

PLC & TP HV solutions



Power Line Carrier and Teleprotection systems

- Analog, digital & universal PLC terminals for HV lines
- Stand alone analog, digital & universal teleprotections
- Built-in teleprotection modules for PLC terminals
- Dedicated PLC for teleprotection applications
- Telecontrol (Scada) modems

PLC & TP HV solutions



Each product is subject to rigorous quality controls to guarantee customer satisfaction

Description

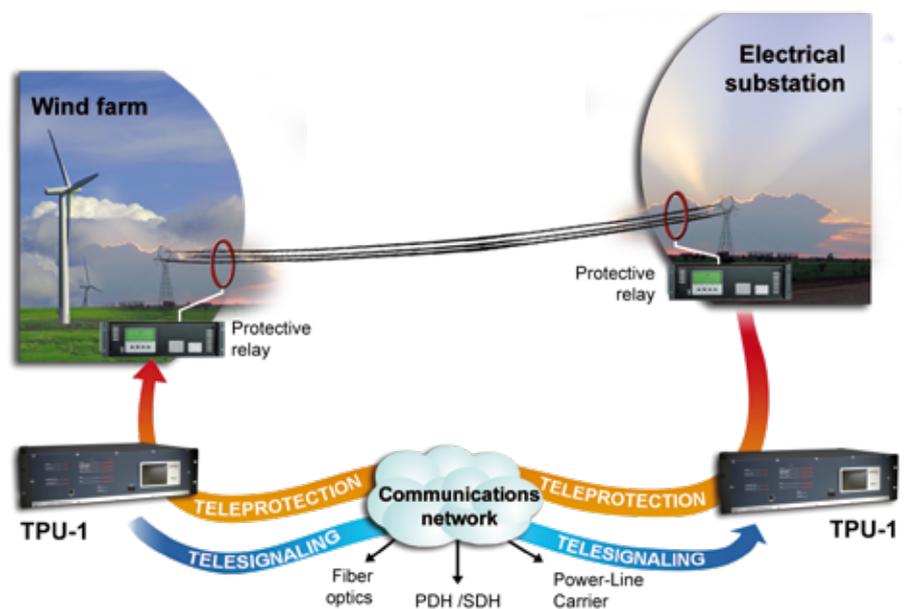
Introduction

Power line carrier systems for HV lines are part of the power utility's communication network. They are used to transmit critical information related to the operation of the electrical system: teleprotection signals, speech, telegraphy, remote measurements and telecontrol (SCADA signals). Power line carrier technology has proven to be the most reliable communication media, even in the event of natural disasters, thanks to its robustness and the reliability of the electronic equipment that has been engineered for an extremely long life.

ZIV COMMUNICATIONS' wide experience and extensive product range for power line carrier and teleprotection applications, enable easy adaptation to power utility requirements.

ZIV COMMUNICATIONS product portfolio includes:

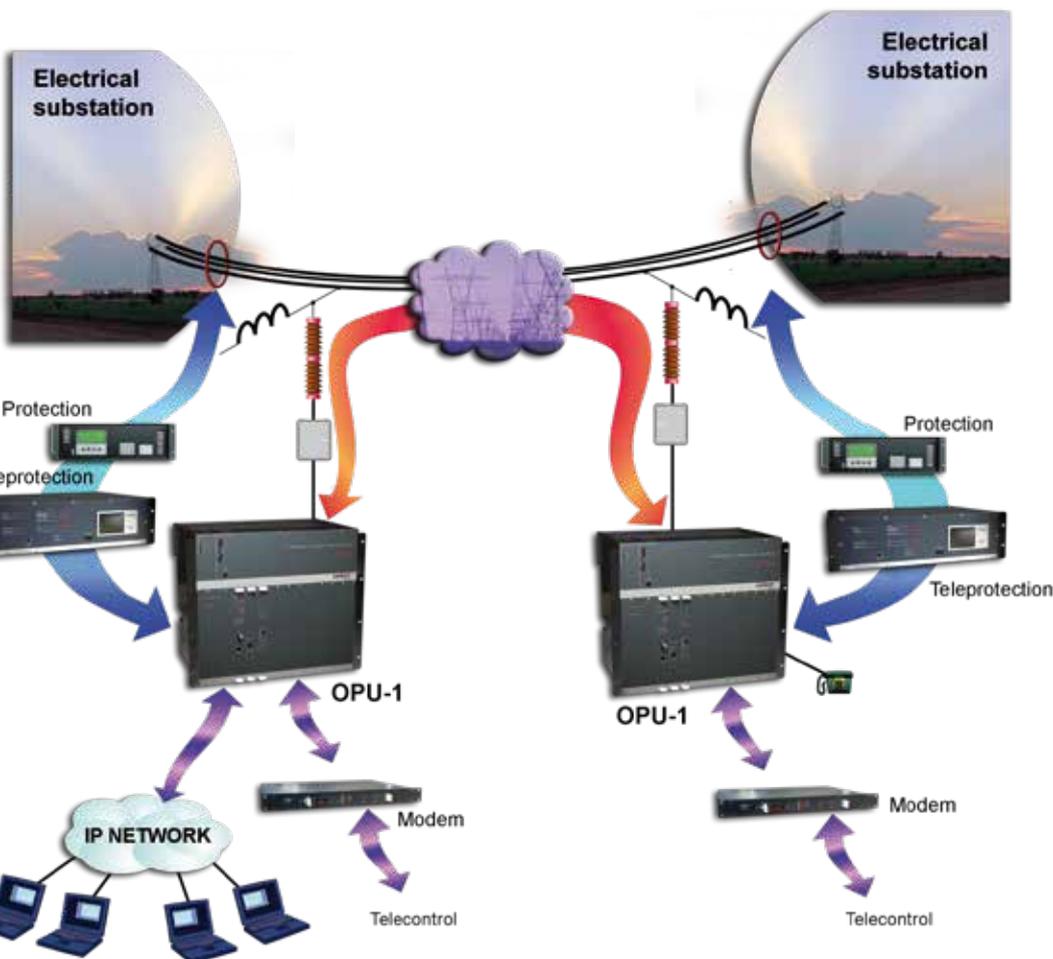
- Analog, digital and universal power line carrier (PLC) terminals for HV lines.
- Stand alone analog, digital and universal teleprotections.
- Teleprotections for the interconnection of distributed energy resources such as wind farms, solar plants, biomass plants and others.
- Dedicated PLC for teleprotection applications with the advantage of using 2kHz band.
- Built-in Teleprotection, as an optional module in the PLC terminals.
- Telecontrol (Scada) modems.



From simple devices to the most sophisticated designs and dedicated systems for teleprotection, ZIV COMMUNICATIONS covers all utility requirements. The wide international experience in HV lines is reflected in the development of key features important for the end users, such as different types of modulation to achieve dependable operation under different noise levels on the HV lines, solving frequency congestion using double line filters, or flexible webserver bandwidth to avoid the need for proprietary software.

In the field of teleprotection, ZIV COMMUNICATIONS offers a complete product range from simple devices, to the most sophisticated designs. The product portfolio covers encoded, single tone, FSK or Teleprotection over MPLS, and the option of selecting some of the most advanced technical features such as IEC 61850 compliance, transits, teed-lines, double communication interfaces, and webserver user interface.

Over four decades, ZIV COMMUNICATIONS has been granted with the confidence of many power utilities that strongly value state of the art devices, backed by 100% in-house development of PLC and teleprotection technology, including the QAM TCM and OFDM modulations; and the vast expertise of ZIV COMMUNICATIONS.



ZIV COMMUNICATIONS' wide experience and extensive product range for power line carrier and teleprotection applications, enable easy adaptation to power utility requirements

Power Line Carrier



OPU-1 Universal Power-Line Carrier Terminal

Modular design & advanced features

The modular design of the OPU-1 terminal and its advanced features ensure a perfect fit to every user need. It can integrate a great variety of interfaces that allow the transmission of all type of services through a high-voltage line.

This modularity allows OPU-1 terminals to transmit analog, digital or both analog and digital channels simultaneously, including teleprotection.

When working with analog channels, the OPU-1 can transmit one or two 4 kHz standard channels in each direction. The effective band of the channel can be used for the transmission of data at high speed, various VF telegraph channels, teleprotection signals or for a speech-plus service.

When working with a digital channel, the OPU-1 can support two different digital modulation schemes (QAM or OFDM).

When using QAM, it offers a transmission rate of 81 kbit/s in a bandwidth of 16 kHz, in each direction. Thanks to the use of a built-in echo canceller, the transmission and reception bands can be superimposed, resulting in a total bandwidth of 16 kHz. Operation in an 8 kHz or 4 kHz bandwidth is also possible over a single frequency slot in superimposed bands or two slots in adjacent bands or non-adjacent bands.

With the OFDM digital modulation scheme, the OPU-1 can support a maximum transmission rate of 324 kbit/s in a bandwidth of 32 kHz, in each direction.

Two digital modulation schemes. The OPU-1 offers two different modulation schemes to better suit all transmission needs in terms of quality of service required by the applications and the transmission line characteristics. Both QAM and OFDM are supported by the OPU-1 and can be selected from the programming software.

Two independent line filters. The OPU-1 can incorporate an additional high-frequency line filter to use different frequency slots in the same

high-voltage line or even independent lines. Apart from frequency congestion solution, this additional filter allows special topology applications such as Teed lines.

Different possibilities for the transmission of teleprotection signals. The teleprotection signals can be transmitted over a dedicated 4 kHz or 2.5 kHz analog band or integrated into the digital operation band.

When using the analog band the teleprotection can be transmitted using tones or encoded commands. The tone format can also be integrated into the digital operation band.

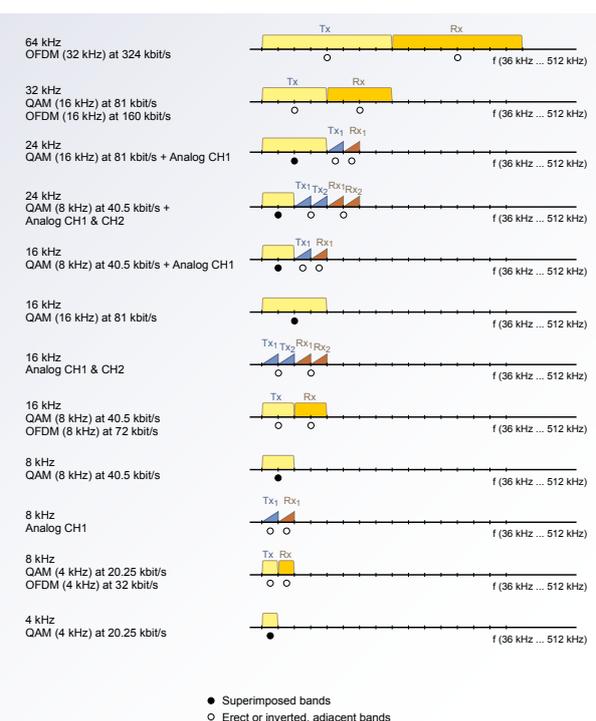
The high-frequency transmission bandwidth can be optimized in those cases where only teleprotection signals need to be transmitted, occupying 2+2 kHz.

Automatic fall-back/increase rates. One remarkable feature of the OPU-1 is the automatic fall-back rate when there is unfavorable line noise and/or signal reflection conditions. When the line conditions improve, the transmission rate is automatically re-established. This automatic feature can be disabled if necessary.

FEC control. The FEC (Forward Error Correction) control is a built-in optional functionality which can be used to improve the quality of the digital link. The link quality measurement is based on the G.821 standard.

Ethernet user interface with built-in bridge functionality. When using the OPU-1 for the interconnection of different line segments, the built-in Ethernet bridge selects the frames to be transmitted to the remote end, thus making a more efficient use of the communications channel.

SNMP agent. The OPU-1 terminals, furthermore, include an SNMP able to make GET and SET operations and send TRAP and INFORM notifications (unsolicited information spontaneously transmitted) about alarms and events of the terminal to the devices specified by the user, and this makes it possible to monitor the OPU-1 from an SNMP management application.



Key features

- Modular design
- Complies with IEC 60495 and IEC 61000-6-5 standards
- Simultaneous transmission of analog and digital channels including teleprotection
- Frequency range of 36 kHz to 512 kHz (from 30 kHz to 1016 kHz upon request)
- QAM or OFDM for best compromise between SNR, BW and transmission rate
- Independent bands to overcome congestion solution and special topology applications
- 10 ms internal latency in QAM mode
- 1 or 2 standard 4 kHz channels in each direction
- Transmission of telephony, data and teleprotection in one single 4 kHz channel
- Superimposed (echo canceller), adjacent or non-adjacent bands
- 81 kbit/s in 16 kHz bandwidth (QAM), 40.5 kbit/s in 8 kHz bandwidth (QAM), and 20.25 kbit/s in 4 kHz bandwidth (QAM)
- 324 kbit/s in 32 kHz bandwidth in each direction (OFDM)
- **Analog built-in optional modules:**
 - Speech module
 - Asynchronous programmable modem
 - Synchronous and asynchronous configurable modem
 - Digital transit filter
 - Input and output combiner
 - 2 or 4-command teleprotection system using tones or encoded commands in a 4 kHz bandwidth
 - 2 or 4-command teleprotection system using tones integrated in the digital band
 - 2 or 4-command teleprotection system using encoded commands in a 2.5 kHz analog band
- **Optional built-in TDM multiplexer:** DMPU/TMPU modules
- Multiple user interface options: Ethernet, G.703, V.35, V.11 and V.24/V.28
- 20, 40 or 80 W PEP, shared between the analog and digital channels
- Compact 19"9 U chassis for 20 W and 40 W
- Additional 19"3 U chassis for 80 W or an extra line filter
- Dedicated 19"3 U chassis for the **Narrow-band High-Frequency teleprotection application** in a 2+2 kHz bandwidth (2 or 4-commands using tones)
- Fully programmable (full coverage of the transmission frequency range with a single set of capacitors)
- Automatic fall back/increase rates
- Integrated optional Reed-Solomon FEC
- Integrated G.821 statistics
- Ethernet user interface with built-in bridge functionality
- SNMP agent
- Web Management system with LAN connection
- IRIG-B port for GPS time synchronization
- Sequence of Events register (1000 alarms and events) with 1 ms resolution
- Redundant power supply (optional)
- Built-in or cabinet-mounted terminal blocks



Its modular design and advanced features ensure a perfect fit to every user need

Power Line Carrier



OPC-2 Multi-function platform

A simple and reliable solution for PLC networks with frequency congestion

The OPC-2 is a highly flexible platform that is conceived with a dual purpose: Power-Line Carrier functionality or, alternately, Narrow-Band High-Frequency Teleprotection functionality.

The required OPC-2 functionality is established by simply configuring the microswitches in the management & process unit and line filter modules.

The output power (20, 40 or 80 W P.E.P.) determines the OPC-2 platform version. 20 W and 40 W versions are integrated in a single 6 U chassis with an additional 3 U chassis required in the 80 W versions.

All OPC-2 versions can be equipped with a redundant power-supply module.

Power-Line Carrier Functionality

The Power-Line Carrier functionality is a well-proven, cost effective solution to enable electrical power utilities to use high-voltage lines to transmit different types of information (telecontrol/SCADA data, speech and teleprotection signals) over long distances, using one or two standard 4 kHz channels in each direction.

A large variety of optional modules can be added to an OPC-2 platform with PLC functionality. Examples include: a speech module, a 2 or 4-command teleprotection system, an asynchronous programmable modem, a digital transit filter and an input/output combiner. When equipped with the optional synchronous and asynchronous configurable modem, the effective band of the channel can be used exclusively for transmission of synchronous or asynchronous data at a speed of up to 28.8 kbit/s.

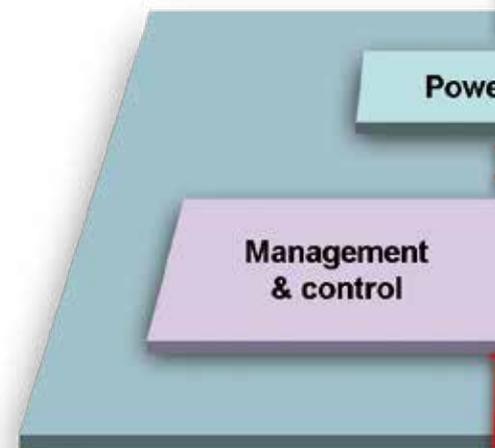


HF Teleprotection Functionality

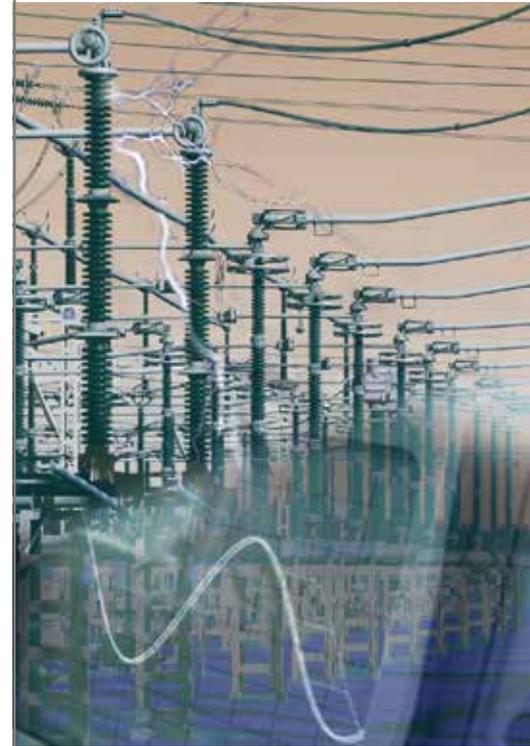
The High-Frequency Teleprotection functionality enables electrical power utilities to transmit teleprotection commands over high-voltage lines, in only one standard 4 kHz channel, using 2 kHz for transmission and 2 kHz for reception.

The OPC-2 platform allows three nominal transmission times to be programmed. The system meets the security and dependability requirements specified in IEC 60834-1 Recommendation for the three types of teleprotection command schemes: Permissive tripping schemes, Intertripping schemes (Direct or transfer tripping) and Blocking protection schemes.

High Frequency



User in



Key features

- Intelligent bandwidth use
- Single 6 U chassis for 20 or 40 W
- Single side-band (SSB) with suppressed carrier
- Frequency range of 36 kHz to 508 kHz
- Fully programmable (full coverage of the transmission frequency range thanks to the set of capacitors)
- IRIG-B port for GPS time synchronization
- Sequence of Events register (1000 alarms and events) with 1 ms resolution
- Web Management System with LAN connection for both functionalities
- Internal channel for end-to-end supervision
- Redundant power supply (optional)
- 3 programmable alarm relays and 1 relay per power supply

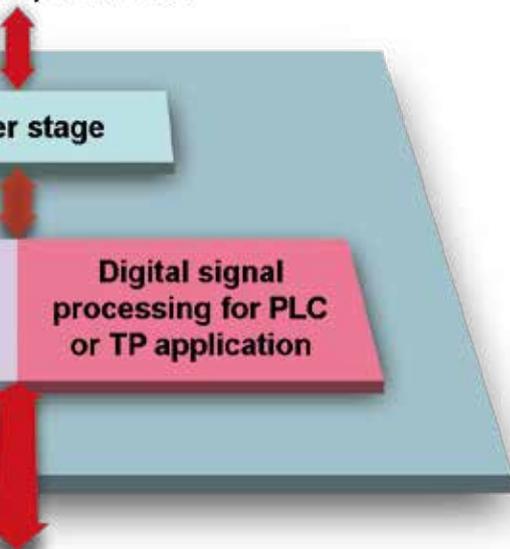
PLC application characteristics

- Versions for data transmission (D-type) or for speech-plus transmission (T-type)
- Single and twin-channel versions
- Erect or inverted, adjacent or non-adjacent programmable bands
- Available band of 300 to 3850 Hz with pilot tone out of band
- Service telephony channel
- Optional modules:
 - Asynchronous programmable modem
 - Synchronous and asynchronous configurable modem
 - 2 or 4-command teleprotection system by tones for a 4 kHz bandwidth
 - 2 or 4-command teleprotection system by FSK channels for a 4 kHz bandwidth
 - Speech
 - Digital transit filter
 - Input/Output combiner
- Meets International Recommendation IEC 60495, regarding PLC equipment

Teleprotection application characteristics

- 2-command and 4-command versions
- Only one standard 4 kHz channel (2 kHz for Tx and 2 kHz for Rx) is needed
- Guard and command frequencies located in the 300-2000 Hz band
- High dependability and extremely high security
- Meets Recommendation IEC 60834-1 regarding teleprotection systems
- Intended for blocking, direct tripping and permissive tripping schemes as well as for telesignalling
- Three programmable nominal transmission times depending on application
- From 1 to 4 command inputs (optocoupled)
- From 1 to 4 command outputs by solid-state relay, with voltage-free contact and current limitation

Emergency connection



Interfaces

A single platform with two applications:
 Power-Line Carrier functionality (telecontrol/SCADA data, speech and teleprotection signals)
 or Narrow-Band High-Frequency Teleprotection functionality

Power Line Carrier & Accessories



OPL-1 Small-size Analog Power-Line Carrier Terminal

High reliability and robustness

The OPL-1 analog Power-Line Carrier terminal is a small-size device where all the basic operating elements are contained in only four main modules.

The basic terminal has one standard 4 kHz channel with an output power (PEP), measured at the coaxial-connector output, of 20 W or 40 W.

The twin-channel version of the OPL-1 terminal can be supplied upon request, the use of both channels having to be specified.

Both types, single-channel and twin-channel, allow the transmission of teleprotection commands coming from an external analog teleprotection unit.

Optional features include a speech module, an external analog teleprotection unit, and an asynchronous programmable narrowband modem. An AF transit option can be configured from the Management System.

Key features

- Small-size design
- A single 5 U chassis
- 20 W and 40 W PEP
- Single side-band (SSB) with suppressed carrier modulation
- Single-channel and, optionally, twin-channel
- Frequency range of 40 kHz to 500 kHz
- Fully programmable (full coverage of the transmission frequency range thanks to the set of capacitors)
- 3 programmable alarm relays
- IRIG-B port for GPS time synchronization
- Sequence of Events register (1000 alarms and events) with 1 ms resolution
- Internal channel for end-to-end supervision
- Local management system based on a Web interface
- Integrated options: speech, AF transit and an asynchronous programmable modem
- Optional external analog teleprotection unit
- Optional external connection with cabinet-mounting terminal blocks



OPL-1T Analog Power-Line Carrier Terminal

With built-in teleprotection

The OPL-1T system is the result of the combination of the well-proven OPL-1 terminal together with ZIV COMMUNICATIONS' wide experience in analog teleprotection systems.

The OPL-1T architecture is fully modular and provides different services by installing the appropriate modules into the unit. The OPL-1T offers an optional built-in analog teleprotection system and up to four physical slots for optional submodules, including a speech circuit, an FSK modem and a baseband input/output circuit intended for audiofrequency transit, external modems or external analog teleprotection terminals type TPU-1 or CTP-1.

The OPL-1T can have an output power of 20 W, 40 W and 80 W (PEP), measured at the coaxial-connector output.

Key features

- Single 5 U chassis for 20 W and 40 W and two 5 U chassis for 80 W models
- Single side-band (SSB) with suppressed carrier modulation
- Single-channel and twin-channel
- Frequency range of 40 kHz to 500 kHz
- Fully programmable (full coverage of the transmission frequency range thanks to the set of capacitors)
- 3 programmable alarm relays (PLC system) plus 9 programmable alarm relays (built-in teleprotection system)
- IRIG-B port for GPS time synchronization
- Sequence of Events register (1000 alarms and events) with 1 ms resolution
- Internal channel for end-to-end supervision
- Local management system based on a Web interface
- 2 or 4 command built-in analog teleprotection system by tones intended for blocking, direct and permissive tripping as well as for telesignalling
- Up to four optional submodules: baseband input/output circuit (intended for an AF transit, external modems and external analog teleprotection terminals), speech and FSK modem
- Optional external connection with cabinet-mounting terminal blocks
- Complies with IEC 60495, IEC 60834-1 and IEC 61000-6-5 standards





Modems for PLC systems

Built-in

• MAFP (MFPU) and MQBT (MBPU)

The MAFP (MFPU) is an asynchronous narrowband modem with frequency-shift keying (FSK) modulation for the transmission of data at speeds of 50 to 1200 Bd. The technology used in the modem is based on digital signal processing and allows programming the transmission speed and center frequency of each channel. The modem is capable of operating at 1200 Bd in superimposed band and, in this way, share the channel of the PLC terminal with speech frequencies up to 2000 Hz and with a ZIV COMMUNICATIONS teleprotection terminal working with a guard frequency of 3800 Hz. The data interface complies with specifications V.24 and V.28 of the ITU-T and RS-232C of EIA.

The MQBT (MBPU) is a modem with a programmable modulation scheme, capable of operating with frequency-shift keying (FSK) modulation according to Recommendations V.23 and V.21 of ITU-T, as well as with multi-level modulations (DPSK, QAM and TCM) according to Recommendations V.34, V.32bis, V.32, V.22bis and V.22 of ITU-T. It can transmit synchronous or asynchronous data at a speed of up to 28800 bit/s in line.

It has two types of interface: V.24/V.28 of the ITU-T (with one clock for transmission and another for reception) and V.11 in accordance with standard ISO4903 (single clock).

External

• MDD-3, MAS-2 and VDM-1

The MDD-3 consists of a 19" / 6U chassis, allowing up to 14 modules type MAFP and/or AVDM to be installed.

The MAS-2 modem consists of a 19" / 1U chassis, incorporating a single modem module type MAFP.

The AVDM (VDM-1) is a module that converts an V.24 input port into a 2 Mbit/s G.703 output port.



• F2MUX

The F2MUX family is intended to convert a multimode optical fiber into an electrical or optical interface.

It consists of a 19" / 1U chassis, incorporating a F2MUX module. There are four different versions depending on the interface type:

- F2MUX.00: Optical into electrical (G.703 at 64 kbit/s).
- F2MUX.01: Optical into electrical (G.703 at 2 Mbit/s).
- F2MUX.02: Optical into electrical (V.35 at 64 kbit/s).
- F2MUX.04: Optical into optical (C37.94).



ZIV COMMUNICATIONS
offers a wide range of
Power-line Carrier Systems

Teleprotection



TPU-1 Universal Teleprotection Terminal

Highly flexible configuration for diverse applications

The flexible design of TPU-1 terminals allows the use of different types of modules depending on each application. This modularity allows TPU-1 terminals to manage one or two digital and/or analog channels. In cases where the TPU-1 terminal manages two channels, it can be configured to operate as two independent teleprotection terminals (in a single chassis).

TPU-1 terminals operating in analog channels can transmit and receive up to four teleprotection commands. TPU-1 terminals configured to operate in digital channels (with electrical or optical interface) enable two-way transmission of up to eight teleprotection commands. The command transmission initiate can be defined using an AND or OR combination of up to sixteen logic inputs. It is also possible to define the output logic for each command received.

• DER applications

DER applications (wind, solar, biomass and others), in most cases, require the use of teleprotection terminals to ensure the plant disconnection (intertripping). Provided with specific modules, the TPU-1 can transmit and receive analog measurements and digital signals (states, alarms, etc.) from the DER plant to the Utility Substation and commands (controls) from the Utility Substation to the DER plant.

• IEC 61850

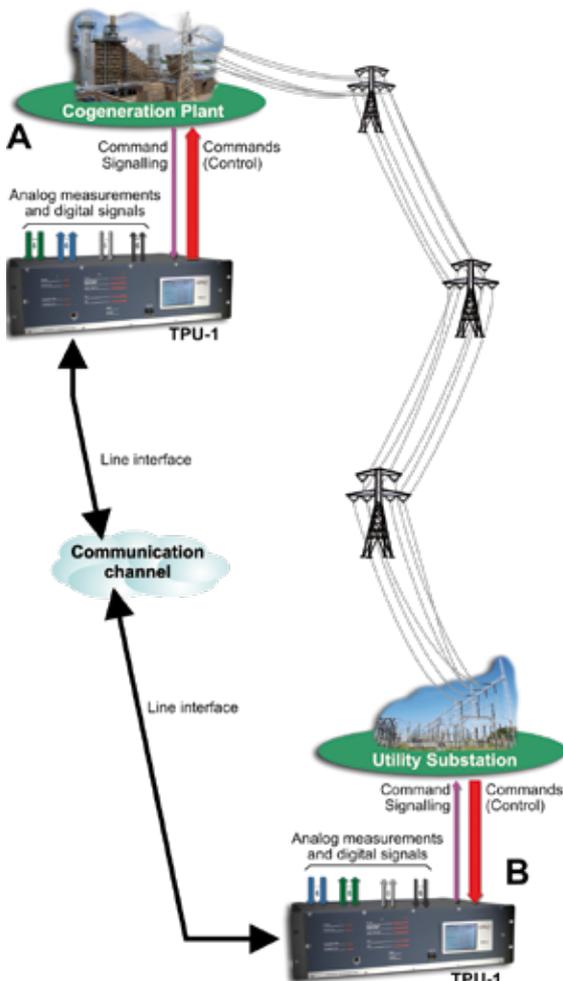
TPU-1 terminals are IEC 61850-compatible, so communication between a TPU-1 and a protection device inside a substation can be carried out according to this standard (GOOSE messages). However, if a protection device is not compatible with IEC 61850 standard, TPU-1 terminals can also communicate using analog protection interfaces (optoisolated inputs and solid-state relays).

• IP interface

The teleprotection information can be transmitted over an IP network using the IP communications interface. The teleprotection packets are given priority to ensure that the network load will not affect the performance of the teleprotection system.

Key features

- Modular design
- Complies with IEC 60834-1 and IEC 61000-6-5 standards
- Complies with ANSI IEEE C37.90.1 and ANSI IEEE C37.90.2 standards
- Compatible with IEC 61850 standard (optional)
- IP communications interface for connection to IP networks (optional)
- SNMP agent
- Extremely high security and dependability
- Two independent teleprotection terminals (in a single chassis)
- Operates over analog and/or digital channels
- Up to four commands in analog channels; Power-Line Carrier links, telephone cables, radio links, etc. Operation using tones or FSK channels or encoded commands
- Up to eight commands in digital channels; E1/T1 interfaces (G.703), 64 kbit/s (G.703, V.11 or V.35 or X.21), 64 kbit/s single-mode optical fiber (9/125 μm , 1300 nm or 1550 nm), and C37.94 multimode optical fiber (62,5 μm and 50 μm , 830 \pm 35 nm)
- Input and output logic programmable by the user (up to sixteen analog inputs and outputs and optional up to sixteen inputs and outputs in accordance with IEC 61850 standard)
- Can be used for blocking, direct and permissive tripping schemes as well as for telesignalling systems
- Specific modules for telesignalling and remote measurements
- Command transmits in a ring and in T (Teed-line)
- IRIG-B port for GPS time synchronization
- Synchronization via Ethernet using the NTP protocol
- Sequence of Events register (1400 alarms and events) with 1 ms resolution
- Web management system with LAN connection
- Internal channel for end-to-end supervision
- Signalling and alarm relays programmable by the user
- Built-in or cabinet-mounted terminal blocks
- Optional features such as LCD screen for command-counters, power-supply redundancy, and more.





CTP-1 Small-size Teleprotection



Encoded Teleprotection

A TPU-1 model allows the transmission of up to 32 commands using a signal encoded procedure over one or two line interfaces, in the 0 to 4 kHz band, by means of 4-wire connections.

The 32 commands can be divided into two different groups: A and B.

Group A commands have a higher priority and are normally used for teleprotection applications. The system allows the transmission of up to 4 commands, and any combination of them, of Group A.

Group B commands have a lower priority and are used for the control of devices. The system allows the transmission of up to 28 commands of Group B.

If a Group A command input is activated during the transmission of a Group B command, the Group B command is temporarily interrupted and the Command A transmitted. The transmitter memorizes the duration of the interruption of the Group B command and once the Group A command is finished the transmission of command B is resumed for its original duration.

When only Group B commands are transmitted, they are transmitted one by one depending on the priority established for them within the group.

Priority is established according to the command numbering. The commands with lower numbers have higher priority.

Operates over analog or digital channels

The CTP-1 is ZIV COMMUNICATIONS' answer to the ever increasing demand for small-size terminals for power utilities.

The non-linear detection process used for the analog channel as well as the frame format used for the digital channel guarantee security, dependability and transmission time values that meet or exceed the requirements of IEC 60834-1.

Key features

- Small-size design
- Complies with IEC 60834-1 and IEC 61000-6-5 standards
- Complies with ANSI IEEE C37.90.1 and ANSI IEEE C37.90.2 standards
- Extremely high security and dependability
- Intended for blocking, direct tripping and permissive tripping schemes as well as telesignalling
- Operates over analog or digital channels
- Up to four commands in analog channels; Power-Line Carrier links, telephone cables, radio links, etc.
- Up to four commands in digital channels; E1/T1 interfaces (G.703), 64 kbit/s (G.703, V.11 or V.35), and 64 kbit/s single-mode optical fiber (9/125 μm, 1300 nm)
- Fully programmable
- IRIG-B port for GPS time synchronization
- Sequence of Events register (900 alarms and events) with 1 ms resolution
- Local management system based on a Web interface
- Internal channel for end-to-end supervision
- Signalling and alarm relays programmable by the user
- Built-in or cabinet-mounted terminal blocks
- Optional features such as front-plate transmitted/received command counters, and more.

ZIV COMMUNICATIONS teleprotection terminals provide an optimal combination of security, dependability and transmission time



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