GRID AUTOMATION PRODUCTS

500NMD Ethernet DSL switches
DIN rail wide area networking

- Seamless transition from copper to fiber optics with one product family
- Predictive failure notification lowering overall TCO
- Legacy serial communication support
- Integrated telecontrol IEC 60870-5-101 and -104 support including transparent conversion
ABB 500NMD is a product series of ruggedized Ethernet/SHDSL switches especially designed to support critical infrastructure companies by enhanced robust communication technology offering integrated data conversion, minimal downtime, predictive failure notification and encrypted management.
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Communication for Telecontrol, Telemetering and Smart Grids
Networking for small stations

The 500NMD series out of the EDS500 product family is a product series of ruggedized Ethernet/SHDSL switches. It is especially designed to support critical infrastructure companies by enhanced robust communication technology offering minimal downtime, predictive failure notification and encrypted management. The switch and multifunction device is especially designed to support the characteristics of telecontrol communication. The devices are used in a variety of markets which require the need for cost-efficient reliable communication.

Utilities
500NMD devices are used for a wide range of applications in the energy, water, gas and fluid distribution:
- As communication switch in subtransmission and distribution networks for telecontrol, telemetering and smart grids to interconnect substations
- As communication switch along pipelines to attach RTU, IED or PLC driven valves, pump stations and depots
- As protocol and interface converter
- In retrofit applications to transmit legacy serial protocols

Transportation
The device series 500NMD is suited for railway, waterway and highway applications:
- Within train stations to connect passenger information systems (e.g. monitors) as well as video surveillance systems
- Along railway tracks to communicate to interlockings, signals, points and auxiliary systems like point heatings
- In highway environments to connect dynamic road signs, fog and ice sensors as well as radar traps
- Along waterways to connect water level and fog sensors or watergates

Oil & Gas
The product series can be used for pipeline monitoring and control as well as wellhead automation for small production facilities.

Industries
500NMD products can be deployed in large-scale industry installations to connect processing entities.

Connectivity
The 500NMD series of switches consists of multiple products allowing to establish wide area networking connections via customer-owned copper for fibre optical cables. A variety of interfaces are supported to provide connectivity to client and other communication devices:
- Four Ethernet ports (IEEE 802.3) for LAN connection
- Up to two SHDSL (Single-pair high-speed digital subscriber line) interfaces for data communication over 2-wire copper cable, reaching distances of up to 25 km and transmission rates up to 15,000 kbps
- Up to two pluggable optical transmission facilities for communication over fiber optics, realized as SFP (Small Form-factor Pluggable) to enable easy mounting of different kinds of transceivers, reaching distances up to 180 km
- Serial interfaces (one EIA-232/V.24, EIA-485 combined, additional optional EIA-232/V.24) to connect legacy client equipment
- Optional managed Power over Ethernet support to power video cameras or IP phones directly

To enable high network availability, the devices
support to build redundant structures like rings and/or backup routes.

**Management**
The extensive self-monitoring functions allow monitoring such as the signal quality on copper and fiber optic cables. In order to enable remote monitoring, the devices support management tools like Syslog, SNMP, SSH, Telnet, IEC 60870-5-101/-104 as well as an integrated webservice for easy device access. Additionally, the product supports up to two serial interfaces for configuration purposes or alternatively for tunneling serial telecontrol protocols.

**Benefits**
The connectivity and management qualities highlight the 500NMD series as ideal transmission technology for telecontrol communication using IEC 60870-5-104, IEC 61850 or IEC 60870-5-101. Existing copper lines used by voice frequency modems can become high performance IP networks without changing RTUs or IEDs. Existing telecontrol systems can be kept in service using mixed mode serial and Ethernet operation, while new extended technology can be added gradually using the same connection cables (examples: mixed IEC 60870-5-104 and -101 networks, VoIP for remote stations).

Security functions like network access control (IEEE 802.1X), access control lists, rate limiting, centralized account management or encrypted management traffic provide future ready mechanisms to adapt to requirements in changing networks.

Features like configuration stick support or predictive failure notification (alarming before a condition becomes critical) lowers significantly total cost of ownership (TCO) and unplanned downtime.

Simple integration of IP cameras is achieved by optional Power over Ethernet capability which includes a variety of power management features.

The compact case without moveable parts for easy installation on DIN rail, a wide area power supply (24 … 60 V) with small power consumption, extended temperature range and integrated overvoltage protection complete the concept of the 500NMD product series.

**RTU560 integration**
Many products of the 500NMD series are also available as plug modules for RTU560. This includes modules for SHDSL communications as well as Ethernet switches.

<table>
<thead>
<tr>
<th>Product</th>
<th>Ethernet interfaces</th>
<th>SHDSL interfaces</th>
<th>Optical SFP interfaces</th>
<th>Serial interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>500NMD30</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>500NMD01</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>500NMD02</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>500NMD11</td>
<td>4</td>
<td>1</td>
<td>(up to) 1</td>
<td>2</td>
</tr>
<tr>
<td>500NMD20</td>
<td>4</td>
<td>-</td>
<td>(up to) 2</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fibre type</th>
<th>Up to 2 km</th>
<th>Up to 15 km</th>
<th>Up to 40 km</th>
<th>Up to 80 km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimode</td>
<td>available</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Singlemode</td>
<td>-</td>
<td>available</td>
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</tr>
</tbody>
</table>
Network Structures

Numerous network structures like point-to-point, lines, rings, stars, branches and arbitrarily meshed networks can be realized with the devices of the 500NMD product series.

**Line**
A line topology usually follows the physical path of an infrastructure installation, e.g. an energy line or pipeline. In a line topology multiple transmission media can be used: SHDSL using copper wires (Cu) or optical transmission using fiber optic cable (fiber). Clients like RTUs, IEDs, IP phones and cameras or service laptops are attached via Ethernet.

**Ring**
The ring topology adds redundancy to line topologies by closing the loop back to the control center. To protect an installation against device failure the ring can be closed via the same cable. If separate cable paths are used a ring also protects against cable faults. In a ring each station can be reached over two paths. In case of a cable or device fault the data is automatically routed through the operational path.
**Star**
The star topology is used in centralized applications with multiple point-to-point connections. There is typically a large aggregation switch in the control center the different connections of the star are attached to. Fiber optical lines are connected by the use of SFPs for different media and distance support. Notice that ports can also remain unequipped if the port is not in use.

**Line with branches**
In a branched line one or more stations branch to a subline usually following physical infrastructure. In these stations a back-to-back coupling of multiple switches can be performed to add additional WAN interfaces. Branches can be also realized in arbitrary structures including ring or mesh networks at any given position of the structure.
Redundant point-to-point connection
Connections between stations can be implemented as redundant links, using either SHDSL over copper lines, fiber optical transmission, or both. The 500NMD series will automatically use the best connection available, thus achieving a higher operating reliability. To achieve a higher data rate the two connections can also be combined while maintaining the redundancy.

Redundant mobile radio communication
The monitor functionality of the 500NMD devices can be used to track the operational state of the network's uplink. This feature can be used to create redundant connections to island networks. Upon breakdown of the primary uplink (here: VPN tunnel through the Internet) the 500NMD device in station 4 activates the secondary uplink (dial-in connection using a mobile radio modem). By placing the uplink points on opposite ends of the line, failover is not only enabled when the VPN tunnel breaks down, but also whenever any connection between stations 1 to 4 breaks down.
Product Features

The 500NMD series of switches provides a rich feature set starting from basic connectivity features to high level conversion functions and high availability enhancements as well as predictive failure notification.

**Legacy serial protocol and IEC support**
By supporting both TCP/IP-based protocols such as IEC 60870-5-104, as well as legacy RS-232-based serial protocols such as IEC 60870-5-101, it is possible to transmit these (and other) protocols in the same network at the same time. Using this mixed operation, existing telecontrol networks can be gradually modernized and extended, while retaining telecontrol devices in place and updating only the transmission devices to future-proof IP technology.

Numerous legacy serial protocols can be transferred using this technique, including amongst others IEC 60870-5-101, Modbus, RP570/571, SEAB-1F and many more.

By using the serial tunneling, existing serial networks can be supplemented with the advantages of packet-oriented IP networks:

- Failover to redundant links (rings, backup connections)
- Surveillance and monitoring
- Fast transmission via modern SHDSL or fiber optic connections

Multiple serial lines can be tunneled over a single IP connection.

The native support for IEC 60870-5-101 and -104 makes the devices particularly suitable for future-oriented, gradual extension of networks for the purpose of modernization. The integrated converter functionality between IEC 60870-5-101 and IEC 60870-5-104 enables the operation of a modern IEC 104 control center and the reorganization of the network to a packet-oriented IP transmission technology, while existing IEC-101 RTUs can be kept unchanged. The required transmission technology for a future exchange of these RTUs with modern IEC-104 devices is already in place then.

Serial protocols transmitted over the RS-232 interface can be transported over packet-oriented IP networks with the help of 500NMD series devices. The serial data stream is converted into individual packets and sent to one or more remote stations. There, the packets are reassembled into a serial data stream. To avoid data loss due to lost packets, an error-correcting protocol can be activated.

**Monitor and interface dependencies**
500NMD devices can monitor the reachability of an IP address in the network. Alternatively an entry in the routing table can be observed. Using the interface dependencies function, port states can be coupled to other port states or the monitor state respectively. Inverse coupling is also supported (link1-up-when-link2-up vs. link1-up-when-link2-down). Thus a breakdown of the primary connection can cause the establishment of a secondary (backup) connection, for example using a dial-up modem or mobile radio device.
Switching and redundancy

The primary application of the 500NMD series is the role of a layer 2 switch. In certain application limited routing functionality is required. 500NMD is able to perform routing tasks on an VLAN base.

In the operation mode of a switch a device processes incoming Ethernet frames by forwarding them to certain ports, depending on the destination MAC address. During this process the MAC table of the device learns the source MAC address of the frame in conjunction with the port. Ethernet frames with known destination addresses are only forwarded to the respective port. Thus a network can be expanded self-learning. An automatic aging process in the MAC table will ensure that once learned network structures can also be changed and removed.

To avoid illegitimate duplication of Ethernet frames that subsequently force the network into a deadlock situation (so-called broadcast storm), a loop-free topology without active alternative paths must be guaranteed. For this purpose the 500NMD devices implement the Spanning Tree, Rapid Spanning Tree and Multiple Spanning Tree Protocol (IEEE 802.1D-2004 and IEEE 802.Q-2011) as well as Ethernet Ring Protection Switching (ITU-T G.8032). These protocols are able to activate/deactivate redundant paths by creating one or more logical trees, such that every destination is only reachable over one route.

Virtual LANs (VLANs)

VLANs provide a way for a physical network to be divided into multiple logical subnets. By this means, without adding hardware, additional sub-segments can be created that are isolated from each other. Effectively this feature separates for example traffic from an IP phone from an RTU in way that there is no communication possible between the two types of devices.

VLANs are supported according to the standard IEEE 802.1q. 500NMD devices are aware of up to 4095 VLAN identifiers and are able to interact with other devices using trunk (multiple VLANs) and access ports (interface to non-VLAN aware devices like clients) as well as one more management VLANs.

Predictive failure notification

Predictive Failure Notification is the ability to detect, monitor and analyze conditions that lead to circumstances that may result in severe error conditions and/or malfunctions and notify the user before such a condition becomes critical.

500NMD monitors signal quality on SHDSL and fiber optical links, temperature, operating hours and line utilization to rate the risk of a critical failure.

Predictive Failure Notification converts part of unplanned downtime into plannable maintenance and therefore reducing maintenance and consequential costs of service outages.

Rugged design

The product series is designed for harsh environments and is extensively tested regarding EMC, temperature and humidity, vibration, shock and bump.

All interfaces offer at least an overvoltage protection level of 4 kV (acc. to IEC 61000-4-5). The SHDSL interface is capable to withstand 6 kV surge voltages eliminating the need for an external overvoltage protection device in many applications.

500NMD products are maintenance free and have no moveable parts while offering at the same time an extended temperature range.

Installation

500NMD products are designed for minimum commissioning, installation and configuration effort:

- Powerful command line interface and human-readable and changeable configuration file
- Integrated web-server for intuitive change of configuration, uploading of new firmware and readout of status
- Auto fallback to last known working configuration in case of configuration error from remote
- Single config possible for all devices by use of DHCP
- Configuration stick for subsequent configuration of preinstalled devices and for simple exchange of devices
- Verification of topology by neighbor detection
- 500NMD products are scriptable via CLI and SNMP

The firmware of all switches is remote upgrad-
able without the need for change of configuration. The configuration is always backward compatible to any new firmware release. Additionally the firmware for devices of the same product series is identical, drastically reducing the amount of files to manage.

**Management**

500NMD devices support a wide range of monitoring and management possibilities, starting from alarm relay up to encrypted SNMPv3.

For small installations without dedicated network management system, the switches can be monitored either via the alarm relay, the integrated webserver or an IEC 61850-5-104 capable control center.

For simple monitoring of the 500NMD product series the Syslog protocol is supported, which transmits human-readable status and error messages from the devices.

For large installation any network management tool can access and control the devices via SNMP. A large variety of standard SNMP objects is supported as well as a customer specific management information base to handle special parameters e.g. for SHDSL connections.

For mass configuration changes or updates the scriptable command line interface (CLI) can be used.
Ordering Information
DIN rail products

BASIC PRODUCTS

500NMD series switches with four Ethernet and up to two WAN interfaces.

<table>
<thead>
<tr>
<th>Type</th>
<th>Identnumber</th>
<th>SHDSL</th>
<th>SFP</th>
<th>RS-232/485</th>
<th>RS-232</th>
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<tbody>
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<td>500NMD30 R0002</td>
<td>1KGT038890R0002</td>
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<td>-</td>
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<td>-</td>
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<tr>
<td>500NMD01 R0002</td>
<td>1KHW025096R0002</td>
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<td>500NMD20 R0002</td>
<td>1KHW025098R0002</td>
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<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

POE ENABLED PRODUCTS

500NMD series switches with additional support for Power over Ethernet (PoE+)

<table>
<thead>
<tr>
<th>Type</th>
<th>Identnumber</th>
<th>Max. Power</th>
<th>Input Voltage</th>
<th>Basic Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>500NMD40 R0001</td>
<td>1KGT038891R0001</td>
<td>280 W</td>
<td>51* - 57 VDC</td>
<td>500NMD30 R0002</td>
</tr>
<tr>
<td>R0002</td>
<td>1KGT038891R0002</td>
<td>36 W</td>
<td>24 - 60 VDC</td>
<td>500NMD30 R0002</td>
</tr>
<tr>
<td>500NMD41 R0001</td>
<td>1KGT038892R0001</td>
<td>280 W</td>
<td>51* - 57 VDC</td>
<td>500NMD01 R0002</td>
</tr>
<tr>
<td>R0002</td>
<td>1KGT038892R0002</td>
<td>36 W</td>
<td>24 - 60 VDC</td>
<td>500NMD01 R0002</td>
</tr>
<tr>
<td>500NMD42 R0001</td>
<td>1KGT038893R0001</td>
<td>280 W</td>
<td>51* - 57 VDC</td>
<td>500NMD02 R0002</td>
</tr>
<tr>
<td>R0002</td>
<td>1KGT038893R0002</td>
<td>36 W</td>
<td>24 - 60 VDC</td>
<td>500NMD02 R0002</td>
</tr>
<tr>
<td>500NMD43 R0001</td>
<td>1KGT038894R0001</td>
<td>280 W</td>
<td>51* - 57 VDC</td>
<td>500NMD11 R0002</td>
</tr>
<tr>
<td>R0002</td>
<td>1KGT038894R0002</td>
<td>36 W</td>
<td>24 - 60 VDC</td>
<td>500NMD11 R0002</td>
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<tr>
<td>500NMD44 R0001</td>
<td>1KGT038895R0001</td>
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<td>51* - 57 VDC</td>
<td>500NMD20 R0002</td>
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<tr>
<td>R0002</td>
<td>1KGT038895R0002</td>
<td>36 W</td>
<td>24 - 60 VDC</td>
<td>500NMD20 R0002</td>
</tr>
</tbody>
</table>

* 48 VDC supply voltage can be used if PoE is sufficient (instead of PoE+)
SFP MODULES

SFP modules for different range and fiber type. Modules for use on single fiber require complementary type at remote location.

<table>
<thead>
<tr>
<th>Type</th>
<th>Identnumber</th>
<th>Fiber Type</th>
<th>Wavelength</th>
<th>Appr. Range</th>
<th>Fibers</th>
</tr>
</thead>
<tbody>
<tr>
<td>500SMM02 R0001</td>
<td>1KGT038901R0001</td>
<td>Multimode</td>
<td>1310 nm</td>
<td>2 km</td>
<td>2</td>
</tr>
<tr>
<td>500SSM15 R0001</td>
<td>1KGT038902R0001</td>
<td>Singlenode</td>
<td>1310 nm</td>
<td>15 km</td>
<td>2</td>
</tr>
<tr>
<td>500SDM20 R0001</td>
<td>1KGT038903R0001</td>
<td>Singlenode</td>
<td>1550/1310 nm</td>
<td>20 km</td>
<td>1</td>
</tr>
<tr>
<td>500SUM20 R0001</td>
<td>1KGT038904R0001</td>
<td>Singlenode</td>
<td>1310/1550 nm</td>
<td>20 km</td>
<td>1</td>
</tr>
<tr>
<td>500SSM40 R0001</td>
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<td>Singlenode</td>
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<td>500SUM40 R0001</td>
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<td>1310/1550 nm</td>
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<td>500SSM80 R0001</td>
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<td>Singlenode</td>
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<td>500SSM90 R0001</td>
<td>1KGT038920R0001</td>
<td>Singlenode</td>
<td>1550 nm</td>
<td>200 km</td>
<td>2</td>
</tr>
</tbody>
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POWER SUPPLIES, CABLES AND ADAPTERS

Accessories for use with 500NMD series of switches.

<table>
<thead>
<tr>
<th>Type</th>
<th>Identnumber</th>
<th>Description</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP-E 24/2.5 R0001</td>
<td>1SVR427032R0000</td>
<td>100...240 VAC to 24 VDC / 60 W</td>
<td>Power supply</td>
</tr>
<tr>
<td>CP-E 48/1.25 R0001</td>
<td>1SVR427031R2000</td>
<td>100...48 VAC to 48 VDC* / 60 W</td>
<td>PoE Power supply</td>
</tr>
<tr>
<td>CP-E 48/5 R0001</td>
<td>1SVR427034R2000</td>
<td>100...48 VAC to 48 VDC* / 240 W</td>
<td>PoE Power supply</td>
</tr>
<tr>
<td>500CAB03 R0001</td>
<td>1KGT038909R0001</td>
<td>Configuration cable RJ12 / DB9-F</td>
<td>Serial cable 2.5 m</td>
</tr>
<tr>
<td>500CAB06 R0001</td>
<td>1KGT038912R0001</td>
<td>Serial cable RJ12 / DB9-F</td>
<td>Serial cable 1.2 m</td>
</tr>
<tr>
<td>500CAB07 R0001</td>
<td>1KGT038913R0001</td>
<td>Adapter cable 500NMD / 500FSD</td>
<td>Serial cable 1.2 m</td>
</tr>
<tr>
<td>500CAB10 R0001</td>
<td>1KGT038924R0001</td>
<td>Adapter cable 500NMD / RTU500</td>
<td>Serial cable 1.2 m</td>
</tr>
<tr>
<td>500LTD03 R0001</td>
<td>1KGT026600R0003</td>
<td>Line transformer for SHDSL</td>
<td>7.5 kV isolation</td>
</tr>
<tr>
<td>500NMA01 R0001</td>
<td>1KHWG27870R0001</td>
<td>Configuration stick for backup</td>
<td>Memory stick</td>
</tr>
</tbody>
</table>

* adjustable to meet PoE+ requirements
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