70 mm high. Two different materials which have proven their suitability in practice are available for the code rail: plastic laminate and stainless steel. The code rail is supplied in a coil. Unless ordered otherwise, the code rail always begins with a positional value of 0.

Laminate code rail

The black laminate code rail is made of a special polyester laminate. It is distinguished by excellent physical and chemical characteristics with a low deadweight. The material is highly resistant to rupture, and is neutral with respect to oils, greases and solvents. Thanks to its resistance to acids, lyes and aggressive gases, this material is also suitable for use in galvanising plants. As a standard feature the laminate code rails are supplied with mounting holes (WCS3-CS70-L1, also see the drawing below). If an angle system is used to mount code rails it is recommended to use code rails without mounting holes (WCS3-CS70-L0) as shown, for example, on page 16.

The laminate code rails can be used in a temperature range of between -40 °C and 60 °C. Temperatures higher than 70 °C will lead a deformation of the material. The specific coefficient of thermal expansion is approx. $2.8 \times 10^{-5} \text{ K}^{-1}$. Due to the material properties, the laminate code rails must not be mounted when temperatures of 10 °C may occur. In case of applications with larger temperature variations (> 50 K), we recommend the use of the stainless steel code rail.



Attention

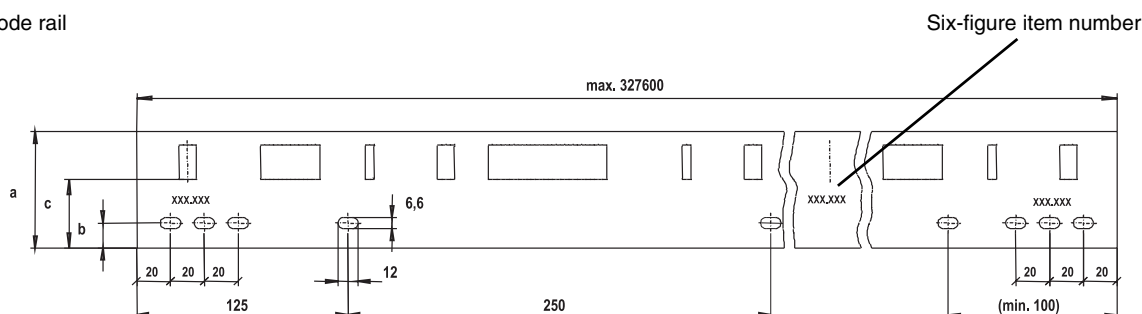
When mounting the laminate code rail, please make sure that grinding dust of collectors cannot fall on to the surface of the code rails directly. For this reason, the laminate code rails should be mounted laterally above the contact lines.

Stainless steel code rail

The stainless steel code rail is manufactured in corrosion-resistant spring steel. It is rust-proof and displays high mechanical stability and low thermal expansion. The stainless steel code rails can be used within a temperature range of -40 °C ... 80 °C.

The specific thermal expansion coefficient is $1.6 \times 10^{-5} \text{ K}^{-1}$. Protective gloves must be worn when installing the stainless steel code rails.

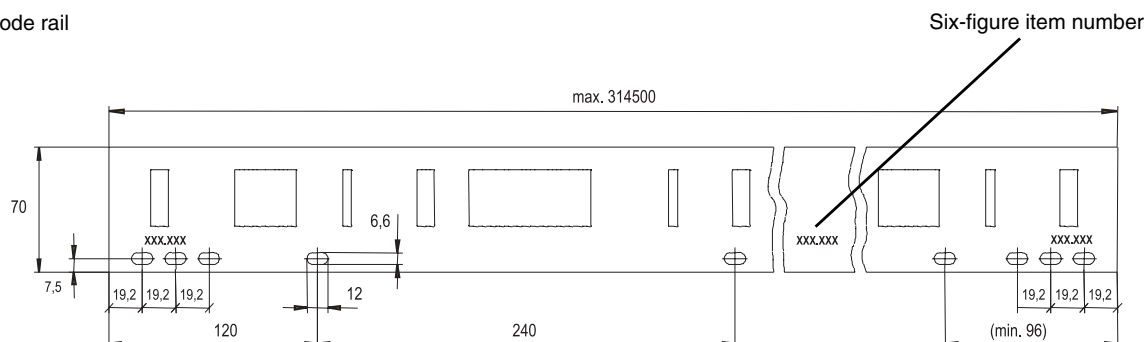
WCS2 code rail



Dimensions [mm]

	a	b	c
Band 55 x 0.5	55	7.5	25
Band 70 x 0.5	70	15	41

WCS3 code rail



Grounding of code rail

During the installation of the laminate or stainless steel WCS code rail, please ensure that it is connected to a low-ohmic potential at a distance of at least every 30 m.

Tensioning device for the stainless steel code rail

Using the tensioning device prevents the stainless steel code rail buckling due to temperature fluctuations after installation. It also facilitates installation. Three holes are punched at the beginning and at the end of the stainless steel rail and can be

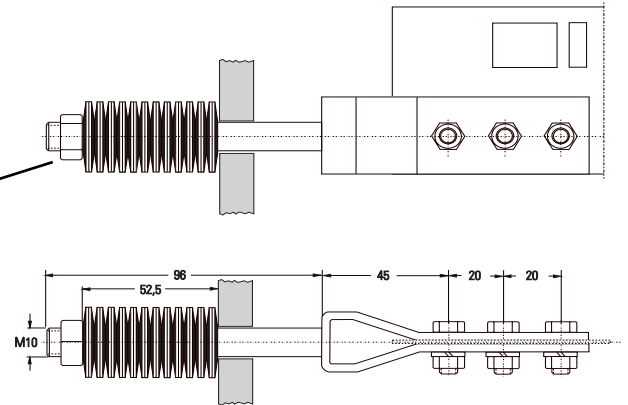
used to attach the tensioning device.

There are two possibilities when using the tensioning device:

1. The code rail is fixed at one end and tensioned at the other end using the tensioning device.
2. The code rail is fixed in the middle and tensioned at both ends using the tensioning device. The method is of advantage for longer sections (> 50 m).

Tensioning device WCS-MT1

Stainless steel code rail	Torque
WCS2, 55 mm	6 nm
WCS2, 70 mm	9 nm
WCS2, 70 mm	7 nm



ID-Pads WCS3-ID70-M1

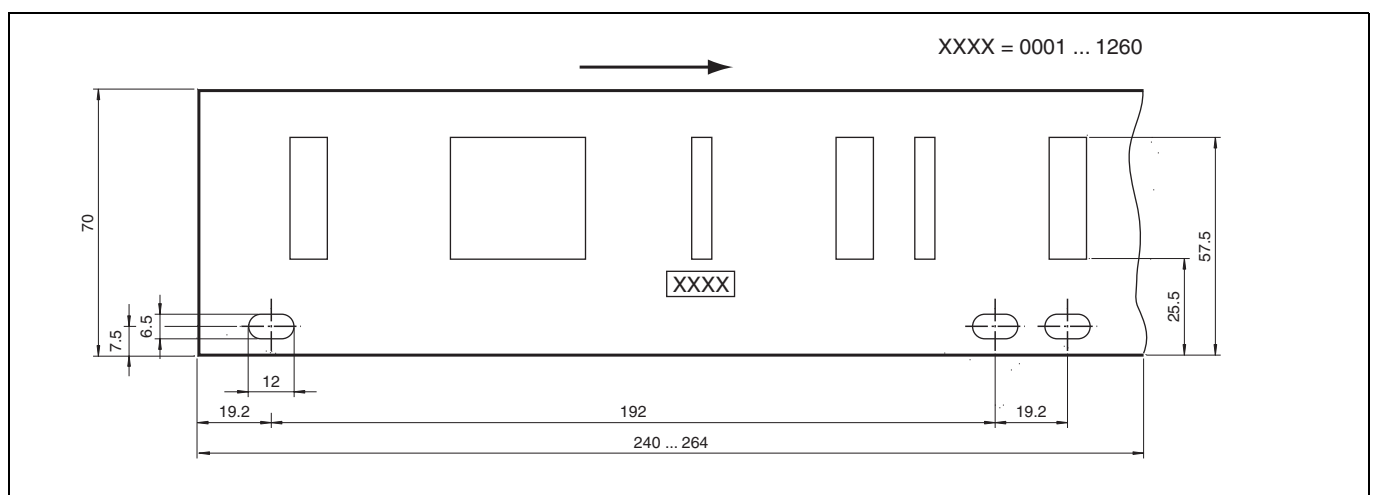
In applications where the vehicle numbers in the system have to be recognized, special code rail segments, so-called ID pads, are available for the WCS3 system. In case of these applications, the reading head is firmly mounted in most cases, and the ID pads mounted to the vehicle the reading head at certain points in the system.

The positional value read by the reading head is then used by the control to calculate the integer vehicle number according

to a formula. In total, 1,260 different ID pads can be supplied

$$\text{Vehicle number} = \text{INT}((\text{WCS positional value } 30)/312)+1$$

The position value determined by the reading head enables the fine positioning of the ID pad in the reading head gap, apart from the calculation of the vehicle number, and thus an exact positioning of the vehicle.



Mounting the code rail

If continuous path measurement of a distance is required, the rail has to be mounted in one piece. Independent of the conditions of use, there are plenty of possibilities of mounting the code rails, basically. The easiest possibility to mount the code

rail is to screw it down to a suitable angle. During the installation, please make sure that the tolerance in vertical and horizontal direction is observed as required by the respective reading head.

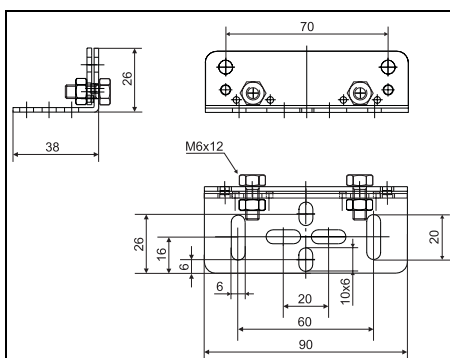


Fig. 1
Mounting bracket straight section (WCS-MB)

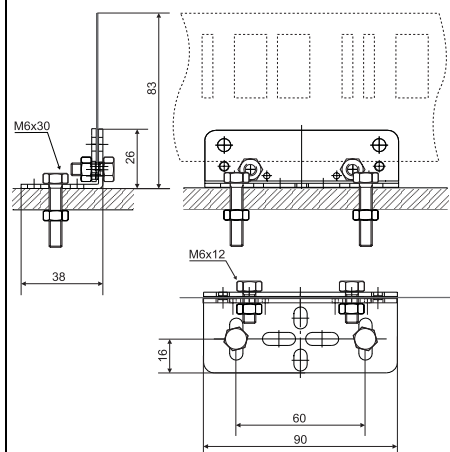


Fig. 2
Screw-on mounting bracket,
straight section (WCS-MB1)

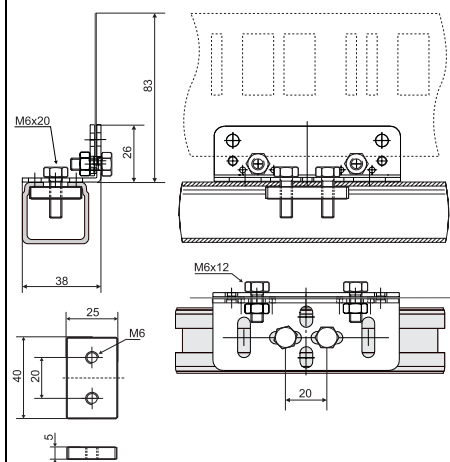


Fig. 3
Mounting bracket for C profile
straight section (WCS-MB2)

Mounting the code rail with the mounting bracket system

The angle system is one possibility to mount the laminate or stainless steel code rail. It consists of brackets for installing straight sections (Fig. 1) of the code rail, and brackets for installing the code rail in bends and on circular runways (Fig. 5). The brackets are made of galvanised steel plate and supplied pre-assembled.

The mounting brackets for the installation of the WCS code rail on straight distances can be supplied in three different designs:

- WCS-MB: angle for straight section without fixing screws (Fig. 1)
- WCS-MB1: angle for straight section with fixing screws (Fig. 2)
- WCS-MB2: angle for straight section with mounting system for installation in C profile rail 30 x 32 mm (Fig. 3).

The mounting brackets for installing straight sections are fitted to the substructure at intervals of max. 1.25 m along the runway. The code rail is pushed into the bracket until it makes contact. Subsequently the code rail is slightly tensioned by pulling and tightening of the two hexagonal screws (M6 x 12) in the angle. The torques for these hexagonal screws (M6 x 12):

- for laminate code rail: max. 8 Nm
- for stainless steel code rail: max. 5 Nm

The code rail is tensioned by pulling at the free end. The counternuts of the screws are pressed into the angle sheet which means that the nuts need not be countered. Given correct mounting, the tensioning force on the angles is high that the code rails cannot be pulled out of the angle any more.

In addition to the clamping action, the code rail can be screwed down to the angle. For this purpose, use the two upper free boreholes of the angle (M6). The screw connection produces a reference point between the code rail and the subconstruction. The screws for the reference point do not belong to the scope of delivery.

The use of C profiles is advantageous for angle mounting. They are arranged longitudinally or transversely to the travel intended. Thus, the angles can be mounted and aligned easily in the C profiles.

Powder-coated version

The mounting bracket for straight sections is also available in a powder coated version. In this version, the fixing screws are stainless steel (high grade steel V4A).

Two different variants can be supplied:

- WCS-MB-C: Powder-coated angle for straight laying without fixing screws
- WCS-MB2-C: powder-coated angle for straight laying with mounting system for installation in C profile rails 30 x 32 mm.

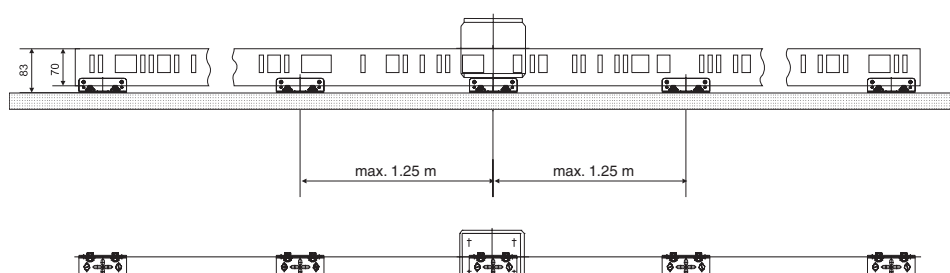


Fig. 4
Application example: mounting bracket, straight section

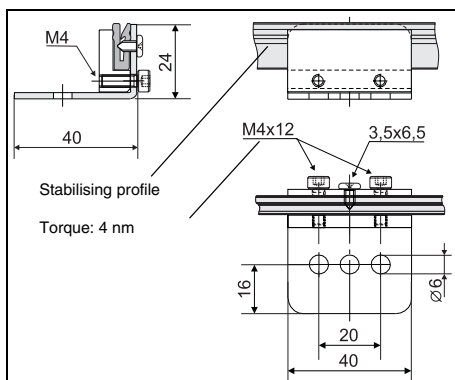


Fig. 5
Mounting bracket, bend (WCS-MB/B)

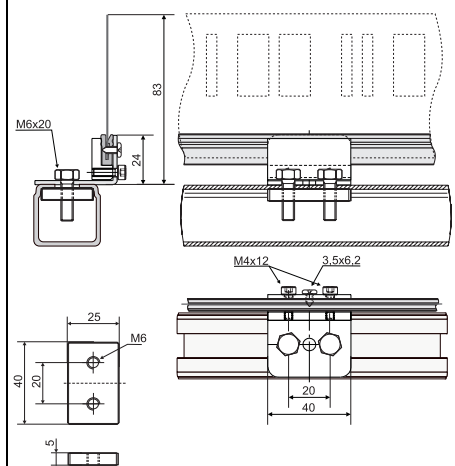


Fig. 6
Mounting bracket for C profile, bend (WCS-MB2/B)

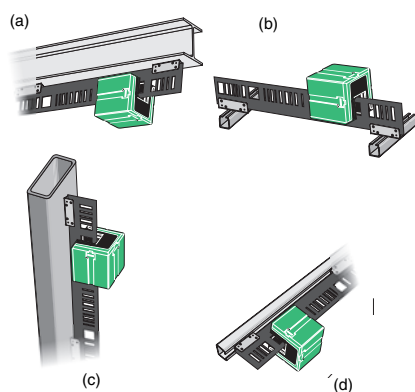


Fig. 7
Installation positions of code rail

Bend

To produce bends, the mounting brackets for bends (bend brackets, Figs. 5 and 6) are used together with a special stabilising profile (WCS-SP2). The stabilising profile is supplied as a coil of the length ordered.

The mounting brackets for installation of the WCS code rail on curved distances can be supplied in three different designs:

- WCS-MB-B: Mounting bracket for bend without fixing screws (Fig. 5)
- WCS-MB1-B: Mounting bracket for bend with fixing screws
- WCS-MB2-B: Mounting bracket for bend with mounting system for installation in C profile rail 30 x 32 mm (Fig. 6).

The curved angle has been designed in such a way that no height or transverse offset of the code rail occurs when the straight stretch changes into the curve.

The curve angles are mounted tangentially along the circle / curve bend; maximum support distance 0.7 m (0.5 m recommended). Subsequently the stabilization profile is cut to the length of the curve bend and is laid into the curve angle. The code rail is now pressed right into the groove of the stabilization profile. Subsequently, the clamping screws (M4; hexagon socket) is used to clamp the code rail together with the stabilization profile into the curve angle, where the cutting screw supplied is used for locking.

Circuit

Given a closed route (circuit, oval, et cetera), the following special features have to be observed: due to the functions of the WCS, the code rail cannot be laid on the whole circuit. A distance of least 85 mm has to be kept between the beginning and the end of the code rail. At the interrupted point of the code rail, the control will receive the value "OUT" - reading head outside of the code rail" from the reading head. When using two reading heads mounted after each other at a distance, continuous travel information is possible at all positions of the circuit. In this case the control switches over to the position value of the second reading head when the "OUT" message has been received.

Installation position of code rail

The code rail can be installed in any position desired (see Fig. 7). When installing the code rail, care must be taken that all the mounting brackets are installed at the same level, i. e. the surface on which the brackets are installed must be flat.

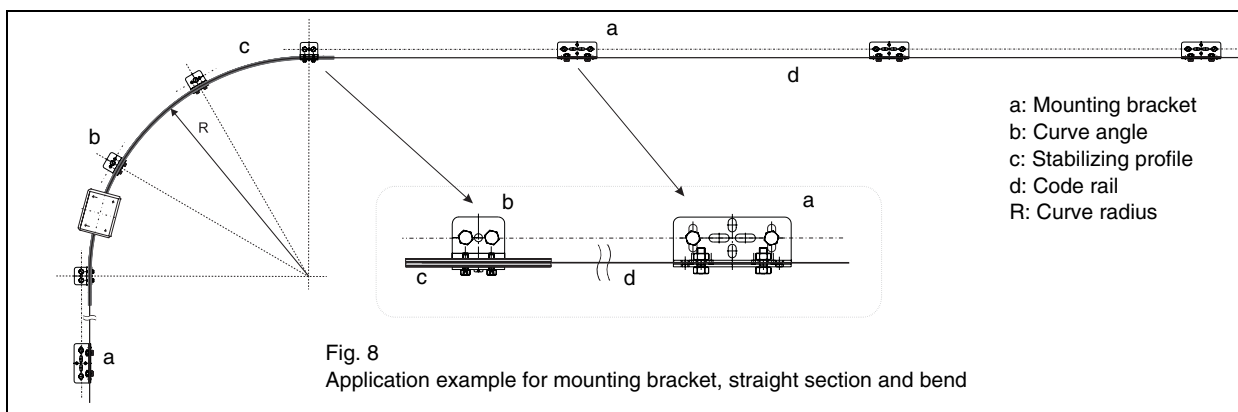


Fig. 8
Application example for mounting bracket, straight section and bend

Fig. 1
WCS2 aluminium profile system

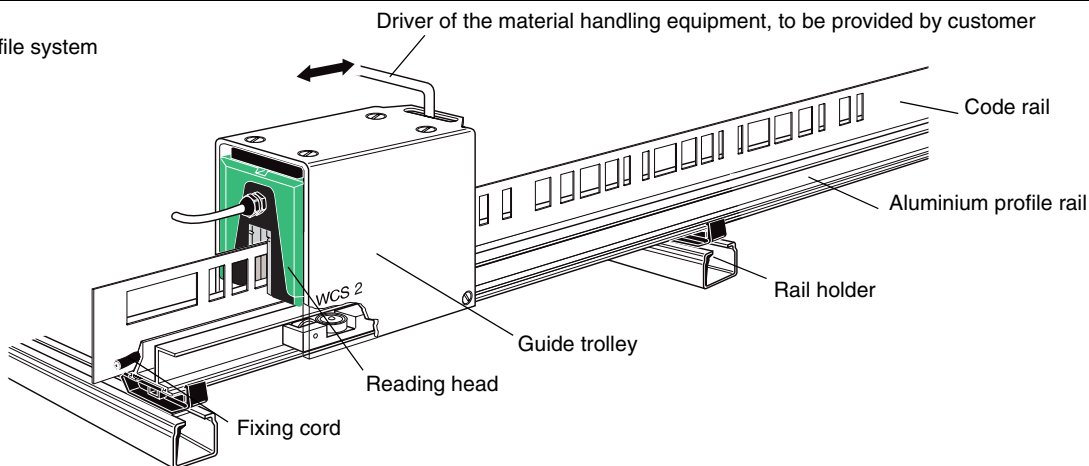
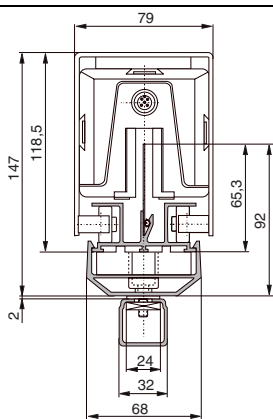


Fig. 2
Aluminium profile system WCS2 with C profile rail



Mounting WCS2 code rails with aluminium profile system

A special aluminium profile system has been developed for fast mounting of the 55 mm code rail made of plastic laminate or stainless steel. The aluminium profile has been designed in such a way that it takes the code rail and the guide trolley. The guide trolley ensures the ideal position of the reading head relative to the code rail and compensates the travel tolerances between the vehicle and the WCS system. At the same time the reading head is decoupled from the vehicle vibrations. The aluminium profile system can be mounted in any position. The profile rails are supplied in segments of 5 m in length and have been provided with a 45 deg. miter at the ends. The aluminium profile rails can be supplied with a powder coating and in curved segments.

Mounting the aluminium profile rail

For mounting the aluminium profile rail, rail holders are available for fast mounting, in which the profile rail snaps in. The rail holders can be supplied in three different variants:

- WCS2-MH: Rail holder without fixing screws
- WCS2-MH1: Rail holder with fixing screw (Fig. 4)
- WCS2-MH2: Rail holder with mounting system for installation in C profile rail 30 x 32 mm (Fig. 5).

The suspension distance for the aluminium profile rail must not exceed 1.5 m (min. 3 rail holders per 5 m section) for both upright and suspended mounting.

If the WCS2 aluminium profile system is mounted laterally, a support spacing of 1.25 m (four rail holders per rail of 5 meters in length) is recommended.

Fig. 3
Mounting rail holder

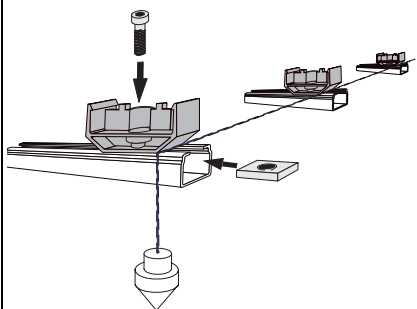


Fig. 4
Screw-on holder

- 1 rail holder
- 2 M6 x 30 cheese-head screw
- 3 M6 hex. nut
- 4 spring washer

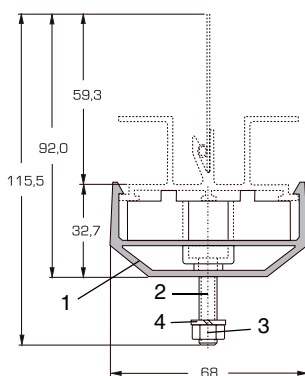


Fig. 5
Holder for C profile WCS-MH2

- 1 rail holder
- 2 M6 x 20 cheese-head screw
- 3 square nut 30 x 25 mm, M6
- 4 washer R 6.6

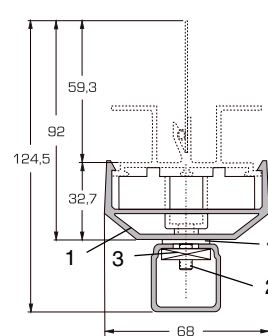
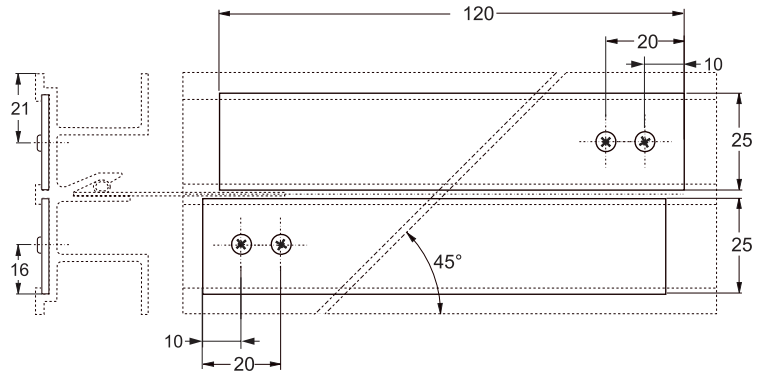


Fig. 6
Joint (WCS2-MC1),
view from below



Connectors for aluminium profile rails

Connectors are necessary for joining the aluminium profile rails. Each connector (WCS-MC1) consists of two flat aluminium pieces and four self tapping screws (3 mm x 4.5 mm). The flat pieces are pushed into the bottom grooves in the two profile rails to be joined, with drillholes ahead. Then the screws will be screwed into the holes of the flat pieces (see drawing at left side). The tips of the screws will be pressed into the aluminium profile and fix the flat pieces in the grooves.

Note: The rail connection must be screwed down on one side only (see Fig. 6).

Stainless steel connectors are used for joining the powder-coated aluminium profile rails (WCS-MC2).

Notes on installing the aluminium profile rail

When assembling the aluminium profile rails with the connectors, it is important to leave a gap to compensate for thermal expansion in case the temperature maximum operating temperature possible should be higher than the temperature during installation. The gap width necessary is calculated as follows:

$$\text{Gap width in mm} = 0.11 \cdot \Delta\vartheta$$

$$\Delta\vartheta = \vartheta_{\text{max. operation}} - \vartheta_{\text{installation}}$$

Examples:

$$\Delta\vartheta = 10 \text{ K, gap width} = 1.1 \text{ mm}$$

$$\Delta\vartheta = 20 \text{ K, gap width} = 2.2 \text{ mm}$$

$$\Delta\vartheta = 30 \text{ K, gap width} = 3.3 \text{ mm}$$

Installing the code rail in the profile rail

First of all, aluminium profile rail is attached to the substructure using the rail holders and aligned. The joints must be produced as described. Then the code rail can be laid fully in the groove of the profile rail. The code rail is ultimately fixed by means of a plastic cord which is pressed into the groove of the profile rail. To do so, the cord is pressed into the groove while simultaneously pressing down the code rail. Pressing it in correctly is extremely important for reliable operation, in particular if the aluminium profile system is suspended.

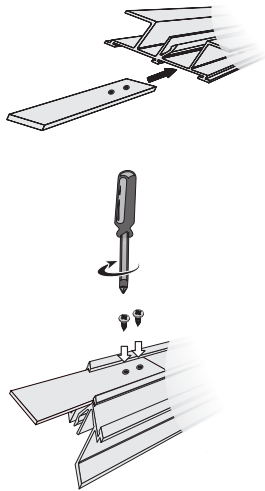


Fig. 7
Installation of connector

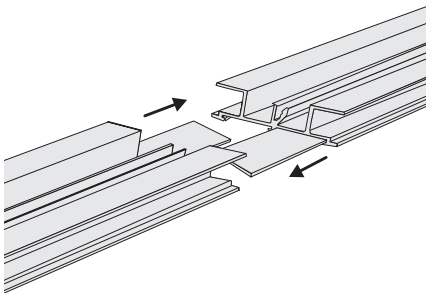


Fig. 8
Assembling aluminium profiles

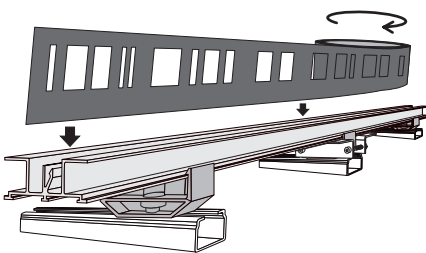


Fig. 9
Installation of WCS2 aluminium profile

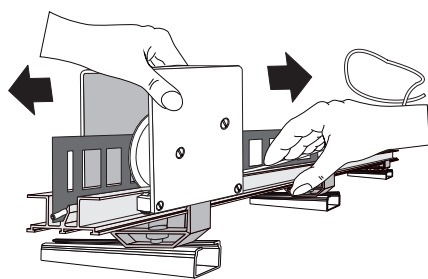


Fig. 10:
Fitting tool for code rail
(WCS2-FT1)

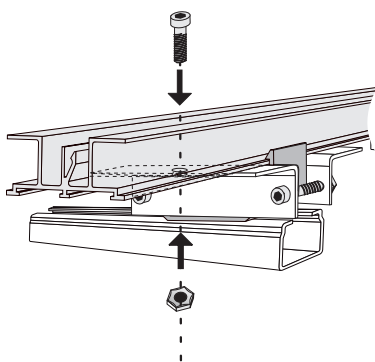


Fig. 11:
Locking bracket for aluminium profile
(WCS-LB1)

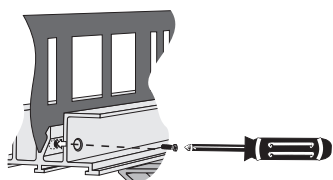


Fig. 12:
Fixed point for code rail

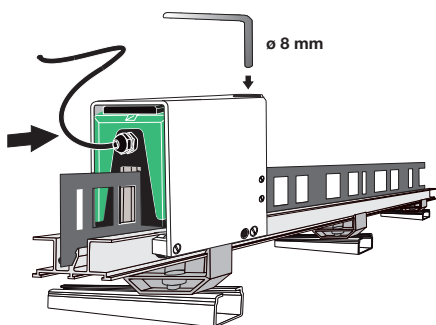


Fig. 13:
WCS2 guide trolley (WCS2-GT09-P1)

Fitting tool

A special fitting tool is available for speedy and safe installation of the code rail. The fitting tool is to be recommended particularly if the aluminium profile system is suspended. The tool consists of a housing with wheels similar to the guide trolley. The trolley is pulled along the profile rail. The code rail is held in position by the guide roller and pressure roller and the fixing cord pressed into the groove of the aluminium profile by the pressing wheel. Moving the trolley back and forth ensures that the plastic cord sits in the groove correctly (Fig. 10). If it is installed correctly, the pressure of the fixing cord is only sufficient to prevent the code rail slipping out of the aluminium profile even if it is in a suspended position.

The seating of the plastic cord and the code rail should be checked during maintenance, in particular if the aluminium profile is suspended.

Fixed points

To prevent the aluminium profile rails slipping in the rail holders when installed horizontally, a locking bracket is necessary. The locking bracket (Fig. 11) is fitted around a rail holder in the middle of the runway. During installation, bracket and aluminium profile are joined with the screw supplied. To do this, the aluminium profile must be drilled through at one point (drill 7 mm). If installed vertically, we recommend locking the aluminium profile with a suitable support bracket (by customer). To prevent the code rail slipping in the aluminium profile, it can be fixed in the centre of the runway by inserting a spring dowel pin or self-tapping screw (Fig. 12).

Guide trolley

The guide trolley (Fig. 13 and 14) for the reading head always ensures optimum position of the reading head in relation to the code rail. The mounting plate for the reading head is already prefitted on the trolley so that it only needs to be pushed on. By means of the towing arm moving freely in the oblong hole of the guide trolley (8 mm in diameter), on the one hand the movement between vehicle and reading head is isolated, and on the other hand mechanical tolerances are equalised. When fitting the towing arm installed on the conveyor vehicle, take care that no forces are exerted (no rigid connection between towing arm and guide trolley!). On the guide trolley holes are provided for fitting the cleaning brushes for the code rail (WCS2-GTBR). The cleaning brushes (optional extra) are only necessary, if the code holes in the WCS code rail may be clogged during to the application, such as by leaves or bird feathers. The brushes can be retrofitted. In dusty environments, such as in foundries or in the building materials industry, we recommend the use of guide trolleys fitted with metal rollers (WCS2-GT09-M1).

If the WCS2 aluminium profile system is mounted laterally, the use of the guide trolley with extended guide rails (WCS2-GT09-P2 or WCS2-GT09-M2) is recommended.

The maximum velocity for the reading head with guide trolley is 8 m/sec. The guide trolley is also available powdercoated (WCS2-GT09-P1-C).

Note: Push the guide trolley with the reading head into the profile rail in such a way that the electric plug connector points in the direction of the ascending positional values.

Fig. 14:
WCS2 guide trolley for reading head
(WCS2-GT09-P1)

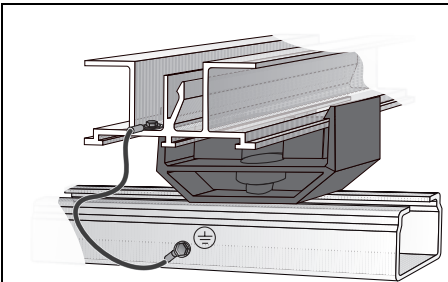
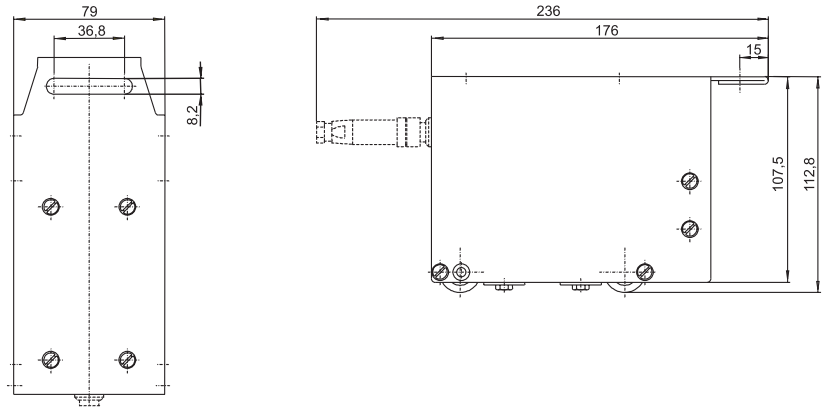


Fig. 15:
Grounding aluminium profile

Grounding the aluminium profile

The aluminium profile must be connected up to the low-ohmic potential at a distance of at least every 30 meters (Fig. 15).

Further information

Stainless steel or laminate code rails can be used with the aluminium profile system. The laminate code rail has proved to be suitable for normal industrial applications. In addition to cost advantages, the plastic laminate code rail is of advantage during installation, in particular on long runways, due to its lighter weight.

For extreme operating conditions, e. g. sparking in a welding shop, severe dirt accumulation during operation (e. g. waste incineration) or if cleaning brushes are used on the guide trolley, we recommend using the stainless steel code rail.

Pre-tensioning the code rail is not necessary for the system functions. This is merely useful if high temperature fluctuations may occur within short periods of time.



Attention

The tensioning device can only be used in conjunction with the stainless steel code rail (p. 15).

For more information and instructions on the installation of the WCS2 aluminium profile system, please refer to our website on the Internet at <http://www.pepperl-fuchs.com>.

Fig. 1
WCS3 aluminium profile system

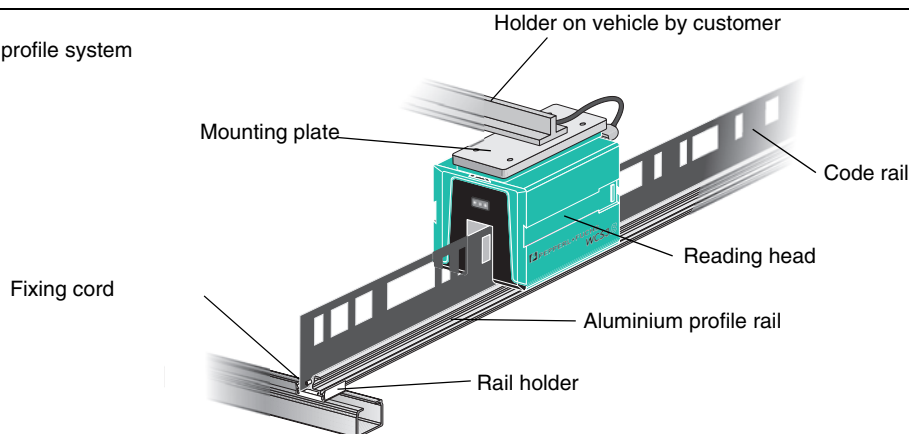
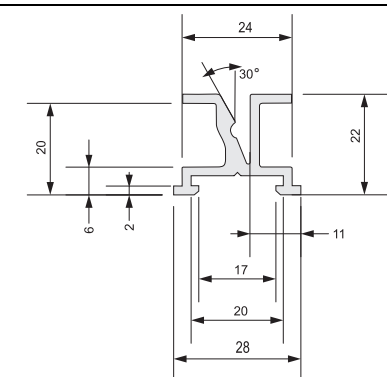


Fig. 2
Aluminium profile system WCS3 (WCS3-PS1)



Installation of WCS3 code rail with aluminium profile system

A special aluminium profile system has been developed for the rapid installation of the 70 mm high WCS3 code rail in plastic laminate or stainless steel. The aluminium profile is designed to take the code rail. It has been designed to provide optimum flexural strength in all directions in spite of its low weight. The aluminium profile system can be fitted in any position. The profile rails are supplied in 6 m sections. On request, the aluminium profile rail can also be supplied powder-coated and in curved sections.

Installing the aluminium profile rail

Rail holders, into which the profile rail is clipped, are available for rapid installation of the aluminium profile rail. The rail holders are available in three different versions:

- WCS3-MH: Rail holder without mounting screws
- WCS3-MH1: Rail holder with mounting screw (Fig. 5)
- WCS3-MH2: Rail holder with mounting system for installation in C profile rail 30 x 32 mm (Fig. 6).

The recommend spacing is 2.00 m (three rail holder per 6 meter segment); the maximum spacing between supports is 2.50 m.

Rail connectors for aluminium profile rails

Connections are necessary for joining the aluminium profile rails. Each connector (WCS3-MC1) consists of a 170 mm long aluminium extruded section and two selftapping screws M3 x 4.5 mm. The connector is pushed into the bottom grooves in the two profile rails to be joined. Then the screws are screwed into the holes (1.8 mm in diameter), see Fig. 7. The tips of the screws are pressed into the aluminium profile and hold the connector down.

Note: The rail connection may be screwed down on one side only (see Fig. 7).

Fig. 3
Aluminium profile system WCS3 with C profile rail

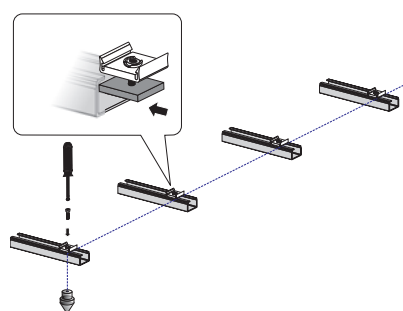


Fig. 4
Installation the rail holder

Fig. 5
Screw-on holder WCS3-MH1

- 1 - rail holder
- 2 - M6 x 30 cheese-head screw
- 3 - M6 hex. nut
- 4 - A6 spring washer

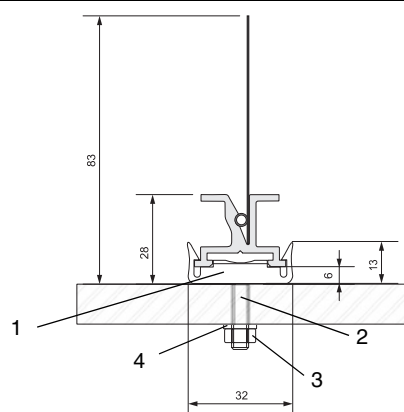


Fig. 6
Holder for C profile WCS3-MH2

- 1 - rail holder
- 2 - M6 x 20 cheese-head screw
- 3 - square nut 30 x 25 mm, M6

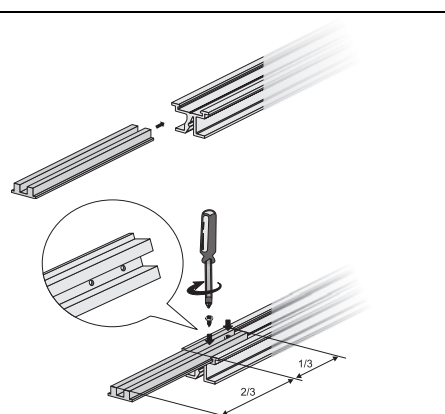
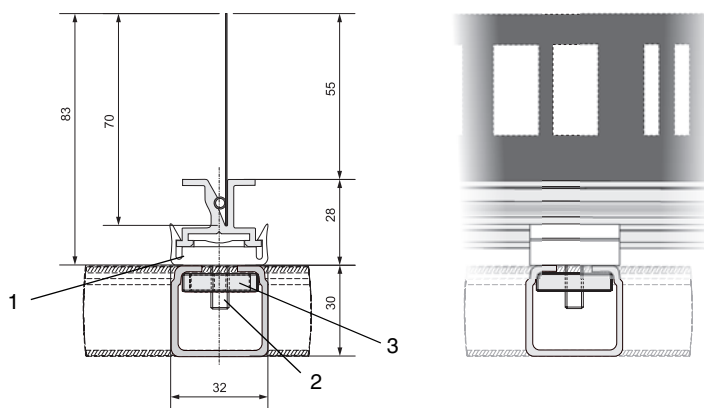


Fig. 7
Installation of connector

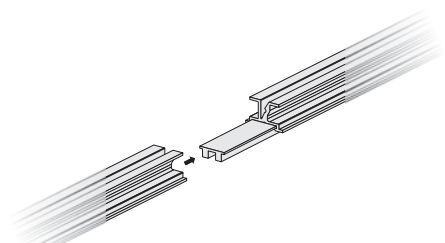


Fig. 8
Assembling aluminium profiles

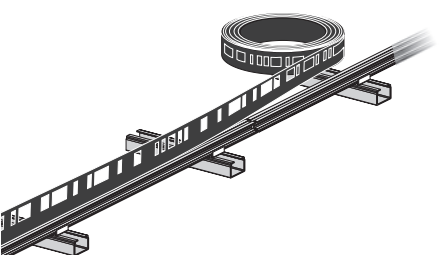


Fig. 9
Installation of WCS3 aluminium profile

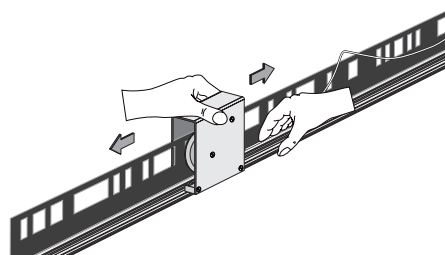


Fig. 10:
Fitting tool for code rail
(WCS3-FT1)

Notes on installing the aluminium profile rail

When assembling the aluminium profile rails with the connectors, it is important to leave a gap to compensate for thermal expansion. This is necessary if the maximum operating temperature possible should be greater than the temperature during installation. The gap width necessary is calculated as follows:

$$\text{Gap width [mm]} = 0.12 \cdot \Delta\vartheta$$

$$\Delta\vartheta = \vartheta_{\text{max. operation}} - \vartheta_{\text{installation}}$$

Examples:

$$\Delta\vartheta = 10 \text{ K, gap width} = 1.2 \text{ mm}$$

$$\Delta\vartheta = 20 \text{ K, gap width} = 2.4 \text{ mm}$$

$$\Delta\vartheta = 30 \text{ K, gap width} = 3.6 \text{ mm}$$

Grounding the aluminium profile system

The aluminium profile must be connected up to the low-ohmic potential at a distance of at least every 30 meters (see Fig. 15 on page 21).

Installing the code rail in the profile rail

First of all, the aluminium profile rail is attached to the substructure using the rail holders and aligned. The joints must be produced as described. Then the code rail can be laid fully in the groove of the profile rail. The code rail is ultimately fixed by means of a plastic cord which is pressed into the groove of the profile rail. To do so, the cord is pressed into the groove while simultaneously pressing down the code rail. Pressing it in correctly is extremely important for reliable operation, in particular if the aluminium profile system is suspended.

Fitting tool

A special fitting tool is available for secure and speedy attachment of the code rail. It is particularly recommended if the aluminium profile system is suspended. The tool consists of a wheeled housing. The trolley is pulled over the profile rail, the code rail being held in position by the guide roller and the fixing cord pressed into the groove of the aluminium profile by the pressing wheel. Moving the mounting trolley back and forth ensures that the fixing cord lies correctly in the groove of the aluminium profile (Fig. 10). If fitted correctly, the pressure from the fixing cord is sufficient to prevent the code rail slipping out of the aluminium profile even when suspended.

The seating of the fixing cord and cord rail must be checked during maintenance, particularly if the aluminium profile is suspended.

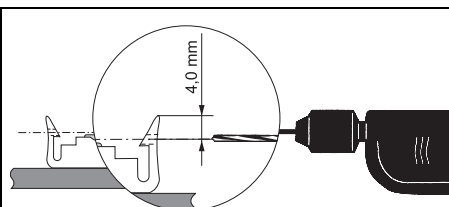


Fig. 11:
Fixed point

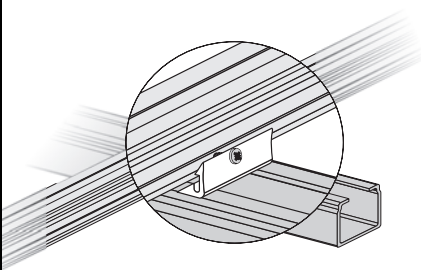


Fig. 12:
Fixed point



Fig. 13:
Cutting code rail edge

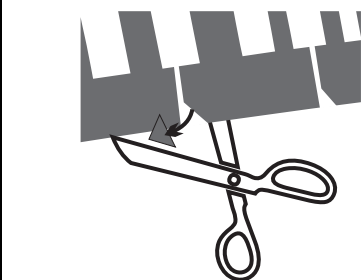


Fig. 14:
Detail view - Cut the code rail

Fixed points

To prevent the aluminium profile rails slipping in the rail holders when installed horizontally, the profile must be firmly connected to the substructure. A rail holder in the centre of the runway is rough-drilled on both sides with a drilling 1.8 mm in diameter (Fig. 11). Self-tapping screws (3 x 6 mm) are screwed into these drillings. The self-tapping screws are not supplied. The screws press into the aluminium profile forming a keyed connection (Fig. 12) between rail holder and aluminium profile. We recommend to fix the aluminium profile as described at several points along a runway. An adequate expansion joint between the aluminium profiles must be ensured (see also page 23).

If installed vertically, we recommend locking the aluminium profile with a suitable support bracket (by customer).

Vertical bend

Beside horizontal bends, also vertical bends are needed, to realize upward/downward gradients. With the help of the aluminium profile rail, together with the laminate code rail, vertical bends up to a minimum radius of 4 m can be made very simply. For this, the aluminium profiles bent with the appropriate radius are clipped into the rail holders. To ensure that the code rail can follow the vertical course of the bend, a cut is made from the start of the bend up to its end, in the distance of approx. 50 mm. The cuts are always made from below, i. e. from the wider side of the code rail until into the code windows (see Fig. 13). In addition, a small triangle is cut off with every cut (see Fig. 14). This prevents the code rail from overlapping in the aluminium profile.

If the code rail was cut as described, it is inserted together with the fixing cord and by means of the fitting tool into the pre-curved aluminium profile.

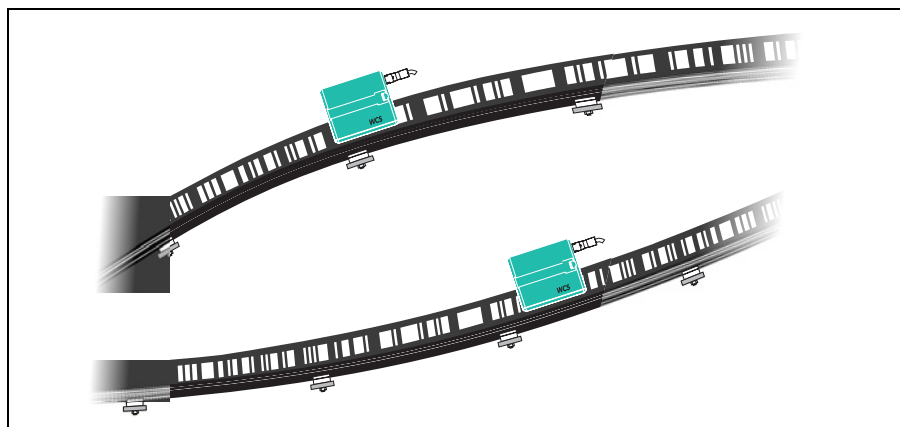


Fig. 15:
Vertical bend

Breaks in aluminium profile

For some applications, it may be necessary to interrupt the code rail, e. g. for crane crossovers, fire doors or large expansion joints in buildings. The break in the code rail must be at least 85 mm and the two code rail sections must be aligned. The maximum clearance between the end of an aluminium profile rail and the next rail holder must not exceed 0.5 m.

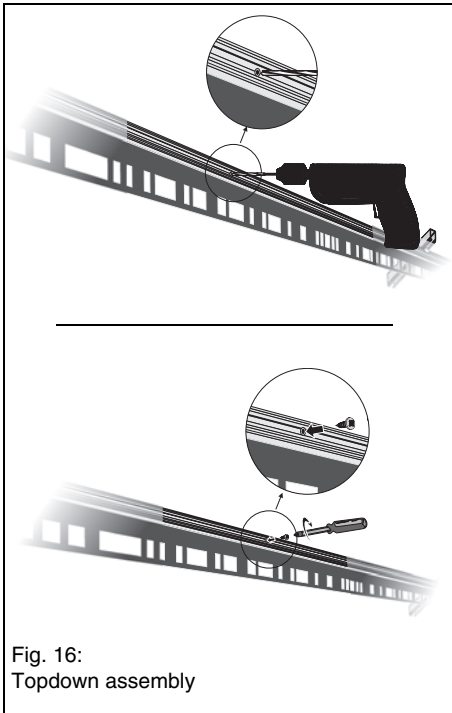


Fig. 16:
Topdown assembly

Suspension of stainless steel code rail

When the stainless steel code rail is suspended, in particular if there are frequent temperature fluctuations, it must be secured against falling. Using the tensioning device is sufficient for lengths up to approx. 25 m. Above this, we recommend securing the stainless steel code rail in the aluminium profile every 12 m with a self-tapping screw or a spring dowel pin. The aluminium profile and the code rail are through-drilled from the side (see Fig. 16). Then the self-tapping screw is screwed into this drilling (or the dowel pin pressed in). The self-tapping screw or dowel pin are not supplied.

Further information

The stainless steel or laminate code rails can both be used with the WCS3 aluminium profile system. The laminate code rail has proved to be suitable for normal industrial applications. In addition to cost advantages, the plastic laminate code rail is of advantage during installation, in particular on long runways, due to its lighter weight. With regard to operating conditions, the same applies as for the WCS2 profile system (see p. 18), with one exception: a guide trolley is not used in conjunction with the WCS3 aluminium profile system.

You will find further information and installation hints in "WCS3 special aluminium profile system". This document can be requested from us or downloaded from our Internet home page.

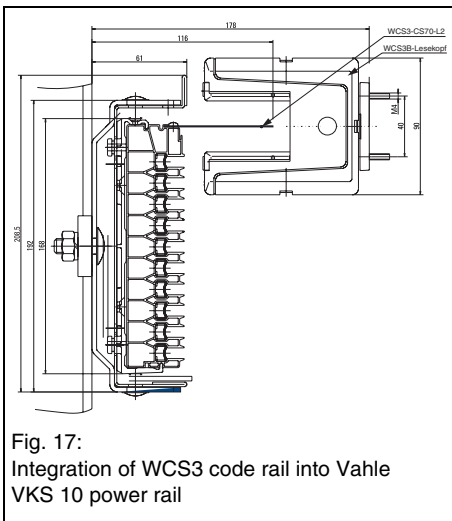


Fig. 17:
Integration of WCS3 code rail into Vahle
VKS 10 power rail

Integrating WCS code rail into conductor lines

In many applications, energy is transmitted to a vehicle by means of conductor lines. Users often request an integrated solution for energy transmission and positional measurement. This demand has been taken into account in developing the new Vahle VKS 10 power rail. The VKS 10 is flexible as regards the number and cross-sections of conductors and enables the WCS code rail to be integrated economically into the plastic base of the conductor line. Special holes for installation, and thus a special code rail, is necessary for installing the WCS3 code rail in the VKS10 system (WCS3-CS70-L2).

The laminate code rail is characterised by high flexibility and tear resistance. Reproducibility of location coordinates is guaranteed by the use of the code rail, independent of the ambient conditions. Reproducibility of location coordinates is guaranteed by the use of the code rail, independent of the ambient conditions.

Grounding the code rail

If During the installation of the WCS code rail in the VKS10 system, the code rail has to be connected to a low-ohmic plant potential at distance of at least every 30 meters.

You can obtain further information on the VKS 10 conductor line system from the Vahle sales organisation. You will find the relevant sales office at www.vahle.de.

Connection of WCS reading head to control

The WCS2B and WCS3B reading heads are available in different interface versions: RS 485 interface and SSI interface (serial synchronous interface). The WCS3B reading head is available also with an integrated CANopen interface.

Reading head with RS485 interface

The reading head can be connected directly to the control via a serial RS 485 interface. Various data protocols and data transmission rates are available. Up to four WCS2B and/or WCS3B reading heads can be connected together in an RS 485 bus line. In this case, the reading heads must have different bus addresses. The bus address for the reading head, if it has not been preset, has to be configured in the reading head. The configuration instructions can be downloaded from the Internet website. The reading head address has been preset already, this is indicated by the type designation of the reading head (type plate on the reading head). Please also see pages 44 and 51.

Type of reading head

The reading head type is given by the RS 485 terminating resistor, baud rate and data protocol.

Example: LS221-1 means:

2 ... reading head with RS485 terminating resistor

2 ... baud rate 62.5 kBaud

1 ... data protocol 1 and 2

1 ... reading head address 1

See also types summary on page 51.

Electric connection of the WCS2B reading head with RS 485 interface

The electrical connection of the WCS2B reading head is via a 5-pole M12 plug.

WCS2B, RS 485 interface	
Pin	Designation
1	RS 485 -
2	UB+
3	GND
4	RS485 +
5	n. c.

Electric connection of WCS3B reading head with RS 485 interface

The electrical connection of the WCS2B reading head is via a 5-pole M12 plug.

WCS3B, RS 485 interface	
Pin	Designation
1	UB+
2	RS 485 +
3	GND
4	RS 485 -
5	reserved *)

*) Speed output in reading heads with option S (see p. 30).

The counter-piece of the plug connector, the 5-pole M12 socket, is not part of the supply of the reading head.

Different pin configurations in WCS2B and WCS3B reading heads

The configuration of the plug connector of the WCS2B is compatible with the WCS2 and WCS2A reading head.

The WCS3B reading head is the first reading head in the WCS3 type series with an M12 plug connector. The configuration of the M12 connector in the WCS3B reading head is thus in keeping with the M12 standard configuration for sensors.

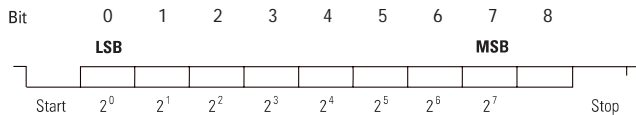
For electrical connection, we recommend confectioned M12 cable sockets or shielded data cable with attached M12 cable sockets provided by Pepperl+Fuchs (see section "Data cables and accessories" on page 48).

The WCSB reading heads have no connection possibilities for the cable shield, either on the plug connector or on the reading head housing. A low-resistance (wide area) connection between the cable shield and the system potential is made in the control panel. In the case of high electromagnetic interference radiation, it is recommended to make a low-resistance connection between the shield of the data cable and the system potential by an earthing clamp in the direct vicinity of the reading head.

Data protocols of WCS reading heads with RS485 interface

Various data protocols and data transmission rates are available for the direct connection of the reading head to the primary control via a serial communication channel. The data protocols and baud rates are identical for the corresponding types of both WCS2 and WCS3 reading heads.

A byte has the following format:



The control must always request the reading head to transmit. The data protocols can be selected independent of the baud rate.

The following baud rates are available:

187.5 kBaud: reading head type LS21x
 62.5 kBaud: reading head type LS21x
 38.4 kBaud: reading head type LS21x
 31.25 kBaud: reading head type LS21x
 19.2 kBaud: reading head type LS21x
 9.6 kBaud: reading head type LS25x

See also type summary page 51.

Data protocols 1 and 2 use the eighth data bit as a means of differentiating between request byte and response byte. Data protocol 3 is available for controls which do not support direction control through the eighth data bit. Reading heads with RS485 interface and data protocol 3 can be supplied as type LSxx6 = data protocol 3 with parity (even parity), 9 bit/byte or as type LSxx7 = data protocol 3 without parity = 8 bit/byte.

Response times

The minimum response time of the reading head (start transmission of 1st data bytes of response telegram) is dependent on the internal time sequence of the reading head and is 10 ... 180 µsec for data protocols 1 and 2.

For data protocol 3, the response time is one byte time + 10 ... 100 µsec. The byte time is dependent on the baud rate and is calculated from 1/baud rate * 11,000 in µsec.

Example: 38.4 kBaud

Byte time = 1/38.4 * 11,000 = 286.5 µsec.

Data protocol 1

Request byte to reading head									
Bit	8	7	6	5	4	3	2	1	0
	1	0	0	0	F0	0	0	A1	A0

Response telegram from reading head									
Bit	8	7	6	5	4	3	2	1	0
Byte 1	0	OUT	Err	A1	A0	DB	P18	P17	P16
Byte 2	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 4	0	OUT	Err	A1	A0	DB	P18	P17	P16
Byte 5	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 6	0	P07	P06	P05	P04	P03	P02	P01	P00

NEW: Protocol 1 with position and velocity output

Request byte to reading head									
Bit	8	7	6	5	4	3	2	1	0
	1	1	0	0	0	0	0	A1	A0

Response telegram from reading head									
Bit	8	7	6	5	4	3	2	1	0
Byte 1	0	OUT	Err	A1	A0	DB	P18	P17	P16
Byte 2	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 4	0	SST	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 5	0	OUT	Err	A1	A0	DB	P18	P17	P16
Byte 6	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 7	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 8	0	SST	SP6	SP5	SP4	SP3	SP2	SP1	SP0

Data protocol 2

Request byte to reading head									
Bit	8	7	6	5	4	3	2	1	0
	1	0	1	1	F0	0	0	A1	A0

Response telegram from the reading head									
Bit	8	7	6	5	4	3	2	1	0
Byte 1	0	OUT	Err	A1	A0	DB	P18	P17	P16
Byte 2	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 4	0	Exclusive or coupling byte 1 ... byte 3							

NEW: Protocol 2 with position and velocity output

Request byte sent to reading head									
Bit	8	7	6	5	4	3	2	1	0
	1	1	1	1	0	0	0	A1	A0

Response telegram from reading head									
Bit	8	7	6	5	4	3	2	1	0
Byte 1	0	OUT	Err	A1	A0	DB	P18	P17	P16
Byte 2	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 4	0	SST	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 5	0	Exclusive OR linkage Byte 1 ... Byte 4							

Data protocol 3

Request byte to reading head									
Bit	8	7	6	5	4	3	2	1	0
	PAR	1	0	0	F0	0	0	A1	A0

Response telegram from reading head									
Bit	8	7	6	5	4	3	2	1	0
Byte 1	PAR	0	0	A1	A0	0	DB	OUT	Err
Byte 2	PAR	0	0	0	P18	P17	P16	P15	P14
Byte 3	PAR	0	P13	P12	P11	P10	P09	P08	P07
Byte 4	PAR	0	P06	P05	P04	P03	P02	P01	P00
Byte 5	PAR	Exclusive or coupling byte 1 ... byte 4							

NEW: Protocol 3 with position and speed output

Request byte to reading head									
Bit	8	7	6	5	4	3	2	1	0
	PAR	1	1	1	0	0	0	A1	A0

Response telegram from reading head									
Bit	8	7	6	5	4	3	2	1	0
Byte 1	PAR	0	SST	A1	A0	0	DB	OUT	Err
Byte 2	PAR	0	0	0	P18	P17	P16	P15	P14
Byte 3	PAR	0	P13	P12	P11	P10	P09	P08	P07
Byte 4	PAR	0	P06	P05	P04	P03	P02	P01	P00
Byte 5	PAR	0	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 6	PAR	Exclusive OR linkage Byte 1 ... Byte 5							

Explanation of data bits, see p. 43.

Reading head with CANopen interface

After configuration, the WCS3B reading head with CANopen interface can be connected directly to a CANopen bus. A DIP switch is used for configuration in deenergised state.

The CAN interface is galvanically separated. The reading head operates as a CANopen slave in "Predefined connection set" and sends data in TxPDO1 format.

Electrical connection

The connection is established via 5-pole M12 plug. The counterpiece of the plug connector is not part of supply of the reading head.

WCS3B, CANopen interface	
Pin	Designation
1	n. c.
2	UB+
3	GND
4	CAN-H
5	CAN-L

CAN terminating resistor

A simple DIP switch is located on the middle PCB in the reading head. This switch can be used to switch the 120 Ohm CAN terminating resistor on or off. In delivery condition, the terminating resistor has been switched on.

Baud rate

The baud rate can be changed by means of two switches of the 8 DIP switches located on the middle PCB in the reading head. In delivery condition, the baud rate has been set to 250 kBaud.

DIP8-8	DIP8-7	Baud rate
OFF	OFF	125 kBaud
OFF	ON	250 kBaud
ON	OFF	500 kBaud
ON	ON	1 MBaud

Node ID

The address in the CANopen bus, the node ID, can be changed by means of the switches 1 to 6 of the 8 DIP switches located on the middle PCB in the reading head. The node ID is coded in binary mode. The smallest possible node ID is 1; the highest possible node ID is 63; node ID 0 is not permitted. In delivery condition, the node ID has been set to 1.

Transmission mode in the CANopen bus

By means of three switches of the 4 DIP switches on the lateral PCB of the reading head, the transmission mode and the inhibit time can be configured.

Asynchronous

Switch position 0 to 3; see Table 1; the reading head sends the data to the CAN bus automatically as soon as they have changed in the reading head. A wait time of at least x ms has to have run down since the last data package, which prevents an overload of the bus. At x = 0 ms no wait time is considered; in this case, the maximum data rate to the CAN bus is about 1.5 to 2 ms. If the data do not change in the reading head, they are sent to the CAN bus every y ms. Thus, the control will receive data also when the vehicle is at a standstill.

Synchronous

Switch position 7; see Table 1. The reading head sends data to the control after having received the SYNC command. The typical delay time after the receipt of the SYNC command is 2 ms; the maximum delay is 5 ms. In delivery condition, switches 1 to 3 = OFF, i. e. the asynchronous data transmission is 0 ms / 10 ms.

Switch position	DIP4-3	DIP4-2	DIP4-1	x ms / y ms
0	OFF	OFF	OFF	0 ms / 10 ms
1	OFF	OFF	ON	5 ms / 20 ms
2	OFF	ON	OFF	10 ms / 50 ms
3	OFF	ON	ON	20 ms / 50 ms
4	ON	OFF	OFF	reserved
5	ON	OFF	ON	reserved
6	ON	ON	OFF	reserved
7	ON	ON	ON	SYNC mode

Table 1

Data protocols

Two data protocols are supported: CAN data protocol 1 and CAN data protocol 2.

The data protocols always have a length of 8 byte. The data protocol is selected by means of the fourth switch of the 4 DIP switches on the lateral PCB of the reading head.

DIP4-4 = OFF: CAN data protocol 1

DIP4-4 = ON: CAN data protocol 2

In delivery condition, the reading head has been set to CAN data protocol 1.

Data protocol 1

Bit	7	6	5	4	3	2	1	0
Byte +0	0	0	0	0	0	P18	P17	P16
Byte +1	P15	P14	P13	P12	P11	P10	P09	P08
Byte +2	P07	P06	P05	P04	P03	P02	P01	P00
Byte +3	0	0	SST	DB	Err	OUT	0	0
Byte +4	0	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte +5	0	0	0	0	0	0	0	0
Byte +6	0	0	0	0	0	0	0	0
Byte +7	0	0	0	0	0	0	0	0

Data protocol 2

Bit	7	6	5	4	3	2	1	0
Byte +0	0	0	SST	DB	Err	OUT	0	0
Byte +1	P07	P06	P05	P04	P03	P02	P01	P00
Byte +2	P15	P14	P13	P12	P11	P10	P09	P08
Byte +3	0	0	0	0	0	P18	P17	P16
Byte +4	0	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte +5	0	0	0	0	0	0	0	0
Byte +6	0	0	0	0	0	0	0	0
Byte +7	0	0	0	0	0	0	0	0

Explanation of data bits, see p. 43.

Reading head with SSI interface

The reading head with SSI interface can be supplied with Gray (LS311) or binary code (LS310), and is connected directly to the SSI input channel of the respective control.

Electric connection of the WCS2B reading head with SSI interface

The electrical connection of the WCS2B reading head with an SSI interface is established by means of an 8-pole M12 connector.

WCS2B, SSI interface	
Pin	Designation
1	UB+
2	GND
3	CLK+
4	CLK-
5	DATA+
6	DATA-
7	n. c.
8	n. c.

Electric connection of WCS3B reading head with SSI interface

The electrical connection of the WCS3B reading head with SSI interface is via a 8-pole M12 connector.

WCS3B, SSI interface	
Pin	Designation
1	UB+
2	GND
3	CLK+
4	CLK-
5	DATA+
6	DATA-
7	*)
8	n. c.

*) Speed output in reading heads with S option (see page 30). In case of reading head without S option this connection has to remain free.

The counter-piece of the plug connector, the 8-pole M12 socket, is not part of the supply of the reading head.

For electrical connection, we recommend confectioned M12 cable sockets or shielded data cable with attached M12 cable sockets provided by Pepperl+Fuchs (see section "Data cables and accessories" on page 48).

The WCSB reading heads have no connection possibilities for a cable shield, either in the plug connector or in the reading head housing. A low-resistance (wide area) connection between the cable shield and the system potential is made in the control panel. In the

case of high electromagnetic interference radiation, it is recommended to make a low-resistance connection between the shield of the data cable and the system potential by an earthing clamp in the direct vicinity of the reading head.

SSI data format

The reading head with SSI interface corresponds as to its data format to a 25 bit absolute value encoder with 4096 revolutions and 4096 increments per revolution. The WCS reading head effectively supplies a maximum of 512 revolutions and 1024 increments per revolution.

The clock-pulse rate between control and reading head can be 100 ... 1.000 kHz.. The recommended value is 250 kHz.

Error signal

If the reading head detects an error, the error bit KB is set and the error code is transmitted to the control:

$$\begin{aligned} \text{KB} &= 1 \\ \text{POS } 2^0 \dots 2^2 &= \text{error number} \\ \text{POS } 2^3 \dots 2^{18} &= 0 \end{aligned}$$

For detailed description of errors, see p. 43.

Reading head outside of code rail

A distinction is made between two different states:

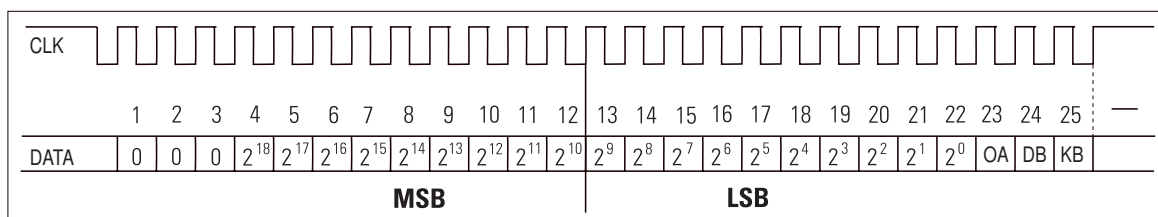
1. The code rail is in the gap in the reading head, but outside of the possible tolerances (see also page 8). In this case, the control receives the following bit pattern:

$$\begin{aligned} \text{KB} &= 0 \\ \text{OA} &= 0 \\ \text{POS } 2^0 \dots 2^{18} &= 1 \text{ (= positional value 524287)} \end{aligned}$$
2. There is no code rail in the gap in the reading head. In this case, the bit OA = 1 (out all) is set in addition to the bit pattern rendered above.

On the reading head with data output in Gray code, the value in the data bits $2^0 \dots 2^{18}$ is output in Gray code.

Soiling message (warning)

If dirt accumulation on the reading head is detected, the bit DB = 1 (diagnose bit) is set in the data protocol.



25 Bit SSI protocol



Features and options

Detection of dirt accumulation

The reading heads WCS2B and WCS3B continuously check the condition of the optics. If the light output of the infrared transmitter is reduced, e. g. due to dirt accumulation on the transparent liners, the reading head automatically increases the light intensity. If too much dirt accumulates, a warning signal is transmitted to the primary control (diagnosis bit DB=1). The automatic light adjustment in the reading head provides adequate time to clean the reading head during the next maintenance.

The condition "dirt accumulation detected" is also signalled optically on the WCS3A reading head - the yellow and red LEDs on the face of the reading head flash alternately.

In order to clean the optics, the reading head must be removed from the code rail (pulled off the mounting plate). After cleaning the transparent liners, the dirt accumulation signal is automatically deleted by the reading head. If the signal is not deleted in spite of careful cleaning or replacement of the plastic liners, there might be a defect. In this case the reading head must be sent for inspection.

Option H - space heating in reading head, type LS...H

For applications where there is a risk of dewing (fast temperature fluctuations from cold to warm, high relative humidity), the WCS reading head can be equipped optionally with space heating. The heating is powered by the reading head, i. e. no additional electric connection is necessary for the space heating. The cross-section of the supply cable to the reading head must be suitably dimensioned (see also data cable, page 48).

The space heating is switched on immediately when the voltage is connected to the reading head, the power consumption is 7 VA in the WCS2B and 9 VA in the WCS3B. A controller is used in the WCS3B space heating which switches off automatically at temperatures above 60 °C measured at the transparent liners of the reading head. The space heating option permits the reading head to be used in temperature range from -40 °C ... 60 °C.

Option S - velocity output, type LS...S

(only WCS3B)

On the WCS3A reading head with velocity output, exceeding a limit velocity is signalled via an additional 24 V DC output. The limit speed can be configured at the 4 DIP switches in the reading head. The limit velocity can be configured on the 4-fold DIP switch in the reading head.

$U_{out} = U_{B+}$: $v_{actual} < v_{limit}$
 $U_{out} = \text{floating}$: $v_{actual} > v_{limit}$



Note

Significance of the yellow LED in reading head altered.
See page 31

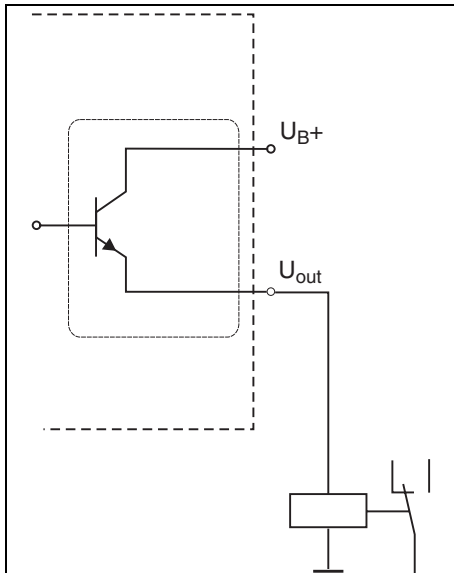


Fig. 1
Speed output

DIP switches		
S3	S4	Limit overspeed [m/s]
0	0	0,7
0	1	2.0
1	0	3.0
1	1	4.0

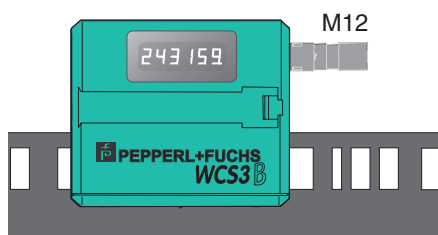


Fig. 2
Integrated 7 segment display

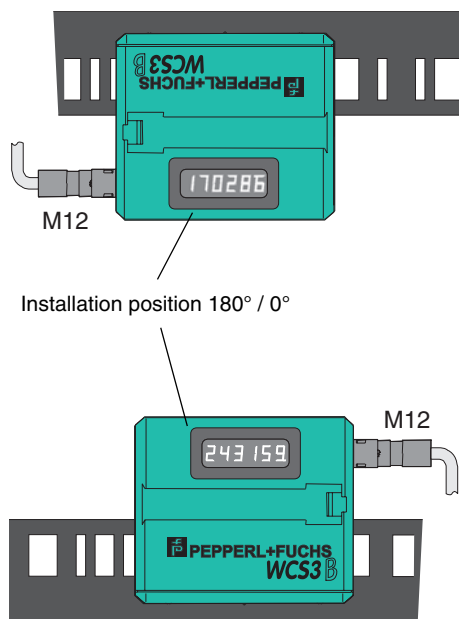


Fig. 3
Display position

Option D - integrated display in reading head, type LS...D

(only WCS3B)

The WCS3B reading head may be supplied with an optional six-digit display module. The current position value is indicated on the 7 segment display. After the reading head has been switched on,

- reading head type, e. g. "LS-221"
- reading head address, e. g. "Addr0"
- software version, e. g. "PR1.01"

is displayed one after the other. In standstill, the reading head switches to the "Information" mode. Cyclically, the following data are displayed:

- "12:34:56", internal clock (hh.mm.ss)
- "Good" or "Bad"

Condition of the optics/optoelectronics

- "LE - - -", no error signal
or "LE 1", reading head has detected error 1
- "Lo ---", reading head was not outside code rail or "Lo xxx", reading head was outside code rail xxx times (xxx = 1 ... 255).
Example: "Lo 34", reading head was outside code rail 34 times.
- "LS ---", limit velocity was not exceeded or "LS xxx" limit velocity was exceeded xxx times (xxx = 1 ... 255).
Example: "LS 128" limit velocity was exceeded 128 times (only in reading heads with velocity output option)

All values are reset when the voltage is switched on.

The maximum time is 99:59:59, then the time restarts at 00:00:00 again.

The maximum reading for Lo and LS is 255.

The display position can be adapted to the installation position of the reading head (reading head gap down or up). In order to alter the display position, the housing cover must be removed from the reading head, and the switch on the display p.c.b. has to be set to "on" or "off". The display position setting is not marked on the rating plate of the reading head.



LED display on WCS3B reading head

The WCS3A reading head has three LEDs on the front with the following significance:

green continuous:	internal voltage present
yellow continuous:	data transmission is active
red is flashing:	reading head outside code rail
red is lit:	reading head is reporting error
yellow/red are flashing alternately: (f=1.5 Hz)	dirt accumulated on reading head optics

All LEDs are activated for 2 sec after switching on or reset.

LED display on WCS3B reading head with velocity output

yellow continuous:	limit speed is not exceeded
yellow is not lit:	limit speed has been exceeded
red is flashing:	reading head outside of the code rail or reading head soiled

WCS interface modules

Apart from the possibility to poll data directly from the reading head(s), various interface modules (interface converter) are offered. The interface modules query the position values of the reading head(s) permanently, and thus always have the current data of the reading heads. The update cycle for a reading head is approx. 1 ms. The respective interface is used to transmit the reading head data to the control.

The following interface modules are available:

- parallel
- SSI
- Profibus DP
- DeviceNet
- CANopen
- Ethernet
- Interbus-S
- ProfiNet
- Modbus-RTU

When the reading head(s) is connected to a WCS interface module, the type of reading head is determined by the interface module. The corresponding reading head type is listed in the description of the respective interface module. Up to

four reading heads with RS485 interfaces can be connected up to the interface modules. If several reading heads are connected, the reading heads have to be provided with different addresses. An exception to this rule is the interface module with an SSI interface. Due to the SSI interface, only one reading head can be connected which always has to have the address 0. If the data bus is not connected to the respective WCS interface module by means of terminals, the counterpiece of the plug connector is not part of the delivery range of the interface module. The data cable for the connection to the control or the interface module is not part of the scope of supply of the reading head either.

The WCS catalog contains an overview of the interface modules. A detailed description of the respective interface module is available on the Internet in the product selector of the Pepperl+Fuchs website at <http://www.pepperl-fuchs.com>. Special configuration files or configuration programs can be downloaded there as well, if the respective data bus requires this action.

Interface module with parallel interface



With the interface module with parallel interface, the data are transmitted serially with RS 485 interface between the reading head(s) and the interface module and in parallel from the interface module to the control. The data can be transmitted to the control in binary (IP110) or Gray code (IP111). The interface module is available with or without RS 485 terminating resistor. A maximum of four reading heads of type LS211 (or LS111) can be connected. If more than two reading heads are connected, the number of reading heads must be stated when ordering the interface module..

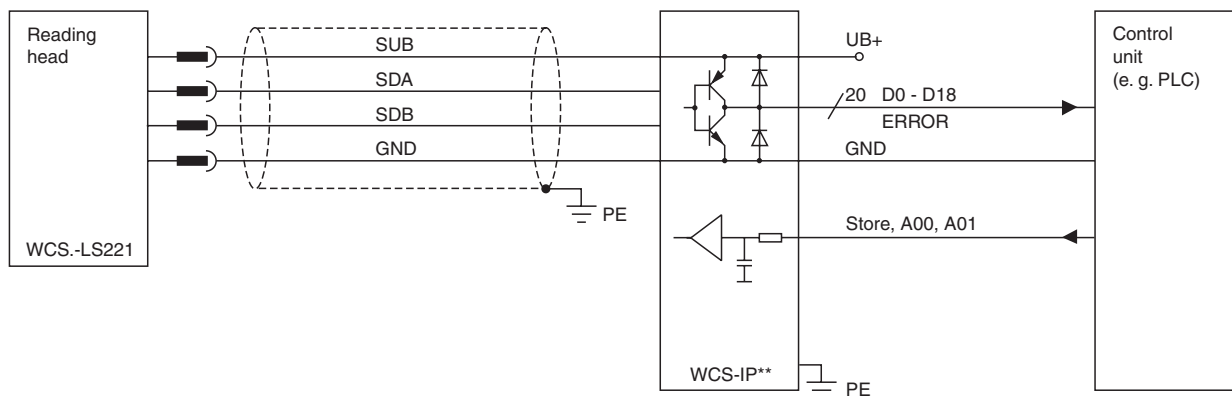
With the interface module with parallel interface, the data are transmitted serially with RS 485 interface between the reading head(s) and the interface module and in parallel from the interface module to the control. The data can be transmitted to the control in binary (IP110) or Gray code (IP111). The interface module is available with or without RS 485 terminating resistor. A maximum of four reading heads of type LS211 (or LS111) can be connected. If more than two reading heads are connected, the number of reading heads must be stated when ordering the interface module..

Dimensions and attachment

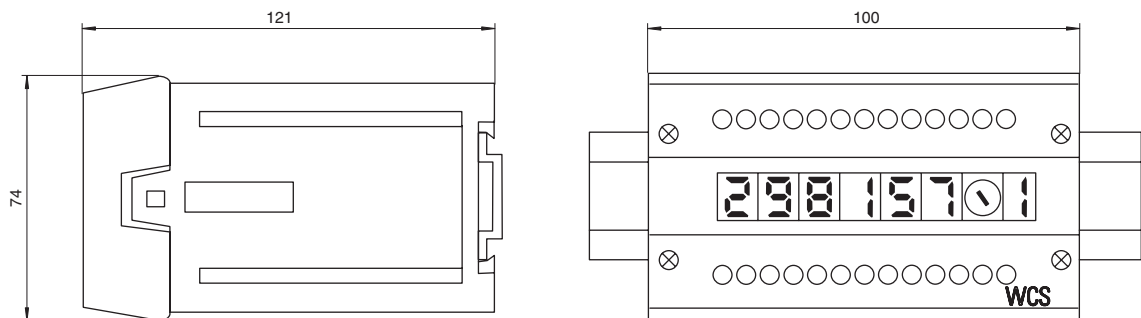
- 100 x 118 x 74 in mm (W x H x D)
- Clip-on attachment on 35 mm top-hat rail (EN 50022-35)

Connection to control

Electrical connection



Dimensions



Output of the position value

The position value is transmitted to the control by nineteen digital outputs (P00 to P18). The 24 VDC outputs of the interface module operate as push-pull power amplifiers (driver output 15 mA) and are connected directly to the corresponding I/O assembly of the control. P00 is the least significant bit (LSB) and P18 the most significant bit (MSB) of the output word.

Error bit (ERR)

If an error is detected in the WCS system, it is transmitted to the control as follows:

ERR = 1
P00 ... P04 = error code.

Address lines (A01 and A00)

If several reading heads are operated on one interface module, the reading head whose data are to be transmitted to the outputs must be selected via the two address inputs. If only one reading head (with address 0) is connected to the interface module the address inputs are not connected.

Store bit (STO)

Input for storing the outputs of the interface module. A "1" means that the outputs are no longer being changed, "0" means that the outputs are actualised in a 1 ms-cycle. The store signal is active immediately, i. e. the outputs are no longer actualised after the interface module has detected the signal at the input.

Interface module with SSI interface



On the interface module with SSI interface, the data are transmitted serially with RS 485 interface between the reading head and the interface module, and with SSI protocol (serial synchronous interface) from the interface module to the control.

The data are transmitted to the control in binary code (WCS-IS310/320) or in Gray code (WCS-IS311/ 321). Only one reading head can be connected up to the interface module. The reading head always has to have the address 0. A reading head type LS211-0 is connected to interface module WCS-IS310/311, and a reading head type LS221-0 to interface module WCS-IS320/321. The interface module is always supplied with RS 485 terminating resistor.

Properties

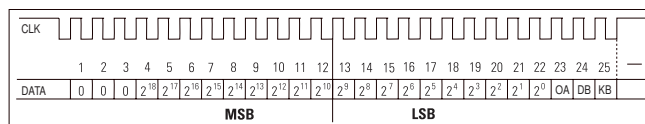
When the data cable are laid in the area of electromagnetic fields, the clock-pulse-edge controlled SSI data transmission is more susceptible to failure compared to the asynchronous data transmission process. When using the SSI interface module, the data are transmitted asynchronously from the reading head to the interface module by means of the RS485 interface; the conversion to the SSI protocol takes place directly next to the control. Thus the data transmission is more stable and less susceptible to failure. Other advantages of the interface module are the position value indication and the possibility to diagnose the reading heads by means of the device display.

Dimensions and installation

- 100 x 118 x 74 in mm (W x H x D)
- Clip-on attachment on 35 mm top-hat rail (EN 50022-35)

Connection to the control

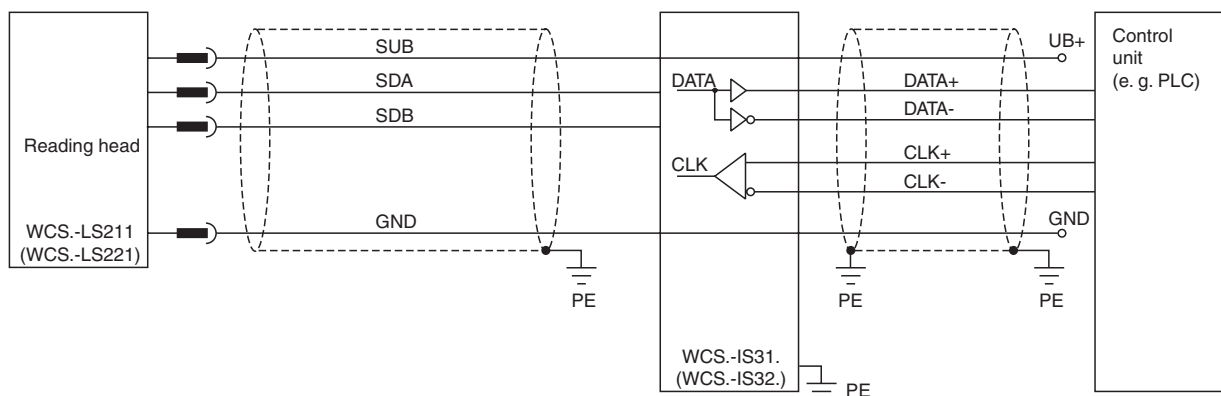
Four lines are used for the connection to the control: two clock lines and two data lines.



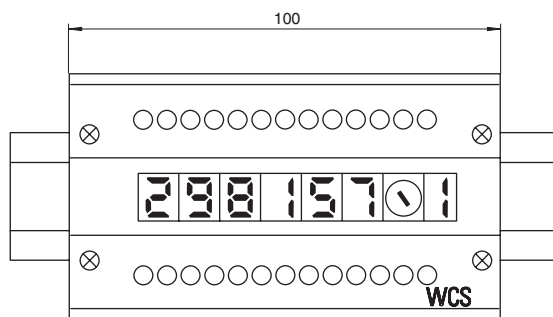
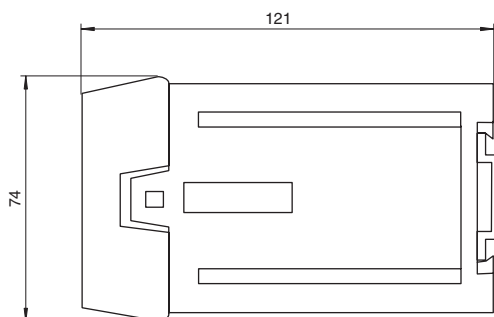
With respect to the data format the interface module with an SSI interface corresponds to a 25 bit absolute encoder with 4,096 revolutions and 4,096 increments/revolution. Effectively the WCS interface module supplies a maximum of 512 revolutions and 1,024 increments/revolution.

The cycle rate between control and reading head may amount to between 100 and 1,000 kHz; recommended value: 250 kHz.

Electrical connection



Dimensions



Interface module with Profibus DP interface



The interface module WCS-PG210 operates as a Profibus DP slave. It is used as an interface between the WCS reading head and the Profibus DP. The data are transmitted between the reading head(s) and the WCS-PG210 to the control via the RS485 interface, and between WCS-PG210 and the control via the Profibus DP. A maximum of four WCS reading heads of type LS221

(or LS121) can be connected. The number of reading heads connection is configured by the GSD file. The module has the following configuration:

- Baud rate: max. 12 MBaud (automatic recognition)
- Diagnose data: max. 8 Byte
- Sync: supported
- Freeze: supported
- Id No.: 0x2079

Dimensions and attachment

- 90 x 127 x 55 in mm (W x H x D)
- Clip-on attachment on 35 mm top-hat rail (EN 50022-35)

Connection to the control

The connection to the Profibus DP is effected by means of a 9-pole connector in keeping with the Profibus standard. A 9-pole Sub D connector is used which is plugged to the 9-pole Sub D socket of the device. This connector is not part of the scope of supply of the interface module. The Profibus address is set hexadecimally by means of the rotary switches "Profibus ID" "High" and "Low".

Example: Address 19 (=13h): High = 1, Low = 3.

The terminating resistor in the Profibus is switched on or off via the sliding switch "Termination".

Data exchange with the Profibus DP master

For configuring the master, a disk is supplied containing the configuration file (GSD file). This file can be downloaded from the website. The configuration data permit the selection of one, two, three or four reading heads connected. Independent of the number of reading heads selected, a byte is reserved for the activation of the reading head(s) in the master, 4 bytes per reading head are reserved for the response data. (Configuration data with 4 reading heads: 0x20, 0xD1, 0xD1, 0xD1, 0xD1).

Response of the reading head(s)

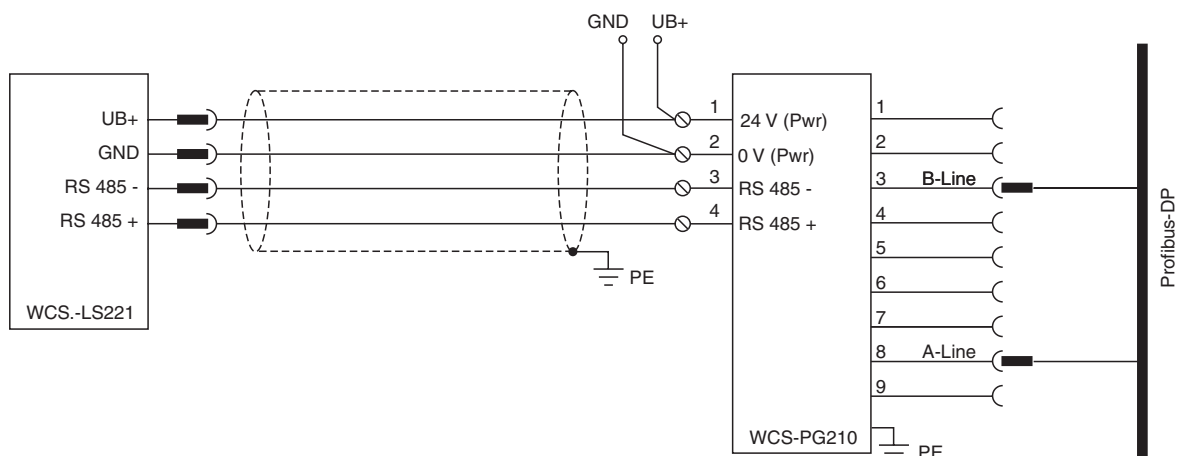
	Read.head address 3		Read.head address 2		Read.head address 1		Read.head address 0	
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

Data format of interface module for one reading head (4 bytes)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	0	0	P18	P17	P16	P15	P14	P13	P12	P11	P10	P09	P08
Word n+1	P07	P06	P05	P04	P03	P02	P01	P00	0	0	0	DB	Err	OUT	A1	A0

The significance of the data bits is explained on page 43.

Electrical connection



Interface module with DeviceNet interface



The WCS-DG210 acts as interface between the WCS reading head and the DeviceNet bus. The data are transmitted via the RS 485 interface between the reading head(s) and the DG210 and via the DeviceNet protocol from the DG210 to the control. A maximum of four reading heads of type LS221 (or LS121) can be connected. The DG210 complies with the conditions as per "DeviceNet

Specification Release 2.0" and functions as a DeviceNet "Group 2 only slave". (Vendor ID: 272, Device type: 12)

The interface module permits data transmission rates up to 500 kBaud in the DeviceNet.

Dimensions and attachment

- 90 x 127 x 55 in mm (W x H x D)
- Clip-on attachment on 35 mm top-hat rail (EN 50022-35)

Connection to control Connection to the DeviceNet via the 5-pole plug connector with screw terminals. The MAC-ID of the DeviceNet address is set with the 6-pole DIP switch "Node ID". MAC-ID "0" is not permissible.

The terminating resistor in the DeviceNet can be switched on or off with the sliding switch "Termination".

The data transmission rate in the DeviceNet is set on the WCS-DG210 by means of two switches.

Data exchange in the DeviceNet

The DG210 acts as "Group 2 Only Slave" in the DeviceNet. The access procedures "Polling", "Bit-Strobe" and "Change of state" are supported. If more than two reading heads are connected to the WCS-DG210, the data can only be interrogated via polling access. Transmitting a function byte from

the control to the WCS-DG210 also is only possible in polling mode. The data content for reading heads not connected has been defined with 0x00.

Polling In polling, a function byte is transmitted to the DG210 by the master. The DG210 then returns 16 data bytes. The 16 byte contain the data of the 4 reading heads (4 x 4 bytes).
Bit-strobe With bit-strobe access, the command "bit-strobe" is transmitted by the master without any further data. The master then always receives 8 data bytes as a response from the interface module. The 8 data bytes contain the data of the reading heads with address 0 and 1 (2 x 4 bytes).

Change of state In this procedure, the DG210 transmits 8 data bytes to the master without being requested as soon as the content of the data is changed. The data format corresponds to that for bit-strobe access. If the data of the reading heads change constantly, e. g. if the reading head is traveling fast, the data are transmitted every 5 ms. In this case the rest time is necessary to avoid overloading the Device-Net bus.

Function byte for activating the reading head(s) in polling

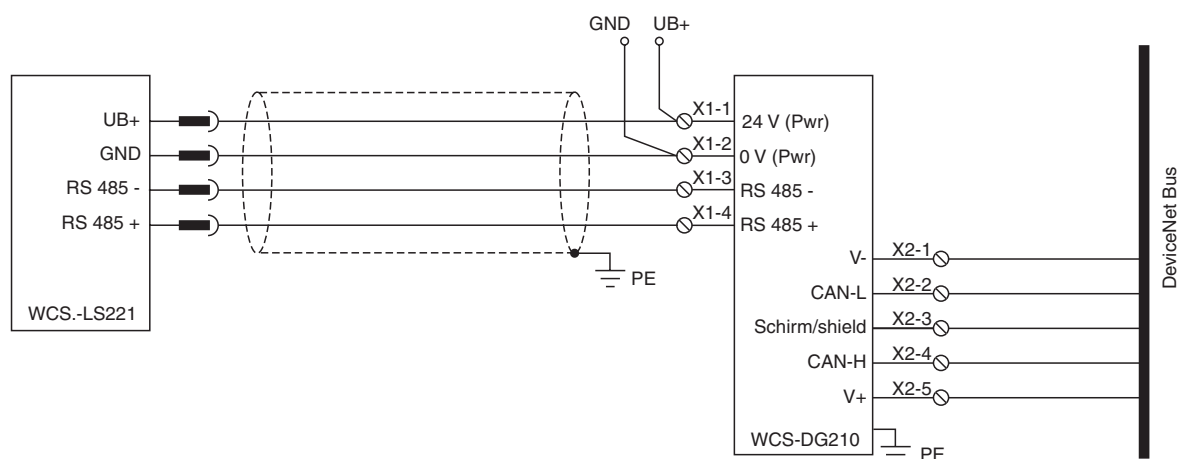
	Read.head address 3		Read.head address 2		Read.head address 1		Read.head address 0	
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

Data format of interface module for one reading head

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	0	0	P18	P17	P16	P15	P14	P13	P12	P11	P10	P09	P08
Word n+1	P07	P06	P05	P04	P03	P02	P01	P00	0	0	0	DB	Err	OUT	A1	A0

The meaning of the data bits is explained on p. 43.

Electrical connection



Interface module with CANopen interface



The WCS-CG210 interface module acts as interface between the WCS reading head and the CAN bus. The data are transmitted between the reading head(s) and the WCS-CG210 via the RS485 interface, and from the WCS-CG210 via the CANopen protocol. A maximum of four reading heads of type LS221 (or LS121) can be connected. The interface module WCS-CG210

functions as CANopen slave in the "Predefined connection set" and permits data transmission rates of between 10 kBaud and 1 Mbaud.

Dimensions and attachment

- 90 x 127 x 55 in mm (W x H x D)
- Clip-on attachment on 35 mm top-hat rail (EN 50022-35)

Connection to control

The connection to the CANopen bus is via a 9-pole plug connector. The counterpiece, the 9-pole SUB-D socket, is not part of the supply of the interface module. The module ID of the CANopen address is set via the 6-pole DIP switch "Node ID" (the most significant bit of the 7-digit module ID is "0"). Node ID "0" is not permissible.

The terminating resistor in the CANopen bus can be switched on or off by means of the sliding switch "Termination"

Data exchange in the CANopen bus

The "Transmission type" can be configured in the WCS-CG210 by means of rotary switches.

Asynchronous

In this mode WCS-CG210 transmits data automatically if the data of the reading head change.

Synchronous

In this mode CG210 transmits after receipt of the SYNC command. The typical delay in SYNC is 2 ms, the maximum delay is 5 ms.

The CG210 functions as CANopen slave in the "Predefined connection set". 5 objects are defined for the data of the WCS reading heads:

- Object 0x2000: 1 byte - function byte for response of the reading heads - object 0x2001: 4 bytes data of reading head, address 0
Object 0x2002: 4 bytes - data of reading head, address 1
Object 0x2003: 4 bytes - data of reading head, address 2
Object 0x2004: 4 bytes - data of reading head, address 3

The data format of the objects 0x2001...0x2004 is identical.

Access to the objects is via the PDO (process data object). Here,

TxPDO1: Objects 0x2001 and 0x2002 being transmitted

TxPDO2: Object 0x2003 and 0x2004 being transmitted

RxPDO1: Object 0x2000 being received
RxPDO2: not assigned

Object 0x2000 - function byte for activating the reading head(s)

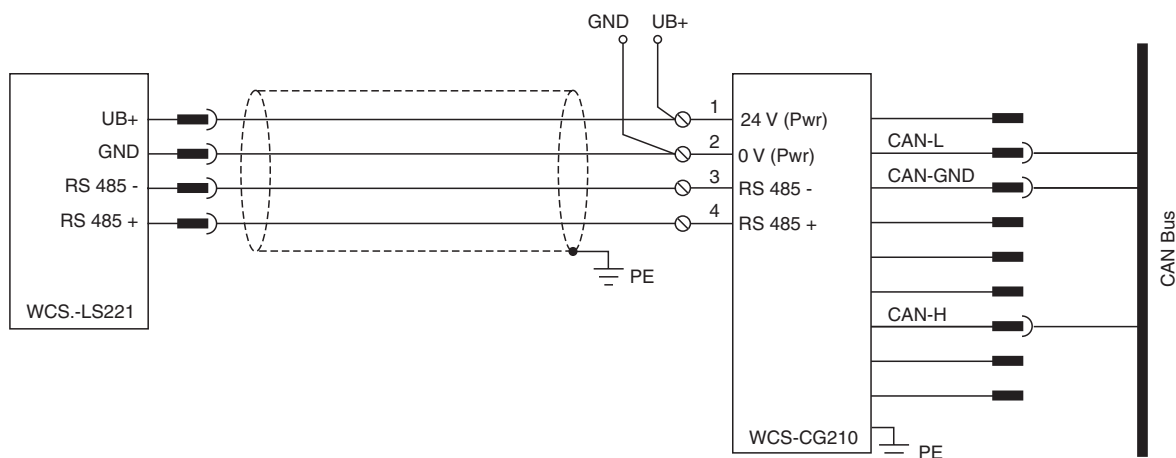
	Read.head							
	Address 3	Address 2	Address 1	Address 0				
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

Object 0x2001...0x2004 - 4 byte data of reading head

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	0	0	P18	P17	P16	P15	P14	P13	P12	P11	P10	P09	P08
Word n+1	P07	P06	P05	P04	P03	P02	P01	P00	0	0	0	DB	Err	OUT	A1	A0

The meaning of the data bits will be explained on page 43.

Electrical connection



Interface module with Ethernet interface



The WCS-EG210 acts as interface between the WCS reading head and the Ethernet protocols TCP/IP or UDP/IP. The data are transmitted between the reading head(s) and the WCS-EG210 to the control with RS485 interface and between WCS-EG210 and the control via the configured Ethernet protocol. A maximum of four reading heads of type LS221 (or LS121) can be connected. The baud rate in the Ethernet

bus is detected automatically and is 10 MBit/s or 100 MBit/s. The IP addresses and the Subnet mask are set by a Windows program which can be downloaded from the web-site.

Dimensions and attachment

- 90 x 127 x 55 in mm (W x H x D)
- Clip-on attachment on 35 mm top-hat rail (EN 50022-35)

Connection to control

Connection to the control is via 8-pole RJ45 socket. Data cable of category 5 have to be used. The number of connected reading heads and the Ethernet protocol, TCP/IP or UDP/IP are set by means of the rotary switch.

TCP/IP Protocol

In case of the TCP protocol, the interface module sends a data package to the client the connection of which has been opened automatically everytime the reading head data have changed.

UDP/IP protocol

If UDP protocol is used it is necessary that the station sends a request byte to cause a response of the reading heads. Subsequently the WCS-EG210 returns a data package to this station everytime the reading head data have changed.

Data exchange in Ethernet

Response of the reading head(s)

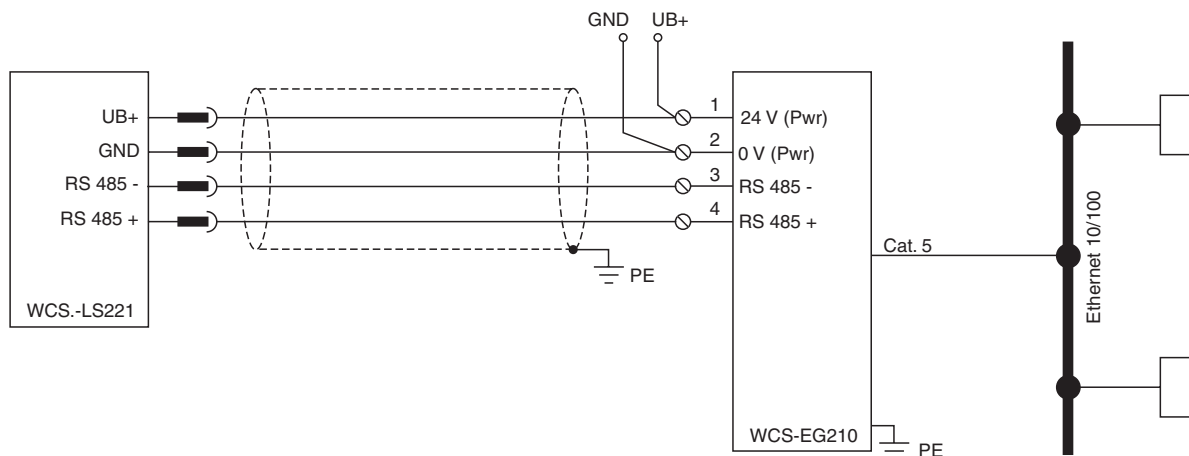
	Read.head address 3		Read.head address 2		Read.head address 1		Read.head address 0	
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

Data format of interface module for one reading head

Byte address	15	14	13	12	11	10	9	8
Address 0	0	0	0	0	0	P18	P17	P16
Address + 1	P15	P14	P13	P12	P11	P10	P09	P08
Address + 2	P07	P06	P05	P04	P03	P02	P01	P00
Address + 3	0	0	0	DB	Err	OUT	A1	A0

The significance of the data bits is explained on page 43.

Electrical connection



Interface module with InterBus-S interface



The interface module WCS-IG110 is used as an interface between the WCS reading head and the InterBus-S (Interbus-S remote bus). The data are transferred serially between the reading head(s) and the interface module WCS-IG110 (with RS485 interface) and from the interface module WCS-IG110 to the control by means of the InterBus-S protocol. One or two reading heads of type LS221 (or LS121) can be connected. On request, the connection of up to four reading heads is possible. The data can be transmitted in binary or Gray code. The bus baud rate can be switched over between 500 kBaud and 2 MBaud.

On request, the connection of up to four reading heads is possible. The data can be transmitted in binary or Gray code. The bus baud rate can be switched over between 500 kBaud and 2 MBaud.

Dimensions and attachment

- 90 x 127 x 55 in mm (W x H x D)
- Clip-on attachment on 35 mm top-hat rail (EN 50022-35)

Connection of Interbus-S

There are two 9-pole Sub-D plug connectors on the front of the device for connecting the InterBus-S line.

InterBus-S receiving (IBS-IN)

The incoming InterBus cable is connected via the 9-pole Sub-D plug on the front of the interface module. The 9-pole socket as counterpart to the plug is not part of the supply.

InterBus-S continuing (IBS-OUT)

The outgoing InterBus cable is connected via the 9-pole Sub-D socket on the front of the interface module. The 9-pole plug as counterpart to the socket is not part of the supply.

If other devices are to be operated on the InterBus-S after the interface module, a bridge must be soldered into the plug of the outgoing cable between 5 (+ 5 VDC) and PIN 9 (RBST).

Data exchange in the InterBus-S

Two data words (4 bytes) are reserved for each connected WCS reading head in the InterBus. The module transmits the data from the reading heads to the master. The reading head data transmitted are not delayed as the reading head(s) are continuously interrogated by the interface module independent of the InterBus-S.

Activation of interface module by master

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Word n+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Response of interface module

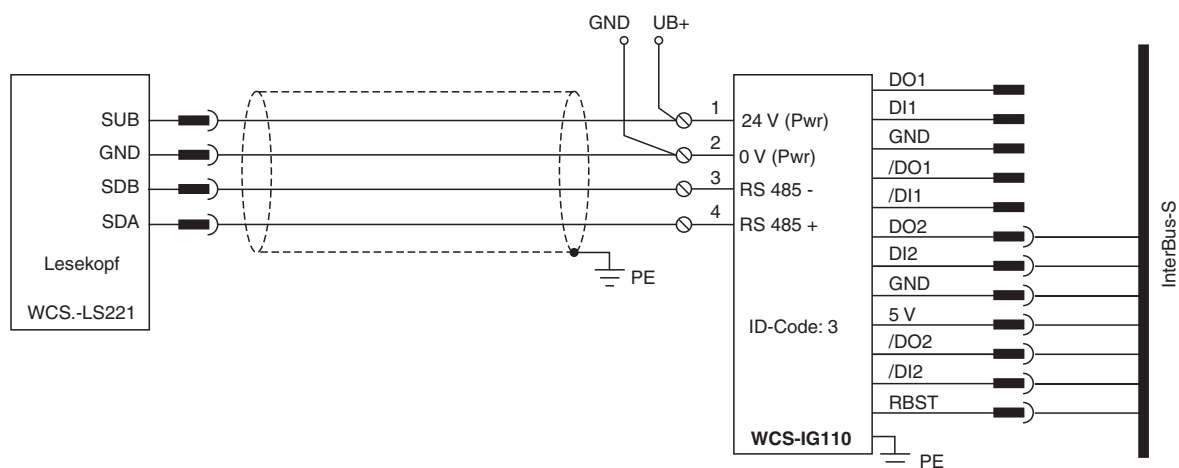
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	DB	Err	OUT	A1	A0	P7	P6	P5	P4	P3	P2	P1	P0
Word n+1	P15	P14	P13	P12	P11	P10	P9	P8	0	0	0	0	0	P18	P17	P16

The meaning of the data bits is explained on page 43.

Replacement module for interface module type WCS-IS2xx

WCS-IG110 may replace the previously supplied interface module of type WCS-IS2xx. Additional information is render on the internet or upon request.

Electrical connection





Interface module with Profinet interface



The interface module WCS-PNG110 acts as interface between the WCS reading head and the Profinet RT. The data are transmitted between the reading head(s) and the WCS-PNG110 to the control via the RS485 interface, and between WCS-PNG110 and the control via the Profinet protocol.

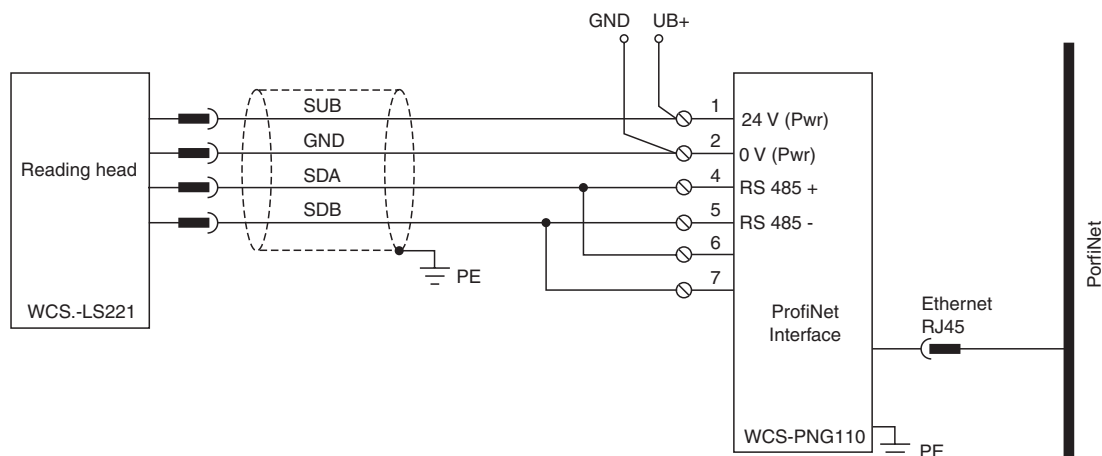
A maximum of four reading heads of type LS221 (or LS121) can be connected. The number of reading heads connected is configured by the hardware project setting using the GSDML file.

The Profinet-IO controller configures the interface module during the startup phase. It is only after faultfree termination of the startup phase that the WCS-PNG110 starts the data traffic to the reading heads connected.

Dimensions and installation

- 23 x 100 x 117 in mm (W x H x D)
- Clip-on attachment on 35 mm top-hat rail (EN 50022-35)

Electrical connection



Connection to the control

The connection to the control is established by an 8-pole RJ45 socket. Data cable of category 5 have to be used.

Data exchange in the Profinet

Response of the reading head(s)

	Read.head address 3		Read.head address 2		Read.head address 1		Read.head address 0	
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

Data format from interface module for a reading head

Byte address	15	14	13	12	11	10	9	8
Address 0	0	0	0	0	0	P18	P17	P16
Address + 1	P15	P14	P13	P12	P11	P10	P09	P08
Address + 2	P07	P06	P05	P04	P03	P02	P01	P00
Address + 3	0	0	0	DB	Err	OUT	A1	A0

The significance of the data bits will be explained on page 43.

Interface module with Modbus-RTU interface



The interface module WCS-MBG210 acts as interface between the WCS reading head and the Modbus-RTU. The data are transmitted between the reading head(s) and the WCS-MBG110 to the control by via the RS485 interface, and between WCS-MBG110 and the control via the Modbus-RTU protocol. The data transmission to the Modbus is via the RS485 interface. The Baud rate in the Modbus can be configured and is either 19.2 or 38.4 kBaud.

A maximum of four reading heads of type LS221 (or LS121) can be connected. The number of reading heads connected is set with rotary switches.

Dimensions and attachment

- 23 x 100 x 117 in mm (W x H x D)
- Clip-on attachment on 35 mm top-hat rail (EN 50022-35)

Connection to control

The Modbus address is set via rotary switches on the front side of the device.

Data exchange in the Modbus-RTU

The reading head data are saved each in two Address Holding Registers. The contents of the register is 0x00 in case no reading heads are connected. The access to the Address Holding Register is possible by means of function 3.

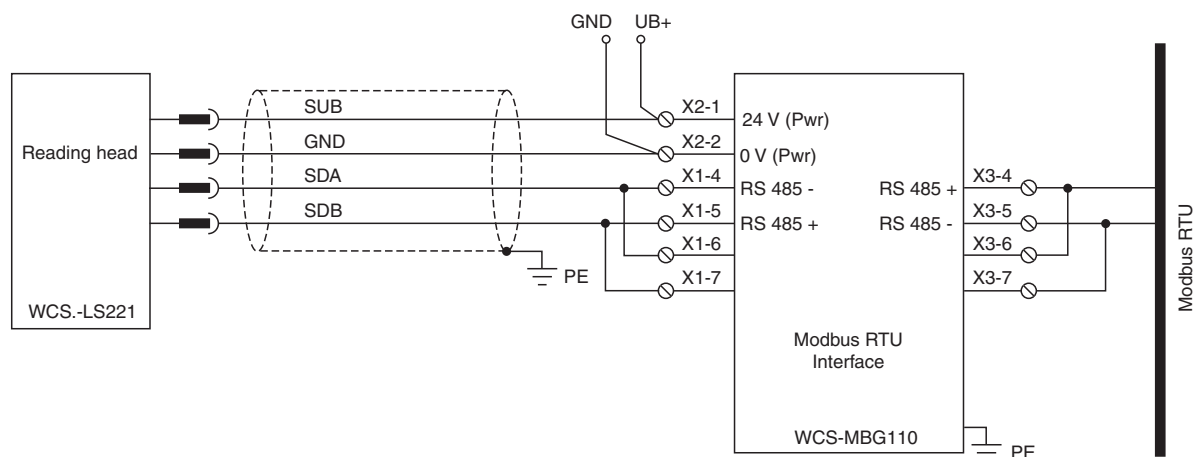
Data format of interface module

Address Holding Register	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
40001h	0	0	0	0	0	0	0	0	OUT	Err	A1	A0	DB	P18	P17	P16
40002h	P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P01	P00
40003h	0	0	0	0	0	0	0	0	OUT	Err	A1	A0	DB	P18	P17	P16
40004h	P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P01	P00
40005h	0	0	0	0	0	0	0	0	OUT	Err	A1	A0	DB	P18	P17	P16
40006h	P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P01	P00
40007h	0	0	0	0	0	0	0	0	OUT	Err	A1	A0	DB	P18	P17	P16
40008h	P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P01	P00

Reading head address 0: Holding register 40001h and 40002h, A0=0, A1=0
 reading head address 1: Holding register 40003h and 40004h, A0=1, A1=0
 reading head address 2: Holding register 40005h and 40006h, A0=0, A1=1
 reading head address 3: Holding register 40007h and 40008h, A0=1, A1=1

The significance of the data bits is explained on page 43.

Electrical connection



Display and diagnosis module

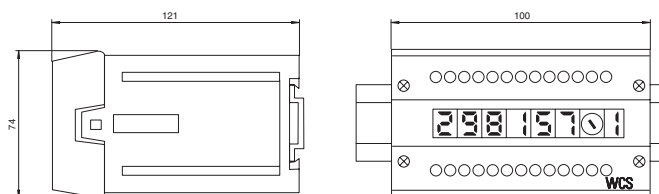


The WCS-DDM1 display module is used for the display and extended diagnosis of WCS reading head data. It is connected to the reading head(s) and passively logs the data communication between the reading head(s) and the control or the interface module. In addition to the current positional

value of the reading head(s) other diagnostic data can be displayed on the six-figure seven-segment display. The data are called up by means of the hex rotary switch next to the display.

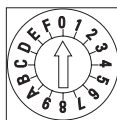
Dimensions and attachment

- 100 x 118 x 74 in mm (W x H x D)
- Clip-on attachment on 35 mm top-hat rail (EN 50022-35)



The display module has three display modes which can be selected automatically dependent upon number and type of reading heads connected.

The individual diagnostic values such as current position, highest priority error, time of error signal and last valid position when error occurred (not in display mode 1) can be called up for each reading head connected. When the display module is switched on, first



a functional test is performed (all segments illuminated), then the reading head type (e. g. LS211) and finally the device code are displayed. Then the display changes to the value set by the rotary switch. The current switch position is shown on the seven-segment display to the right of the rotary switch.

Functions of HEX switch

The following table the allocation of diagnostic values to switch position in each display mode.

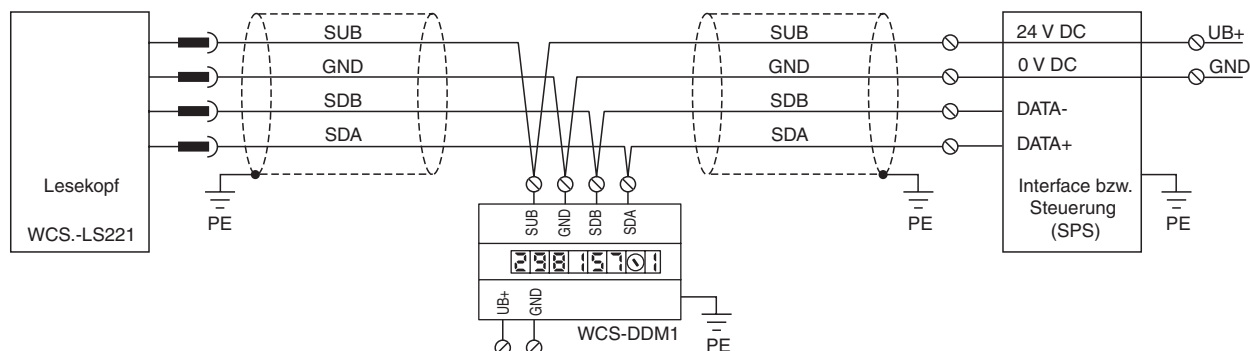
HEX switch	Display mode 1	Display mode 2	Display mode 3 (ext. protocol)
0	Data address 0	Data address 0	Data address 0
1	Error address 0	Error address 0	Velocity adr. 0
2	Time of error adr. 0	Time of error adr. 0	Error address 0
3	Data address 1	Last position adr.0	Time of error adr. 0
4	Error address 1	Data address 1	Last position adr.0
5	Time of error adr. 1	Error address 1	Data address 1
6	Data address 2	Time of error adr. 1	Velocity adr. 1
7	Error address 2	Last position adr.1	Error address 1
8	Time of error adr. 2	Data address 2	Time of error adr. 1
9	Data address 3	Error address 2	Last position adr.1
a	Error address 3	Time of error adr. 2	-
b	Time last error adr. 3	Last position adr.2	-
c	Last system error	Last system error	Last system error
d	Time last system error	Time last system error	Time last system error
e	Device code Toggle Info	Device code Toggle Info	Device code Toggle Info
f	Delete Error memory (5 sec.)	Delete Error memory (5 sec.)	Delete Error memory (5 sec.)

Diagnosis bits at outputs

The diagnosis bits DB, ERR and OUT of the individual bus addresses are output for at least 40 ms, or as long as a signal is present, at outputs P00 to P18 and can thus be processed optionally by an SPC. In the case of system errors, the error output is energised (also for at least 40 ms). The outputs are allocated as follows:

Diagnosis output at terminals																		
			Bus address 3				Bus address 2				Bus address 1				Bus address 0			
P18	P17	P16	P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P01	P00
-	-	-	OUT	Err	DB	-	OUT	Err	DB	-	OUT	Err	DB	-	OUT	Err	DB	-

Electrical connection



Description of protocol data

Activation of reading head

F0	A1	A0	Read.head address
x	0	0	Read.head address 0
x	0	1	Read.head address 1
x	1	0	Read.head address 2
x	1	1	Read.head address 3
0	x	x	Send position value
1	x	x	Send results of diagnosis

Data from reading head

Function number for reading head F0 = 0 (Transmitting positional value)					
Err	DB	OUT	SST	Description	State optical system reading head
0	0	0	x	Current positional value in P00...P18, binary coded	good
0	0	1	x	Reading head outside code rail, no positional value (see OUT message)	good
0	1	0	x	Current positional value in P00...P18, binary coded	bad
0	1	1	x	No positional value, reading head outside code rail (see OUT message)	bad
1	x	x	x	No positional value, error signal from reading head, error number in P00 ... P04, binary coded	-
x	x	x	1	Current speed unknown, last speed in SP0...SP6 ^{*)}	-
x	x	x	0	Current speed in SP0...SP6 ^{*)}	-

^{*)} Speed information

SP0...SP6... speed in 0.1 m/s, binary coded
 0: Speed less than 0.1 m/s
 126: Speed higher than 12.5 m/s
 127: Speed unknown Examples:

SP0...SP6... 1: Speed 0.1 m/s
 37: Speed 3.7 m/s
 112: Speed 11.2 m/s

Diagnosis function F0=1

The reading head can be requested to perform a diagnosis of the optoelectronics by means of the request byte. The reading head must be outside the code rail. On reading head types WCS2B and WCS3B, the degree of dirt accumulation on the optical unit is monitored automatically during operation and the diagnosis bit (DB) set if dirt accumulation is too high. Thus the specific request for diagnosis to the reading head via F0 in the request byte is no longer necessary. However for reasons of downwards compatibility this function is also supported by the new reading heads.

Diagnosis bit DB

Err	DB	OUT	Description	State optical system reading head
0	1	0	Diagnosis invalid, reading head not outside code rail	-
0	1	1	Diagnosis result in P16...P18	
			P16...P18 = 0	good
			P16...P18 > 0	bad
1	x	x	Error signal from reading head, error no. in P00...P04, binary coded	-

OUT signal

Err	DB	OUT	SST	Description	Condition
0	x	1	x	P00...P18 = 0 -> Reading head is partially out of the code rail	OUT
				P00 = 1, P02...P18 = 0 -> Reading head is complete out of the code rail	OUT A

OUT means that the positional value cannot be determined as the position of the code rail in the reading head gap is not correct.

OUT A (A=All) means that no code rail is located in the reading head gap; all light barriers of the reading head report signal.

The "OUT" message may be requested and desired, when the code rail is interrupted, for example, and the WCS (or the reading head) sends this information to the control between the individual rail sections. If the "OUT" message must not occur, the following test steps have to be carried out:

	Remedy
Top of code rail is outside tolerance range of reading head	Align code rail exactly Align reading head Use guide system for reading head

If these measures do not solve the problem, the reading head must be sent for repair.

ERR signal

Error Code	Cause	Remedy
1 2	Reading head cannot calculate positional value because:	
	Optical unit is dirty	Provide for optical system to be cleaned
	Plastic liners are scratched	Align reading head and code rail correctly. Replace the plastic shells
	Direction of reading head relative to code rail incorrect	Install reading head correctly. see p. 10ff et seqq.
	Light barriers have failed.	Send reading head in for repair
3	RAM error reading head	Send reading head in for repair
4	EPROM error reading head	Send reading head in for repair
5	ROM error reading head	Send reading head in for repair
6	Reserved	
7	No position value available Reading head in initialising routine.	Message only after switching on the reading head or RESET.
8 9 10 11 12	Data transmission error between reading head and interface module, data transmission is disturbed	Check cable connection from reading head to interface module; check shielding concept; check EM compatibility of system
13	Reading head cannot be activated by interface module	Check cable connection from reading head to the interface module; check operating voltage of the reading head
14	Reading head is in initialising or diagnosis routine	Wait completion of initialising; end diagnosis (set selector switch on the interface module to 0 ... 7)
15	Interface module is not been for communication with several reading heads	Send interface module in for correct configuration to be set
19	RAM error in the interface module	Send interface module in for repair
20	EPROM error in the interface module	Send interface module in for repair

Connection of RS485 reading heads to interface module/control

The RS485 interface, which permits several end-of-line devices to be interconnected via a bus line has proved extremely successful in practice. Due to its reliability, it is used with many bus systems such as Profibus. In the WCS system, the RS 485 interface is used for data communication between reading head and control. Also when Pepperl+Fuchs interface modules are used, data transmission between the reading heads and the interface module takes place via an RS 485 interface.

Reading head addresses

If several devices are interconnected in a bus, the bus users have to have different addresses. The data in the bus can then be clearly assigned by means of the relevant bus address. The WCS bus is designed in such a way that the control or interface module functions as master. The WCS reading heads are slave users and are cyclically polled by the master.

If only one reading head is connected to the control or interface module, this reading head always receives the address 0.

A maximum of four WCS reading heads (addresses 0 ... 3) can be connected to an interface module or an RS485 interface of the control by an RS485 bus line.

The reading head is available with four different addresses. The reading head address is included in the type designation (see also p. 51). WCS2 and WCS3 reading heads can be connected up in one bus line.

Example:

LS221-0: Reading head with the address 0

LS221-1: Reading head with the address 1.

If the address is not clearly stated, e. g. LS221, this synonymous with address 0. The master does not require an address of its own, however it must know the number of reading heads connected. On this point, see the description of the relevant interface module.

Information and installation hints for configuration of the reading head address can be requested from us or downloaded from our Internet home page.

Cable routing in RS485 bus

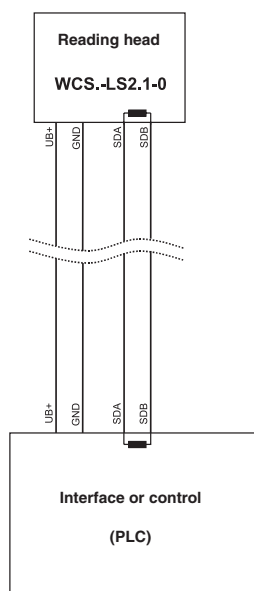
The data cable must be installed in such a way that an in-line connection always results between the first and the last bus user. This in-line connection must be terminated at the beginning and the end by a terminating resistor (resistance value: 120 ... 150 Ohm).

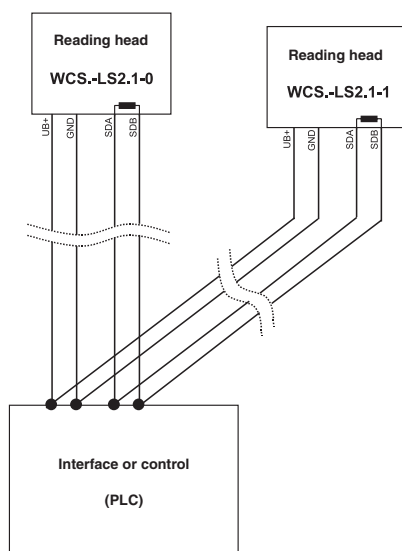
The RS485 terminating resistors are integrated into the WCS reading heads and the WCS interface modules and can be activated or deactivated.

In the case of interface modules with field bus interface (Profibus, DeviceNet, CAN-open), the terminating resistors can be activated or deactivated from outside. This is not possible in the case of the interface module with parallel interface and the WCS reading heads due to the type of housing and protection class. Thus when ordering, it must be stated whether the device is to be supplied with or without RS 485 terminating resistor.

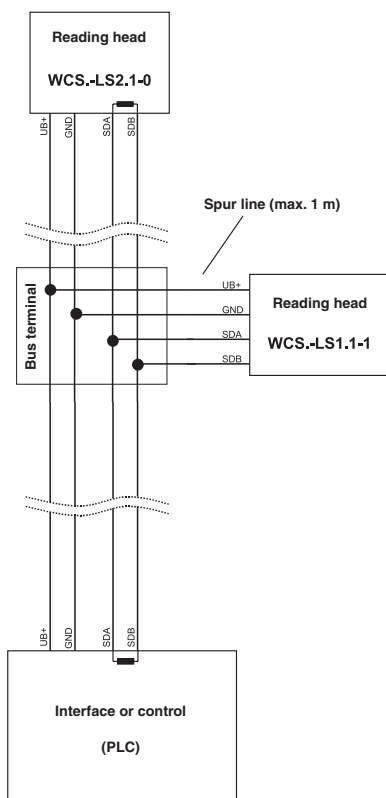
In the simplest case, only one **reading head** is connected to the control or the interface module. In this case, there is one device at the beginning and one device at the end of the data line. The RS485 terminating resistor is activated on both devices.

If two **reading heads** are connected to a serial communications channel or interface module, two wiring versions are possible:





Version A:



Version B:

Version A:

The RS 485 terminating resistor is activated on both reading heads. In this case, there is a reading head both at the beginning and the end of the data line, the interface module is in between.

It has no terminating resistor.

In this version, each reading head is connected to the interface module with a separate data cable.

Version B:

The interface module is at the beginning of the data line, with the RS 485 terminating resistor activated.

The RS485 terminating resistor is also activated on the reading head at the end of the data line. The second reading head has no terminating resistor. is connected to the in-line connection between the interface module and the first reading head with a short spur line (length <1 m). The BT111 bus terminal is used to connect the spur line (see p. 47).

The decision as to which of the wiring versions is more suitable must be taken dependent on the individual application.

If **three or four reading heads** are used on the same interface module, they must be connected between the end-of-line devices to the in-line connection via spur lines (as in version b).

Fig. 1

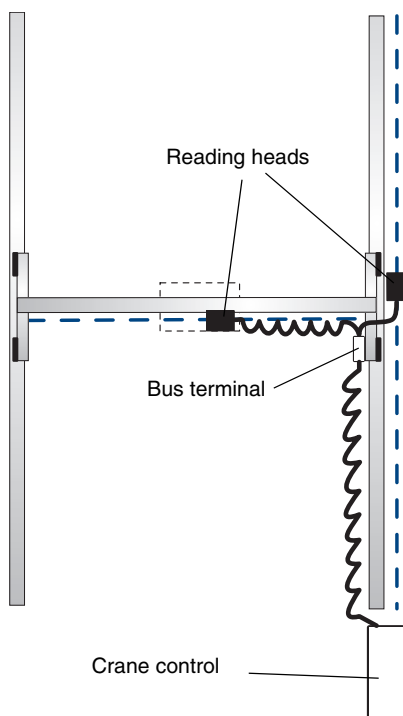
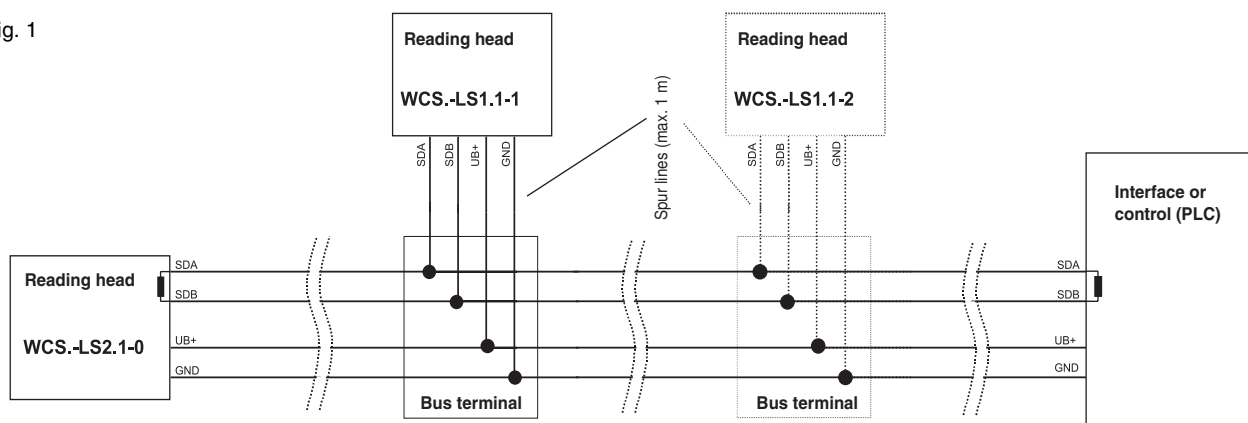


Fig. 2

Examples:

Example 1:

The longitudinal and vertical travel of a transport vehicle is to be measured.

The control and the interface module are on the vehicle, i. e. the control travels together with the vehicle. The length of the data cable between the reading heads and the interface module is relatively short. In this case it is an advantage to connect each reading head to the interface module with a separate data cable. Both reading heads are equipped with RS 485 terminating resistors, the interface module has no resistor (version a).

Example 2:

On a crane, the travel along the crane runway and the crane bridge is to be measured. The control and the interface module are in a control centre, i. e. the control is stationary (Fig. 2). The distance between the interface module and the reading heads is great. In this application, it is advisable to connect both reading heads to the interface module with one data cable. The reading head on the crane bridge and the interface module are equipped with the RS 485 terminating resistor. The second reading head on the crane runway has no terminating resistor. It is connected to the data cable via a short spur line (version b).

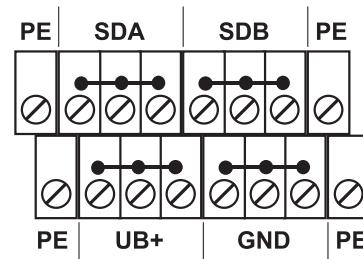
BT111 bus terminal

The bus terminal is used as terminal connection when a reading head is connected to the RS 485 data line via a spur line (see also p. 45).

It can also be used to reduce the cross-section of data cables, e. g. if due to the diameter of a cable (festoon cable) it is possible to connect the reading head directly to the incoming data cable. The bus terminal provides an optimum connection of the data lines and the shielding so that reliable data transmission is always ensured.

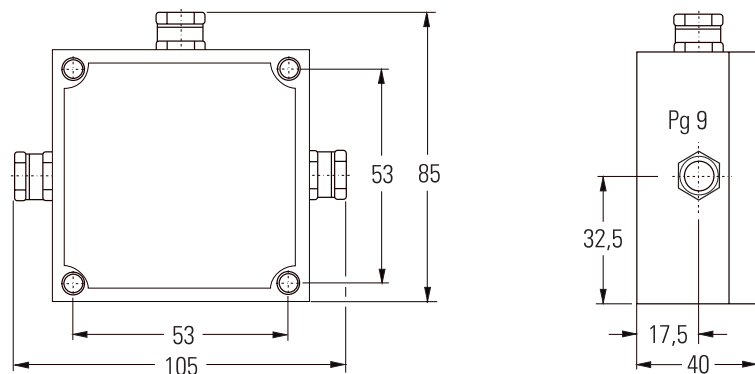
The PG glands on the bus terminal are suitable for cable diameters of 5 ... 9 mm.

BT111 terminal connection



Terminal	Description
UB+	UB+ (24 V DC)
SDA	Data line RS 485+
SDB	Data line RS 485
GND	GND
PE	Protective earth

Dimensions of the bus terminal BT 111



The housing of the bus terminal must be connected to PE.

Data cables and accessories

RS485 data cable

A 4-wire paired shielded data cable must be used for the RS 485 data transmission. One pair of wires is used for the supply voltage and one pair for the RS 485 data connection. The maximum length of the cable depends on the one hand on the capacity of the data cable (wire to wire) for data transmission, on the other hand on the cross-section of the cables for the voltage supply of the reading heads. A small wire cross-section and thus a low cable capacity is an advantage for data transmission, however for the voltage supply as great a cross-section as possible is desirable. The table below illustrates the cable lengths possible dependent on the cable cross-section.

The calculations are based on the most unfavourable case: All the reading heads are at the end of the data line. In the case of long cable lengths and if several WCS2 reading heads with heating facility are connected, 6-wire data cables (3 x 2) can be used. In this case, two pairs are used for voltage supply (doubling the cable cross-section) and one pair for the RS 485 data line.

Capacity (wire to wire)	RS 485 interface		
	19.2 kb (LS246)	62.5 kb (LS221)	187.5 kb (LS211)
60 pF	500 m	500 m	300 m
90 pF	500 m	450 m	275 m
120 pF	500 m	400 m	250 m

The table shows the cable lengths possible dependent on the cable capacity (wire to wire). The number of reading heads connected is immaterial.

SSI data cable

A 6-wire shielded data cable (3 x 2 paired) must be used for the SSI data transmission. One pair of wires is used for the voltage supply, one pair for the CLK and one pair for the DATA data line. The cable lengths technically possible can be seen from the tables.

Capacity (wire to wire)	SSI interface		
	125 kHz	250 kHz	500 kHz
60 pF	200 m	100 m	30 m
90 pF	150 m	80 m	25 m
120 pF	100 m	60 m	20 m

Cable diameter	AWG	No. reading heads without heating				No. reading heads with heating			
		1	2	3	4	1	2	3	4
0.14 mm ²	~ 26	200 m	110 m	70 m	50 m	15 m	10 m	7 m	5 m
0.22 mm ²	~ 24	320 m	170 m	110 m	80 m	30 m	15 m	10 m	7 m
0.25 mm ²		350 m	190 m	130 m	90 m	35 m	17 m	12 m	8 m
0.28 mm ²		400 m	220 m	150 m	110 m	40 m	20 m	15 m	10 m
0.34 mm ²	~ 22	500 m	250 m	180 m	140 m	50 m	25 m	17 m	12 m
0.50 mm ²	~ 20	500 m	400 m	270 m	200 m	70 m	35 m	25 m	17 m

Data cables WCS-DCS / WCS-DCF

Two types of data cable are offered:

- WCS-DCS for stationary installation
- WCS-DCF installation in festoon systems and chains

The data cables are paired and have a tinned braided cable shield. The braiding encloses all the wire pairs. The parameters of the data cables suitable for RS 485 and SSI data transmission are listed in the table below.

	WCS-DCS	WCS-DCF
Capacity (wire to wire)	95 pF/m	60 pF/m
Cross-section	0.14 mm ²	0.25 mm ²
Number of wires	6 (3) 2	6 (3) 2
External diameter	5.8 mm	7.5 mm
Temperature range	-30 °C ... 70 °C	-5 °C ... 70 °C
Order no.	WCS-DCS	WCS-DCF

Overview of cable sockets and adapter cables

Confectionable cable sockets M12 x 1

	Number of poles	Cable diameter	Order no.
straight	4	6 mm ... 8 mm ...	V1-G-PG9
angled	4	6 mm ... 8 mm ...	V1-W-PG9
straight	5	6 mm ... 8 mm ...	V15-G-PG9
angled	5	6 mm ... 8 mm ...	V15-W-PG9
straight	8	6 mm ... 8 mm ...	V17-G-PG9
angled	8	6 mm ... 8 mm ...	V17-W-PG9 *)

*) Cable outlet at the top, not variable

Shielded connection cable with cable sockets M12 x 1

	Number of poles	Cable length	Order no.
straight	4	2 m	V1-G-2M-PUR-ABG
straight	4	5 m	V1-G-5M-PUR-ABG
angled	4	2 m	-
angled	4	5 m	V1-W-5M-PUR-ABG
straight	5	5 m	V15-G-5M-PUR-ABG
angled	5	5 m	V15-W-5M-PUR-ABG
straight	8	2 m	V19-G-2M-PUR-ABG
straight	8	5 m	V19-G-5M-PUR-ABG

Other connection cables on request

Adapter cables

To be used for	Order designation	Description
WCS2 - WCS2B WCS2A - WCS2B		
SSI interface	# V19-G-1M-PUR ABG-V423-G	M12 cable socket, 8-pole / connector, 6-pole
WCS3 - WCS3B WCS3A - WCS3B		
RS485 interface	V15-G-0,5M-PUR-ABG-SUBD9	M12 cable socket, 5-pole / SUBD connector, 9-pole
SSI interface	V19-G-0,5M-PUR-ABG-SUBD9	M12 cable socket, 8-pole / SUBD connector, 9-pole

The data sheets of the connecting and adapter cables can be downloaded from the Pepperl+Fuchs website at <http://www.pepperl-fuchs.com>.

Cable installation

The precondition for trouble-free data transmission is that the data cables are installed in such a way as to prevent interference from electromagnetic fields and other disturbances. In order to install the cables to ensure EMC, it is necessary to divide them into groups and install these groups separately.

Group A

- shielded data cables (also analogue)
- unshielded cables for direct and alternating voltages 0 V to 60 V
- shielded cables for direct and alternating voltages 0 V to 230 V
- coaxial cables for monitors

Group B

- unshielded cables for direct and alternating voltages 60 V to 400 V

Group C

- unshielded cables for direct and alternating voltages greater than 400 V

Shielding of cables



Note

Shielding is a means of reducing electromagnetic interference. To prevent these error currents themselves becoming a source of interference, a low-ohm or low-impedance connection to the protective earth is particularly important. Use only cables with shielding braided shield (avoid foil shields). The shield is brought into contact on both sides, i. e. in the panel box and on the reading head (via the cable lug on the reading head housing).

In exceptional cases, connecting the shield on one side only may be better, if

- no equipotential cable is or can be installed and/or
- a foil shield is used.

The following points must also be observed for shielding:

- Use metal cable clips which enclose the shield over a large area.
- Bring the cable shield into contact with the earth bar immediately after its entry into the panel box.
- Lead protective earth connections to a point in star form.
- Use the largest cable cross-sections possible for grounding.

Notes for use

Break in code rail

The WCS principle permits a break in the code rail. A minimum gap of 85 mm between two code rail sections must be observed. The reading head recognises that it is leaving the code rail and signals "OUT" to the control.

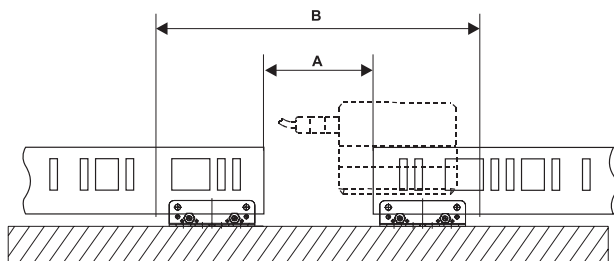


Fig. 1 Break in code rail

Due to the length of the reading head, the total width of the OUT window is:

$$B = A + 160 \text{ mm.}$$

Replacing a code rail

If a code rail is bent or destroyed, it can be remedied as follows: Try to bend the code rail back into shape. Make sure that the reading head does not brush against the code rail when travelling over this section. If it is not possible to bend the code rail back into shape, the complete rail or a section of it must be replaced. On short runways, it is preferable to replace the complete code rail, on longer runways it is possible to replace the damaged section only.

Calculate the beginning and end position of the code rail to be replaced. The section of code rail is ordered stating these two positional values and the type of code rail (WCS2, WCS3, stainless steel, laminate, height).

Replacing the complete code rail

The method of replacing the code rail is analogous to that for initial installation. To avoid having to reprogram the stopping positions in the control, the following sequence is to be recommended:

1. Move reading head to a defined position, fix it in position and read positional value
2. Remove code rail
3. Insert code rail and move it until the reading head signals the same position to the control as for the old code rail.
4. Fix the code rail in position

Replacing a section

If a section is replaced, the replacement section must overlap the installed code rail at the beginning and the end by approx. 10 cm. This additional length at the beginning and the end must be taken into account when calculating the beginning and end position of the code rail to be replaced.

Cut out the faulty section of code rail. Place the replacement section onto the code rail so that the code pattern of both rails matches. Join the replacement section to the existing code rail. Recommended method of joining the code rails:

Stainless steel: spot welding, riveting
Laminate: riveting, stapling

Repair set for code rails

A repair set is available to order for WCS3 code rails - WCS3-CS70-REP. This repair set can be used to replace defective sections of a code rail up to 900 mm. The repair set contains a 1 meter transparent code strip, which contains the raster of the code rail, as well as a black strips of various width for the code webs of the code rail. The code raster of the defective code, which is still recognizable as a rule even in case of a destroyed code rail, is copied by sticking the transparent carrier. The finished copy is then placed into the existing code rail.

Difficult ambient conditions

The WCS scans the code rail opto-electronically. The optical system prevents use in paint cabins or in installations with water vapour or spray. However the WCS2 has proved successful in dusty ambiances (e. g. foundries). In these ambiances, we recommend using the WCS2 reading head with the aluminium profile system (see p. 18 et seq.). The WCS2 reading head will receive additional protection from being installed in a guide trolley. Due to the installation in the guide trolley, the WCS2 reading head is protected additionally. As an option, brushes for cleaning the code rail may also be attached to the guide trolley.

Cleaning the reading head

The quick-action lock on the mounting plate enables the reading head to be removed within a few seconds. After removal, the transparent protective liners which protect the reading area of the reading head are cleaned using a clean cotton rag. If they are very soiled, the liners can also be easily removed and cleaned with warm water (if necessary with the addition of washing-up liquid). If the surface is scratched, the protective liners must be replaced (see also page 13).

Outdoor use

For WCS applications in the open air we recommend the WCS2 system:

- Use of the WCS2 reading head with space heating facility
- Installing code rail with aluminium profile system (see p. 18 et seq.)
- Aluminium profile system suspended, i. e. code rail points downwards (any dirt falls downwards)
- Use of stainless steel code rail (increased temperature range of stainless steel code rail)
- Guide trolley with cleaning brush option (additional enclosure for reading head and code rail cleaned if it should become soiled) and steel wheels
- Instal WCS system in a sheltered position or protect with a suitable roof (do not instal on weather side, rain or snow must not enter gap in reading head)



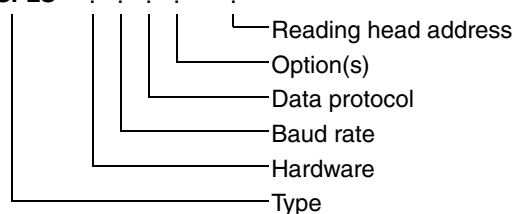
Note

You will find further notes for use on our Internet homepage
<http://www.pepperl-fuchs.com>.

Type summary

Type summary for reading heads

WCS.-LS



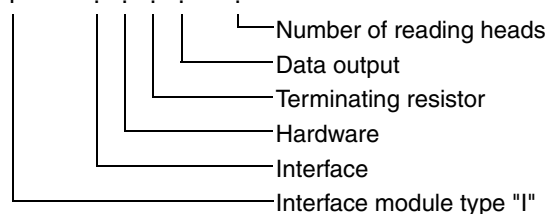
Type	2B	WCS2B reading head
	3B	WCS3B reading head
Hardware	1	Reading head with RS 485 interface Without RS 485 terminating resistor
	2	Reading head with RS 485 interface With RS 485 terminating resistor
	3	Reading head with SSI interface
	4	Reading head with CANopen interface
Baud rate		Reading head with RS 485 interface
	1	187.50 kBaud
	2	62.50 kBaud
	3	31.25 kBaud
	4	19.20 kBaud
	5	9.60 kBaud
	6	38.40 kBaud
		Reading head with SSI interface
	1	100 ... 1,000 kHz
		Reading head with CANopen interface
	1	125, 250, 500 kBaud, 1 MBaud
Data protocol		Reading head with RS 485 interface
	1	Data protocol 1, data protocol 2 (*)
	6	Data protocol 3 with even parity (9 Bit/Byte)
	7	Data protocol 3 without parity (8 Bit/Byte)
		Reading head with SSI interface
	0	Data output in binary code
	1	Data output in Gray code
		Reading head with CANopen interface
	0	Data output in binary code
Option(s)	h	Reading head with option heating
	S	Reading head with option velocity output
	d	Reading head with option integrated display
Reading head address		Reading head with RS 485 interface
	0	Reading head address 0
	1	Reading head address 1
	2	Reading head address 2
	3	Reading head address 3
	-	Reading head address 0

(*) Data protocol as per request byte to reading head

Information and installation hints for configuration of the reading head address can be downloaded from our website <http://www.pepperl-fuchs.com>.

Type summary for interface modules

WCS-I

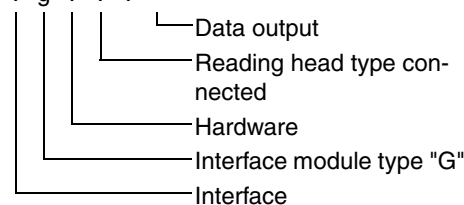


Reading heads type LS211 are connected to interface modules type "I".

Note: The "2" in types WCS-IS320 and IS321 means that a reading head type LS221-0 is connected.

Interface	P	Parallel interface
	S	Serial interface
Hardware		Parallel interface
	1	Push-pull output stage
		Serial interface
	2	InterBus-S
Terminating resistor	3	SSI
Data output	1	With RS 485 terminating resistor
	2	Without RS 485 terminating resistor
No. of reading heads	0	Binary code
	1	Gray code
	1	1 reading head can be connected
	2	1 ... 2 reading heads can be connected
	3	1 ... 3 reading heads can be connected
	4	1 ... 4 reading heads can be connected
	-	1 ... 2 reading heads can be connected

WCS-g



Interface	P	Profibus DP interface
	d	DeviceNet interface
	c	CANopen interface
	i	INTERBUS-S interface
	PN	ProfiNet
	MB	Modbus
Hardware	1	Hardware version 1
	2	Hardware version 2
Connection - type of reading head	0	Type LS 246
	1	Type LS 221
Data output	0	Binary code

Technical data

Code rail

WCS2	
Minimum radius of bend	500 mm
Length	0.1 ... 327 m
Height	55 mm or 70 mm
WCS3	
Minimum radius of bend	300 mm
Length	0.1 ... 314 m
Height	70 mm
Stainless steel code rail	
Material	X 12 Cr Ni 17 7
Thickness	0.5 mm
Weight	55 mm: 175 g/m 70 mm: 240 g/m
Storage and operating temperature	-40 °C ... 80 °C
Coefficient of thermal expansion	$1.6 \times 10^{-5} \text{ K}^{-1}$
Laminate code rail	
Material	Polyester laminate
Thickness	0,7 mm
Weight	55 mm: 30 g/m 70 mm: 40 g/m
Storage and operating temperature	-40 °C ... 60 °C
Installation temperature	10 °C ... 60 °C
Coefficient of thermal expansion	$2.8 \times 10^{-5} \text{ K}^{-1}$
Maximum bias force, stainless steel	
WCS2 code rail	55 mm: 4,500 N 70 mm: 6,500 N
WCS3 code rail	5,000 N
Maximum pretension force, laminate	
WCS2 code rail	55 mm: 230 N 70 mm: 340 N
WCS3 code rail	260 N

Mounting bracket

Mounting bracket	
Material	Galvanized steel sheet, thickness 2 mm
Temperature range	-40 °C ... 100 °C
Weight without fastening screws	Straight: 125 g for curves: 85 g

Stabilizing profile

Stabilizing profile for curves	
Material	PVC
Storage and operating temperature	-40 °C ... 60 °C
Weight	100 g/m

Aluminium profile system

Aluminium profile rail	
Material	Aluminium
Weight	WCS2 profile: 1,000 g/m WCS3 profile: 450 g/m
Temperature range	-40 °C ... 70 °C
Coefficient of thermal expansion	$2.4 \times 10^{-5} \text{ K}^{-1}$
Minimum radius of bend	WCS2: 1.000 mm WCS3: 700 mm
Joint for aluminium profile rail	
Material	Aluminium
Weight	100 g
Rail holder	
Material	WCS2: Polyamide WCS3: POM
Weight	20 g
Fixing cord	
Material	Polyethylene
Weight	5 g/m
Powder-coated version	
Film thickness	100 µm

WCS2 guide trolley

WCS2 guide trolley for aluminium profile system	
Material	Galvanized steel sheet
Weight	1000 g
Wheels	Diameter: 21.5 mm Wheels with ball-bearing (2RS bearings)
Temperature range	-30 °C ... 70 °C
Speed	Max. 8 m/s
Powder-coated version	
Film thickness	100 µm

BT111 bus terminal

BT111 bus terminal	
Housing	Aluminium
Weight	200 g
Protection to EN 60 529	IP 65
Operating temperature	-40 °C ... 70 °C
Relative humidity	90% at 20 °C, 50% at 40 °C, non-dewing
Connection	16-pole screw terminal
No. of PG glands	3
External diameter of connection cable	5 ... 9 mm

WCS2B / WCS3B reading head

WCS2B / WCS3B reading head	
Housing	Plastic
Weight	500 g
Protection to EN 60529	IP 54
Relative humidity	90% at 20 °C, 50% at 40 °C non-dewing
Operating temperature	0 °C ... 60 °C -40 °C ... 60 °C with heating facility
Operating voltage	10 ... 30 VDC
Power consumption	2 VA 9 VA with heating facility WCS2B 11 VA with heating facility WCS3B
Interference immunity	EN 61000-6-2
Emitted interference	EN 61000-6-4
Vibration resistance	EN 60068-2-6 sinus, 10...2,000 Hz, 5g, 10 cycles
Shock resistance	EN 60068-2-27 half-sinus, 30g, 18 ms
WCS2B	
Resolution	1,200 positions/m = 0.833 mm
Speed	Max. 12.5 m/s
WCS3B	
Resolution	1,250 positions/m = 0.80 mm
Speed	Max. 12.5 m/s

SSI interface

SSI interface	
Number of pulses	n = 25 or 26
Number of revs.	4,096, effective 512
Resolution/rev.	4,096, effective 1,024
Positional output	19 Bit binary code or 19 Bit Gray code
Rest period	tp = min. 20 µs
Double interrogation same pos. value	possible, if tp < 10 µs
Input signal (CLK)	
Input stage	Optocoupler input
Input voltage	± 3 ... 5 mA
Input current	7 ... 20 mA
Input frequency	100 ... 1,000 mA
Output signal (CLK)	
Switching type	RS 485
Output voltage	< 5 V
Output current	Max. 60 mm

Interface module

Interface module	
Housing	Plastic
Weight	200 g
Protection to EN 60 529	IP 20
Operating temperature	0 °C ... 40 °C
Relative humidity	90% at 20 °C, 50% at 40°C/ 55 °C, non-dewing
Operating voltage	24 VDC ± 20 %
Power consumption	2 VA (without reading head) 4 VA (InterBus-S, without reading head)
Interference immunity	EN 61000-6-2
Emitted interference	EN 55011, Cl. A
Vibration resistance	EN 60068-2-6 sinus, 10...500 Hz, 4g, 10 cycles
Shock resistance	EN 60068-2-27 half-sinus, 15g, 11 ms

Order information

Code rail

Designation	Order No.
WCS2 code rail	
WCS2 code rail, 55 mm, plastic laminate	WCS2-CS55-L1
WCS2 code rail, 70 mm, plastic laminate	WCS2-CS70-L1
WCS2 code rail, 55 mm, stainless steel	WCS2-CS55-M1
WCS2 code rail, 70 mm, stainless steel	WCS2-CS70-M1
WCS3 code rail	
WCS3 code rail, 70 mm, plastic laminate, without mounting bracket holes	WCS3-CS70-L0
WCS3 code rail, 70 mm, plastic laminate, with standard mounting bracket holes	WCS3-CS70-L1
WCS3 code rail, 70 mm, plastic laminate, with Vahle VKS mounting bracket holes	WCS3-CS70-L2
WCS3 code rail, 70 mm, stainless steel, with standard mounting bracket holes	WCS3-CS70-M1

Repair set for WCS3 code rail

Designation	Order No.
Repair set for WCS3 code rail	WCS3-CS70-REP

Tensioning device for stainless steel code rail

Designation	Order No.
Tensioning device for stainless steel code rail	WCS-MT1

Mounting bracket system for WCS code rail

Designation	Order No.
Mounting bracket, straight section	WCS-MB
Screw-on mounting bracket, straight section	WCS-MB1
Mounting bracket for C profile, straight section	WCS-MB2
Mounting bracket, bend	WCS-MB-B
Screw-on mounting bracket, bend	WCS-MB1-B
Mounting bracket for C profile, bend	WCS-MB2-B
Stabilising profile for WCS code rail (for mounting bracket, bend)	WCS-SP2
Powder-coated version	
Mounting bracket, straight section	WCS-MB-B-C
Mounting bracket for C profile, straight section	WCS-MB2-B-C

WCS2 aluminium profile system

Designation	Order No.
WCS2 aluminium profile complete with 55 mm laminate code rail and fixing cord	WCS2-CS55-L1-PS1 SET
WCS2 aluminium profile complete with 55 mm stainless steel code rail and fixing cord	WCS2-CS55-M1-PS1 SET
WCS2 aluminium profile rail	WCS2-PS1
Fixing cord	WCS-MF1
Connector	WCS2-MC1
Screw-on holder	WCS2-MH
Screw-on holder for screw connections	WCS2-MH1
Rail holder for installation in C profile rail	WCS2-MH2
Locking angle for aluminium profile rail	WCS2-LB1
Guide trolley for reading head	WCS2-GT09-P1
Optional cleaning brushes for guide trolley	WCS2-GT-BR
Fitting tools for WCS2 aluminium profile system	WCS2-FT1
Powder-coated version	
WCS2 aluminium profile powder-coated, complete with 55 mm stainless steel code rail and fastening cord	WCS2-CS55-M1-PS1-C SET
WCS2 aluminium profile powder-coated, complete with 55 mm laminate code rail and fixing cord	WCS2-CS55-L1-PS1-C SET
Rail connection for powder-coated aluminium profile rail made of stainless steel	WCS2-MC2
Locking angle for powder-coated aluminium profile rail	WCS2-LB1-C
Powder-coated guide care for reading head	WCS2-GT09-P1-C

WCS3 aluminium profile system

Designation	Order No.
WCS3 aluminium profile complete with 70 mm laminate code rail and fixing cord	WCS3-CS70-L1-PS1 SET
WCS3 aluminium profile complete with 70 mm stainless steel code rail and fixing cord	WCS3-CS70-M1-PS1 SET
WCS3 aluminium profile rail	WCS3-PS1
Fixing cord	WCS-MF1
Rail connection for aluminium profile rails	WCS3-MC1
Screw-on holder	WCS3-MH
Screw-on holder for screw connections	WCS3-MH1
Screw-on holder for installation in C profile	WCS3-MH2
Fitting tools for WCS3 aluminium profile system	WCS3-FT1

Interface modules

Designation	Order No.
Interface module with parallel interface Binary code, with RS 485 terminating resistor	WCS-IP110
Interface module with parallel interface Binary code, without RS 485 terminating resistor	WCS-IP120
Interface module with parallel interface Gray code, with RS 485 terminating resistor	WCS-IP111
Interface module with parallel interface Gray code, without RS 485 terminating resistor	WCS-IP121
Interface module with SSI interface For reading head type LS211, binary code	WCS-IS310
Interface module with SSI interface For reading head type LS211, Gray code	WCS-IS311
Interface module with SSI interface For reading head type LS221, binary code	WCS-IS320
Interface module with SSI interface For reading head type LS221, Gray code	WCS-IS321
Interface module with Profibus DP interface	WCS-PG210
Interface module with DeviceNet interface	WCS-DG210
Interface module with CANopen interface	WCS-CG210
Interface module with InterBus-S interface	WCS-IG110
Interface module with Profinet interface	WCS-PNG110
Interface module with Modbus-RTU interface	WCS-MBG110

WCS2B reading heads, selection

Designation	Order No.
Reading head with RS 485 interface, 187.5 kBaud With RS 485 terminating resistor	WCS2B-LS211
Reading head with RS 485 interface, 187.5 kBaud Without RS 485 terminating resistor	WCS2B-LS111
Reading head with RS 485 interface, 62.5 kBaud With RS 485 terminating resistor	WCS2B-LS221
Reading head with RS 485 interface, 62.5 kBaud Without RS 485 terminating resistor	WCS2B-LS121
Reading head with RS 485 interface, 19.2 kBaud Data protocol 3, with RS485 terminating resistor	WCS2B-LS246
Reading head with RS 485 interface, 19.2 kBaud Data protocol 3, without RS485 terminating resistor	WCS2B-LS146
Reading head with SSI interface Binary code	WCS2B-LS310
Reading head with SSI interface Gray code	WCS2B-LS311

Options for WCS2B reading heads

Designation	Order No.
Option heating	WCS2B-LS...H

WCS3B reading heads, selection

Designation	Order No.
Reading head with RS 485 interface, 187.5 kBaud, with RS 485 terminating resistor	WCS3B-LS211
Reading head with RS 485 interface, 187.5 kBaud, without RS 485 terminating resistor	WCS3B-LS111
Reading head with RS 485 interface, 62.5 kBaud, with RS 485 terminating resistor	WCS3B-LS221
Reading head with RS 485 interface, 62.5 kBaud, without RS 485 terminating resistor	WCS3B-LS121
Reading head with RS 485 interface, 19.2 kBaud, with RS485 terminating resistor, data protocol 3	WCS3B-LS246
Reading head with RS 485 interface, 19.2 kBaud, without RS485 terminating resistor, data protocol 3	WCS3B-LS146
Reading head with SSI interface, binary code	WCS3B-LS310
Reading head with SSI interface, Gray code	WCS3B-LS311
Reading head with CANopen interface	WCS3B-LS410
Reading head with RS485 interface, 62.5 kBaud with RS485 terminating resistor, with optional speed out- put and integrated display	WCS3B-LS221SD

Options for WCS3B reading heads

Designation	Order No.
Option heating	WCS3B-LS...H
Option integrated position display	WCS3B-LS...D
Option digital velocity output	WCS3B-LS...S

Spare parts for reading heads

Designation	Order No.
Liners with sealing (packaging unit = 2 pcs) for read- ing heads WCS2, WCS2A and WCS2B.	WCS2-PL2
Liners with sealing (packaging unit = 2 pcs) for read- ing heads WCS3 and WCS3A.	WCS3-PL2
Liners with sealing (packaging unit = 2 pcs) for WCS3B reading heads	WCS3B-PL2
Mounting plates for all types of reading head	WCS-MP1

Adapter cable

Designation	Order No.
M12 cable socket, 8-pole for plug, 6-pole Use for WCS2 - WCS2B and WCS2A - WCS2B, SSI interface	V19-G-1M-PUR-ABG-V423-G
M12 cable socket, 5-pole for SUBD plug, 9- pole Use for WCS3 - WCS3B and WCS3A - WCS3B, RS 485 interface	V15-G-0,5M-PUR-ABG-SUBD9
M12 cable socket, 8-pole for SUBD plug, 9- pole Use for WCS3 - WCS3B and WCS3A - WCS3B, SSI interface	V19-G-0,5M-PUR-ABG-SUBD9

Bus terminal and data cable WCS2 / WCS3

Designation	Order No.
Bus terminal with 3 PG glands	WCS-BT111
Flexible 6-core data cable (3 x 2) for RS485 and SSI interface (for stationary use)	WCS-DCS
Highly flexible 6-core data cable (3 x 2) for RS485 and SSI interface (for use as festoon cable)	WCS-DCF

An overview of the confectionable cable sockets M12 x 1 and screened connecting cables with cable sockets M12 x1 is rendered in page 48.

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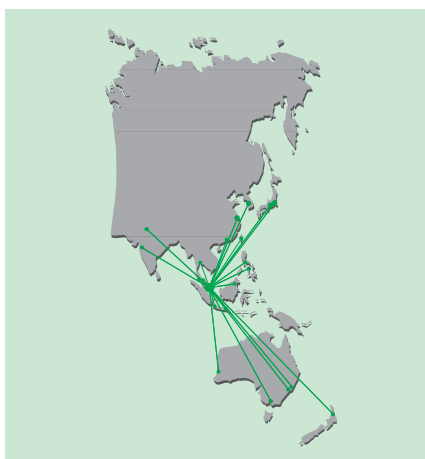
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