

INTERNATIONAL STANDARD

IEC 60445

Fourth edition
2006-11

BASIC SAFETY PUBLICATION

**Basic and safety principles for man-machine
interface, marking and identification –
Identification of equipment terminals and
conductor terminations**



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Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals and conductor terminations

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**BASIC AND SAFETY PRINCIPLES FOR MAN-MACHINE INTERFACE,
MARKING AND IDENTIFICATION –
IDENTIFICATION OF EQUIPMENT TERMINALS AND CONDUCTOR
TERMINATIONS**

FOREWORD

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International Standard IEC 60445 has been prepared by IEC technical committee 16: Basic and safety principles for man-machine interface, marking and identification.

This fourth edition cancels and replaces the third edition published in 1999 and constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

- a) addition of Table 1 – Protective bonding conductor PB (earthed PBE, unearthed PBU);
- b) addition of footnotes e and f in Table 1 indicating "UK special national conditions";
- c) deletion of Annex A (informative): "Comparison of former and present designation".

It has the status of a basic safety publication in accordance with IEC Guide 104.

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

FDIS	Report on voting
16/458/FDIS	16/460/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.

Table 1 of this standard includes UK special national conditions.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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- withdrawn;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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

This basic safety publication is intended for use by technical committees in the preparation of standards in accordance with the principles laid down in IEC Guide 104 and in ISO/IEC Guide 51.

It should be noted that one of the responsibilities of a technical committee is, wherever possible, to include or refer to requirements of basic safety publications in standards for equipment within its scope. Consequently, the requirements of this basic safety publication apply only if they are included, or are referred to in those standards.

In this fourth edition of IEC 60445, the terminology has been aligned with IEC 60050-195.

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BASIC AND SAFETY PRINCIPLES FOR MAN-MACHINE INTERFACE, MARKING AND IDENTIFICATION – IDENTIFICATION OF EQUIPMENT TERMINALS AND CONDUCTOR TERMINATIONS

1 Scope

This International Standard applies to the identification and marking of terminals of electrical equipment such as resistors, fuses, relays, contactors, transformers, rotating machines and, wherever applicable, to combinations of such equipment (e.g. assemblies). It also applies to the identification of terminations of certain designated conductors. This standard further includes general rules for an alphanumeric system.

2 Normative references

The following referenced documents are indispensable for the application 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 60417, *Graphical symbols for use on equipment*

IEC 60446, *Basic and safety principles for man-machine interface, marking and identification – Identification of conductors by colours or numerals*

IEC 60617, *Graphical symbols for diagrams*

IEC Guide 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

3 Terms and definitions

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

NOTE The terms are sorted in alphabetical order.

3.1

functional bonding conductor

conductor provided for functional-equipotential-bonding

[IEV 195-02-16]

3.2

functional earthing conductor

functional grounding conductor (in US)
earthing conductor provided for functional earthing

[IEV 195-02-15]

3.3**line conductor**

phase conductor (in AC systems) (deprecated)

pole conductor (in DC systems) (deprecated)

conductor which is energized in normal operation and capable of contributing to the transmission or distribution of electric energy but which is not a neutral or mid-point conductor

[IEV 195-02-08]

3.4**mid-point conductor**

conductor electrically connected to the mid-point and capable of contributing to the distribution of electric energy

[IEV 195-02-07]

3.5**neutral conductor**

conductor electrically connected to the neutral point and capable of contributing to the distribution of electric energy

[IEV 195-02-06]

3.6**PEL conductor**

conductor combining the functions of both a protective earthing conductor and a line conductor

[IEV 195-02-14]

3.7**PEM conductor**

conductor combining the functions of both a protective earthing conductor and a mid-point conductor

[IEV 195-02-13]

3.8**PEN conductor**

conductor combining the functions of both a protective earthing conductor and a neutral conductor

[IEV 195-02-12]

3.9**protective bonding conductor**

equipotential bonding conductor (deprecated)

protective conductor provided for protective-equipotential-bonding

[IEV 195-02-10]

3.10**protective bonding conductor, earthed**

protective bonding conductor with a conductive path to earth

3.11**protective bonding conductor, unearthed**

protective bonding conductor without a conductive path to earth

3.12

protective conductor

(identification: PE)

conductor provided for purposes of safety, for example protection against electric shock

[IEV 195-02-09]

4 Methods of identification

Where the identification of equipment terminals and of terminations of certain designated conductors is considered necessary, it shall be effected by the use of one or more of the following methods:

- the physical or relative location of the equipment terminals or of terminations of certain designated conductors;
- a colour code for equipment terminals and terminations of certain designated conductors. These colours shall be consistent with IEC 60446;
- graphical symbols in accordance with IEC 60417. If additional symbols are required, these shall be consistent with IEC 60617;
- an alphanumeric notation in accordance with the system laid down in Clause 6.

To keep consistency with the documentation and equipment terminal designation, the alphanumeric notation is recommended.

5 Application of identification means

The identifying colour, graphical symbol or alphanumeric notation shall be located on, or adjacent to, the corresponding terminal.

When more than one identification method is used and confusion is possible, the correlation between the methods shall be clarified in the associated documentation.

When no confusion is possible, the juxtaposition of numerical and alphanumeric notation may be applied.

6 General rules for an alphanumeric system

6.1 General

If letters and/or numerals are used for identification, letters shall be upper case Latin characters only and numerals shall be Arabic numerals.

NOTE It is recommended that the reference letters for DC elements be chosen from the first part and reference letters for AC elements from the second part of the alphabet.

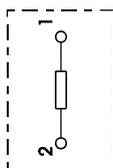
Letters I and O shall not be used to prevent confusion with the numerals 1 and 0; “+” and “–” may be used.

Where no confusion is possible, parts of the complete alphanumeric notation laid down in the following marking principles may be omitted.

6.2 Marking principles

Terminal marking is based on the following principles:

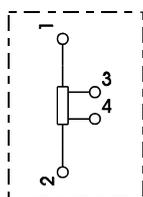
6.2.1 The two end points of an element are distinguished by consecutive reference numbers, the odd number being lower than the even number, for example 1 and 2 (see Figure 1).



IEC 1448/99

Figure 1 – Single element with two terminals

6.2.2 The intermediate points of a single element are distinguished by reference numbers, preferably in a numerical order, for example 3, 4, 5, etc. The reference numbers chosen for intermediate points shall be higher than those chosen for the end points; their numbering commences at the point which lies closest to the end point with the lower reference number. Thus, for example, the intermediate points, of an element with the end points 1 and 2 will be denoted by the reference numbers 3 and 4 (see Figure 2).

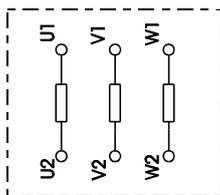


IEC 1449/99

Figure 2 – Single element with four terminals: two endpoints and two intermediate points

6.2.3 If several similar elements are combined in a group of elements, then one of the following methods for marking the elements shall be used:

- the two end points and intermediate points, if any, are distinguished by letters preceding the reference numbers referred to in 6.2.1 and 6.2.2; for example U, V, W corresponding to the phases of a three-phase AC system (see Figure 3);

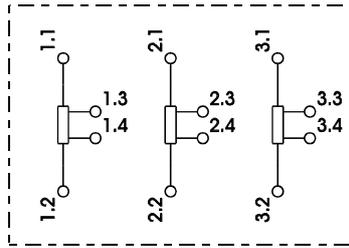


IEC 1450/99

Figure 3 – Three-phase equipment with six terminals

- the two end points and intermediate points, if any, are distinguished by numbers preceding the reference numbers referred to in 6.2.1 and 6.2.2 where a phase identification is not necessary or possible. To avoid confusion these numbers shall be separated by a full stop. For example the end points of one element may be marked 1.1 and 1.2, those of another element 2.1 and 2.2 (see Figure 4);

NOTE For examples of an unambiguous terminal designation with respect to the object to which the terminal belongs, see Annex B of IEC 61666.



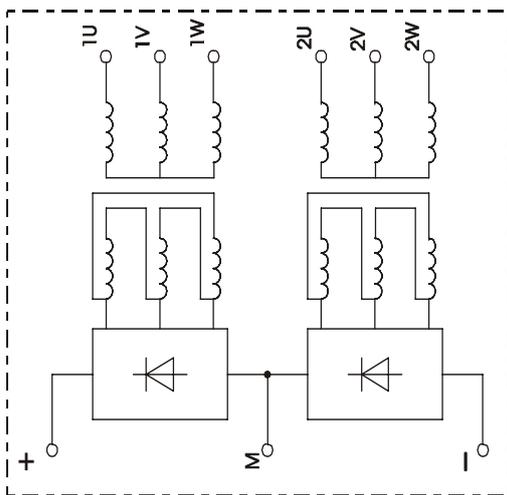
IEC 1451/99

Figure 4 – Three-element equipment with twelve terminals: six endpoints and six intermediate points

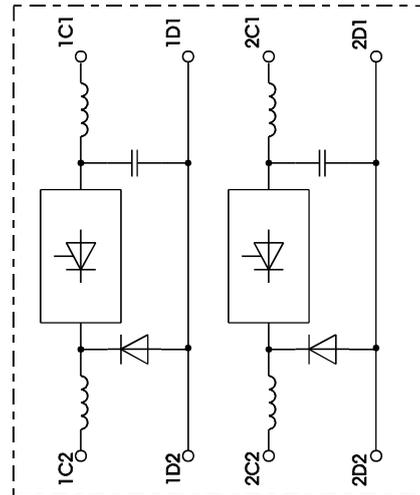
– in case of terminal blocks, numerical identification in numerical order.

Further detailed requirements on terminal markings and identification may be given by relevant product committees.

6.2.4 Similar groups of elements having the same reference letters are distinguished by a numerical prefix to the reference letters (see Figures 5a and 5b).



IEC 1452/99



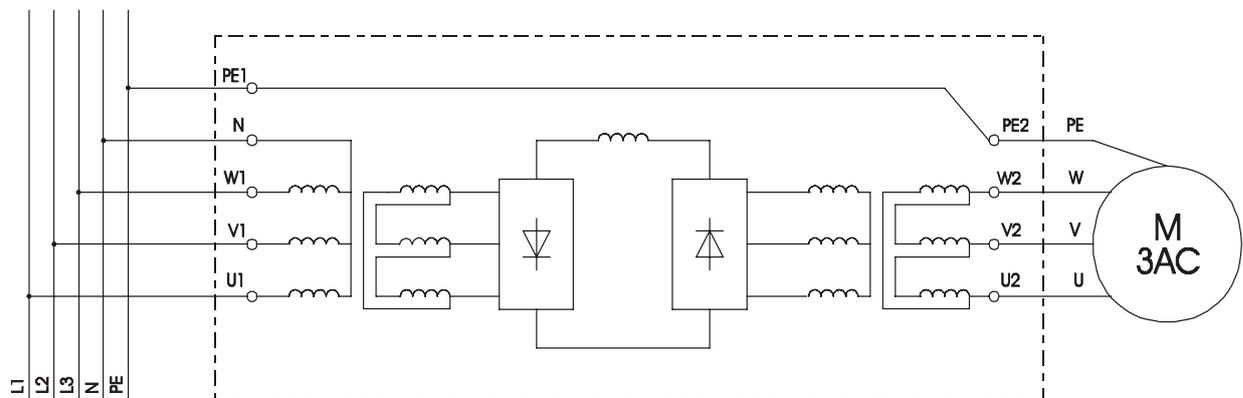
IEC 1453/99

Figure 5a – Three-phase equipment with two groups of elements

Figure 5b – Two-phase equipment with two groups of elements with four terminals each

Figure 5 – Equipment with groups of elements

Figure 6 illustrates the interconnection of equipment terminals and certain designated conductors, marked in accordance with the alphanumeric notation.



IEC 1454/99

Figure 6 – Interconnection of equipment terminals and certain designated conductors

7 Marking of equipment terminals intended for certain designated conductors and of terminations of these conductors

Equipment terminals which are intended to be connected directly or indirectly to certain designated conductors, and terminations of certain designated conductors shall be marked with reference letters or graphical symbols or both reference letters and graphical symbols according to Table 1. Conductor colour designations shall be according to IEC 60446.

Table 1 – Marking of equipment terminals intended for certain designated conductors

Designated conductors	Equipment terminal marking	Marking by graphical symbols for use on equipment ^b
AC conductors		
Line 1 (L1)	U	
Line 2 (L2)	V ^a	
Line 3 (L3)	W ^a	
Mid-point conductor (M)	M	
Neutral conductor (N)	N	
DC conductors		
Positive (L+)	+	
Negative (L-)	-	
Protective conductor (PE)	PE	
– PEN conductor (PEN)	PEN	
– PEL conductor (PEL)	PEL	
– PEM conductor (PEM)	PEM	
Protective bonding conductor (PB) ^c	PB	
– earthed (PBE)	PBE	
– unearthed (PBU)	PBU	
Functional earthing conductor (FE) ^d	FE	 e, f
Functional bonding conductor (FB)	FB	

^a Only necessary in systems with more than one phase.

^b The graphics shown correspond to the following symbol No in IEC 60417.

	IEC 60417-5032		IEC 60417-5019
	IEC 60417-5031		IEC 60417-5018
	IEC 60417-5005		IEC 60417-5020
	IEC 60417-5006		IEC 60417-5021

^c A protective bonding conductor will in most cases be a protective bonding conductor earthed. It is not necessary to designate these with PBE. In those cases where both a distinction between a protective bonding conductor earthed and a protective bonding conductor unearthed are used, a clear distinction between them shall be made (for example, within electro medical installations) and the designations PBE and PBU should be applied.

^d Neither the designation FE nor the graphical symbol 5018 of IEC 60417 shall be applied for conductors or terminals having a protective function

^e In UK, the symbol  shall not be used to indicate a “functional earthing conductor (FE)” or terminal but shall be used to indicate a “noiseless (clean) earth conductor or terminal”. In UK, Note d) of Table 1 shall read “The designation FE shall not be applied to conductors or terminals having a protective function.”

^f In UK, the symbol  shall be used to indicate a “functional earthing conductor or terminal (FE)”.

Bibliography

IEC 60050-195:1998, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*

IEC 61666:1997, *Industrial systems, installations and equipment and industrial products – Identification of terminals within a system*



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