5 RS 485 Repeater

5.1 Application of the RS 485 Repeater

What is an RS 485 Repeater?

An RS 485 repeater amplifies data signals on LAN cables and connects bus segments.

Using the RS 485 Repeater

You require an RS 485 repeater in the following situations:

- ➢ When there are more than 32 stations connected to the bus
- ➢ When electrically isolated bus segments are required or
- ➢ When the maximum cable length of a segment (standard LAN cable) is exceeded (see Table 5.1).

Transmission Rate	Maximum Cable Length of a Segment (in m)
9.6 to 93.75 Kbps	1000
187.5 Kbps	800
500 Kbps	400
1.5 Mbps	200
3 to 12 Mbps	100

Table 5.1: Maximum Cable Length of a Segment (Standard LAN Cable)

Rules

If you want to install the bus with RS 485 repeaters, the following rules apply:

- ➢ A maximum of 9 RS 485 repeaters can be connected in series.
- ➢ The maximum cable length between two nodes must not exceed the values in Table 5.2:

Transmission Rate	Maximum Cable Length Between Two Nodes (in m) with RS 485 Repeaters
9.6 to 93.75 Kbps	10000
187.5 Kbps	8000
500 Kbps	4000
1.5 Mbps	2000
3 to 12 Mbps	1000

Table 5.2: Maximum Cable Length Between Two Nodes (Standard LAN Cables)

5.2 Appearance of the RS 485 Repeater (6ES7 972-0AA00-0XA0)

Appearance of the RS 485 Repeater

Table 5.3 shows the elements of the RS 485 repeater:

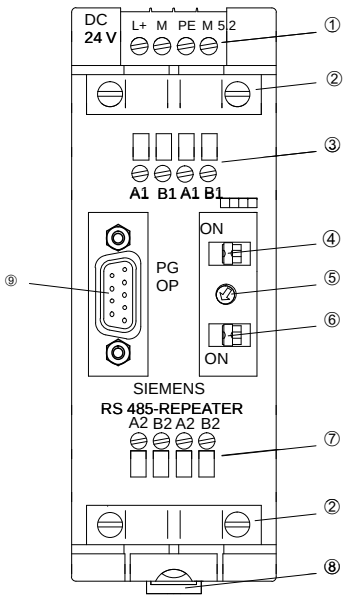
Front View of the Repeater	No.	Function
	①	Terminal for connecting the power supply of the RS 485 repeater (pin ”M5.2” is the reference ground if you want to measure the voltage between terminals ”A2” and ”B2”).
	②	Shield clamp for strain relief and grounding the LAN cable of bus segment 1 or bus segment 2
	③	Terminal for the LAN cable of bus segment 1
	④	Terminating resistor for bus segment 1
	⑤	Switch for transmission rate the settings are as follows: 0: Bus segments not connected 1: 9.6 Kbps 2: 19.2 Kbps 3: 93.75 Kbps 4: 187.5 Kbps 5: 500 Kbps 6: 1.5 Mbps 7: 3 Mbps 8: 6 Mbps 9: 12 Mbps
	⑥	Terminating resistor for bus segment 2
	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

Table 5.3: Description and Functions of the RS 485 Repeater

☞ **Terminal M5.2 of the power supply (see Table 5.3,①) is used as the reference ground for signal measurements if problems occur and must not be wired up.**

Technical Data

Table 5.4 shows the technical data of the RS 485 repeater:

Technical Data	
Power supply – Rated voltage – Ripple	 24 V DC 18 V to 30 V DC
Power consumption at rated voltage – Without load on the PG/OP connector – Load on the PG/OP connector (5 V/90 mA) – Load on the PG/OP connector (24 V/100 mA)	 100 mA 130 mA 200 mA
Electrical isolation	yes, 500 V AC
Redundant mode	no
Transmission rate	9.6 Kbps to 12 Mbps
Degree of protection	IP 20
Dimensions W × H × D (in mm)	45 × 128 × 67
Weight (including packing)	350 g

Table 5.4: Technical Data of the RS 485 Repeater

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

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

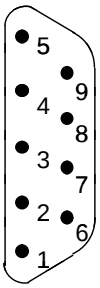
Layout	Pin No.	Signal Name	Meaning
	1	–	–
	2	M24V	Chassis 24 V
	3	RxD/TxD-P	Data line B
	4	RTS	Request To Send
	5	M5V2	Data reference voltage (of station)
	6	P5V2	Power plus (from station)
	7	P24V	24 V
	8	RxD/TxD-N	Data line A
	9	–	–

Table 5.5: Pin Assignment of the 9-Pin Sub D Connector PG/OP Connector

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

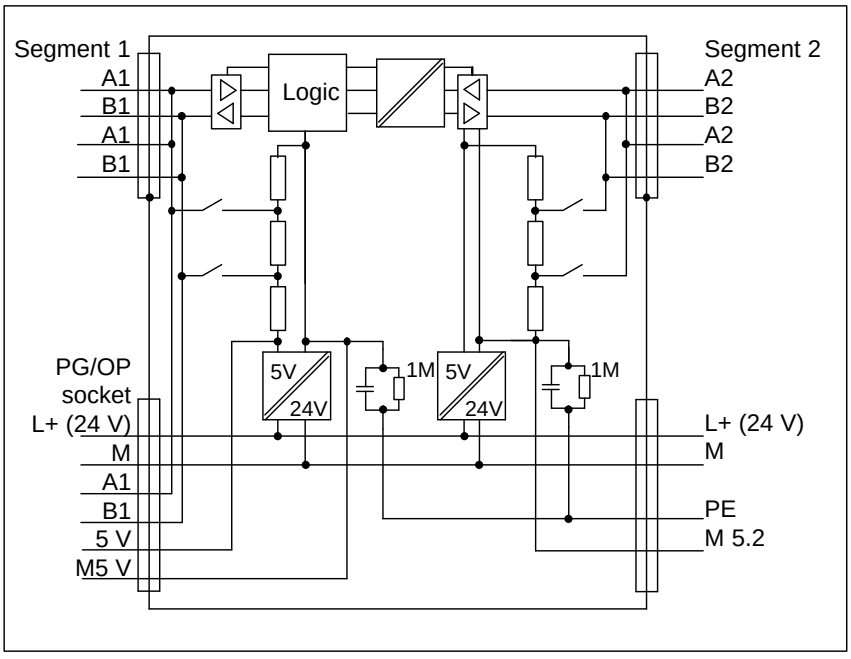


Figure 5. 1: Block Diagram of the RS 485 Repeater

5.3 Possible Configurations with the RS 485 Repeater

Overview

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

- ➢ Segment 1 and Segment 2 terminated on the RS 485 repeater
- ➢ Segment 1 terminated on the RS 485 repeater and Segment 2 connected through on the RS 485 repeater
- ➢ Segment 2 terminated on the RS 485 repeater and Segment 1 connected through on the RS 485 repeater
- ➢ Segment 1 and Segment 2 connected through on the RS 485 repeater

Terminating Resistor On/Off

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

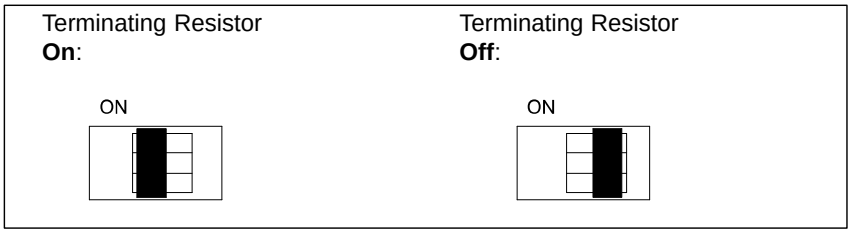


Figure 5. 2: Setting of the Terminating Resistor

Segments 1 and 2 Terminated

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

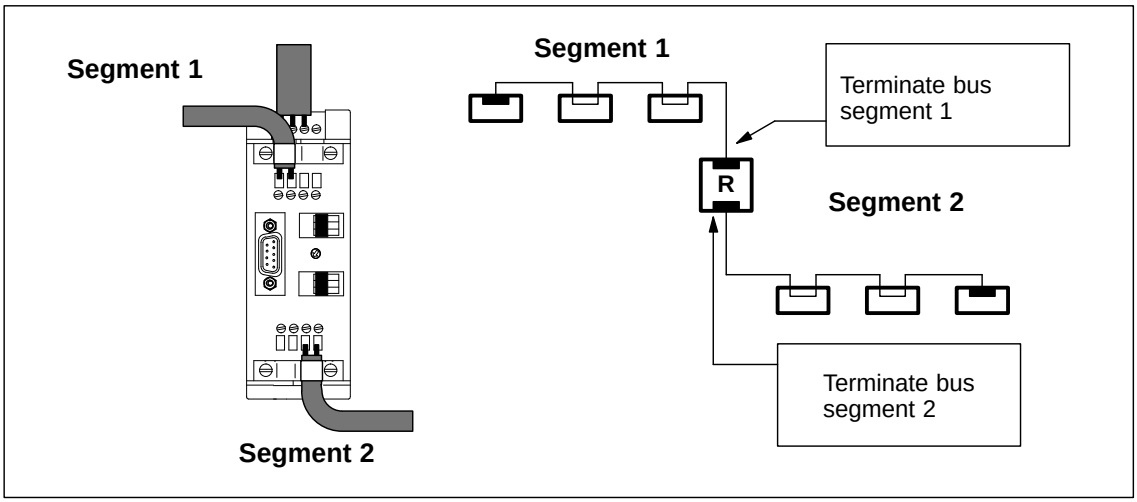


Figure 5. 3: Connecting Two Bus Segments to the RS 485 Repeater (1)

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:

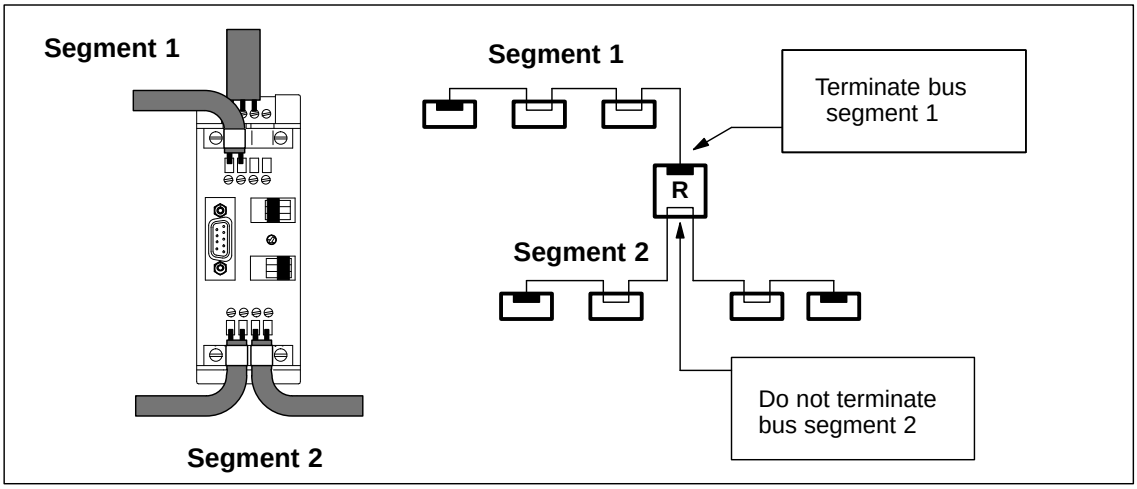


Figure 5. 4: Connection of Two Bus Segments on the RS 485 Repeater (2)

Segments 1 and 2 Connected Through

Figure 5. 5 shows the connection of two segments via an RS 485 repeater with both LAN cables connected through on the repeater.

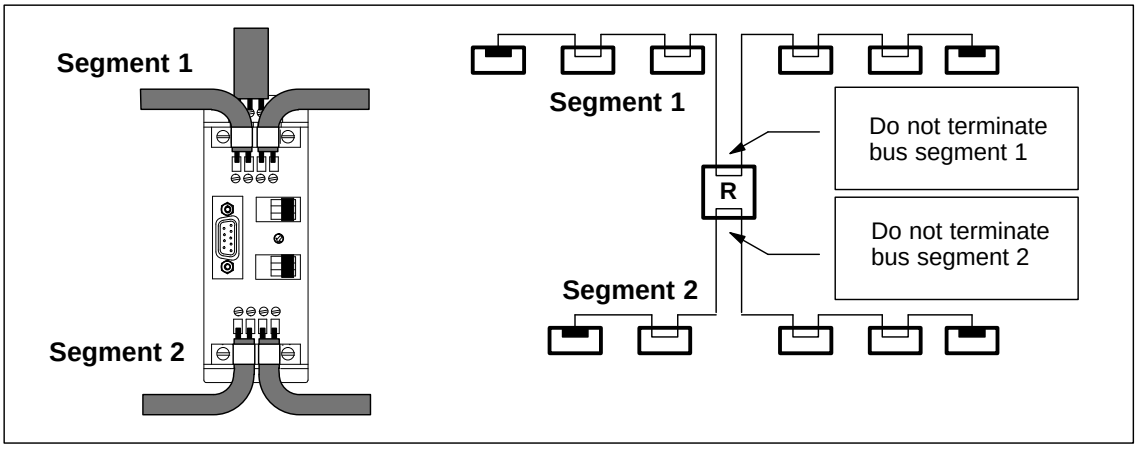


Figure 5. 5: Connection of two Bus Segments on the RS 485 Repeater (3)

5.4 Installing and Uninstalling the RS 485 Repeater

Overview

You can install the RS 485 repeater as follows:

➢ On a rail for S7-300

or

➢ On a standard rail (DIN EN 500 22-35x7.5)

Installation on a Rail for S7-300

To install the RS 485 repeater on a rail for S7-300s, 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).

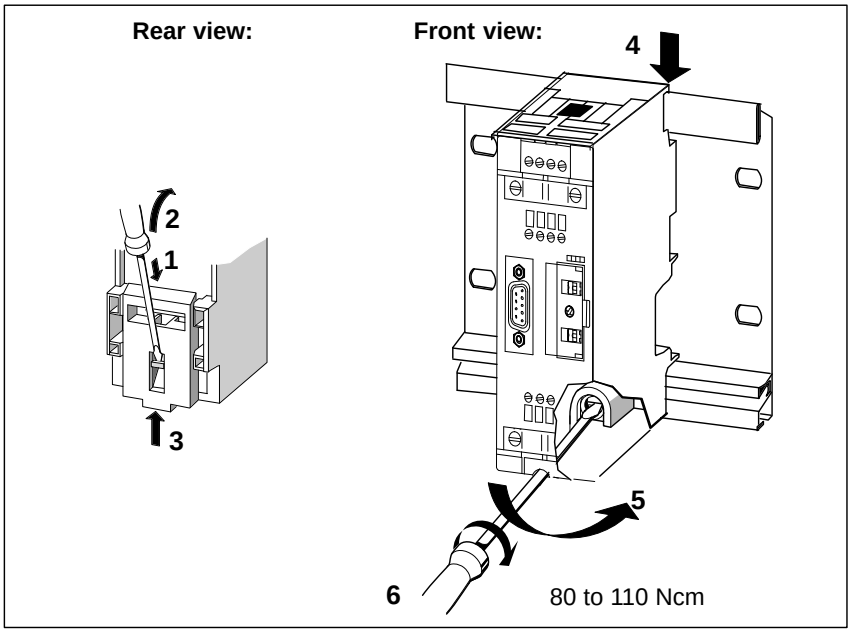


Figure 5. 6: Installing the RS 485 Repeater on a Standard Rail for an S7-300

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).

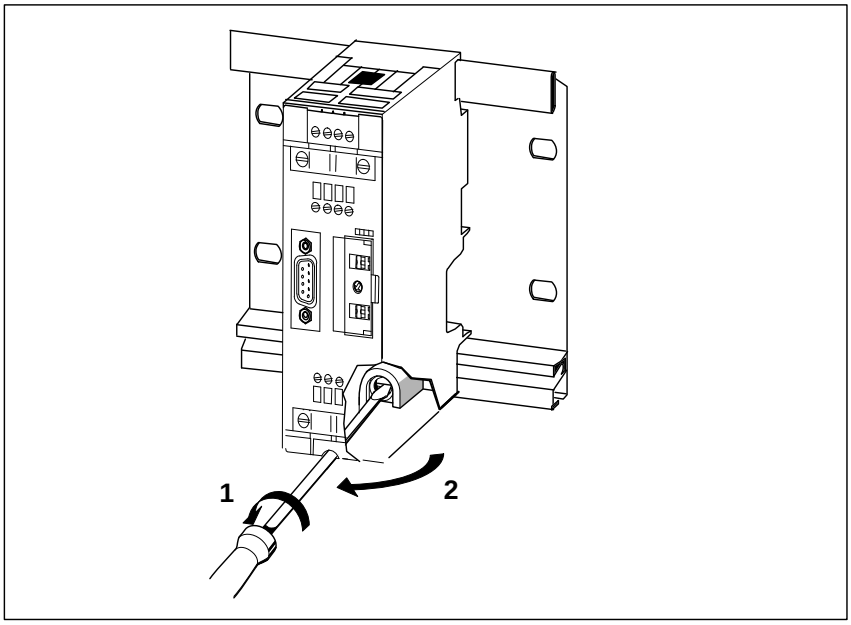


Figure 5. 7: Removing the RS 485 Repeater from the S7-300 Rail

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.

5.5 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.

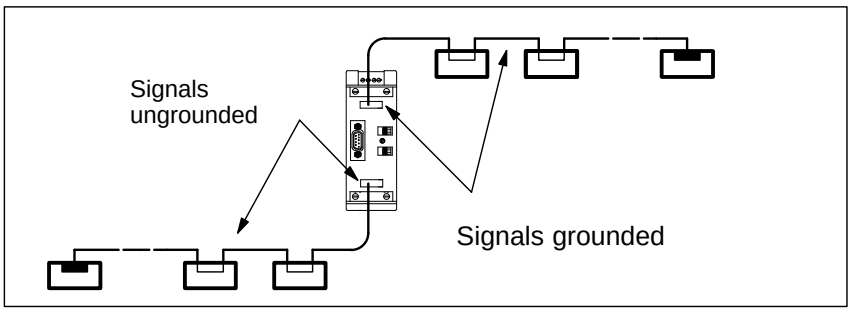


Figure 5. 8: Ungrounded Operation of ET200 Bus Segments

5.6 Connecting the Power Supply

Cable Type

To connect the 24 V power supply, use flexible cables with a cross section of 0.25 mm^2 to 2.5 mm^2 (AWG 26 to 14). Use suitable wire-end ferrules for the wire cross section.

Rules for Cabling

Appendix D contains detailed information about cabling.

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”.

5.7 Connecting the LAN Cables

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

1. Cut the PROFIBUS LAN cable to the required length.

2. Strip the insulation from the PROFIBUS LAN cable as shown in Figure 5. 9.

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

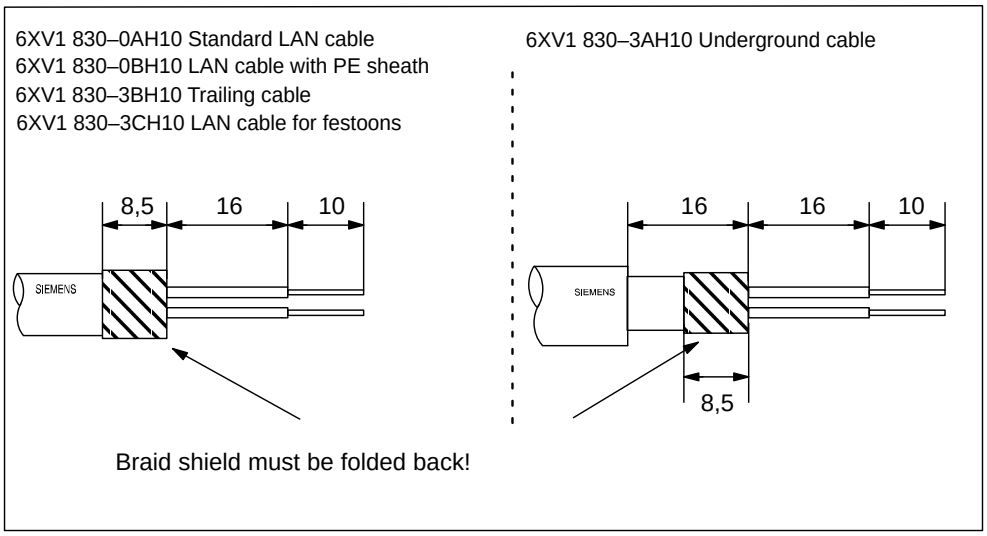


Figure 5. 9: Lengths for Stripping the Cable to Connect it to the RS 485 Repeater

3. Connect the PROFIBUS LAN 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.