ETL600 – the secure communication solution for critical infrastructure

ETL600 has been designed keeping the customers’ investment protection in mind by ensuring a seamless transition from today’s to tomorrow’s PLC solutions.

Long-time tradition
Power Line Carrier systems have been used for decades by Electric Power Utilities to transfer vital information for the operation and protection of the electric power grid. Despite the forced deployment of optical fibers in recent years, PLC systems have continued to be used as a cost efficient and reliable solution for mission-critical services, either as the main and only medium where installations of optical fibers are economically not justified, or as a backup solution for the most important services that are normally conveyed over broadband media.

In recent years, technology advances brought about new opportunities for PLC applications, in particular related to higher bandwidth provisioning, integration into digital networks, combined with functional enhancements as well as ease and flexibility of use. These new possibilities – together with economic and reliability considerations which PLC is known for – have led to a remarkable revival of PLC systems worldwide.

With ETL600, ABB continues its successful line of PLC equipment, supporting all applications from legacy analog to most advanced digital solutions with a future-proof concept.

ETL600 preserves all of the functionality of the proven ETL500 – with thousands of units in operation worldwide – and at the same time offers a range of unprecedented features which makes ETL600 the perfect fit for demanding communication infrastructure.

The link to the future
The transition from analog to digital communication needs to be properly addressed by any new design. Besides concurrently supporting legacy and modern applications, existing PLC terminals themselves must be re-usable and upgradeable to advanced and future-proof digital PLC technology.

ETL600 has been designed keeping the customers’ investment protection in mind by ensuring a seamless transition from today’s to tomorrow’s PLC solutions with a smooth migration concept. No matter whether analog or digital applications are in your focus, ETL600 provides the solution to your operational communication needs with its universal and flexible system architecture.

Designed for the harsh substation environment
In order to provide the security and reliability that is expected from PLC, ETL600 incorporates extra measures, which contribute to providing high availability and protection against electromagnetic interference and damage due to overvoltage stress. Apart from complying with all relevant EMC/EMI standards, all interfaces including data ports are electrically isolated, hence providing additional protection against overvoltages, ground potential rise and ground loops beyond standard requirements.
ETL600 – ready for the future

ETL600’s advanced design allows the integration of all kinds of analog and digital services via commonly used interfaces, based on IEC standards and ITU recommendations.

Future-proof concept
Bandwidth has always been a scarce resource for PLC. The need for more communication capacity brought about frequency congestion problems, which made the extension of the PLC network increasingly difficult.

In order to meet the demands of fitting into existing frequency plans, or to cope with the need for higher data transmission speeds as required by data-centric applications, ETL600 offers a high degree of flexibility with regard to bandwidth selection. Not only is the available carrier frequency range extended from 500 kHz to 1000 kHz – thus duplicating the number of applicable PLC channels – the transmission bandwidth is also programmable beyond the traditional 4 kHz or 8 kHz, resulting in transmission rates as high as 256 kbps. This unprecedented data rate may be used by a single application from an external device like a multiplexer, switch or router (using the PLC link as a pure “high-speed data pipe”) or may be shared between a number of integrated configurable user data ports that are time-division multiplexed by the internal adaptive multiplexer MUX600. If gaps of an existing frequency plan with 4 kHz or 8 kHz nominal bandwidth shall be filled and analog speech is required, special operating modes with one 2 kHz analog channel (APLC) and one 2 or 6 kHz digital channel (DPLC) can be programmed (ensuring maximum data throughput in the DPLC channel).

No matter whether you are confined to traditional frequency planning or want to go beyond the typical 64 kbps of today’s digital PLC, ETL600 provides all the options as on-site programmable features.

Multi-service equipment
ETL600 integrates all the applications that are critical for electrical utilities:

- Transparent transmission of voice-frequency signals, such as band limited speech with superimposed teleoperation
- Digital transmission of compressed voice
- Fully transparent and/or UART-compliant transmission of asynchronous data up to 9600 bps with minimum delay in point-multipoint applications that are typical for polling SCADA
- Adaptive multiplexing of data services with traffic flow control
- Synchronous data transmission from 9.6 kbps to 256 kbps
- Port and channel sharing for most efficient use of scarce bandwidth resources
- Ethernet/IP-forwarding for LAN interconnections and IEC 60870-5-104 TCP/IP-based SCADA
- Teleprotection for up to 2 x 4 independent and simultaneous commands
- Easy connection of external switches, multiplexers and routers for network integration, service aggregation and traffic management via standardized interfaces

ETL600 system overview
ETL600 – the future-oriented platform

ETL600 preserves all the functionalities of the proven ETL500 and at the same time offers a range of unprecedented features which makes ETL600 the perfect fit for demanding communication infrastructure.

Universal architecture

With its universal hardware and software architecture, ETL600 makes the choice between traditional analog and advanced digital PLC finally pointless and obsolete – in contrast to most conventional systems where the choice is final and irreversible.

Using the same hardware components, the operating mode can be selected and changed by the user on site with a few mouse-clicks only. In addition to user-friendliness and unprecedented application flexibility, ETL600 also guarantees unconditional compatibility with legacy as well as state-of-the-art digital telecommunication environment.

In line with ABB's endeavor to protect the customers' large investment in PLC technology, it is even possible to upgrade existing ETL500 equipment to the most advanced ETL600 technology, preserving existing installations to the best possible extent, therefore considerably extending the lifetime of past investments.

ETL600 Release 4 – new features at a glance

Increased output power:
− 50 Watts and 100 Watts up to 1 MHz

More compact equipment versions:
− New single rack 50 Watts version for most used equipment configurations

Enhanced network (LAN) functionality:
− 4 integrated LAN ports (switching and IP routing, VLAN support)
− Improved Cyber Security, supporting latest standards

Digital transit of compressed voice channels:
− Reduced delay and unchanged speech quality in tandem operations
− Interconnection of up to 5 ETL600 terminals in a substation

Single or redundant power supply for all rack configurations
ETL600 – the ultimate response to customers’ need

ETL600 automatically copes with difficult situations by making optimum use of the available spectrum by means of novel algorithms, based on ABB’s long experience with digital PLC in real networks.

Your benefits

- Universal architecture for digital and analog operation in the same platform
- Operating mode configurable with a few mouse-clicks
- Wide range of transmission channel bandwidth, programmable without exchanging hardware
- SSB and Multi-Carrier (OFDM) digital modulation with Trellis Coding, user programmable on site
- Extended carrier frequency range up to 1000 kHz, duplicating the useful frequency band
- Standard high frequency output power is 50 W, 100 W is achieved with a second power amplifier stage
- Single-step frequency conversion and direct digital frequency synthesis (DDS)
- Up to 3 analog (APLC) channels in either 8 kHz or 12 kHz bandwidth for traditional “speech plus” applications
- Digital high-speed broadband channel (DPLC), user configurable with respect to speed and transmission bandwidth (2 kHz to 32 kHz)
- Two special operating modes: 2 kHz APLC plus 2 kHz DPLC in 4 kHz nominal bandwidth, 2 kHz APLC plus 6 kHz DPLC in 8 kHz nominal bandwidth (for each mode, 1 or 2 additional APLC channels of 4 kHz can be configured)
- Integrated high-speed broadband modem for up to 256 kbps user data rate
- Dynamic Speed Adaptation (DSA) for maximum data throughput and availability
- Automatic Jammer Suppression (AJS) – increases immunity to line interferences

Dynamic Speed Adaptation

Dynamic Speed Adaptation (DSA) allows to automatically adjusting the data rate in 5 user-defined steps according to the prevailing line condition – a feature introduced by ABB for digital PLC. DSA increases the availability of critical services by preventing the collapse of data transmission in case of link degradation (noise) that is significantly affected by changing weather conditions.

For example, the transmission of LAN/IP traffic will be continued at lower speeds in case of a deterioration of the channel condition (rain, ice), or the internal multiplexer (MUX600) discards lower priority data channels in favor of higher priority services – as determined by the user.

Alternatively, DSA will increase the actually transmitted data rate if the channel conditions permit to do so, hence maximizing the average data throughput.

- Integrated adaptive multiplexer for 10 data channels and 16 compressed voice channels
- Up to 2 internal teleprotection units with 4 independent commands each
- Adaptive signal evaluation ensuring shortest possible transmission times for teleprotection
- Special operating mode for single purpose teleprotection in 2 kHz transmission bandwidth
- Up to 4 integrated programmable low-delay narrowband modems, with speeds up to 9600 bps and adaptive equalizer for optimum performance
- Up to 4 LAN ports for Ethernet/IP traffic (VLAN support) and equipment configuration
- IP header compression (e.g. of VoIP packets) to make most efficiently use of the available data rate for LAN traffic over DPLC
- Up to 16 digital compressed voice channels for telephony services (using just 5.3 or 6.3 kbps per channel)
- Digital transit of compressed voice channels, to reduce the delay and maintain the speech quality when telephony links are connected in tandem (up to six ETL600 links in a chain)
- Up to five ETL600 terminals can be interconnected in a substation with the digital transit bus, i.e. the compressed voice channels can be forwarded in one out of four possible directions
- Graphical User Interface (GUI) for convenient operation and maintenance
- Secure management access, supporting latest cyber security measures (authentication, access logging, SSL, etc.)
- Element Management System (EMS) for supervision and equipment settings across the entire PLC network via LAN and Embedded Operations Channel (EOC)
- SNMP alarm traps for serving a communication network management system

SNR (dB)

Data rate (kbps)

foul … fair weather
high … low noise

DSA - the key to high link availability
ETL600 – a step ahead in transmission speed

ETL600’s novel adaptive signal processing algorithms ensure shortest transmission times for teleprotection, without compromising the security in any respect.

Reliable teleprotection
The transmission of protection commands is one of the most important tasks of PLC systems. PLC links have proven their reliability and security for decades, be it as the main channel or as backup for broadband systems, keeping in mind that the robustness of the transmission path is determined by the ruggedness of the power line itself – no other wire or fiber-bound solution can offer the same degree of security.

ETL600 can be equipped with one or two integrated teleprotection units NSD600. Each unit supports the transmission of up to four simultaneous and individually programmable commands for blocking, permissive tripping and direct tripping. The commands are transmitted in-band (i.e. within the speech or data channel), hence no extra bandwidth is consumed by the teleprotection. During the short time of command transmission, other services can be disabled allowing to allocate the full available transmit power to the protection signals (command level boosting). Novel adaptive signal processing algorithms ensure shortest transmission times even for direct tripping applications, without compromising the security in any respect. Should the transmission of up to 8 simultaneous commands not be sufficient, external teleprotection equipment – like ABB’s NSD570 – can be connected in addition to the integrated NSD600s.

A special ETL600 mode of operation with nominal bandwidth of 2 kHz offers single purpose teleprotection with 3 independent/simultaneous commands and 1 prioritized command (used in case of multi-phase failures, for example).

Broadband data transmission
The integrated broadband modem (MOD600) supports the transmission of high-speed data from 9.6 kbps to 256 kbps. The bandwidth is easily field-programmable and does not require the exchanging of hardware components.

During teleprotection operation, broadband data transmission is briefly interrupted (alternate purpose). Special algorithms ensure that data transmission is resumed immediately after the fault has been cleared, avoiding a re-synchronization that would introduce extra delay.

Automatic jammer suppression
The wider the transmission bandwidth the more likely it becomes that a certain portion of the band is adversely affected by narrowband interferences.

ETL600 automatically copes with such difficult situations by making optimum use of the available spectrum by means of novel algorithm, based on long experience with digital PLC in real networks.

Integrated multiplexer
The broadband capacity may be used by the internal time division multiplexer (MUX600) for the transmission of up to 10 synchronous or asynchronous data channels and for up to 16 compressed voice channels, or by a single service, for example a LAN interconnection. Alternatively, it may be used by external networking devices such as multiplexer, switch or router providing additional service aggregation functions and/or traffic management facilities. Data rates and/or traffic flow is controlled by the automatic data speed adaptation algorithm which constitutes a seamless optimization of the overall system performance for the management of varying and difficult channel conditions.

Narrowband data transmission
Up to four integrated narrowband modems (NSK600) support the transmission of unformatted (transparent) data with speeds up to 1200 bps, or UART compliant data with speeds up to 9600 bps. Center frequencies are user-programmable in steps of 60 Hz, transmission bandwidth range from 240 Hz at 100 bps to 3360 Hz at 9600 bps. In particular, these modems can be operated above the analog speech band (300 Hz to 2000 Hz) at transmission rates as high as 1200 bps transparent or 2 x 2400 bps or 1 x 4800 bps, compliant with all commonly used UART data formats. These modems introduce very low delays, their signals can be dropped and inserted flexibly on analog or digital basis with channel and port-sharing facilities using standard handshake-control signals.

An adaptive equalizer can be enabled for each NSK600 modem, which ensures optimum performance by compensating slowly changing channel characteristics over time. These features – together with their application flexibility – make the NSK600 modems ideal for polling SCADA systems using standard or even proprietary transmission formats – an invaluable asset ensuring compliance with legacy environments.
The ETL600 system features a very user-friendly Human Machine Interface software utility with built-in test functions for easy commissioning and maintenance.

LAN/Ethernet connectivity

The LAN600 service offers either transparent bridging/switching (including VLAN support) or IP routing (forward all or static routes), i.e. no external router is required when two LANs shall be interconnected via an ETL600 link, for example. The LAN600 can make use of the full broadband capacity or share it with other services. The Dynamic Speed Adaptation applies in either case.

It is also possible to configure and monitor the ETL600 locally or remotely via one of the four available LAN ports. IP header compression techniques can be enabled in order to considerably reduce the size of the packets, thus using the available data rate of LAN600 most efficiently (and maximizing the number of transferable VoIP channels, for example).

Network management

By means of its Embedded Operation Channel (EOC) and standard graphical user interface HMI600, ETL600 supports alarm polling and management of all terminals in a network. Access to any terminal in the network is possible via PC/notebook from any station, or from remote locations via serial data links or via an Intranet/Internet connection.

Supervision of a network consisting of ETL600 and/or ETL500 terminals is also possible using SNMP (Simple Network Management Protocol).

With ABB’s “FOXMAN” communication network management system, a geographical map with the network can be displayed on screen. A connection to the ETL600 concerned is established by simply clicking on the icon that changed its color due to the incoming SNMP alarm trap.

Built in test facilities

The ETL600 features built-in test functions for automatic link equalization with both graphical and numeric presentation, which in most instances eliminate the need of costly external test equipment such as spectrum analyzer and level meter.

Human Machine Interface

The ETL600 system features a user-friendly Human Machine Interface (HMI600) software utility. It provides for example the following extended facilities and characteristics:

- Setting of the operating frequencies and transmission bandwidth of the link
- Setting of the modulation type and mode of operation
- Setting of the user ports for voice, data and teleprotection with respect to levels, data speed and application
- Setting of remote terminal parameters via the integrated service channel (EOC)
- Polling of alarms and collection of operational status information from the network
- Generation of signals for tuning and testing of the transmit and receive filters
- Upload and display of recorded alarm events and teleprotection command events