IEC 62488-2

Edition 1.0 2017-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Power line communication systems for power utility applications – Part 2: Analogue power line carrier terminals or APLC

Systèmes de communication sur lignes d'énergie pour les applications des compagnies d'électricité – Partie 2: Équipements terminaux à courants porteurs sur lignes d'énergie analogiques ou APLC



IEC 62488-2:2017-07(en-fr)



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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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POWER LINE COMMUNICATION SYSTEMS FOR POWER UTILITY APPLICATIONS –

Part 2: Analogue power line carrier terminals or APLC

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This first edition of IEC 62488-2 cancels and replaces the relevant parts of IEC 60663 and IEC 60495, which will be withdrawn at a later date.

This standard is to be used in conjunction with IEC 62488-1.

This bilingual version (2020-03) corresponds to the monolingual English version, published in 2017-07.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
57/1867/FDIS	57/1891/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 62488 series, published under the general title *Power line communication systems for power utility applications,* can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The contents of the corrigenda 1 (2020-01) and 2 (2023-03) have been included in this copy.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC 62488 series is a family of standards dealing with all aspects of power line communication systems operating over electricity power lines.

These international standards apply to power line carrier terminals and systems (PLC) used to transmit information over power networks including extra high, high and medium voltage (EHV/HV/MV) power lines. Both analogue and digital modulation as well as narrow and broadband systems will be included.

The complexity and extensive size of present-day electricity generation, transmission and distribution systems are such that it is possible to control them only by means of an associated and often equally large and complex telecommunication system having a high order of reliability.

The control of electrical networks and transmission and reception of data are through a combination of analogue and digital communication systems controlling devices and systems distributed throughout the electrical network.

The emergence of digital communication systems for controlling the devices of the electrical distribution network enables faster data transmission. The traditional analogue communication systems mainly due to legacy applications are still extensively used.

The ability to represent the various electrical parameters as an analogue signal and/or a digital signal ensures the quality and quantitative aspects of seamless communication to be maintained throughout the electrical power network.

Therefore, by using either analogue power line communication, digital power line communication or a combination of both types of systems, seamless efficient communication may be maintained throughout the power network.

In many countries, Power Line Carrier (PLC) channels represent a main part of the utility-owned telecommunication system. A circuit which would normally be routed via a PLC channel can also be routed via a channel using a different transmission medium, such as a point to point radio or open-wire circuit. Since, in many cases, automatic switching is used, the actual rerouting, although predetermined, is unpredictable.

It is important, therefore, that the input and output signals and criteria exchanged among all terminal used in the communications system are compatible. This compatibility is also beneficial in creating the ability to interchange and interconnect terminals from different sources.

This document has been prepared to enable compatibility between APLC links from different sources or between APLC links and other transmission medium to be achieved and to define the terminal performance required in APLC networks.

POWER LINE COMMUNICATION SYSTEMS FOR POWER UTILITY APPLICATIONS –

Part 2: Analogue power line carrier terminals or APLC

1 Scope

This part of IEC 62488 applies to Amplitude Modulation Single Sideband (AM-SSB) Analogue Power Line Carrier (APLC) Terminals and Systems used to transmit information over power lines (EHV/HV/MV).

In particular this document covers basically baseband signals with bandwidths of 4 kHz and 2,5 kHz, or multiples thereof, corresponding to the same high frequency bandwidth/s for single or multi-channel APLC terminals.

Figure 1 shows a schematic representation of the scope of the IEC 62488-2 standard within a complete power line communication system installation.

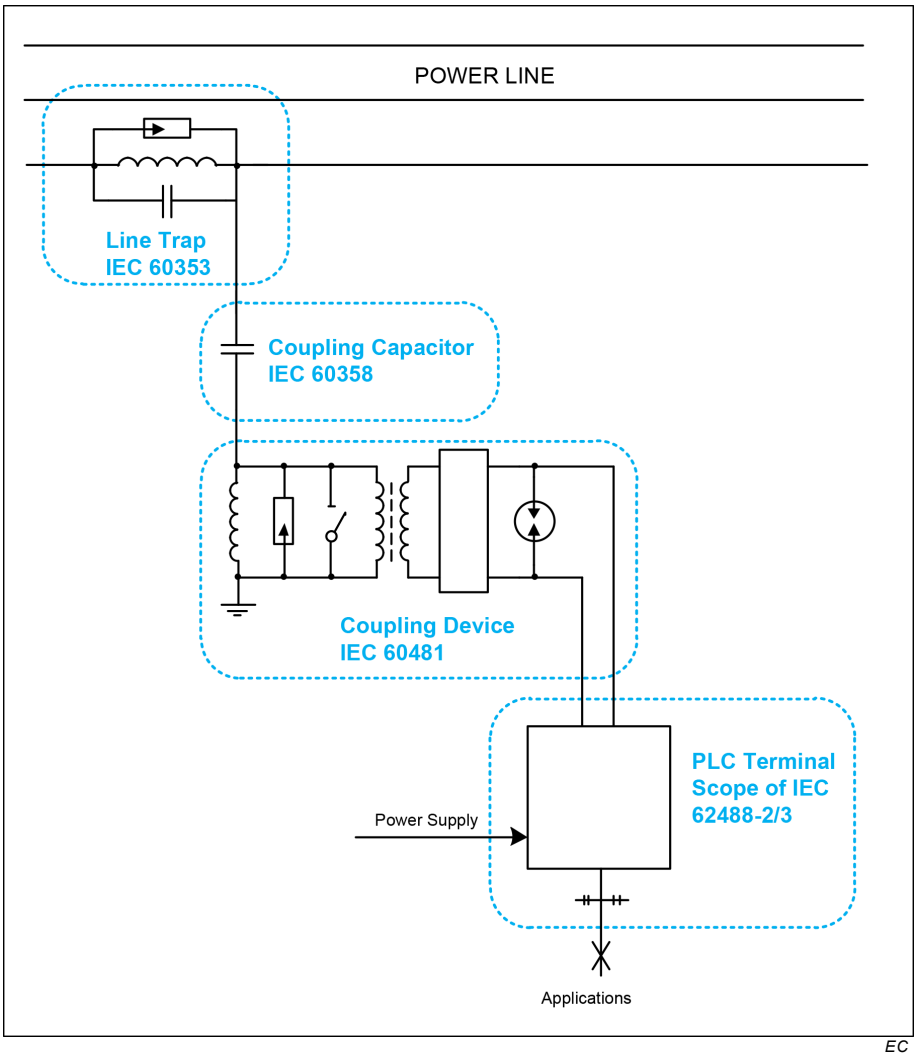


Figure 1 – Schematic representation of the scope of IEC 62488-2

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60038, *IEC standard voltages*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60255-27:2013, *Measuring relays and protection equipment – Part 27: Product safety requirements*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60721-3-1:1997, *Classification of environmental conditions – Part 3 Classification of groups of environmental parameters and their severities – Section 1: Storage*

IEC 60721-3-2:1997, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 2: Transportation*

IEC 60721-3-3:1994, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations*
IEC 60721-3-3:1994/AMD1:1995
IEC 60721-3-3:1994/AMD2:1996

IEC 60834-1, *Teleprotection equipment of power systems – Performance and testing – Part 1: Command systems*

IEC 60950-1, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3 : Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-16, *Electromagnetic compatibility (EMC) – Part 4-16: Testing and measurement techniques – Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz*

IEC 61000-4-17, *Electromagnetic compatibility (EMC) – Part 4-17: Testing and measurement techniques – Ripple on d.c. input power port immunity test*

IEC 61000-4-18, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

IEC 61000-4-20:2010, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

IEC 61000-4-29, *Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-4:2006, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*
IEC 61000-6-4:2006/AMD1:2010

IEC 61000-6-5:2015, *Electromagnetic compatibility (EMC) – Part 6-5: Generic standards – Immunity for equipment used in power station and substation environment*

IEC 62488-1:2012, *Power line communication systems for power utility applications – Part 1: Planning of analogue and digital power line carrier systems operating over EHV/HV/MV electricity grids*

CISPR 16-1-1:2015, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 16-1-2:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements*

CISPR 16-1-4:2010, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements*

CISPR 16-2-1:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*

CISPR 16-2-3:2016, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*

CISPR 14-1:2016, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

CISPR 22:2008, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62488-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
absolute power level
power of a signal expressed in decibels referred to 1mW as defined by Equation (1)

$$X[\text{dBm}] = 10 \times \log_{10}(P/1\text{mW}), \quad (1)$$

where

P = signal power

3.1.2
APLC equipment
PLC equipment with an LF interface for each LF channel, applying AM-SSB modulation to the signals at the input of each LF interface and transmitting over the power line the modulated signals, which occupy adjacent frequency bands fully covering the HF transmission band of the PLC

Note 1 to entry: The LF channel bandwidths are typically either 4,0 or 2,5 kHz, but can be different.

Note 2 to entry: In addition to the mentioned interfaces other interfaces may be present such as data interfaces, LF teleprotection and control interfaces or teleprotection command interfaces.

3.1.3
basic high frequency band
elementary subdivision of the high frequency range or part thereof allocated to a single APLC transmit or receive high frequency channel

3.1.4
effective transmitted voice band
that part of the voice-frequency baseband used for telephone communication, not including the telephone signalling channel

3.1.5
level reference point
point in a system with the relative level 0 dBr

Note 1 to entry: More specifically, a sinusoidal reference signal of 1020 Hz in the voice frequency band is thought to pass the signal path under consideration with such amplitude that its absolute level is 0 dBm at the 0 dBr point. [ITU-T G.100.1]

Note 2 to entry: The level reference point may exist physically or only hypothetically.

3.1.6
LF channel
frequency band used for the signal transmission of a low frequency interface

3.1.7
load capacity, <for the multi-channel terminal>
maximum single frequency sine wave power expressed in dBm0 which a multi-channel amplifier must transmit without appreciable overloading

3.1.8
mean high frequency band output power
output power of an APLC terminal at nominal high frequency band terminal averaged over a time sufficiently long compared with the cycle time of the lowest modulation frequency and during which this average power assumes the highest value for which the terminal has been designed

3.1.9
nominal high frequency band
frequency band in which a particular APLC transmitter or receiver is operating within the carrier-frequency range

Note 1 to entry: The nominal high frequency band is also referred to as nominal carrier frequency band.

3.1.10
nominal high frequency band output power
output power of an APLC terminal at nominal high frequency band expressed as the peak envelope power (PEP) for which the terminal has been designed, compatible with the requirements for spurious emissions and inter-channel interference (for multi-channel PLC terminals), available at the high frequency interface output across a resistive load equal to the nominal impedance

3.1.11
power ratio
ratio between the powers P_1 and P_2 of two signals

Note 1 to entry: The power ratio X_{12} is usually expressed in decibels (dB) and is calculated according to equation (2)

$$X_{12}[\mathrm{dB}] = 10 \times \log_{10}(P_1/P_2). \quad (2)$$

3.1.12
relative power level
power level at a point on a circuit given by the expression 10 x $\log_{10}$ (P/P_0) dBr, where P represents the power of a sinusoidal signal at the reference frequency 1020 Hz at the point concerned and P_0 the power of that signal at the 0 dBr reference point [ITU-T P.10/G.100 R-8, ITU-T G.100.1]

Note 1 to entry: The relation between the relative power level P_{rel}, the absolute power level P and the system power level P_0 is given by Equation (3):

$$P_{\mathrm{rel}}[\mathrm{dBr}] = P[\mathrm{dBm}] - P_0[\mathrm{dBm0}] \quad (3)$$

Note 2 to entry: The relative power level depends on the measuring point and not on the type of signal.

3.1.13
spurious emissions
emissions on a frequency, or on frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information

Note 1 to entry: Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of-band emissions [ITU-R SM.329-12].

3.1.14
system power level
power level expressed in dBm0, such that x dBm0 means x dB above or below 1 mW at the level reference point of the system, according to whether x is positive or negative, i.e. x dB above or below the level reference signal of 1020 Hz at any point of the system

Note 1 to entry: Networks are often designed to carry different types of signals (speech, modem, fax, etc.) at different levels, expressed in dBm0 [ITU-T G.100.1].

3.1.15
system psophometric power level
psophometrically weighted level expressed in dBm0p as defined according to ITU-T O.41

Note 1 to entry: The term dBm0p is used in the same way as dBm0 when the level is measured with a psophometer instead of a flat-response level measuring set. The psophometric weighting is used only in connection with the specification of noise levels on voice channels. The equivalent noise bandwidth of the psophometrically-weighted filter is about 1,8 kHz.

3.2 Abbreviations

AC	Alternating Current
AM-SSB	Amplitude Modulation SSB
APLC	Analogue PLC
DC	Direct Current
DPLC	Digital PLC
DSP	Digital Signal Processing, Digital Signal Processor
E&M	Ear & Mouth
FAR	Fully Anechoic Room
FDM	Frequency Division Multiplexing, Frequency Division Multiplexer
FSK	Frequency Shift Keying
FXO	Foreign Exchange Office
FXS	Foreign Exchange Subscriber
HF	High Frequency
LAN	Local Area Network
LCL	Longitudinal Conversion Loss
LF	Low Frequency
MIB	Management Information Base
OATS	Open Area Test Site
OSB	Output Signal Balance
PBX	Private Branch Exchange
PEP	Peak Envelope Power
PLC	Power Line Carrier
RMS	Root Mean Square
Rx	Receiver, receive

SAC	Semi Anechoic Chamber
SNMP	Simple Network Management Protocol
SSB	Single Side Band
Tx	Transmitter, transmit
VF	Voice Frequency
WAN	Wide Area Network
2W	Two Wire
4W	Four Wire

4 Low frequency side interfaces

4.1 General

All interfaces described in Clause 4 are optional. However, as stated in the definition of 3.1.2, it shall be possible to configure APLC equipment such that it has one low frequency interface for each LF channel.

Figure 2 shows the generic architecture of an APLC terminal with the LF interfaces on the left and the RF interface on the right. The type of interface – digital (⎍) or analogue (∿) – is indicated. In addition, two internal conceptual signals appear in this figure: (1) The “Baseband signal”, representing the FDM multiplexed signal of all LF signals and (2) the “Passband signal”, representing the baseband signal converted to the RF band by SSB modulation. These two signals are generally not accessible by the user. In case only one LF interface is present, the function of the block “Frequency Division Multiplexer / Demultiplexer” degenerates to a simple through connection.

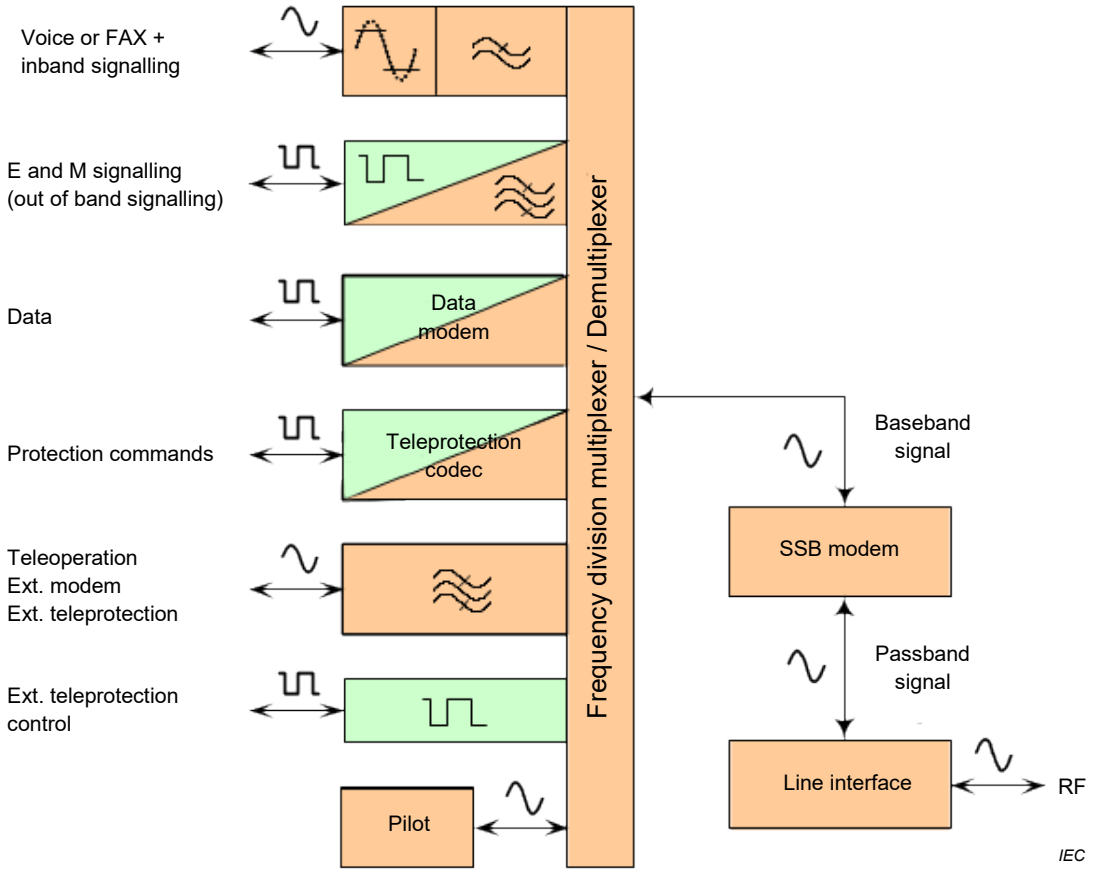


Figure 2 – Generic architecture of an APLC terminal