

TECHNICAL SPECIFICATION



Graphical symbols for diagrams – Guidance on design for standardization in IEC 60617

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TECHNICAL SPECIFICATION



**Graphical symbols for diagrams – Guidance on design for standardization in
IEC 60617**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**GRAPHICAL SYMBOLS FOR DIAGRAMS – GUIDANCE ON DESIGN
FOR STANDARDIZATION IN IEC 60617**

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Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 63064, which is a Technical Specification, has been prepared by IEC technical committee 3: Information structures and elements, identification and marking principles, documentation and graphical symbols.

The text of this Technical Specification is based on the following documents:

Draft TS	Report on voting
3/1309/DTS	3/1329/RVDTS

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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GRAPHICAL SYMBOLS FOR DIAGRAMS – GUIDANCE ON DESIGN FOR STANDARDIZATION IN IEC 60617

1 Scope

This document gives guidance and basic principles on how to design graphical symbols for diagrams for standardization and inclusion in IEC 60617.

This document does not specify how to apply such graphical symbols in the diagrams.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60617, *Graphical symbols for diagrams* (available at <http://std.iec.ch/iec60617>)

IEC 62744:2014, *Representation of states of objects by graphical symbols*

IEC 80000 (all parts), *Quantities and units*

IEC 81714-2:2006 *Design of graphical symbols for use in the technical documentation of products – Part 2: Specification for graphical symbols in a computer-sensible form including graphical symbols for a reference library, and requirements for their interchange*

ISO 128-20:1996, *Technical drawings – General principles of presentation – Part 20: Basic conventions for lines*

ISO 14617 (all parts), *Graphical symbols for diagrams*

ISO 80000 (all parts), *Quantities and units*

ISO 81714-1:2010, *Design of graphical symbols for use in the technical documentation of products – Part 1: Basic rules*

Drawing grid template, available at

http://www.iec.ch/standardsdev/resources/draftingpublications/writing_formatting/IEC_template/iec_graphical_symbols_for_diagrams.htm > *The graphical symbols for diagrams template*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

graphical symbol

visually perceptible figure with a particular meaning used to transmit information independently of language

[SOURCE: ISO 17724:2003, 31]

3.2

reference point

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

[SOURCE: ISO 81714-1:2010, 3.2, modified — the note has been deleted.]

3.3

symbol family

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

[SOURCE: ISO 81714-1:2010, 3.3]

3.4

connect node

location on a graphical symbol intended for connection

Note 1 to entry: Graphical symbols are connected via connect nodes of different types to external networks, see IEC 81714-3.

[SOURCE: ISO 81714-1:2010, 3.4, modified — Note 1 has been added.]

3.5

terminal line

line of a graphical symbol ending at a connect node

[SOURCE: ISO 81714-1:2010, 3.5, modified — the note has been deleted.]

3.6

qualifying symbol

qualifier

graphics and/or letter symbol representing a characteristic

Note 1 to entry: ISO 80000 (all parts), IEC 80000 (all parts) and IEC 60027 (all parts) specify letter symbols for use as qualifiers representing a physical quantity.

Note 2 to entry: Qualifying symbols are added to any existing combination of graphical symbols containing at least one graphical symbol. Usually qualifying symbols have a simple graphical presentation.

3.7

orientation

identified position of a graphical symbol with regard to the process flow direction or signal transfer direction

Note 1 to entry: The graphical symbol for diagrams has eight (A, B, C, D, E, F, G, H) possible orientations where the default value is A (see ISO 81714-1:2010, Clause 8).

Note 2 to entry: The term orientation of a graphical symbol is used as synonym for the term variant of a graphical symbol as used in ISO 81714-1:2010, Clause 8.

Note 3 to entry: See also IEC 61082-1:2014, 7.4.4.4.

3.8

grid

pattern of parallel lines crossing each other to form squares

4 Concept considerations

4.1 General

When a graphical symbol for diagrams required to represent an object in a diagram is not found in IEC 60617, the graphical symbols S00059, S00060 or S00061 (see Figure 1) can be applied.

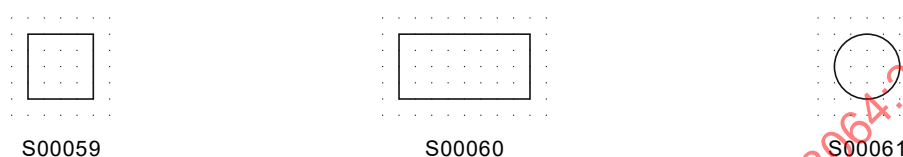


Figure 1 – IEC 60617 graphical symbols for diagrams for basic concept

If this is not suitable then the following rules shall be applied.

The design process shall start by providing a definition of the concept to be represented by the graphical symbol, together with an associated name (see IEC 60617). The concept shall be defined unambiguously.

The designer of the graphical symbol for diagrams shall consider the following issues:

- Is the name of the proposed graphical symbol for diagrams given with unambiguous textual information corresponding to the intended concept?
- Do any similar standardized concepts exist in IEC 60617 or ISO 14617 (all parts)?
- Is the proposed graphical symbol for diagrams a possible member of an existing symbol family?
- For what kind of diagrams is the new graphical symbol for diagrams intended to be used?
- Are there similar graphical presentations already standardized in IEC 60617 or ISO 14617 (all parts)?
- Are there already standardized qualifying symbols which represent the same intended characteristic?
- Are there application notes relevant to the proposed graphical symbol?
- Are the graphical symbol elements arcs, lines, etc. arranged in such a way that the intended connect nodes to other elements of a diagram are situated at intersections of the 1 M or 0,5 M orthogonal grid?
- Is the proposed graphical presentation of the concept clearly understood without using explicitly drawn terminal lines – being part of the graphics of the proposed graphical symbol – or is it necessary to indicate anticipated connections for example by using dotted lines?

4.2 Shape of graphical symbols for diagrams

The visual impression of graphical symbols for diagrams shall be:

- simple, in order to provide good perceptibility and reproducibility;
- easily associated information of the concept, i.e. either self-evident, or easy to learn and to remember.

Graphical symbols for diagrams with the same visual impression representing different information should be avoided. Due to the limited number of graphical elements and the limited number of their combinations, different concepts may be assigned the same graphical shape. In such cases, a separate graphical symbol shall be assigned to each concept identified by a separate identifier (see ISO 81714-1:2010, 6.16).

Graphical symbols for diagrams with different shapes should not represent the same concept. Depending on needs, different shapes may represent the same information such as in Form 1, Form 2, and so on. For a human reader, the meaning of a graphical symbol for diagrams can normally be recognized because of the context of the diagram. If not, such graphical symbols for diagrams shall be provided with supplementary information in the diagram.

4.3 Operational states

Graphical symbols for diagrams shall be designed in orientation A, as defined in IEC 81714-2:2006, Figure 3.

For a graphical symbol for diagrams having a potential change of shape depending on its operational state, the following requirements shall be followed:

- the at-rest (unaffected) position for objects with automatic return (e.g. a spring-loaded safety valve, a relay with spring return),
- the non-active position for objects without automatic return (e.g. a shut-off valve in a closed position, an electromechanical switching device in an open-circuit position), and
- the de-energized position.

If a graphical symbol for diagrams is also used for indicating other operational states, the requirements established in IEC 62744:2014, Table 1 shall apply.

NOTE IEC 62744:2014 provides generic rules for the representation of states of objects by graphical symbols for diagrams standardized in IEC 60617, ISO 14617 (all parts) and IEC 60417. IEC 62744:2014, Table 1 provides examples of generically defined operational states of an object.

4.4 Qualifying symbols

Qualifying symbols representing physical quantities shall be exclusively taken from the letter symbols as specified in IEC 80000 (all parts), ISO 80000 (all parts) and IEC 60027 (all parts).

5 Grids and module

5.1 Orthogonal grid system

As a basis for the design of a graphical symbol for diagrams, an orthogonal grid system of parallel lines spaced 1 M apart, where M is the module, shall be used. See Annex A.

For the detailed design of graphical symbols for diagrams, 1 M is subdivided into 0,5 M. See also Annex A and ISO 81714-1:2010, Figure 9.

For the purpose of inclusion of graphical symbols in IEC 60617 the size of module $M = 2,5$ mm is defined.

NOTE 1 The dots 1 M apart are not part of a graphical symbol. The dots are used for presenting dimensions of a graphical symbol for standardization and inclusion in IEC 60617.

NOTE 2 The electronic grid template for the design of graphical symbols is available under the following URL: http://www.iec.ch/standardsdev/resources/draftingpublications/writing_formatting/IEC_template/iec_graphical_symbols_for_diagrams.htm > *The graphical symbols for diagrams template*.

5.2 Layers for designing graphical symbols for diagrams

Each graphical symbol for diagrams shall be designed in orientation A using the orthogonal grid system. It is foreseen that a drawing layer technique is applied, applying six layers where each layer has a specific purpose as follows:

- Layer 1: presenting the graphical symbol of the concept (see 3.1);
- Layer 2: presenting qualifying symbols (see 3.6);
- Layer 3: presenting the 1 M dots;
- Layer 4: presenting the 1 M grid;
- Layer 5: presenting the 0,5 M grid;
- Layer 6: presenting the 0,1 M grid.

For examples of the orthogonal grid system, see Annex A.

NOTE 1 The foreseen organization of the different layers separates the graphical presentation of a graphical symbol for diagrams to be extracted for presentation purposes. Layer 2 allows adding qualifying symbols without changing the graphical symbol presented in Layer 1. The combination of Layer 1 with Layer 2 allows the extraction of existing graphics for visualization purposes. Layer 3 provides the information of the locations of the connect nodes. Layer 4 is the grid serving as basis for the design of a symbol. Layers 5 and 6 are for the convenience of the designer and can be switched off or on depending on the designer's needs.

NOTE 2 For location of textual information to be added to the graphical symbol for diagrams, see IEC 81714-2:2006, Figure 29.

NOTE 3 The colour of the 1 M orthogonal grid in the electronic template is chosen as colour grey (RGB colour code: #808080).

5.3 Drawing of symbols for diagrams

The graphical symbols shall be drawn by using the achromatic colour black (RGB colour code: #000000).

The graphical symbol for diagrams shall be drawn in vector graphics.

5.4 Margin

The margin around the graphical symbols for diagrams should be at least 1 M.

5.5 File format

The graphical symbol for diagrams shall be submitted in an editable PDF file to maintain the vector graphics and to keep the layers. In addition, it is recommended to submit a PNG in 300 pixel per inch by converting it from the PDF file.

NOTE The editable PDF file allows to generate other files such as SVG, PNG.

6 Design process for graphical symbols for diagrams

The proposed graphical symbol may be composed of one or more graphical symbols complemented by one or more qualifying symbols.

The graphical symbol designer shall consider the following sequence:

- a) use the drawing grid template (available at http://www.iec.ch/standardsdev/resources/draftingpublications/writing_formatting/IEC_template/iec_graphical_symbols_for_diagrams.htm > *The graphical symbols for diagrams template*) and prepare in accordance with Clause 5;
- b) select the most appropriate graphical symbol for reflecting the main concept (if a suitable graphical symbol is not available, then combine two or more graphical symbols);
- c) draw the proposed graphical symbol on Layer 1 in the orientation A, taking into account the intended directions of signal and process flows;
- d) select qualifying symbols for the concept, if applicable;
- e) insert qualifying symbols adjacent to the graphical symbol into Layer 2, if applicable;
- f) if there is doubt that the concept cannot be understood without terminal lines, then locate the positions of the foreseen connect nodes in Layer 3 and draw the needed terminal lines as short as possible in Layer 3.

The number of supplementary symbols and qualifiers should be limited in number to what is required to emphasize the desired concept.

The graphical symbols for diagrams and qualifying symbols should not be overloaded to design a new graphical symbol for diagrams.

Qualifying symbols shall be designed for general purposes in order to make the application as broad as possible. They are intended to be used only in combination with a graphical symbol.

The qualifying symbols should be:

- explicitly classified as “conceptual elements or qualifying symbols” in their application class in IEC 60617; or
- any other graphical symbol for diagrams in IEC 60617 and, if necessary, suitably modified in size.

NOTE 1 The additional graphical symbols or qualifying symbols are placed inside the closed outline, outside the closed outline, or across the graphical symbol depending on needs.

NOTE 2 No specific rules are given since the placement to a high degree depends on the shapes of the symbols, available space in or around the graphical symbol, etc.

Qualifying symbols, each representing a specific characteristic, shall be arranged in immediate vicinity or directly on top of the graphical symbol, therefore adding functionality to the intended concept.

7 Requirements for designing graphical symbols for diagrams

7.1 General

Graphical symbols for diagrams shall be prepared using lines.

7.2 Line width

The line width shall be 1/10 M in accordance with ISO 81714-1. If different line widths are required, the ratio between any two-line widths shall be at least 2:1.

7.3 Lines and arcs

Line types shall be in accordance with ISO 128-20:1996, Table 1.

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 or of arc segments and straight lines.

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

- 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.

7.4 Line end type

The line end type shall be the coded line end type 1 defined in IEC 81714-2:2006, Figure F 1, as shown in Figure 2.

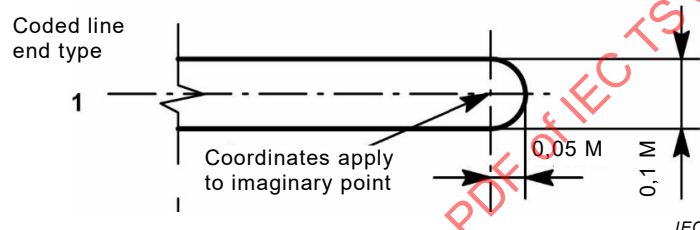


Figure 2 – Coded line end type 1

7.5 Line corner type

The line corner shall be the coded line corner type 1 defined in IEC 81714-2:2006, Figure F.2, as shown in Figure 3.

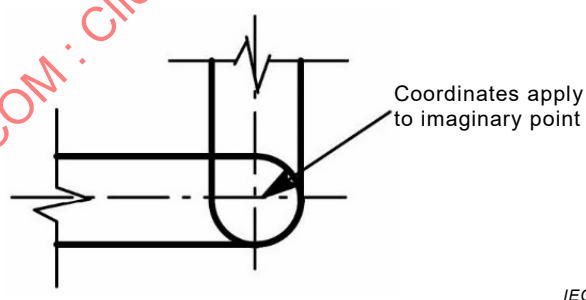


Figure 3 – Coded line corner type 1

7.6 Minimum space between parallel lines

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

7.7 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.

7.8 Connect node

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

7.9 Position of a connect node

A connect node shall lie on an intersection of the 1 M grid.

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.

For more detailed information, see IEC 81714-2.

7.10 Terminal lines and anticipated connections

If terminal lines are required, they should be as short as practicable with regard to the space required for the terminal or port designations. See also IEC 81714-2.

If it is required for the understanding of the graphical symbol that anticipated connections are shown, then such connections may be indicated by dotted lines.

NOTE Dotted lines are not part of the graphical symbol for diagrams.

7.11 Reference point

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

For more detailed information, see IEC 81714-2.

7.12 Text

The height of letters shall be 1 M.

For more detailed information, see IEC 61082-1.

NOTE In drawing applications where supported font types are based on the unit system "point" only, the font type "Arial" of 10-point fits to 1 M of size 2,5 mm.

Annex A (informative)

Specification of orthogonal grid system and examples of its application

A.1 Specification of electronic orthogonal grid system

The electronic orthogonal grid system for designing a new graphical symbol for diagrams is composed of the following four layers in addition to the two layers for the presentation of the graphical symbols and qualifying symbols:

NOTE The grid in the orthogonal grid system is a pattern of straight lines, crossing each other to form squares. [SOURCE: Oxford Advanced Learners English Dictionary]

- a) orthogonal grid of parallel lines spaced 1 M apart, where M is the module, to be used for the main purpose of graphical design, 1 M grid;
- b) dots, diameter of each of which is 0,1 M, placed at the intersections of the orthogonal grid of the parallel lines spaced 1 M for the purpose of evaluation, validation and release of finalized graphical symbols;
- c) orthogonal grid of parallel lines spaced 0,5 M apart for the supplementary purpose of graphical design, 0,5 M grid; and
- d) orthogonal grid of parallel lines spaced 0,1 M for providing the reference point of textfield as required in 6.8.4 and 6.14 of IEC 81714-2:2006, 0,1 M grid.

Each of the layers are controllable for visualization depending on needs such as in design process and standardization process.

An example of visualization of the electronic orthogonal grid system of $M = 2,5 \text{ mm}$ in 16 rows and 16 columns split into each of the layers is shown in Figure A.1.

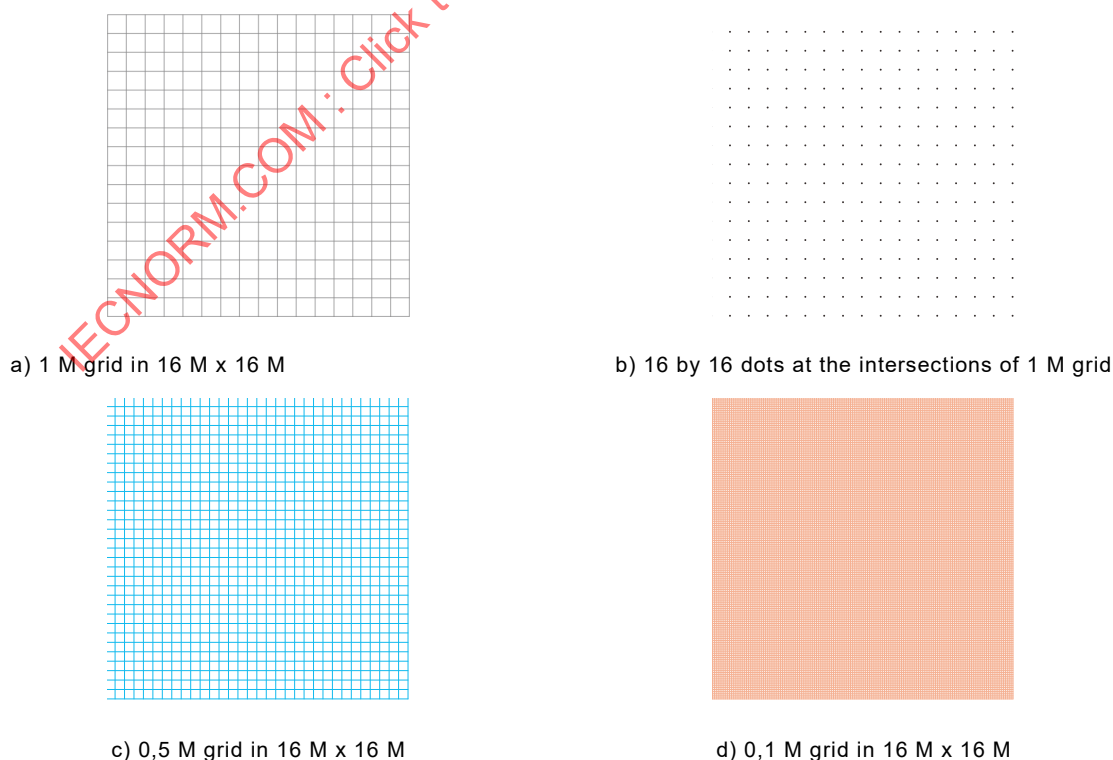


Figure A.1 – Example of visualization of the electronic orthogonal grid system of $M = 2,5 \text{ mm}$ in 16 rows and 16 columns

A.2 Example of the application of the orthogonal grid system

For the purpose of demonstration of an example, a supposed to be new graphical symbol, actually already standardized as S00589 for "Inductor with moveable contact, variable in steps" is used.

In this example, since the size of a graphical symbol with a typical margin is 6 M x 4 M, the corresponding portion of the orthogonal grid system is trimmed out of the given orthogonal grid system of 16 M x 16 M and the concept symbol together with the qualifying symbols are laid out as shown in Figure A.2.

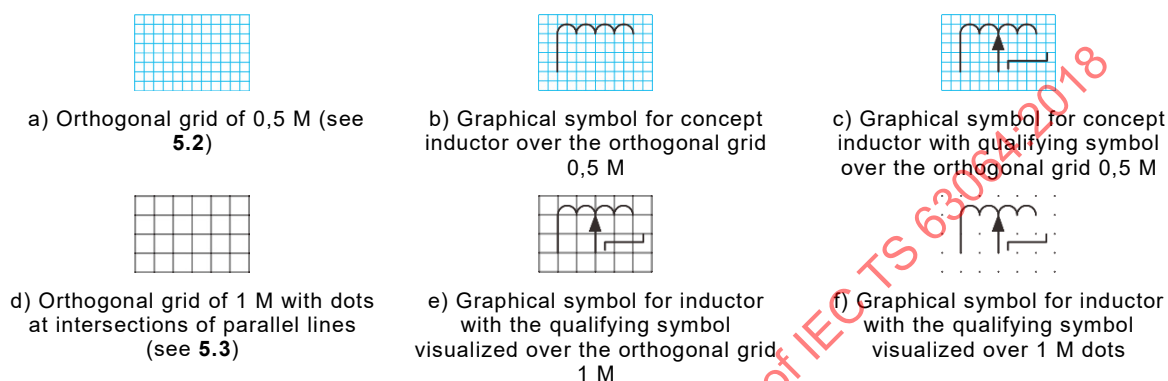


Figure A.2 – Example of application of the orthogonal grid system of M = 2,5 mm visualized layer-by-layer