Communication

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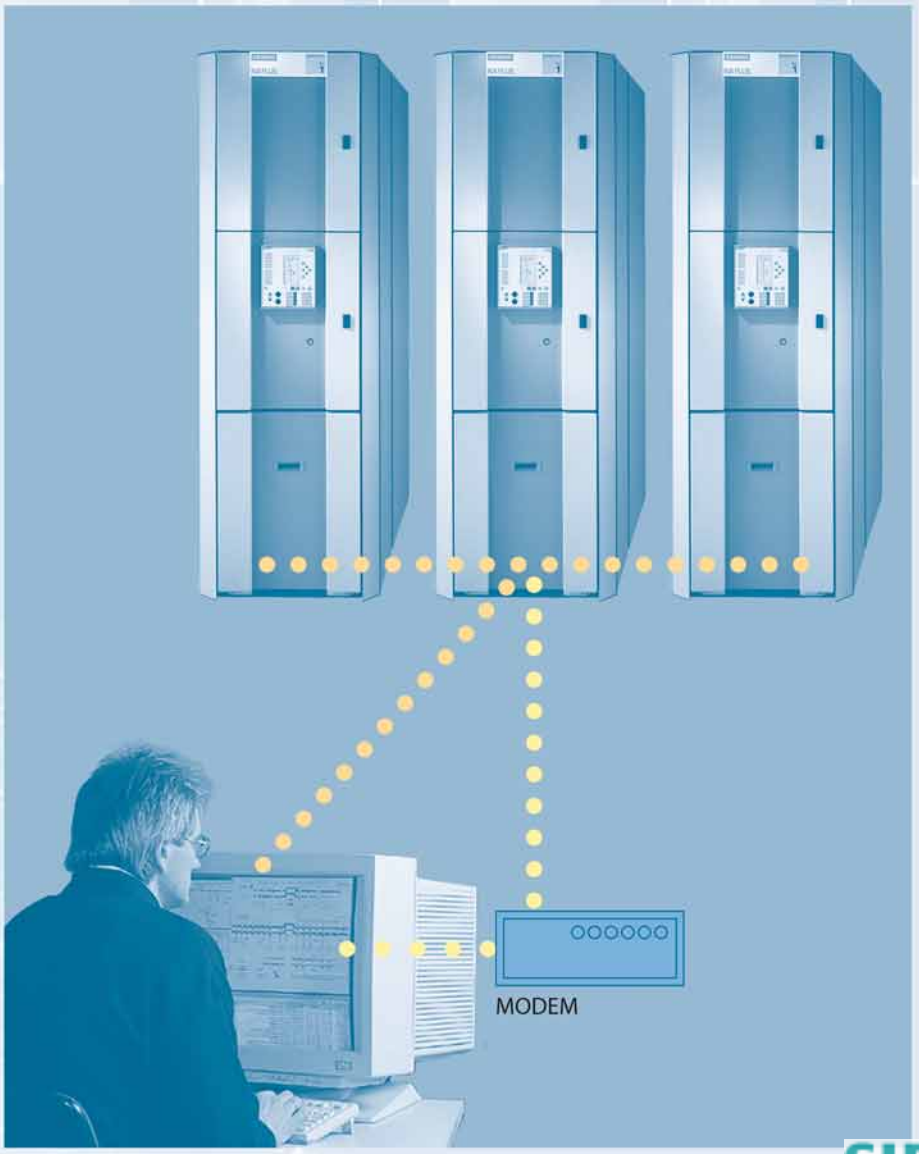

Communication

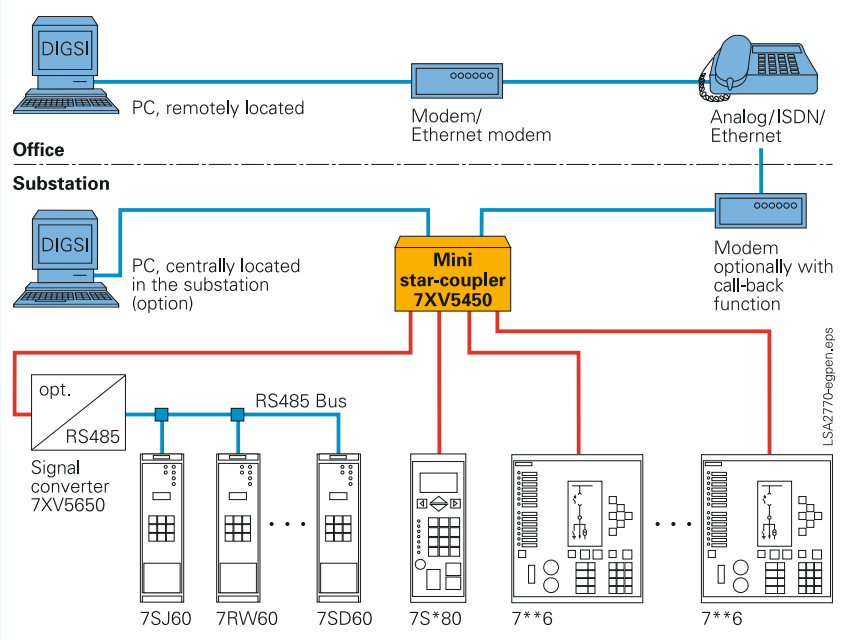

Fig. 4/1

Description

Communication interfaces on protection relays are becoming increasingly important for the efficient and economical operation of substations and networks. The interfaces can be used for:

- Accessing the protection relays from a PC using the DIGSI operating program. Remote access via modem, Ethernet modem is possible with a serial service port at the relay. This allows remote access to all data of the protection relay.
- Integrating the relays into control systems with IEC 60870-5-103 protocol, PROFIBUS-FMS protocol, PROFIBUS-DP protocol, DNP 3.0 protocol and MODBUS protocol.
  The standardized IEC 61850 protocol is available since Oct. 2004 and with its SIPROTEC units Siemens has provided this standard as the first manufacturer worldwide.
- Peer-to-peer communication of differential relays and distance relays to exchange real-time protection data via fiber-optic cables, communication network, telephone networks or analog pilot wires.

Function overview

Description

- Remote communication with DIGSI
- Remote communication with SIPROTEC 4 units
- Remote communication with SIPROTEC 3 units and SIPROTEC ‘600 units

Typical applications

- SIPROTEC 4 units on an RS485 bus
- SIPROTEC 4 units with FO/RS485
- Mixed system SIPROTEC 4, SIPROTEC 3 units, SIPROTEC ‘600 units
- Configuration with active star-coupler

Integration into substation control systems

Integration into the SICAM power automation system

Integration into other systems

Description

Remote communication with DIGSI

By using the remote communication functions of DIGSI it is possible to access relays from your office via the telephone network. So you do not have to drive to the substation at all and, if you need to carry out a quick fault analysis, for example, you can transfer the fault data into your office in just a few minutes so that you can use DIGSI to evaluate it.

Another alternative is the ability to access all the units of a substation from a central point within that station. This saves you having to connect your PC individually to all the relays in the station.

In both cases you need a few simple communication units and a PC with DIGSI and a remote communication component installed. The data traffic with DIGSI uses a secure protocol based on the IEC standard similar to IEC 60870-5-103 so that, amongst other things, the relays have unique addresses for accessing purposes. A high level of data integrity is achieved through the check sum incorporated in the telegram. Any telegrams that might become distorted during transmission are repeated. A comparison of parameters between relay and PC to ensure that they match also improves the integrity. There are other security functions too such as passwords and a substation modem call-back function which can also be triggered from events.

Remote communication with SIPROTEC 4 units

SIPROTEC 4 units are well equipped for remote communication. A separate serial service interface for the protection engineer, independent of the system interface, allows the units to be easily integrated into any communication configuration. The front interface then remains free for local operation. Together with a flexibility in the choice of interface, i.e. optical with an ST connector for multi-mode FO cables or electrical for RS232 or RS485 hard-wired connections, it is easy to create the optimum solution for any particular application.

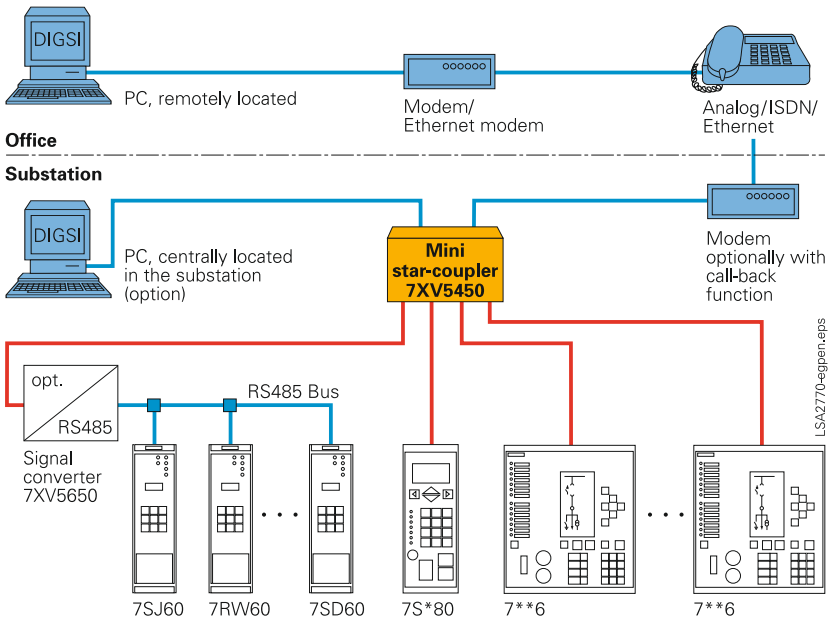

Fig. 4/2 Remote relay communication

With SIPROTEC 4 units you can also use PROFIBUS-FMS to provide a central link with DIGSI via the control system interface. For this you will need a PC with a special PROFIBUS card that must be connected to the PROFIBUS system. This solution is intended exclusively for SIPROTEC 4 units with PROFIBUS-FMS.

Since Oct. 2004, a relay can be accessed remotely with DIGSI via an Ethernet interface in the relay and with the IEC 61850 protocol. This allows access to the relays via an Ethernet network. Some relays include a Web server, so an Internet browser can also be used for remote access via Ethernet.

Remote communication with SIPROTEC 3 and series '600 relays

These relays are ideal for applications involving remote communication. When configuring the actual communication system, however, it is important to take into account the smaller number of relay interfaces compared with SIPROTEC 4 units.

In the case of SIPROTEC 3 units, communication is normally effected via the system interface at the back of the unit. If this interface is already being used for communication with the substation control system, the front interface can be used for the DIGSI communication instead. A suitable connector module is available to convert from electrical to optical interface.

Series '600 relays normally have one RS485 interface which can be used for communication either with the substation control system or with DIGSI.

SIPROTEC series '80 relays offer the same features regarding communication possibilities as SIPROTEC 4 devices.

Typical applications

An extensive range of communication components, such as modems, star couplers, optoelectric converters, prefabricated FO connection cables and electric connection cables (see part 12 of this catalog) allows you to create a variety of different solutions: FO connections immune to interference or cost-effective solutions using the two-wire RS485 electric bus.

The following examples give some indication of what configurations are possible, which items are needed for the purpose and what baud rates are possible.

Example 1: SIPROTEC 4 units on an RS485 bus

Remote communication is effected via a private or public telephone network with both analog or digital telephone lines being possible. An Ethernet network can also be used together with Ethernet modems. The 8N1 data format and an analog baud rate of 57.6/64 kbit/s have become established as the standard for serial modem links. The connection between modem and units is initially optical. An FO/RS485 converter 7XV5650 that can be installed close to the units then converts the signals for the RS485 bus. Up to 31 relays can be connected to the RS485 bus. Particularly in the case of modems, we recommend the use of the types of units listed in part 12. Other accessories can be found in the same part (see Fig. 4/3).

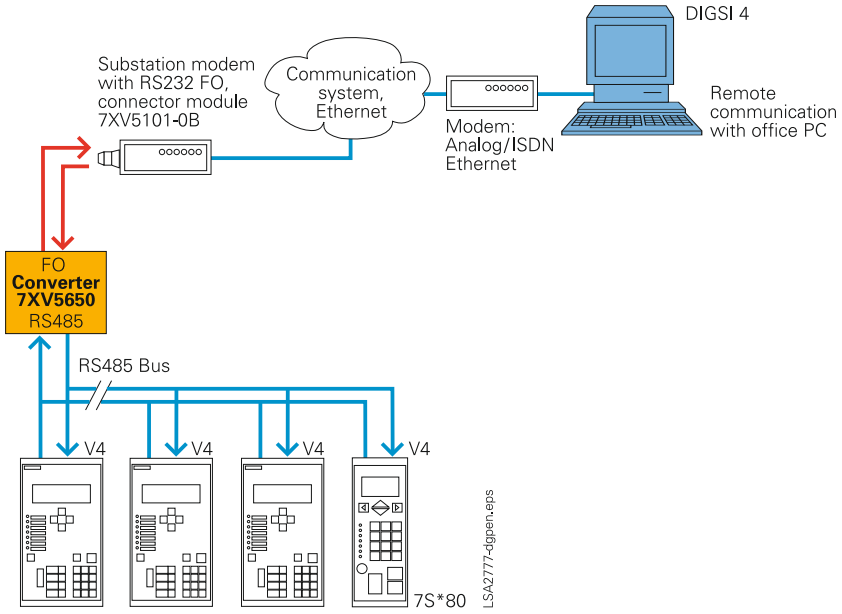

Fig. 4/3 SIPROTEC 4 units on an RS485 bus (Example 1)

Example 2: SIPROTEC 4 units with FO/RS485

In the case of larger substations with longer distances we recommend the use of FO connection cables. The following example shows a mixed system of optical and electrical connections. Typically, all relays in a cubicle can be linked together via RS485 and the cubicles themselves can be connected to the star coupler via FO cables (see Fig. 4/4).

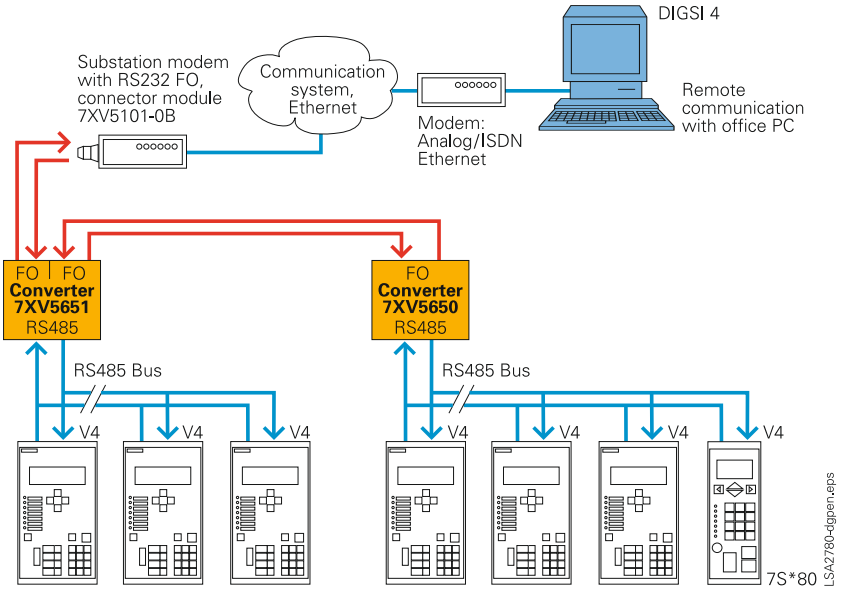

Fig. 4/4 Two groups of SIPROTEC 4 units on an RS485 bus (Example 2)

Typical applications

Example 3: Mixed system – SIPROTEC 4, SIPROTEC 3, series '600

Relays from different families can be integrated into a remote communication system, as illustrated in Example 3 (see Fig. 4/5). This example also shows how relays can be integrated by means of FO links and star couplers. With this kind of arrangement the baud rate for all links must be set at 19.2 kbaud because the SIPROTEC 3 units and the series '600 relays cannot support a higher baud rate. In this case we recommend to use the 7XV5550 active mini star-coupler (see Fig. 4/6).
Communication will then generally be at 57.6/64 kbit/s on the modem link. For any units that cannot operate at this baud rate the active star-coupler will convert the rate accordingly.

Example 4: Configuration with active star-coupler

With this configuration it is also possible to integrate relays that can only be connected via the front interface and whose maximum baud rates are less than 19.2 kbaud (see Fig. 4/6).

The following points must be noted with this type of configuration:

- One output of the active mini star-coupler is used to service several SIPROTEC 4 units through further star couplers or RS485 converters. On that output, a mixed system containing SIPROTEC 3 and series '600 relays should be avoided so that 57600 baud operation is possible for SIPROTEC 4 relays.
- Several SIPROTEC 3 units and series '600 relays can also be connected to another output of the active mini star-coupler (via mini star-couplers or RS485 converters). The baud rate for this output must be set less or equal to 19200 baud.
- Relays that are not available with communication functions according to IEC 60870-5-103 protocol (e.g. 7VE51, 7VK51, 7SV51 and older firmware versions of some relays) can also be connected via the active star-coupler as illustrated in Fig. 4/6. In this case one output must be assigned to each relay. The baud rate must be set according to the unit.

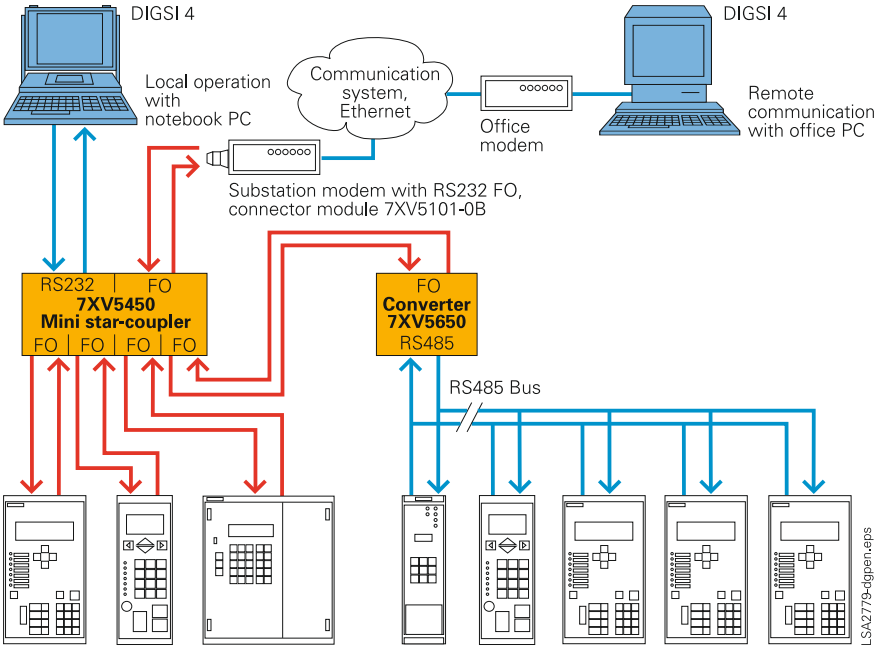

Fig. 4/5 Mixed system, FO/RS485 with units from different families (Example 3)

The solutions for central and/or remote communication with SIPROTEC units have easy upgrade compatibility. Different versions of relays can be integrated into a remote communication concept. This is supported by the substation and device management in the DIGSI software. A substation can be retrofitted with add-on remote communication components provided it has the communication connection available. And changing of the telephone line from, say, analog to digital does not necessitate the replacement of all components. Also, Ethernet networks can be used. The telephone modem is then replaced by an Ethernet modem. The infrastructure in the substation remains unchanged.

Typical applications

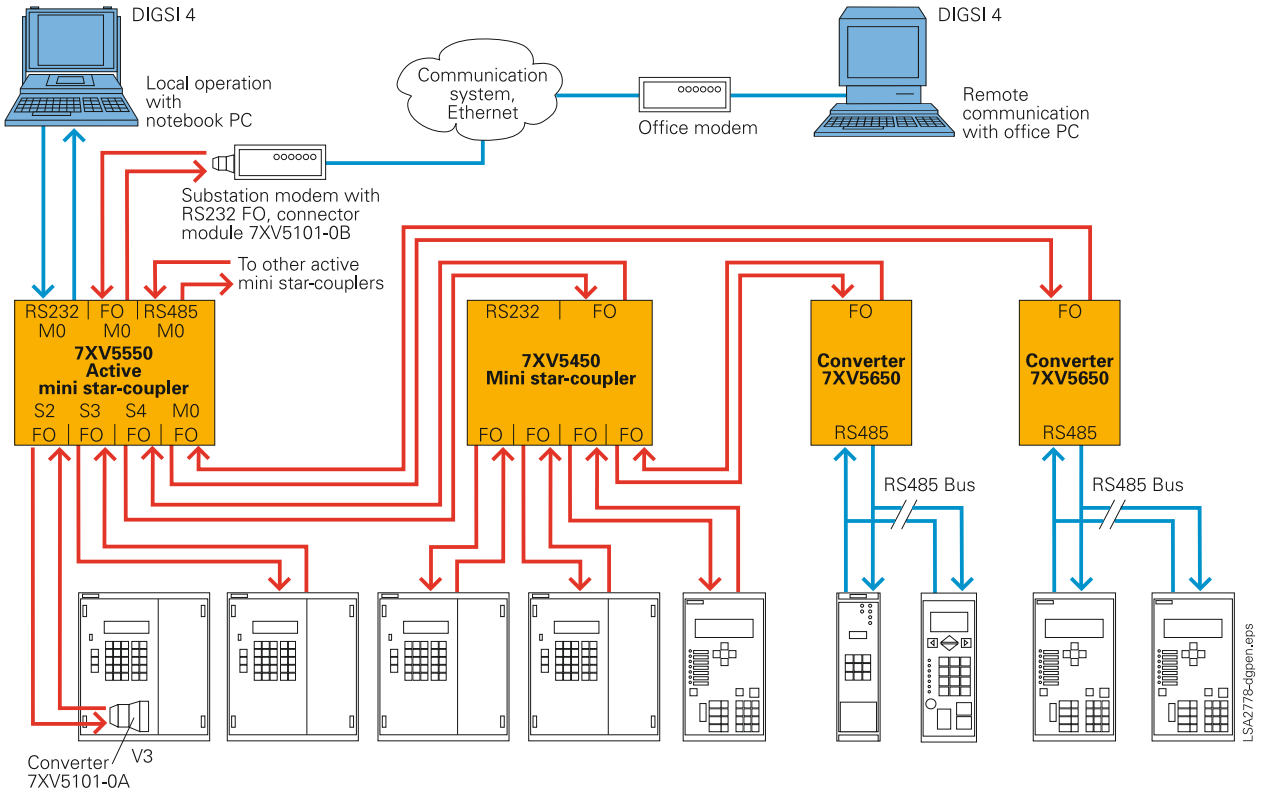

Fig. 4/6 Mixed system with relays from different families, with active star-coupler (Example 4)

Integration into substation control systems

Almost all SIPROTEC units can be integrated into substation control systems via communication interfaces.

The relays can be supplied as part of an integrated Siemens system offering all substation control and protection. In addition, the relays can also be integrated into other control systems via standard protocols. An integrated system offers type-tested functions, consistent configuration and optimally coordinated communication protocols. SICAM PAS and SICAM 1703 are two proven systems available from Siemens. These systems, also offer Ethernet communication with IEC 61850.

For situations where you would like to integrate SIPROTEC units into other control systems we can offer open communication interfaces. In addition to the IEC 60870-5-103 protocol that is available in almost all relays we can also offer other communication protocols for SIPROTEC 4 units like PROFIBUS-DP, MODBUS or DNP 3.0. IEC 61850 is available since Oct. 2004.

Relay type	Substation control telegram				
	IEC 61850	IEC 60870-5-103	PROFIBUS-DP	MODBUS	DNP 3.0
6MD61	V4.0	V4.0	V4.0		
6MD63	V4.6	V4.0	V4.2	V4.2	V4.2
6MD663/4	V4.6	V4.2	V4.2		
7SA522	V4.6	V4.0	V4.2		V4.2
7SA6..	V4.6	V4.0	V4.2		V4.2
7SD52.	V4.6	V4.0	V4.21		V4.21
7SD61	V4.6	V4.0	V4.2		V4.2
7SJ600		V1.0			
7SJ602		V1.0 / V3.5	V3.5	V3.5	
7SJ61/62/63	V4.6	V4.0	V4.2	V4.2	V4.2
7SJ64	V4.6	V4.0	V4.4	V4.4	V4.4
7S*80	V4.0	V4.0	V4.0	V4.0	V4.0
7UM61		V4.0	V4.0	V4.1	V4.1
7UM62	V4.6	V4.0	V4.0	V4.0	V4.1
7UT6.	V4.6[1)]	V4.0	V4.0	V4.0	V4.0
7VE6	V4.6	V4.0	V4.0	V4.0	V4.0
7VK61	V4.6	V4.0	V4.0		V4.0

1) Not 7UT612

Integration into substation control systems

The table on page 4/7 shows which communication protocols are available in the various SIPROTEC relays starting with the firmware version. The latest version can be found on the Internet at www. siprotec.com.

IEC 61850 protocol

Since Oct. 2004, the Ethernet-based IEC 61850 protocol is the worldwide standard for protection and control systems used by power supply corporations, Siemens was the first manufacturer to support the protocol in its devices. By means of this protocol, information can also be exchanged directly between bay units so as to enable the creation of simple masterless systems for bay and system interlocking. Access to the units via the Ethernet bus is also possible with DIGSI.

It will also be possible to retrieve operating and fault messages and fault recordings via a browser. This Web monitor will also provide a few items of unit specific information in browser windows.

IEC 60870-5-103 protocol

The IEC 60870-5-103 protocol is an international standard for the transmission of protective data and fault recordings. All messages from the unit (and also control commands) can be transferred via published, Siemens-specific extensions.

PROFIBUS-DP protocol

PROFIBUS-DP is the most widespread protocol in industrial automation. Via PROFIBUS-DP, SIPROTEC units make their information available to a SIMATIC controller or, in the control direction, receive commands from a central SIMATIC. Measured values can also be transferred. The information is assignable to a mapping file with DIGSI.

MODBUS RTU protocol

This uncomplicated, serial protocol is mainly used in industry and by power supply corporations, and is supported by a number of unit vendors. SIPROTEC units behave as MODBUS slaves, making their information available to a master or receiving information from it. Information is assignable to a mapping file with DIGSI.

DNP 3.0 protocol

Power supply corporations overseas use the serial DNP 3.0 (Distributed Network Protocol) for the station and network control levels, SIPROTEC units behave as DNP slaves, supplying their information to a master system or receiving information from it. Information is assignable to a mapping file with DIGSI.

	Substation control port B					Port C
	IEC 61850	IEC 60870-5-103	PROFIBUS-DP	MODBUS	DNP 3.0	DIGSI
Alarms (relay → central unit)	√ with time stamp	√ with time stamp	√ with time stamp	√ with time stamp	√ with time stamp	√ with time stamp
Commands (BC/central unit → relay)	√	√	√	√	√	√
Measured values	√	√	√	√	√	√
Time synchronization	√	√	√	√	√	1)
Fault records (sampled values)	√	√	Separate port (with DIGSI)[2)]	Separate port (with DIGSI)[2)]	Separate port (with DIGSI)[2)]	
Protection settings	√ (with DIGSI)	Separate port (with DIGSI)[3)]	Separate port (with DIGSI)[3)]	Separate port (with DIGSI)[3)]	Separate port (with DIGSI)[3)]	√
Parameter group switchover	√	√	√	√	√	√

1) There is no time synchronization via this protocol. For time synchronization purposes it is possible to use a separate time synchronization interface (Port A in SIPROTEC 4 relays).

2) The transmission of fault records is not part of the protocol. They can be read out with DIGSI via the service interface Port C or the front operating interface.

3) This protocol does not support the transmission of protection settings. Only setting groups can be changed. For this purpose you should use the service interface or the front operating interface together with DIGSI.

Integration into the SICAM power automation system

SIPROTEC 4 is tailor-made for use with the SIMATIC-based SICAM power automation system. The SICAM family comprises the following components:

- SICAM 1703, the modern telecontrol system with automation and programmable logic functions
- SICAM PAS, the substation automation system based on dedicated hardware

Data management and communication is one of the strong points of the SICAM / SIPROTEC 4 system. Powerful engineering tools make working with SICAM convenient and easy. SIPROTEC 4 units are optimally matched for use in SICAM PAS. With SICAM and SIPROTEC 4 continuity exists at three crucial points:

- Data management
- Software architecture
- Communication

The ability to link SICAM/ SIPROTEC to other substation control, protection and automation components is assured, thanks to open interfaces such as IEC 60870-5-103 protocol and the Ethernet-based IEC 61850 protocol. Other protocols like PROFIBUS-DP, DNP 3.0 and MODBUS are also supported.

Integration into substation automation system

SIPROTEC 4 is tailor-made for use with the SICAM substation automation system. Over the low-cost electrical RS485 bus, the units exchange information with the control system. Units featuring IEC 60870-5-103 interfaces can be connected to SICAM interference free and radially by fiber-optic link. Through this interface, the system is open for the connection of units of other manufacturers.

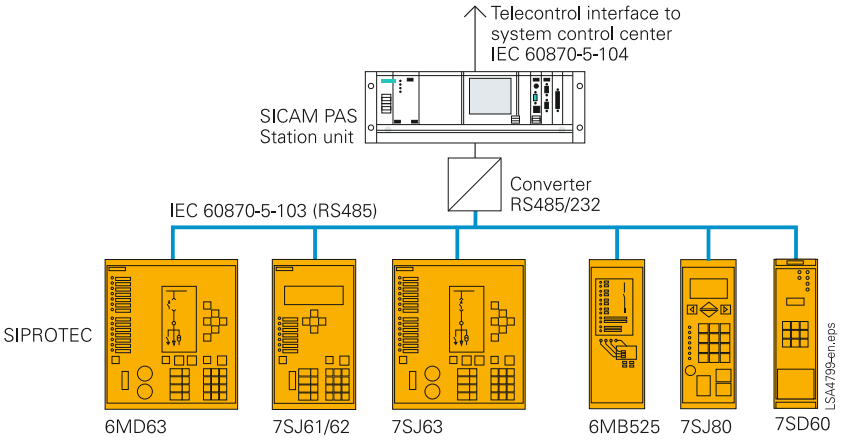

Fig. 4/7 Communication structure with substation automation system

Integration into the SICAM PAS power automation system

SIPROTEC 4 is tailor-made for use with the SICAM power automation system together with IEC 61850 protocol. Via the 100 Mbit/s Ethernet bus, the units are linked electrically or optically to the station PC with PAS. Connection may be simple or redundant. The interface is standardized, thus also enabling direct connection of units of other manufacturers to the Ethernet bus. Units featuring an IEC 60870-5-103 interface or other serial protocols are connected via the Ethernet station bus to SICAM PAS by means of serial/Ethernet converters (see Fig. 4/8). DIGSI and the Web monitor can also be used over the same station bus.

Together with Ethernet/IEC 61850, an interference-free optical solution is also provided (see Fig. 4/9). The Ethernet interface in the relay includes an Ethernet switch. Thus, the installation of expensive external Ethernet switches can be avoided. The relays are linked in an optical ring structure.

Integrated SNMP (Simple Network Management Protocol) facility allows the supervision of the network from the station controller.

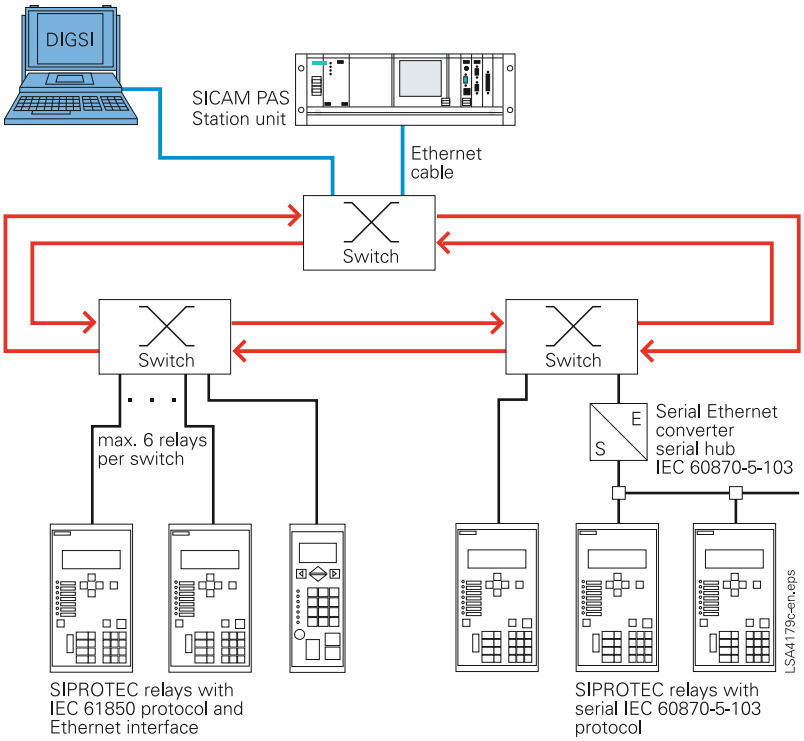

Fig. 4/8 Ethernet-based system with SICAM PAS with electrical Ethernet interface

Integration into a substation automation system of other makes

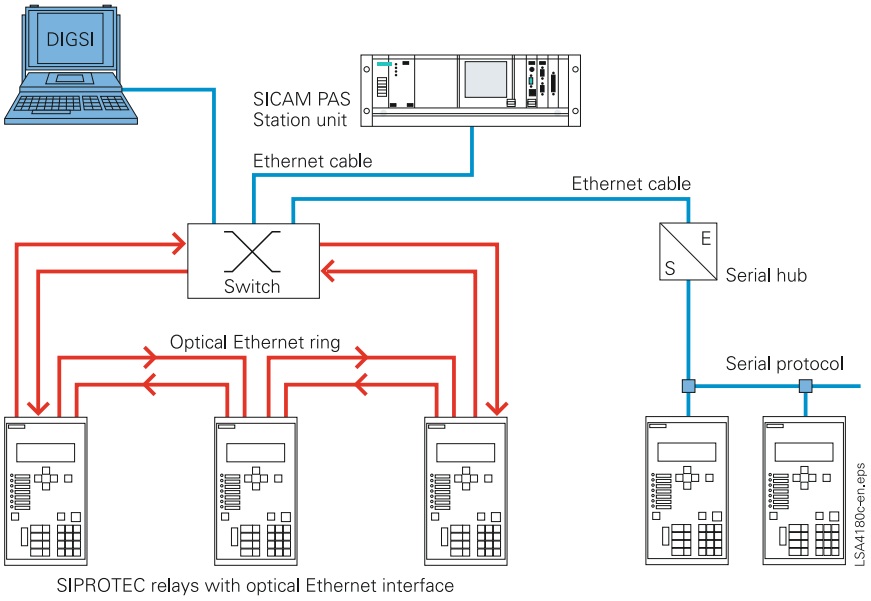

Fig. 4/9 Ethernet-based system with SICAM PAS with optical Ethernet interface

Thanks to the standardized interfaces, IEC 61850, IEC 60870-5-103, DNP3.0, MODBUS, PROFIBUS-DP, SIPROTEC units can also be integrated into non-Siemens systems or in SIMATIC S5/S7. Electrical RS485 or optical interfaces are available. The optimum physical data transfer medium can be chosen thanks to opto-electrical converters. Thus, the RS485 bus allows low-cost wiring in the cubicles and an interference-free optical connection to the master can be established.

Solution without substation control system

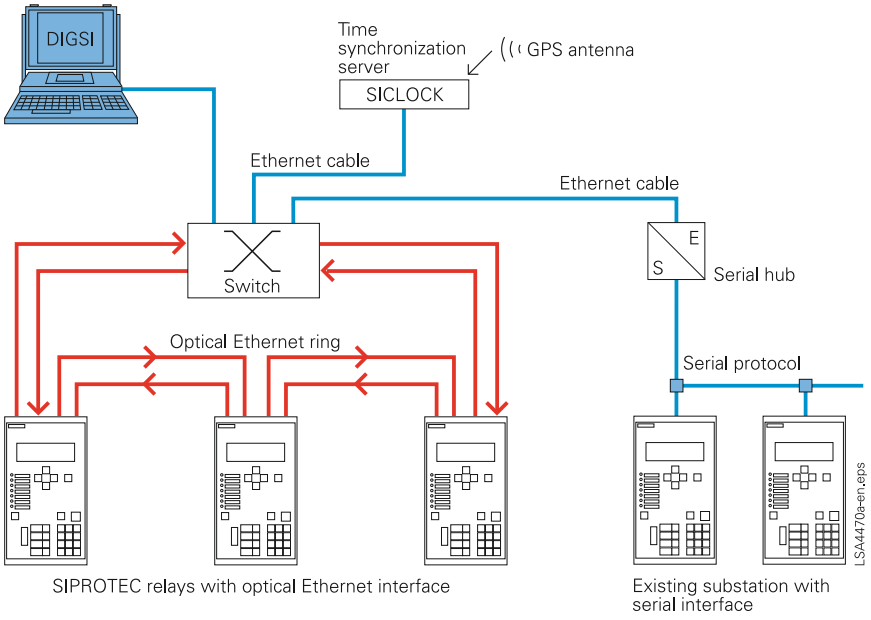

Fig. 4/10 Ethernet-based system with optical Ethernet interface and migration of relays with serial protocol

Ethernet-based communication with optical Ethernet interface between SIPROTEC protection relays without substation control offers many advantages:

- Fast remote access via DIGSI 4
- High-speed setting and parameterization with DIGSI 4
- Interlocking between different field devices and exchange of binary signals via GOOSE messages of IEC 61850
- Common time synchronization of all relays from central time synchronization server (eg. SICLOCK)

For automation of new substations (or plants) and modernization of existing substations you get future investment security, without additional investment.