PLC & TP HV solutions

Making the Smart Grid Real

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

Description

Introduction

Power line carrier systems for HV lines are part of the power utilitie'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 extense 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 2 kHz band.

- Built-in Teleprotection, as an optional module in the PLC terminals.

- Telecontrol (Scada) modems.

Each product is subject to rigorous quality controls to guarantee customer satisfaction
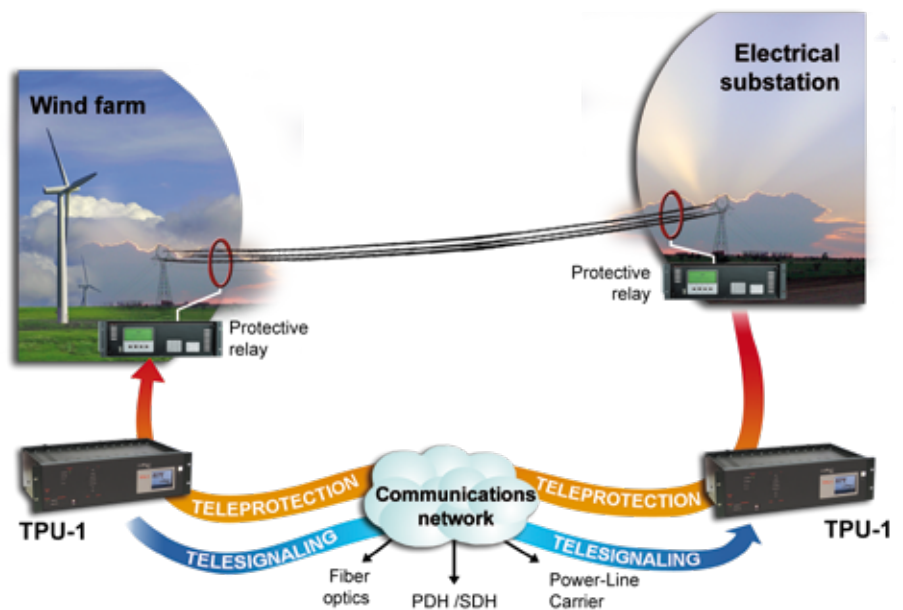
From simple devices to the most sophisticated designs and dedicated systems for teleprotection, ZIV COMMUNICATIONS covers all utility requirements.

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 (dual tone), single tone 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.
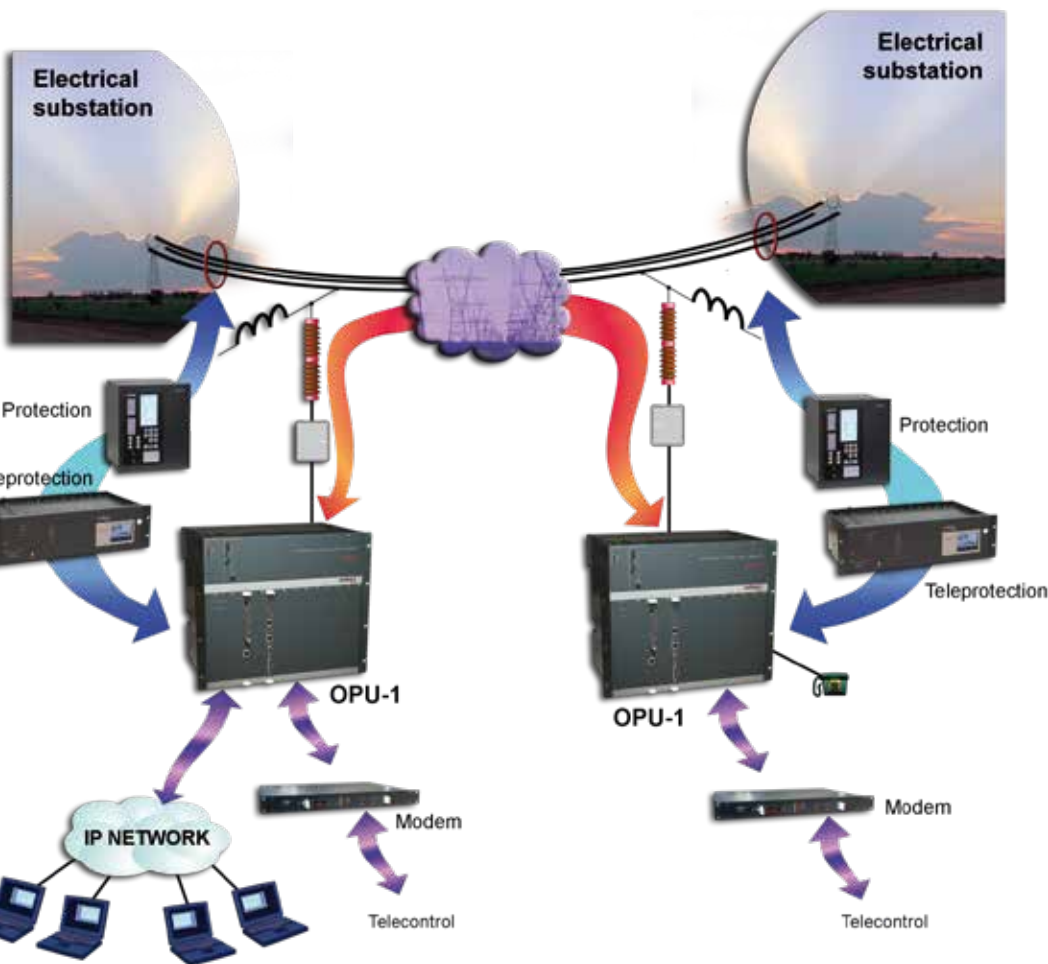
ZIV COMMUNICATIONS' wide experience and extense product range for power line carrier and teleprotection applications, enable easy adaptation to power utility requirements

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 up to 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 analog band or integrated into the digital operation band.
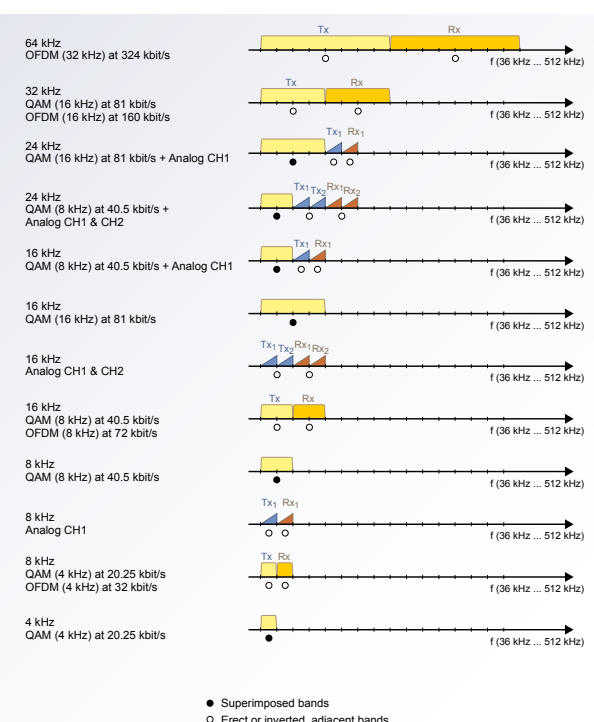
  The high-frequency transmission bandwidth can be optimized in those cases where only teleprotection signals need to be transmitted, occupying 2+2 kHz.

- **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.

64 kHz
OFDM (32 kHz) at 324 kbit/s

32 kHz
QAM (16 kHz) at 81 kbit/s
OFDM (16 kHz) at 160 kbit/s

24 kHz
QAM (16 kHz) at 81 kbit/s + Analog CH1

24 kHz
QAM (8 kHz) at 40.5 kbit/s +
Analog CH1 & CH2

16 kHz
QAM (8 kHz) at 40.5 kbit/s + Analog CH1

16 kHz
QAM (16 kHz) at 81 kbit/s

16 kHz
Analog CH1 & CH2

16 kHz
QAM (8 kHz) at 40.5 kbit/s
OFDM (8 kHz) at 72 kbit/s

8 kHz
QAM (8 kHz) at 40.5 kbit/s

8 kHz
Analog CH1

8 kHz
QAM (4 kHz) at 20.25 kbit/s
OFDM (4 kHz) at 32 kbit/s

4 kHz
QAM (4 kHz) at 20.25 kbit/s

● Superimposed bands
○ Erect or inverted, adjacent bands

Key features

- Multi-function platform

- 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

- 1 or 2 standard 4 kHz channels in each direction

- Superimposed (echo canceller), adjacent or non-adjacent bands

- 81 kbit/s in 16 kHz bandwidth (QAM), 40.5 kbit/s in 8 kHz (QAM), and 20.25 kbit/s in 4 kHz (QAM)

- Up to 324 kbit/s in 32 kHz bandwidth in each direction (OFDM)

- **Analog built-in optional modules**:
  - Speech module
  - Asynchronous programmable modem
  - Digital transit filter
  - Input and output combiner
  - 2 or 4-command teleprotection system using single tone in a 4 kHz bandwidth
  - Teleprotection system of up to 4 independent commands or in any combination using dual tone in a bandwidth of 1 kHz, 2 kHz or 4 kHz
  - 2 or 4-command teleprotection system using single tone or dual tone, which is integrated in the QAM digital 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 for 20 W and 40 W

- Dedicated 19"/ 3 U chassis for the **Narrow-band High-Frequency teleprotection application** in a standard 4 kHz channel, 2 kHz being used for transmission and 2 kHz for reception

- 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

- Time synchronization of the chronological register via GPS (IRIG-B) or via Ethernet (SNTP protocol)

- Capacity of chronological register for 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 & Accessories

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 circuits into the unit.

The OPL-1T offers an optional built-in analog teleprotection system and up to four physical slots for optional submodules.

The OPL-1T 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.

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

The OPL-1 terminal for 20W and 40 W PEP is made up of one 5 U chassis. An additional 5 U chassis is required for 80 W PEP.

The elements necessary for external connection are included in the equipment itself.

Key features

- High reliability and robustness
- Complies with IEC 60495, IEC 60834-1 and IEC 61000-6-5 standards
- Frequency range of 40 kHz to 500 kHz
- Single-channel and twin-channel
- Single side-band (SSB) with suppressed carrier modulation
- 20, 40 or 80 W PEP
- Single 19"/ 5 U chassis for 20 W and 40 W and two 19"/ 5 U chassis for 80 W
- Fully programmable (full coverage of the transmission frequency range with a single set of capacitors)
- 3 programmable alarm relays (PLC system) plus 9 programmable alarm relays (built-in teleprotection system)
- Time synchronization of the chronological register via GPS (IRIG-B)
- Capacity of chronological register for 1000 alarms and events with 1 ms resolution
- Local management system based on a Web interface
- 2 or 4 command built-in analog teleprotection system by single tone intended for blocking, direct and permissive tripping as well as for telesignalling
- Up to four physical slots for optional submodules, being available the following:
  - speech circuit (KTPT submoule)
  - FSK modem (KFPT submodule)
  - baseband input/output circuit (KCPT submodule) intended for audio-frequency transit, external modem or external analog teleprotection terminal

  NOTE: The OPL-1T system admits one teleprotection system per channel

- Optional external connection with cabinet-mounting terminal blocks

Modems / Converters for PLC systems

Built-in

• MFPU

The 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 rate and central frequency of each channel.

The modem is capable of operating at 1200 Bd in the frequency band above speech-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.

• AVDM

The AVDM is a module that converts an V.24 input port (from 50 up to 19200 bit/s) into a 2 Mbit/s codirectional G.703 output port.

External

• MDD-3, MAS-2 and VDM-1

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

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

The VDM-1 consists of a 19" / 1U chassis, incorporating a single module type AVDM (converter).

• F2MUX

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

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

- F2MUX.00: Optical (multimode) into electrical (G.703 at 64 kbit/s)

- F2MUX.01: Optical (multimode) into electrical (G.703 at 2 Mbit/s)

- F2MUX.05: Optical (single mode) into electrical (G.703 at 2 Mbit/s)

- F2MUX.02: Optical (multimode) into electrical (V.35 at 64 kbit/s)

- F2MUX.04: Optical (multimode) into multimode optical (C37.94)

ZIV COMMUNICATIONS offers a wide range of accessories for 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 combined (single tone) or independent (dual tone) teleprotection commands or up to thirtytwo encoded (dual tone) commands.

TPU-1 terminals configured to work over digital channels (with electrical or optical interface) enable two-way transmission of up to eight teleprotection commands.

- **DER (distributed energy resources) 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 can be compatible with the IEC 61850 standard and, therefore, allows the teleprotection-protection communication in a substation to be carried out in accordance with the said 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 packet 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.

Encoded commands

TPU-1 terminals allow the transmission of up to 32 commands using a signal encoded procedure over one or two analog 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 electrical high-frequency line protection schemes. 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.

Key features

- Modular design

- A single 19"/ 3 U chassis

- Can be used for blocking, direct and permissive tripping schemes as well as for telesignalling and remote measurements systems

- 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

- Mixed protection interfaces (analog and in accordance with IEC 61850 standard)

- Specific modules for telesignalling and remote measurements

- IP interface for connection to packet networks

- Possibility to transit teleprotection commands in configurations in T (Teed-line) or in a ring configuration

- Two independent transmission channels that can be either analog or digital

- Up to four commands in analog channels; Power-Line Carrier links, telephone cables, radio links, etc. Operation using single tone or encoded commands (dual tone)

- Up to eight commands in digital channels; E1/T1 interfaces (G.703), 64 kbit/s (G.703, V.35 or V.11/ X.21), 64 kbit/s single-mode optical fiber (9/125 µm, 1310 nm or 1550 nm), and C37.94 multimode optical fiber (62,5 µm and 50 µm, 830 nm)

- Input and output logic programmable by the user

- Time synchronization of the chronological register via GPS (IRIG-B) or via Ethernet (SNTP protocol)

- Capacity of chronological register for 4000 alarms and events with 1 ms resolution

- SNMP agent

- Web management system with LAN connection

- Signalling and alarm relays programmable by the user

- Built-in or cabinet-mounted terminal blocks
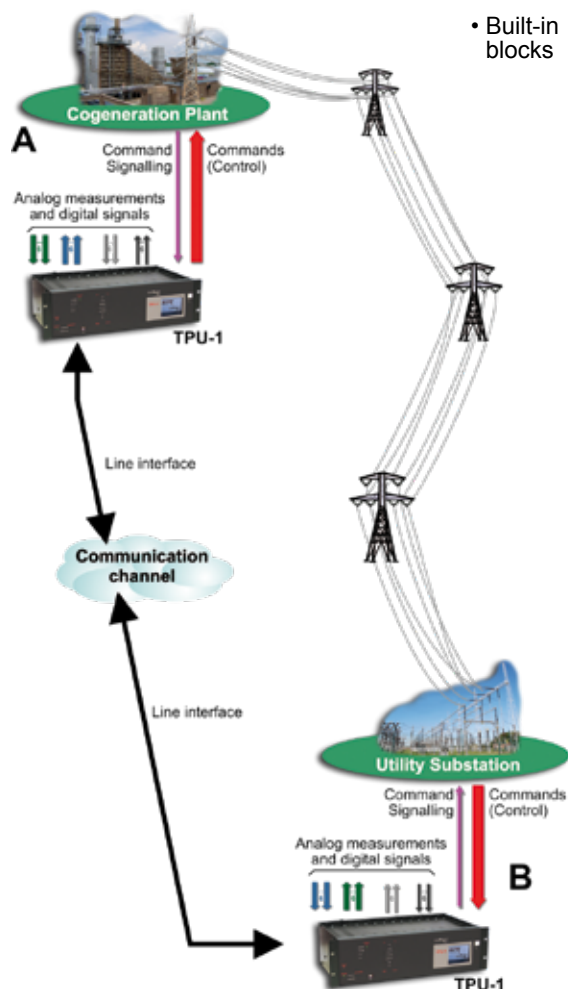
ZIV COMMUNICATIONS teleprotection terminals provide an optimal combination of security, dependability and transmission time

Making the Smart Grid Real

7 Manufacturing facilities & 14 Customer support centers

Chicago (USA)	**Dublin (IRL)**	**Paris (FRA)**	**Zamudio (ESP)**	**Dubai (ARE)**
Mexico (MEX)	**Newcastle (GBR)**		**Madrid (ESP)**	**Ryhad (SAU)**
Niteroi (BRA)			**Barcelona (ESP)**	**Bangalore (IND)**
				Singapore (SGP)
				Yakarta (IDN)

Making the Smart Grid Real *...with you*