INTERNATIONAL STANDARD

ISO 81714-1

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Design of graphical symbols for use in the technical documentation of products —

Part 1: **Basic rules**

Création de symboles graphiques à utiliser dans la documentation technique de produits —

Partie 1: Règles fondamentales

Reference number
ISO 81714-1:1999(E)

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 81714-1 was prepared jointly by Technical Committees ISO/TC 10, *Technical drawings, product definition and related documentation*, ISO/TC 145, *Graphical symbols*, and IEC/TC 3, *Documentation and graphical symbols*. Formal voting has taken place within both ISO and IEC.

This first edition of ISO 81714-1 cancels and replaces ISO/IEC 11714-1:1996, which has been updated. It serves as the basis for the design of graphical symbols in all fields of the technical documentation of products. Applications of this part of ISO 81714 are, for example, future editions of IEC 60617 and ISO 14617.

In order to collect all requirements concerning relevant graphical symbols within one single numerical series, ISO/TC 10 and IEC/TC 3, in conjunction with ISO/TC 145, agreed to publish all parts of this International Standard within the 81714 series.

The Technical Management Board of ISO and the Committee of Action of IEC have decided that for each part of this series, one organization shall be chosen responsible. The Technical Committees involved have agreed not to change any part of International Standard 81714 without mutual agreement.

International Standard 81714 consists of the following parts, under the general title *Design of graphical symbols for use in the technical documentation of products*:

ISO 81714-1 — *Part 1: Basic rules*

IEC 81714-2 — *Part 2: Specification for graphical symbols in a computer sensible form including graphical symbols for a reference library, and requirements for their interchange*

IEC 81714-3 — *Part 3: Classification of connect nodes, networks and their encoding*

Further parts specific to individual subject field requirements are under consideration.

Design of graphical symbols for use in the technical documentation of products —

Part 1:
Basic rules

1 Scope

This part of ISO 81714 specifies basic rules for the design of graphical symbols for use in the technical documentation of products taking into account basic application needs.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 81714. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of ISO 81714 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 31–11:1992, *Quantities and units - Part 11: Mathematical signs and symbols for use in the physical sciences and technology.*

ISO 129: 1985, *Technical drawings - Dimensioning - General principles, definitions, methods of execution and special indications.*

ISO 6428 :1982, *Technical drawings - Requirements for microcopying.*

ISO/IEC 8859 (all parts), *Information processing - 8-bit single-byte coded graphic character sets.*

ISO/IEC 10367:1991, *Information technology - Standardized coded graphic character sets for use in 8-bit codes.*

ISO/IEC 10646–1:1993, *Information technology - Universal Multiple-Octet Coded Character Set (UCS) - Part 1: Architecture and Basic Multilingual Plane.*

IEC 61286: 1995, *Information technology - Coded graphic character set for use in the preparation of documents used in electrotechnology and for information interchange.*

3 Definitions

For the purposes of this part of ISO 81714, the following definitions apply.

3.1 graphical symbol
visually perceptible figure used to transmit information independently of language

NOTES —

1 The graphical symbol may represent objects of interest, such as products, functions or requirements for manufacturing, quality control etc.

2 This is not to be confused with the simplified representation of products which is always drawn to scale and may look like a graphical symbol.

3.2 reference point
origin of the coordinate system used in the description of all the graphical elements of the graphical symbol

NOTE - The reference point may be used for positioning and transformation, e. g. mirroring, turning, moving.

3.3 symbol family
set of graphical symbols with a common conception using graphical characteristics with specific meanings

3.4 connect node
location on a graphical symbol intended for connection

3.5 terminal line
line of a graphical symbol ending at a connect node

3.6 text
string of alphabetical, numerical and/or other characters

3.7 arc
curved line without inflection point

4 Markers

In this part of ISO 81714 the following marker is used in order to illustrate positions of connect nodes.

5 Design of graphical symbols

5.1 Graphic representation

Graphical symbols shall be designed to convey information concerning a function or a special requirement. This also applies when physical products are to be represented by graphical symbols.

5.2 Design procedure

The design of graphical symbols shall follow the rules defined in clause 6, taking into account

- the description of what the graphical symbol is intended to represent;

- the requirements pertaining to their presentation on paper or other solid media and in data processing;

- the analysis of the consequences when turning, mirroring or scaling (permitting different values of scaling factors on the *x*- and *y*-axes, if required);

- if graphical symbols are functionally related, they shall be designed as a symbol family;

- the normal application of the graphical symbol, for example of reference designation (see IEC 61346-1), technical data etc.;

- additional requirements as specified in ISO 6428 shall be applied if microcopying is intended.

6 Design principles

6.1 Shape

The shape of a graphical symbol shall be:

- simple, in order to improve perceptibility and reproducibility;

- easily associated with its intended meaning, i. e. either self-evident, or easy to learn and to remember.

Graphical symbols with the same shape representing different information should be avoided.

Due to the limited number of graphical elements and the limited number of combinations of these elements, different meanings may have to be assigned to graphical symbols having the same shape. In these cases, a separate graphical symbol shall be assigned to each meaning.

Graphical symbols with different shapes shall not represent the same information.

For a human reader, the meaning of a graphical symbol can normally be recognized because of the context of the document. If not, such graphical symbols shall be provided with supplementary information.

6.2 Operational state

Graphical symbols having an element representing a movable part in a product, for example a valving element in a directional valve for fluid power and a contact in an electromechanical switching device, shall be designed in a position that corresponds to:

- the at-rest (unaffected) position for products with automatic return (for example: a spring return);

- the non-active position for products without automatic return (for example: a closed valve, an electromechanical switching device in open-circuit position).

If operational states other than those specified here are required, the relevant information should be given in the standard for graphical symbols.

6.3 Classes of graphical symbols

Two classes of graphical symbols are recognized:

class 1 - graphical symbols providing basic information;

class 2 - graphical symbols providing supplementary information.

Graphical symbols belonging to class 2 should be designed without relation to any specific context in order to make their application as broad as possible. These graphical symbols are intended to be used only together with graphical symbols of class 1.

Graphical symbols belonging to class 1, normally reduced in size, may be used to provide supplementary information as well (see figures 1 and 2).

NOTE — The graphical symbols providing the basic information for a pump as shown in figure 1, and for a capacitor as shown in figure 2, are used in each of the combinations as a graphical symbol giving supplementary information.

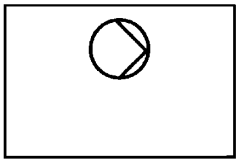


Figure 1 – Pumping system

Figure 2 – Electrostatic microphone

6.4 Combination of graphical symbols

6.4.1 General

Graphical symbols may be combined to form a new graphical symbol. The information represented by the new composite graphical symbol shall be consistent with the information represented by its constituents. Examples of combinations of graphical symbols are shown in figure 3.

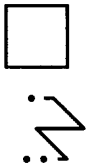
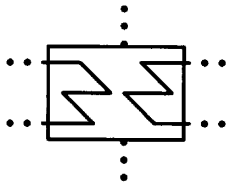
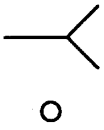
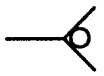
Example	Graphical symbol	Assigned description	Composite graphical symbol	Assigned description
1		Anode Directly heated cathode Bulb of a tube		Diode with directly heated cathode
2		Envelope, vessel Heating or cooling coil		Heat exchanger with 3 flowpaths
3		Seat of a check valve Moving part of a check valve		Check valve / non–return valve
NOTE – The dotted lines shown in example 2 are not part of the graphical symbol (see 6.12)				

Figure 3 – Examples of combinations of graphical symbols

6.4.2 Graphical symbols for complex assemblies

The graphical symbol representing an assembly shall be constructed by combining the graphical symbols representing the constituents of that assembly.

If the graphical symbol for a complex assembly, either for reasons of complexity or lack of graphical symbols representing the constituents, cannot be constructed in the above way, the following applies.

The graphical symbol shall be based on a simple solid outline, being supplemented preferably within this outline by information according to a) through f) or combinations of these as shown below. The outline should preferably be that of a square or, if necessary, a rectangle or any other closed shape.

a) Graphical symbol(s) representing the most significant constituent(s) (see figure 1).

b) Mathematical signs and/or formulas, letter symbols for quantities, chemical formulas, graphs and symbols of International Standards. Mathematical signs shall be in accordance with ISO 31-11 (see figure 4).

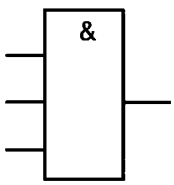


Figure 4 – AND element

c) An abbreviation, preferably mnemonic, based on the English language (see figure 5).

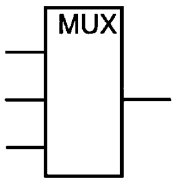


Figure 5 – Multiplexer

d) Graphical symbols providing supplementary information related to each input and each output (see figure 6).

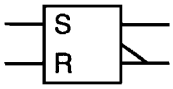


Figure 6 – Bistable element

e) Graphical symbols providing supplementary information related to the assembly as a whole, located inside or outside the continuous outline (see figure 7).

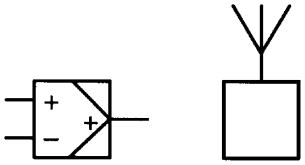
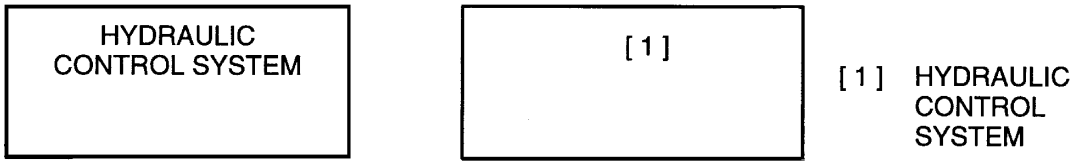


Figure 7 – Feedback controller and radio system

f) If it is impossible to describe the meaning of the graphical symbol by the methods given in a) through e), a short descriptive text may be added.

This text should be written in English, independent of the language(s) used, e.g. in a diagram. However, for use limited to a defined language region, a different language may be used instead. The text may be located inside or outside the outline (see figure 8) and should be as short as possible.



NOTE — Location of the text outside the outline distinguishes an international graphical symbol from language-related information and facilitates reproduction in different languages.

Figure 8 – Hydraulic control system

6.4.3 Graphical symbols including flow direction

Graphical symbols applying a flow direction, used to provide supplementary information, shall be applied in such a way that the overall flow is emphasized (see figure 16).

6.5 Grid; module

As a basis for the design of a graphical symbol, an orthogonal grid of parallel lines spaced 1 M apart, where M is the module, shall be used. This grid may be subdivided into a 0,1 M or a 0,125 M grid (see figure 9). For the same graphical symbol or symbol family, only one of these two grid systems shall be used and indicated in an appropriate document.

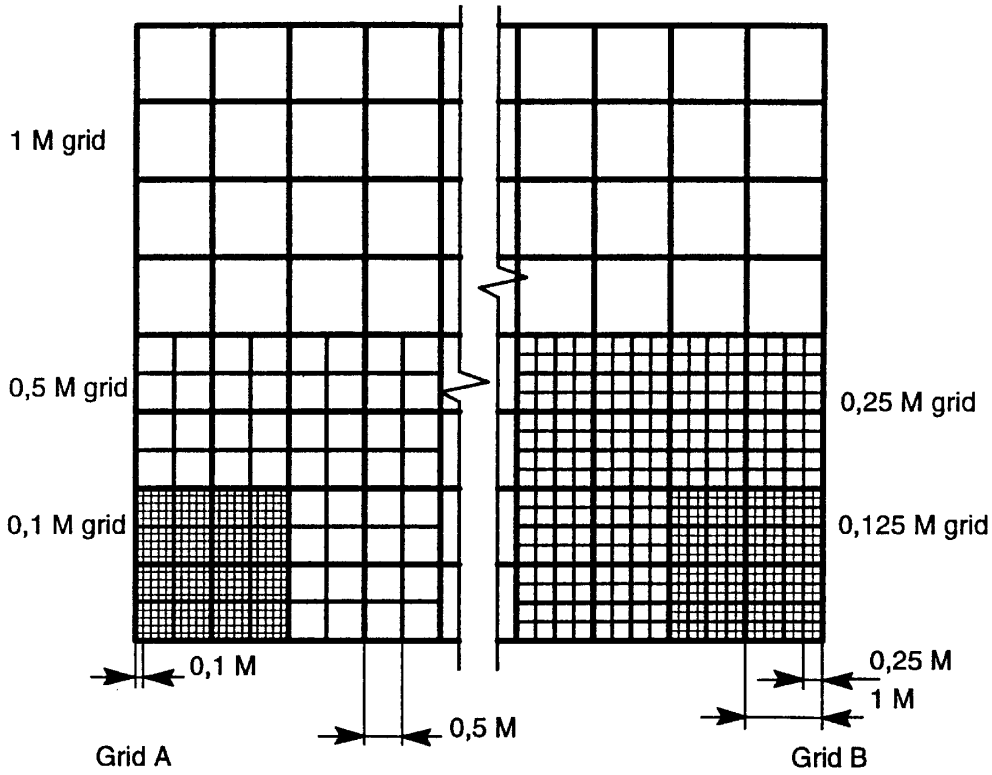


Figure 9 – Examples of grids

6.6 Line width

The relation between the line width and the module size M used for the design of graphical symbols shall be 0,1. Characters and lines of graphical symbols should have the same line width. If additional line widths are required, the ratio between any two line widths should be at least 2:1. Standardized line widths given in ISO 128-20 are recommended.

6.7 Arcs and lines

Line types should be in accordance with ISO 128-20. Lines which come into contact or intersect at an acute angle should not have angles of less than 15°. Straight lines which do not run parallel to grid lines should have increments of 15° or should be defined with gradient ratios (for example 1:1, 2:1, 3:1, 4:1). Straight lines should begin and end on an intersection of the grid.

The end points of an arc shall lie on intersections of the grid. Curves shall consist only of arc segments and/or straight lines.

The following applies to straight lines and arcs defining the outline of a graphical symbol on which connect nodes are required (see figure 10):

- the axis of horizontal and vertical lines shall lie on the 0,5 M or 1 M grid;

- the axis of inclined lines or arcs shall intersect as many intersections of the 0,5 M grid as connect nodes are needed.

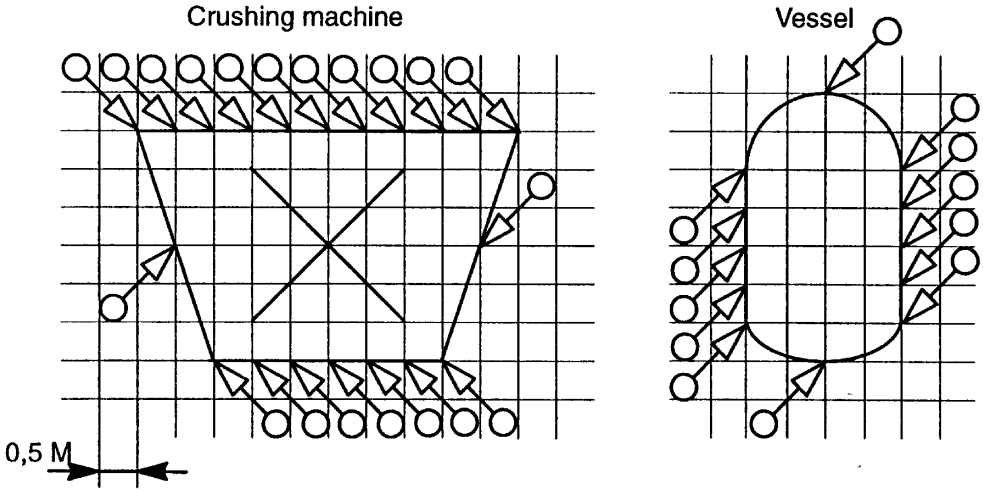


Figure 10 – Examples of graphical symbol outlines containing connect nodes

6.8 Minimum space between parallel lines

The minimum space between parallel lines shall be at least twice the line width of the widest line.

6.9 Hatched and filled areas

For hatched areas, the requirements with respect to the minimum space between parallel lines and to the line width shall be applied.

Filled areas should be avoided.

6.10 Connect node

If required, the graphical symbol should be provided with the appropriate number of connect nodes representing inputs and outputs.

6.11 Position of a connect node

A connect node should lie on an intersection of the 1 M or the 0,5 M grid (see for example figure 10).

If it is intended to position text between connect nodes or parallel terminal lines, the minimum space between these nodes or lines shall be 2 M.

6.12 Terminal line

If a terminal line is required, it should be as short as practicable.

In those cases where the graphical symbol does not include terminal lines and the connection lines should be attached to the graphical symbol in a specific manner, the connection lines should be indicated by dotted lines (see figure 3, example 2).

6.13 Reference point

For use in computer-aided systems, graphical symbols require a reference point. It shall lie on an 0,5 M or 1 M intersection of the same grid as that used for the design of the graphical symbol.

NOTE — Further recommendations regarding the location of the reference point may be given in other relevant International Standards.

6.14 Text assigned to graphical symbols

6.14.1 Typeface of characters

The typeface of characters should conform to ISO 3098-2 type B vertical, where applicable. Letter symbols of quantities, given in ISO 31 and IEC 60027 are recommended.

6.14.2 Set of characters

Any text within graphical symbols should be composed from standard character sets. To maintain compatibility with computer processing, characters should be restricted to those characters encoded in the ISO/IEC 646 seven-bit character set, International Reference Version (IRV), excluding control and national replacement characters. If additional characters are required, they shall be selected from existing coded character sets, i.e. ISO/IEC 8859, ISO/IEC 10367, ISO/IEC 10646-1 and IEC 61286.

6.14.3 Text orientation

The orientation of text (reading direction) shall comply with the rules for the orientation of dimensioning values in ISO 129, limited to horizontal and vertical values.

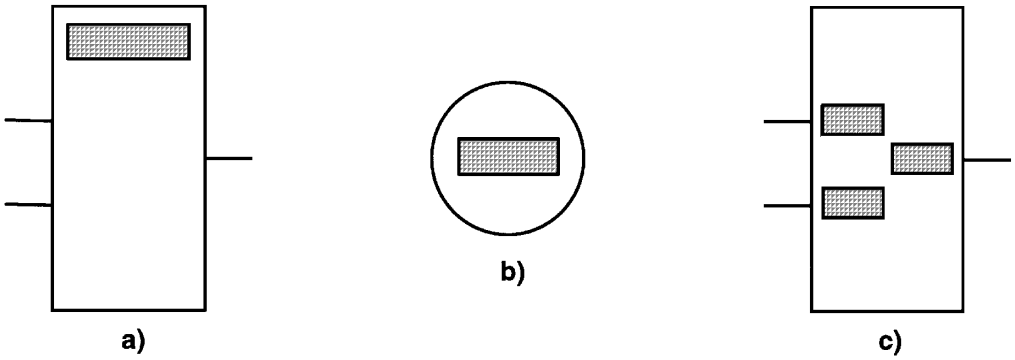
6.14.4 Location of text inside an outline

Text related to the graphical symbol as a whole should preferably be placed in the top centre [see figure 11a)] or alternatively in the middle [see figure 11b)] of the outline of the graphical symbol.

Text related to input/output shall be placed next to the relevant input/output [see figure 11c)].

6.14.5 Minimum distances

The minimum space between a text and its surrounding geometry shall be at least twice the line width (*d*) of the wider line (see figure 12).



NOTE – The filled-in areas show the areas occupied by the text.

Figure 11 – Examples of text locations

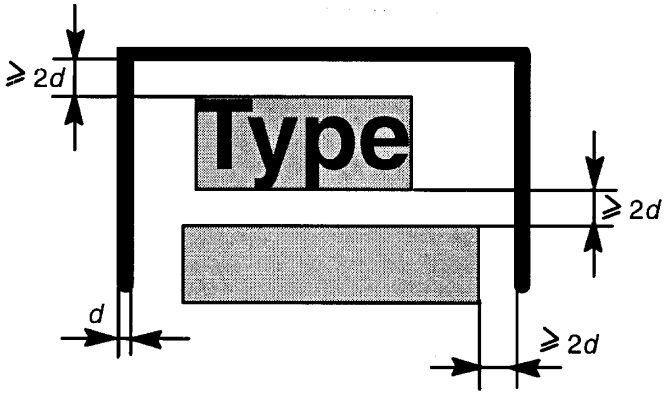


Figure 12 – Minimum distances between text and lines

6.15 Size of graphical symbols

The size of a graphical symbol should take into account space requirements, such as included text, included constituent graphical symbols, other graphical details, location and number of connect nodes.

7 Modification of proportions

The standardized proportions of graphical symbols should be as shown in relevant International Standards. When applied, however, the proportions of an existing graphical symbol, for example the graphical symbols shown in figures 4 and 5, may be modified, as long as the modified graphical symbol conveys the same information as the original one.

NOTE — Allowed modifications or versions of graphical symbols may be shown, for example, in a separate documentation or in application standards.

8 Variants of graphical symbols

NOTE — In the context of this part of ISO 81714, variants of graphical symbols are not considered to be different graphical symbols.

When applied, different variants of a graphical symbol, satisfying different requirements with regard to flow direction and reading directions, may be needed. Due to the different geometric shape of the graphical symbol, up to two, four or eight such variants may be required.

In simple cases, the variants can be obtained by turning or mirroring. As examples, in figures 13, 14 and 15, variant A is turned anti-clockwise by steps of 90° to variants B, C and D. Variant E is constructed by mirroring variant A around the *y-y* axis. Variant E again is turned anti-clockwise by steps of 90° to variants F, G and H.

In more complicated cases, for example if the graphical symbol includes text, it might be necessary to adjust the reading direction (see clause 6.14.3) and to shift the position of the text.

From all the possible variants shown in figures 16 and 17, variants A, B, E and F are the preferred ones in accordance with the rules set up in this part of ISO 81714.

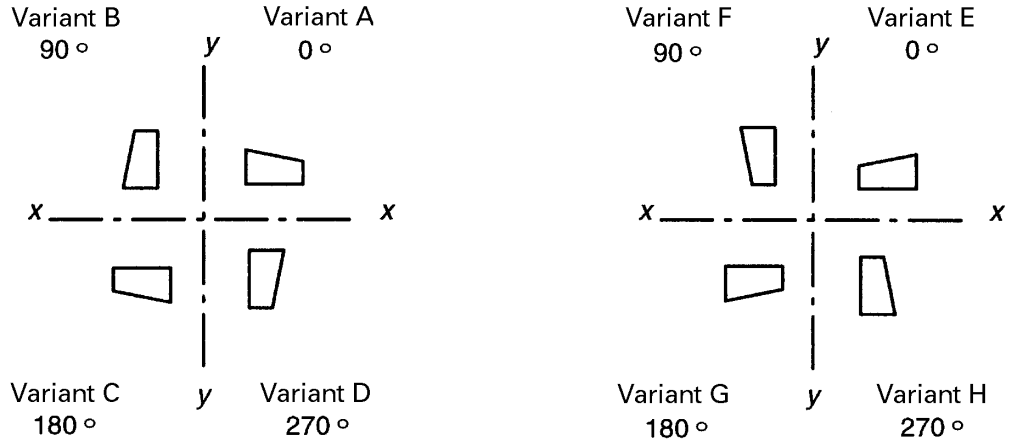


Figure 13 – Possible variants of the graphical symbol for an asymmetric reduction

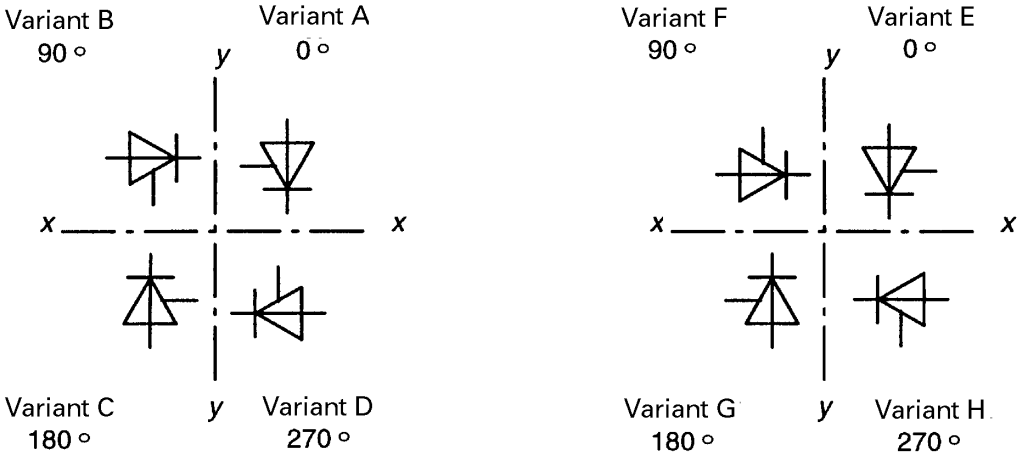


Figure 14 – Possible variants of the graphical symbol for a thyristor

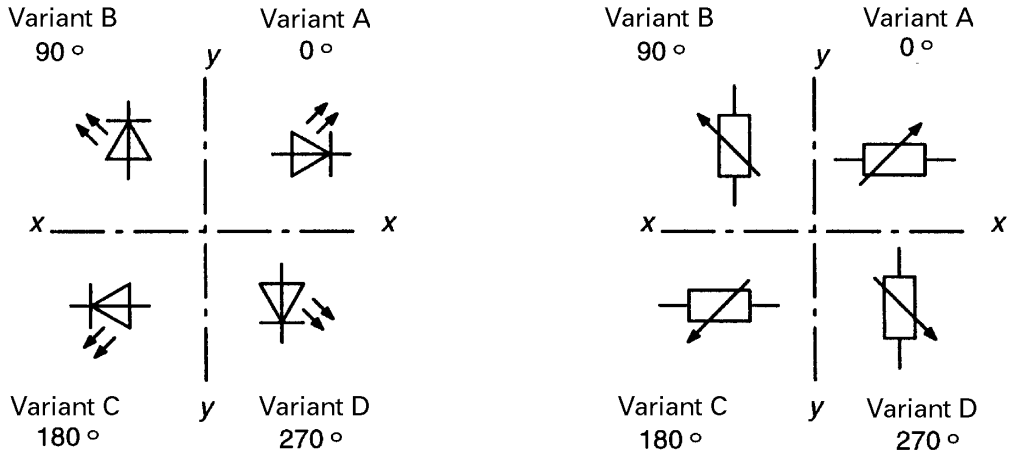


Figure 15 – Possible variants of composite graphical symbols

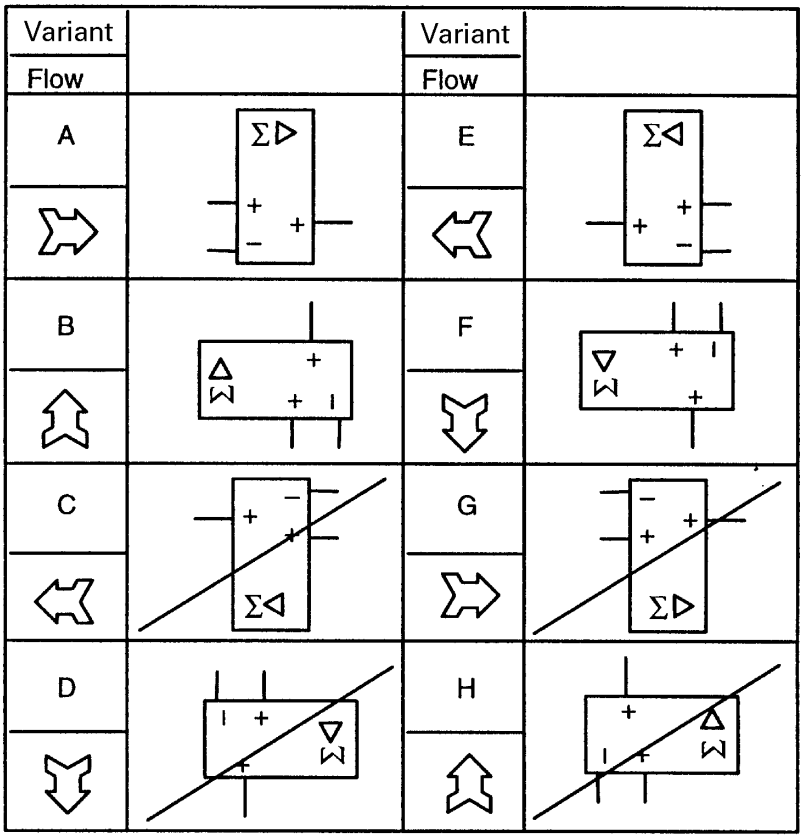


Figure 16 – Example of required modifications in different variants

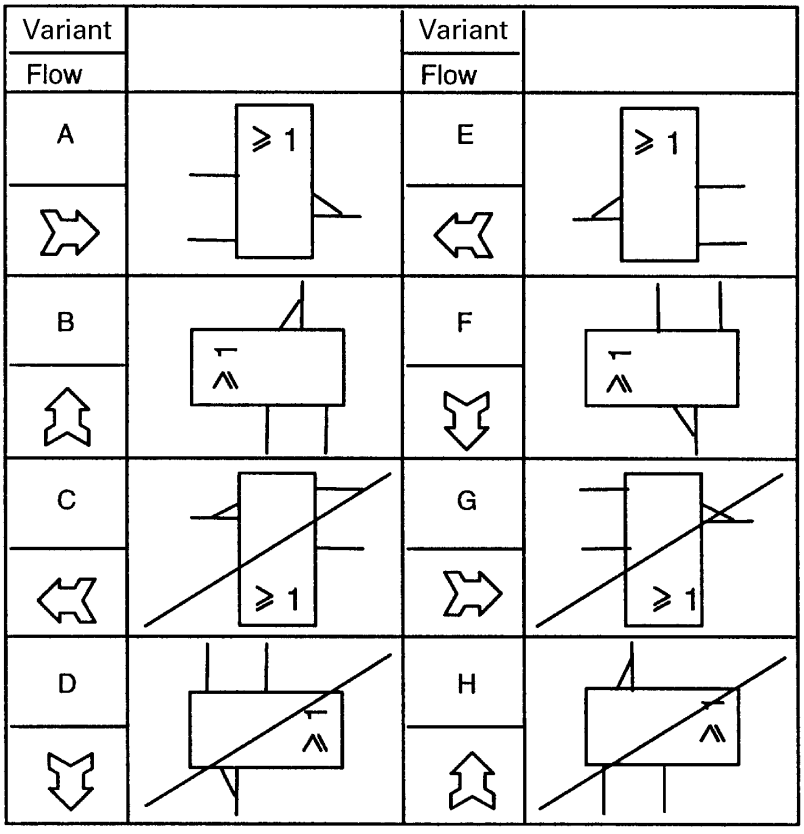


Figure 17 – Example of required modifications in different variants

Annex A

(informative)

Bibliography

[1] ISO 31 (all parts), *Quantities and units.*

[2] ISO 128-20:1996, *Technical drawings - General principles of presentation - Part 20: Basic conventions for lines.*

[3] ISO 3098-2:—[1)], *Technical product documentation - Lettering - Part 2: Latin alphabet, numerals and marks.*

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[5] IEC 60027 (all parts), *Letter symbols to be used in electrical technology.*

[6] IEC 61082-1:1991, *Preparation of documents used in electrotechnology - Part 1: General requirements.*

[7] IEC 61346-1:1996, *Industrial systems, installations and equipment and industrial products - Structuring principles and reference designation - Part 1: Basic rules.*

1) To be published. (Revision of ISO 3098-1:1994)

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