Communication Networks
NSD570 - Teleprotection Equipment

Power and productivity
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ABB

Protection of Power Networks

High performance demands on teleprotection equipment
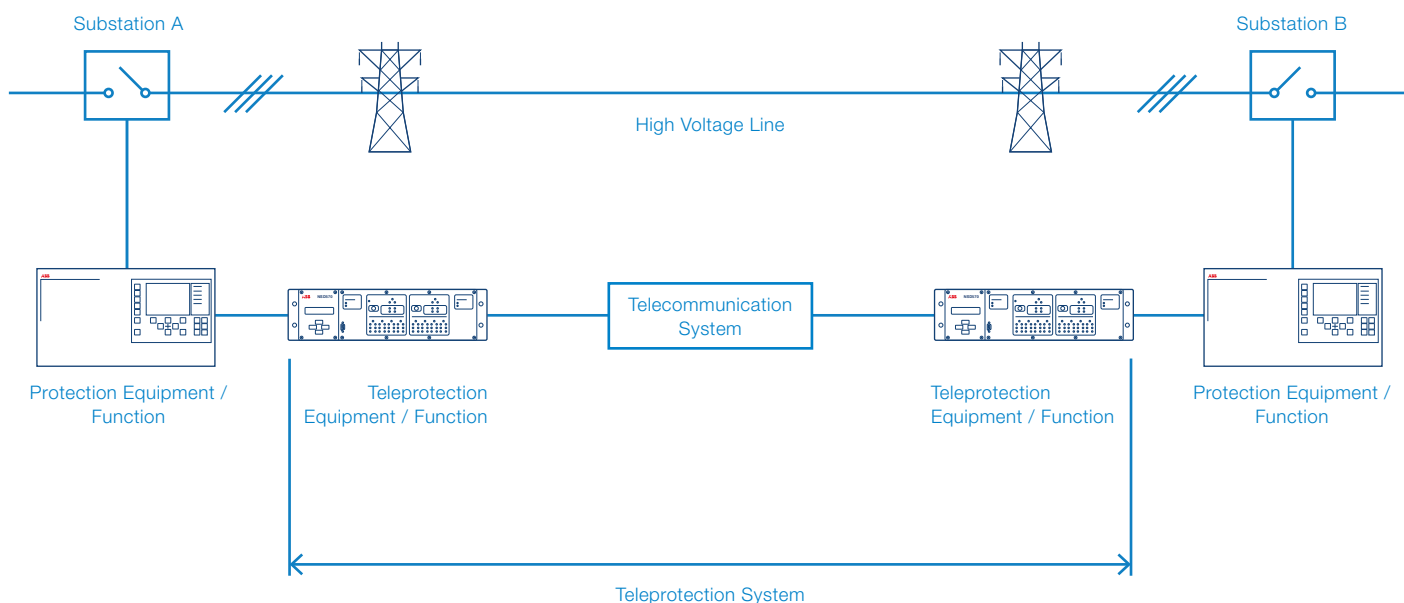
Typical line protection system architecture.

NSD570 - fast, reliable and secure transmission of protection signals

A secure and uninterrupted supply of electricity is only possible with the help of comprehensive protection and control functions, which ensure the reliable operation of the power system.

As the complexity and ratings of electrical power systems increase, so do also the demands on the protective devices and systems, which have to protect them from damage and preserve power system stability.

Protection equipment in conjunction with communication links provide the best possible means of selectively isolating faults on high voltage transmission lines, transformers, reactors and other important items of electrical plants.

To prevent the power system from failure and damage, the teleprotection system enables to selectively disconnect the faulty part by transferring command signals within the shortest possible time.

The NSD570 is suitable for all types of protection command transmission in "State Comparison" protection schemes:

– Transfomer, reactor, generator and line protection
– Single-circuit and double-circuit lines
– Including the protection of teed feeders with single or multiple tee-offs.

Depending on the protection scheme in use, the command signals trip the remote circuit-breaker either directly (direct tripping) or are first enabled by the local protection device (permissive tripping). Other protection schemes involve tripping prevention by the local protection device (blocking).

A fundamental requirement in all these applications is that command signals are communicated reliably at the highest possible speed. In the event of a fault on the protected unit, the command signals must be received at the remote end in the shortest possible time even if the channel is disturbed by the fault (dependability).

On the other hand, interference on the communications channel must never cause unwanted operation of the protection by simulating a tripping signal when there is no fault on the power system (security).

The most important performance features of a teleprotection equipment are therefore transmission time, dependability and security. From the communications engineering point of view, the bandwidth or data rate a teleprotection equipment occupies must also be taken into account.

Application

Protection signaling over all communication media
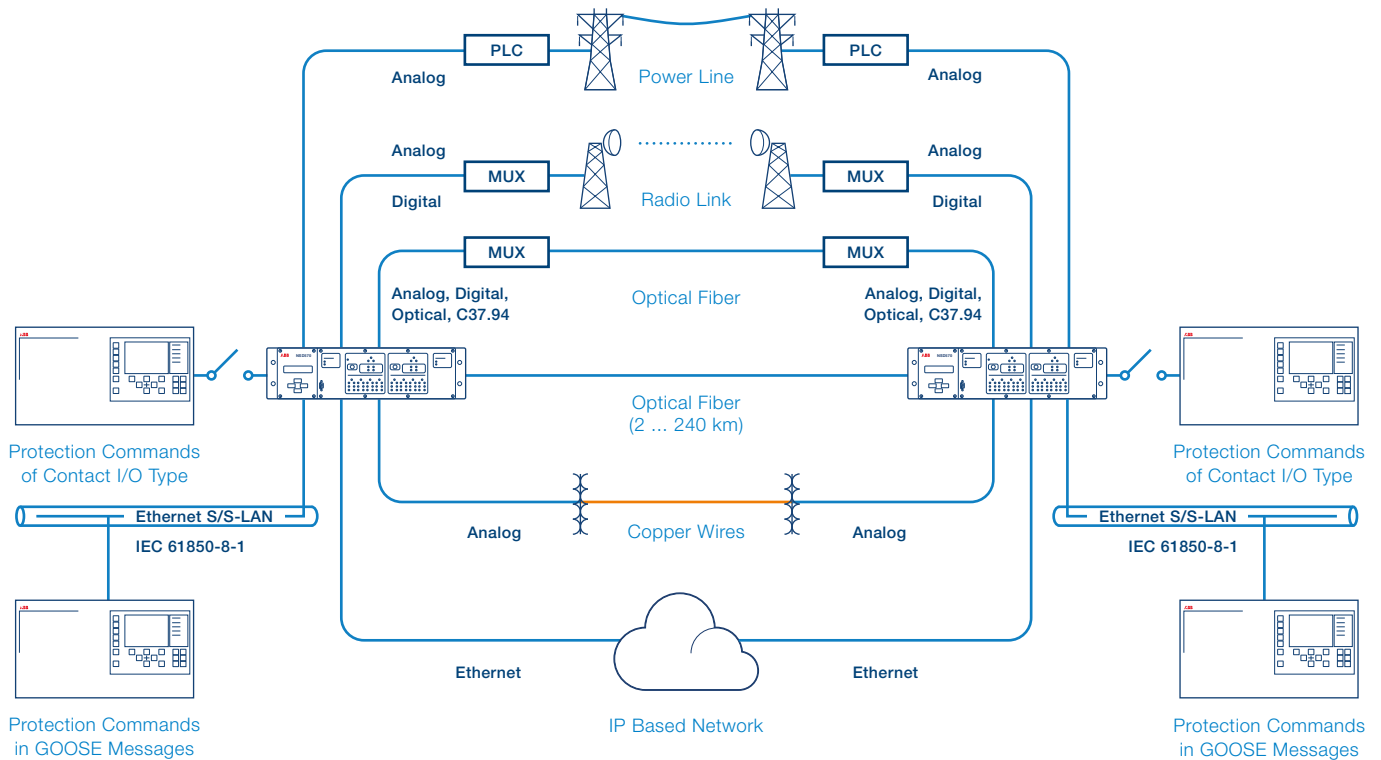
NSD570 offers a complete set of line interfaces to the various communication channels for teleprotection. On the other hand all command interfaces to the different type of protection equipment are available.

Requirements on teleprotection equipment

In view of increasing power plant capacities and closer meshing of high-voltage networks, stringent demands are placed on protection systems featuring absolute selectivity and short fault clearing times.

Fast exchange of information between the ends of protected circuits is therefore essential.

A modern teleprotection equipment has to be adaptable both with respect to the requirements of the protection and the constraints of the communications system and must provide the best possible support for solving complex protection and communication problems.

NSD570 connectivity

NSD570 is designed for the transmission of protection commands over all kinds of communication media, like copper wires, optical fibers, analog and digital channels of optical networks and microwave radio links, as well as Ethernet/IP based telecommunication networks.

The interface between protection equipment and teleprotection equipment is traditionally based on "hardwired" contact type binary inputs and outputs. NSD570 also supports the exchange of "GOOSE messages" with protection equipment, via direct Ethernet access to a substation network according to IEC 61850 (thus teleprotection equipment acting as the proxy gateway between the substations).

"GOOSE" and contact type commands can be signaled in parallel over the same NSD570 link. Additionally, GOOSE messages from one substation can be released via contact type command outputs in the remote substation. In this respect, NSD570 also supports the step-by-step retrofit of substations with IEC 61850, i.e. the interconnection of traditional substations with IEC 61850 enabled substations via existing or new NSD570 teleprotection channels.

One or two independent NSD570 systems can easily be placed in one module rack. Identified by the chosen communication line interface, a mix of analog, digital/optical and Ethernet systems in any combination is possible.

Functionality
Modular and flexible

Overview
- Versatile application
- Compact and flexible design
- Modular structure, few modules – low inventory
- Robust and reliable
- Advanced technology, digital signal processing
- In-operation testing
- Upgradeability and convertibility (e.g. from Analog to Digital or Ethernet system by just replacing one module)

Main features
- For analog, digital/optical and Ethernet/IP based communication links
- 4 independent commands in analog channels
- 8 independent commands in digital/optical channels and Ethernet/IP circuits
- Each command individually configurable for blocking, permissive or direct tripping
- Adaptive signal processing for shortest transmission times
- Fast, dependable and secure
- Continuous channel supervision, alarm is given if channel is unavailable or has insufficient quality (e.g. if end-to-end delay is too high)
- Integrated event recorder and trip counters
- Real Time Clock for event recording, synchronized with IRIG-B, 1PPS or NTP/SNTP
- Fully programmable by means of a browser-based Human Machine Interface (HMI), for convenient configuration, operation and maintenance
- Remote monitoring and configuration, including Simple Network Management Protocol (SNMP) alarm traps for serving a communication Network Management System (NMS)
- HMI integrated Element Management System (EMS) for supervising and managing of the entire NSD570 network via LAN, station bus and Embedded Operation Channel (EOC)

Simple operation
The NSD570 system was designed to provide simple commissioning, operation and supervision of teleprotection links. The modular design of NSD570 provides the greatest possible flexibility and adaptability for all application requirements. The NSD570 is equipped with comprehensive self-test diagnostics that continuously monitor the system functionality. A serial port permits to connect directly to your computer for programming and monitoring the local and remote station.

- Flexible structure with one exchangeable line interface (analog 2-/4-wire, digital G.703 or V.11/X.21/X.24, Ethernet 10/100 Mbps) and one protection interface for two commands each (up to four protection interfaces per system)
- Optional plug-on modules for digital line interface: E1/T1 interface for electrical connection to SDH/SONET multiplexer, or optical interface for direct fiber connection and optical IEEE C37.94 connection to digital multiplexers (short and long haul SFP versions)
- Transmission of up to 8 "GOOSE" messages according to IEC 61850-8-1 (automated configuration of multiple substations as per IEC 61850 Ed. 2 is supported)
- Web-enabled for remote management with optional integrated LAN/Ethernet Interface
- Equipment status indicated by front panel LEDs and optional integrated LCD display
- 1+1 configuration to protect against communication path failures (just a second "standby" line interface of any type is required, no need to duplicate the protection interfaces)
- Cost saving schemes for protection of multi-ended circuits (T-operation)
- Single or redundant power supplies
- Comprehensive set of measures against cyber/IT security attacks

Front panel LEDs and an optional integrated LCD display indicate the equipment status without requiring additional tools.

NSD570's modern technology and modular system structure allows user-oriented solutions for every application.

Remote Supervision

Easy to access and to manage

System configuration by means of HMI570 user interface software
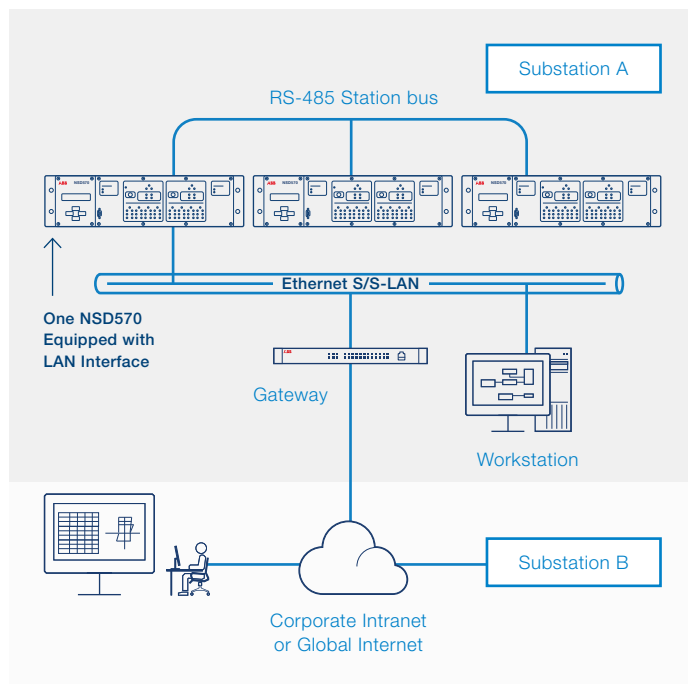
Secure remote access to your system

The browser-based Human Machine Interface (HMI) allows easy configuration, operation and monitoring of the system.

The HMI application program and a small Web server (HMI570 user interface) are quickly installed on your PC. Self-explaining menus of HMI570 make it possible to set up and operate your system within the shortest possible time.

Access NSD570 the way that fits you best, e.g. via Intranet, World Wide Web, local PC or integrated LCD front panel display.

Direct access from your PC to the equipment is possible via the serial port on the front, or via the optional LAN port at the back.

For local access to the equipment via an Ethernet port or for remote access via the Intranet/Internet, an optional Management interface can be used. It supports SNMP and VLAN ID & priority settings. To secure this management access, enhanced encryption/authentication features and user activity logging are provided. Individual accounts can be set up, with different access rights assigned to the registered users.

In a substation, several NSD570 can be connected to a local station bus (RS-485). Connection to the Intranet/Internet is provided by a single Management interface. In such a network, all NSD570s are accessible with a unique device address. A connection to the equipment, either local or remote, is always secured by means of a user log-in with a three-level password identification (admin, modify or view access rights).

Local alarm polling in a substation and polling the alarms of an entire NSD570 network in several substations is standard function of the HMI570, an extra Network Management System (NMS) is therefore not required. The alarms of all accessible NSD570 units are polled by an HMI570 in a control center, for example, and can be displayed on a single screen.

Of course, the integrated SNMP agent can also serve higher level NMS programs with alarm and equipment information.

The event recorder traces all command and alarm events.

Status display of NSD570 network alarm polling.

Architecture
Plug-in modules

Modules
- Power supply – single or dual (redundant)
- Analog line interface
- Digital line interface (with optional optical or E1/T1 extension)
- Ethernet line interface
- Protection interface (contact type and/or "GOOSE" type)
- Management interface (optional
- Display panel (optional)
- Wiring directly to connectors at the back or to terminals of optional connecting cables

Analog line interface
- Up to 4 independent commands (simultaneous, in any combination)
- Each command configurable for blocking, permissive or direct tripping
- Programmable bandwidth: from 120Hz to 2800 Hz
- Programmable centre frequencies: from 360 Hz to 3900 Hz in 60 Hz steps
- EOC (embedded operation channel) for remote monitoring and configuration
- 4-wire or 2-wire circuit, full duplex operation
- High dynamic range and wide setting range for Tx/Rx levels
- Command signal power boosting

Digital line interface
- Up to 8 independent commands (simultaneous, in any combination)
- Each command configurable for blocking, permissive or direct tripping
- Programmable data interfaces and data signaling rate
- EOC (embedded operation channel) for remote monitoring and configuration
- Set of serial data interfaces (G.703 codirectional or V.11/X.21/X.24)
- Optional integrated E1/T1 interface or optical interface (IEEE C37.94 or direct fiber)
- Terminal addressing to protect against channel crossovers in switched or routed networks

Mechanical Data

Dimensions and weight	
Height	4 U / 177 mm (including 1 U for cable duct)
Width	19 inch / 485 mm
Depth	300 mm
Weight	approx. 6.0 kg

300 mm

177 mm

133 mm

485 mm

Ethernet line interface

– Up to 8 independent commands (simultaneous, in any combination)
– Each command configurable for blocking, permissive or direct tripping
– Programmable data interfaces and data signaling rate
– EOC (embedded operation channel) for remote monitoring and configuration
– Electrical interface (10/100Base-TX) and optional optical interface (SFP)
– Proven IT/security mechanisms (e.g. only traffic from authenticated sources accepted)
– IP Address, UDP port and priority settings, VLAN support

Protection interface (contact type)

– Electrically isolated contact type command input/output circuits
– Two command inputs and four command/alarm outputs per module
– Up to four protection interfaces per NSD570 system in the rack
– Nominal tripping voltage range: from 24 VDC to 250 VDC
– Commands can individually be mapped on any input and output
– Alarms and special functions are freely assignable to the outputs (e.g. unblocking)
– Single-pole or double-pole tripping

Protection interface (GOOSE type)

– Up to 8 "GOOSE" messages according to IEC 61850-8-1, exchanged with the same protection equipment or with several devices
– Commands are transferred to the remote station via a "proxy gateway" (choice of analog/digital/optical/Ethernet line interface)
– One protection interface per NSD570 system in the rack, contact type protection interface(s) can be used in parallel (to transfer traditional commands or to signal alarms)
– Support of automated engineering processes, based on substation configuration description (SCD files), compliant to IEC 61850 Ed. 1 or Ed. 2 (HMI-configurable)
– Command value and - if required - its quality can be transferred (Logical Nodes: GGIO, PSCH, RBRF, ITPC).
– Electrical interface (10/100Base-TX) and optional optical interface (SFP)
– VLAN support

Technical data

Feature	
Nominal power supply voltage	24 VDC to 60 VDC / 110 VDC to 250 VDC / 120 VAC to 230 VAC
Number of commands	Up to 4 independent commands for analog communication channels
	Up to 8 independent commands for digital/optical and Ethernet/IP based communication channels
Command keying — Inputs	Contact + external battery 24 VDC to 250 VDC
	Contact + internal 24 VDC auxiliary supply (option)
	Two inputs per protection interface, electrically isolated
Outputs	Solid state 5 VDC to 250 VDC, ≤ 2 A
	Relay contact 5 VDC to 250 VDC, ≤ 5 A
	Two solid state and two relay contact outputs per protection interface, electrically isolated
Processing of line signal	Adaptive, always ensuring shortest transmission times (< 4 ms minimum)
Line interfaces — Analog	2-wire or 4-wire, 600 Ohms or high impedance
	Transmit level: -24 to +11 dBm
	Receive level: -30 to +2 dBm nominal; dynamic range 30 dB
	Bandwidth and channel center frequency programmable
Digital	V.11 / X.21 / X.24; RS-422 / RS-530 / RS-449,
	G.703.1 (64 kbps, co-directional)
	E1 / T1 for direct connection to SDH / SONET multiplexer
Optical	850 nm MM: nominal reach 1 km, max. 2 km
	1310 nm SM short haul: nominal reach 30 km, max. 50 km
	1310 nm SM long haul: nominal reach 60 km, max. 80 km
	1550 nm SM long haul: nominal reach 120 km, max. 150 km
	1550 nm CWDM SM extra long haul: nominal reach 180 km, max. 240 km
	Optical direct fiber connection, or optical connection to ABB-/non-ABB-multiplexers (IEEE C37.94)
Ethernet	10/100 Mbps Fast Ethernet
	Auto/manual negotiation, full/half duplex
	Electrical port (RJ45)
	Optical port (optional SFP: 850 nm MM 0.5 to 1 km or 1310 nm SM 30 to 50 km
Management facility	By means of standard PC and browser software
	From one end via EOC (Embedded Operation Channel)
	Via LAN or Web with integrated Management interface (option, ports: same as line interface "Ethernet")
	Integrated LCD display panel (option)
Event recorder & trip counters	Integrated, non-volatile (up to 7500 command/alarm events, up to 65536 counts for each command/test
Synchronization of Real Time Clock	Inputs for external IRIG-B and 1PPS signal
	With optional Management interface: NTP/SNTP (IRIG-B output to synchronize other NSD570)
Alarms	Free contacts with configurable alarm allocation
IEC 61850 support (Ed. 1 and Ed. 2, HMI-configurable)	GOOSE interface to the protection (up to 8 commands; ports: same as line linterface "Ethernet")
	Automated exchange of data between substation engineering tool and HMI570 user interface (SCD-files)
	Engineering process of multiple substations according to IEC 61850 Edition 2
Standards	IEC 60834-1 (Teleprotection Command Systems)
	EMC Directive 2004/108/EC
	Low Voltage Directive 2006/95/EC
	EN/IEC 61000-6-2 (immunity)
	EN/IEC 61000-6-4 (emission)
	EN/IEC 60950-1 (safety)
	KEMA certified
Power consumption	Approx. 10 Watt per system in the rack
Temperature range	-5 to +55 ºC (operation)
	-40 to +70 ºC (transport and storage)

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