

Single sideband power-line carrier terminals

The European Standard EN 60495:1994 has the status of a
British Standard

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National foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee and is the English language version of EN 60495:1994 *Single sideband power-line carrier terminals*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 495:1993, published by the International Electrotechnical Commission (IEC).

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 32, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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English version

Single sideband power-line carrier terminals

(IEC 495:1993)

Equipements terminaux à courants
porteurs sur lignes d'énergie, à bande, latérale
unique
(CEI 495:1993)

Geräte für die Einseitenband-Trägerfrequenz-
Nachrichtenübertragung über
Hochspannungsleitungen
(IEC 495:1993)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 57(CO)63, as prepared by IEC Technical Committee 57: Telecontrol, teleprotection and associated telecommunications for electric power systems, was submitted to the IEC-CENELEC parallel vote in October 1992.

The reference document was approved by CENELEC as EN 60495 on 8 December 1993.

The following dates were fixed:

- latest date of publication of
an identical national
standard (dop) 1994-12-01
- latest date of withdrawal of
conflicting national
standards (dow) 1994-12-01

For products which have complied with the relevant national standard before 1994-12-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1999-12-01.

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard, Annex A and Annex ZA are normative and Annex B, Annex C and Annex D are informative.

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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 facilities which can normally be provided as part of the telecommunication system can be listed as follows:

- telephony (operation, maintenance and administration speech circuits);
- facsimile transmission;
- telegraphy;
- telecontrol;
- load frequency control;
- teleprotection;
- data transmission.

The communication channels can be provided by circuits leased from public facilities, by means of utility-owned private circuits or, national regulations permitting, by a combination of both types of circuit. The need for a high availability on these circuits generally calls for the provision of multiple routing, preferable by geographically diverse routes.

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 may 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 voice frequency input and output criteria of all equipment used in the communications system are compatible. This compatibility is also beneficial in creating the ability to interchange and interwork equipment from different sources.

This International Standard has been prepared to enable compatibility between PLC links from different sources or between PLC links and other transmission media to be achieved and to define the terminal performance required in PLC networks.

This International Standard covers basically 4 kHz and 2,5 kHz bandwidth single channel PLC equipments that use amplitude modulation with single sideband transmission.

The application of this International Standard to multichannel equipment is described in Annex A.

1 General

1.1 Scope and object

This International Standard applies to Single Sideband (SSB) Power Line Carrier (PLC) Terminals used to transmit information over High Voltage (HV) Lines.

The object of this standard is to establish recommended values for characteristic input and output quantities of single sideband PLC terminals (see Figure 1) and the definitions essential for an understanding of these recommendations. All the tests verifying the requirements shall be considered as type tests as defined in the International Electrotechnical Vocabulary (IEV 151-04-15).

This standard defines two versions of the PLC equipment intended for two different applications:

- **standard terminal**, i.e. equipment with a voice frequency side interface which offers transmission of a frequency band of 300 Hz to 3 400 Hz on a four-wire basis plus signalling facilities. This equipment is capable, via analog interfaces, of being connected to networks that may consist of transmission equipment of different types and from different manufacturers. There may be facilities for additional point-to-point connections (e.g. a teleprotection connection) which may fall outside the frequency band of 300 Hz to 3 400 Hz (see Figure 2);
- **speech-plus terminal**, i.e. equipment where specific interfaces for signals like speech, data and teleprotection are present at the voice frequency side (see Figure 3).

The two versions will have parts in common and the requirements of these common parts are dealt with in 5.2 and 5.3.1.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. IEC 38:1983, *IEC standard voltages*.

IEC 50 (55):1970, *International Electrotechnical Vocabulary (IEV) — Chapter 55: Telegraphy and telephony*.

IEC 50 (151):1978, *International Electrotechnical Vocabulary (IEV) — Chapter 151: Electrical and magnetic devices*.

IEC 255-4:1976, *Electrical relays — Part 4: Single input energizing quantity measuring relays with dependent specified time*.

IEC 255-5:1977, *Electrical relays — Part 5: Insulation tests for electrical relays*.

IEC 255-22-1:1988, *Electrical relays — Part 22: Electrical disturbance tests for measuring relays and protection equipment — Section 1: 1 MHz burst disturbance tests*.

IEC 663:1980, *Planning of (single-sideband) power line carrier systems*.

IEC 721-3-1:1987, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Storage*.

IEC 721-3-2:1985, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Transportation*.

IEC 721-3-3:1987, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Stationary use at weatherprotected locations*.

IEC 721-3-4:1987, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities. Stationary use at non-weatherprotected locations*.

IEC 801-2:1991, *Electromagnetic compatibility for industrial-process measurement and control equipment — Part 2: Electrostatic discharge requirements*.

IEC 801-3:1984, *Electromagnetic compatibility for industrial-process measurement and control equipment — Part 3: Radiated electromagnetic field requirements*.

IEC 801-4:1988, *Electromagnetic compatibility for industrial-process measurement and control equipment — Part 4: Electrical fast transient/burst requirements*.

IEC 834-1:1988, *Performance and testing of teleprotection equipment of power systems — Part 1: Narrow-band command systems*.

CCITT Blue Book, Volume V, 1988, *Telephone transmission quality. Series P recommendations*.

CCITT Blue Book, Volume III, Fascicle III.1, 1988, *General characteristics of international telephone connections and circuits. Recommendations G.100 to G.181*.

CCITT Blue Book, Volume III, Fascicle III.2, 1988, *International analogue carrier systems. Recommendations G.211 to G.544*.

2 Definitions

2.1 General

For the purpose of this International Standard, the following definitions apply.

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).

In addition to these, a number of relevant established telecommunications terms are given in Annex B.

2.2 Frequency bands

2.2.1

carrier-frequency range

the total band available for power line carrier use

2.2.2

basic carrier-frequency band

the elementary subdivision of the carrier frequency range or part thereof allocated to a single PLC transmit or receive channel

2.2.3

nominal carrier-frequency band

the frequency band in which a particular PLC transmitter or receiver is operating

2.2.4

effectively transmitted speech-band

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

2.2.5

effectively transmitted signal-frequency band

that part of the voice-frequency band used for the transmission of signals essential for the operation of power systems (including data transmission, protection signals and any other signals); this band may include the telephone signalling channel

2.3

nominal impedance

the nominal impedance, as used in this standard, is the value of impedance for which an input or output circuit has been designed and for which the prescribed requirements apply

2.4 Carrier-frequency output power

2.4.1

nominal carrier-frequency output power

the nominal carrier-frequency output power of a PLC terminal is the peak envelope power, PEP, (see Annex B) for which the equipment has been designed, compatible with the requirements for spurious emissions, available at the carrier-frequency output (point G of Figure 2 and Figure 3) across a resistive load equal to the nominal impedance

2.4.2

mean carrier-frequency output power

the mean carrier-frequency output power of a PLC terminal is the output power 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 equipment has been designed

NOTE 1 The ratio between peak envelope power and mean power depends on all factors influencing the multiplex signal (speech level, presence or absence of a compressor, number, type and level of signals). This ratio may be assumed to lie typically between 8,5 dB and 10 dB under normal service conditions.

NOTE 2 The power injected at the coupling point of the HV line (see Figure 1) is less than the power measured at the carrier-frequency output and is sometimes limited by national telecommunications authorities.

2.5

spurious emissions

spurious emissions are emissions, at one or more frequencies, located outside the nominal carrier-frequency band

spurious emissions comprise harmonics, parasitic signals and intermodulation products

3 Operating conditions

3.1 Temperature and humidity

The equipment, including its protection, shall meet the requirements of this standard while operating under the conditions specified in IEC 721-3-3, class 3K5 amended as follows:

— *High air temperature*

The equipment shall operate without damage at temperatures up to + 55 °C for a period of not more than 24 h per month. In these conditions a temporary degradation in performance may be accepted.

— *Low air temperature*

The lower temperature limit of operation shall be 0 °C.

— *Condensation; formation of ice*

In normal operation the formation of ice shall not occur. The equipment shall not be exposed to any type of water spraying.

Temporary condensation may occur during maintenance when spare parts are introduced which have been stored at a lower temperature than that prevailing in the telecommunication equipment environment.

Table I (Classification of climatic conditions) and Figure B.5 (Climatogram for class 3K5) of IEC 721-3-3 are shown in Annex C.

3.2 Power supply

NOTE The requirements of this subclause may be changed some time in the future in order to correspond more closely with identical clauses of other International Standards within the scope of IEC technical committee 57.

3.2.1 A.C. supply

Nominal a.c. voltages shall be in accordance with the preferred values listed in IEC 38, but the following values are recommended:

$$\left. \begin{array}{l} 220 \text{ V} \\ 110 \text{ V} \end{array} \right\} 50 \text{ Hz or } 60 \text{ Hz}$$

Requirements are given in Table 1.

Table 1 — Power supply requirements

		Requirement
A.C. supply	Voltage tolerance	+ 10 % to – 15 %
	Frequency tolerance	± 5 %
	Harmonic content	< 10 %
D.C. supply	Voltage tolerance	+ 20 % to – 15 %
	Ripple peak-to-peak	≤ 5 %

3.2.2 D.C. supply

Nominal d.c. voltages shall be in accordance with the preferred values listed in IEC 38, but the following value is recommended:

48 V

Requirements are given in Table 1.

The equipment shall be capable of operating with the positive pole earthed.

Conducted noise:

The noise measured across the power supply terminals of the equipment shall not be greater than 3 mV psophometrically weighted (see CCITT Recommendation P.53 for psophometer weighting coefficients). The test circuit is indicated in Figure 4.

4 Storage and transportation conditions

4.1 Storage conditions

The equipment, including its protection (not the equipment itself), shall meet during storage the requirements in IEC 721-3-1, class 1K5.

Table I (Classification of climatic conditions) of IEC 721-3-1 is shown in Annex D.

4.2 Transportation conditions

The requirements for the equipment, including its protection (not the equipment itself) depends on the means of transportation and the transportation route.

IEC 721-3-2 can serve as a guide.

5 Requirements for input and output quantities of PLC terminals

5.1 General

In all test procedures which require the use of a pair of PLC terminals, the carrier-frequency inputs and outputs (point G of Figure 2 and Figure 3) shall be connected by an artificial line (resistive attenuator with an attenuation in dB which is equal to the nominal carrier-frequency output power level in dBm minus 15 dB), matched to the nominal impedance of the terminals.

$$A \text{ (dB)} = L_{\text{nom}} \text{ (dBm)} - 15 \text{ dB}$$

where

A is the artificial line attenuation,;

L_{nom} is the nominal carrier-frequency output power level.

5.2 Carrier-frequency side

5.2.1 Carrier-frequency range and bands

The typical carrier-frequency range is 40 kHz to 500 kHz and the manufacturer shall state the range of carrier frequencies within which the recommended values will be maintained. Parts of the range may be barred by national regulations.

5.2.2 Nominal impedance, return loss and tapping loss

The nominal impedance at the carrier-frequency interface shall be 75 Ω (unbalanced) or 150 Ω (balanced). Other impedance values may be agreed between manufacturer and purchaser.

The return loss within the nominal carrier-frequency transmit band shall be not less than 10 dB.

The impedance outside the nominal carrier-frequency transmit and receive band shall be such that any other PLC equipment, connected to the same coupling equipment, shall not suffer from a tapping loss higher than indicated in Figure 5.

5.2.3 Balance to ground

For carrier-frequency interface of the balanced type the balance to ground shall not be less than 40 dB at power frequency (50 Hz or 60 Hz).

The measuring circuit for the determination of the balance to ground is indicated in Figure 6a.

5.2.4 Spurious emissions

The maximum permitted level of spurious emissions is indicated in Figure 7.

In order to measure spurious emissions, the transmitter shall be modulated by two sinusoidal signals of equal amplitude, the transmitter being terminated with a resistive load equal to the nominal impedance.

For equipment with a 4 kHz basic carrier-frequency band the frequencies shall be 350 Hz and 3 300 Hz.

For equipment with a 2,5 kHz basic carrier-frequency band the frequencies shall be 350 Hz and 2 300 Hz.

The amplitude of the test signals shall be chosen so that each produces a quarter of the stated nominal carrier-frequency output power.

The measurement shall be made with the aid of a selective level measuring set with an adequate bandwidth. It is necessary to ensure that the limiting action of the limiter, if any, does not occur when making this measurement.

5.2.5 Carrier-frequency levels

The carrier-frequency levels of speech and signals shall be subject to agreement between manufacturer and purchaser. IEC 663 may serve as a guideline.

5.2.6 Frequency accuracy

The virtual carrier-frequency shall not differ from its nominal value by more than ± 10 Hz.

5.3 Voice-frequency side

The following requirements apply to terminals without compandors. If compandors are used, reference can be made to the relevant CCITT Recommendations (Volume III, Fascicle III.1). Guidelines on the use of compandors are given in IEC 663.

5.3.1 Common requirements

This subclause contains requirements that are common to the two versions defined as "Standard terminal" and "Speech-plus terminal".