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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

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 EHT/HT/MT

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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This first edition of IEC 62488-1 cancels and replaces the relevant parts of IEC 60663 and IEC 60495, which will be withdrawn at a later date.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
57/1279/FDIS	57/1298/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- withdrawn,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.

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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 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 ability to represent the various electrical parameters as an analogue signal and or 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 (APLC) or digital power line communication (DPLC) or a combination of both types of system, seamless efficient communication may be maintained throughout the power network.

The development of digital techniques for communications in the electrical distribution networks is now very widespread along with other applications in electronics. This is especially relevant for the electrical distribution network where many of the devices have built into them analogue to digital converters, together with digital signal processing enabling them to perform many functions and offer fast seamless communication. The conversion of the analogue signal into a binary signal requires the binary digits to be formed into a code for the transmission of the information. These codes take different forms to represent the information to be transmitted. However, the main advantage for this is that digital signals compared with analogue signals provide for virtually error free transmission and the minimum errors that do arise may be detected and corrected by using suitable data encoding techniques. Further, digital transmission circuits generally are compatible with the digital devices in the communications circuit. The most commonly used multiplex systems are frequency division multiplex (FDM) and time division multiplex (TDM).

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 transmission and reception techniques improved the quality of transmission and reception 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, IEC 62488-3, IEC 62488-4, covering respectively analogue, digital power line carrier and broadband power line terminals.

The first part of this series is IEC 62488-1. Following this standard, parts IEC 62488-2, IEC 62488-3, IEC 62488-4 will follow. During the development of the above mentioned standards, the existing standards IEC 60663 and IEC 60495 will be maintained in use. They will be subsequently phased out at a date to be agreed by the International Electrotechnical Commission in conjunction with IEC technical committee 57.

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

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 EHV/HV/MV electricity grids;

Part 2: Analogue power line terminals or APLC;

Part 3: Digital power line carrier terminals or DPLC;

Part 4: Broadband power line systems or BPL.

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

1 Scope

This part of IEC 62488 applies to the planning of analogue and digital power line carrier systems operating over EHV/HV/MV electricity grids. 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 over Power Networks.

The transmission media used by the different electricity supply industries will include analogue and digital systems together with more common communication services including national telecommunications authorities, radio links and fibre optic networks and satellite networks. With the developments in communication infrastructures over the last two decades and the ability of devices connected in the electricity communications network to internally and externally communicate, there is a variety of architectures to use in the electricity distribution network to provide efficient seamless communications.

These series of standards for the planning of power line carrier systems will also be an integral part of the development of the overall architecture, standard IEC 61850 developed within IEC TC57 which provides the fundamental architecture for the formation of the smart grid.

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
code division multiple access
CDMA
multiple access technique in which a number of transmitters modulate their data on pseudo random signals which are orthogonal to each other, which prevents the demodulators from seeing signals other than their own

2.1.13
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.

2.1.14
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.

2.1.15
coupling capacitor
capacitor used for the coupling of the carrier signal to the power line in a PLC system

2.1.16
coupling system
group of devices used to couple the PLC high frequency signals to the power line

2.1.17
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.

2.1.18
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.

2.1.19
effectively transmitted signal-frequency band
that part of the frequency band used for the transmission of the baseband signal

2.1.20
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.

2.1.21
error free second
EFS
a one second period without bit error

2.1.22
errored second
ES
a one-second period in which one or more bits are in error