

Fig. 13/34 RS485 bus cable system (left) / 7XV5103 cable and connector modules / adapters (right)

Description

The RS485 bus is a low-cost half-duplex communication bus, which, due to its relatively high interference immunity, is not only used for monitoring and control in industrial systems, but is now increasingly used for SCADA and protection applications by utilities in substations. Protocols, such as DIGSI, IEC 60870-5-103, DNP 3 and MODBUS up to 115 kbit/s, are used between a station master and up to 31 slave devices on shielded twisted-pair (STP) cable. In ideal conditions, the length of the bus may be up to 1000 m. This requires correct configuration of the bus, use of suitable cables, and connector connectors, as well as correct termination of the bus. Devices with different termination methods require special adaptors to achieve the highest possible interference immunity. The RS485 bus systems 7XV5103 are optimized in this respect for our control and protection product range.

With the ordering code 7XV5103, two different RS485 bus systems are available.

When combining the required components for a RS485 bus, the corresponding application examples contained in this document can be of assistance.

The bus system with 9-pin SUB-D connectors has long been applied in systems with SIPROTEC protection devices, 7XV5 converters, and master units. Connection to the individual devices is achieved directly with a special Y-cable or with a corresponding adapter cable to devices with different termination methods. The bus terminates in a 9-pin SUB-D bus terminating connector with an integrated 220-Ω resistor.

On some SIPROTEC devices, the serial signals are routed to RJ45 female connectors on the communication module, as is the case, for example, with the redundant IEC 60870-5-103 module. There the bus is based on double-shielded CAT 5 patch cables. Connection of the individual devices to the two redundant buses is achieved via two special Y-adapter cables each. The buses each terminate with a RJ45 bus terminating connector with a 120-Ω resistor.

A combination of the two bus systems and the different device interfaces or a combination of the two systems is also possible using the Y-adapter cable 7XV5103-2BA00.

Function overview

- For data transfer up to 115 kbit/s (e.g. DIGSI, IEC 60870-5-103, DNP 3)
- Variable bus structure with shielded cables of various lengths.
- Metal-plated, shielded connector housings with reduced mounting depth and strain relief.
- Bus termination with terminating connectors and integrated resistor.
- Connection of the SIPROTEC 4 protection devices with redundant IEC 60870-5-103 interface via the Y-adapter cable and RJ45 connector.
- Connection of the SIPROTEC 4 protection devices with RS485 interface and SUB-D connector directly, or via a Y-adapter cable.
- Adapter/cable for compact protection devices with RS485 interface on screw-type terminals, e.g. 7SJ600, 7SD600, 7RW600 etc.
- Connection to various RS485 converters, e.g. 7XV5650/51.
- Combination of both bus systems is possible.
- Max. length of the bus within a common grounding system may be up to 1000 m.

Please note that this system must not be used for PROFIBUS-FMS or PROFIBUS-DP. These have their own bus system with components suitable for use with PROFIBUS.

Application

Application

Notes on configuring the RS485 bus system

The housings of all devices connected to the bus must be solidly grounded to a common ground to avoid dangerous ground currents flowing via the cable shields.

Larger distances, especially into other buildings with separate grounding system should preferably be covered via converters (e.g. 7XV5650/51) using FO links.

The RS485 bus must be linear, i.e. tee-offs from the bus (e.g. a terminal strip) to the connected bus devices must not be used. This would form a star configuration, which has negative influence on the functionality.

The bus must be terminated at the first device (usually the master) and at the last device with a bus terminating resistor to avoid interference due to reflection. No further terminating resistors must be connected between these terminals.

As all of the devices, maximum 32 (including the master) are listening in on the RS485 bus, all the devices on the bus must be set to the same baud rate and the same data format.

The slaves must all have different device addresses.

Within the system, only one master may be active at any one time and only one slave may respond.

The bus system with 9-pin SUB-D connectors

The bus system with 9-pin SUB-D bus terminating connectors has long been used with SIPROTEC protection devices, the converters 7XV5 and Siemens master units. Connection of individual devices to devices with various connection modes is achieved directly via specialized Y cables, or via suitable adapter cables. The bus terminates at a 9-pin SUB-D bus terminating connector with an integrated 220-Ω resistor.

Specifications

- Direct connection to SIPROTEC 4 protection devices with RS485 interface via a FO-RS485 converter 7XV5650/51
- Adapter/cable for compact protection devices with RS485 interface on screw-type terminals, e.g. 7SJ600, 7SD600, 7RW600 etc.
- 4 cable lengths from 1 to 10 meters
- Shielded twisted-pair (STP) cable with 9-pin SUB-D connector connectors
- Metal-plated, shielded connector housings with reduced mounting depth and strain relief
- Data transfer up to 115 kbit/s (e.g. DIGSI, IEC 60870-5/VDEW)
- Maximum length of the bus up to 1000 m within a common grounding system
- Bus termination with terminating connectors and integrated 220-Ω resistor

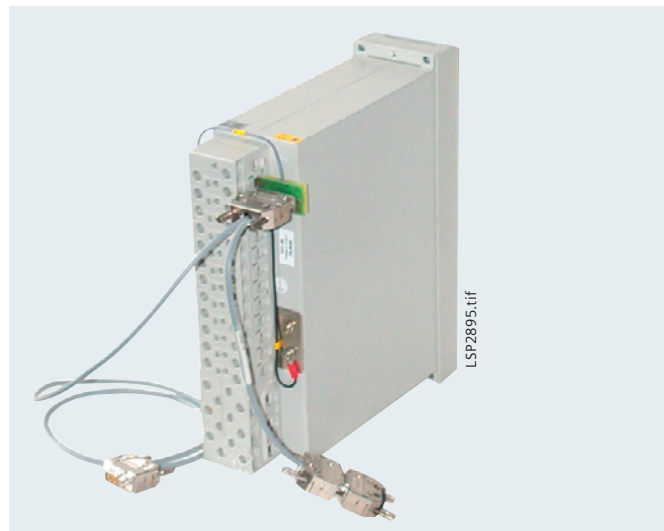


Fig. 13/35 Protection unit connected to the RS485 bus

Application example 1:

The 9-pin male connector of the Y bus cable S1 always comes from the master side and provides the connection to the slaves via the 1, 3, 5 or 10-m cable and 9-pin male connector S2. At the connector S2 a 20-cm long cable with a 9-pin female connection B3 is provided to extend the bus. The compact protection devices, e.g. 7SJ600 are directly connected via the adapter cable 7XV5103-2AA00 with female connector B2 or an RS485 adapter 7XV5103-3AA00. After the final device, a bus terminating connector 7XV5103-5AA00 is connected to connector B3 to terminate the bus.

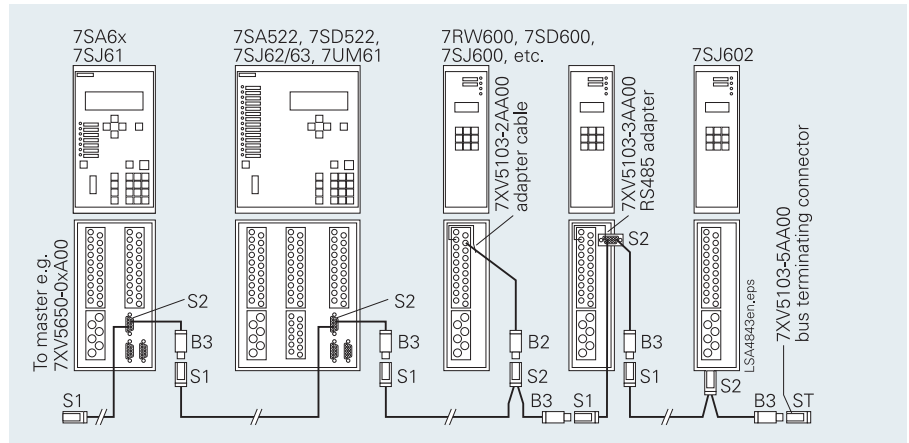


Fig. 13/36 SIPROTEC protection devices on the RS485 bus

Selection and ordering data

Description	Order No.
RS485 Y-bus cable shielded twisted pair with 9-pin SUB-D connectors 7XV5103 RS485 bus with SUB-D connectors	7XV5103-0AA□□
Length 1 m	0 1
Length 3 m	0 3
Length 5 m	0 5
Length 10 m	1 0
RS485 bus extension cable STP with 9-pin SUB-D connector	7XV5103-1AA□□
Length 10 m	1 0
Length 20 m	2 0
Length 30 m	3 0
Length 40 m	4 0
Length 50 m	5 0
RS485 adapter	7XV5103-□AA00
Adapter cable with STP with ferrule/9-pin SUB-D connector for units with screw-type terminals or compact protection units, e.g. 7SJ600, 7SD600 etc.	2
RS485 adapter with 9-pin SUB-D connector formounting on screw-type terminals on compact protection units, e.g. 7SJ600, 7SD600 etc.	3
Bus terminating connector 220-Ω, 9-pin SUB-D connector	5
RS485 cable to thermo-box (RTD)	7XV5103-7AA□□
For connection between the 7XV5662-□AD10 thermo-box and SIPROTEC 4 units (port C or port D with RS485 interface)	
Length 5 m	0 5
Length 25 m	2 5
Length 50 m	5 0

Application

Bus system with RJ45 patch cables

The bus system with RJ45 connectors was specially developed for SIPROTEC devices for communication modules with serial RJ45 connectors and is built with low cost double-shielded CAT 5 patch cables.

Connection of the individual devices to the two redundant buses is achieved via two special Y-adapter cables each. The buses each terminate with a RJ45 bus terminating connector with an integrated 120-Ω resistor.

Specifications

- Low-cost bus structure with shielded patch cables (CAT 5) with RJ45 connectors
- Cable lengths from 0.5 to 20 meters (7KE6000-8G)
- Connection of SIPROTEC 4 protection devices with redundant IEC 60870-5-103 interfaces via Y-adapter with RJ45 connector
- Connection of SIPROTEC 4 protection devices with RS485 interface via Y-cable to SUB-D connector
- Adapter/cable for compact protection devices, e.g. 7SJ600, 7SD600, 7RW600 etc.
- Metal-plated connector housings with strain relief of the cable connections
- Compact connectors
- Data transfer up to 115 kbit/s (e.g. DIGSI, IEC 60870-5/VDEW)
- Maximum extension of the bus of up to 800 m within a common grounding system
- Bus termination with terminating connectors and integrated 120-Ω resistor
- Connection to the FO-RS485 converter 7XV5650 or the bus system with SUB-D connector via Y-adapter

Notes on configuring the RS485 bus system (application examples 2 and 3, see page 13/9)

The housings of all devices connected to the bus must be solidly grounded to a common ground to avoid dangerous ground currents flowing via the cable shields.

Larger distances, especially into other buildings with separate grounding system should preferably be covered via converters (e.g. 7XV5650/51) using FO cables.

The RS485 bus must be linear, i.e. tee-offs from the bus (e.g. a terminal strip) to the connected bus devices must not be used.

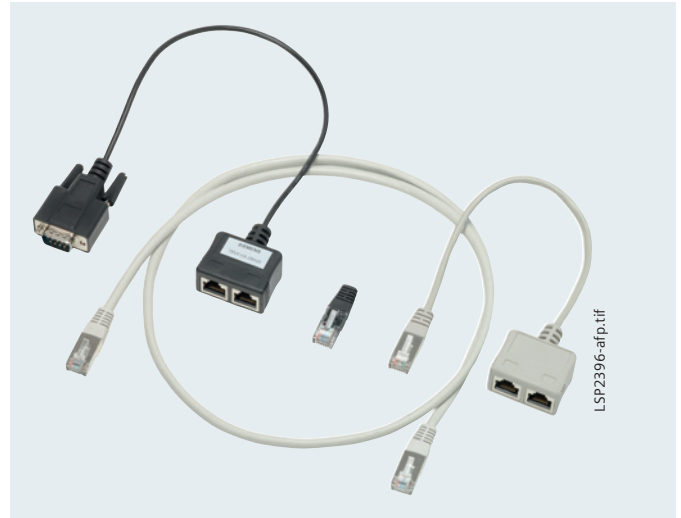


Fig. 13/37 Bus system with RJ45 patch cable

This would form a star configuration, which has negative influence on the functionality.

Only CAT 5 double-shielded patch cables (e.g. 7KE6000) must be used as the bus cables. The maximum bus length must not exceed 800 m.

The bus must be terminated at the first device (usually the master) and at the last device with a bus terminating resistor to avoid interference due to reflection. No further terminating resistors must be connected between these terminals.

As all of the devices, maximum 32 (including the master) are listening in on the RS485 bus, all the devices on the bus must be set to the same baud rate and the same data format. The slaves must all have different device addresses.

Within the system on each bus, only one master may be active at any one time and only one slave may respond.

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Application example 2: Connection of SIPROTEC 4 to a (redundant) control system

The RS485 bus cable system with patch cables (CAT 5) was developed as a low-cost alternative to the previous systems 7XV5103 with SUB-D connectors. The advantages are the widespread use of patch cables throughout the world and the compact dimensions of the RJ45 connector. This allows a redundant IEC 60870-5-103 interface with a single interface module within a SIPROTEC 4 device.

Two different Y-adapters permit implementation of a RS485 bus with patch cables and connection of devices having RS485 interfaces and different designs of interface connector. Both Y-adapters have two RJ45 female connectors in parallel to facilitate the implementation of the buses. The approx. 20 cm long connection cable to the device either has a RJ45 or SUB-D connector.

Devices with SUB-D connector (e.g. Master RTU, 7XV5650/51, SIPROTEC 4 devices with SUB-D) are connected using the Y-adapter 7XV5103-2BA00.

Devices with RJ45 connector such as SIPROTEC 4 with redundant IEC 60870-5-103 interface are connected with the Y-adapter 7XV5103-2CA00. For the redundant bus system 2 Y-adapters are required per SIPROTEC 4 device.

After the final device the bus is terminated with a bus terminating connector 7XV5103-5BA00. For the redundant bus system, a bus terminating resistor is required for each bus.

Application example 3: Central operation of SIPROTEC 4 units with DIGSI 4

The RS485-bus cable system with patch cables (CAT 5) was developed as a low-cost alternative to the previous systems 7XV5103 with SUB-D connectors. The advantages are the widespread use of patch cables throughout the world and the compact dimensions of the RJ45 connector.

The Y-adapter 7XV5103-2BA00 allows for the implementation of a RS485 bus with patch cables and the connection of various SIPROTEC devices having RS485 interfaces. The Y-adapters have two RJ45 female connectors in parallel to facilitate the implementation of the buses. The approx. 20 cm long connection cable to the device has a RJ45 with suitable pin allocation.

Devices with an RS485 interface and SUB-D connector (7XV5650/51, SIPROTEC 4 devices) with SUB-D are connected using the Y-adapter 7XV5103-2BA00.

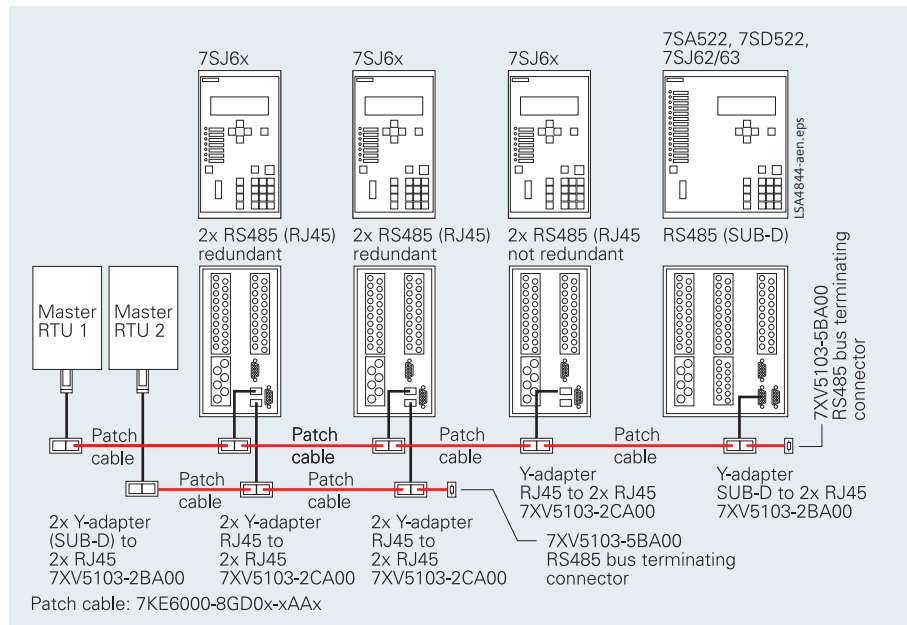


Fig. 13/38 Connection of SIPROTEC 4 to a (redundant) control system

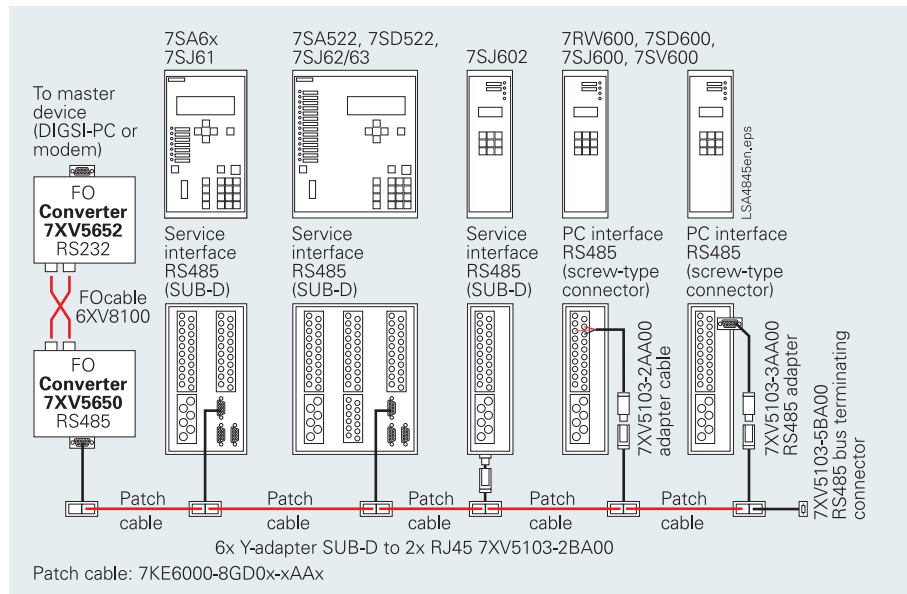


Fig. 13/39 Central operation of SIPROTEC 4 units with DIGSI 4

Devices with an RS485 interface on screw-type connectors require an additional adapter for 9-pin SUB-D to single core, e.g. 7XV5103-2AA00 or 7XV5103-3AA00.

After the last device, the bus is terminated with a bus terminating connector 7XV5103-5BA00

Accessories/7XV5103

Selection and ordering data

Description	Order No.
RS485 adapter/accessories	7XV5103-□□□00
Adapter cable STP with ferrule/9-pin SUB-D connection for devices with screw-type terminals or compact protection devices, e.g. 7SJ600	2 A A
Y-adapter cable for connection of SIPROTEC 4 or other devices with a 9-pin SUB-D connection to a RS485 bus with patch cables (RJ45)	2 B A
Y-adapter cable for connection of SIPROTEC 4 with a redundant T103 interfacemodule to a RS485 bus with patch cables (RJ45) 2 C A	2 C A
RS485 adapter with 9-pin SUB-D connection formounting on screw-type terminals with compact protection devices, e.g. 7SJ600, 7SD600 etc.	3 A A
Bus terminating connector 220-Ω in a 9-pin SUB-D connector	5 A A
Bus terminating connector 120-Ω in a RJ45 connector	5 B A
Patch cable CAT 5 shielded with RJ45 connectors	7KE6000-8GD0□-□AA0/BB
See Accessories for Communication 7KE6000-8Gx	

Application example 4: Connecting the two bus systems 7XV5103

The Y-adapter 7XV5103-2BA00 enables configuration of the RS485 bus with RJ45 patch cables and connection of SIPROTEC devices with an RS485 interface with a SUB-D connector.

Use of an additional gender changer (female-female) enables connection of a RS485 bus with Y-bus cables 7XV5103-0AAxx instead of a SIPROTEC device.

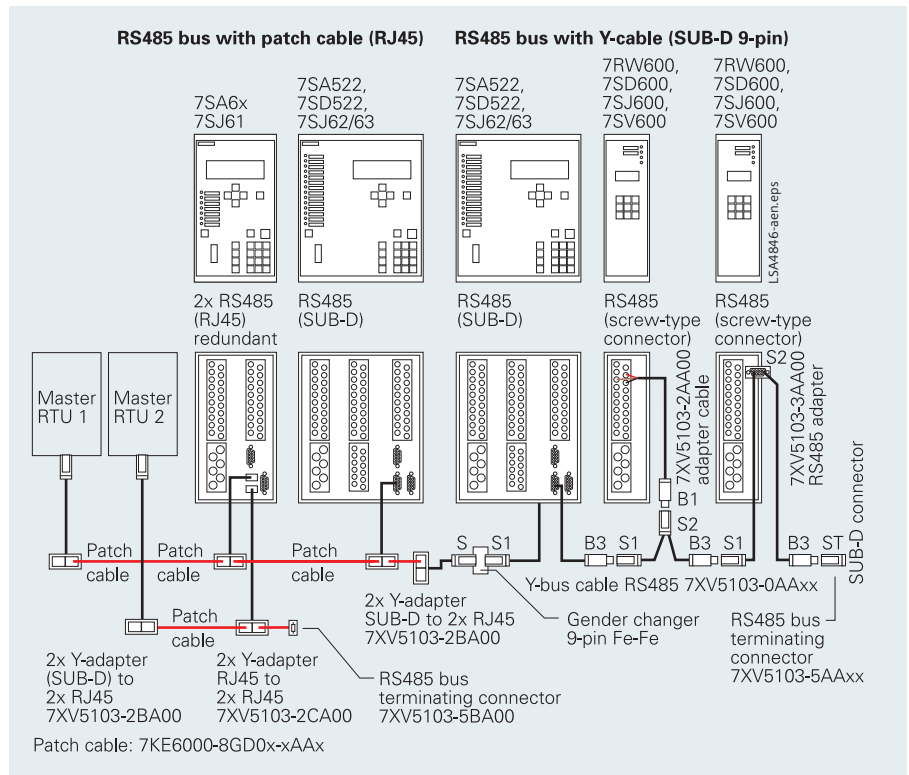


Fig. 13/40 Connecting the two 7XV5103 bus systems

Accessories/7XV5103

Selection and ordering data

Description	Order No.
RS485 Y-bus cable shielded twisted-pair with 9-pin SUB-D connector	7XV5103-0AA <input type="checkbox"/> <input type="checkbox"/>
Length 1 m	0 1
Length 3 m	0 3
Length 5 m	0 5
Length 10 m	1 0
RS485 bus extension cable STP with 9-pin SUB-D connector	7XV5103-1AA <input type="checkbox"/> <input type="checkbox"/>
Length 10 m	1 0
Length 20 m	2 0
Length 30 m	3 0
Length 40 m	4 0
Length 50 m	5 0
RS485 adapter/accessories	7XV5103- <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 00
Adapter cable STP with ferrule/9-pin SUB-D connector for devices with screw-type terminals or compact protection devices, e.g. 7SJ600	2 A A
Y-adapter cable for connection of SIPROTEC 4 or other devices with 9-pin SUB-D connection to a RS485 bus with patch cables (RJ45)	2 B A
Y-adapter cable for connection of SIPROTEC 4 with a redundant T103 interface module to a RS485 bus with patch cables (RJ45)	2 C A
RS485 adapter with 9-pin SUB-D connector formounting to screw-type terminals for compact protection devices, e.g. 7SJ600, 7SD600 etc.	3 A A
Bus terminating connector 220-Ω in a 9-pin SUB-D connector	5 A A
Bus terminating connector 120-Ω in a RJ45 connector	5 B A
RS485 cable to thermo-box (RTD)	7XV5103-7AA <input type="checkbox"/> <input type="checkbox"/>
Connection cable for thermo-box 7XV5662-xAD to SIPROTEC 4 Open cable ends, each 5/20 cm with ferrules to 9-pin SUB-D connector with an integrated 220-Ω terminating resistor	
Length 5 m	0 5
Length 25 m	2 5
Length 50 m	5 0
Patch cable CAT 5 shielded with RJ45 connector	7KE6000-8GD0 <input type="checkbox"/> - <input type="checkbox"/> AA0/BB
See Accessories for Communication 7KE6000-8G	