SLOVENSKI STANDARD
oSIST prEN IEC 62488-1:2024

01-november-2024

Sistemi komunikacij po elektroenergetskih vodih za elektroenergetska podjetja - 1. del: Načrtovanje analognih in digitalnih nosilnih frekvenc na elektroenergetskih vodih, ki obratujejo na visokonapetostnih (HV) električnih omrežjih

Power line communication systems for power utility applications - Part 1: Planning of analogue and digital power line carrier systems operating over HV electricity grids

Systeme zur Kommunikation über Hochspannungsleitungen für Anwendungen der elektrischen Energieversorgung - Teil 1: Planung von Systemen zur analogen und digitalen Nachrichtenübertragung über Hochspannungsleitungen

Systèmes de communication sur lignes d'énergie pour les applications des compagnies d'électricité - Partie 1: Conception des systèmes à courants porteurs de lignes d'énergie analogiques et numériques fonctionnant sur des réseaux d'électricité HT

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IEC TC 57 : POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE	
SECRETARIAT: Germany	SECRETARY: Mr Heiko Englert
OF INTEREST TO THE FOLLOWING COMMITTEES:	HORIZONTAL FUNCTION(S):
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TITLE:

Power line communication systems for power utility applications – Part 1: Planning of analogue and digital power line carrier systems operating over HV electricity grids

PROPOSED STABILITY DATE: 2027

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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POWER LINE COMMUNICATION SYSTEMS FOR POWER UTILITY APPLICATIONS –

Part 1: Planning of analogue and digital power line carrier systems operating over HV electricity grids

FOREWORD

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This International Standard has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This first edition of IEC 62488-1 cancels and replaces the relevant parts of IEC 60663 and IEC 60495, which will be withdrawn at a later date.

The text of this standard is based on the following documents:

FDIS	Report on voting
57/XXXX/FDIS	57/XXXX/RVD

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

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

A list of all parts of IEC 62488 series, 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

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

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 simultaneous use of the power distribution network for both energy transmission and data communication is unique and reduces the costs of installing two services over one transmission path. This communication technology is called generically power line carrier (PLC) communications.

Therefore, by using either analogue power line carrier communication (APLC) or digital power line carrier communication (DPLC) or a combination of both types of system (ADPLC), seamless efficient communication may be maintained throughout the power network.

The development of digital techniques for communications in the HV electrical power networks is now very widespread along with other applications in electronics. This is especially relevant for the electrical distribution network where many of the PLC devices use analogue to digital converters together with digital signal processing techniques enabling higher flexibility and HW efficiency.

The development of the technical report “Planning of power line carrier systems” was first produced by the International Electrotechnical Commission through publication IEC 60663 in 1980 entitled Planning of (single sideband) power line carrier systems. In 1993, the International Electrotechnical Commission produced IEC 60495 “Single sideband power-line carrier terminals”. In the intervening years, electronic systems and the associated communications systems for electronic devices evolved and developed considerably. The introduction of digital communication techniques improved the quality of transmission and reception PLC signals within electronic devices, enabling them to provide more detailed quality analysis and control of the data being communicated throughout the electricity distribution network, from control centre to service provider.

Both of these standards, IEC 60663 and IEC 60495, are being updated and replaced by the following: IEC 60663 is replaced by IEC 62488-1 and IEC 60495 is replaced by IEC 62488-2 and IEC 62488-3 covering respectively analogue, digital and hybrid analog-digital power line carrier terminals.

These international standards apply to power line carrier (PLC) terminals used to transmit information over HV power networks. Both analogue and digital modulation systems will be considered.

IEC 62488 series consists of the following parts under the general title: Power line communication systems for power utility applications:

Part 1: Planning of analogue and digital power line carrier systems operating over HV power networks;

Part 2: Analogue power line carrier terminals or APLC;

Part 3: Digital power line carrier (DPLC) terminals and hybrid ADPLC terminals.

POWER LINE COMMUNICATION SYSTEMS FOR POWER UTILITY APPLICATIONS –

Part 1: Planning of analogue and digital power line carrier systems operating over HV power networks

1 Scope

This part of IEC 62488 series applies to the planning of analogue (APLC), digital (DPLC) and hybrid analogue-digital (ADPLC) power line carrier communication systems operating over HV electric power networks. The object of this standard is to establish the planning of the services and performance parameters for the operational requirements to transmit and receive data efficiently and reliably.

Such analogue and digital power line carrier systems are used by the different electricity supply industries and integrated into their communication infrastructure using common communication technologies such as radio links, fibre optic and satellite networks.

2 Terms, definitions and abbreviations

2.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE Other terms used in this standard and not defined in this clause have the meaning attributed to them according to the International Electrotechnical Vocabulary (IEV).

2.1.1
amplitude modulation
AM
modulation technique in which information is transmitted through amplitude variation of a carrier wave

2.1.2
analogue interface
interface dedicated to the processing of voiceband analogue signals

2.1.3
anomaly
small discrepancy between the actually received and the desired data

Note 1 to entry: The occurrence of a single anomaly does not cause interruptions of the applications using the transmitted data.

2.1.4
attenuation
power reduction along a transmission line for the mode or modes under consideration, quantitatively expressed either by the ratio or the logarithm of the ratio of an input power at the initial point to the corresponding output power at the final point

2.1.5
availability
time or fraction of time a system is operational over a given time interval

2.1.6
background noise
noise present over all real high voltage power-line channels due mainly to corona and, partial discharges and electromagnetic interference with other PLC equipments operated over the same electricity grid and other interferences due to radio stations working in the same radio frequency spectrum

2.1.7
bit error ratio
BER
ratio of the number of bits errors received divided by the total number of bits sent

2.1.8
bit error ratio test
BERT
set of instruments and measurement methodology to be adopted to evaluate the BER of a transmission system

2.1.9
broadband over power line
BPL
technology that allows data to be transmitted over utility power lines using bandwidths of several MHz

Note 1 to entry: These systems typically run over a frequency spectrum in a range from 1 MHz to 30 MHz allowing the transmission of broadband communications. These systems can be found on all the range of power lines from LV to MV. The BPL systems are means to deliver broadband communications to homes and business facilities. Among the BPL systems, we can distinguish the systems used outsides the homes or offices (to-the-home-internet access also called access BPL or smart-grid applications operated by the electricity companies) and the “in-home” or “in-house” applications used for home networking (Generally using an Ethernet network technology) and automation. These applications are generally called Home Plug applications.

2.1.10
carrier-frequency range
bandwidth available for a specific power line carrier communication technology

Note 1 to entry: In Europe, the typical carrier-frequency range for narrowband HV PLC is 3 kHz to 148,5 kHz or for broadband PLC is 1,6 MHz to 30 MHz. For the USA IEEE PLC standard the frequency range is 45 kHz to 450 kHz. Parts of the range may be barred by national regulations.

2.1.11
channelling
elementary subdivision of the carrier frequency range or part thereof allocated to a single PLC transmits and receive channel (bidirectional)

2.1.12
coloured noise
non-white noise or any wideband noise whose spectrum has a non-flat shape

Note 1 to entry: Also called non-white noise; examples are pink noise, brown noise and autoregressive noise.

2.1.13
corona noise
noise caused by partial discharges on insulators and in air surrounding electrical conductors of overhead power lines

Note 1 to entry: Discharges occur on the three different phase conductors at different times. The corona noise level is considerably dependent on weather conditions. The effect of the corona noise is particularly strong under foul weather conditions.

2.1.14
coupling capacitor
capacitor used for the coupling of the carrier signal to the power line in a PLC system

2.1.15
coupling system
group of devices used to couple the PLC high frequency signals to the power line. Usually coupling system consist of an line trap, a coupling capacitor and a coupling device

2.1.16
defect
large discrepancy between the actually received and the desired data

Note 1 to entry: Defects cause interruptions of the applications using the transmitted data and are used as input for performance monitoring, the control of consequent actions, and the determination of fault causes.
Examples are: loss of signal, sync loss, alarm indication signal, slip, loss of frame alignment.

2.1.17
distribution line carrier
DLC
system for communication over the distribution power lines

Note 1 to entry: They DLC systems can be narrow band high speed communication systems on the medium voltage distribution network, or broadband/narrow band communication systems on the low voltage distribution network.

2.1.18
effectively transmitted signal-frequency band
that part of the frequency band used for the transmission of the baseband signal

2.1.19
environment
external conditions in which a system operates

Note 1 to entry: Different classes of constraints and limits for EMC/EMI are defined for environment classes such as industrial, commercial, domestic.

2.1.20
error free second
EFS
a one second period without bit error

2.1.21
errored second
ES
a one-second period in which one or more bits are in error

2.1.22
errored second ratio
ESR
ratio of errored seconds ES to total seconds in available time during a fixed measurement interval

2.1.23
Ethernet interface
interface dedicated to the processing of data signals in accordance with IEEE 802.3

2.1.24
forward error correction
technique used for correcting errors in data transmission over unreliable or noisy communication channels by encoding the message at the sender in a redundant way by using an error-correcting code so as to enable the receiver to correct a limited number of bit errors

2.1.25
frame check sequence
FCS
extra bits or characters added to a data frame for error detection

2.1.26
frame loss rate
the number of frames that never reached the destination divided by the number of frames transmitted successfully by the source

Note 1 to entry: It is usually expressed as a percentage.

2.1.27
frequency division multiplexing
FDM
multiplexing technique in which several transmitters are allotted separate frequency bands for transmission over a common channel

2.1.28
frequency shift keying modulation
FSK
a frequency modulation technique in which coded information is transmitted through discrete frequency changes of a carrier wave

2.1.29
group delay
propagation time of a narrowband signal from input to output of a linear system

Note 1 to entry: Mathematically, group delay equals the negative derivative of the phase shift in radians between input and output of a linear system versus angular frequency.

2.1.30
impulsive noise
noise consisting of short-duration pulses of random amplitude and random duration

2.1.31
jitter
short-term variations of the significant instants of a timing signal from their ideal positions in time (where short-term implies that these variations are of frequency greater than or equal to 10 Hz)

2.1.32
latency
time from the source sending a packet into a packet switched network to the destination receiving it

Note 1 to entry: One-way latency is distinguished from round trip latency, which is the one-way latency from source to destination plus the one-way latency from the destination back to the source. Round-trip latency is more often quoted, because it can be measured from a single point. Note that round trip latency excludes the amount of time that a destination system spends processing the packet.

2.1.33
Coupling device
unit which interfaces the HV side of power line with the PLC equipment (also known as line matching unit (LMU))

Note 1 to entry: It usually consists of a box mounted near the coupling capacitor. Its characteristics are normalized by IEC 60481.