SIEMENS

SIMATIC NET

Description and Operating Instructions **Stand/ Dated / 1/00**

Order Number **6ZB5530-3AC30-0BA1**

PROFIBUS ILM (Infrared Link Module)

Im Nachfolgenden finden Sie Informationen in deutscher Sprache.

The following description contains information in English.

Hinweis / Note / Avertissement / Avvertenza / Indicatiòn

Achtung

Vor der Inbetriebnahme Hinweise in der entsprechenden aktuellen Dokumentation beachten. Die Bestelldaten hierfür entnehmen Sie bitte den Katalogen oder wenden Sie sich an Ihre örtliche SIEMENS-Niederlassung.

Die Inbetriebnahme ist solange untersagt, bis festgestellt wurde, daß die Maschine, in die diese Komponente eingebaut werden soll, den Bestimmungen der Richtlinie 89/392/EWG entspricht.

Attention

Prior to startup you must observe the notes in the relevant documentation. For ordering data of the documentation please refer to catologs or contact your local SIEMENS representative.

Startup must not take place until it is established that the machine, which is to accommodate this component, is in conformity the guideline 89/392/EEC.

Attention

Avant la mise en service, respecter les instructions de la documentation actuelle correspondante. Pour les références de commande de la documentation, veuillez-vous reporter aux catalogues ou consulter votre agence locale SIEMENS.

La mise en service est interdite tant que la machine dans laquelle est incorporé ce composant n'est pas conforme aux prescriptions de la directive 89/392/CEE.

Attenzione

Prima della messa in funzione, osservare attentamente le avvertenze riportate nella documentazione corrente. Per i dati di ordinazione consultare i cataloghi oppure rivolgersi alla locale fidale SIEMENS.

La messa in funzione è vietata fino a quando non è stato acctertato che macchina, in cui il componente deve essere installato, non rispetta le disposizioni della direttiva 89/392/CCE.

Atenciòn

Antes de la puesta en marcha observar las indicaciones contenidas en la documentatción actual correspondiente. La referencia de la misma puede consultarse en los catáloges o solicitarse a su agencia SIEMENS local.

Está prohibida la puesta en marcha hast comprobar que la máquina en donde ca a incorporarse este componente cumpie lo especificado en la directiva 89/392/CCE.

Wir haben den Inhalt der Druckschrift auf Übereinstimmung mit der beschriebenen Hardware geprüft. Dennoch können Abweichungen nicht ausgeschlossen werden, so daß wir für die vollständige Übereinstimmung keine Gewähr übernehmen. Die Angaben in der Druckschrift werden jedoch regelmäßig überprüft. Notwendige Korrekturen sind in den nachfolgenden Auflagen enthalten. Für Verbesserungsvorschläge sind wir dankbar.

Technische Änderungen vorbehalten.

We have checked the contents of this manual for agreement with the hardware described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcome.

Technical data subject to change.

Order Number

SIMATIC NET PROFIBUS ILM	6GK1 503-0AA00
Description and Operating Instructions	6ZB5530-3AC30-0BA1

Siemens AG
Infoservice
Abteilung A&D Z 533
Postfach 23 48
90713 Fürth

Germany

Note

We would point out that the contents of this product documentation shall not become a part of or modify any prior or existing agreement, commitment or legal relationship. The Purchase Agreement contains the complete and exclusive obligations of Siemens. Any statements contained in this documentation do not create new warranties or restrict the existing warranty.

We would further point out that, for reasons of clarity, these operating instructions cannot deal with every possible problem arising from the use of this device. Should you require further information or if any special problems arise which are not sufficiently dealt with in the operating instructions, please contact your local Siemens representative.

General

This device is electrically operated. Adhere strictly to the safety requirements relating to voltages applied to the device as described in the operating instructions!

WARNING!

Failure to heed warnings may result in serious physical injury and/or material damage. Only appropriately qualified personnel may operate this equipment or work in its vicinity. Personnel must be thoroughly familiar with all warnings and maintenance measures in accordance with these operating instructions. Correct and safe operation of this equipment requires proper transport, storage and assembly as well as careful operator control and maintenance.

Personnel qualification requirements

Qualified personnel as referred to in the operating instructions or warning notes are defined as persons who are familiar with the installation, startup and operation of this product and who possess the relevant qualifications for their work, e.g. B.:

- ➢ Training in or authorization for connecting up, grounding or labeling circuits and devices or systems in accordance with current standards in safety technology;
- ➢ Training in or authorization for the maintenance and use of suitable safety equipment in accordance with current standards in safety technology;
- ➢ First Aid qualification.

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1 The Product

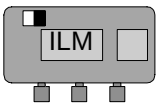
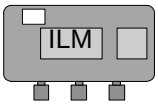
1 x PROFIBUS ILM

1 x sealing plugs for unused threaded cable inlet
1 x order form

Not included with the product are:

- ➢ Mounting brackets
- ➢ Cables for attaching to PROFIBUS or power supply cables
- ➢ Description and Operating Instructions

2 Symbols

	LAN cable (twisted pair)
	Bus connector terminating resistor deactivated
	Bus connector terminating resistor activated
	Active or (or passive) bus node
	Passive bus node
	Infrared link module (ILM) terminating resistor activated
	Infrared link module (ILM) terminating resistor deactivated
☞	Important information and notes
✓	“Sequence of actions” to be performed by the user.

3 Introduction

The SIMATIC NET PROFIBUS ILM (Infrared Link Module) is intended for use in PROFIBUS networks. It allows the conversion of electrical PROFIBUS interfaces (RS 485 level) into transmittable light signals in the infrared, invisible wavelength range and vice-versa.

With the PROFIBUS ILM, it is possible to link an existing PROFIBUS network with a second PROFIBUS network without a physical cable connection between the two subnets (electrical cables or fiber-optic cable).

The PROFIBUS ILM is therefore particularly suitable for cableless links with the following:

- ➢ Turntables
- ➢ Automatic transport systems
- ➢ Modifiable test equipment

The transmission is optical and therefore depends on line-of-sight contact between two PROFIBUS ILMs. Apart from point-to-point links, point-to-multipoint links are also possible.

At least two PROFIBUS ILMs are necessary for a transmission link.

4 Description of the Device

Each PROFIBUS ILM has an optical and an electrical channel each with a transmitter and receiver section.

The sending PROFIBUS node generates an electrical signal with RS 485 level that is transferred via the PROFIBUS cable to the PROFIBUS ILM of the sending PROFIBUS node. The PROFIBUS ILM converts this electrical signal to a coded light signal. This coded light signal is detected by the optical receiver of the PROFIBUS ILM of the receiving PROFIBUS node. After filtering and decoding, an electrical signal is available on the receiving PROFIBUS ILM that is then transferred via the PROFIBUS cable to the receiving PROFIBUS node.

The data transmission is half duplex as normal in PROFIBUS, in other words at any point in time only one node can send while all others receive. Each node can, however, send and receive.

A wireless link between PROFIBUS ILM and data light barriers of other manufacturers is not possible due to the differences in the optical transmission techniques.

The electrical channel of the PROFIBUS ILM uses the RS 485 transmission technique which is typical for PROFIBUS and processes the standard data rates of 9600 bps to 1.5 Mbps. The data rate must be set by the user.

The electrical channel is connected via SIMATIC NET PROFIBUS cables (for ordering data, see Catalog IK10). The cables enter the casing via heavy-duty threaded cable inlets. The shield makes contact here and the wires are connected using screw-type terminals.

The PROFIBUS ILM can be used at any position in an electrical PROFIBUS network. When it is connected at the end of a segment, the user must activate a terminating resistor.

The operating voltage is an intrinsically safe 24 V direct voltage and is connected just as the PROFIBUS cables by feeding the cable through a heavy-duty threaded cable inlet to a terminal block.

LEDs signal the correct operating status and any problems in operation.

Problems occurring during operation can also trigger a signaling contact allowing centralized monitoring of a system.

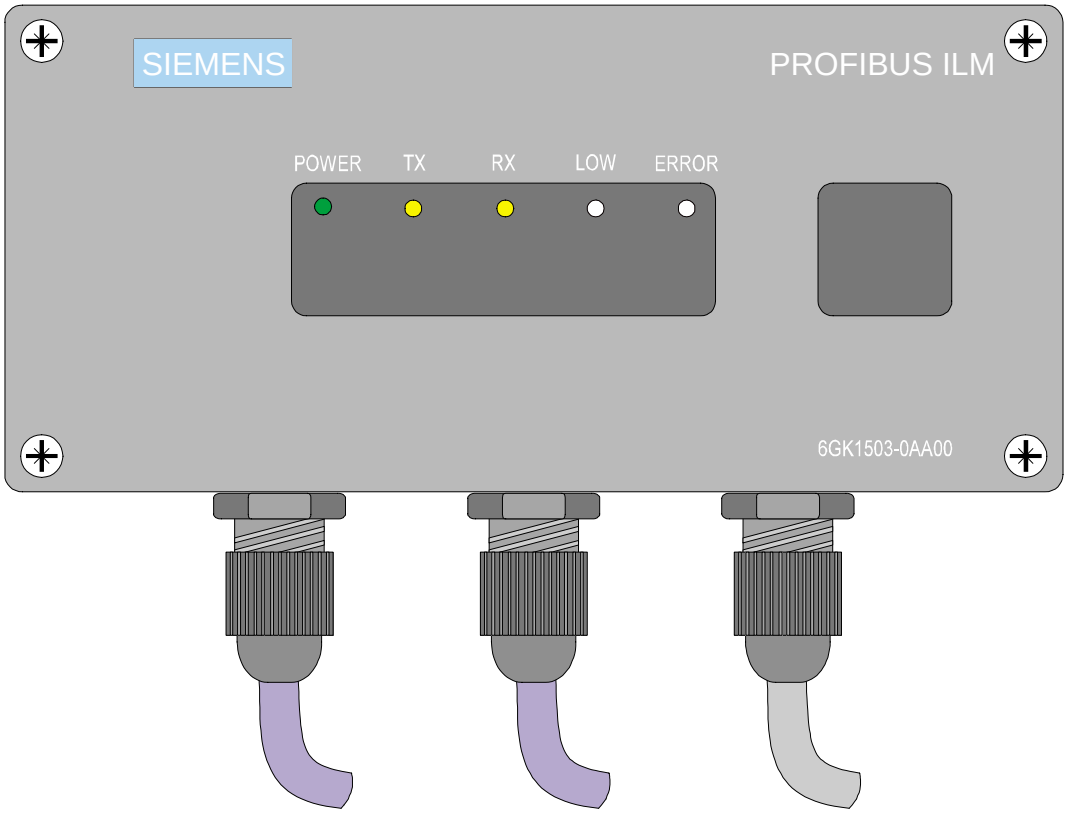


Figure 1: PROFIBUS ILM

The mechanical construction is a compact, stable metal housing (splash-water protected) with degree of protection IP65. The casing must be mounted by the user on a grounded surface with two screws. **When shipped, the data rate is set to 1.5 Mbps, the signaling contact is not activated if errors occur and the terminating resistor is not activated.**

5 Description of the Functions

5.1 Transmission Rate

The SIMATIC NET PROFIBUS ILM supports the following transmission rates:

9.6	Kbps
19.2	Kbps
45.45	Kbps
93.75	Kbps
187.5	Kbps
500	Kbps
1.5	Mbps (default)

The transmission rates of the connected network nodes can have the tolerance of +/–0.3% as specified in the PROFIBUS standard.

5.2 Topologies

The PROFIBUS ILM can be used in two topologies:

- The point-to-point link between two PROFIBUS ILMs where **one or more master or slave nodes can be attached to one subnet** and **one or more slave nodes can be attached to the other.**
- The point-to-multipoint link between a PROFIBUS ILM to which **a subnet with one or more masters or slaves** is connected and n PROFIBUS ILMs **with n subnets or DTEs without master functionality**. In a point-to-multipoint link, the optical contact between the master network and the subnets is necessary. For a PROFIBUS ILM with purely slave subnets, an unobstructed view between them is not necessary.

Possible topologies are illustrated below based on sample configurations.

5.2.1 Point–to–Point–Link

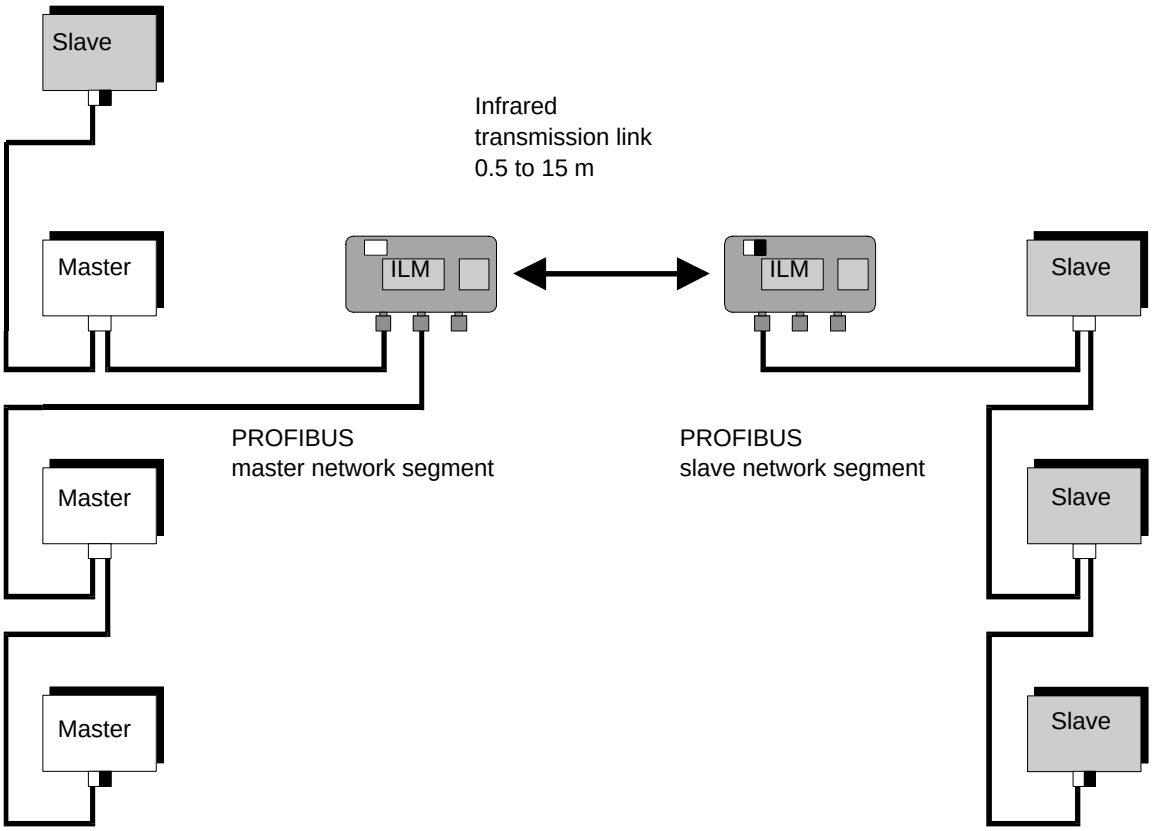


Figure 2: Point-to-Point Link with Two PROFIBUS ILMs

Figure 2 describes the typical layout of a PROFIBUS network with master and slave nodes and an infrared transmission link with two PROFIBUS ILMs. The infrared transmission link is implemented as a point-to-point link by the two PROFIBUS ILMs. In this situation, the two PROFIBUS ILMs replace a cable connection between the two network segments. Remember that only slave nodes are permitted in the slave network segments.

☞ **Make sure that the terminating resistors are activated at the segment ends (either in the bus connector or in a PROFIBUS ILM).**

Cascading is a further application for a point-to-point link.

Note

This “cascading with PROFIBUS ILM” mode is possible, but does involve a risk when operating PROFIBUS. The transmission using an infrared link is generally more susceptible to problems than transmission via cable (optical or electric).

☞ **Make sure that the infrared link cannot be disturbed, for example by “interrupting” the link with obstacles, extraneous light etc.**

When cascading with PROFIBUS ILM, only one segment with master nodes is permitted, the cascaded segments must only contain slave nodes.

☞ **Make sure that the two infrared transmission links do not interfere with each other, in other words either the spatial arrangement of the modules (clearance) or a physical barrier (wall) must ensure that each PROFIBUS ILM can only detect the transmission of its partner module and cannot detect emissions from either of the modules of the other infrared link.**

Note

When cascading, the delay times of the PROFIBUS ILMs must be taken into account. The delay times are shown in Table 3 and must be included in the calculations during configuration.

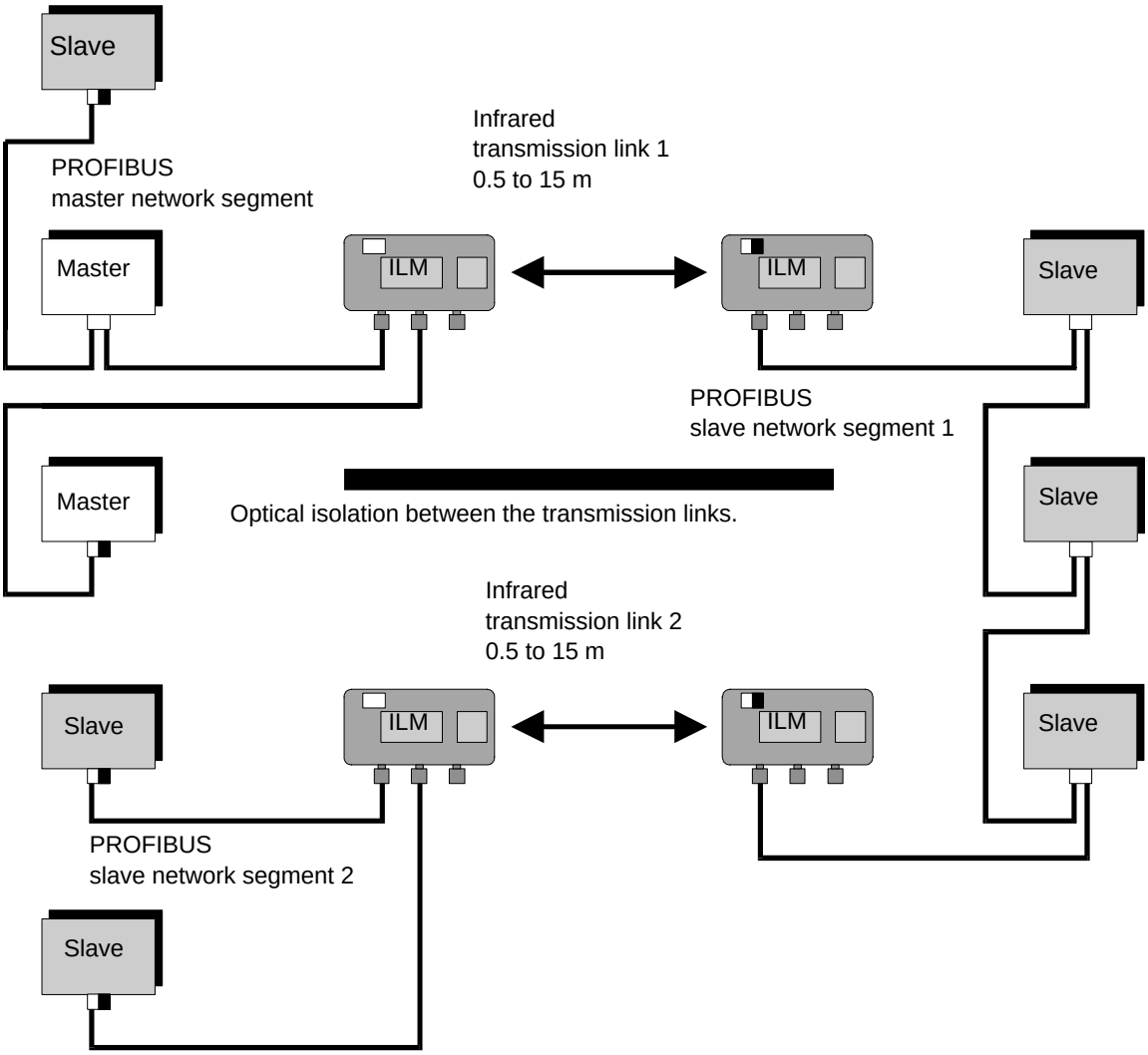


Figure 3: Cascading Two PROFIBUS ILM Transmission Links

A further application of a point-to-point link is described below. Figure 4 shows how several slave network segments can be connected to one master network segment using their own infrared transmission links.

☞ **Once again, make sure that the infrared transmission links do not interfere with each other, in other words either the spatial arrangement of the modules (clearance) or a physical barrier (wall) must ensure that each PROFIBUS ILM can only detect the emission of its partner module and cannot detect emissions from the modules of the other infrared links.**

If this is not guaranteed, this can lead to problems in the master network segment. The response of a slave node is detected at slightly different times in the master segment due to the unsynchronized operation of the PROFIBUS ILM causing pulses to be lost on the master network segment.

The advantage of this arrangement is that if there is a problem on an infrared link between two PROFIBUS ILMs, only the connected slave segment is disconnected. The master network segment and the other slave network segments retain their functionality. This topology is also suitable when the PROFIBUS ILMs of the slave network segments cannot be arranged so that they are all located in the light cone of the PROFIBUS ILM on the master network segment.

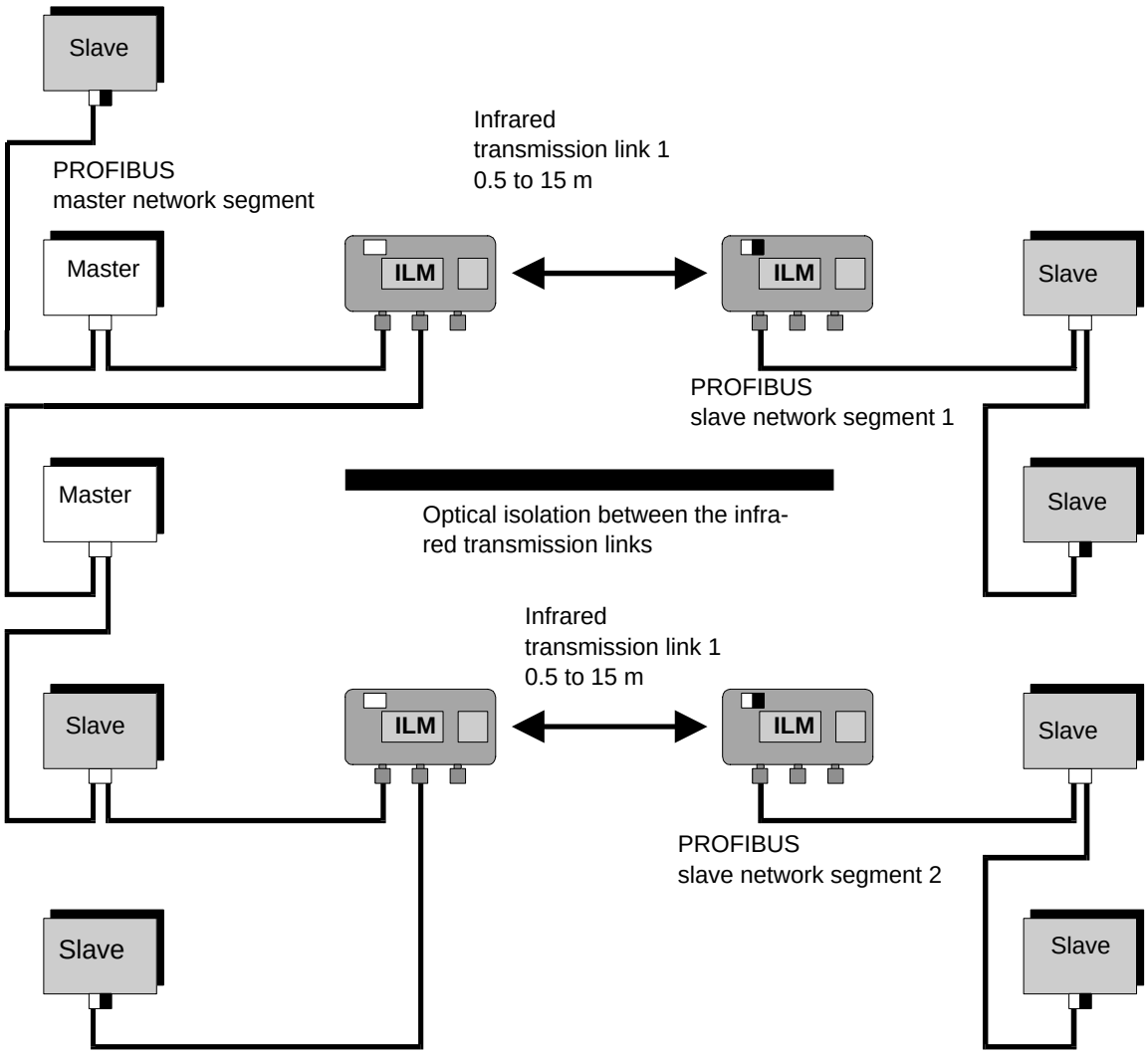


Figure 4: Link Between Several Slave Network Segments and One Master Network Segment

5.2.2 Point–to–Multipoint Link

Instead of the multiple use of point-to-point links, the point-to-multipoint link can also be used. Optical isolation between the infrared transmission links is not necessary. If the configuration is correct, only one slave node responds to the request of a master node and because there is only one PROFIBUS ILM on the master network segment, there are no synchronization problems with the response.

The advantage of this arrangement is that with n slave segments only n + 1 PROFIBUS ILMs are required.

The disadvantages of this arrangement are not only the restrictions in the arrangement of the slave PROFIBUS ILMs to a solid angle of +/–10 degrees but also from the point of view of the master PROFIBUS ILM the poorer monitoring of the link because the acknowledgment pulse mechanism cannot be used (see Section 5.6.2).

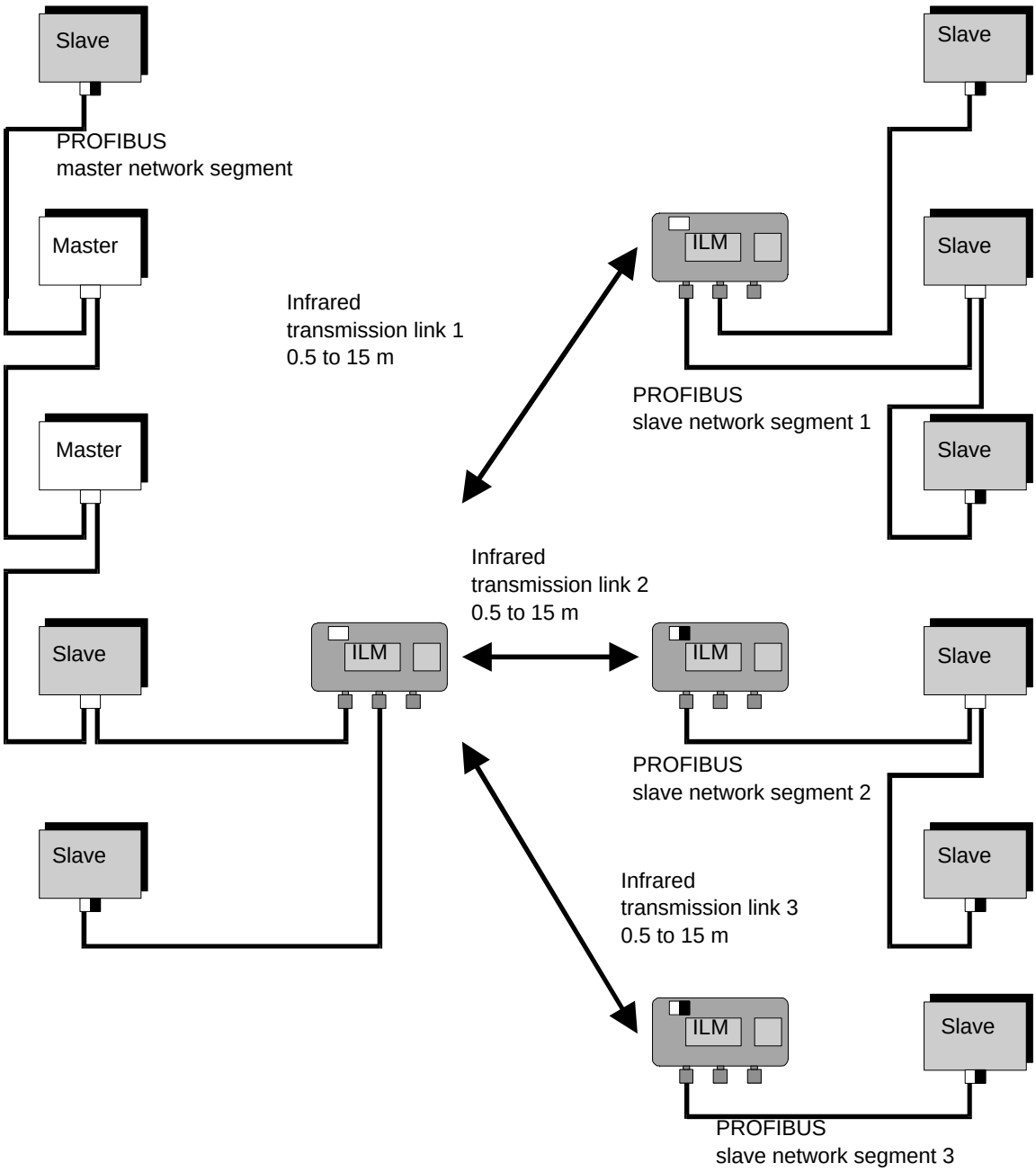


Figure 5: Point-to-Mulitpoint Link with n + 1 PROFIBUS ILMs (One Master Subnet, 3 Subnets with Slaves)

5.3 Signal Regeneration

The PROFIBUS ILM regenerates the signal shape and amplitude of the received signals. This makes it possible to cascade unconnected network segments using infrared transmission links. Since the PROFIBUS ILM, however, has a delay time for processing and passing on the signal the delay on the PROFIBUS ILM must be taken into account. If fast response times are required in a DP system, cascading must be restricted depending on the remaining network length and other active components in the network (repeaters, OLMs).

5.4 Monitoring the Received Optical Level

The PROFIBUS ILM monitors the received level when receiving data via the infrared link. The receive level is compared with a fixed reference value. If the level falls below this reference value during reception, the red **”LOW”** LED is always lit. With suitable configuration, the user can also trigger the signaling contact in this situation.

The reference value corresponds to 1.4 x the minimum receive level. This situation (1.4 x the minimum receive level) applies when the distance between the sending and receiving PROFIBUS ILM is 80 to 85% of the maximum distance in this direction.

In the optical axis (receiver and sender are directly opposite and turned through exactly 180 degrees to each other) the maximum distance is 15 m, in other words at approximately 12 m to 13 m between the sending and receiving PROFIBUS ILMs, the received optical level is still 1.4 times the minimum receive level. A reserve of 2 to 3 m remains along the optical axis. This reserve is however drastically reduced if the position of one of the PROFIBUS ILMs is changed in such a way that it is moved out of the optical axis (if the PROFIBUS ILM is moved sideways or turned). When close together, a displacement of only a few centimeters vertically away from the optical axis can lead not only to the level monitoring responding but also to errors on the bus.

5.5 Constant Light Monitoring

To transmit data, the PROFIBUS ILM uses infrared light as emitted by other energy sources. If the received light exceeds a certain intensity, the working range of the receiving diode is exceeded and errors in the data can occur. The infrared wavelength used cannot be seen by the human eye.

The PROFIBUS ILM therefore indicates when other light sources subject it to an illegally high infrared radiation by lighting up the red **”ERROR”** LED. The user can also configure a switch to activate the signaling contact in this situation.

5.6 Monitoring the Optical Link

The PROFIBUS ILM has two mechanisms with which it monitors problems on the optical link.

– monitoring of the optical receive activity

– monitoring of the optical link with an acknowledgment pulse

5.6.1 Monitoring the Optical Receive Activity

With the yellow “RX” LED, the PROFIBUS ILM indicates the reception of data via the optical channel of the PROFIBUS ILM. The pulse for the LED is extended to approximately 300 ms so that it is possible to recognize data reception even when small amounts of data are received.

Apart from the optical display using the “RX” LED, the PROFIBUS ILM also has integrated monitoring logic that triggers the signaling contact when problems occur receiving data on the optical channel provided the user configures this function with a switch. Problems in reception on the optical channel occur when there has been no change in the status of the optical receive channel for a period of approximately 300 ms, in other words when no message was received within 300 ms or a received message takes longer than 300 ms.

Note

The “activate signaling contact if problems occur in reception” configuration should not be set on the PROFIBUS ILM in the master subnet if its partner ILM only has one slave node that is not addressed during this time.

5.6.2 Monitoring the Optical Link with an Acknowledgment Pulse

During configuration, the user can activate a mechanism so that an acknowledgment pulse is expected from the receiving station after data have been sent. This acknowledgment must be received within the time set as the interval between sending and transmitting on PROFIBUS (11 bit times). This acknowledgment pulse is not passed on to the electrical channels of the sending or receiving PROFIBUS ILM but is restricted exclusively to the optical transmission link.

Note

The “monitor link with acknowledgment pulse” configuration must be activated on both PROFIBUS ILMs of a point-to-point link.

This monitoring logic must not be used on a point-to-multipoint link. Otherwise problems can occur in the PROFIBUS network.

The display of the acknowledgment pulse function is one of the functions of the “TX” LED. With the yellow “TX” LED, the PROFIBUS ILM indicates that data are being sent on the optical channel of the PROFIBUS ILM. The pulse for the LED is extended to approximately 300 ms so that send activity can also be recognized with short data fields.

➢ If an acknowledgment is received for a sent frame and the “monitor link with acknowledgment pulse” configuration is set, the “TX” LED is lit yellow.

➢ If no acknowledgment is received and the “monitor link with acknowledgment pulse” configuration is set, the “TX” LED changes color from yellow to orange. The pulse for this display is also extended to 300 ms so that a lost acknowledgment can also be recognized by the user.

The user can also configure a switch to activate a signaling contact. The signaling contact remains inactive unless the “monitor link with acknowledgment pulse” configuration was set.

6 Modes and Settings

To operate the PROFIBUS ILM, **the terminating resistor**, **the data rate and the monitoring options must be set manually**.

Note:

When shipped, the configuration is as follows:

- ➢ The terminating resistor is inactive
- ➢ The data rate is set to 1.5 Mbps
- ➢ The “monitor link with acknowledgment pulse” monitoring mechanism is inactive.
- ➢ The activation of the signaling contact is disabled.

The settings can be made after removing the cover from the basic module using switches S201 (transmission rate and monitoring mechanisms) and S202 (terminating resistor).

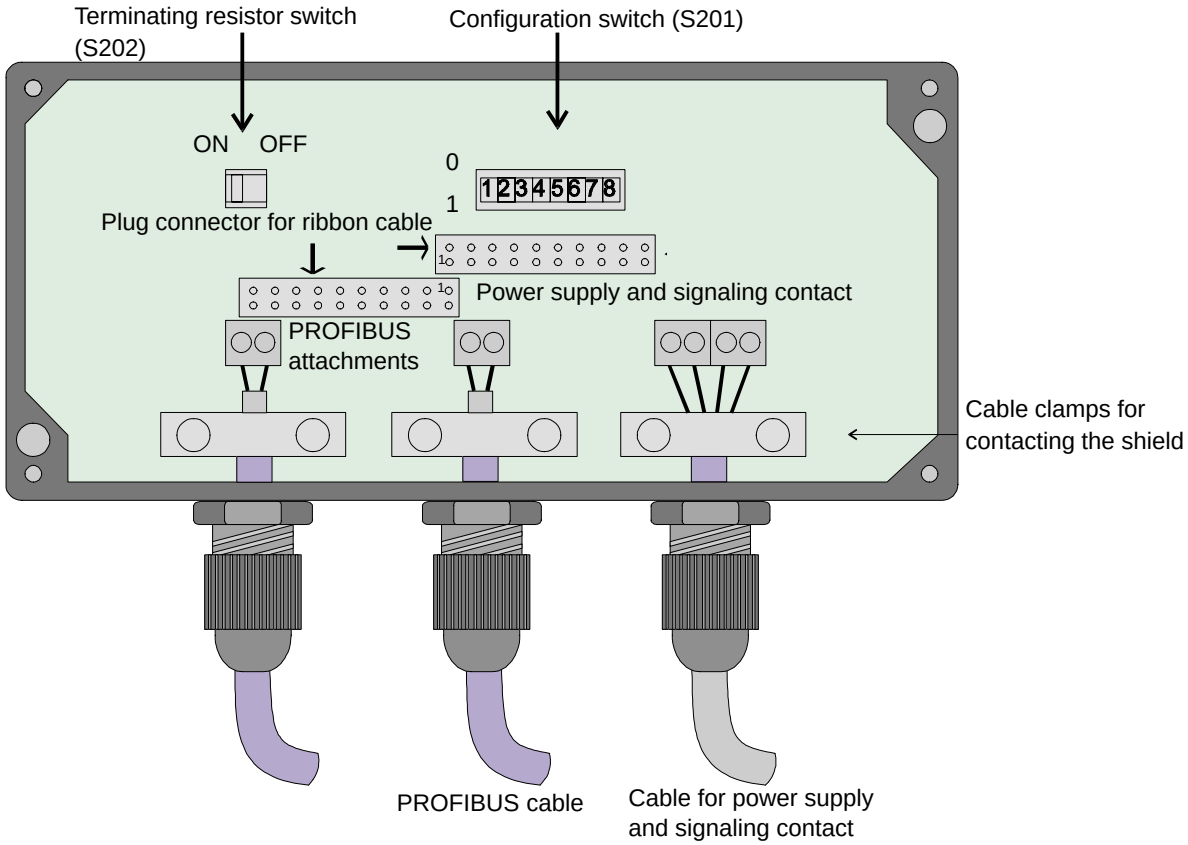


Figure 6: Elements for Setting the Configuration of the PROFIBUS ILM

6.1 Setting the Terminating Resistor

Electrical cables in a PROFIBUS network must be terminated with the characteristic impedance of the cable at the start and end of the bus. Switch S202 is used for this purpose on the basic module of the PROFIBUS ILM.

Note

Note that the switch must be set to “terminating resistor activated” if a PROFIBUS ILM is located at the start or end of an electrical PROFIBUS network (only one PROFIBUS cable connected).

The switch must be set to “terminating resistor deactivated” if a PROFIBUS ILM is looped into a PROFIBUS network (two PROFIBUS cables connected).

If the terminating resistor is not set correctly, sporadic errors will occur on PROFIBUS that cannot be detected by the PROFIBUS ILM.

Terminating resistor off

Terminating resistor on

Figure 7: Setting the Terminating Resistor

6.2 Setting the Transmission Rate

To operate the PROFIBUS ILM, the **transmission rate must be set manually**. The transmission rates normal in PROFIBUS (9,6 Kbps to 1.5 Mbps) are possible and in addition also the transmission rate of 45.45 Kbps. The transmission rate of the attached bus nodes must be within the tolerance of +/– 0.3%. The user must set the same transmission rate on all PROFIBUS ILMs in a PROFIBUS network.

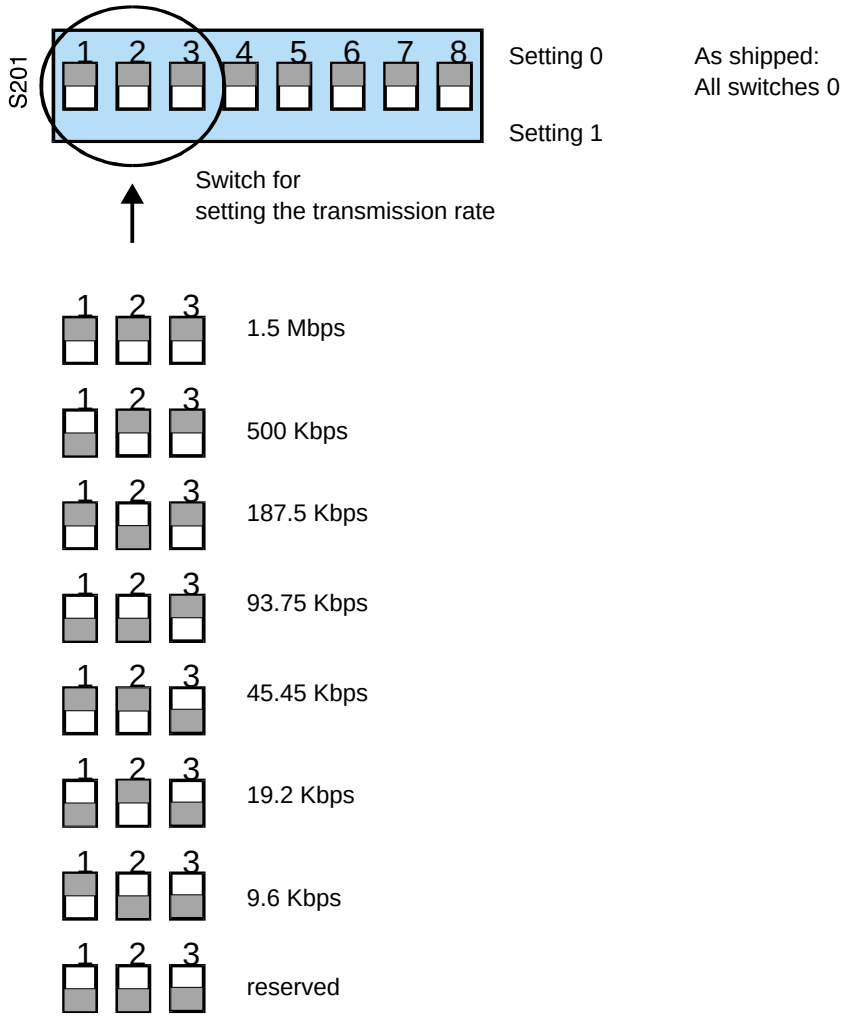


Figure 8: Setting the Transmission Rate

6.3 Operation With Acknowledgment Pulse

For operation of the PROFIBUS ILM with acknowledgment pulses, a manual setting must made during configuration. Operation with acknowledgment pulse is only intended for the use of point-to-point links between two PROFIBUS ILMs.

Note

If a point-to-multipoint topology is being used, this mechanism must be deactivated otherwise problems can occur on the bus.

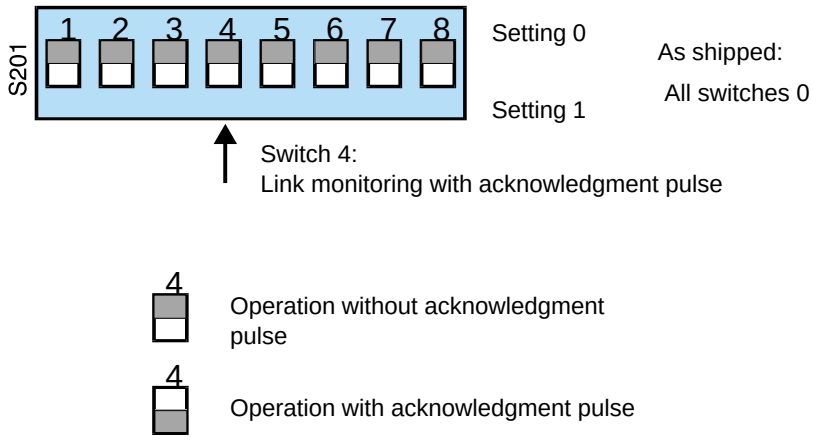


Figure 9: Operation with Acknowledgment Pulse and the Corresponding Switch Setting

6.4 Operation with Signaling Contact

The signaling contact is used to monitor the PROFIBUS ILM via a digital input on a PLC or as part of a current loop. **If problems occur the contact opens**, in other words a connected current loop is then interrupted. By setting four switches, the user decides which events trigger the signaling contact. If more than one problem is configured to trigger the signaling contact, the problem cannot be localized using the signaling contact alone. In this case, the LED displays can also provide information and step-by-step disabling of the switches that activate the signaling contact can narrow down the problem.

Note

Remember that if you want to activate the signaling contact when the acknowledgment pulse is absent, the “monitor link with acknowledgment pulse” configuration must be activated.

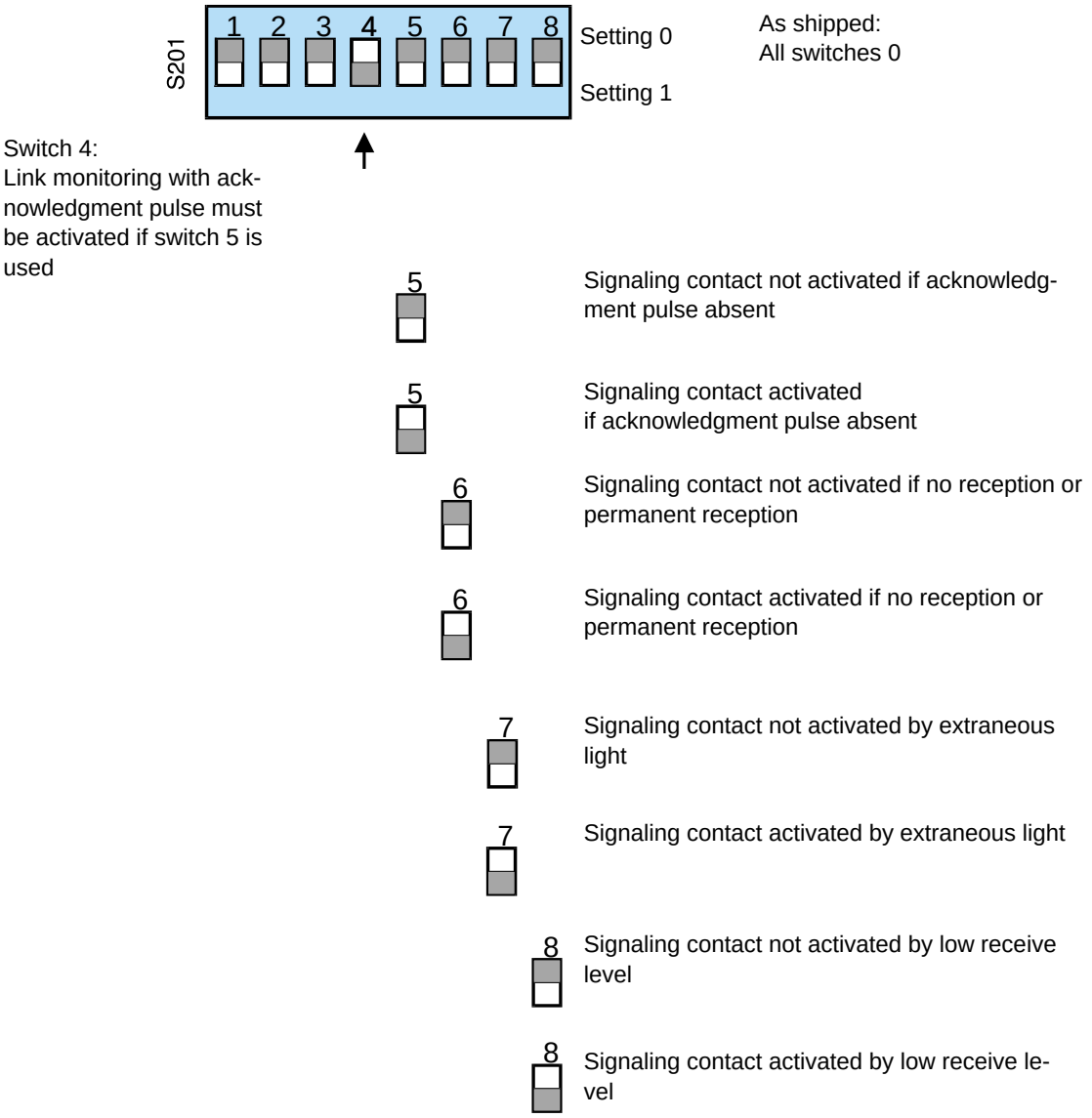


Figure 10: Configuration for Triggering the Signaling Contact

7 Installation and Startup

7.1 Notes on Safety

➢ Use the PROFIBUS ILM only as described in this “description and operating instructions”.

➢ Never connect the PROFIBUS ILM to the mains power supply 110 V – 240 V.

➢ In particular, take note of all the warnings and notes relating to safety.

➢ The operating voltage must be a safety extra-low voltage complying with IEC 950/EN 60 950/VDE 0805 of maximum +30V (typically + 24 V). According the CUL approval you should connect the PROFIBUS ILM only at the load side of a Class 2 or Class 3 Power source as defined by the National Electric Code (NEC), Article 725–2 and the Canadian Electrical Code (CEC).

➢ The voltage connected to the signalling contact must be a safe extra-low voltage complying with IEC 950/EN 60 950/ VDE 0805 According the CUL approval you should connect the signalling contact only at the load side of a Class 2 or Class 3 power source as defined by the National Electric Code (NEC), Article 725–2 and the Canadian Electrical Code (CEC).

➢ Wiring the PROFIBUS ILM, pay attention to the wiring methods described in NEC article 725–52, 725–54, 725–61 and 725–71.

➢ Select a site to install the module so that the climatic limit values listed in the technical specifications are not exceeded.

➢ The device emits infrared light in the non-visible range. According to the currently valid regulations, the PROFIBUS ILM is included in the class of devices subject to the regulations covering laser protection IEC 60 825–1 although the device does not include laser equipment. The emitted infrared power is below the limit values of laser protection class 1.

7.2 General Notes on Installation and Startup

First, select the network topology suitable for your system.

You can then install and start up the PROFIBUS ILM step-by-step as shown below:

✓ Check the area for suitable sites where you can install the modules.

✓ Make mounting brackets suitable for the sites you have chosen. Chapter 8 describes an example of a general-purpose support consisting of two identical mounting brackets that are easy to make.

✓ Remove the four cover screws and disconnect the 20-pin ribbon cable from the basic module and then remove the top panel of the PROFIBUS ILM.

☞ **Caution:**
Disconnect the cable by pulling out the connector, do not pull the cable itself !
Do not touch the electronics module in the top panel !
Do not loosen the screws securing the electronics module !

✓ Mount the PROFIBUS ILM on the support or device using two screws.

✓ Ground the PROFIBUS ILM with low resistance.

✓ Connect the PROFIBUS cable(s) and the power supply and signaling contact cable. In awkward locations, it is sometimes better to connect the cables before actually mounting the modules.

✓ Depending on your bus topology, activate or deactivate the terminating resistor (active when the ILM is at the end of the cable, deactivated if the ILM is looped into the cable),

✓ Set the transmission rate configured in the PROFIBUS network to the same setting on all PROFIBUS ILMs of a PROFIBUS network using the switches.

✓ Set the “monitor link with acknowledgment pulse” mode for a point-to-point link, if required.

✓ Set the errors to trigger the signaling contact using the switch if you want to use the signaling contact for monitoring.

✓ Plug in the ribbon cable of the electronics section into one of the coded plug connectors on the basic module. The plug connectors are coded to prevent reverse polarity.

✓ Replace the top cover of the PROFIBUS ILM using the four cover screws.

✓ Align the PROFIBUS ILM to the partner station so that the emission of the PROFIBUS ILM is along the optical axis to the partner ILM.

✓ Test the arrangement with power applied but without data exchange.

Only the green POWER LED must be lit.

✓ Test the transmission link with data exchange.

The yellow TX and RX LEDs should be lit as well as the green power LED.

The red “ERROR” LED must not be lit since this indicates too much extraneous light which always causes

transmission errors.

The red “LOW” LED should only be lit when the level on the infrared link is close to the minimum receive level (operation at the edge of the illumination cone).

✓ Check the data exchange for incorrect data using SCOPE for PROFIBUS (TMG i-tec), a tool for diagnostics on PROFIBUS networks.

8 Installing the PROFIBUS ILM

The PROFIBUS ILM can be mounted with two screws on a flat surface (approximately 180 x 80 mm). This can be a wall, a mounting plate or the surface of a device or vehicle.

The holes in the PROFIBUS ILM are intended for screws with a thread diameter of maximum 4.5 mm and a screw head diameter of maximum 8.5 mm.

Figure 11 shows the location of the holes drilled in the ILM.

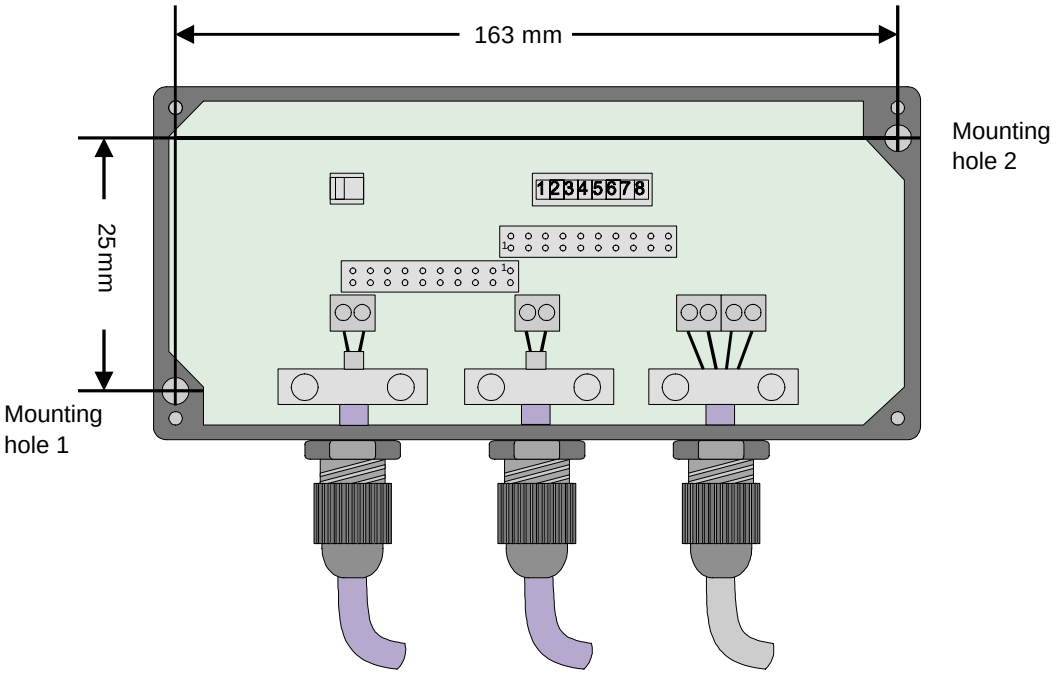


Figure 11: Dimensions for Securing the PROFIBUS ILM to a Mounting Plate

Select the site for installing the module so that the climatic limit values and mechanical stress values as described in the technical specifications are adhered to. When installing the module, make sure, in particular, that no direct sunlight falls on the device otherwise both the temperature range of the device (maximum 60°C) and the light intensity in the infrared range will be exceeded and cause functional problems. It is advisable to protect the device with a “sunshade” making sure that it cannot subjected to direct sunlight even when the sun is extremely low.

Note

Make sure that there is sufficient space to connect the bus and power supply cables. The cables must not extend into the area of the send and receive window.

Make sure that there are no infrared sources in the illumination cone in front of a PROFIBUS ILM. There should also be no reflecting surfaces in any part of the illumination cone to avoid reflecting back the modules own emission.

Before mounting the PROFIBUS ILM, connect the power supply and PROFIBUS cables if the site where the module is being installed is awkward to reach.

Mount the PROFIBUS ILM on a low-resistance and low-inductance earthed metal wall, support or mounting plate. Make sure that there is a reliable electrical connection between the ILM casing and the mounting plate. Use toothed washers under the screw heads to break through any paint. Secure the modules with machine screws (for example M 4 x 30).

The most suitable way of mounting the PROFIBUS ILM is to use a support that allows the module to be aligned with the partner station.

A suitable support would be as follows:

- Mechanically stable
- Low-resistance and low-inductance connection to ground or the vehicle chassis
- Adjustable so that optimum alignment along the optical axis to the partner station is possible.
- Simple and cheap to make
- Corrosion-proof depending on the characteristics of the installation site.

One possible design of a support is the mounting angle shown in Figure 12. This can be made easily in any workshop (cutting sheet metal, bending, drilling). Each support requires two identical angles to allow adjustment in two axes.

The angles are bolted together with standard components such as M4 or M6 bolts, washers or toothed washers and M4 and M6 nuts.

3 mm thick sheet aluminum is, for example, suitable or galvanized 2 mm sheet steel. If suitable profile material is available, this makes construction even simpler since it is not necessary to bend the arm.

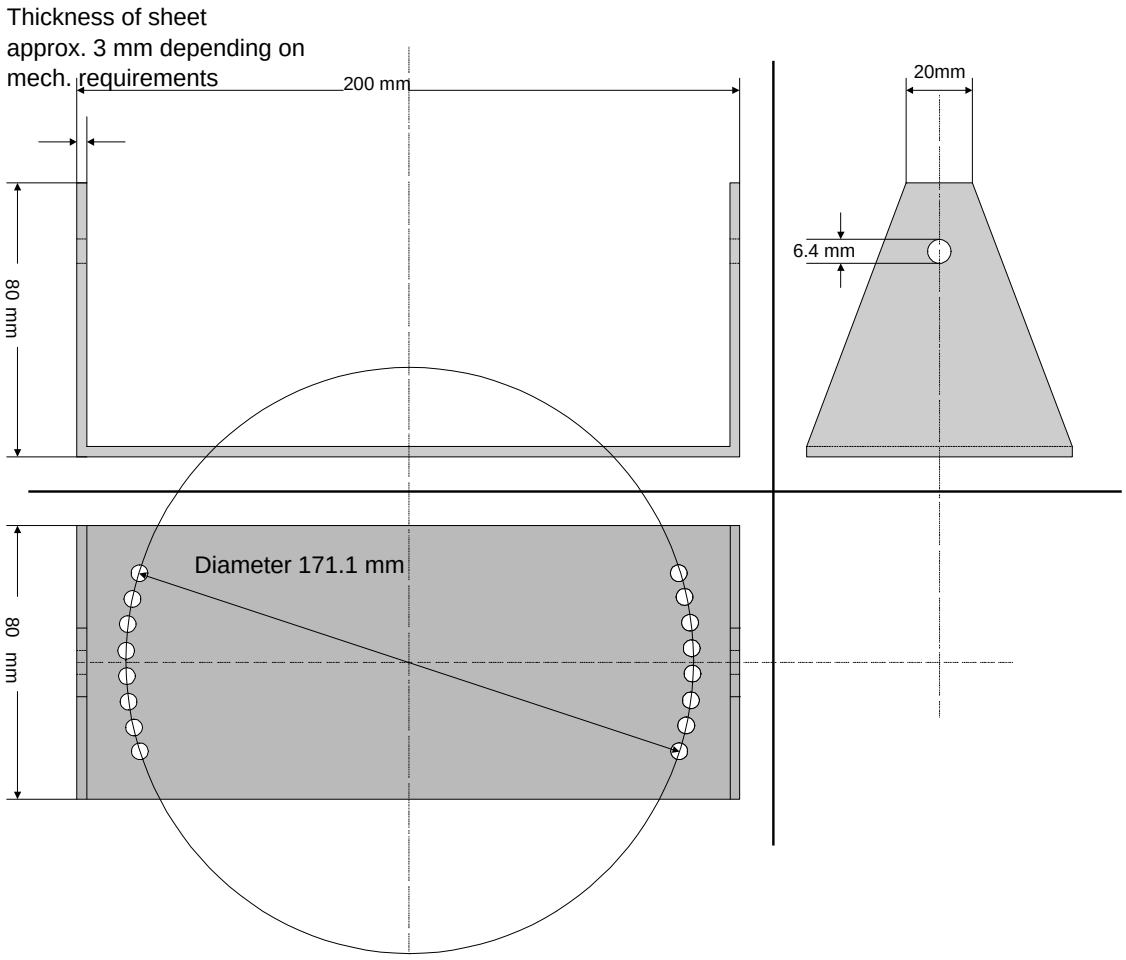
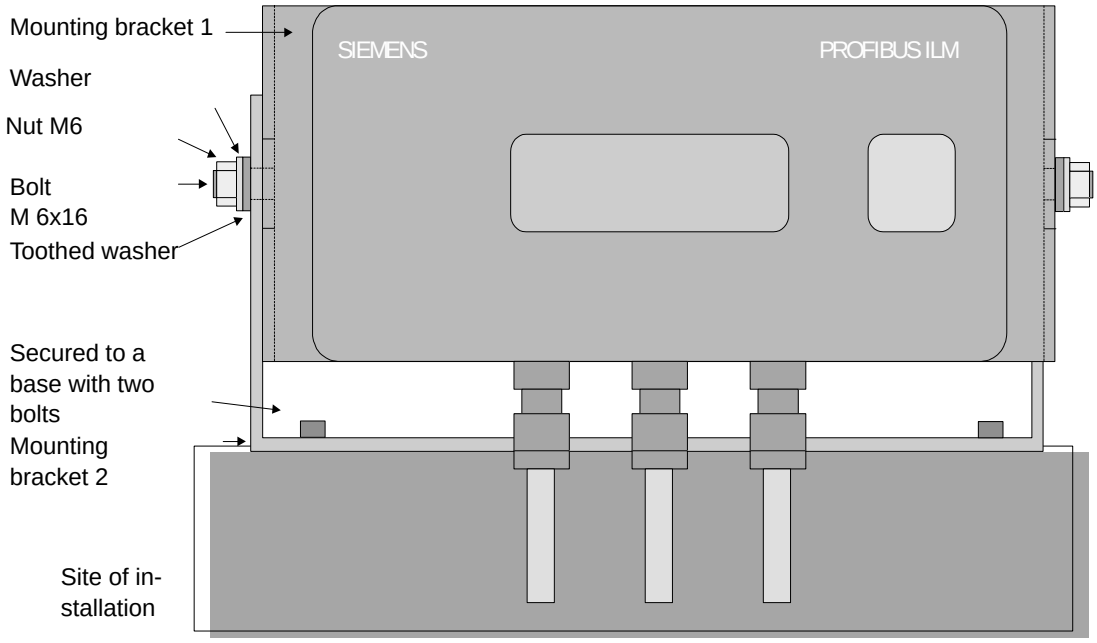


Figure 12: Example of a Simple Mounting Bracket

Instead of drilling individual holes in a circular arc with a diameter of 171.1 mm with 4.5 mm diameter pairs of holes opposite each other, you can also cut two arc-shaped slits in the plate.This requires a cutting device but has the advantage that the ILM can be aligned continuously and therefore more accurately on the vertical axis during operation.

The finished construction of the support with two mounting angles and the securing of the PROFIBUS ILM is described in Figures 13 to 15.



Installation of the ILM with a mounting bracket
front view

Figure 13: Front View of the PROFIBUS ILM Installed with Mounting Brackets

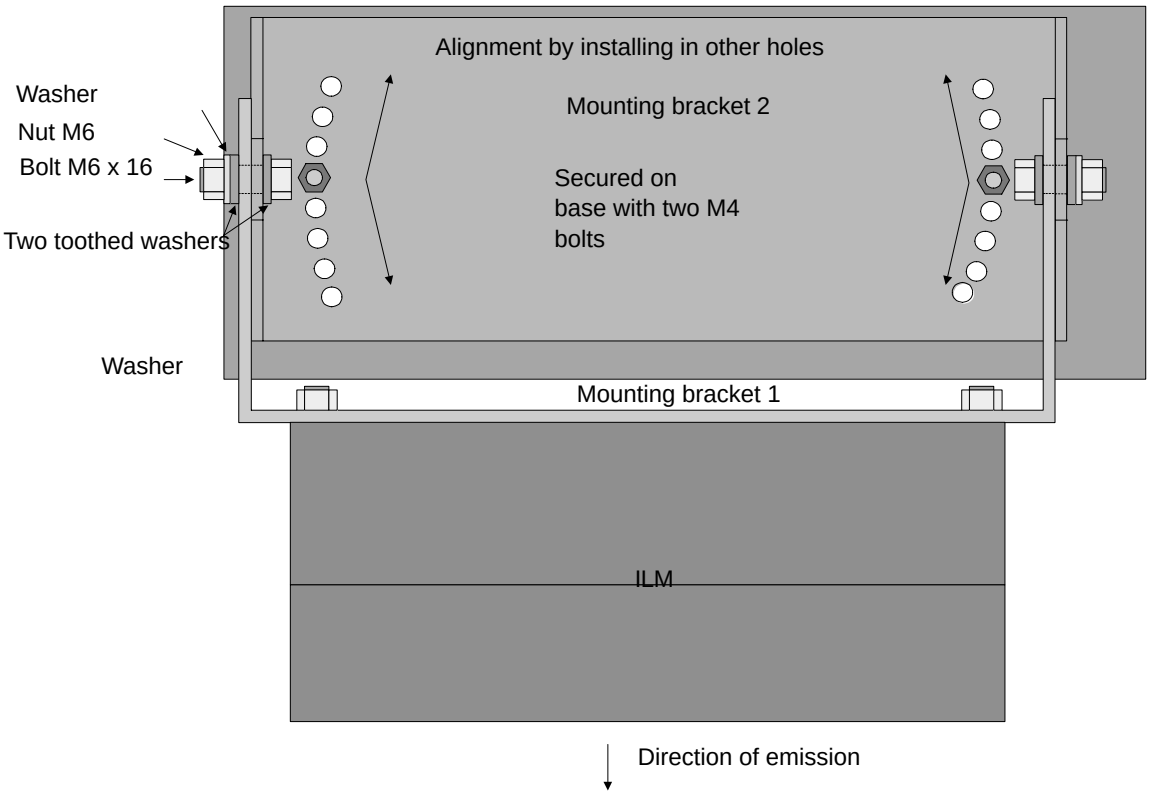
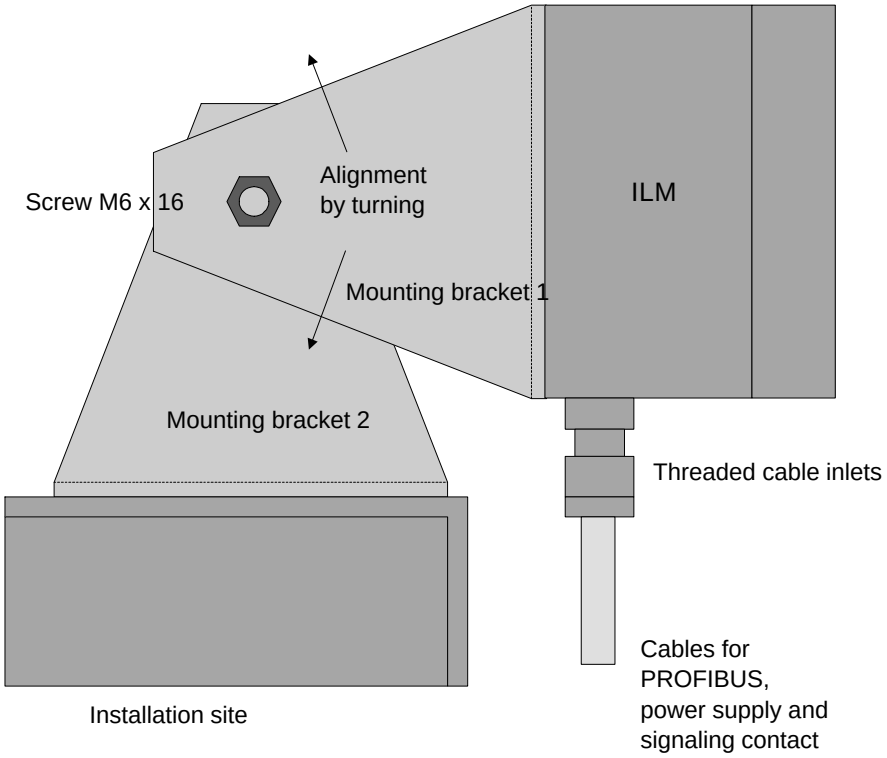


Figure 14: Top View of the PROFIBUS ILM Installed With Mounting Brackets



Installing the ILM with mounting bracket
side view

Figure 15: Side View of a PROFIBUS ILM Installed With Mounting Brackets

By installing angle 1 in different holes on the mounting surface, it is possible to turn the PROFIBUS ILM through the vertical axis, however the adjustment is not continuous.

By loosening the M6 securing bolts, the PROFIBUS ILM can be adjusted continuously to align it to the partner station in the horizontal axis. To add greater stability, it is advisable to use toothed washers with the bolts.

It is also advisable to install the module at the edge of the mounting surface so that the cables lead to and from the module unhindered and to make sure that there is no reflection of the sender to its own receiver caused by the installation site itself.

8.1 Connecting the Electrical RS 485 Bus Cables

For the RS 485 bus cable, use only shielded twisted pair cables with an outer diameter of 7.5 to 10 mm. Appendix B lists the electrical parameters of cable types recommended in compliance with the standard.

Make sure that you connect the same cores (green or red) uniformly to all bus terminals of a cable section, either terminal A or terminal B.

The following are recommended for field bus networks:

Terminal A: Green core

Terminal B: Red core

Do not connect any RS 485 LAN cables that are laid completely or partly outside buildings without first protecting the network using a suitable surge voltage protector. Otherwise, lightning strikes in the area can destroy the PROFIBUS ILM or other network components.

Connect the RS 485 LAN cable to the terminal block as shown in Figure 16.

The terminals marked A or B are electrically identical.

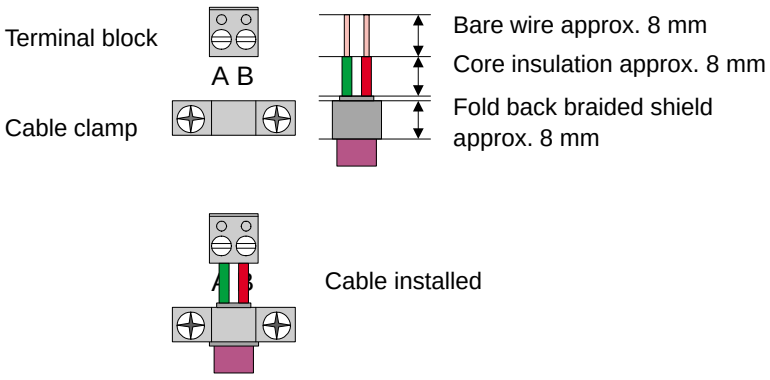


Figure 16: Connecting the PROFIBUS Cables

Fold back the braided shield over the outer jacket of the LAN cable. This provides you with a sufficiently large cable diameter to clamp the cable.

Screw the threaded cable inlet so that if IP65 is required, the cable connection is watertight. If this is required, PROFIBUS cables with a round cross-section and an outer diameter of 7.5 to 10 mm must be connected.

Tighten the threaded cable inlet with a torque of approx. 2.5 to 3 Nm so that the collar of the cable inlet is sealed against the casing of the PROFIBUS ILM. When the cable is connected, the union nut of the cable inlet must be tightened so that the cable can no longer be pulled out. When tightening the nut, make sure that the cable does not turn with it.

If a union nut must be released again, the threaded cable inlet should be tightened again afterwards to make sure that this is still flush against the casing.

If the device is at the start or end of an electrical PROFIBUS segment, you must seal one threaded cable inlet using the accompanying sealing plug.

If the mechanical stress on the PROFIBUS cable is liable to change, make sure that you install additional strain relief. The cable clamp in the device itself is only intended for low-resistance discharge of spurious voltages on the shield. The threaded cable inlet is used only for sealing the cable entry and to prevent the cable being pulled out accidentally. Neither of these, however, is intended as strain relief against continuous tensile stress on the cables.

8.2 Connecting the Power Supply and the Signaling Contact

Use a two-wire round cable if you do not want to use the signaling contact or a four-wire round cable if the signaling contact is required. This is necessary so that the threaded cable inlet seals the cable entry and prevents the cable from being pulled out. Ideally, you should use twisted pair cables since they are less susceptible to noise. The outer diameter of the cables must be between 7.5 and 10 mm.

Do not connect power supply or signaling contact cables that are laid partly or completely outside buildings without first providing a suitable surge voltage protector to protect the PROFIBUS ILM and your low-voltage network. Otherwise, lightning strikes in the area can destroy the PROFIBUS ILM or other network components. If the cable is laid outside buildings and in cable cable conduits along with cables supplying power, you should also use a shielded cable for the power supply and signaling contact to prevent interference from the power cables.

Connect the power supply and signaling contact cable to the terminal block as illustrated in Figure 17.

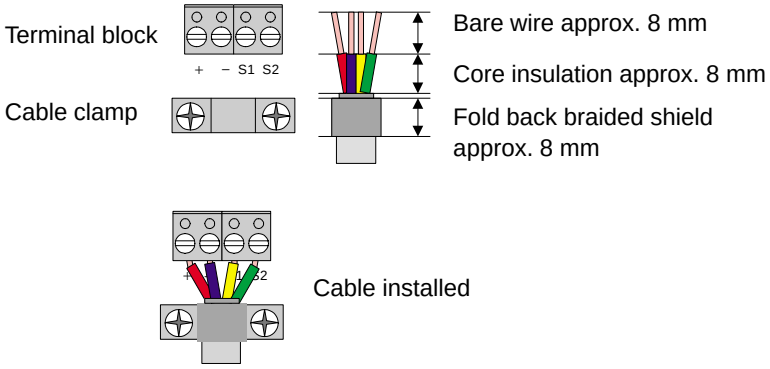


Figure 17: Connecting the Power Supply and Signaling Contact Cable

If you have chosen a shielded cable, make sure that there is a good electrical connection between the braided shield and shield clamp. This is guaranteed if you fold back the braided shield over the outer jacket of the cable. This provides you with a sufficiently large cable diameter to clamp the cable.

Screw the threaded cable inlet so that if IP65 is required, the cable connection is watertight.

If this is required, PROFIBUS cables with a round cross-section and an outer diameter of 7.5 to 10 mm must be connected.

Tighten the threaded cable inlet with a torque of approx. 2.5 to 3 Nm so that the collar of the threaded cable inlet is sealed against the casing of the PROFIBUS ILM. When the cable is connected, the union nut of the cable inlet must be tightened so that the cable can no longer be pulled out. When tightening the nut, make sure that the cable does not turn with it.

If the power supply and signaling contact cable is subject to changing tensile stress, make sure that you provide additional strain relief. The cable clamp in the device itself is only intended for low-resistance discharge of spurious voltages on the shield. The threaded cable inlet is used only for sealing the cable entry and to prevent the cable being pulled out accidentally. Neither of these, however, is intended as strain relief against continuous tensile stress on the cables.

Figure 18 shows the functional wiring of the power supply and signaling contact cable. The pair of cores connected to “+” and “–” supplies the power for the PROFIBUS ILM. This pair must always be wired up.

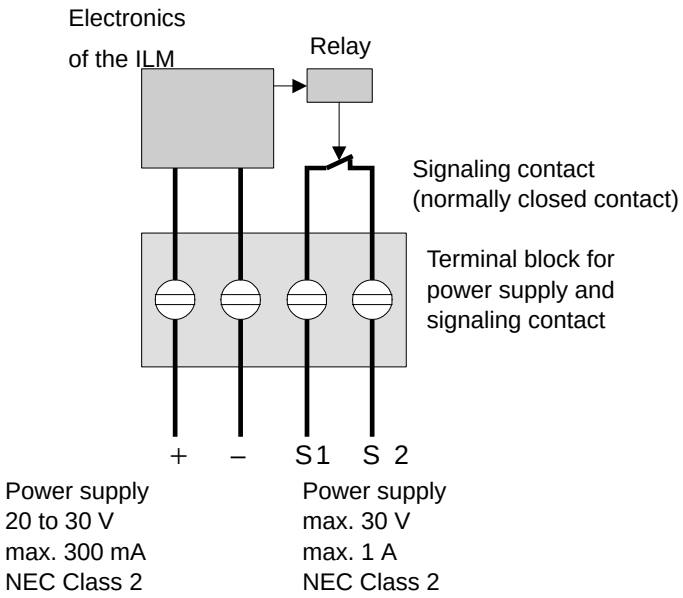


Figure 18: Wiring of the Power Supply and Signaling Contact

The pair of cores connected to “S1” and “S2” is used to wire the signaling contact and is only necessary if you intend to use the signaling contact.

The signaling contact is closed in normal operation and opens if the following problems occur:

- ➢ The device has no power supply
- ➢ Acknowledgment pulse was not detected (acknowledgment pulse mechanism activated and configured to trigger the signaling contact),
- ➢ No changing reception activity on the optical receiver if this was configured to trigger the signaling contact.
- ➢ Too much extraneous light at the optical receiver if this was configured to trigger the signaling contact.
- ➢ Receive level low at optical receiver if this was configured to trigger the signaling contact.

The signaling contact has no electrical connection to any other components of the PROFIBUS ILM.

Limit values of the relay

- ➢ Maximum switching power: 30 W
- ➢ Maximum switching voltage: 30V DC;
- ➢ Maximum switching current: 1.0 A

The voltage connected to the signaling contact must be a safety extra-low voltage complying with IEC 950/EN 60 950/ VDE 0805. According to the CUL approval you should connect the signalling contact only at the load side of a Class 2 or Class 3 power source as defined by the National Electric Code (NEC), Article 725–2 and the Canadian Electrical Code (CEC).

9 Displays

POWER		
green LED	not lit	No power supply or internal power supply defective or ribbon cable not plugged in.
	lit green	Power supply OK
TX		
yellow/orange LED	not lit	Data not sent optically
	lit yellow	Data are sent, acknowledgment bit correctly received or acknowledgment bit mechanism not activated.
	lit orange	Data being sent, acknowledgment bit activated but not correctly received.
RX		
yellow LED	not lit	Data not optically received
	lit yellow	Data optically received
LOW		
red LED	not lit	Receive level OK (RX LED lit) no receive level (RX LED also not lit)
	lit red	Data optically received, the level is however low (RX LED also lit) risk of data errors
ERROR		
red LED	not lit	Infrared level at receiver is not critical
	lit red	Infrared level at receiver is critical, risk of data errors

10 Help With Problems During Operation

10.1 Status Displays for Incorrect Operation

LED Display		Possible Causes	Signaling Contact
POWER LED	not lit	- Power supply failed or turned off - Module defective - Ribbon band cable not plugged in when assembling the module	Always signals
POWER LED TX LED RX LED	lit green not lit not lit	- Interruption on one or more cores of the RS 485 LAN cable - Reversed connection of core A and B of the RS 485 LAN cable - Connected PROFIBUS master defective (not sending) - PROFIBUS node is not attached or attached PROFIBUS node is not turned on - No partner station detected with attached PROFIBUS master	
POWER LED TX LED RX LED	lit green not lit lit yellow	- Interruption on one or more cores of the RS 485 LAN cable - Reversed connection of core A and B of the RS 485 LAN cable - Attached PROFIBUS slave defective (not sending) - PROFIBUS slave is not attached or attached PROFIBUS slave is not turned on - PROFIBUS slave node not correctly addressed and therefore not responding	
POWER LED TX LED RX LED	lit green lit orange, not lit	- No acknowledgment pulse received, partner station not responding	Signals when configured (acknowledgment pulse)

LED Display	Possible Causes	Signaling Contact
POWER LED lit green TX LED lit orange, RX LED lit yellow	- No acknowledgment pulse received since partner station not configured with acknowledgment pulse - On point-to-multipoint links on the PROFIBUS ILM of the master subnet if acknowledgment bit configured (see Section 6.4)	Signals when configured (acknowledgment pulse)
POWER LED lit green TX LED lit orange, RX LED lit yellow, LOW LED lit red	- No acknowledgment pulse received since partner station is not configured with acknowledgment pulse or receive level for acknowledgment pulse and response frame too low. - On a point-to-multipoint link on the PROFIBUS ILM on a slave subnet if configured with acknowledgment bit (see Section 6.4)	Signals if configured (acknowledgment pulse, level monitoring)
POWER LED lit green TX LED lit yellow RX LED not lit	- Partner station not responding because not attached, infrared link interrupted, incorrectly configured (PROFIBUS address of the slave incorrect, data rate of the partner PROFIBUS ILM set incorrectly etc.)	Signals when configured (bus activity)
POWER LED lit green TX LED lit yellow, RX LED lit yellow, LOW LED lit red	- Risk of problems on bus, since infrared link has too much attenuation (obstacles in area of transmission link, distance between PROFIBUS ILMs too great, PROFIBUS ILM turned out of line with partner station)	Signals when configured (level monitoring)
POWER LED lit green TX and RX LEDs not lit ERROR LED lit red	- Risk of problems on bus due to incidence of extraneous light (for example sunlight, lamps with infrared component, halogen lamps with high energy)	Signals when configured (constant light)
POWER LED lit green RX LED lit yellow ERROR LED lit red	- Bus problems must be expected due to incidence of extraneous light with high-frequency modulation (for example energy-saving lamps with HF switching device)	Signals when configured (constant light)

Table 1: Possible problems operating the PROFIBUS ILM

If no display indicates an error and communications problems nevertheless occur, check the parameters set on both PROFIBUS nodes. You should also check the electrical RS 485 wiring. The most common cause of problems is activating or deactivating the terminating resistor incorrectly. You should also check that the cable shields at the ends of all PROFIBUS cables and all shielded power supply cables are making satisfactory contact.

Note

Remember that sporadic data errors on the cable network are not detected by the PROFIBUS ILM. The PROFIBUS ILM cannot check the contents of frames but can only monitor the basic functions and optical transmission quality.

10.2 Errors Due to Incorrect Network Configuration

In large PROFIBUS networks with numerous modules and long cable lengths, the delay caused by network components and cables (transmission delay) must be taken into account when setting the monitoring times. If you do not take these delay times into account, problems will occur during operation. In such situations, the active partner does not receive a response to a request within the slot time of PROFIBUS because this has been configured too short.

In large networks, or networks with looped-in active components, the transmission delay time(TTD) must be calculated to allow correct configuration.

The transmission delay time is the maximum time that can elapse during the transmission of a frame between the sender and receiver on the transmission medium.

Note

If the configuration software you have used to configure your PROFIBUS network does not support the PROFIBUS parameter TTD, increase the two times min. TSDR and max. TSDR in each case by 2 x TTD (the reaction time of the responder is increased by the transmission delay time for the outward and return path).

10.2.1 Calculating the Propagation Time on Electric Cables and Fiber-Optic Cables

The propagation times on electrical cables or fiber-optic cables are physically related to the speed of light and certain material characteristics and are therefore almost constant (approximately 5 µs/km).

First calculate the transmission link with the longest propagation time between the sender and receiver of a frame. PROFIBUS nodes that communicate with each other (for example DP slave with DP slave) do not need to be taken into account.

Indicators for long propagation times are as follows:

- Long fiber-optic or copper cables
- High cascading depth of active components (PROFIBUS OLMs, PROFIBUS ILMs, PROFIBUS repeaters)

The delay time is approximately 5 µs per km cable length.

Converted to bit times this results in the following:

Transmission Rate in Kbps	Delay Time in bit times per km
9.6	0.05
19.2	0.10
45.45	0.23
93.75	0.47
187.5	0.94
500.0	2.50
1500.0	7.50

Table 2: Delay Times of Fiber-Optic and RS 485 LAN Cables

To calculate the cable delay time, the maximum cable length in km is multiplied by the delay time corresponding to the transmission rate from the table.

10.2.2 Delay Time of the PROFIBUS ILM

In contrast to the propagation time of electrical cables and fiber-optic cables, the delay time through the logic of the PROFIBUS ILM clocked at the transmission frequency is not a physical time constant but depends on the transmission rate. The number of logic levels in series is relevant with each causing a bit time delay.

The delay time per PROFIBUS ILM is 6 bit times from RS 485 input to infrared output when sending and 3 bit times from infrared input to RS 485 output when receiving. The total delay time of the RS 485 input of the sending PROFIBUS ILM to the RS 485 output of the receiving PROFIBUS ILM is therefore 9 bit times.

If several PROFIBUS ILM links are cascaded, the total delay time is the product of 9 bit times of the individual links and the cascading depth.

10.2.3 Delay Time of Further Active PROFIBUS Network Components

Please refer to the delay time listed in the documentation of the specific product.

10.2.4 Transmission Delay Time TTD

The total delay time of the PROFIBUS network is the sum of all the values calculated in Sections 10.2.1 to 10.2.3.

11 Technical Specifications

Operating voltage Safety extra-low voltage (SELV)	24 V DC (20 V to 30 V)
Current consumption	max. 300 mA
Transmission rate	9.600 Kbps; 19.200 Kbps; 45.45 Kbps, 93.75 Kbps; 187.5 Kbps; 500 Kbps; 1.5 Mbps;
Setting the transmission rate	Using 3 DIP switches
Setting the mode	Using 5 DIP switches
Bit error rate	$<10^{-6}$
Signal delay time RS 485 input → infrared output	<= 6 bit times
Signal delay time infrared input → RS 485 output	<= 3 bit times
Electrical channel	
Input/output signal	RS 485 level
Input voltage dielectric strength	–10 V to + 15 V
Interface signals	Ungrounded within the SELV limits
Terminating resistors	Activated with DIP switch
Optical channel	
Optical source	21 LEDs
Optical power	280 mW effective with alternating 0–1 sequence
Receiver sensitivity	0.5 A/W – 28 dBmW
Wavelength	860 nm to 880 nm
Distance between two ILMs	maximum 15 m in the optical axis 12 m at +/–2 m distance from the optical axis
Signaling contacts	Limit values of the relay maximum switching power 30 W Maximum switching voltage 30 V DC Maximum switching current 1.0 A

Table 3: Technical Specifications of the PROFIBUS ILM

Electromagnetic Compatibility (EMC)	
Noise emission	Limit Class B (EN 55022)
Immunity to static discharge	On shield connection and casing ±8 kV contact discharge (IEC 1000–4–2)
Immunity to high frequency noise	10 V/m at 80% amplitude modulation with 1 kHz, 80 MHz – 1 GHz (ENV 50140; IEC 1000–4–3) 10V/m at 50% duty cycle at 900 MHz (ENV 50 204) 10 V/m at 80% amplitude modulation at 1 kHz, 10 kHz – 80 MHz (ENV 50141)
Immunity to disturbances on the cable (burst)	On power supply cables and shielded RS 485 LAN cables: ±2 kV (IEC 1000–4–4)
Immunity to disturbances on the cable (surge)	On power supply cables: ±1 kV balanced On shielded RS 485 cables: ±2 kV unbalanced (IEC 1000–4–5)

Safety	
VDE specifications	VDE 0806=EN60950 and IEC950
UL/CSA approval	Requirements are met
Climatic environmental conditions	
Ambient temperature	0 °C to + 60 °C (IEC 68–2–1, IEC 68–2–2)
Storage temperature	–40 °C to + 70 °C (IEC 68–2–14)
Relative humidity	< 95% (none condensing) (IEC 68–2–30) If condensation forms on the window, there is a temporary reduction in the distance that can be covered. There is no permanent functional disturbance and no damage to the electronics if the threaded cable inlet fulfills the requirements of IP65.
Mechanical environmental conditions	
Oscillation during operation	10 to 58 Hz, 0.075 mm deflection 58 to 150 Hz, 10 m/s^2 (1g) acceleration (IEC 68–2–6)
Oscillation during transportation	5 to 9 Hz, 3.5 mm deflection 9 to 500 Hz, 10m/s^2 (1g) acceleration
Degree of protection	IP 65
Weight	800 g
Dimensions	175 × 80 × 58 mm
Casing material	Die-cast aluminum

Table 4: Environmental Conditions for the Use of the PROFIBUS ILM

11.1 Illumination Range

To determine the arrangement of two PROFIBUS ILMs on an infrared transmission link, the illumination range of the sending PROFIBUS ILM must be known. The receive cone is broader so that with the half-duplex transmission used with PROFIBUS the restriction results from the narrower cone.

Note

Each PROFIBUS ILM on an infrared link must be arranged and aligned so that it reaches its partner with its transmit cone.

The illumination range of the sender is shown in Figure 19. In the range from 0.5 to 12 m, there is adequate illumination density in a solid angle of +/– 10 degrees with free emission without shadows caused by obstacles. At 12 m distance from the sending PROFIBUS ILM, there is an illuminated circular area with a diameter of approximately 4 m. Although the send window of the PROFIBUS ILM is neither round nor square, from a distance of 2 m the illuminated area is practically round since from this distance the light source can be assumed to be a point.

At a distance greater than 12 m, in the same way as the illumination provided by a spotlight, the illuminated area starts to reduce. At 15 m distance, an illuminated area of 2 m diameter is guaranteed.

Note

These data are only guaranteed when the windows of the PROFIBUS ILM are clean. From time to time, the window should be cleaned using a clean soft cloth as usual with other optical devices or glasses. Under no circumstances should aggressive or abrasive cleaning agents be used.

Condensation on the window or wetting with water or other liquids reduces the illumination range. With condensation, a reduction of approximately half of the maximum range has been measured. If the liquid produces bubbles, the reduction is sometimes even higher since not only the optical attenuation but also the optical refraction of the liquid takes effect.

The “LOW” LED displays critical receive levels.

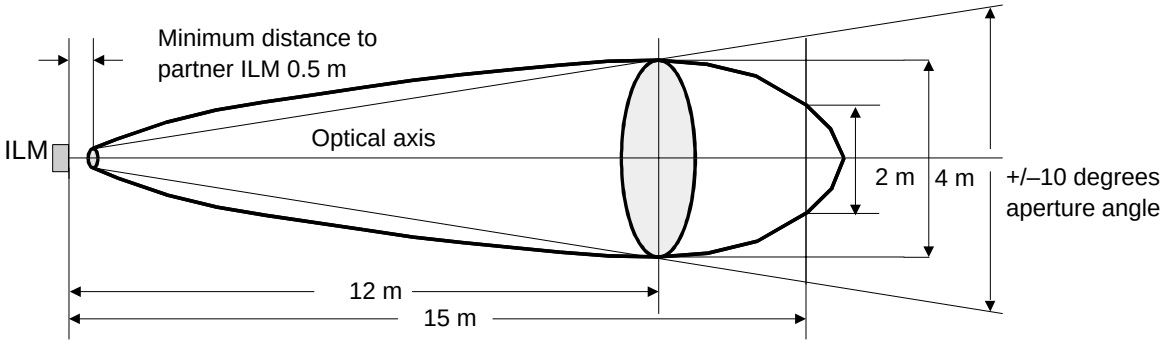


Figure 19: Transmitter Illumination of the PROFIBUS ILM

12 Appendix

Electrical parameters of the RS 485 LAN cables

You can use the following cables to attach an RS 485 bus segment and individual DTEs to the PROFIBUS ILM:

- ➢ Cable Type A complying with PROFIBUS DP; (DIN 19 245 Part 2)
- ➢ Cable Type B complying with DIN 19 245 Part 1; 04.91; Section 3.1.2.3

Remember the restricted distance and transmission rate possible with the Type B cable (according to Table 2).

Cable Parameters	Type A	Type B
Characteristic resistance	135 to 165 ohms (3 to 20 MHz)	100 to 130 ohms (f →100 kHz)
Capacitance per unit length	<30 pF/m	<60 pF/m
Loop resistance	<110 Ohms/km	–
Core diameter	→0.64 mm	→0.53 mm
Core cross-section	→0.34 mm^2	→0.22 mm^2

Table 5: Electrical Parameters of the Shielded Twisted Pair LAN Cables

13 References

➢ PROFIBUS networks
SIEMENS AG

➢ DIN 19245 Part 1 (04.91):
"Messen, Steuern, Regeln; PROFIBUS Teil 1;
Process Field Bus; Übertragungstechnik, "

➢ DIN 19245 Teil 2 (10.91):
"Messen, Steuern, Regeln; PROFIBUS Teil 3;
Process Field Bus; Dezentrale Peripherie (DP)"

➢ EIA Standard RS 485 (April 1983):
"Standard for electrical characteristics of generators
and receivers for use in balanced digital multipoint systems"

Product name:

Infrared Link Module (ILM) Order no. 6GK1 503–0AA00

CE The SIMATIC NET product named above meets the reuirements of the following EU directives:

EMC 89/336/EEC

Directive 89/336/EEC “Electromagnetic Compatibility”.

Area of application

The product is designed for operation in an industrial and domestic environment.

Area of application	Requirements	
	Noise emission	Noise immunity
Industrial	EN 50081–2 : 1993	EN 50082–2 : 1995
Domestic, business and workshop	EN 50081–1 : 1992	EN 50082–1 : 1997

Conformity Certificates

The EU conformity certificates are available for the relevant authorities according to the EU directive and are kept at the following address:

Siemens Aktiengesellschaft
A&D PT2
Industrielle Kommunikation
Postfach 4848
D–90327 Nürnberg

Directive on Machines

The product remains a component in compliance with Article 4(2) of the EU directive on machines 89/392/EEC.
According to the directive on machines, we are obliged to point out that this product is intended solely for installation in a machine. Before the final product is started up, it must be established that it conforms to the directive 89/392EEC.

Installation Guidelines

The product meets the requirements providing you adhere to the guidelines for installation and operation in the documentation SIMATIC NET PROFIBUS Networks.