OPU-1

DIMAT Universal Power-Line Carrier Terminal

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

Simultaneous transmission of analog and digital channels including teleprotection

Two digital modulation schemes

Independent bands to overcome congestion and special topology applications

Automatic fall-back/increase rates

DIMAT

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OPU-1

Key features:

- Modular design
- Simultaneous transmission of analog and digital channels including teleprotection
- 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
- Fully programmable (full coverage of the transmission frequency range with a single set of capacitors)
- Automatic fall back/increase rates

Description

Introduction

The use of the most advanced technology in digital signal processing together with DIMAT's wide experience in digital and analog power–line carrier terminals have resulted in a highly flexible, robust and reliable Universal PLC terminal.

The modular design of the OPU-1 terminal and 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. A bandwidth of 8 kHz or 4 kHz is also possible, single for superimposed bands or in each direction for non-adjacent bands.

With the OFDM digital modulation scheme, the OPU-1 can support a maximum transmission rate of 256 kbit/s in a bandwidth of 32 kHz, in each direction.

Examples of transmission capacity are represented in Figure 4 (see Technical specifications).

Product overview

The OPU-1 terminal for 20 and 40 W PEP is made up of two shelves, one of 6 s.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 s.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 s.u. shelf is required for 80 W PEP or for an extra line filter.

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

As far as the options are concerned, there are five slots available for different analog options (see Technical specifications) which fit perfectly in the 6 s.u. shelf with the rest of the basic modules.

The multiplexing of the different services, if desired, can be carried out by using an optional internal TDM multiplexer which have three additional slots available for up to three additional modules with up to three submodules each, either speech or data ports (see Technical specifications).

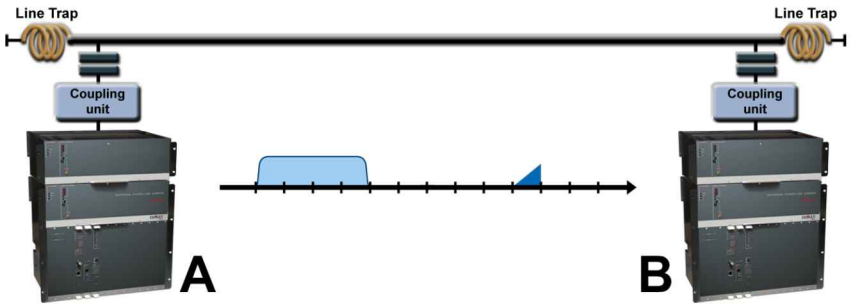


Figure 1 Example of application

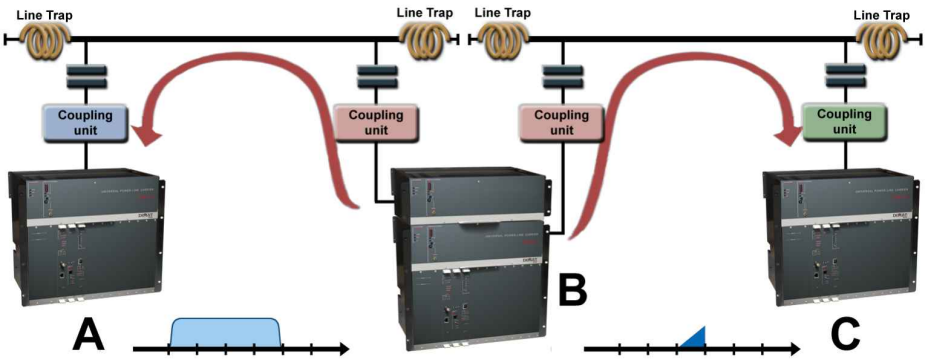


Figure 2 Example of application

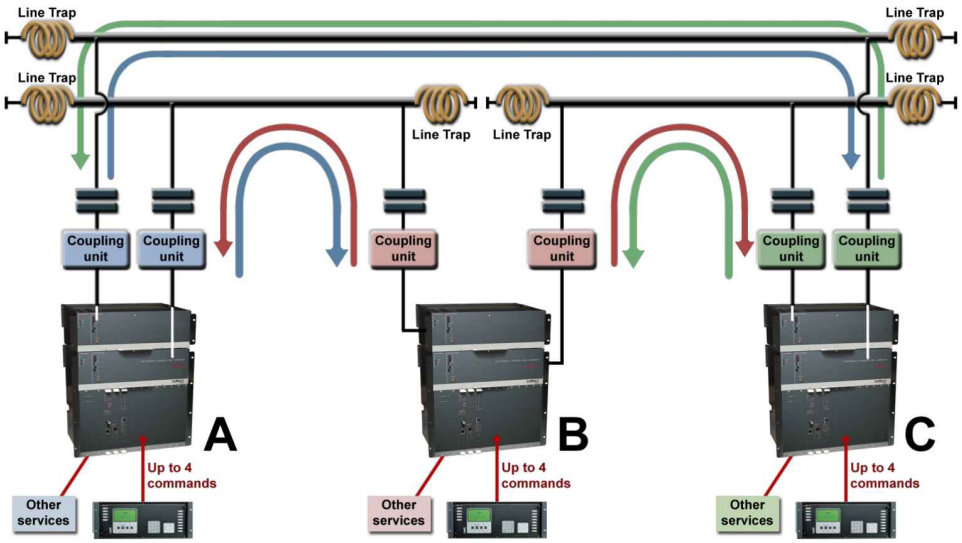


Figure 3 Example of application

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 like Teed lines (see Figure 3).

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 choice between QAM and OFDM depends on the required transmission rate, required BER and internal latency, on the one hand, and S/N ratio and line attenuation on the other hand. QAM can work at lower values of S/N and has a lower transmission latency, whereas OFDM increases the transmission rate at the expense of a higher transmission latency and needs higher values of S/N ratio.

In general terms QAM is more suited for long lines and medium transmission rates, while OFDM is more suited for higher transmission rates over short lines.

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 from the programming software 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 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 concepts.

Narrow-Band High-Frequency Teleprotection

The OPU-1 can incorporate an optional teleprotection system that enables electrical power utilities to transmit teleprotection commands between protection relays over high–voltage lines, in only one standard 4 kHz channel, using 2 kHz for Tx and 2 kHz for Rx.

Management System

The DIMAT 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.

The communication between the PC and the terminals can be established via direct connection or through an IP network.

SNMP agent

The OPU-1 terminals, furthermore, include an SNMP agent 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 terminal from an SNMP management application.

The MIB contains all variables of the OPU-1 terminal that can be monitored. An integration kit for major management platforms is available upon request.

Cascaded internal service channel

The terminal offers the possibility to connect in cascade the internal service channel of different OPU-1 links. This is a useful feature that makes the remote management of the OPU-1 terminals possible when not all of them have the possibility of connection to an IP network.

For other functionality or technical characteristics, please contact DIMAT.

24 h. Assistance in Europe and Africa

24 h. Assistance in USA and Canada

24 h. Assistance in Brazil and South America

Technical specifications

General characteristics

Operating mode	Simultaneous transmission of analog and digital channels including teleprotection
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 channel: Superimposed or non-adjacent OFDM channel: Non-adjacent
Basic bandwidth	Analog channel: 4 kHz per channel in each direction QAM channel: 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 for non–adjacent bands (with a minimum band-spacing of 16 kHz or 8 kHz, respectively) OFDM channel: 32 kHz at 256 kbit/s, in each direction for non-adjacent bands
Transmission capacity	See Figure 4. The possibilities can be enlarged with the use of the additional line filter (see Figures 1 to 3)

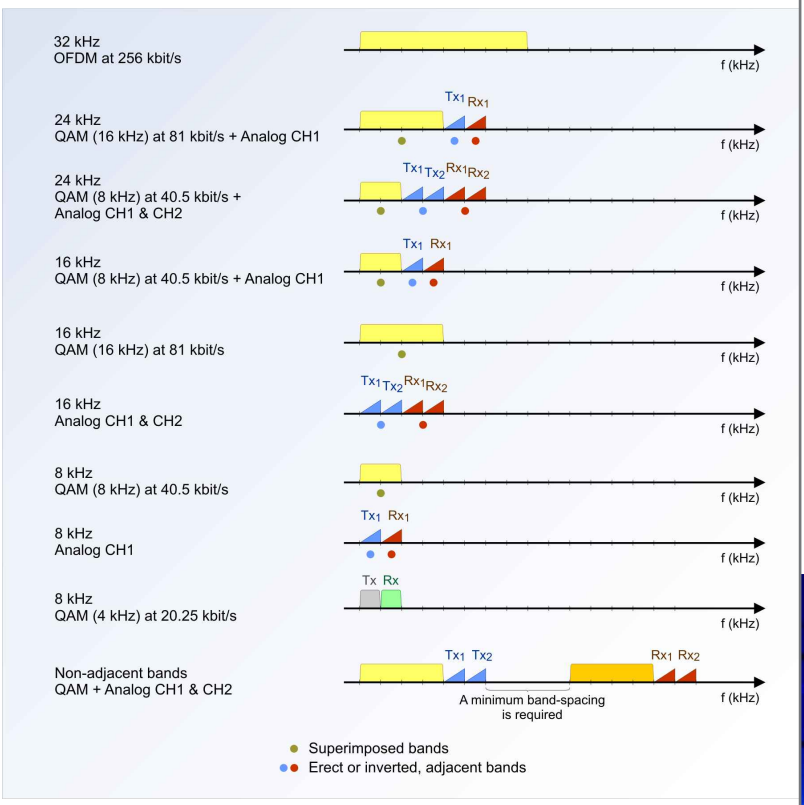


Figure 4 Examples of transmission capacity

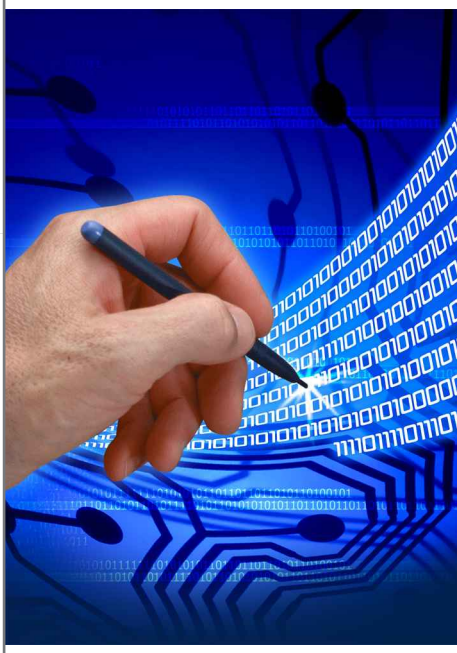
Supervision of the quality of the data link	According to the G.821 standard
Optional built-in FEC	Selectable between the following m/n ratios: 8/7, 4/3
GPS time synchronization	IRIG–B port
Chronological register	1 ms resolution. 1000 alarms and events

High-frequency characteristics

Frequency range	From 36 kHz to 512 kHz (from 36 kHz to 1 MHz upon request)
Nominal impedance	Selectable among 50, 75, 125 and 140 Ω
Return loss	Better than 10dB
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 bandwidth) Digital channel: -10 dBm (measured in the whole QAM bandwidth)
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)

Key features:

- Redundant power supply (optional)
- 1 or 2 standard 4 kHz channels in each direction plus a large variety of analog options
- 81 kbit/s in 16 kHz bandwidth (QAM) plus an optional internal TDM multiplexer
- 256 kbit/s in 32 kHz bandwidth in each direction (OFDM)
- 20, 40 or 80 W PEP, shared between the analog and digital channels
- Compact 19"/9 s.u. shelf for 20 W and 40 W
- An additional 19"/3 s.u. shelf for 80 W or an extra line filter



Technical specifications

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, 20.25 kbit/s or 13.5 kbit/s QAM of 4 kHz: 20.25 kbit/s, 10.125 kbit/s or 6.75 kbit/s
Fall back/increase rate	Automatic. Can be disabled from the programming software
Minimum S/N ratio, with white gaussian noise (AWGN) at receiver input	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. With optional built-in multiplexer: 15 ms at 81 kbit/s. 20 ms at 40.5 kbit/s. 25 ms at 27 kbit/s

General characteristics of the OFDM digital modem

Gross bit rate	256 kbit/s
Fall back/increase rate	Automatic. Can be disabled from the programming software

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, 50 to 14400 bit/s)
Ethernet data port	10/100Base Tx with built-in bridge functionality
Optional built-in multiplexer	Up to nine additional ports, either speech or data
Speech ports	16 kbit/s, ADPCM coding 4800, 6400 or 8000 bit/s, MP-MLQ compression
Data ports	V.24/V.28 (RS-232C) 600 to 38400 bit/s, synchronous 50 to 28800 bit/s, asynchronous 60 to 1440 bit/s, anisochronous

Analog optional modules

- Speech module
- Asynchronous programmable modem
- Synchronous and asynchronous configurable modem
- 2 or 4-command teleprotection system using tones in a 4 kHz or 2 kHz bandwidth
- 2 or 4-command teleprotection system using FSK channels in a 4 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 one voltage-free changeover contact

Power supply

48 V_{DC} ±20%. Others on request. Supports redundancy of the power–supply (optional)

Dimensions

Basic terminal	482 x 400 x 313 mm (one 19"/6 s.u. shelf and one 19"/3 s.u. shelf)
80 W or additional line filter	482 x 534 x 313 mm (one 19"/6 s.u. shelf and two 19"/3 s.u. shelves)

Operating conditions

Temperature and humidity	From –5ºC to +55ºC and relative humidity not greater than 95%, in accordance with IEC 721-3-3 class 3K5 (climatogram 3K5)
Maximum temperature	+55ºC for a period not greater than 24 hours (IEC 495 cls.3.1)

Management computer

Type	Compatible PC with Pentium III 350 MHz processor or higher
Operating system	Microsoft Windows 2000 or Microsoft Windows XP
Web browser	Microsoft Internet Explorer v 5.5 or higher

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

Key features:

- 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
- Cascaded internal service channel
- IRIG-B port for GPS time synchronization
- Chronological register with 1 ms resolution

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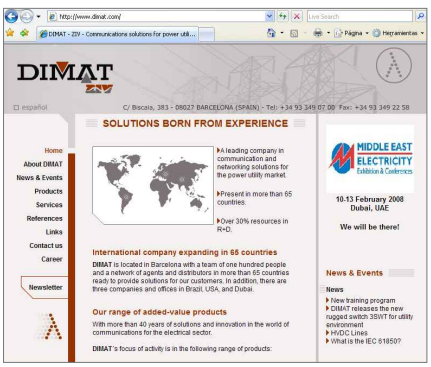

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