IEC 61148

Edition 2.0 2011-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Terminal markings for valve device stacks and assemblies and for power conversion equipment

Marquage des bornes de blocs et d'ensembles d'éléments de valve et d'équipement de conversion de puissance

IEC 61148:2011

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:
Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,…). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:
Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

IEC 61148

Edition 2.0 2011-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Terminal markings for valve device stacks and assemblies and for power conversion equipment

Marquage des bornes de blocs et d'ensembles d'éléments de valve et d'équipement de conversion de puissance

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX T

ICS 29.200

ISBN 978-2-88912-705-4

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

TERMINAL MARKINGS FOR VALVE DEVICE STACKS AND ASSEMBLIES AND FOR POWER CONVERSION EQUIPMENT

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61148 has been prepared by IEC technical committee 22: Power electronic systems and equipment.

This second edition cancels and replaces the first edition published in 1992. This second edition constitutes a technical revision.

This second edition includes the following significant technical changes with respect to the previous edition:

– the whole document has been rewritten according to the current Directives;
– the identification codes were deleted according to the withdrawal of IEC 60971;
– examples of terminal marking were added, especially for self-commutated converters.

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

FDIS	Report on voting
22/185/FDIS	22/188/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.

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

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.

TERMINAL MARKINGS FOR VALVE DEVICE STACKS AND ASSEMBLIES AND FOR POWER CONVERSION EQUIPMENT

1 Scope

This International Standard is applicable to the terminal markings for the main circuits of valve device stacks and assemblies, and of integrated conversion equipment. The terminal markings refer to stacks, assemblies and equipment comprising semiconductor valve devices.

NOTE 1 Terminal markings for auxiliary circuits, including gate terminals and non-integrated conversion equipment with separate manufacturing of its components and their interconnection only after installation on site, are not considered in this standard.

For such equipment the relevant standards, if any, for the individual components apply.

Gate terminal markings are given in 6.3.

Terminal markings for other circuits such as protective conductor are not considered in this standard.

The object of this standard is to specify a logical alphanumeric marking system for the identification of the external main terminals of the main power circuits in a stack, valve device assembly or integrated conversion equipment, which is applicable for the purpose of reference in circuit diagrams, catalogues, descriptions, and information exchange and storage.

In the case of stacks and assemblies, alphanumeric terminal marking systems are indicated for those converter connections which are the most important and most commonly used ones.

Terminal marking systems making use of graphic symbols or identifying colours are not considered in this standard.

NOTE 2 The terminals of auxiliary circuits should be marked such that they may be clearly identified.

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 60050-551, *International Electrotechnical Vocabulary – Part 551: Power electronics*

IEC 60146-1-1, *Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-551, IEC 60146-1-1 and the following apply.

3.1
external main terminals
terminals of the main power circuit of the stack, assembly or equipment to which the external power supply or the load are connected

NOTE 1 In the following clauses this term is abbreviated to "terminals".

NOTE 2 For stacks and assemblies the main power circuit is formed by the principal valve arms.

3.2
integrated conversion equipment
factory-built conversion equipment the components of which are assembled, interconnected and tested in the factory thus forming a complete equipment

NOTE 1 Equipment composing one or more semiconductor switches is considered to be conversion equipment.

NOTE 2 For transport purpose, the equipment can be divided in several cubicles that will have to be reassembled at the site.

3.3
anode
electrode capable of emitting positive charge carriers to and/or receiving negative charge carriers from the medium of lower conductivity

[IEC 60050-151: 2001, 151-13-02]

NOTE 1 The direction of electric current is from the external circuit, through the anode, to the medium of lower conductivity.

NOTE 2 In some cases (e.g. electrochemical cells), the term "anode" is applied to one or another electrode, depending on the electric operating condition of the device. In other cases (e.g. electronic tubes and semiconductor devices), the term "anode" is assigned to a specific electrode.

3.4
cathode

electrode capable of emitting negative charge carriers to and/or receiving positive charge carriers from the medium of lower conductivity

[IEC 60050-151:2001, 151-13-03]

NOTE 1 The direction of electric current is from the medium of lower conductivity, through the cathode, to the external circuit.

NOTE 2 In some cases (e.g. electrochemical cells), the term "cathode" is applied to one or another electrode, depending on the electric operating condition of the device. In other cases (e.g. electronic tubes and semiconductor devices), the term "cathode" is assigned to a specific electrode.

4 Method of identifying terminals

The use of alphanumeric notation should be preferred to any alternative marking, as in j).

a) The marking of the terminals should be based on alphanumeric notation employing capital (upper case) roman characters and Arabic numerals.

NOTE 1 It is recommended that the reference letters for d.c. terminals are chosen from the first part and reference letters for a.c. terminals from the second part of the alphabet.

NOTE 2 In those cases where difficulties could otherwise arise in correspondence, documents, etc., the use of small (lower case) letters, which have the same significance, is permitted.

b) Letters “I” and “O” shall not be used to prevent confusion with the numerals “1” and “0”.

c) For converter connections with unchangeable polarity, “+” or “pos” may be used to the positive terminal and “–” or “neg” may be used to the negative terminal.

NOTE 3 In this standard, if not otherwise stated, the term “polarity” is used with respect to the direction of current flow.

d) The complete notation is based on the use of combinations of alternate alphabetical and numerical character groups, each containing one or more letters and/or digits.

e) Terminals with identical basic markings according to Clause 5 and Clause 6 should be distinguished by a reference number in a naturally ascending sequence according to the sequence of operation or the direction of current flow starting with 1 and following the basic terminal markings, for example X1 – X2 – X3, Y1 – Y2 – Y3.

f) Terminals with identical basic markings according to Clause 5 and Clause 6 in two or more similar terminal groups should be distinguished by a reference number in a naturally ascending sequence starting with 1 and preceding the basic terminal markings, for example 1X – 1Y – 1Z, 2X –2Y – 2Z, etc.

g) If, for further differentiation of terminal groups, further letters or numbers are required in addition to the terminal marking in Clause 5 and Clause 6 and in f), such additional marking should be placed before this marking, separated from it by a full stop.

h) The marking shall be clearly legible and durable.

i) The marking of the main terminals according to Clause 5 to Clause 6 shall be shown clearly on the corresponding circuit diagram. This shall also be observed for main and auxiliary terminals not considered in this standard.

j) In cases where the construction mode or size of a stack or assembly prevents the application of the alphanumeric notation for terminal marking, the terminals shall be clearly identified by another applicable method, for example by identifying colours or graphic symbols which, however, are not the subject of this standard.

5 Terminal marking for valve device stacks and assemblies

5.1 Single and double way connections

5.1.1 General

The external main terminals of an individual principal arm or of a number of inter-connected principal arms of the same polarity shall be marked by a capital letter corresponding to the polarity of the end of the arm(s) connected to the terminal to be identified, also in cases where the arms comprise, in addition to the valve devices, further components, for example fuses, reactors, capacitors, etc.

The terminal for a common connection point of arms ending with the same polarity shall be identified by the capital letter M placed behind the identification letter for its polarity.

– End terminal of a principal arm forming:
  - an anode: basic terminal marking A
  - a cathode: basic terminal marking K

NOTE Although other markings may be used for valve devices, e.g. C and B or D and S, A and K are used for arms.

– Terminal for interconnection point of the anode of a principal arm with the cathode of a second principal arm:
  - basic terminal marking AK

– Terminal for the interconnection point of two or more principal arms of the same polarity forming:
  - an anode: basic terminal marking AM
  - a cathode: basic terminal marking KM

– Terminal for an interconnection point of the same number of anodes and cathodes of principal arms:
  - basic terminal marking AKM

– If the valve device stack or assembly is used in a specific converter or semiconductor switch, and its terminals are connected to terminals of the converter or switch, the terminal marking of which may be used:
  - d.c. terminal: alternative terminal marking C, D
  - a.c. terminal: alternative terminal marking U, V, W

– For converter connections with unchangeable polarity of the d.c. terminals the following marking may be used alternatively:

- the sign + for the positive terminal
- the sign – for the negative terminal

If several identical principal arms are combined to a connection in a single stack or assembly, the end terminals with the same polarity shall be distinguished by natural reference numbers, for example 1, 2, 3... placed behind the basic terminal markings, i.e. A1 – A2 – A3, K1 – K2 – K3.

5.1.2 Single way connections

5.1.2.1 Single arm connection

Terminal marking:

– Anode side: A

– Cathode side: K

EXAMPLES: See Figure 1. Examples are shown for rectifier diode, P-gate reverse blocking triode thyristor, PNP bipolar transistor, NPN bipolar transistor, N-channel IGBT and N-channel Type C enhancement type MOSFET.

NOTE 1 The terminals of an individual principal arm which is intended to be part of a converter connection comprising several principal arms may be marked like those of a single arm connection.

NOTE 2 The marking of terminals connected to auxiliary arms only is not considered in this standard.

NOTE 3 The arm which consists of several valve devices connected series and/or parallel is considered to be one arm. The arm which consists of switched valve device and series diode for reverse blocking is also considered to be one arm.

NOTE 4 In some kinds of controllable valve devices, rectifier diodes connected anti-parallel may be integrated in common semiconductor chip or packaged in a common case. If the rectifier diodes are used, these arms are considered as half-controllable anti-parallel pairs. See 5.2.1.

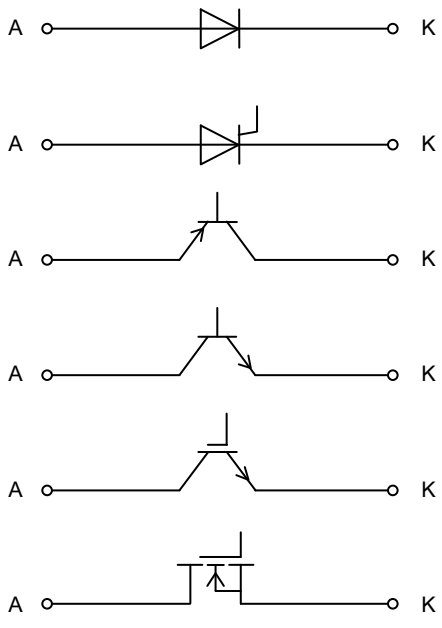

Figure 1 – Typical markings in single arm connections

5.1.2.2 Centre tap and star connection

The *m* principal arms with one and the same polarity connected to a common point, forming the d.c. terminal (*m* being a whole number equal to or greater than 2):

– Cathodes forming the d.c. terminal:
  - Marking of individual arm terminals: A1, A2 ... A*m*
  - Marking of common d.c. terminal: KM
  - For diode rectifiers admissible: +
– Anodes forming the d.c. terminal:
  - Marking of individual arm terminals: K1, K2 ... K*m*
  - Marking of common d.c. terminal: AM
  - For diode rectifiers admissible: –

EXAMPLES: See Figure 2 and Figure 3.

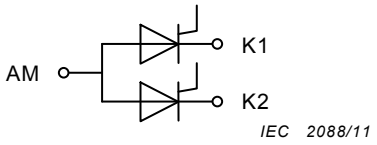

Figure 2 – Star connection with two arms

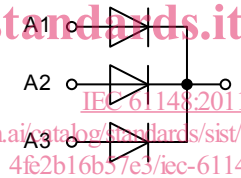

Figure 3 – Star connection with three arms

5.1.2.3 Several centre tap and star connections in a common assembly

A given number *n* of identical groups of *m* principal arms, all groups with the same polarity of the d.c. terminals, for example *n* commutating groups with pulse number *p*, isolated from each other, intended for interconnection via an external interphase transformer:

– Cathodes forming the d.c. terminal:
  - Marking of individual arm terminals: 1A1 – 1A2 to 1A*m*
    2A1 – 2A2 to 2A*m*
    *n*A1 – *n*A2 to *n*A*m*
  - Marking of common d.c. terminal: 1KM to *n*KM
– Anodes forming the d.c. terminal:
  - Marking of individual arm terminals: 1K1 – 1K2 to 1K*m*
    2K1 – 2K2 to 2K*m*
    *n*K1 – *n*K2 to *n*K*m*
  - Marking of common d.c. terminal: 1AM to *n*AM

EXAMPLES: See Figure 4 and Figure 5.

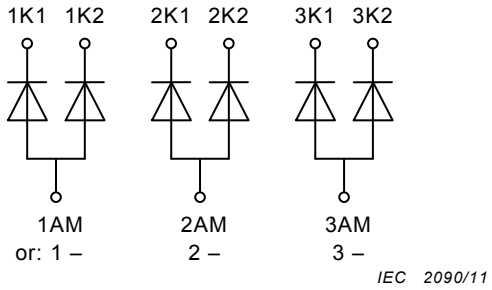

Figure 4 – Three groups with two arms

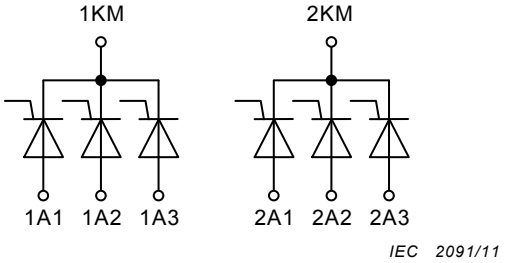

Figure 5 – Two groups with three arms

5.1.2.4 Switched valve device arm and series connected reverse-direction diode arm for d.c. chopper

This terminal marking is applied for choppers.

EXAMPLE: See Figure 6.

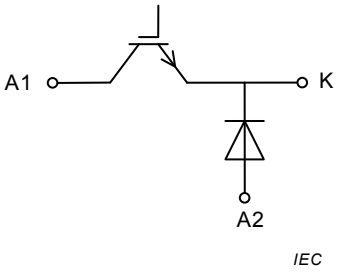

Figure 6a) – Regular terminal marking

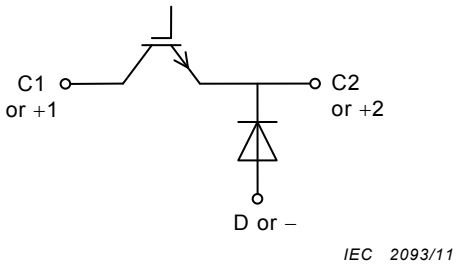

Figure 6b) – Alternative terminal marking

Figure 6 – Assembly for d.c. chopper

5.1.3 Double way connections

5.1.3.1 Pair of arms

Terminal marking:

- Central terminal: AK
- Anode side: A
- Cathode side: K

EXAMPLE: See Figure 7.

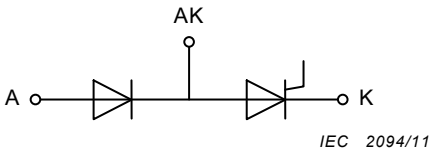

Figure 7 – Pair of arms

5.1.3.2 Bridge connection

m pairs of arms connected to a bridge connection.

Terminal marking:

- Central terminals: AK1 – AK3 to AK*m*
- Anode side d.c. terminal: AM
- Cathode side d.c. terminal: KM
- For diode rectifiers admissible: – for AM, + for KM

EXAMPLE: See Figure 8.

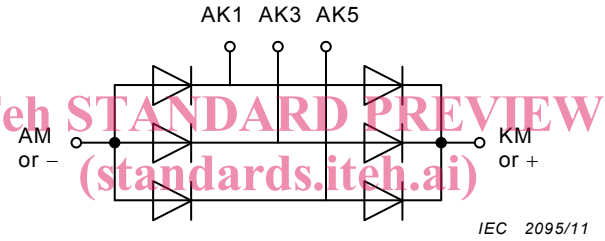

Figure 8 – Bridge connection

NOTE 1 According to the conduction sequence of six diodes, 1, 3 and 5 are used as reference numbers.

NOTE 2 An open bridge connection with the positive bridge section isolated from the negative bridge section, each section provided with separated a.c. terminals, can be considered as two centre tap or star connections. For this connection mode the terminals of the two sections should be marked according to 5.1.2.2, e.g. A1 – A3 – A5/KM and K4 – K6 – K2/AM.

5.1.3.3 Several bridge connections in a common assembly

The *n* bridge connections, isolated from each other.

Terminal marking:

- Central terminals: 1AK1 – 1AK3 to 1AK*m* to *n*AK1 – *n*AK3 to *n*AK*m*
- Anode side d.c. terminals: 1AM to *n*AM
- Cathode side d.c. terminals: 1KM to *n*KM

EXAMPLE: See Figure 9.

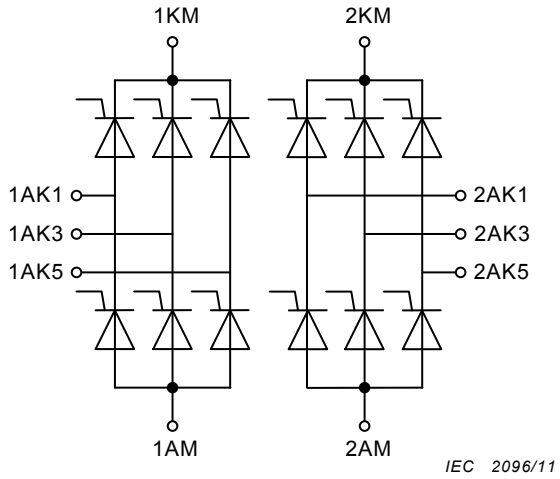

Figure 9 – Double bridge connection

5.1.4 Combination of connections

5.1.4.1 Anti-parallel single way and double way connections

Terminal marking:

– Centre tap and star connections:
  - Marking of common d.c. terminal: AKM
– Bridge connections:
  - Marking if common d.c. terminals: AKM1 and AKM2

EXAMPLE: See Figure 10.

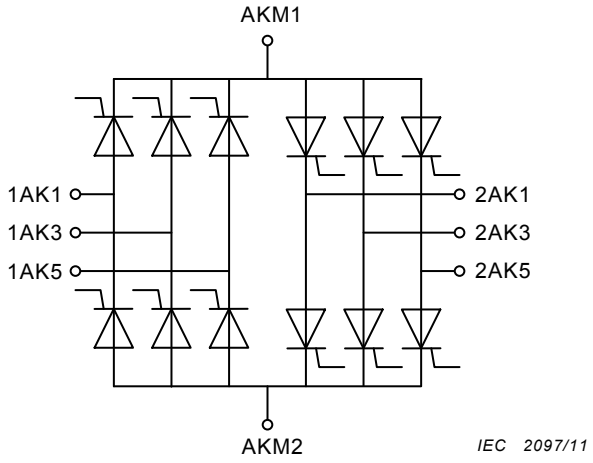

Figure 10 – Anti-parallel bridge connection

5.1.4.2 Series connection of bridges

Intermediate terminal, if any (between the two bridges): AKM

EXAMPLE: See Figure 11.