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Siemens PROFIBUS Standard Repeater Termination Guide

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1. Introduction

This document provides an overview of the Siemens SIMATIC RS-485 Repeater and guidance on its correct installation, wiring and termination within a PROFIBUS Decentralised Peripheral (DP) network. It covers the four possible wiring configurations and related termination settings.

The SIMATIC RS-485 Repeater is also referred to as the Siemens Standard Repeater or Siemens Standard PROFIBUS Repeater. The concepts around wiring and terminations would apply to most 2 Segment Standard PROFIBUS Repeaters for example B1 Repeater from Anybus.

This document is intended for persons working in the fields of configuring, commissioning, and servicing automation systems. General knowledge of automation technology is required to understand the document.

2. Overview

The SIMATIC RS-485 Repeater amplifies data signals (amplitude, edge slope and signal width) on PROFIBUS DP (RS-485) bus cables and links PROFIBUS DP segments together.

A SIMATIC RS-485 Repeater is required in the following situations:

- When there are more than 32 devices with RS-485 interfaces (including PROFIBUS DP Masters, PROFIBUS DP Slaves, Repeaters, OLMs (optical link modules) & Couplers) connected to the PROFIBUS DP segments. A maximum of 127 PROFIBUS Addressable Devices (including PROFIBUS DP Masters, PROFIBUS DP Slaves, Diagnostic Repeaters, DP/PA Link Modules, DP/PA Couplers) are allowed per PROFIBUS DP network (Addresses: 0-126).
- When the maximum cable length of a segment (baud rate dependent) is exceeded.

Transmission rate	Max. cable length of a bus segment (in m)
9.6 to 187.5 kbps	1000
500 kbps	400
1.5 Mbps	200
3 to 12 Mbps	100

Table 1: Maximum allowed cable length per segment based on the transmission rate

- When electrically isolated PROFIBUS DP segments are required (for example some segments underground, different potential earths, different floors in a building, branching to electrically noisy equipment such as VSDs (Variable Speed Drives), large motors and arc furnaces).
- The signals are to be regenerated in amplitude and time to increase network distance and signal integrity.

Note: You can connect a maximum of nine SIMATIC RS-485 Repeaters in series.

Refer to the Siemens SIMATIC RS 485 Repeater User Manual for more information.

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3. Technical Specifications

Below are the technical specifications for the SIMATIC RS-485 Repeater.

Technical Specifications	
Power supply • Rated voltage • Ripple (static limit)	 24 V DC 20.4 V DC to 28.8 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)	 200 mA 230 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

Table 2: SIMATIC RS-485 Repeater Technical Specifications

4. Design of the SIMATIC RS-485 Repeater

The following table shows the design and function of the SIMATIC RS-485 Repeater:

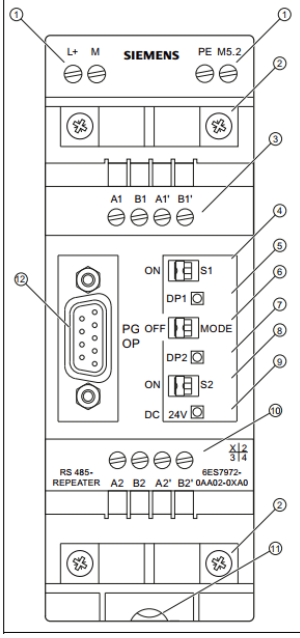
Design of the repeater	no.	Function
	①	Connection for the RS 485 repeater power supply (pin "M5.2" is the ground reference, if you want to measure the voltage difference between terminals "A2" and "B2").
	②	Shield clamp for the strain relief and grounding of the bus cable of bus segments 1 or 2
	③	Terminals for the bus cable of bus segment 1
	④	Switches for terminating resistance for bus segment 1
	⑤	LED for bus segment 1
	⑥	OFF switch (= isolate bus segments from each other, for example, for commissioning)
	⑦	LED for bus segment 2
	⑧	Switches for terminating resistance for bus segment 2
	⑨	LED 24 V supply voltage
	⑩	Terminals for the bus cable of bus segment 2
	⑪	Slide for mounting and removing the RS 485 repeater on the standard mounting rail
	⑫	Interface for PG/OP on bus segment 1

Table 3: SIMATIC RS-485 Repeater Design & Functions

5. Installing a SIMATIC RS-485 Repeater

You can install a SIMATIC RS-485 Repeater as follows:

- On an S7-300 mounting rail
- On a standard mounting rail

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5.1. Installing a SIMATIC RS-485 Repeater on an S7-300 Mounting Rail

To install the SIMATIC RS-485 Repeater on an S7-300 mounting rail, the catch on the rear of the SIMATIC RS-485 Repeater must first be removed (see below figure):

Insert the screwdriver below the tongue of the catch (1) and

1. Push the screwdriver towards the rear of the module (2). Hold the screwdriver in this position.
   Result: The catch of the SIMATIC RS-485 Repeater is released.
2. Using your free hand lift the catch as far as it will go and then remove the catch (3).
   Result: The catch is removed from the SIMATIC RS-485 Repeater.
3. Fit the SIMATIC RS-485 Repeater into the S7-300 mounting rail (4).
4. Push it towards the back as far as it will go (5).
5. Tighten the securing screw with a torque of 80 to 110 Ncm (6).

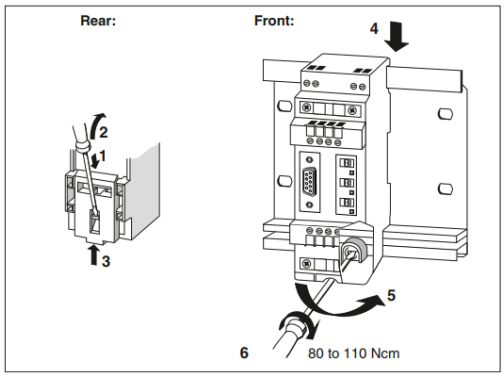


Figure 1: Installing the SIMATIC RS-485 Repeater on an S7-300 mounting rail

5.2. Installing a SIMATIC RS-485 Repeater on a Standard Mounting Rail

To install on a standard mounting rail, the catch must be present on the rear of the SIMATIC RS-485 Repeater:

1. Fit the SIMATIC RS-485 Repeater into the standard mounting from above and
2. Push it towards the back until the catch locks it in place

6. Uninstalling a SIMATIC RS-485 Repeater

You can uninstall a SIMATIC RS-485 Repeater as follows:

- From an S7-300 mounting rail
- From a standard mounting rail

6.1. Uninstalling a SIMATIC RS-485 Repeater from an S7-300 Mounting Rail

To remove the SIMATIC RS-485 Repeater from the S7-300 mounting rail:

1. Loosen the fixing screw of the SIMATIC RS-485 Repeater (1) and
2. Pull the SIMATIC RS-485 Repeater up and out (2).

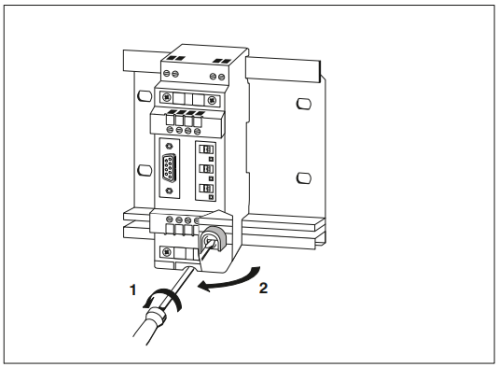


Figure 2: Removing the RS-485 Repeater on an S7-300 mounting rail

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6.2. Uninstalling a SIMATIC RS-485 Repeater from a Standard Mounting Rail

To remove the SIMATIC RS-485 Repeater from the standard mounting rail:

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

7. Connecting the PROFIBUS Cable

Connect the PROFIBUS cable to the SIMATIC 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 4. The braided shield must be folded back onto the cable. Only then can the shield clamp serve as strain relief and as the shield contact.

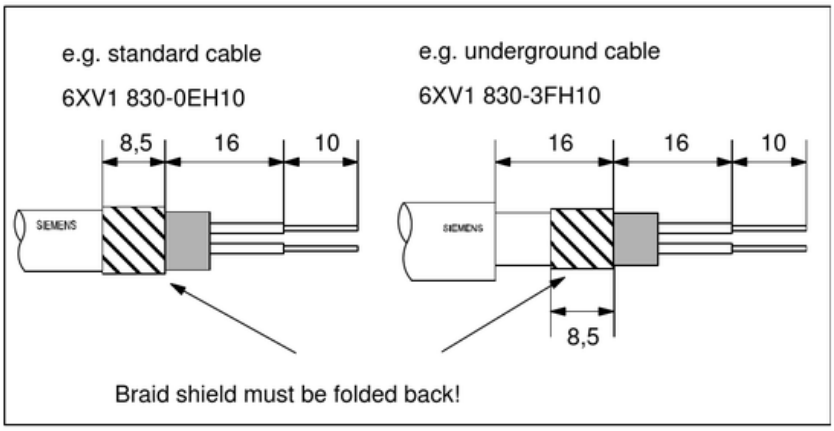


Figure 3: Stripping the Cable to Connect it to the RS-485 Repeater

3. Cut the PROFIBUS cable to the required length.
4. Connect the PROFIBUS cable to the PROFIBUS Standard Repeater:
   Connect the same wires (green/red for the PROFIBUS 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).
5. Tighten the shield clamps so that the shield makes good contact with the clamp.
6. Connect the PROFIBUS cable to the SIMATIC RS-485 repeater:
   Connect the same wires (green/red for the PROFIBUS 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). Tighten the shield clamps so that the shield makes good contact with the clamp.

You can also find the stripping length printed on the SIMATIC RS-485 repeater:

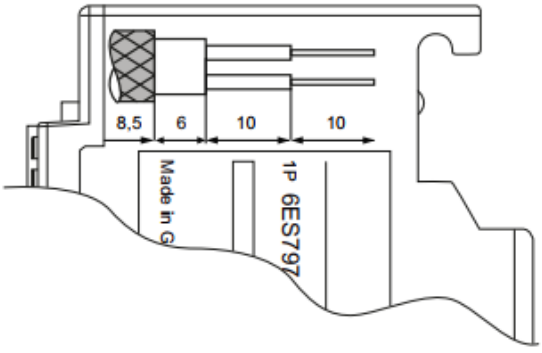


Figure 4: SIMATIC RS-485 Repeater Cable Stripping Length Markings

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8. RS-485 Repeater Rules

If you set up a PROFIBUS network with SIMATIC RS-485 repeaters:

- Up to a maximum of nine SIMATIC RS-485 repeaters may be connected in series.
- The number of SIMATIC RS-485 repeaters in series must be configured with the PLC program.
- The maximum cable length between two nodes with nine SIMATIC RS-485 repeaters between them may not exceed the values listed in the table below:

Transmission rate	Maximum cable length between 2 nodes (in m) with RS 485 repeater
9.6 to 187.5 kbps	10000
500 kbps	4000
1.5 Mbps	2000
3 to 12 Mbps	1000

Table 3: Maximum permitted cable length per transmission rate for 9 Siemens standard repeaters in series

9. Termination Resistor

Below shows the ON / OFF setting for the termination resistor on the Siemens Standard Repeater. ON the termination resistor switch is set to the left. OFF the termination resistor switch is set to the right. There are two termination resistors one for Segment 1 (Top) and the other for Segment 2 (Bottom).

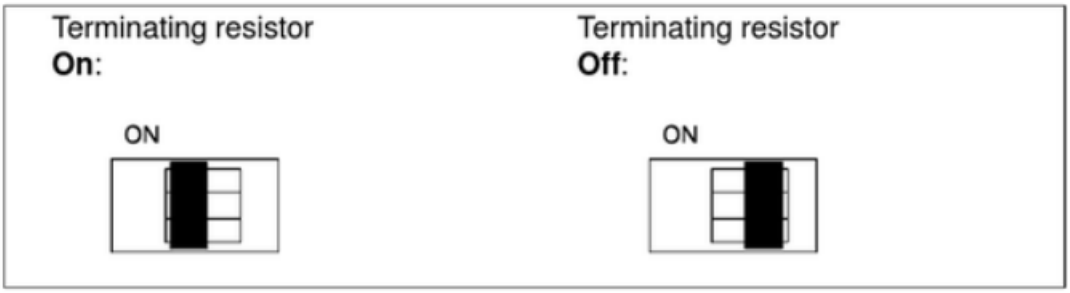


Figure 5: Standard repeater termination setting

Where only one cable is wired into Segment 1 (Top) or Segment 2 (Bottom) of the SIMATIC RS-485 Repeater the relevant Terminating resistor must be set to ON and where two cables are wired into Segment 1 (Top) or Segment 2 (Bottom) of the SIMATIC RS-485 Repeater the relevant terminating resistor must be set to OFF.

The reason is, if only one cable is wired in/out of the top/bottom then this means the relevant segment ends/begins at the SIMATIC RS-485 Repeater and termination is required for that segment and the Terminating resistor should be set to ON whilst if two cables are wired through the top or bottom of the SIMATIC RS-485 Repeater then this means the segment daisy chains (connects) through the SIMATIC RS-485 Repeater and termination is not required at the SIMATIC RS-485 Repeater and the Terminating resistor should be set to OFF and Termination should be enabled elsewhere on that segment namely at the begin and end of the segment.

10. Four Wiring Configurations for a SIMATIC RS-485 Repeater

There are four possible configurations in terms of wiring a SIMATIC RS-485 Repeater namely:

1. Segment 1 and Segment 2 both terminated on the SIMATIC RS-485 Repeater
2. Segment 1 terminated on the SIMATIC RS-485 Repeater and Segment 2 daisy-chained through on the SIMATIC RS-485 Repeater
3. Segment 1 daisy-chained through on the SIMATIC RS-485 Repeater and Segment 2 terminated on the SIMATIC RS-485 Repeater
4. Segment 1 and Segment 2 are both daisy-chained through on the SIMATIC RS-485 Repeater

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The following four sections show the wiring and related termination resistor settings for the above four possible configurations.

10.1. Configuration 1: Segment 1 and Segment 2 Terminated

In this scenario, two PROFIBUS DP segments are joined together at the SIMATIC RS-485 Repeater with Segment 1 ending and Segment 2 beginning at the SIMATIC RS-485 Repeater. Both terminating resistors should be ON.

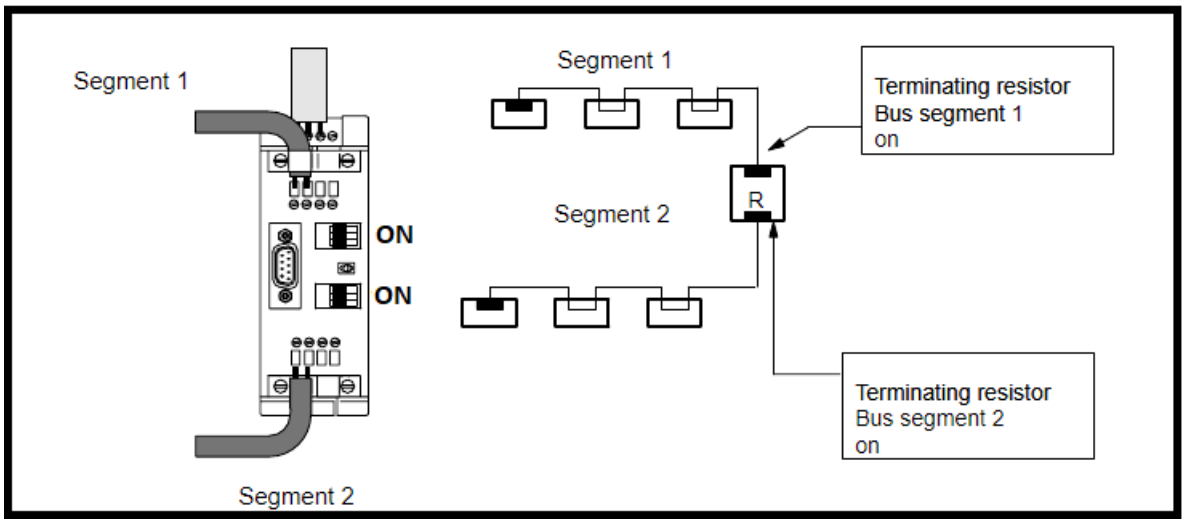


Figure 6: Segment 1 and Segment 2 Terminated

A maximum of 31 devices with RS-485 interfaces can be attached to Segment 1 and Segment 2, respectively.

10.2. Configuration 2: Segment 1 Terminated and Segment 2 Daisy Chained

In this scenario, two PROFIBUS DP segments are joined together at the SIMATIC RS-485 Repeater with Segment 1 terminating at the SIMATIC RS-485 Repeater and Segment 2 daisy-chained through the SIMATIC RS-485 Repeater.

The Segment 1 terminating resistor should be ON, and the Segment 2 terminating resistor should be OFF. The two required terminations for Segment 2 should be set to ON at the beginning and end of Segment 2.

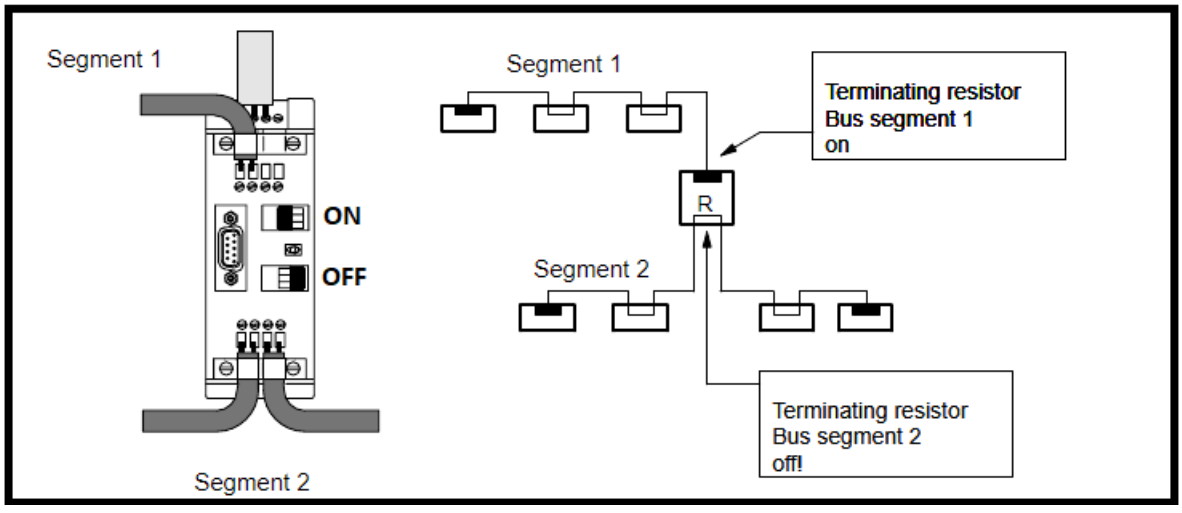


Figure 7: Segment 1 Terminated and Segment 2 Daisy Chained Through

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A maximum of 31 devices with RS-485 interfaces can be attached to Segment 1 and Segment 2, respectively. Segment 2 devices can be found both to the left and right of the SIMATIC RS-485 Repeater as Segment 2 is daisy-chained through the SIMATIC RS-485 Repeater.

10.3. Configuration 3: Segments 1 Daisy Chained and Segment 2 Terminated

In this scenario, two PROFIBUS DP segments are joined together at the SIMATIC RS-485 Repeater with Segment 1 daisy-chained through the SIMATIC RS-485 Repeater and Segment 2 terminating at the SIMATIC RS-485 Repeater.

The Segment 1 terminating resistor should be OFF, and the Segment 2 terminating resistor should be ON. The two required terminations for Segment 1 should be set to ON at the beginning and end of Segment 1.

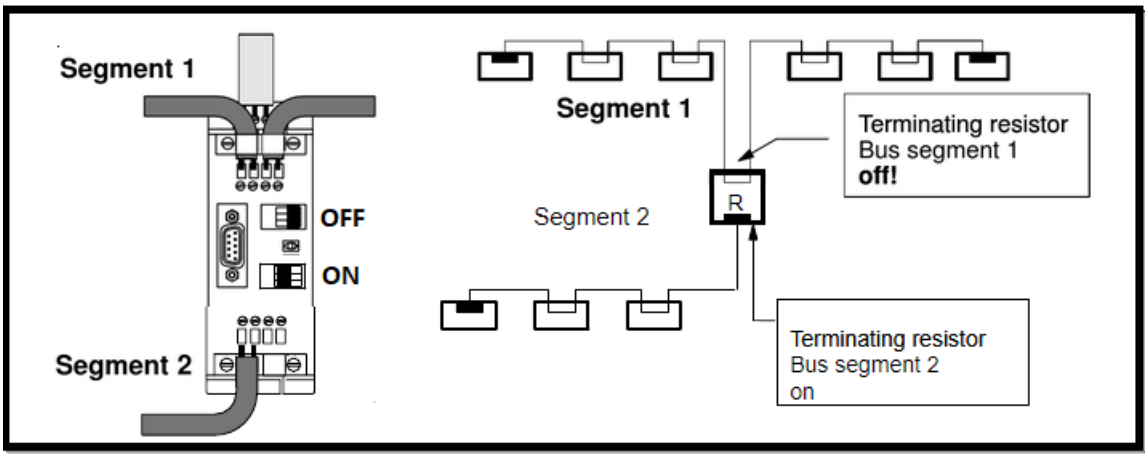


Figure 8: Segment 1 Daisy Chained Through and Segment 2 Terminated

A maximum of 31 devices with RS-485 interfaces can be attached to Segment 1 and Segment 2, respectively. Segment 1 devices can be found both to the left and right of the SIMATIC RS-485 Repeater as Segment 1 is daisy-chained through the SIMATIC RS-485 Repeater.

10.4. Configuration 4: Segments 1 and 2 Daisy Chained Through

In this scenario, two PROFIBUS DP segments are joined together at the SIMATIC RS-485 Repeater with Segments 1 and 2 both daisy-chained through the SIMATIC RS-485 Repeater. The two required terminations for Segments 1 and 2 are at the two opposite ends of the respective segments. Both terminating resistors for Segment 1 and 2 should be OFF.

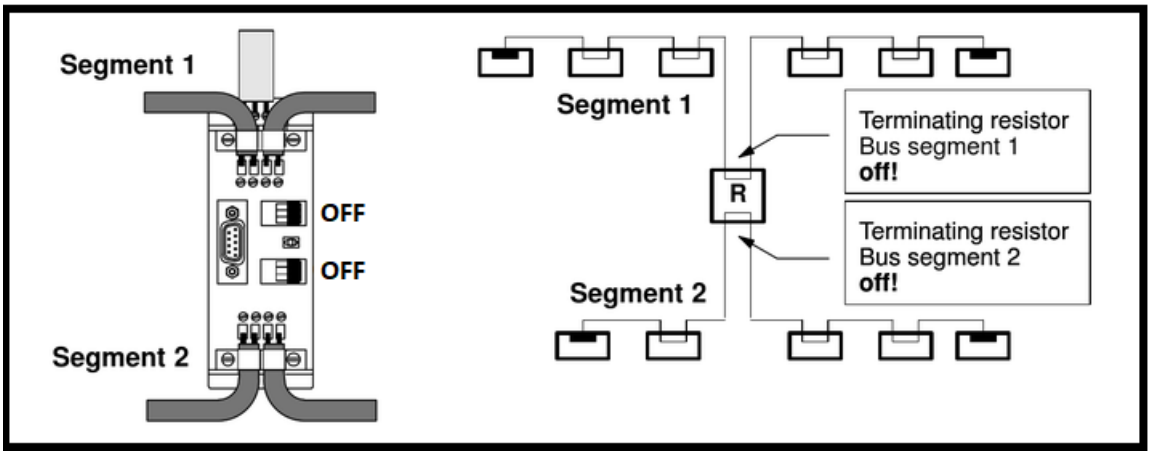


Figure 9: Segment 1 and Segment 2 Daisy Chained Through

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A maximum of 31 devices with RS-485 interfaces can be attached to Segment 1 and Segment 2, respectively. Segment 1 and Segment 2 devices can be found both to the left and right of the SIMATIC RS-485 Repeater as both Segment 1 and Segment 2 are daisy-chained through the SIMATIC RS-485 Repeater.

11. PG Port

The PG Port on the SIMATIC RS-485 repeater (refer to function item 12 in section 4 Design of the SIMATIC RS-485 Repeater) is connected to Segment / Bus 1 back towards the PLC from the end of the previous segment.

One recommendation is to install the SIMATIC RS-485 repeater upside down (or wire it in reverse Segment 1 into the bottom and Segment 2 into the top) so when plugging into the PG Port on the SIMATIC RS-485 repeater you are analysing Segment / Bus 2, the beginning of the next segment.

12. Powering Off Complete Bus Segments

When you turn off the power supply of a complete bus segment, the terminating resistors of the connected nodes are also without a power supply. This can lead to disruptions or undefined signal states in this bus segment that are not recognized by the RS-485 repeater and can then lead to problems in the other bus segment.

Whenever possible, we recommend the following procedure:

- Alternative 1: Disconnect the two bus segments before turning off the power supply using switch 6 (refer to Design of the SIMATIC RS-485 Repeater) on the repeater (set to "OFF").
- Alternative 2: Connect the SIMATIC RS-485 repeater to the power supply of the bus segment to be turned off so that the repeater is also turned off. In this case, make sure that the SIMATIC RS-485 repeater is not at the end of the previous bus segment since the SIMATIC RS-485 repeater then acts as the terminator which has no effect if there is no power supply. If this solution is required, use a PROFIBUS terminator with a permanent power supply downstream from the RS-485 repeater.
- Alternative 3: If you want the SIMATIC RS-485 repeater to retain its power supply, use PROFIBUS terminators to terminate the bus segment you want to turn off since these also require a permanent power supply. You require 1 terminator if the bus segment to be turned off, ends at the SIMATIC RS-485 repeater, otherwise you require 2 terminators.

13. Siemens SIMATIC RS-485 Repeater vs Siemens SIMATIC Diagnostic Repeater for PROFIBUS-DP

Compared to the SIMATIC RS-485 repeater, the Siemens Diagnostic Repeater has new characteristics namely diagnostic function and modelling as the DP slave.

For additional information, refer to IDXT1102 Siemens PROFIBUS Diagnostic Repeater Termination Guide and the Siemens SIMATIC Diagnostic Repeater for PROFIBUS-DP User Manual.

About Industrial Data Xchange:

Industrial Data Xchange (IDX) provides industrial ICT products, services, solutions and training that connect plant infrastructure and transform complex data into actionable insights, supporting smarter decisions and operational excellence.

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