

# Active Components for RS-485 Networks

# 5

## 5.1 RS-485 Repeater

### What is an RS-485 Repeater?

An RS-485 repeater amplifies data signals on bus cables and links bus segments.

### Using the RS-485 Repeater (6ES7 972-0AA01-0XA0)

You require an RS-485 repeater in the following situations:

- When there are more than 32 stations (including repeaters) connected to the bus
- When electrically isolated bus segments are required or
- When the maximum cable length of a segment is exceeded (see Chapter 3 "Network Configuration").

### Rules

If you want to install a PROFIBUS network with RS-485 repeaters, you can connect a maximum of nine RS-485 repeaters in series.

### Design of the RS-485 Repeater

Table 5-1 shows the elements of the RS-485 repeater.

Table 5-1 Description and Functions of the RS-485 Repeater

Layout of the Repeater	No.	Function
<p>The diagram shows the front panel of a Siemens RS 485-Repeater. At the top left is a DC 24V power supply terminal (10). To its right are terminals L+, M, PE, and M5.2 (1). Below these are two shield clamps (2). In the center are two RJ45 ports for bus segments 1 and 2 (3). To the right of these are two terminating resistor switches (4) labeled DP1 and DP2, each with ON and OFF positions (5). Below the switches are two more RJ45 ports (7). At the bottom are two LED indicators (11 and 12) and a mounting catch (8). A PG/OP interface is located on the left side (9).</p>	①	Terminal for connecting the power supply of the RS 485 repeater (pin "M5.2" is the reference ground if you want to measure the voltage between terminals "A2" and "B2").
	②	Shield clamp for strain relief and grounding the LAN cable of bus segment 1 or bus segment 2
	③	Terminal for the LAN cable of bus segment 1
	④	Terminating resistor for bus segment 1 ) <sup>1</sup>
	⑤	Switch for OFF state (= Disconnect bus segments 1 and 2, for example, during commissioning)
	⑥	Terminating resistor for bus segment 2 ) <sup>1</sup>
	⑦	Terminal for the LAN cable of bus segment 2
	⑧	Catch for mounting and removing the RS-485 repeater on a standard rail
	⑨	Interface for PG/OP on bus segment 1
	⑩	LED 24 V power supply
	⑪	LED indicating bus activity on segment 1
	⑫	LED indicating bus activity on segment 2

)<sup>1</sup> If the terminating resistor is activated, the right-hand bus attachment is disconnected (see Figure 5-3) !

### Note

Terminal M5.2 of the power supply (see Table 5-1, no. ①) is used as the reference ground for signal measurements if problems occur and must not be wired up.

## Technical Specifications

Table 5-2 lists the technical data of the RS-485 repeater:

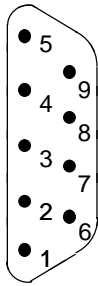
Table 5-2 Technical Data of the RS-485 Repeater

Technical Specifications	
Power supply	
• Rated voltage	24 V DC
• Ripple (static limit)	20.4 V DC to 28.8 V DC
Power consumption at rated voltage	
• Without load on the PG/OP connector	200 mA
• Load on the PG/OP connector (5 V/90 mA)	230 mA
• Load on the PG/OP connector (24 V/100 mA)	300 mA
Electrical isolation	yes, 500 V AC
Transmission rate (detected automatically by repeater)	9.6 Kbps, 19.2 Kbps, 45.45 Kbps, 93.75 Kbps, 187.5 Kbps, 500 Kbps, 1.5 Mbps, 3 Mbps, 6 Mbps 12 Mbps
Degree of protection	IP20
Dimensions W × H × D (in mm)	45 × 128 × 67
Weight (including packing)	350 g

## Pinout of the Sub D Connector (PG/OP Connector)

The 9-pin sub D connector has the following pinout:

Table 5-3 Pin Assignment of the 9-Pin Sub D Connector PG/OP Connector

Layout	Pin no.	Signal name	Meaning
	1	–	–
	2	M24V	Chassis 24 V
	3	RxD/TxD-P	Data line B
	4	RTS	Request To Send
	5	M5V2	Data reference potential (from station)
	6	P5V2	Power supply plus (from station)
	7	P24V	24 V
	8	RxD/TxD-N	Data line A
	9	–	–

## Block Diagram

Figure 5-1 shows the block diagram of the RS-485 repeater:

- Bus segment 1 and bus segment 2 are electrically isolated.
- Bus segment 2 and the PG/OP connector are electrically isolated.
- Signals are amplified:
  - between bus segment 1 and bus segment 2
  - between the PG/OP connector and bus segment 2

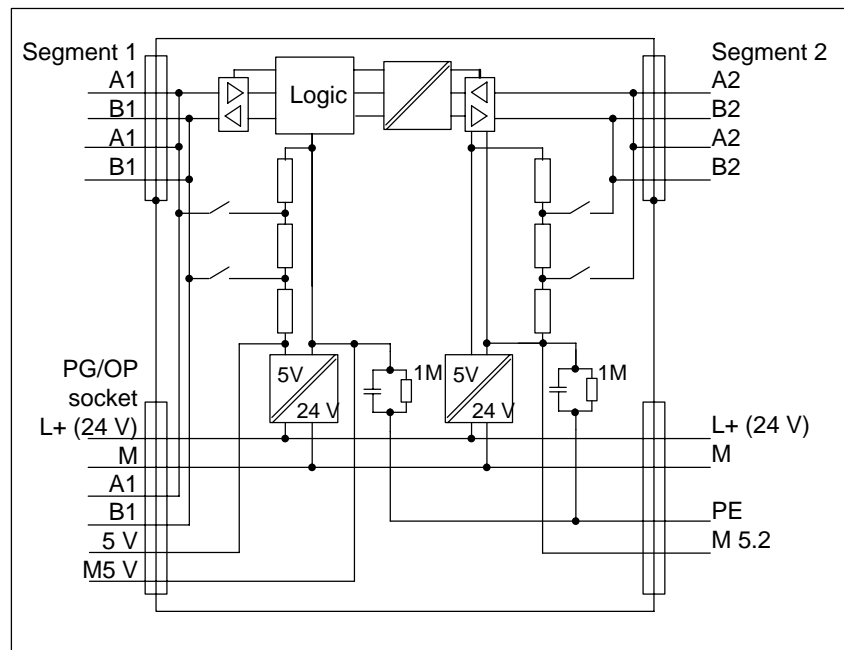


Figure 5-1 Block Diagram of the RS-485 Repeater

## 5.2 Possible Configurations with the RS-485 Repeater

### Overview

The following section explains the configurations in which you can use the RS-485 repeater:

- Segment 1 and Segment 2 terminated on the RS-485 repeater (see Figure 5-3)
- Segment 1 terminated on the RS-485 repeater and segment 2 connected through on the RS-485 repeater (see Figure 5-4 )  
and
- Segment 1 and Segment 2 connected through on the RS-485 repeater (see Figure 5-5 )

### Terminating Resistor On/Off

Figure 5-2 shows the setting for the terminating resistor:

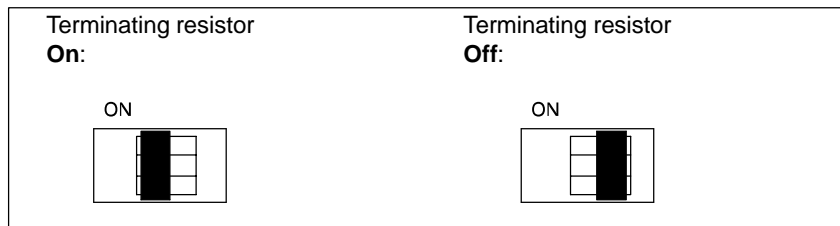


Figure 5-2 Setting of the Terminating Resistor

### Segments 1 and 2 Terminated

Figure 5-3 shows how to connect the RS-485 repeater to the ends between two segments:

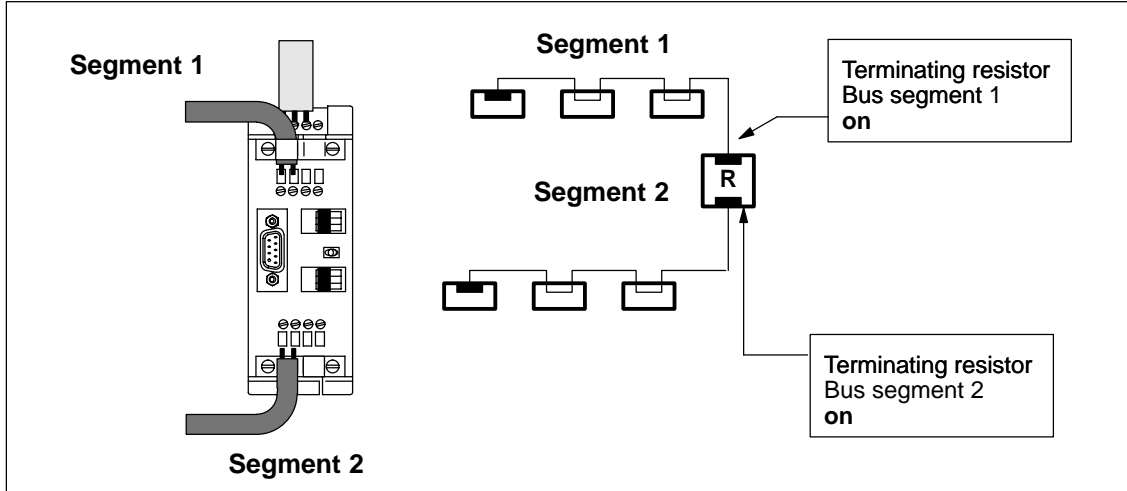


Figure 5-3 Connecting Two Bus Segments to the RS-485 Repeater

### Segment 1 Terminated, Segment 2 Connected Through

Figure 5-4 shows the connection between two segments via an RS-485 repeater with one segment connected through:

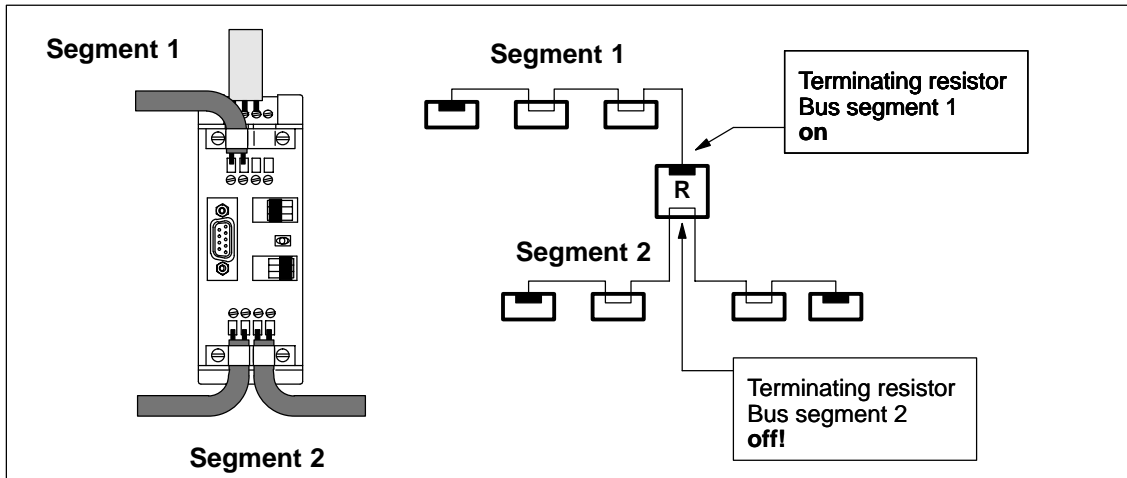


Figure 5-4 Connecting Two Bus Segments to the RS-485 Repeater

## Segments 1 and 2 Connected Through

Figure 5-5 shows the connection between two segments via an RS-485 repeater with each LAN cable connected through:

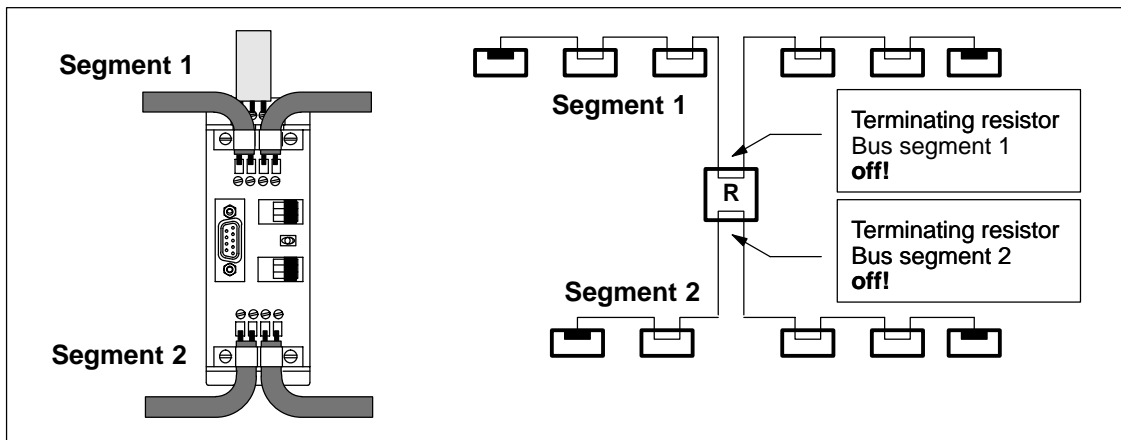


Figure 5-5 Connecting Two Bus Segments to the RS-485 Repeater

### Note

If you turn off the power supply of a complete segment, the terminating resistors of the connected nodes are also without power supply. This can lead to disruptions or undefined signal states in this segment that are not recognized by the repeater and can then lead to problems in the other segment.

Whenever possible, we recommend the following procedure:

- **Alternative 1:**  
Disconnect the two segments before turning off the power supply using switch 5 (Table "Description and Functions of the RS-485 Repeater") on the repeater (set to "OFF").
- **Alternative 2:**  
Connect the repeater to the power supply of the segment to be turned off so that the repeater is also turned off. In this case, make sure that the repeater is not at the end of the previous segment, since the repeater is then the terminating resistor which has no effect if there is no power supply. If this solution is required, use a PROFIBUS terminator with a permanent power supply after the repeater.
- **Alternative 3:**  
If you want the repeater to retain its power supply, use PROFIBUS terminators to terminate the segment you want to turn off since these also require a permanent power supply. You require one terminator if the bus segment to be turned off ends at the repeater, otherwise you require two terminators.

## 5.3 Installing and Uninstalling the RS-485 Repeater

### Overview

You can install the RS-485 repeater as follows:

- On an S7-300 rail
- or
- On a standard rail (order number 6ES5 710-8MA..)

### Installation on an S7-300 Rail

To install the RS-485 repeater on an S7-300 rail, the catch on the rear of the RS-485 repeater must first be removed (see Figure 5-6):

1. Insert a screwdriver below the tongue of the catch (1) and
2. Push the screwdriver towards the rear of the module (2). Hold the screwdriver in this position!

**Result:** The catch is released from the RS-485 repeater.

3. With your free hand lift the catch up as far as it will go and then remove the catch (3).

**Result:** The catch is removed from the RS-485 repeater.

4. Fit the RS-485 repeater onto the rail for an S7-300 (4).
5. Push it towards the back as far as it will go (5).
6. Tighten the securing screw with a torque of 80 to 110 Ncm (6).

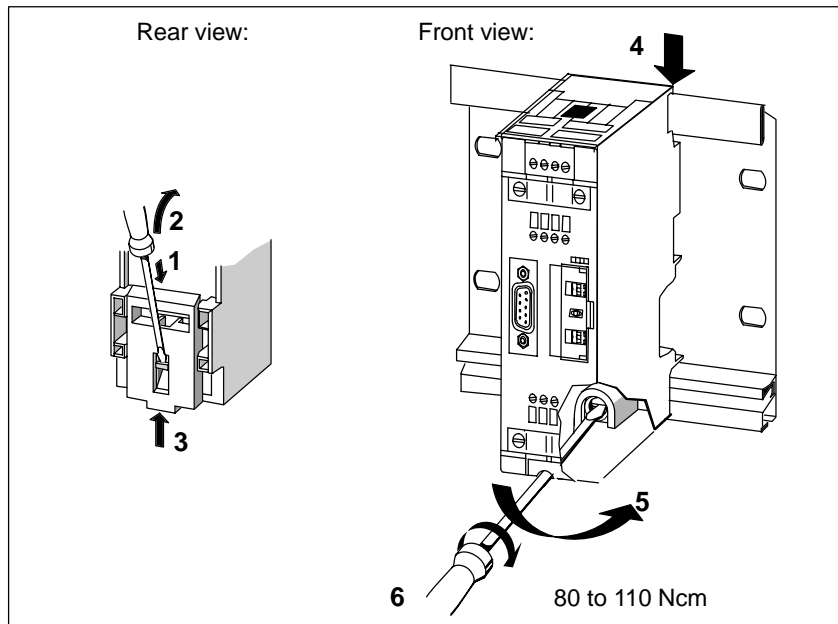


Figure 5-6 Installing the RS-485 Repeater on an S7-300 Rail

### Removing the Repeater from an S7-300 Rail

To remove the RS-485 repeater from the S7-300 rail:

1. Undo the screw securing the RS-485 repeater (1) and
2. Pull the RS-485 repeater out and up (2).

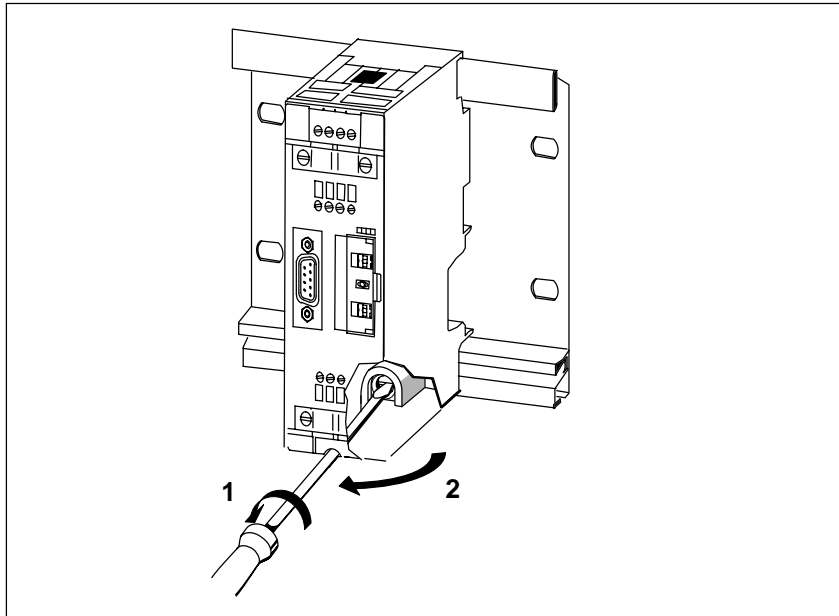


Figure 5-7 Removing the RS-485 Repeater from the S7-300 Rail

### Installation on a Standard Rail

To be able to install the repeater on a standard rail, the catch must be present on the back of the RS-485 repeater:

1. Fit the RS-485 repeater on to the standard rail from above and
2. Push it towards the back until the catch locks it in place.

### Removing the RS-485 from the Standard Rail

To remove the RS-485 repeater from the standard rail:

1. Press down the catch on the bottom of the RS-485 repeater using a screwdriver and
2. Pull the RS-485 repeater out and upwards to remove it from the standard rail.

## 5.4 Ungrounded Operation of the RS-485 Repeater

### Ungrounded Operation

Ungrounded operation means that chassis and PE are not connected.

The ungrounded operation of the RS-485 repeater allows you to operate electrically isolated bus segments.

Figure 5-8 shows the change in the potentials resulting from using the RS 485 repeater.

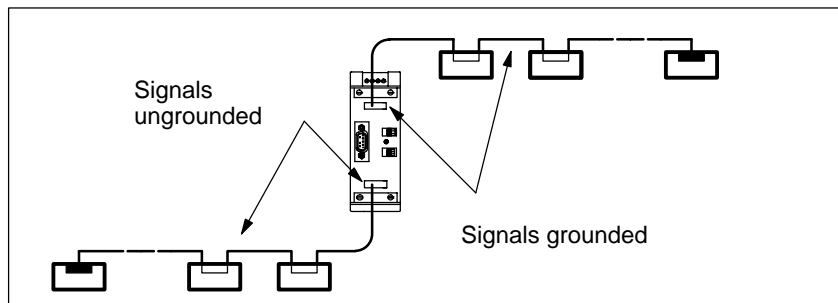


Figure 5-8 Ungrounded Operation of Bus Segments

## 5.5 Connecting the Power Supply

### Cable Type

To connect the 24 V power supply, use flexible cables with a cross section of 0.25 mm<sup>2</sup> to 2.5 mm<sup>2</sup> (AWG 26 to 14).

### Connecting the Power Supply

To connect the power supply of the RS-485 repeater:

1. Strip the insulation from the wire for the 24 V DC power supply.
2. Connect the cable to terminals "L+", "M" and "PE".

## 5.6 Connecting the LAN Cable

All the LAN cables described in Chapter 4 are suitable for attachment to the RS-485 repeater.

### Connecting the PROFIBUS Cable

Connect the PROFIBUS LAN cable to the RS-485 repeater, as follows:

1. Cut the PROFIBUS cable to the required length.
2. Strip the insulation from the PROFIBUS cable as shown in Figure 5-9.

The braid shield must be folded back on to the cable. Only then can the shield clamp serve as strain relief and as the shield contact.

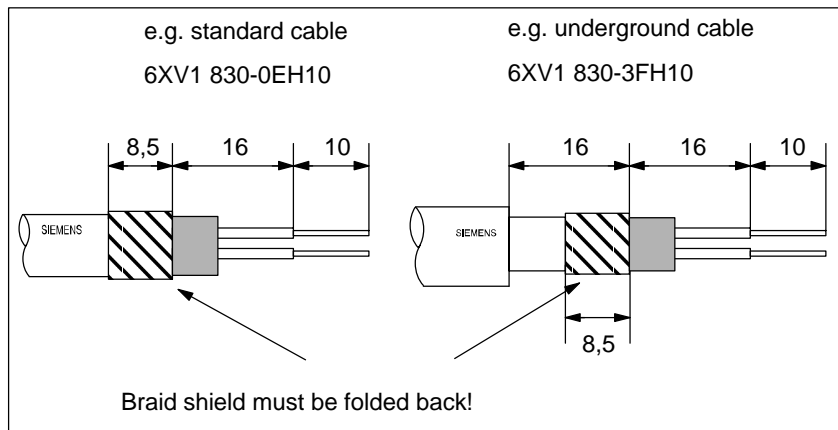


Figure 5-9 Stripping the Cable to Connect it to the RS-485 Repeater

3. Connect the PROFIBUS cable to the RS-485 repeater:

Connect the same wires (green/red for the PROFIBUS LAN cable) to the same terminal A or B (in other words always connect terminal A with a green wire and terminal B with a red wire or vice versa).

4. Tighten the shield clamps so that the shield makes good contact with the clamp.

## 5.7 PROFIBUS Terminator

### What is a PROFIBUS Terminator?

The PROFIBUS terminator provides active termination for the bus. The major advantage of this is that bus nodes can be turned off, removed, or replaced without impairing data transfer. This applies in particular to the nodes at both ends of the LAN cable on which the terminating resistors would have to be activated and supplied with power. The PROFIBUS terminator can be installed on a standard rail.

### Order number

6ES7 972-0DA00-0AA0

### Design of the PROFIBUS Terminator

Table 5-4 shows the design of the PROFIBUS terminator:

Table 5-4 Design of the PROFIBUS Terminator

Design of the PROFIBUS Terminator	No.	Function
	①	LED 24 V power supply
	②	Connection for power supply 24 V DC
	③	PROFIBUS attachment
	④	Shield clamp grounding the braid shield and for strain relief of the LAN cable
	⑤	Ground screw
	⑥	Cable clamp for strain relief of the power supply cable

## Technical Specifications

Table 5-5 lists the technical data of the PROFIBUS terminator:

Table 5-5 Technical Specifications of the PROFIBUS Terminator

Technical Specifications	
Power supply	
<ul style="list-style-type: none"> <li>• Rated voltage</li> <li>• Ripple (static limit)</li> </ul>	24 V DC 20.4 V DC to 28.8 V DC
Power consumption at rated voltage	max. 25 mA
Electrical isolation	yes, 600 V DC
Transmission rate	9.6 Kbps to 12 Mbps
Degree of protection	IP20
Permitted ambient temperatures	0° C to 60° C
Storage temperature	- 40° C to +70° C
Connectable cables; power supply	Screw mechanism;
<ul style="list-style-type: none"> <li>• Flexible cables               <ul style="list-style-type: none"> <li>- With wire-end ferrule</li> <li>- Without wire-end ferrule</li> </ul> </li> <li>• Solid cables</li> </ul>	0.25 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.14 mm <sup>2</sup> to 2.5 mm <sup>2</sup> 0.14 mm <sup>2</sup> to 2.5 mm <sup>2</sup>
Connectable cables; PROFIBUS	Screw mechanism; all SIMATIC NET PROFIBUS cables
Dimensions W × H × D (in mm)	60 × 70 × 43
Weight (including packing)	95 g

## Connecting the PROFIBUS Cable

Connect the PROFIBUS LAN cable to the PROFIBUS terminator, as follows:

1. Cut the PROFIBUS cable to the required length.
2. Strip the insulation from the PROFIBUS cable as shown in Figure 5-10.

The braid shield must be folded back on to the cable. Only then can the shield clamp serve as strain relief and as the shield contact.

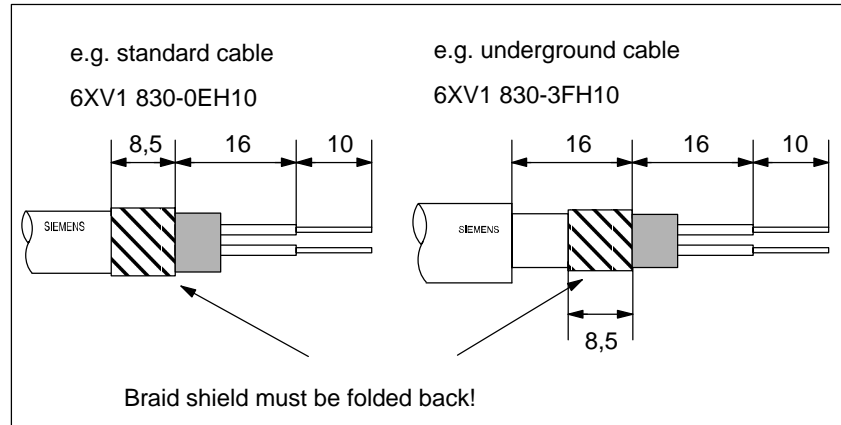


Figure 5-10 Stripping the Insulation to Connect to the PROFIBUS Terminator

3. Connect the PROFIBUS LAN cable to the PROFIBUS terminator:
 

Connect the same wires (green/red for the PROFIBUS LAN cable) to the same terminal A or B (in other words always connect terminal A with a green wire and terminal B with a red wire or vice versa).
4. Tighten the shield clamps so that the shield makes good contact with the clamp.

### Note

When installing the segment, make sure that no terminating resistor is activated on the bus connectors if the two PROFIBUS terminators are included in the PROFIBUS segment.

