Making the Smart Grid Real

OPU-1

Universal Power Line Carrier Terminal

Modular design & advanced features

- Simultaneous transmission of analog and digital channels and teleprotection signals
- Two available modulation schemes for the transmission of digital channels (QAM & OFDM)
- Independent frequency slots to solve frequency congestion and special topologies

OPU-1

Key features:

- Modular design.
- Simultaneous transmission of analog and digital channels including teleprotection.
- Different possibilities for the transmission of teleprotection signals.
- QAM or OFDM for best compromise between SNR, BW and transmission rate.
- Fully programmable (full coverage of the transmission frequency range).

Description

Introduction

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.

Operational characteristics

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, either in superimposed, adjacent or non-adjacent bands.

With the OFDM digital modulation scheme, the OPU-1 can support a maximum transmission rate of 320 / 160 / 72 / 32 kbit/s in a bandwidth of 32 / 16 / 8 / 4 kHz, in each direction.

Examples of transmission capacity are shown in Figure 4.

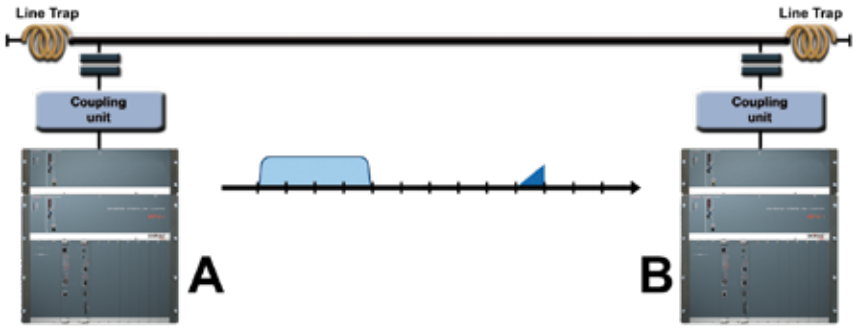

Figure 1 OPU-1 used to overcome frequency congestion

Product overview

The OPU-1 terminal for 20 and 40 W PEP is made up of two chassis, one of 6 U which integrates the power supply, the management, processing and control unit, the input and output interfaces, the digital modem, as well as the optional modules, and the other of 3 U which integrates the power stage modules.

The digital user interface can be chosen from a number of different possibilities: Ethernet, G.703, V.35, V.11 and V.24/V.28.

An additional 3 U chassis is required for 80 W PEP or for an extra line filter.

The terminal can also be equipped with an optional redundant power supply.

There are five slots in the 6 U chassis available for different analog options (see Technical specifications), and three slots available for an optional internal multiplexer, of up to three modules.

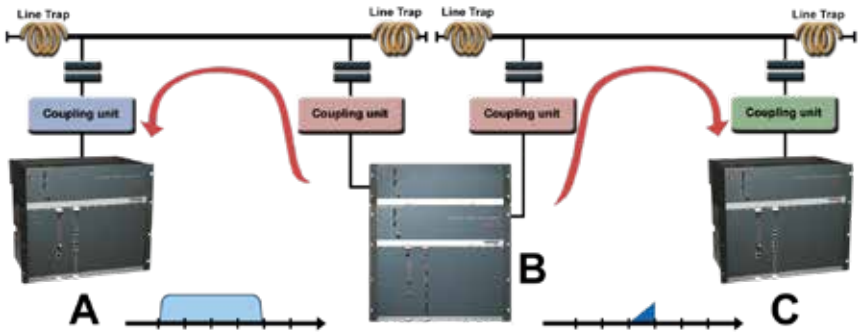

Figure 2 Two virtual OPU-1 units in a single physical device at the intermediate point

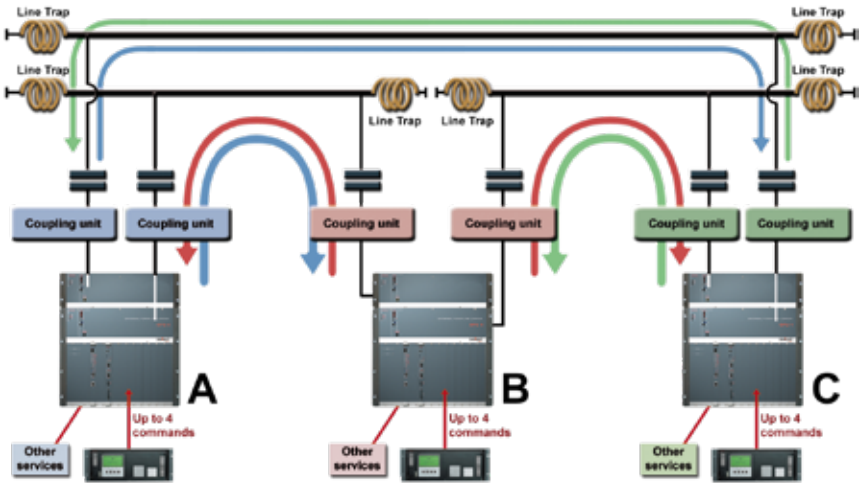

Figure 3 OPU-1 used to transmit teleprotection in Teed lines

Key features:

- Automatic fall-back increase rates.
- Integrated optional Reed-Solomon FEC.
- Web Management system with LAN connection.
- IRIG-B port for GPS time synchronization.
- Chronological register with 1 ms resolution.

Description

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 (see Figure 1) or even independent lines (see Figure 2). Apart from frequency congestion solution, this additional filter allows special topology applications such as Teed lines (see Figure 3).

In a twin-channel analog terminal also allows the transmission and reception bands of each channel to be non-adjacent.

Two digital modulation schemes

The OPU-1 offers two different modulation schemes to better suit all transmission needs in terms of the 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.

The QAM modulation focuses on robustness, being able to operate at lower S/N values and with a lower internal latency.

The OFDM modulation offers a higher transmission capacity at the expense of higher S/N requirements and a higher internal latency.

Automatic fall-back/increase rates

One remarkable feature of the OPU-1 is the automatic fall-back rate when there is unfavourable 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.

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.

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.

Different possibilities for the transmission of teleprotection signals

The teleprotection signals can be transmitted over a dedicated 4 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.

Management System

The OPU-1 terminals have a built-in Web server containing all the HTML pages necessary to carry out programming and monitoring of the system. In this way, OPU–1 terminals are fully programmed, monitored and managed from a PC running a standard Web browser, without the need for additional software.

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.

Technical specifications

General characteristics

Operating mode	Simultaneous transmission of analog and digital channels including TP
Modulation	Analog channel: Single side-band (SSB) with suppressed carrier. Digital modem: QAM with Trellis Coding or OFDM
Transmit and receive bands	**Analog channel**: Erect or inverted, adjacent or non-adjacent **QAM**: Superimposed, adjacent or non-adjacent **OFDM**: Adjacent or non-adjacent
Basic bandwidth	**Analog channel**: 4 kHz per channel in each direction **QAM**: 16 kHz at 81 kbit/s, 8 kHz at 40.5 kbit/s, 4 kHz at 20.25 kbit/s, single for superimposed bands or in each direction **OFDM**: 32 kHz at 324 kbit/s, 16 kHz at 160 kbit/s, 8 kHz at 72 kbit/s, 4 kHz at 32 kbit/s, in each direction
Transmission capacity	See examples in Figure 4

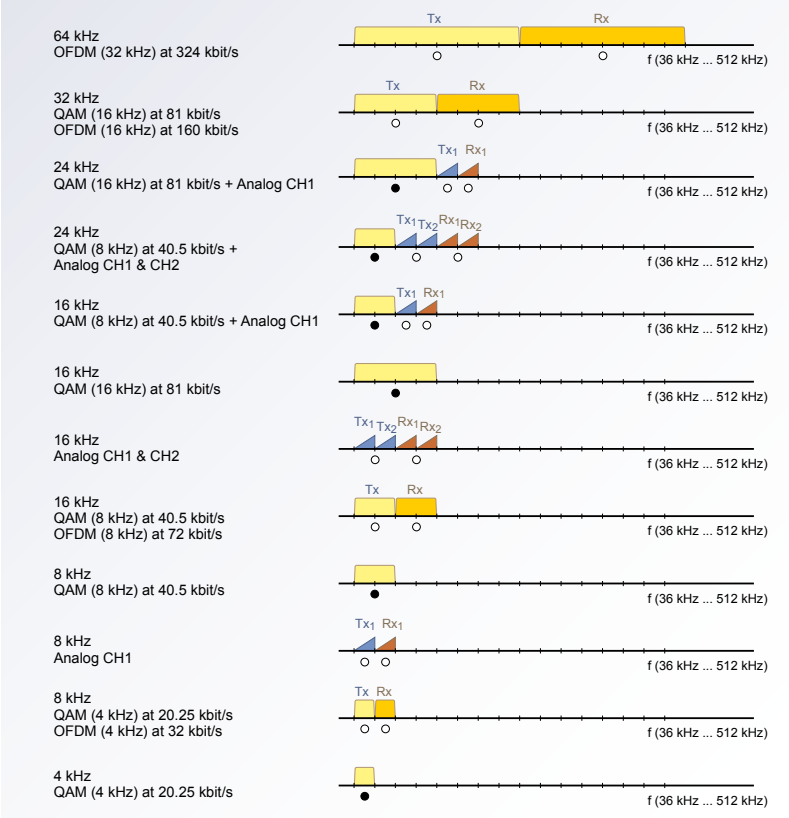

Figure 4 Transmission capacity examples

Supervision of data link quality	According to the G.821 standard
GPS time synchronization	IRIG–B port
Chronological register	1 ms resolution. 1000 alarms and events

Key features:

- **1 or 2 standard 4 kHz channels.**
- **81 kbit/s in 16 kHz bandwidth (QAM).**
- **324 kbit/s in 32 kHz bandwidth (OFDM).**
- **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.**

Technical specifications

High-frequency characteristics

Frequency range	From 36 kHz to 512 kHz (from 30 kHz to 1016 kHz upon request)
Nominal impedance	Selectable among 50, 75, 125 and 150 Ω
Return loss	Better than 10 dB
Tapping loss	In accordance with IEC 495, Fig. A.1 with n=4 (digital channel), figure 5 (analog channel)
PEP	20, 40 or 80 W, shared between the analog and digital channels
Receiver sensitivity	Analog channel: -30 dBm (measured in the pilot signal) Digital channel: -10 dBm (measured in the whole QAM/ OFDM signal)
Receiver selectivity	Higher than 65 dB at 300 Hz, and higher than 75 dB starting from 4 kHz (analog channel); in accordance with IEC 495 cls. 5.3.1.5 (analog and digital channels)

General characteristics of the QAM digital modem

Gross (Net) bit rate	QAM of 16 kHz: 81 kbit/s (79 kbit/s), 40.5 kbit/s (39.5 kbit/s) or 27 kbit/s (26.3 kbit/s) QAM of 8 kHz: 40.5 kbit/s (39.5 kbit/s), 20.25 kbit/s (19.75 kbit/s) or 13.5 kbit/s (13.15 kbit/s) QAM of 4 kHz: 20.25 kbit/s (19.75 kbit/s), 10.125 kbit/s (9.87 kbit/s) or 6.75 kbit/s (6.55 kbit/s)
Minimum S/N ratio, with white gaussian noise (AWGN) at receiver input (16 kHz QAM)	BER = 10^{-3}: 20 dB at 81 kbit/s. 12 dB at 40.5 kbit/s. 8 dB at 27 kbit/s BER = 10^{-6}: 23 dB at 81 kbit/s. 16 dB at 40.5 kbit/s. 12 dB at 27 kbit/s
Internal latency	10 ms

General characteristics of the OFDM digital modem

Gross bit rate	324 kbit/s (32 kHz), 160 kbit/s (16 kHz), 72 kbit/s (8 kHz), 32 kbit/s (4 kHz)
Internal latency	200 ms

Web management interface	10/100 Base-Tx with RJ-45 connector

SNMP agent

SNMP protocol	v1, v2c and v3
Functions	- Transmission of both unconfirmed and confirmed notifications (traps and informs) of alarms and events of the terminal. INFORM available in V2c and V3 only - Supervision of certain monitorable parameters of the terminal by means of a GET operation - Modification of certain configurable parameters of the terminal by means of a SET operation
Supervision by means of SNMP agent	Possible from an SNMP application

Technical specifications

User Interfaces

Analog channel	
Available band	From 300 Hz to 3850 Hz
Interfaces	Two 4-wire inputs and outputs per channel
Nominal impedance	600 Ω, balanced
Return loss	Better than 14 dB
Nominal level	Programmable between -20 dBm and +6 dBm
Digital channel	
Synchronous data port	Configurable V.35 or V.11 (1200 to 7200 bit/s) or G 703 (64 kbit/s), co-directional
Asynchronous data port	V.24/V.28 (RS-232C, 200 to 14400 bit/s)
Ethernet data port	10/100Base Tx with built-in bridge functionality
Optional built-in multiplexer	DMPU/TMPU modules for additional voice and data channels

Dedicated 19'/3 U chassis (Narrow-band High-Frequency teleprotection)

Bandwidth	2+2 kHz (2 or 4-commands using tones)

Analog optional modules

- Speech module
- Asynchronous programmable modem
- Synchronous and asynchronous configurable modem
- 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 bandwidth
- Digital transit filter
- Input/output combiner

Alarms

3 relays programmable by the user and
1 power-supply module relay, all of them with changeover contact

Power supply

48 V_{DC}, 110 to 250 V_{DC} and VAC ±20%.
Possibility of having redundance on the power supply (optional)

Dimensions

Basic terminal	483 x 398 x 355 mm (one 19"/6 U chassis and one 19"/3 U chassis)
80 W or additional line filter	483 x 548 x 355 mm (one 19"/6 U chassis and two 19"/3 U chassis)
Weight	23 kg (20/40 W); 33 kg (80 W)

Operating conditions

Temperature and humidity	From –5 °C to +55 °C and relative humidity not greater than 95%, in accordance with IEC 721-3-3 class 3K5 (climatogram 3K5)

Making the Smart Grid Real

www.zivautomation.com

Headquarters

Parque Tecnológico, 210
48170 Zamudio, Bizkaia, Spain
T: +34 94 452 20 03
F: +34 94 452 21 40

ziv@zivautomation.com

7 Manufacturing facilities & 15 Customer support centers

Chicago (USA)
Mexico (MEX)
Niteroi (BRA)

Dublin (IRL)
Newcastle (GBR)

Paris (FRA)
Grenoble (FRA)

Zamudio (ESP)
Madrid (ESP)
Barcelona (ESP)

Dubai (ARE)
Ryhad (SAU)
Bangalore (IND)
Singapore (SGP)
Yakarta (IDN)

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

Please visit our website for local information in your area

Rev.6.1 - February 2018