IEC 61082-1

Edition 3.0 2014-10
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Preparation of documents used in electrotechnology – Part 1: Rules

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Preparation of documents used in electrotechnology – Part 1: Rules

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PREPARATION OF DOCUMENTS USED IN ELECTROTECHNOLOGY –

Part 1: Rules

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.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 61082-1 has been prepared by IEC technical committee 3: Information structures, documentation and graphical symbols.

It has the status of a horizontal standard in accordance with IEC Guide 108.

This third edition cancels and replaces the second edition published in 2006. This edition constitutes a technical revision and includes the following main technical changes:

a) inclusion of presentation rules for wireless interconnections
b) description of exceptional cases for the application of rules for positioning of reference designations in diagrams
c) correction of errors and update of the normative references
d) harmonization of definitions with respect to referenced publications.

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

FDIS	Report on voting
3/1189/FDIS	3/1196/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.

A list of all the parts in the IEC 61082 series, under the general title *Preparation of documents used in electrotechnology*, can be found on the IEC website.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC 61082-1 deals with the presentation of information in documents. Part of this information is described in other International Standards. Figure 1 – Overview of standards related to the presentation of information in documents provides an overview on the interrelation between some of these standards.

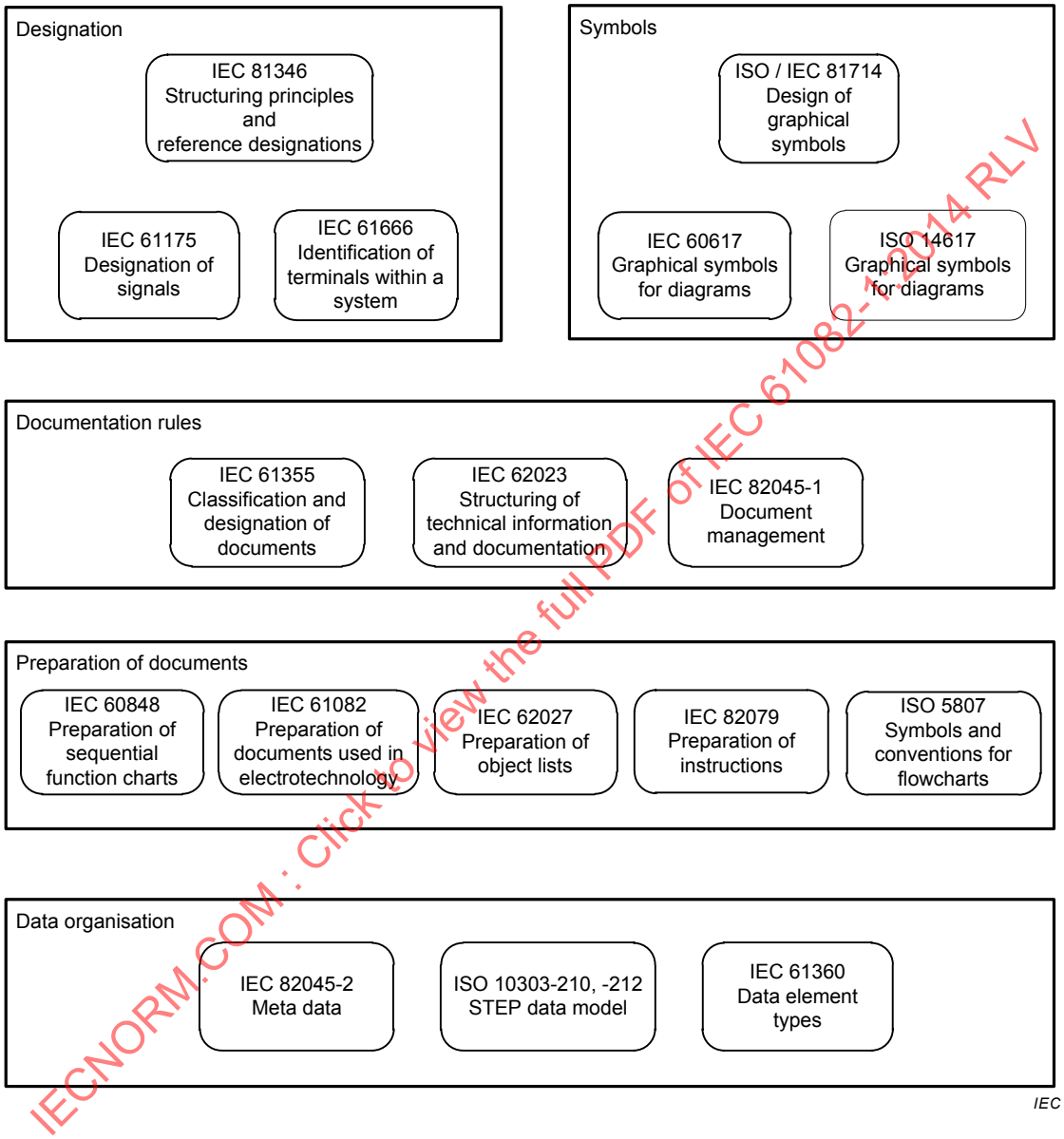


Figure 1 – Overview of standards related to the presentation of information in documents

Examples in this part of IEC 61082 are intended to illustrate a given rule and are not necessarily representative of complete documents.

PREPARATION OF DOCUMENTS USED IN ELECTROTECHNOLOGY –

Part 1: Rules

1 Scope

This part of IEC 61082 ~~provides~~ establishes general rules and guidelines for the presentation of information in documents, and specific rules for diagrams, drawings and tables used in electrotechnology.

Excluded from this part of IEC 61082 are rules and guidelines for all kind of audio or video or tactile presentations.

This horizontal standard is primarily intended for use by technical committees in the preparation of standards in accordance with the principles laid down in IEC Guide 108.

One of the responsibilities of a technical committee is, wherever applicable, to make use of horizontal standards in the preparation of its publications. The contents of this horizontal standard will not apply unless specifically referred to or included in the relevant publications.

2 Normative references

The following documents, in whole or in part are normatively referenced in this document and are indispensable for its application. 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 60375~~:2003~~, *Conventions concerning electric and magnetic circuits*

IEC 60757~~:1983~~, *Code for designation of colours*

IEC 60617~~-DB:-2001~~, *Graphical symbols for diagrams.* Available from: <http://std.iec.ch/iec60617>

IEC 60848~~:2002~~, *GRAFCET specification language for sequential function charts*

IEC 61175~~:2005~~, *Industrial systems, installations and equipment and industrial products- Designation of signals*

IEC 61286~~:2001~~, *Information technology – Coded graphic character set for use in the preparation of documents used in electrotechnology and for information interchange*

IEC 61293~~:1994~~, *Marking of electrical equipment with ratings related to electrical supply – Safety requirements*

~~IEC 61355:1997, *Classification and designation of documents for plants, systems and equipment*~~

IEC 61355-1:2008, *Classification and designation of documents for plants, systems and equipment – Part 1: Rules and classification tables*

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

~~IEC 61804-1:2003, *Function blocks (FB) for process and control – Part 1: Overview of system aspects*~~

~~IEC 61804-2:2004, *Function blocks (FB) for process and control – Part 2: Specification of FB concept and Electronic Device Description Language (EDDL)*~~

IEC 62023~~:2000~~, *Structuring of technical information and documentation*

IEC 62027~~:2000~~, *Preparation of object lists, including parts lists*

~~IEC 62079:2001, *Preparation of instructions – Structuring, content and presentation*~~

IEC 62491, *Industrial systems, installations and equipment and industrial products – Labelling of cables and cores*

~~IEC 61346-1:1996~~ IEC 81346-1, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules*

IEC 81714-2:~~1998~~ 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*

IEC 82045-1:2001, *Document management – Part 1: Principles and methods*

IEC 82045-2~~:2004~~, *Document management – Part 2: Metadata elements and information reference model*

IEC 82079-1, *Preparation of instructions for use – Structuring, content and presentation – Part 1: General principles and detailed requirements*

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

ISO 128-22~~:1999~~, *Technical drawings – General principles of presentation – Part 22: Basic conventions and applications for leader lines and reference lines*

ISO 128-30~~:2001~~, *Technical drawings – General principles of presentation – Part 30: Basic conventions for views*

ISO 2594~~:1972~~, *Building drawings – Projection methods*

ISO 3098-5~~:1997~~, *Technical product documentation – Lettering – Part 5: CAD- lettering of the Latin alphabet, numerals and marks*

~~ISO 5807:1985, *Information processing – Documentation symbols and conventions for data, program and system flowcharts, program network charts and system resources charts*~~

ISO 5455~~:1979~~, *Technical drawings – Scales*

~~[1] Published as a compilation in ISO Standards Handbook, Quantities and units.~~

ISO 5456-2:1996, *Technical drawings – Projection methods – Part 2: Orthographic representations*

ISO 5457:1999, *Technical product documentation – Sizes and layout of technical drawing sheets*

~~ISO 10209-1:1992, *Technical product ducumentation – Vocabulary – Part 1: Terms relating to technical drawings: general and types of drawings*~~

~~ISO 10628:1997, *Flow diagrams for process plants – General rules*~~

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

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

ISO 81714-1:1999, *Design of graphical symbols for use in the technical documentation of products – Part 1: Basic rules*

3 Terms and definitions

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

~~NOTE 1 In the definitions, terms that are defined elsewhere within this clause are shown in *italics*.~~

NOTE 0 provides further information on different document kinds.

3.1 Basic terms

~~**3.1.1**~~
~~**data medium**~~
~~material on which data can be recorded and from which data can be retrieved~~

~~[ISO/IEC 2382-1, definition 01.01.51]~~

3.1.1
document
fixed and structured amount of information intended for human perception that can be managed and interchanged as a unit between users and systems

Note 1 to entry: The term document is not restricted to its meaning in a legal sense.

Note 2 to entry: A document can be designated in accordance with the type of information and the form of presentation, for example overview diagram, connection table, function chart.

[SOURCE: ISO/IEC 8613-1:1994, 3.58, modified – Notes 1 and 2 to entry have been added.]

3.1.2
document kind
type of document defined with respect to its specified content of information and form of presentation

Note 1 to entry: Sometimes the term document type is used for the same concept.

[SOURCE: IEC 61355-1:2008, 3.~~56~~]

3.1.3
documentation
collection of documents related to a given subject

Note 1 to entry: This may include technical, commercial and/or other documents.

Note 2 to entry: The term subject may refer to objects in the sense of IEC 81346 or to other things to be addressed.

Note 3 to entry: A documentation can consist of documents, composite documents and document sets.

Note 4 to entry: The number and kinds of documents in a documentation can differ according to purpose.

[SOURCE: ~~IEC 62023, definition 3.2.2~~ IEC 61355-1:2008, 3.5]

3.1.4
database
collection of data organized according to a conceptual structure describing the characteristics of the data and the relationships among their corresponding entities, supporting one or more application areas

[SOURCE: ISO/IEC 2382-1:1993, 01.08.05]

3.1.5
hyperlink
active link from one place in a presentation to another place in the same presentation or in another presentation

Note 1 to entry: A hyperlink is only active when the presentation of the document is managed by a computer

Note 2 to entry: The hyperlink implies that a user can activate the link in order to get to the other point

3.1.6
object
entity treated in a process of ~~design, engineering, realization, operation, maintenance and demolition~~ development, implementation, usage and disposal

Note 1 to entry: The ~~entity~~ object may refer to a physical or non-physical "thing", ~~or to a set of information associated with it~~ i.e. anything that might exist, exists or did exist

Note 2 to entry: ~~Depending on its purpose, an object may be viewed in different ways called "aspects".~~ The object has information associated to it

[SOURCE: ~~IEC 61346-1~~ IEC 81346-1:2009, 3.1]

3.1.7
object designation
identifier of a specific object in a given context

Note 1 to entry: Examples of such designations are: reference designation, type number, serial number, name.

[SOURCE: IEC 61355-1:2008, 3.13]

3.1.8
reference designation
identifier of a specific object formed with respect to the system of which the object is a constituent, based on one or more aspects of that system

[SOURCE: ~~IEC 61346-1~~ IEC 81346-1:2009, 3.~~7~~11]

3.1.9
single-level reference designation
reference designation assigned with respect to the object of which the specific object is a direct constituent

Note 1 to entry: A single-level reference designation does not include any reference designations of upper level or lower level objects.

[SOURCE: ~~IEC 61346-1~~ IEC 81346-1:2009, 3.~~8~~12]

3.1.10
reference designation set
~~set of~~ collection of two or more reference designations assigned to an object of which at least one unambiguously identifies this object ~~of interest~~

~~NOTE Other members of the set need not necessarily identify the object of interest but other objects of which it is a constituent.~~

[SOURCE: ~~IEC 61346-1~~ IEC 81346-1:2009, 3.~~10~~14]

3.1.11
product
intended or accomplished result of labour, or of a natural or ~~industrial~~ artificial process

[SOURCE: IEC 81346-1:2009, 3.6]

3.1.12
component
~~industrial product which serves a specific function or functions, which is not decomposable or physically divisible in the considered context and which is intended for use in a higher order assembled product~~
product used as a constituent in an assembled product, system or plant

[SOURCE: IEC 81346-1:2009, 3.7]

3.2 Terms related to the forms of presentation of information

3.2.1
drawing form
presentation of information using graphical means

3.2.2
pictorial form
presentation of information using images or geometrically absolute depictions irrespective of the actual perspective used

Note 1 to entry: Pictorial forms can be two- or three-dimensional.

3.2.3
textual form
presentation of information using words and numerals

~~3.3 Terms related to basic document kinds~~

3.2.4
drawing
presentation mainly using the drawing form by showing, usually to scale, the objects and their relative position to each other

~~NOTE Plans, sections, cuts, sketches and views as defined in ISO 10209-1 are specific kinds of drawings.~~

3.2.5
diagram
presentation mainly using the drawing form and ~~in which graphical symbols are used to indicate the objects and their relationships~~ showing the functions of the objects composing a system and their interrelations using graphical symbols

~~[ISO 10209-1, definition 2.4, modified]~~

3.2.6
chart
graph
presentation mainly using the drawing form expressing the relationship between two or more variable quantities, operations or states

[SOURCE: ISO 10209-1:1992, 2.1, modified – "usually within a coordinate system" has been deleted and "operations or states" has been added.]

3.2.7
table
list
presentation in which the information is presented in columns and rows

Note 1 to entry: A list is a specific kind of a table.

Note 2 to entry: A presentation in a table cell can be of any form.

3.3 Terms related to specific document kinds

3.3.1
overview diagram
diagram providing a comprehensive view of an object with a low degree of detailing

3.3.2
function diagram
diagram providing information on the functional behaviour of an object

3.3.3
circuit diagram
diagram providing information on the interaction of the components of electric circuits together with information on physical connections

3.3.4
connection diagram
diagram providing information on the physical connections among components or units

3.3.5
equivalent-circuit diagram
function diagram providing information on an electric and/or magnetic behaviour model of an object

3.3.6
logic-function diagram
function diagram that predominantly uses symbols for binary logic elements

3.3.7
arrangement drawing
drawing providing information on the relative or absolute location of objects

3.3.8
connection table
table providing information on the physical connections among components or units

3.3.9
sequence chart
chart providing information on the succession of operations or status of the units of a system

3.3.10
time sequence chart
sequence chart with the time axis plotted to scale

4 Documentation principles

4.1 General considerations

Technical documentation is essential for the planning, design, manufacture, installation, commissioning, use, maintenance and demolition of a product or a system.

The purpose of the documentation is to provide information in the most appropriate form. In addition it is an essential means to proof and guarantee that safety, environmental and quality requirements related to a product or a system are met.

Technical documentation represents as significant a part of a contract as the supply of equipment, and constitutes an essential element of the after-sales processes.

4.2 Structure of documentation

In ~~IEC 61346-1~~ IEC 81346-1 it is stated that information on products and systems can be organised in tree-like structures. The structures represent the way in which an object is subdivided into constituent objects, for example the process into smaller processes or a product into sub-products.

In accordance with IEC 61355-1, a document should describe and be clearly related to relevant objects. The relationship of a document to the object described is normally given by use of the object designation as part of a document designation.

NOTE The object designation can be either a reference designation (for occurrence related documents) or a type designation (for type related documents). For further information see Clause 0.

The use of structure leads to hierarchy in the presentation of information, see IEC 62023. This means that information is presented in subsequent levels, each showing a different degree of details. For example, documents related to the object represented by the top node in a structure consist of overall information of the complete system, while documents related to the other objects represented in the structure consist of more detailed information of the constituents, see also Clause 0.

The structuring principles also support design and manufacturing based on division of labour or subcontracting. The manufacturer of a component provides all information necessary for the understanding and use of his delivery without taking care of external matters. The documentation for such component or subsystem can then be integrated in any system on the appropriate level of that system structure.

4.3 Presentation of information

The presentation of information, in a document shall be unambiguous and aimed at practical use. This implies that the same information may be presented in different documents applying the same or a different document kind. The information shall be consistent throughout all places of presentation.

When information is stored in a database independent from any form of presentation, this information can be made accessible by distinct views in the moment it is needed and in the form most suitable for the intended purpose, provided adequate tools are available applying the rules of this International Standard (see Figure 2).

Document kinds represent possible and predefined forms of presentations (see IEC 61355-1 and Annex C).

When information is stored dependent on a form of presentation, i.e. as a document, the rules of this International Standard applies when the document is being prepared, see Figure 3. The document could be prepared by means of a CAx-system or directly on paper or equivalent.

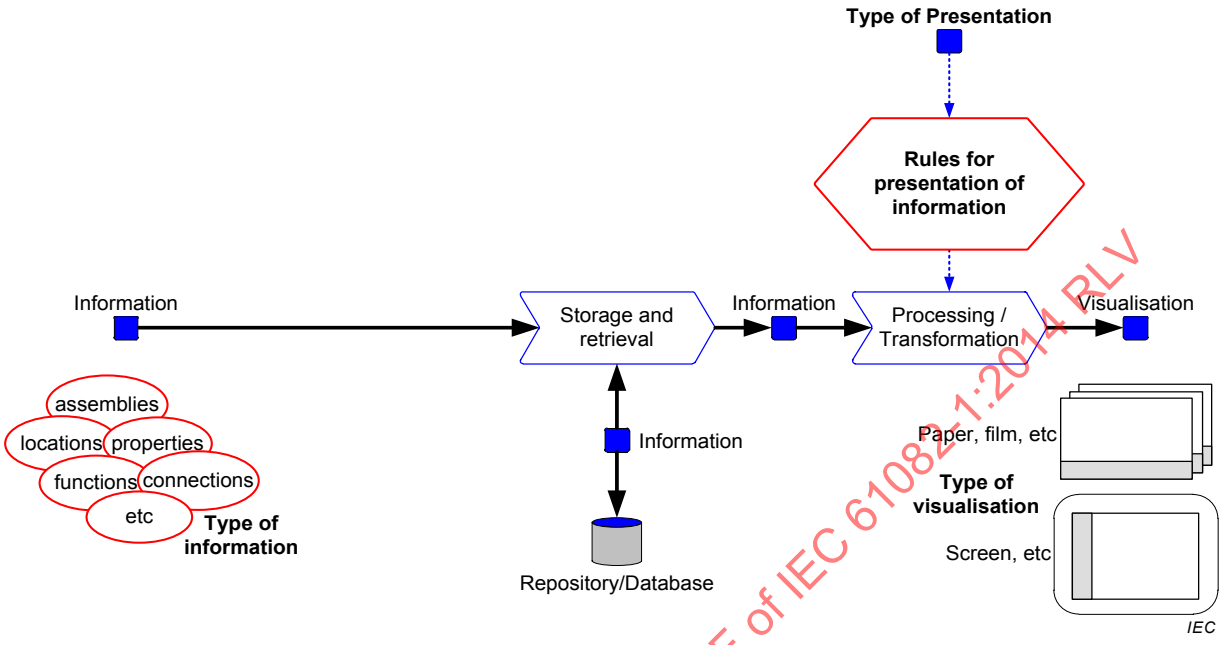


Figure 2 – Documents generated from information stored in a database

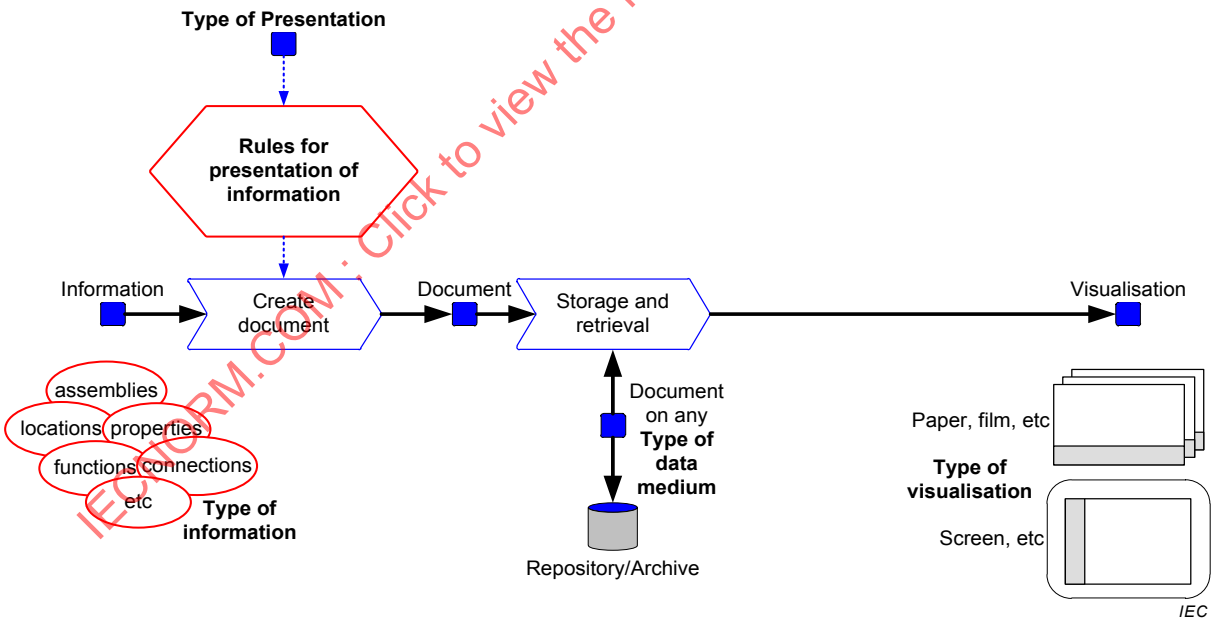


Figure 3 – Documents prepared and stored in a database

4.4 Document identification and designation

Each document shall be identified with at least one identifier, which shall be unambiguous within a given context. As a document may be unambiguously identified within several contexts, the valid context shall be explained in the document or in supporting documentation.

NOTE 1 The context in which a document identifier is valid could be indicated by stating:

– the organization responsible for that document identifier, e.g. the company preparing the document;

– the internationally recognized document or article numbering system, e.g. ISBN, ISSN, EAN, UPC.

In order to relate parts of the documentation to the described objects, a document may be designated in accordance with IEC 61355-1:2008, Clause 5.

NOTE 2 ~~IEC 61355 requires an object designation and document classification code (DCC) as part of the document designation.~~ In accordance with IEC 61355-1, a document designation consists of the parts "object designation" and "document classification code (DCC)". An object designation as described in IEC 61355-1 is either a reference designation in accordance with ~~IEC 61346-1~~ IEC 81346-1 or any other unambiguous identifier.

If the object designation is not a reference designation, it shall be clearly distinguishable from any reference designation.

5 Rules for presentation of information

5.1 Legibility

Whenever information is presented to a user, the presentation shall be legible under the intended conditions of use. The legibility depends on:

- the used forms of presentation and their combinations;
- the arrangement of symbols in relation to each other;
- how the presentation is split into different pages;
- the sizes of a page, see 0;
- the foreseen size modifications of a page;
- the use of simplification techniques, see 0, 0 and 0;
- the use of hyperlinks, see 0;
- the use of static or dynamic presentations;
- the used medium for information presentation, for example paper or screens.

The information can be presented by combinations of:

- symbols, see 0 and 0;
- lines, see 0, 0, 0 and 0;
- text and text strings, see 0, and 0;
- pictures, see 0;
- outlines of objects;
- colours, shading and patterns, see 0.

5.2 Text orientation

A text within a document shall be oriented horizontally or vertically and intended to be read from the bottom edge or from the right-hand edge, see Figure 4.

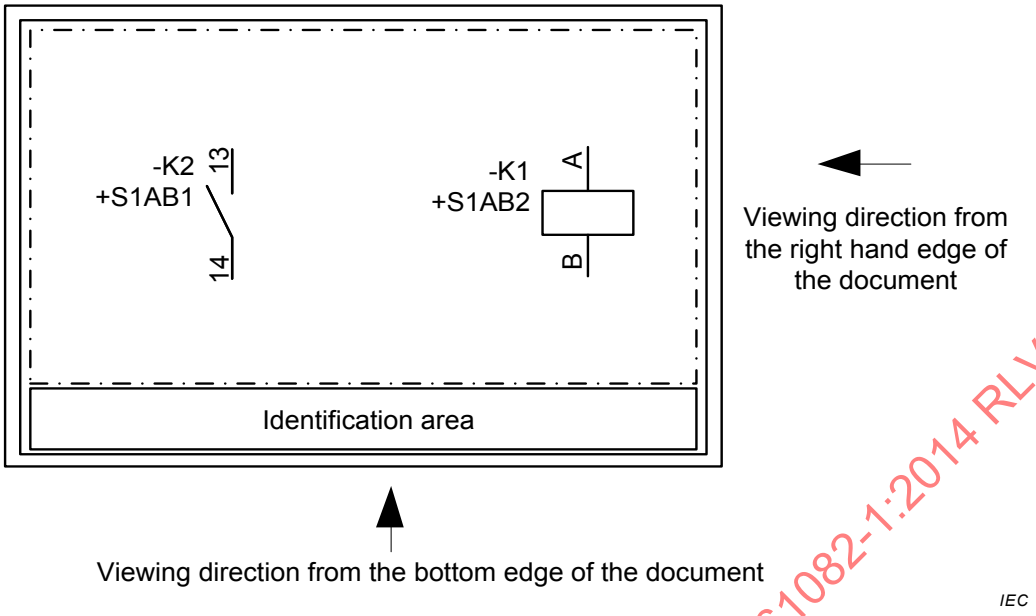


Figure 4 – Viewing directions of a document

5.3 Colours, shading and patterns

Colours should be used only as complementary information. Perception of different colours shall not be the only means for understanding presentations.

NOTE The uses of colours for specific purposes are given in ISO 3864-1, IEC 60204-1, and IEC 60073.

The meaning of the colours used shall be stated in the document or in supporting documentation.

Shadings and patterns may be used to differentiate various areas or surfaces. For documents on paper or equivalent media, the use of colours, shading and/or patterns should be usable for black and white printing.

5.4 Paper page sizes

The size of paper pages or equivalent shall conform to ISO 5457:1999, 3.1. Size A3 is recommended when mainly pictorial or diagram forms of presentation are used;

The elongated sizes defined in ISO 5457:1999, Clause 3 shall not be used.

5.5 Paper page reproduction

For documents on paper or equivalent media intended to be reproduced or microfilmed, centring marks complying with 4.3 of ISO 5457:1999 may be added to facilitate reproduction or microfilming.

5.6 Page identification

A document may consist of more than one page. In order to identify each page, for example for referencing purposes, a page identifier needs to be applied in addition to the document identifier. A single document page is identified by the combination of the document identifier and the page identifier. See Figure 5.

NOTE 1 The page counting number as described in IEC 61355-~~1, 7.2~~ can be used as such a page identifier which is related to a document designation code.

If a page of a document is associated with more than one document identifier, the page shall be given different page identifiers for the different document identifiers. See Figure 6.

NOTE 2 The page identifier related to different document identifiers can look the same.

The page identifier shall be presented adjacent to the document identifier with which it is associated (example, see Clause 0).

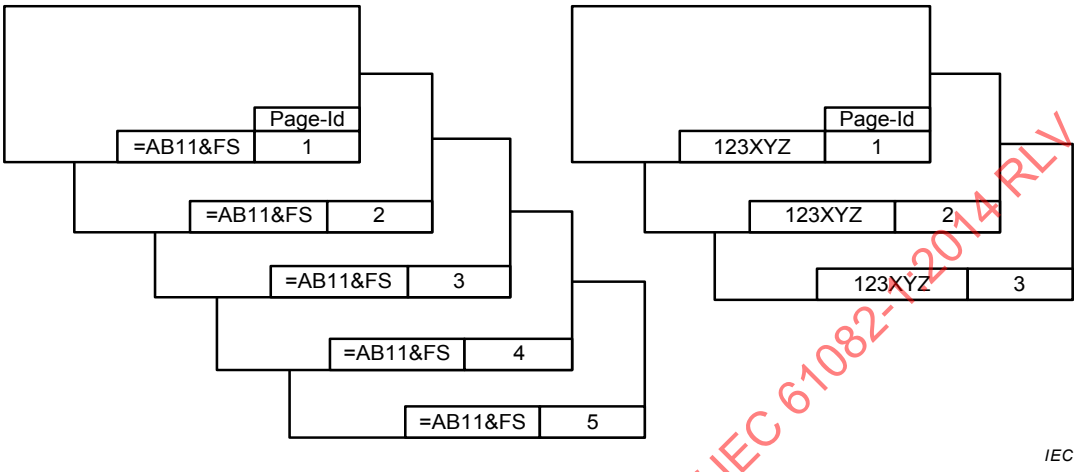
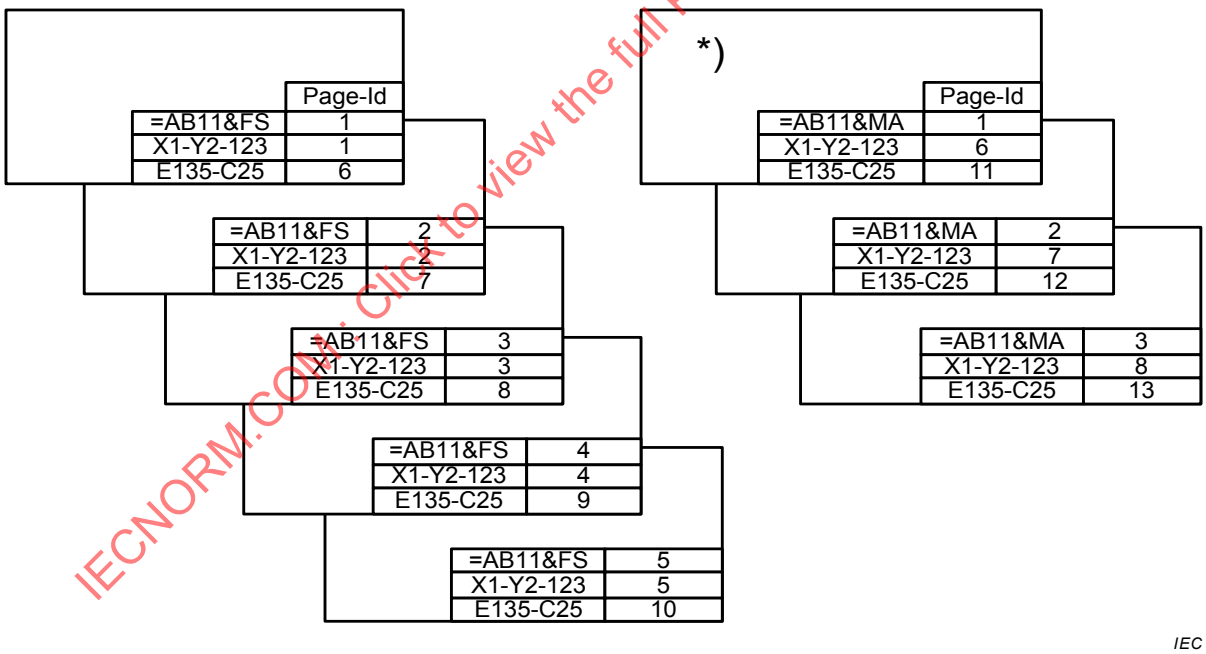


Figure 5 – Examples of documents with document and page identifications



Explanation for page marked with *)

Document designation (IEC 61355)	=AB11&MA page 1
Document number of the supplier	X1-Y2-123 page 6
Document number of the customer	E135-C25 page 11

Figure 6 – Example of documents with multiple document identifiers

5.7 Page layout

5.7.1 General

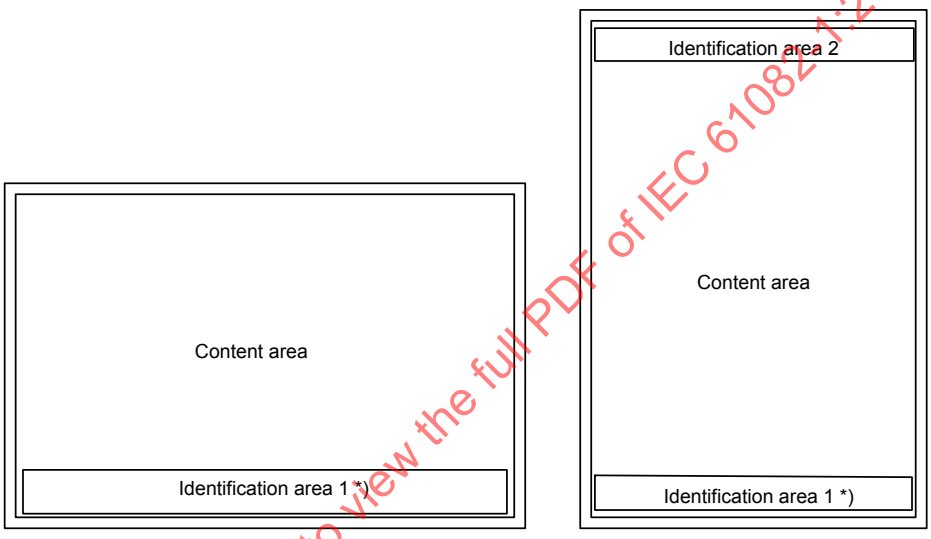
Pages may be portrait or landscape oriented.

A page is divided into:

- one or more identification areas (see 0); and
- one content area (see 0).

Each page of a document shall have at least one identification area clearly separated from the content area, for example by a frame.

Figure 7 shows examples of pages with one or more identification areas.



a) a landscape-oriented page with one identification area
b) a portrait-oriented page with two identification areas

Figure 7 – Examples of pages with defined identification areas

5.7.2 Identification area

5.7.2.1 General

The information to be presented in the identification area should contain document metadata relevant for the reader. The metadata should comply with IEC 82045-2.

Clause 0 lists an extract of the collection of metadata of IEC 82045-2 that should be considered for inclusion.

5.7.2.2 Identification area for documents using the drawing form of presentation

One identification area shall be located at the bottom of the page. Additional identification areas may be located along the other sides of the page, see Figure 7.

Within the identification area located at the bottom, the information related to the identification and classification of the document, for example a title block in accordance with ISO 7200,

shall be located in the ~~right~~ rightmost part of the identification area. Clause 0 shows an example of the layout of a title block.

Clause 0 shows examples of the location of the identification areas for different page sizes and orientations.

~~NOTE~~ Binder techniques and possible punching holes should be considered when locating the identification area and the information within an identification area.

5.7.3 Content area

5.7.3.1 General

The information on the object of interest shall be shown within the content area.

5.7.3.2 Module

The unit M is used as the module for harmonising graphical presentation of objects, for example reference grids, location reference systems, drawing grids, and symbol sizes.

The unit M should for paper presentations or equivalent take one of the following values in millimetres:

1,8 (2,0) mm; 2,5 mm; 3,5 mm; 5 mm; 7 mm; 10 mm; 14 mm; 20 mm.

It is recommended not to use a module size less than 2,5 mm. If the module size 1,8 (2,0) mm is used, special care should be taken to ensure the legibility of the document.

NOTE IEC 81714-2 specifies that the minimum module size for the design of graphical symbols is 2,0 mm instead of 1,8 mm.

For further information concerning scaling, modification of the module size, see IEC 81714-2.

5.7.3.3 Drawing grid

For the purpose of positioning of symbols, lines and text, content areas and identification areas may be provided with a drawing grid of 1M. This drawing grid is an auxiliary means when preparing the document and should not be visible or at least not disturb the reading of the content presented in the document version that is intended to be exchanged between parties.

For the value of M see 0.

5.7.3.4 Reference grid

For reference purposes, see 0, documents presenting information in pictorial or diagram form on paper or equivalent should have a reference grid in accordance with ISO 5457 with a grid size of 10M, 16M or 20M.

NOTE 1 The division of the rows and columns does not need to be equal e.g. the rows could be 20M each and the columns 16M each.

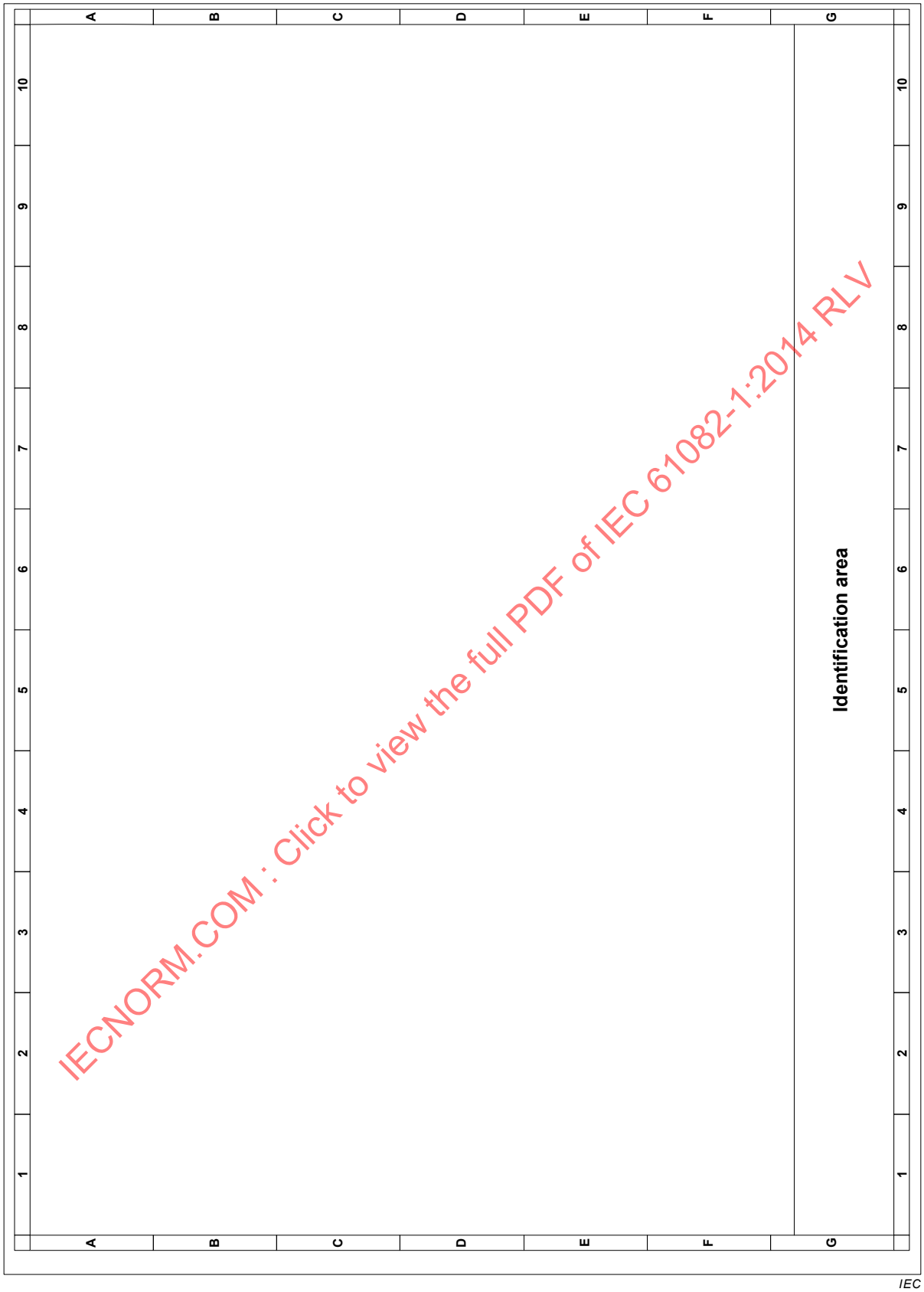
For the value of M see 0.

NOTE 2 For example if M is chosen to 2,5 mm, the reference grid will be 40 mm or 50 mm.

The grid numbering should start at the upper-left corner of the area of the page that is available for content area. For grid numbering purposes capital Latin letters A, B, C, ... excluding I and O, or numbers starting from 0 or 1 shall be used.

The rows of the grid should be identified by capital Latin letters ~~A, B, C, ... excluding I and O.~~ and the columns of the grid should be sequentially numbered ~~starting from 0 or 1,~~ (see Figure 8), or vice versa.

The grid numbering at one side of the page, for example at the shorter side, may be omitted if this is considered sufficient for referencing. It may also be considered sufficient to show the grid numbering at one side/two sides only and to omit its presentations at the opposite sides.



(Page A3 landscape, module size 2,5 mm, reference grid 16 M)

Figure 8 – Example of a reference grid

5.8 Cross-references

A cross-reference may refer to a document, to a page of a document or to a zone on a page. It shall be presented in the following sequence:

- Document
- Page
- Column, row or zone.

The document is identified in accordance with 4.4. If different document identifiers are presented on the document page and confusion is likely, it shall be clearly stated in the document or in supporting documentation which document identifier is used for cross-references.

A page is identified in accordance with 5.6 preceded by the character “SOLIDUS” (/).

A zone is identified by the sign “FULL STOP” (.) followed by the coordinates built in accordance with 5.7.3.4.

If confusion is likely, the cross-reference shall be included in square brackets [...] or brackets (...).

Examples:

=EA2=S1&FS/3.B2	:	Reference to zone B2 on page 3 of a document of type FS (i.e. a circuit diagram) describing the object =EA2=S1
ZAB&FS/3.B2	:	Reference to zone B2 on page 3 of a document of type FS (i.e. a circuit diagram) describing the object type ZAB.
XYZ123456/3.B2	:	Reference to zone B2 on page 3 of document XYZ123456
XYZ123456/3	:	Reference to page 3 of document XYZ123456
XYZ123456	:	Reference to document XYZ123456
[XYZ123456]	:	Reference to document XYZ123456 (if XYZ123456 could be misinterpreted otherwise)

If the reference is in the same document, the reference to the document may be omitted.

Examples:

&FS/3.B2	:	Reference to zone B2 on page 3 of a document of type FS (i.e. a circuit diagram) describing the same object
&FS	:	Reference to a set documents of type FS (i.e. circuit diagrams) of the same object
/3.B2	:	Reference to zone B2 on page 3 of the same presentation
/2	:	Reference to page 2
[/2]	:	Reference to page 2 (if /2 alone could be misinterpreted otherwise)

If the reference is in the same page, the reference to the document and page may be omitted. In this case, the row, column or zone identification shall be preceded by the character “SOLIDUS” /.

Examples:

/.B2	:	Reference to zone B2 on the same page
/.2	:	Reference to column 2 on the same page

Figure 9 shows examples of the application of cross-references.

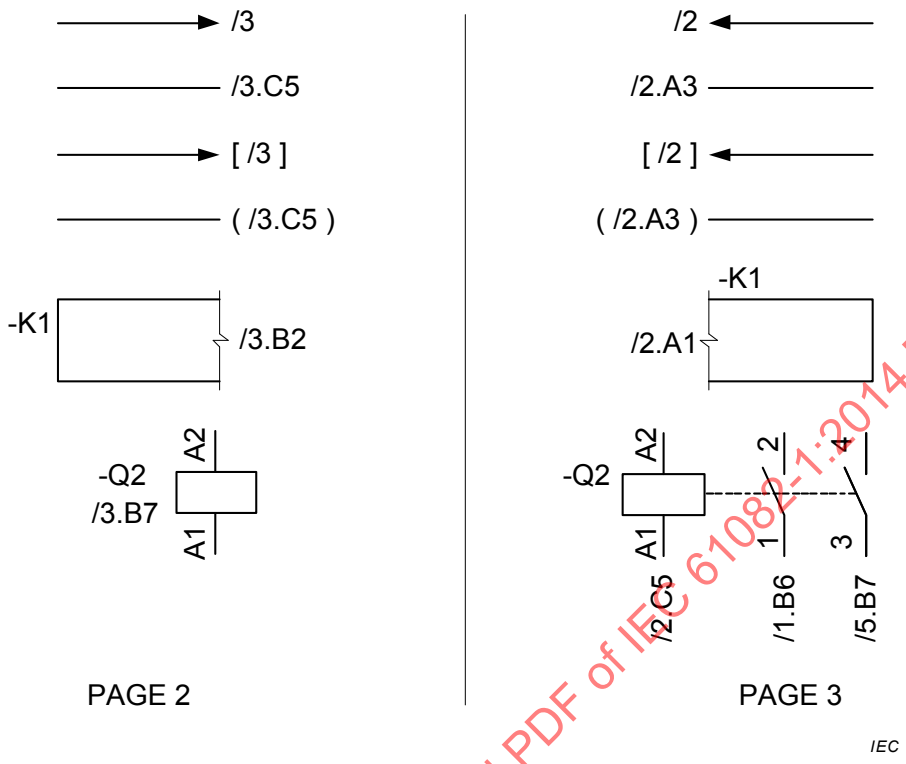


Figure 9 – Examples of the application of cross-references

5.9 Hyperlinks

Hyperlinks may be used as a means for improving the navigation between different sets of information, for example to positions in or to pages of a document, between documents or to external information sources.

The navigation shall not by itself be dependent on the functioning of hyperlinks.

Consequently, the basic navigation within a document needs to be possible, for example via content lists, indexes, explicit page or section references.

Hyperlinks may also be used for linking documents or document parts that constitute a document. However, special care should be taken when the document is under version control, see IEC 82045-1:2001, 4.5.

5.10 Line widths

For drawings the possible line widths are derived from: $0{,}1 \times \left(\sqrt{2}\right)^n \times \mathrm{M}$, with n = 0, 1, 2, 3, ...

For the value of M see 5.7.3.2.

~~NOTE 1~~ EXAMPLE If M is chosen to 2,5 mm, the line width would be 0,25 mm, 0,35 mm, etc.

NOTE 1 For presentation on paper or equivalent media the possible line widths are 0,18 mm (0,2 mm), 0,25 mm, 0,35 mm, 0,5 mm, 0,7 mm and 1,0 mm.

If two or more lines of the same line type but with different widths are used, the ratio between these line widths shall be at least 2:1.

NOTE 2 ISO 6428 provides rules for micro copying of presentations that ~~may~~ can have influence on the choice of line widths.

5.11 Text fonts

For presentations in drawing form, the lettering type CB, vertical (V) of ISO 3098-5 should be used. Both tabular and proportional lettering in accordance with ISO 3098-5 may be used. In addition the following rules apply in this case:

- The character spacing factor should be zero, see E.2.7 of IEC 81714-2:2006. When tabular lettering is used the character aspect ratio should be 0,81 in accordance with 6.7.2 of IEC 81714-2:2006.
- The text height is derived from: $(\sqrt{2})^n \cdot M$, with n = 0, 1, 2, 3, ... For the value of M see 5.7.3.2.

  ~~NOTE 1~~ EXAMPLE If M is chosen to 2,5 mm, the text height would be 2,5 mm, 3,5 mm, etc.

  NOTE For presentation on paper or equivalent media the possible ~~line widths~~ text heights are 1,8 mm, 2,5 mm, 3,5 mm, 5,0 mm, 7,0 mm and 10,0 mm.
- Sloped (inclined) lettering (also called *Italic*), type CB (S) of ISO 3098-5, may be used for letter symbols for quantities, see Figure 62 and Figures A.7, A.8, A.9.
- If another text font than one of the lettering types of ISO 3098-5 is used, the text font of characters shall be ~~in line with~~ scalable and distinct, similar to the stroke style presented in ISO 3098-5.
- For documents intended to be exchanged between CAx-systems the rules of IEC 81714-2 shall be considered.

5.12 Symbols

5.12.1 Choice of symbols

Symbols shall conform to relevant IEC, ISO or IEC/ISO standards, for example:

- IEC 60617 for electrical objects in diagrams and installation drawings
- ISO 14617 for non-electrical objects in diagrams
- ISO 5807 for basic flow charts

also taking ISO 81714-1 into consideration.

Symbols that depict functions may be used independent of technology, for example fibre optics may use symbols from IEC 60617. See Figure 10.

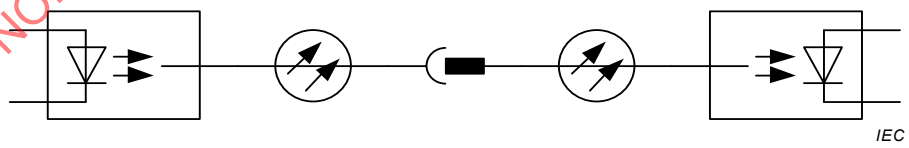


Figure 10 – Example of the use of symbols for fibre optics

Symbols to be used in CAx-applications shall in addition conform to IEC 81714-2.

When symbols have alternative forms, the forms appropriate to the purpose of the presented information shall be chosen.

When an appropriate symbol does not exist, either the general symbols S00059, S00060 or S00061 in IEC 60617 shall be applied, or a symbol may be constructed following the rules of IEC 60617 and ISO 81714-1, see also the normative Annex A.

A symbol may be replaced by one of the general symbols S00059, S00060 or S00061 in IEC 60617 with:

- the considered symbol inscribed as a qualifying symbol in the general symbol; or
- a describing text inscribed in the general symbol.

See also 5.12.2 and Figure 11.

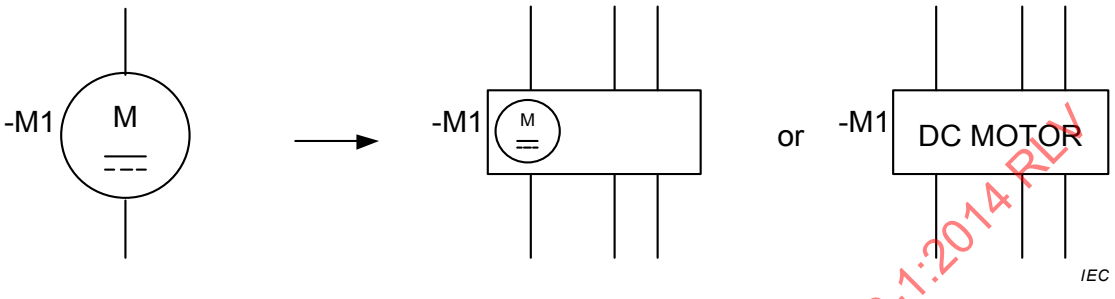


Figure 11 – Example of replacing a symbol with a general symbol

5.12.2 Symbol size

The meaning of a symbol is ~~defined~~ conveyed to the reader by its shape and by its content. The size and line thickness does not affect the meaning.

The symbols in IEC 60617 are shown on a grid pattern with a module M to specify symbol proportions. Symbols used in documentation should preferably retain the same size related to the module M.

A symbol may be enlarged, reduced or replaced by one of the general symbols S00059, S00060 or S00061 in IEC 60617 with qualifying symbol, in order to:

- increase the number of inputs or outputs;
- facilitate the inclusion of additional information;
- emphasise certain aspects;
- facilitate the use of a symbol as qualifying symbol or
- suit the scale of a drawing, plan or map.

When enlarged or reduced the general shape of the symbol shall be maintained, see also Figure 12.

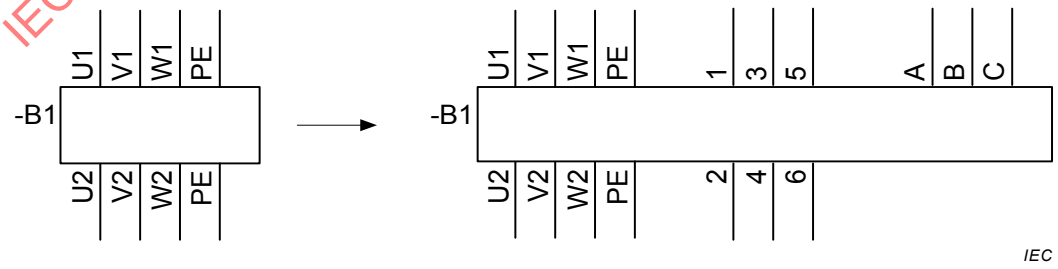


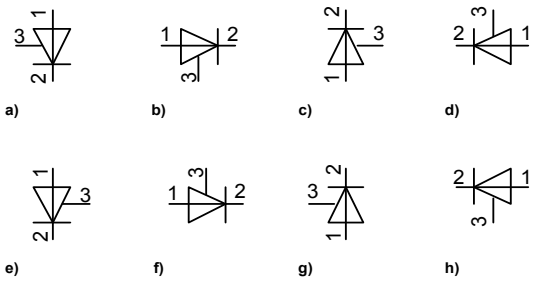
Figure 12 – Example of enlarging a symbol

5.12.3 Orientation of symbols

Symbols should be shown to support the chosen principal direction of flow in the diagram. When the orientation of a symbol to be placed in the diagram thereby deviates from the

orientation the symbol has in the symbol standards, the symbol taken from the symbol standard, may be turned or mirror-imaged if the meaning thereby will not be changed, see Figure 13. In some cases it may be necessary to redesign the symbol following the rules of ISO 81714-1.

Letters, graphs or input/output labels of symbols shall be oriented ~~horizontally or vertically and intended to be read~~ individually, separate from the orientation of the symbol, so that the final reading direction is from the bottom edge or from the right-hand edge of the page, see Figure 13.



~~NOTE~~ The symbol in position a) is as the symbol is shown in IEC 60617. The positions b), c) and d) are obtained by turning the symbol in step of 90° anti-clockwise. The positions e), f), g) and h) are obtained by mirroring the symbols in position a), b), c), and d) by the horizontal axis respectively.

Figure 13 – Turning and/or mirroring of symbol S00055 in IEC 60617

5.13 Scales

For information presented to scale, the scale should be chosen in accordance with ISO 5455.

A scale bar may be included for information purposes, and shall then be shown in the content area.

5.14 Pictorial presentation

Information in two-dimensional pictorial forms shall be presented in accordance with ISO 128-30 following the orthographic projection method in accordance with ISO 5456-2.

For information on buildings in two-dimensional forms, the rules in ISO 2594 apply.

5.15 Quantities, units, values and colour codes

Quantities, units and values should be represented by letter symbols in accordance with IEC 60027, IEC 80000 or other appropriate IEC standards for letter symbols. For items ~~outside the scope of IEC, ISO 31~~ not covered by IEC standards, ISO 80000 should be considered. Examples of the application of letter symbols are shown in Clauses A.3 and A.4.

Codes for designation of colours shall be in accordance with IEC 60757.

5.16 Presentation of ranges and set of elements

A range representing an infinite number of values shall be presented by using the "HORIZONTAL ELLIPSIS" character … (three dots) between the lower and upper limits.

NOTE 1 The parenthesis shown in the following are not part of the character sequence.

EXAMPLE 1 The range 1 A to 5 A can be written: 1 A … 5 A.

A set of elements, i.e.an integer number of elements, shall be presented using:

- the character “COMMA” and “SPACE” (,) between each element of the set; or
- the characters “COMMA”, “SPACE”, “HORIZONTAL ELLIPSIS”, “COMMA” and “SPACE” (, …,) between the lower and upper limits when the set consists of numbers and the increment is one; or
- the characters “COMMA”, “SPACE”, “HORIZONTAL ELLIPSIS”, “COMMA” and “SPACE” (, …,) between the lower and upper limits when the set consists of consecutive ascending letters of the Latin alphabet;
- the characters “COMMA”, “SPACE” and “HORIZONTAL ELLIPSIS” (, …) after the lower limit when the upper limit is undefined and the increment is one;
- the characters “HORIZONTAL ELLIPSIS”, “COMMA” and “SPACE” (…,) before the upper limit when the lower limit is undefined and the increment is one.

EXAMPLE 2:

- The numerical set of elements 1, 2, 3, 4, 5 and 6 can be written 1, …, 6.
- The numerical set of unlimited elements starting from 25 can be written 25, …
- The numerical set of unlimited elements ending with 25 can be written …, 25
- The alphabetical set of elements C, D, E, F and G can be written C, …, G
- The alphabetical set of elements a, b, c, d and e can be written a, …, e

Combinations of upper–case and lower–case letters in a set of elements, for example A, …, c shall not be used, due to their possible ambiguous interpretation.

NOTE 2 Upper–case letters I and O are not used, neither in reference designations in accordance with ~~IEC 61346-1~~ IEC 81346-1 nor in terminal designations in accordance with IEC 60445~~, IEC 60446~~ and IEC 61666. This implies that in such cases the upper–case letter J follows the upper–case letter H, and the upper–case letter P follows the upper–case letter N.

If a set of numerical elements are prefixed or suffixed by the same letter the elements may be presented as for a numerical set of elements.

EXAMPLE 3

- The set of elements 1U, 2U, 3U, 4U can be written 1U, …, 4U
- The set of elements R2, R3, R4, R5 can be written R2, …, R5

If a set of alphabetical elements are prefixed or suffixed by the same number the elements may be presented as for an alphabetical set of elements.

EXAMPLE 4

- The set of elements 1U, 1V, 1W, 1X, 1Y, 1Z can be written 1U, …, 1Z
- The set of elements R2, S2, T2, U2, V2 can be written R2, …, V2

Elements of a non-consecutive order may be represented within a sequence. In this case, the representation of the different elements shall be separated by using the character “COMMA” (,) for example 1, 3, 6. If confusion is likely, the group shall be enclosed in parentheses, for example (1, 3, 6).

A group of elements may also be represented as a set of elements.

EXAMPLE 5 The set of elements 1, 8, 9, 10, 11, 12, 14, A, B, C and D can be written 1, 8, …, 12, 14, A, …, D

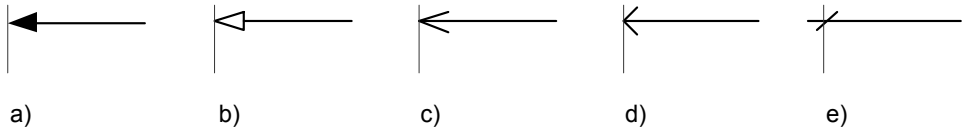
If computer-supported systems are used in presenting information the horizontal ellipsis shall be realised either as:

- a sequence of three characters “FULL STOP” .; or
- a single character “HORIZONTAL ELLIPSIS” … as specified in IEC 61286.

NOTE 3 The rules of 5.16 have been derived from ISO 31-11.

5.17 Dimension lines

Dimension lines including their terminators and the indication of the origin shall be in accordance with ISO 129. Examples of terminators are shown in Figure 14. The choice of the arrowheads in Figure 14 a) to d) has no significant meaning, and only one type should be used within a document.

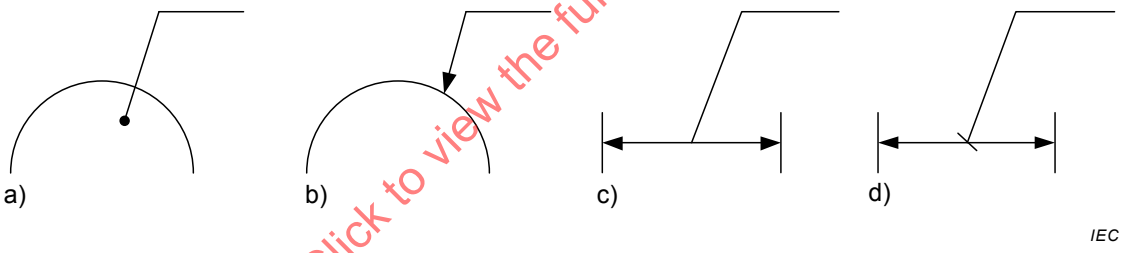


a) Arrowhead, closed and filled 30°
b) Arrowhead, closed 30°
c) Arrowhead, open 30°
d) Arrowhead, open 90°
e) Oblique stroke

Figure 14 – Terminators of dimension lines (from ISO 129)

5.18 Leader lines and reference lines

Leader lines and reference lines shall be presented in accordance with ISO 128-22. Examples are shown in Figure 15.



a) Leader line terminating in an object
b) Leader line terminating on an object
c) Leader line terminating on a line
d) Leader line with a stroke terminating on a line

Figure 15 – Examples of leader lines (from ISO 128-22)

Leader lines ending on a connecting line shall be terminated with an oblique stroke at the connecting line, see Figure 16.

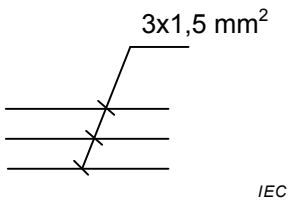


Figure 16 – Example of the use of leader lines to connecting lines

5.19 Explanatory notes and markings

An explanatory note should be used when the meaning cannot otherwise be conveyed. It should be placed adjacent to where it applies, or a reference should be made to a note placed elsewhere in the content area, see Figure 17. In the case of multi-page presentation of information, all notes of a general character should appear on the first page(s).

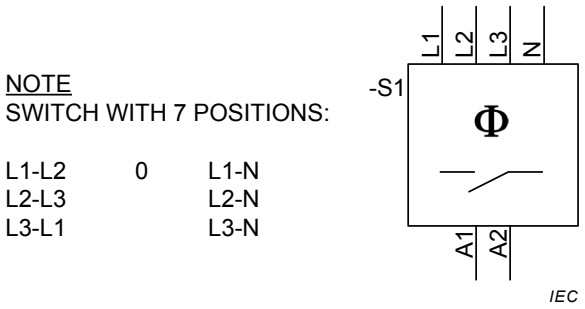


Figure 17 – Example of an explanatory note

If informative markings (for example graphical symbols in accordance with IEC 60417) for man-machine control functions appear on an equipment panel, these same markings should appear adjacent to the corresponding graphical symbol in the ~~underlying~~ related presentation of information in documentation. If the reference direction of the current in a branch, the indication of magnetic flux direction, the reference polarity of voltage, and the correspondence between the voltage polarities of coupled electric circuits, is needed to be shown, the ~~principles of~~ presentation methods shown in IEC 60375 shall be applied.

5.20 ~~Reference designations~~ Designation of objects

5.20.1 General

~~For objects having a reference designation or a reference designation set in accordance with IEC 61346-1, at least one unambiguous reference designation shall be shown at each representation of the object.~~

For objects having an object designation this shall be consistently shown at each representation of the object.

The ~~reference~~ object designation shall be readable from the bottom edge of the page. In diagrams, object designations should be located above or to the left of the object representation, see IEC 81714-2 for further details. In other document kinds the object designation shall be clearly related to the object representation with the requirement not to interfere with other presentation elements shown in the document.

~~A reference~~ An object designation shall be presented on a single line (not split to several lines).

5.20.2 Reference designations

Reference designations in accordance with IEC 81346-1 are object designations for which the requirements provided in 5.20.1 apply.

For ~~the presentation of~~ objects having a reference designation set in accordance with IEC 81346-1, the following applies (see Figure 18):

- the reference designation set may be presented on a single line or on successive lines;
- if the reference designations are presented on successive lines, each reference designation shall start on a separate line;

- if more than one reference designation is presented on the same line, and if not clearly separated for example as in a table, the character SOLIDUS (/) shall be used as separator sign between the different reference designations;
- the order of the presented reference designations in a reference designation set has no significant meaning;
- At least one unambiguous reference designation out of the set shall consistently be shown at each representation of the object.

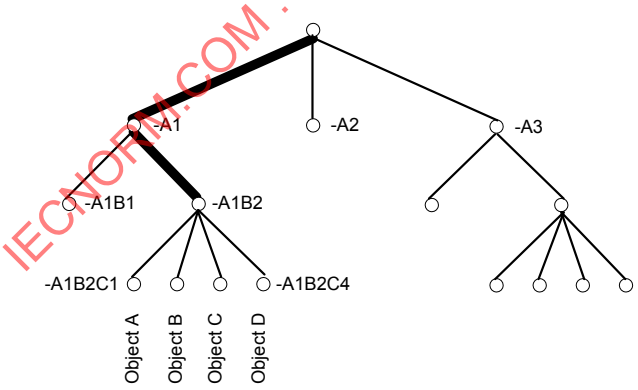
	Reference designations	Possible graphical presentations	
		All presented on the same line	Each presented on one line
Three reference designations in one reference designation set	=A1 -B2 +C3	=A1/-B2/+C3	=A1 -B2 +C3
One reference designation in one reference designation set	=D4-E5+F6	=D4-E5+F6	=D4-E5+F6
Two reference designations in one reference designation set	=G7-H8 +J9	=G7-H8/+J9	=G7-H8 +J9

IEC

Figure 18 – Presentation of reference designations and sets of reference designations

5.20.3 Simplified presentation

A reference designation in accordance with ~~IEC 61346-1~~ IEC 81346-1 is the representation of a path in a tree-like structure. Different objects may therefore have a common initial portion because they are constituents of the same object, including at least one single-level reference designation, of their paths starting from the top of the structure tree, see Figure 19.



The common initial portion of the reference designation for the objects A, B, C and D is -A1B2

IEC

Figure 19 – The common initial portion of reference designations

If all objects shown on a page of a document have a reference designation with a common initial portion, this portion may be presented once at a defined place, depending on the kind of document, in the content area of a document page and shall not be shown in any of the identification areas of the document. (See also 7.1.6)

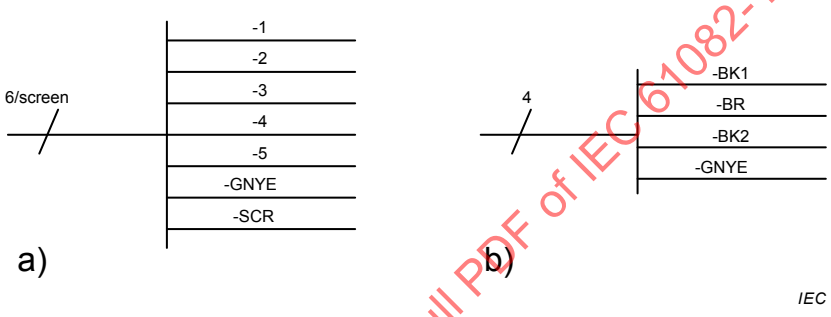
In a series of reference designations, a single level of the reference designations may be presented applying the rules for presentation of set of elements as specified in 5.16, with the indicated set of elements enclosed in parentheses. The complete single level reference designation shall be presented at both the lower and upper limit of the set of elements.

Examples:

- -A2C4F1, -A2C4F2, -A2C4F3 and -A2C4F4 being presented as -A2C4(-F1, ...,-F4)
- =B2-C1, =B2-D3, =B2-F5 being presented as =B2(-C1,-D3,-F5)
- =Q3=1=H1, =Q3=2=H1, =Q3=3=H1 and =Q3=4=H1 being presented as =Q3(=1, ..., =4)=H1

5.20.4 Cable core designations

Cable cores should be identified by their reference designation, for example core numbers or core colour codes, provided by the cable manufacturer, see Figure 20.



a) Cable with numbers printed on the cores, one core marked with colour, and with a concentric lead

b) Cable with colour-marked cores, two cores black

Figure 20 – Examples of cable core designations

If no core identifier is provided by the cable manufacturer, a reference designation for the core should be applied.

NOTE Cables per se are designated in accordance with 5.20.1 and 5.20.2

5.21 Terminal designations

Terminal designations shall be applied in accordance with IEC 61666.

5.22 Signal designations

Signal designations shall be applied in accordance with IEC 61175.

6 Document kinds

This International Standard provides rules for the presentation of four different basic document kinds for electrotechnology:

- Diagrams, see Clause 7;
- Drawings, see Clause 8;
- Tables (lists), see Clause 9.
- Charts and graphs, see Clause 10.

For each basic document kind, more specific rules are provided for specific document kinds to the extent that is necessary for the presentation of these.

Annex C provides a list of specific document kinds with indication of their minimum content and additional content of information to be provided.

For other specific document kinds, relevant IEC and ISO publications exist, for example:

- IEC 60848 for sequential function charts;
- IEC 61131-3 for graphical representations of programming languages for programmable controllers;
- IEC 62027 for parts lists;
- IEC ~~62079~~ 82079-1 for instructions for use;
- IEC/TS 61804-1 and IEC/PAS 61804-2 for the description of function blocks;
- ISO 5807 for flow charts for information processing;
- ISO ~~10628~~ 15519-1 for diagrams in process industry (e.g. process flow diagram, piping and instrumentation diagram).

7 Diagrams

7.1 General

7.1.1 Flow of energy, signal, etc.

If the direction of a flow, for example of a signal, is of importance and is not obvious, the corresponding connecting line shall be provided with arrowheads (symbol S00099 in IEC 60617 (2001-07)). See Figure 21.

NOTE The use of signal classification code as per IEC 61175 ~~may~~ can also provide information on the flow direction.

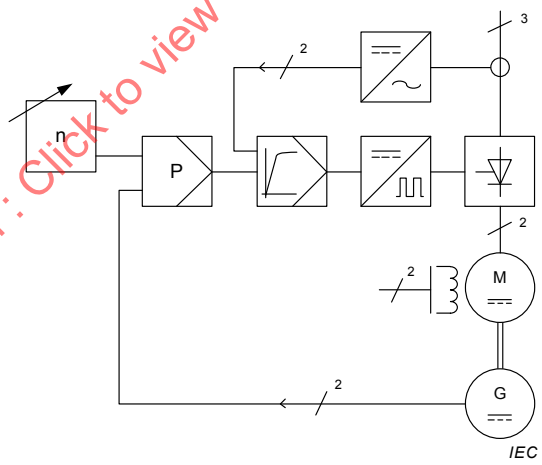


Figure 21 – Example of functional grouping and signal flow directions; a control system

Different flow paths, for example for information, control, energy, and material flow, shall be clearly distinguished and recognizable.

7.1.2 Symbols

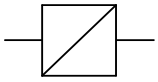
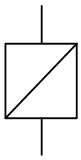
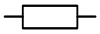
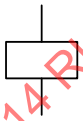
7.1.2.1 Choice of symbols

Symbols shall conform to IEC 60617. For objects outside the scope of IEC 60617, symbols of ISO 14617 should be considered.

NOTE When choosing a symbol representing a component with movable parts, the rule given in 7.4.4.1 applies.

7.1.2.2 Connect nodes

Symbols shall be provided with the appropriate number of connect nodes. The connect nodes shall be positioned on the 1M or 0,5M grid (see ISO 81714-1:2010, 6.11). For standardized symbols that are associated with connect nodes and/or terminal lines (e.g. as in IEC 60617) the position of the connect nodes and terminal lines may be changed as long as the meaning of the symbol is not changed. See Figure 22.

Symbol where different locations of connections do not affect the meaning		**Symbols where the location of connections may affect the meaning** (neglecting the proportions of the symbols)	
			
Symbol S00213 in IEC 60617 (2001-07), Converter, general symbol		Symbol S00555 in IEC 60617 (2001-07), Resistor	Symbol S00305 in IEC 60617 (2001-07), Operating device

IEC

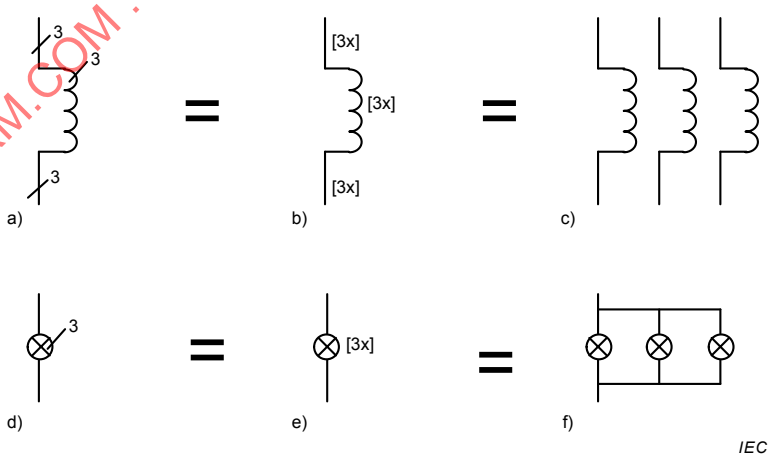
Figure 22 – Example of symbols and different location of connections

7.1.2.3 Simplified presentation

7.1.2.3.1 Identical symbols in a group

A number of identical symbols in a group may be represented by a single symbol, using one of the following methods:

- the single symbol should be provided with a short oblique stroke and a figure indicating the number of symbol elements represented by the single symbol (see Figure 23a) and Figure 23d)); or
- the represented number of symbols by the single symbol should be indicated by a figure followed by a multiplication sign within square brackets, for example [3×] (see Figure 23b) and Figure 23e)).



a) Three independent circuits using an oblique stroke
b) Three independent circuits using the multiplication sign
c) Three independent circuits, complete presentation
d) One circuit with three objects using an oblique stroke
e) One circuit with three objects using the multiplication sign
f) One circuit with three objects, complete presentation

Figure 23 – Simplified presentation

7.1.2.3.2 Parallel connected objects

If identical objects are connected in parallel, they may be simplified presented following the rules in 7.1.2.3 and with the reference designations presented at the symbol shown following the rules for presentation of set of elements in 5.16, see Figure 24. The terminal designations shall be presented at the symbol shown.

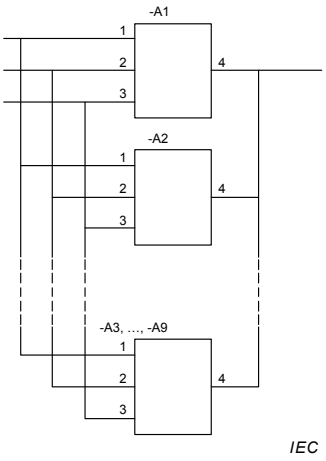


Figure 24 – Simplified presentation of parallel connected identical objects

7.1.2.3.3 Serial connected objects

If identical objects are connected in series and the internal connections among the objects are obvious, they may be simplified presented by showing the symbol for the first and the last symbol of the objects and with a dotted line in between. The reference designations of the objects shall be shown following the rules for presentation of set of elements in 5.16, see Figure 25. The terminal designations shall be presented at the symbols shown.

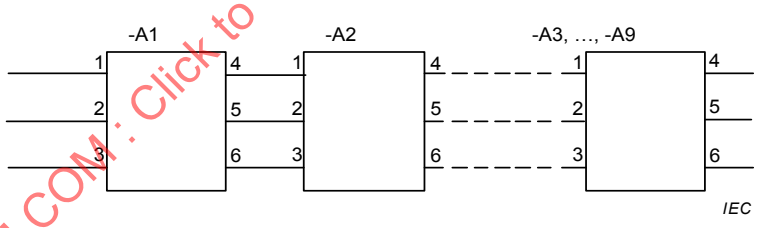


Figure 25 – Simplified presentation of serial connected identical objects

7.1.2.4 Presentation of cross-references related to detached presentations

Cross-references associated with a symbol applying detached representation (see 7.4.3.3) shall be shown adjacent to that symbol. They should be located above the symbol and to the right of the reference designation, when it is shown with mainly horizontal terminal lines or to the left of the symbol and below the reference designation when it is shown with mainly vertical terminal lines. For detailed rules related to symbols used in CAx-systems, see IEC 81714-2.

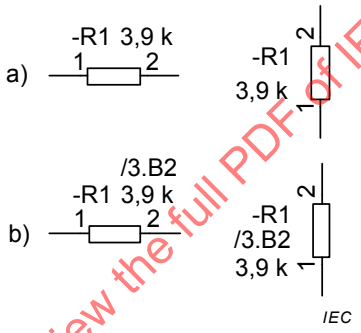
A cross-reference shall not be presented immediately above or to the left of the reference designations presented. See Figure 26.

Figure 26 – Example of cross-references related to detached presentations

7.1.2.5 Presentation of technical data

Technical data associated with the object represented by a symbol shall, if presented, be shown adjacent to that symbol. They shall be located above the symbol when it is shown with mainly horizontal terminal lines or to the left of the symbol when it is shown with mainly vertical terminal lines.

The technical data shall be presented below or to the right of the reference designations presented. See Figure 27.



a) symbol with technical data

b) symbol with cross-reference and technical data

Figure 27 – Example for technical data associated with a symbol

If the meaning of the symbol will not be changed, technical data may also be shown inside the symbol outline. See Figure 28.

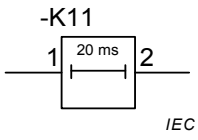


Figure 28 – Example of technical data shown inside a symbol

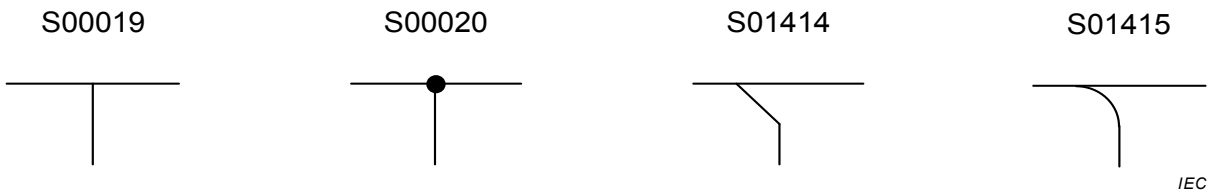
7.1.3 Connecting lines

7.1.3.1 Electrical or functional interconnections

Connecting lines shall be in accordance with symbol S00001 in IEC 60617 (2001-07).

NOTE Symbol S00001 is a continuous line.

When two lines are joined at a specific point, the junction shall be in accordance with symbols S00019, S00020, S01414 or S01415 in IEC 60617 (2001-07), see Figure 29.



~~NOTE 2~~ Symbols S00019 and S00020 provide information that the interconnections exist but not their location. Symbol S01414 indicates ~~that there are two physical electrical interconnections being presented by one connecting line, indicating the direction of the electrical interconnection that enters~~ two physical interconnections that are to be attached to the same terminal (not shown) on the left side. Symbol S01415 is used for graphical bundling indicating the direction of the bundle that enters.

Figure 29 – Symbols representing joining of connecting lines

The interconnection of crossing connecting lines shall be shown using the symbol S00022 in IEC 60617 (2001-07), see Figure 30.

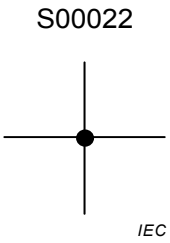


Figure 30 – Symbol representing the interconnection of crossing connecting lines

Figure 31 shows one example where the symbols S00019 and S00020 in IEC 60617 (2001-07) are applied.

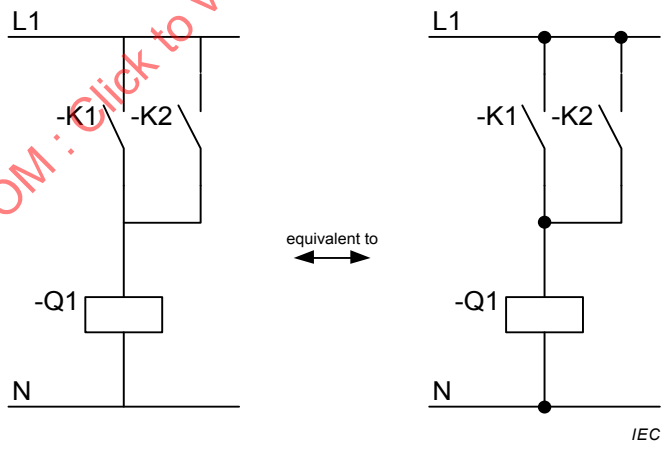


Figure 31 – Examples of the joining of connecting lines

Figure 32 shows an example with the application of symbol S01414 in IEC 60617 (2001-07). The circuit illustrates the same function as in Figure 31, but includes a visualisation of how the wiring shall be done.

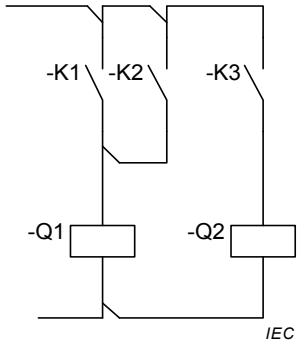


Figure 32 – Example of the joining of connecting lines with indication of where the physical wire goes

Figure 33 shows an example of the application of the symbol S01415 in IEC 60617 (2001-07), illustrating the direction of a bundle when two bundles are joined in a diagram.

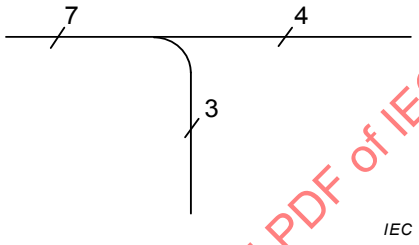


Figure 33 – Example of the joining of connecting lines where the connecting lines represent bundles of wires

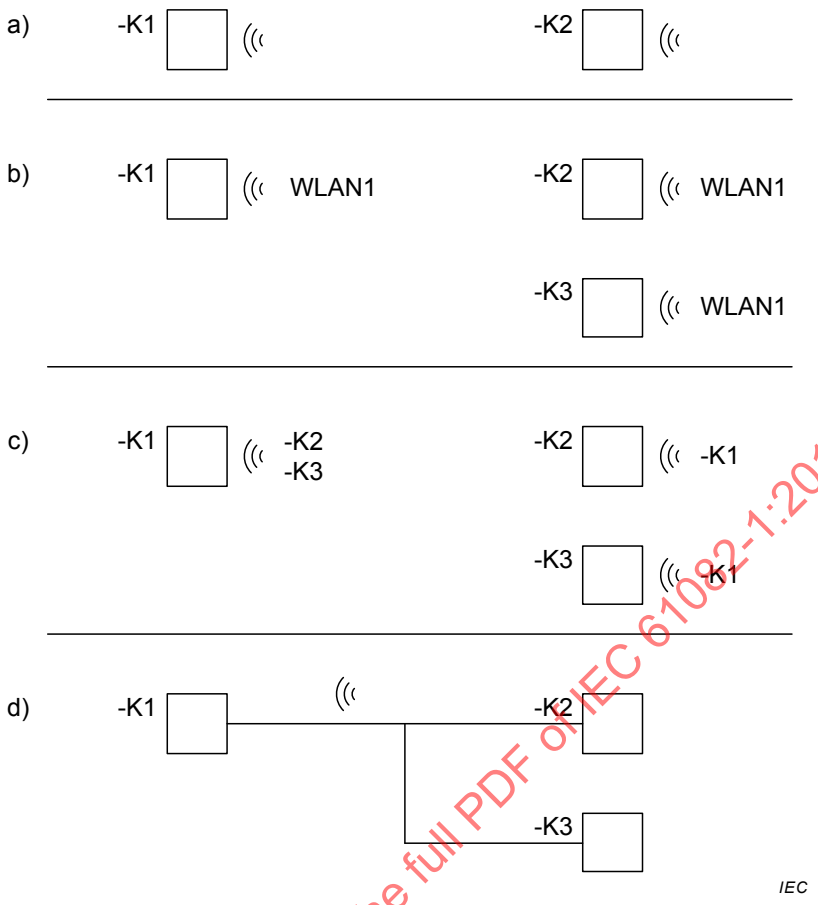
7.1.3.2 Fibre optical interconnections

Fibre optical interconnections shall be shown in accordance with symbol S01318 in IEC 60617 (2001-07), see Figure 10.

7.1.3.3 Wireless interconnections

Wireless interconnections shall be shown in accordance with symbol S01863 (see Figure 34) presented adjacent to the symbols representing the interconnected objects. The direction of waves shall, regardless of the actual information or wave flow direction, be presented as incoming to the object. Any cross-reference to objects that is communicated with or other descriptive indications related to the wireless network shall be presented at the small side of symbol S01318 in IEC 60617 (2001-07).

If required, symbol S00001 (continuous line) representing a connection together with symbol S01863 in IEC 60617 (2001-07) as qualifying symbol may be used to explicitly show the wireless interconnections.



Key

a) Indicates that objects communicate via wireless interfaces

b) Indicates that objects with wireless interfaces communicate via a network with the name WLAN1

c) Reference designation at the wireless interface symbol indicate with which objects is communicated

d) Wireless connections are explicitly presented by qualifying the symbol for a connection (continuous line) with that for a wireless connection

Figure 34 –Different presentation methods for wireless interconnections

Mechanical links

Mechanical links shall be shown in accordance with symbols S00144 or S00147 in IEC 60617 (2001-07), see Figure 35.

NOTE Symbol S00144 is a dashed line. Symbol S00147 is a double continuous line.

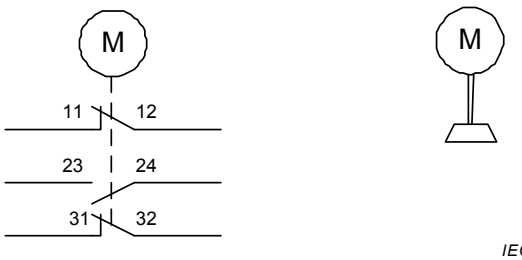


Figure 35 – Example of presentations of mechanical links

7.1.3.4 Arrangement and orientation of connecting lines

Connecting lines shall be oriented horizontally or vertically except in those cases where oblique lines improve the legibility.

Connecting lines should not interfere with other symbols; see IEC 81714-2:2006, 6.11.2.

Bends and crossover of lines should be restricted to a minimum. To avoid bends and crossovers lines may be interrupted. In this case, and also when a line is interrupted on one page and continues on another, the ends of the interrupted line shall be mutually referenced, see 5.8. The ends of the interrupted line should be drawn so that they can easily be recognised, see Figure 36.

NOTE In circuit diagrams, bends and cross-overs can be avoided by regarding the layout principles in accordance with 7.4.2 and the use of detached representation in accordance with 7.4.3.3.

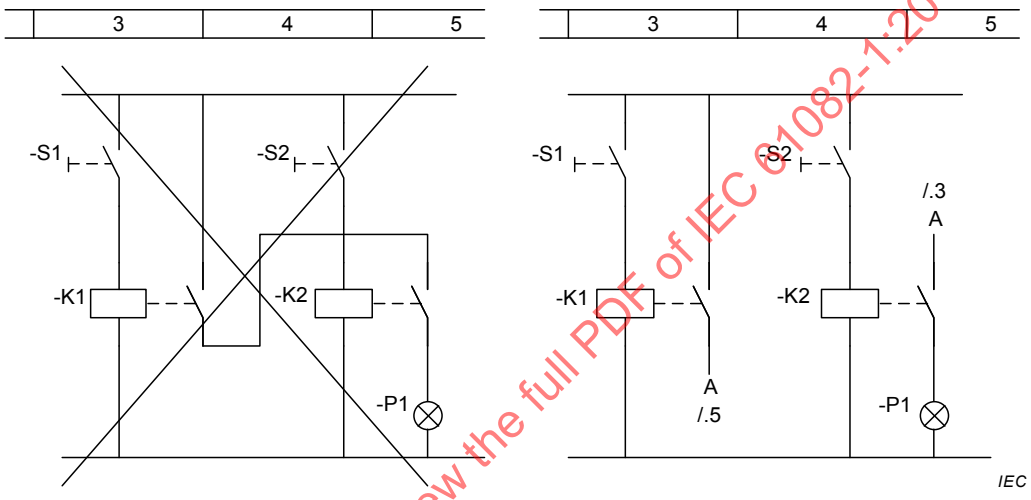


Figure 36 – Example for avoiding bends and cross-overs

The space between two parallel connecting lines shall be at least 1M.

The minimum distance between parallel connecting lines where text is to be shown in between, shall be twice the lettering height and not less than 2M, see Figure 37.

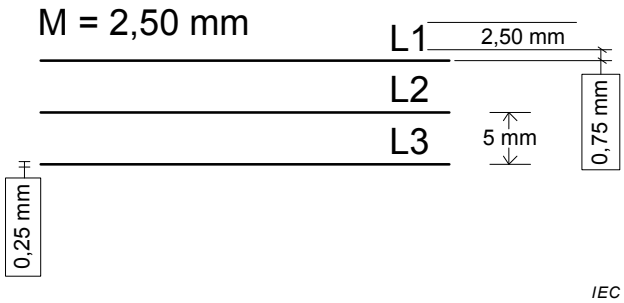


Figure 37 – Spacing of lines

7.1.3.5 Technical data related to connecting lines

Technical data associated with connecting lines:

- shall be clearly related to the associated connecting line;
- shall not touch or cross the connecting line;

- should be located adjacent to – above horizontal and to the left of vertical – connecting lines.

If it is not possible to show the technical data adjacent to the connecting line, it shall be shown elsewhere in the content area together with a leader line or a reference to the connecting line.

The technical data shall be clearly separated from any reference designations, signal designations ~~associated with~~ or terminal designations presented along the connecting line. See Figure 38.

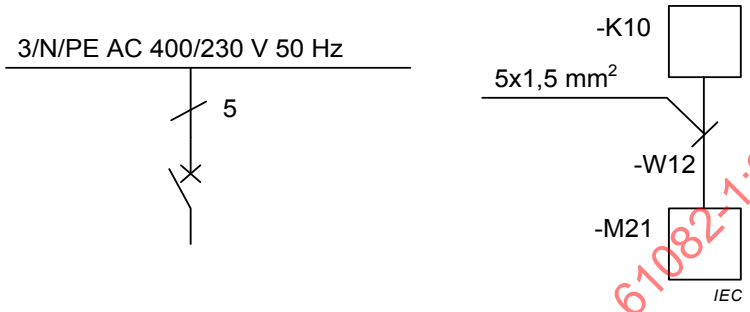


Figure 38 – Examples for technical data associated with connecting lines

Waveforms may be included and should be shown in the way that they normally appear on an oscilloscope screen, detailed as far as necessary for the application.

Electrical ratings of a.c. and d.c. circuits shall be presented in accordance with the examples shown in IEC 61293, preferably in the abbreviated form.

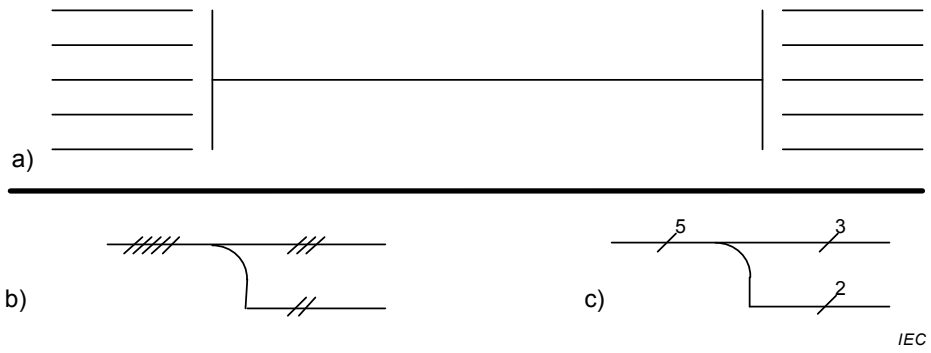
EXAMPLE

- DC 110 V: Direct voltage110 V
- 3 AC 400 V: Three phase, three wire system 400 V
- 3/N/PE AC 400/230 V 50 Hz: Three-phase, five-wire system with N and PE 400/230 V

7.1.3.6 Simplified presentation

Multiple parallel connecting lines may be represented by one line (i.e. bundle) using one of the following methods:

- the parallel lines are interrupted and a cross-line after a short space represents the bundle (See Figure 39.a);
- the number of parallel connecting lines represented by the bundle shall be indicated either by adding as many oblique strokes as the number of connections (see symbol S00002 in IEC 60617 (2001-07) and Figure 39.b), or by adding one stroke followed by the figure for the number of connections (see symbol S00003 in IEC 60617 (2001-07) and Figure 39c).



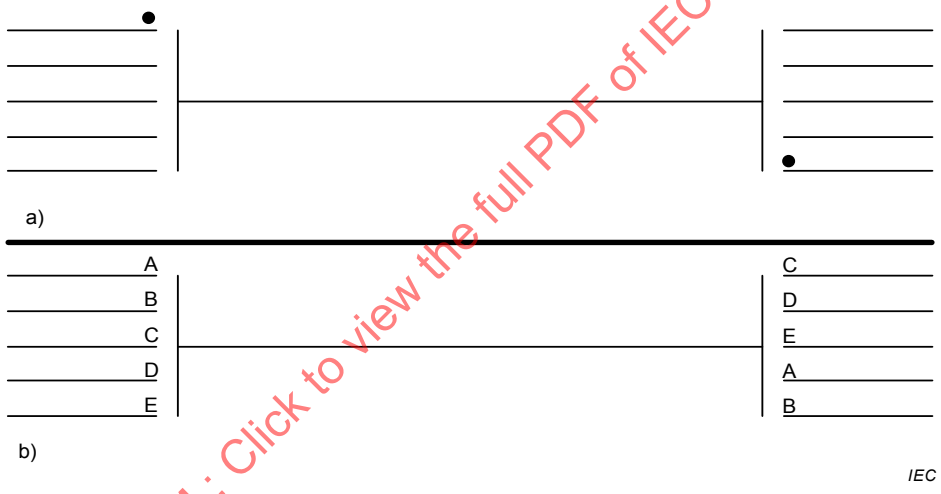
a) Using a cross-line and a space

b) Indication by a number of strokes

c) Indication by numbers

Figure 39 – Presentation of bundles

The sequential order of the parallel lines at both ends of the bundle should be unambiguously indicated, see Figure 40.



a) Using a dot to indicate the first connection

b) Indicating the individual connections

Figure 40 – Indication of sequence within bundles

7.1.4 Representation of binary logic circuits

7.1.4.1 Logic conventions and logic polarity indication

~~7.1.4.1.1 General~~

The relationship between logic states and the nominal values (logic levels) of the physical quantities used to represent these states shall be indicated by using one of the following methods in a diagram:

- Single logic convention (relative notation);
- Direct logic polarity convention (absolute notation).

Figure 41 illustrates the terms "states" and "levels", where:

- “Internal logic state” describes a logic state assumed to exist inside a symbol outline at an input or output.

- "External logic state" describes a logic state assumed to exist outside a symbol outline:
  - on an input connecting line prior to any external qualifying symbol at that input; or
  - on an output connecting line beyond any external qualifying symbol at that output.
- "Logic level" describes the physical quality assumed to represent a logic state of a binary variable:
  - IEC 60617 uses the symbols "0" and "1" to identify the two logic states of a binary variable. These states are referred to as 0-state and 1-state.
  - A binary variable may be equated to any physical quantity for which two distinct ranges can be defines. In IEC 60617-DB these distinct ranges are referred to as logic levels and are denoted "H" and "L". "H" is used to denote the logic level with the more positive algebraic value, and "L" is used to denote the logic level with the less positive algebraic level.

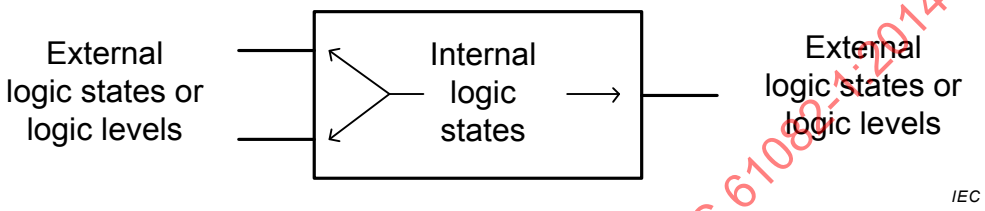


Figure 41 – Illustration of the terms "states" and "levels"

7.1.4.2 Single logic convention

Single logic convention implies that the correspondence between a given external logic state and logic level is the same at all inputs and outputs in the diagram or a portion of a diagram.

The symbol for logic negation (symbols S01466 and S01467 in IEC 60617) shall be used at an input or output terminal to indicate that the internal and external states are the complements of one another for that terminal.

a) Positive logic convention:

The more positive value of the physical quantity (H-level) corresponds to the external 1-state. The less positive value (L-level) corresponds to the external 0-state. If necessary, the positive logic convention may be indicated as:

POSITIVE LOGIC 

b) Negative logic convention:

The less positive value of the physical quantity (L-level) corresponds to the external 1-state. The more positive value (H-level) corresponds to the external 0-state. The use of negative logic convention shall be indicated in the diagram or in supporting documentation as:

NEGATIVE LOGIC 

Figure 42 shows an example of a diagram using positive logic convention.

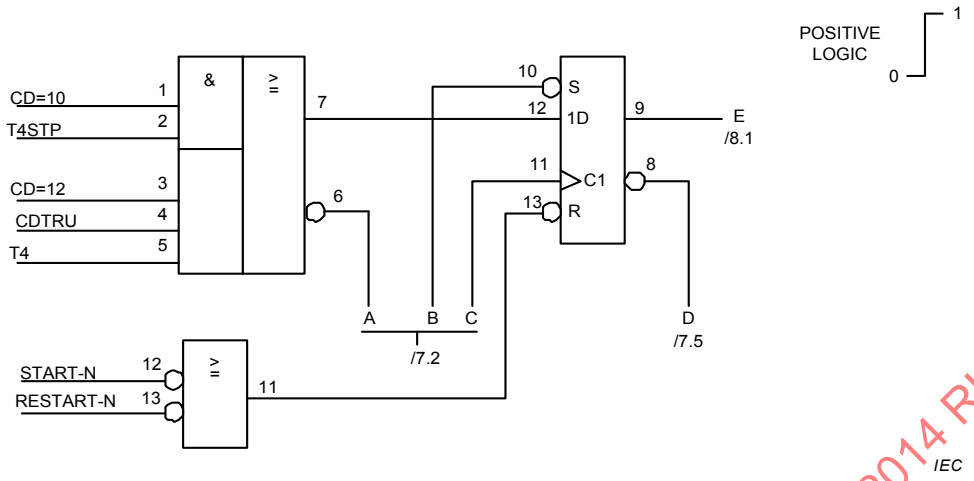


Figure 42 – Detail of a circuit diagram using positive logic convention

7.1.4.3 Direct logic polarity convention

Direct logic polarity convention implies that the relationship between the internal logic state and the (external) logic level of each input of every binary logic element shall be indicated directly by means of the presence or absence of the logic polarity symbol (symbols S01468 through S01471 in IEC 60617 (2001-07)).

The logic polarity symbol shall be used at an input or output terminal to indicate that the (external) low level corresponds to the internal 1-state for that terminal.

NOTE The absence of the logic polarity symbol signifies that the (external) high level corresponds to the internal 1-state for that terminal.

The relationship between the (external) logic level and a signal state shall only by defined by the signal designation in accordance with IEC 61175.

Figure 43 shows an example of a diagram using direct polarity convention.

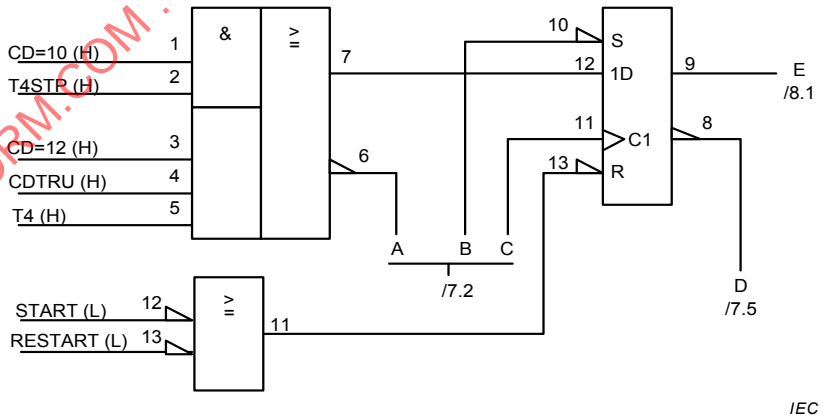


Figure 43 – Detail of a circuit diagram using direct logic polarity convention

For diagrams prepared with direct logic polarity convention, but showing no logic polarity symbols, a statement indicating that direct logic polarity convention is applied shall be placed in the diagram or in supporting documentation.

7.1.5 Boundary frames

A boundary frame shall consist of horizontal and vertical lines using the symbol S00064 in IEC 60617 (2001-07).

NOTE Symbol S00064 is a dashed dotted line. The resulting boundary frame is not a defined symbol itself.

A boundary frame shall represent an object. Objects shown inside the boundary frame shall be constituents of this object and may be represented in a simplified form, provided a reference to a more detailed document is given, see Figure 44.

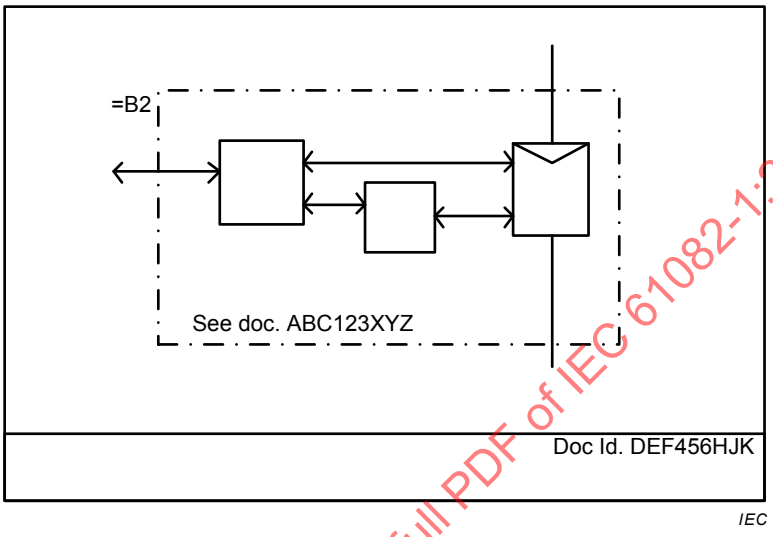


Figure 44 – Boundary frame with a reference to another document

The boundary frame shall be associated with the reference designations of the object it represents.

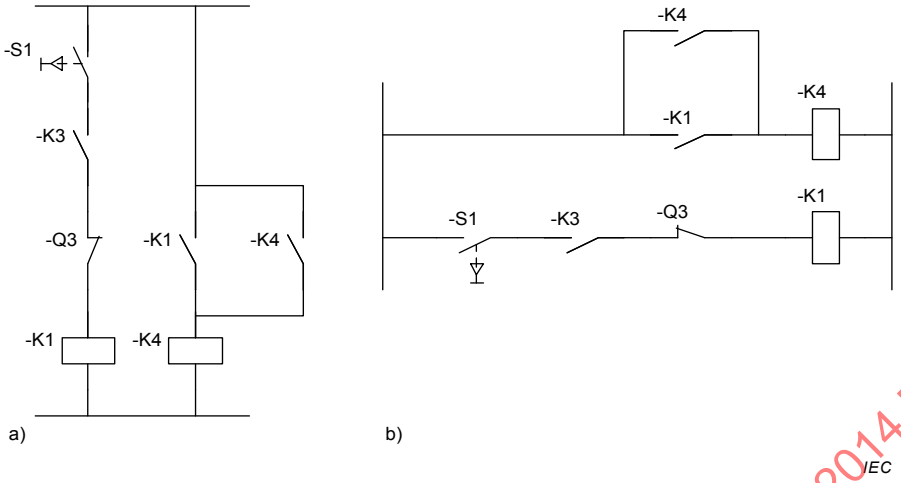
7.1.6 Presentation of reference designations

7.1.6.1 Symbols

Reference designations associated with a symbol shall be located to the left of the symbol when it is shown with mainly vertical terminal lines, see Figure 45a), or above the symbol when it is shown with mainly horizontal terminal lines, see Figure 45b).

NOTE For symbols to be used in CAx-applications more precise rules for the positioning of various text fields in accordance with IEC 81714-2 apply (see also 5.12.1). For example, reference designations or reference designation sets are to be placed in a defined distance above an imagined horizontal centre line or any horizontal terminal line (and also in a defined distance from the symbol outline) when it is shown with mainly vertical terminal lines as indicated in Figure 45a). For symbols with mainly horizontal terminal lines the position of reference designations is to the left of an imagined vertical centre line as indicated Figure 45b).

For reference designations associated with a symbol representing a connection and for boundary frames other rules apply, see 7.1.6.2 and 7.1.6.3.



a) with vertical terminal lines

b) with horizontal terminal lines

Figure 45 – Location of reference designations at a symbol

7.1.6.2 Connecting lines

Reference designations associated with connecting lines:

- shall be clearly related to the associated connecting line;
- shall not touch or cross the connecting line;
- should be located adjacent to – above horizontal and to the left of vertical – connecting lines, and directed along the connecting line.

If it is not possible to show the reference designation adjacent to the connecting line, it shall be shown elsewhere in the content area together with a leader line or a reference to the connecting line. See also Figure 46.

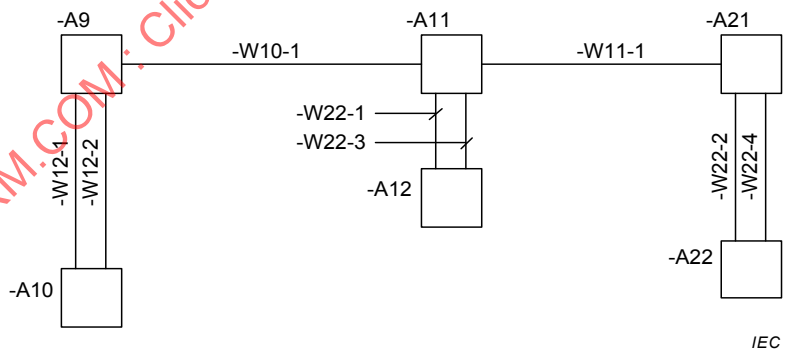


Figure 46 – Examples of reference designations associated with connecting lines

The reference designations shall be clearly separated from any signal designations, terminal designations or technical data associated with the connecting line.

7.1.6.3 Boundary frames

As stated in 7.1.5 each boundary frame represents an object that needs to be identified, for example by a reference designation.

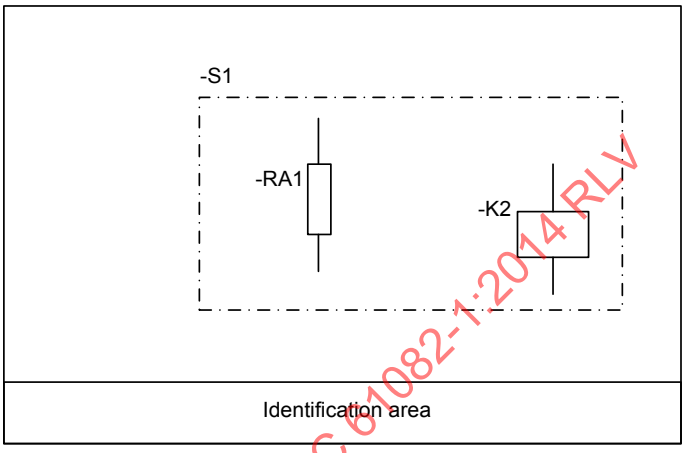
NOTE A boundary frame is a drawing means and not a symbol in accordance with IEC 60617 and IEC 81714-2.

Reference designations associated with a boundary frame shall be located above and at the left edge of the boundary frame, or to the left and at the upper edge of the boundary frame.

For objects presented inside of a boundary frame, the initial portion of their reference designation corresponding to the reference designation of the object represented by the boundary frame shall not be shown at the individual objects, see Figure 47.

Object	Reference designations
Resistor	-S1RA1
Operating device	-S1K2
Boundary frame	-S1

a)



b)

IEC

a) The reference designations of the objects

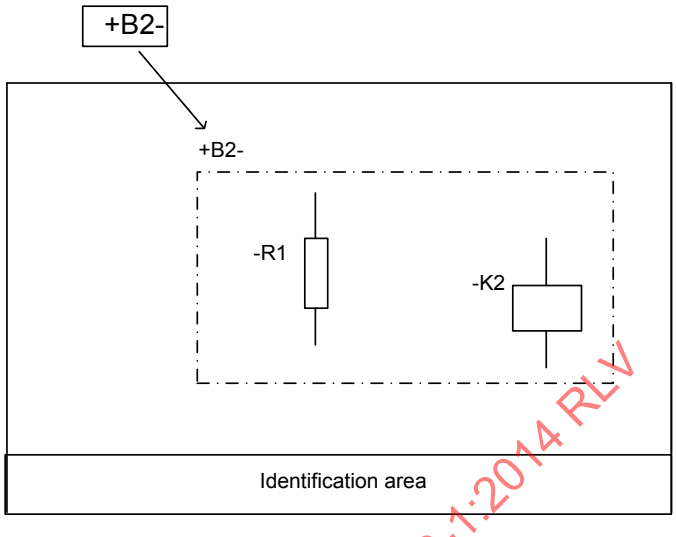
b) The reference designations as shown in a diagram.

Explanation: The reference designation of an object inside the boundary frame is found by concatenating its reference designation with the reference designation presented at the boundary frame.

Figure 47 – Presentation of reference designations at a boundary frame

If the last single-level reference designation associated with the boundary frame is of a different aspect than the first single-level reference designation of the constituent object ~~(i.e. a transition in accordance with IEC 61346-1)~~, the reference designation associated with the boundary frame shall be suffixed with the prefix sign of the latter, see Figure 48.

~~A reference designation of a constituent object is found by concatenating the reference designation associated with the boundary frame with the reference designation of the constituent objects that starts with the same prefix sign as the last prefix sign shown at the boundary frame, see Figure 45.~~



Object	Reference designations
Resistor	+B2-R1
Operating device	+B2-K2
”Boundary frame”	+B2

a) b)

IEC

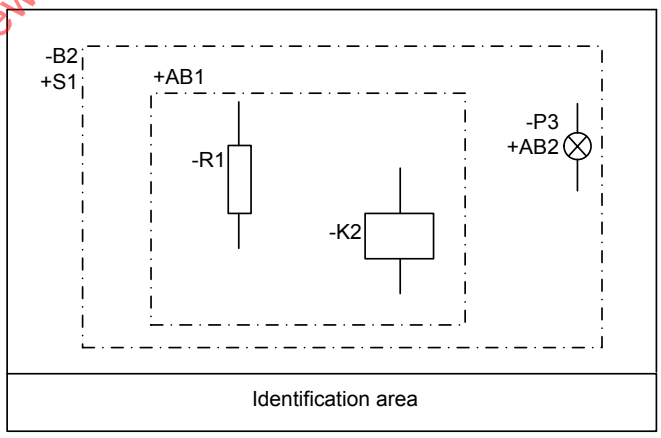
a) The reference designations of the objects

b) The reference designations as shown in a diagram

Explanation: A reference designation of an object inside the boundary frame is found by concatenating its reference designation with the reference designation presented at the boundary frame that is suffixed with the prefix sign shown at the object.

Figure 48 – Presentation of reference designations including different aspect

If the objects presented are associated with more than one reference designation, each reference designation can be simplified presented, see Figure 49.



Object	Reference designations
Resistor	+S1AB1... / -B2R1
Operating device	+S1AB1... / -B2K2
Lamp	+S1AB2 / -B2P3
”Boundary frame”	+S1 / -B2
”Boundary frame”	+S1AB1 / -B2...

a) b)

IEC

a) The reference designations of the objects

b) The reference designations as shown in a diagram

Figure 49 – Presentation of reference designation sets at a boundary frame

7.1.6.4 Document page

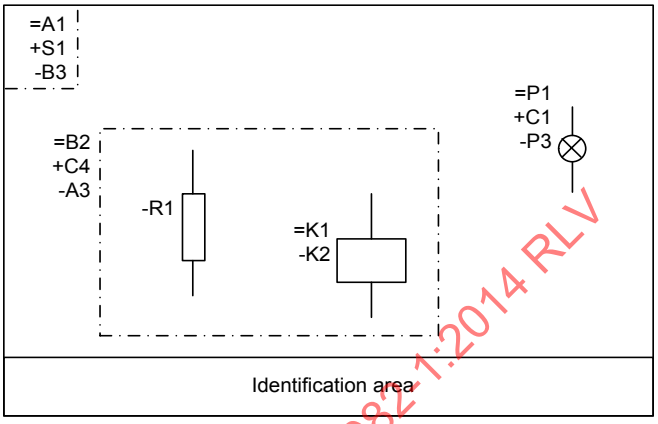
If the reference designation for all objects shown on a page of a document has the same common initial portion, this common initial portion should be shown to the left and preferably at the top within the content area, delimited from the rest of the content area by using the line for a boundary frame, see Figure 50.

~~NOTE 1~~ The content area will in such cases present information related to a single object and could therefore be enclosed by a boundary frame that does not need to be shown completely.

NOTE Any reference designation shown in the identification area of a document page is part of the document designation and is not a part of the reference designations of the objects shown in the content area.

Object	Reference designations
Resistor	+S1C4 / =A1B2 / -B3A3R1
Operating device	+S1C4 / =A1B2K1 / -B3A3K2
Lamp	+S1C1 / =A1P1 / -B3P3
”Boundary frame”	+S1C4 / =A1B2 / -B3A3
”Page content area”	+S1 / =A1 / -B3

a)



b)

IEC

a) The reference designations of the objects

b) The reference designations as shown in a diagram

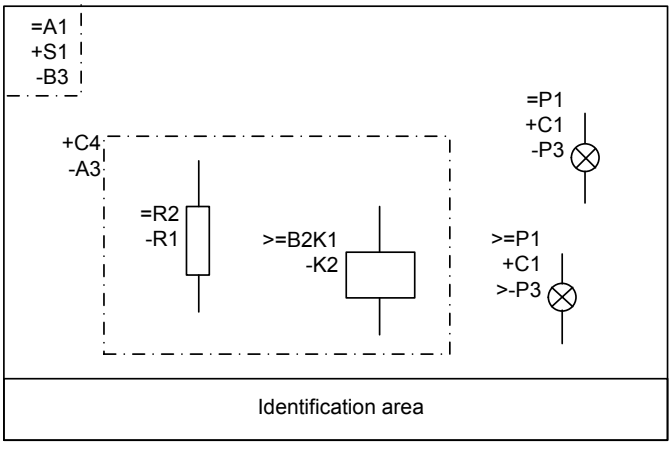
Figure 50 – Presentation of reference designation

7.1.6.5 Exclusion from concatenation

In some cases it may be necessary to show objects inside a boundary frame that are not constituents of the object represented by the boundary frame. In such cases shall the reference designations of these objects in a diagram be presented completely preceded with the character “GREATER THAN” (>), see Figure 51.

Object	Reference designations
Resistor	+S1C4 / =A1R2 / -B3A3R1
Operating device	+S1C4 / =B2K1 / -B3A3K2
Lamp	+S1C1 / =A1P1 / -B3P3
Lamp	+S1C1 / =P1 / -P3
”Page content area”	+S1 / =A1 / -B3

a)



b)

IEC

a) The reference designations of the objects

b) The reference designations as shown in a diagram

Figure 51 – Presentation of reference designations excluded from concatenation

7.1.7 Presentation of terminal designations

Terminal designations shall be located outside the symbol outline, adjacent to the part of the symbol that illustrates the terminal (i.e. a short line at the symbols interface). The presentation shall be above horizontal connecting lines and to the left of vertical connecting lines. Terminal designations shall be oriented along the connecting lines, see IEC 81714-2 for further details. See Figure 52.

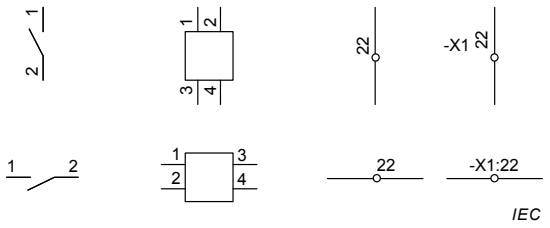


Figure 52 – Examples for the presentation of terminal designations

Simplified presentation of terminal designations can only be performed for terminals belonging to the same object, following the rules for the simplified presentation of series and ranges, see 5.16.

7.1.8 Presentation of signal designations

Signal designations:

- shall be clearly related to the associated connecting line;
- shall not touch or cross the connecting line;
- should be located adjacent to – above horizontal and to the left of vertical – connecting lines, and directed along the connecting line.

If it is not possible to show the signal designation adjacent to the connecting line, it shall be shown elsewhere in the content area together with a leader line or a reference to the connecting line. See Figure 53.

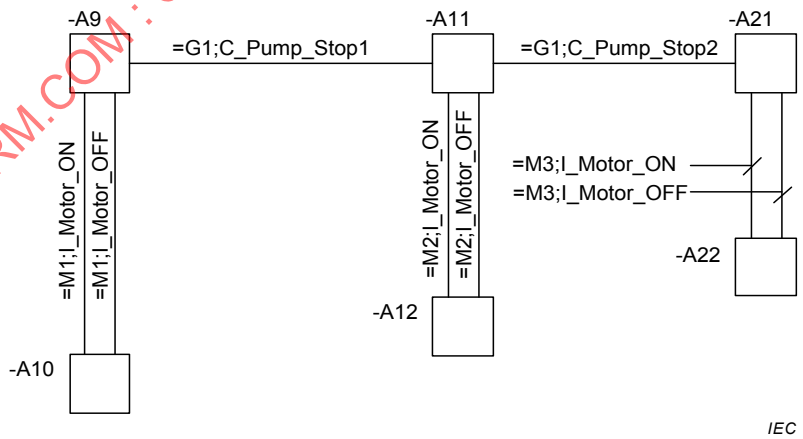


Figure 53 – Examples of signal designations associated with connecting lines

The signal designations shall be clearly separated from any reference designations, terminal designations or technical data associated with the connecting line. See Figure 54.

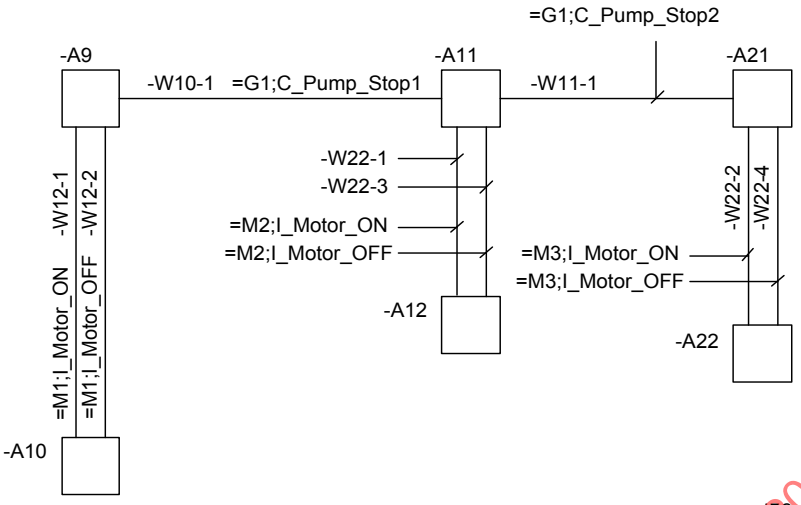


Figure 54 – Examples of reference and signal designations ass. with connecting lines

For signal designations shown inside boundary frames, the reference designation part should be presented following the concatenation rules of 7.1.6.3, 7.1.6.4 and 7.1.6.5. The reference designation shown at a boundary frame or for the document page that is intended to precede the signal designation shown, shall then be suffixed with the character "SEMICOLON" (;), see Figure 55.

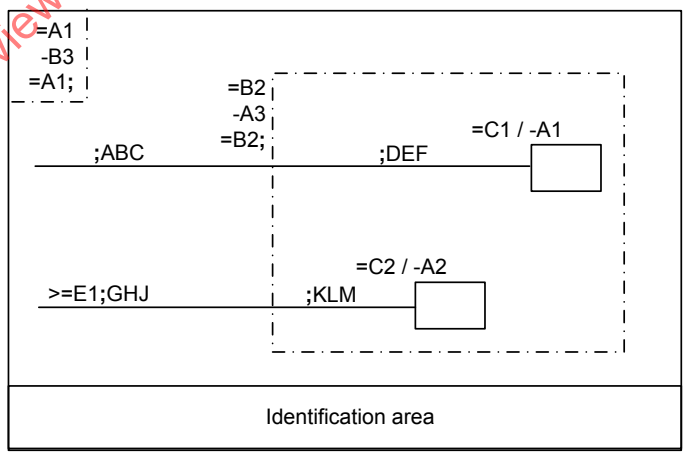
NOTE 1 Reference designations shown at a document page or a boundary frame not suffixed with the character "SEMICOLON" (;) do not precede any signal designations.

NOTE 2 IEC 61175 specifies different methods of assigning a reference designation to a signal name. The rules for presentation of signal designations are independent of the method applied.

Signal name	Signal designations
ABC	=A1;ABC
DEF	=A1B2;DEF
GHJ	=E1;GHJ
KLM	=A1B2;KLM

Object	Reference designations
Object 1	=A1B2C1 / -B3A3A1
Object 2	=A1B2C2 / -B3A3A2

a)



b)

IEC

a) The signal designations of the signals

b) The signal designations as shown in a diagram

Figure 55 – Presentation of signal designations

7.1.9 Method of presentation of multi-phase circuits

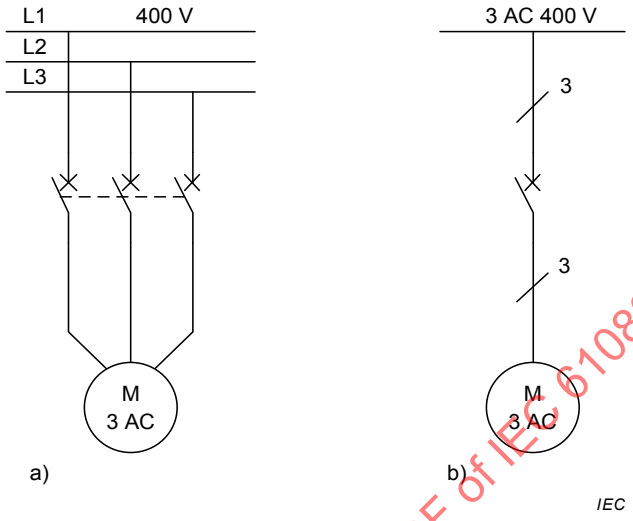
Multi-phase circuits may be presented as a:

- multi-line presentation wherein all phases are presented, see Figure 56a; or

- single-line presentation wherein all phases are represented by a single-phase circuit with indication of the number of phases, see 56b.

The indication of the number of phases may be omitted if no confusion is likely, see Figure 60.

NOTE Single line presentation of multi-phase circuits is not the same as the bundled form of presentation shown in 7.1.3.6.



a) in multi-line presentation

b) single-line presentation

Figure 56 – Example for a multi-phase circuit

7.1.10 Emphasizing of circuits

Emphasizing of circuits may be performed by methods as:

- use of colours; or
- shading; or
- scaling of symbols (see IEC 81714-2); or
- increased line widths, considering the rules in 5.10.

NOTE Increased line widths ~~may~~ can be applied to connecting lines, symbols or both.

7.2 Overview diagrams

An overview diagram provides an overall impression of an object, for example a radio receiver, a power plant or a control program, by showing the main constituents of the object and their main interrelations. Detailed information concerning the constituent objects should be shown in documents applying other document kinds.

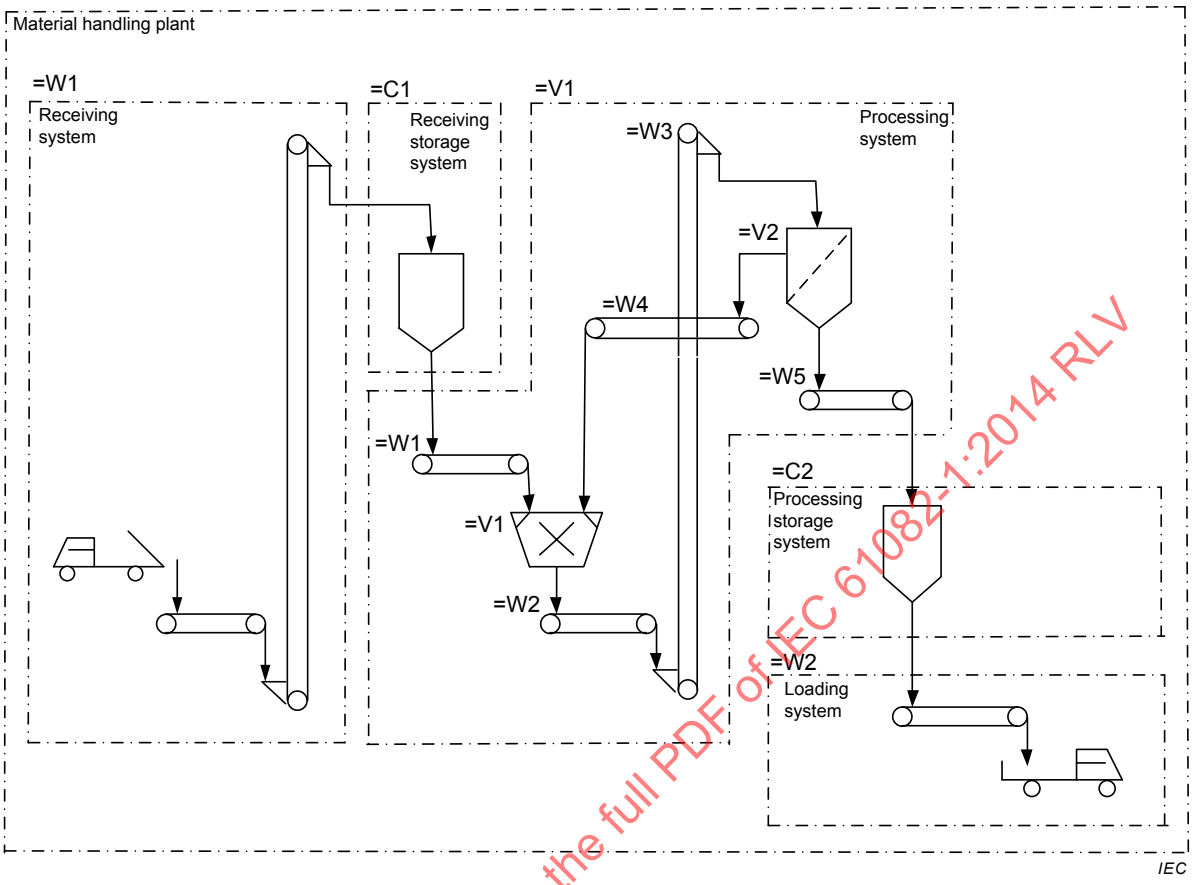
An overview diagram may include non-electrotechnical constituents.

An overview diagram should normally emphasize one aspect of the object described, for example the functional aspect, the topographical aspect, the connectivity aspect.

Any object regardless of its position in a structure can be associated with an overview diagram.

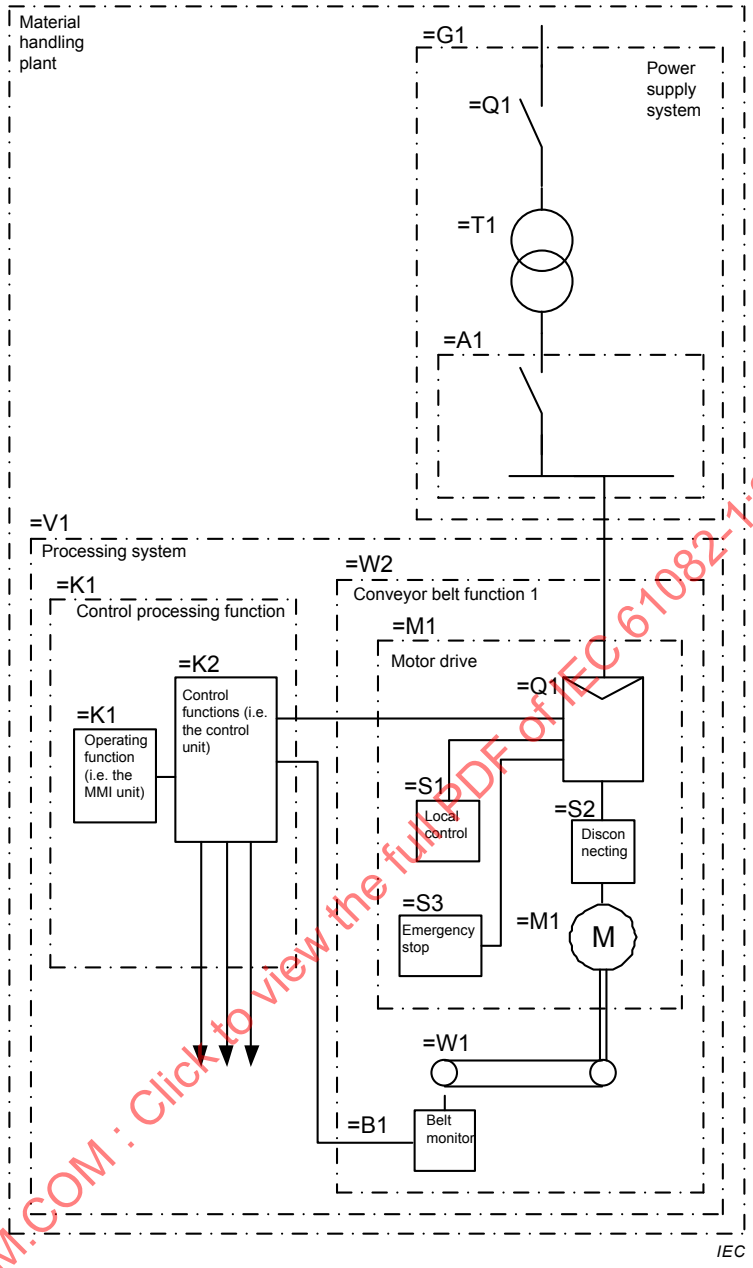
In overview diagrams, multi-phase circuits shall be presented using the single line presentation.

Figure 57, Figure 58, Figure 59 and Figure 60 show examples of different overview diagrams



SOURCE: Figure H.1 of IEC 81346-1:2009

Figure 57 – Overview diagram for a material handling plant ~~(Example taken from IEC 61346-1)~~



SOURCE: Figure H.2 of IEC 81346-1:2009

Figure 58 – Overview diagram for one conveyer belt function ~~(Example taken from IEC 61346-1)~~

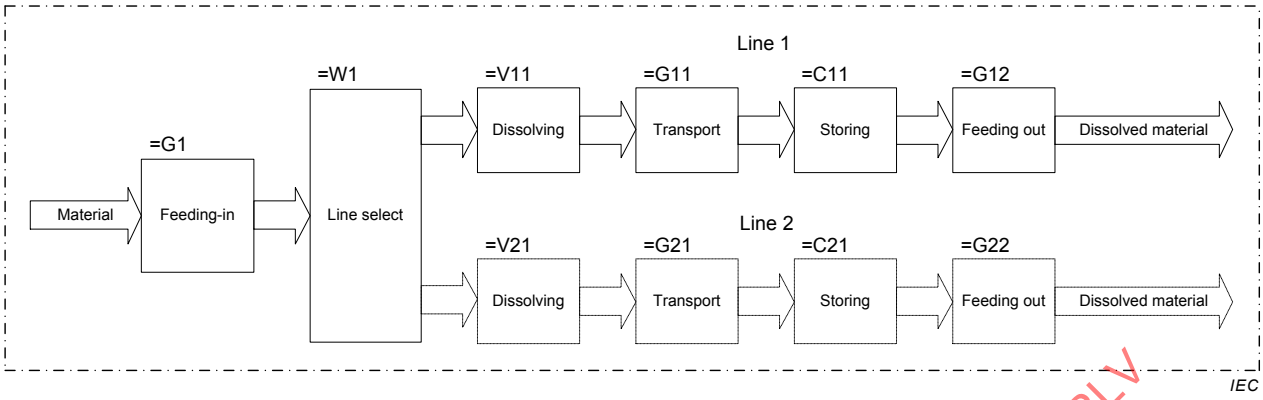


Figure 59 – Overview diagram process plant

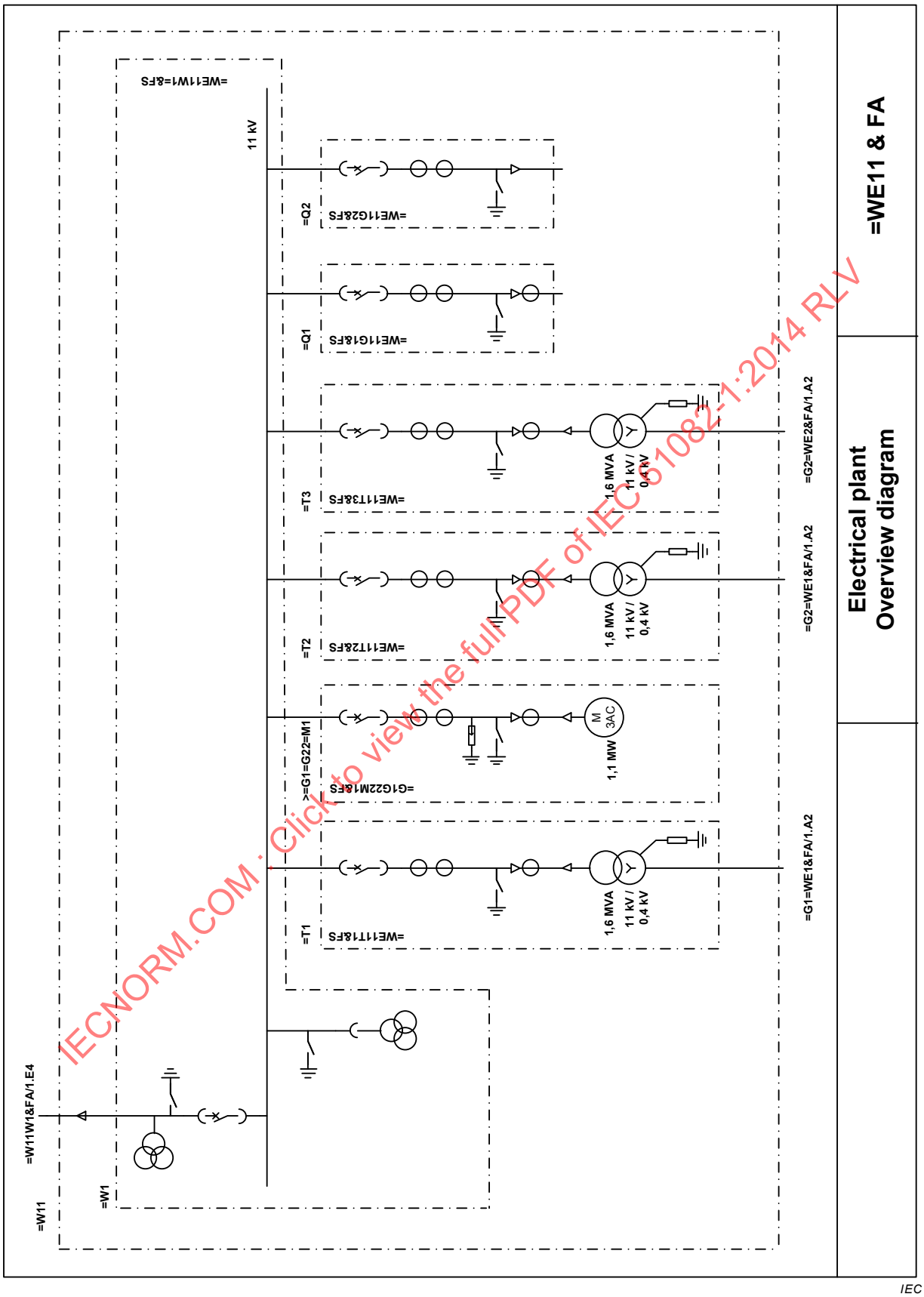


Figure 60 – Overview diagram of an electrical plant

7.3 Function diagrams

7.3.1 General

A function diagram shall describe an object from a functional aspect regardless of its implementation, by showing the functional relations among its constituents.

NOTE IEC 60617 contains both pure functional symbols and symbols to be used for the representation of components.

The principal signal flow in a function diagram should be from left to right and from top to bottom, see Figure 61.

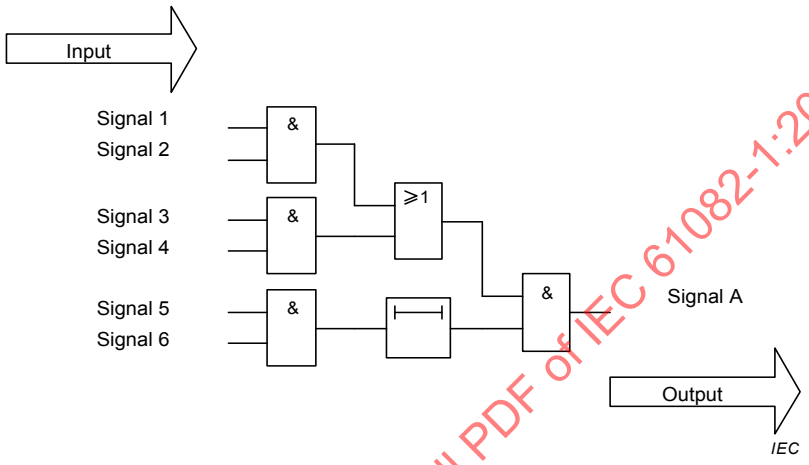


Figure 61 – Signal flow in a function diagram

Function diagrams may include presentations of steps and transitions in accordance with IEC 60848.

7.3.2 Equivalent-circuit diagrams

Equivalent-circuit diagrams shall apply the conventions for electric and magnetic circuits as specified in IEC 60375. See also Figure 62 which shows an example for the calculation of a transformer and its load.

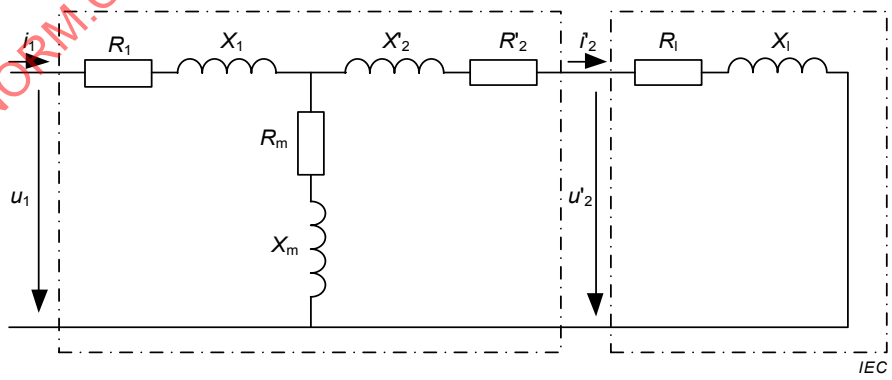
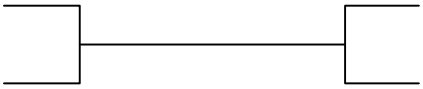
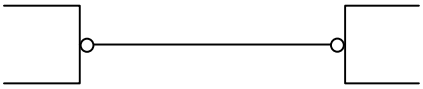
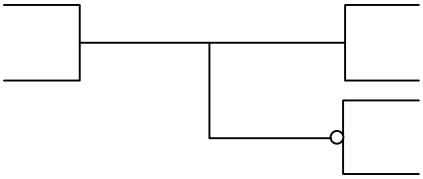
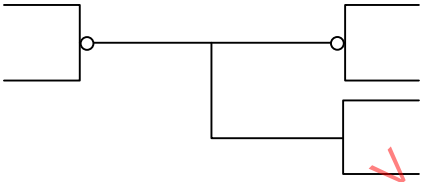


Figure 62 – Example of an equivalent-circuit diagram

7.3.3 Logic-function diagram

In a logic-function diagram the positive single logic convention (see 7.1.4.2) shall be applied. The number of logic negations should be minimized to facilitate the understanding, see Figure 63.

Example	Preferred representation	Non-preferred representation
1		
2		

IEC

Figure 63 – Minimized use of logic negations

7.4 Circuit diagrams

7.4.1 General

A circuit diagram shall show at least the details of the implementation of an object, i.e. the constituent components and their interconnections without taking into account for example physical sizes and shapes of the components. It shall facilitate the understanding of the functioning of the object.

A circuit diagram shall be prepared using:

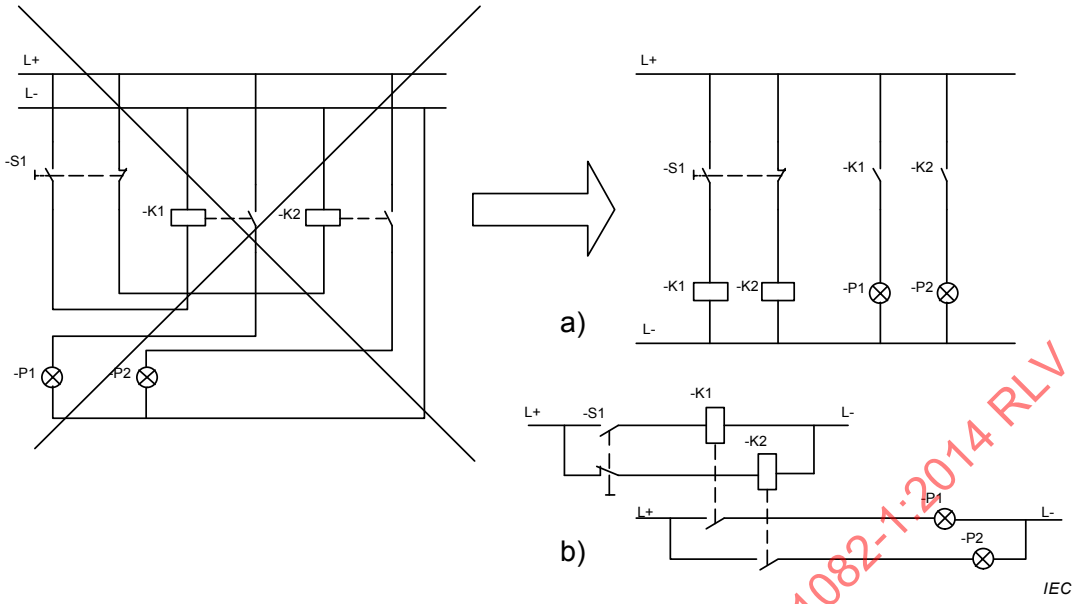
- graphical symbols;
- connecting lines;
- reference designations;
- terminal designations;
- signal-level conventions applicable to logic signals;
- information necessary to trace paths and circuits (signal designations, location references);
- supplementary information necessary for the understanding of the functioning of the object.

7.4.2 Layout

The diagram shall emphasize:

a) the process or signal flow, by lining up symbols and keeping the connection lines of a circuit straight. See Figure 64.

b) the functional relations, by grouping symbols representing functional related components together. See Figure 65.



a) detached presentation of multiple-symbol representation of components

b) semi-attached representation of multiple-symbol representation of components

Figure 64 – Lining-up of symbols

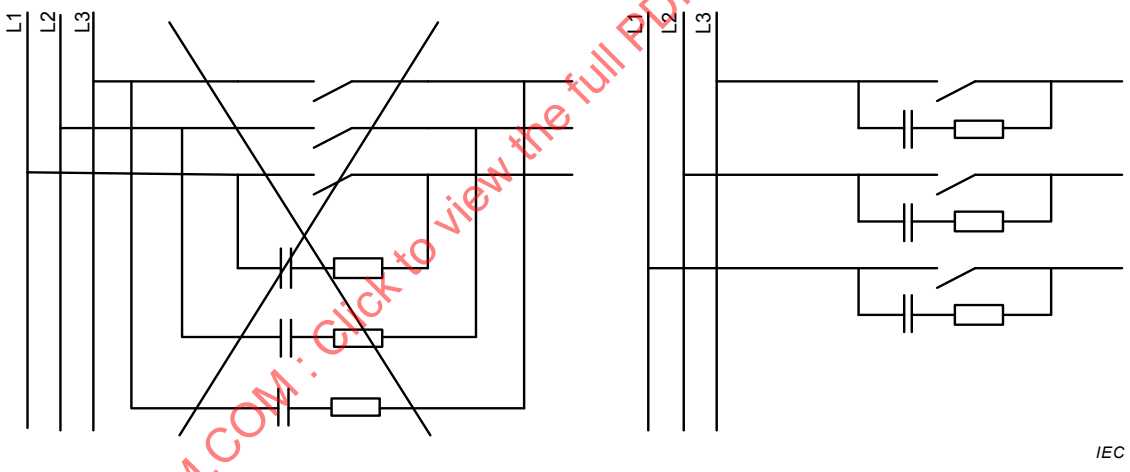


Figure 65 – Grouping of symbols for functionally related components

7.4.3 Methods for representation of components

7.4.3.1 General

A component may be represented by:

- a single symbol; or
- a combination of several symbols.

A single symbol can be shown:

- once; or
- in different locations (repeated presentation).

The combination of symbols can be shown:

- adjacent to each other (attached presentation); or
- apart from each other (detached presentation).

7.4.3.2 Attached presentation of symbols

Attached presentation of symbols for the represented component should only be used for presentation of simple non-extensive circuits.

The interrelation between the symbols can be indicated using a dashed line (symbol S00144 in IEC 60617 (2001-07)), see Figure 66. A double line (symbol S00147 in IEC 60617 (2001-07)) may also be used for mechanical interrelations.

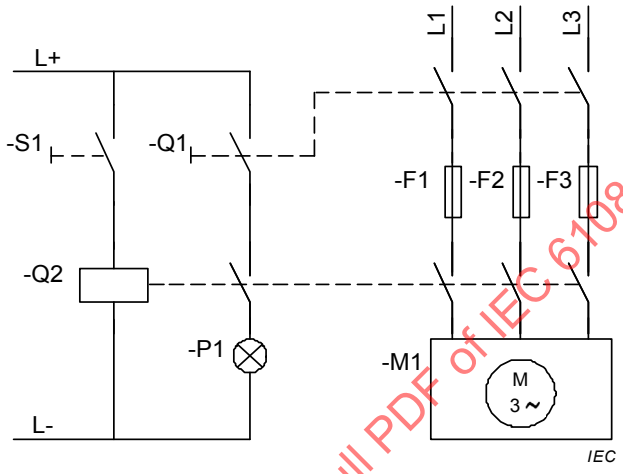


Figure 66 – Attached presentation of symbols

7.4.3.3 Detached presentation of symbols

Detached presentation of symbols for the represented components should be used to ~~facilitate tracing of circuit paths~~ focus on specific functional relationships of the components of a system and to achieve a clear layout without crossing circuits.

In order to indicate the interrelation between the symbols the reference designation of the component shall be shown at each symbol, see Figure 67.

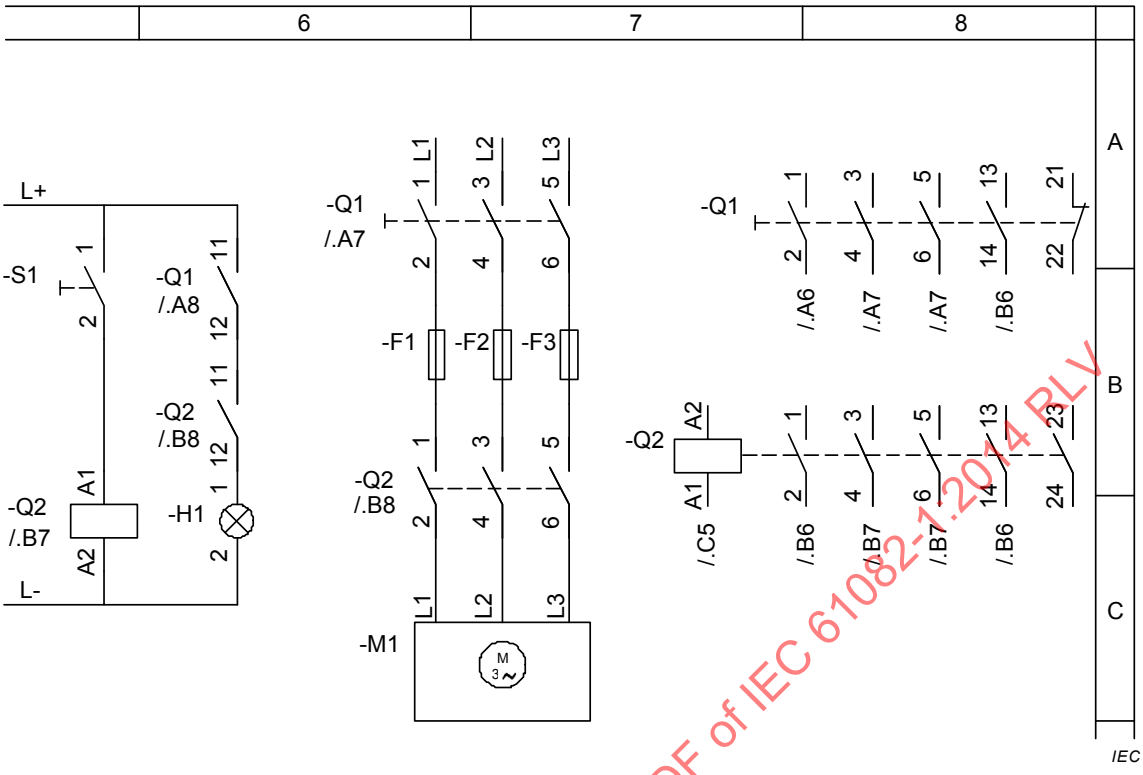


Figure 67 – Detached presentation of symbols

In order to facilitate understanding and navigation within the diagram the component should in addition be:

- represented with attached presentation of all symbols in at least one place of the document (see rightmost symbols for -Q1 and -Q2 in Figure 67); or
- represented by an inset diagram or table located below or to the right of the actuating symbol, or, alternatively by the graphical representation of the constituent parts to be referenced (see Figure 68).

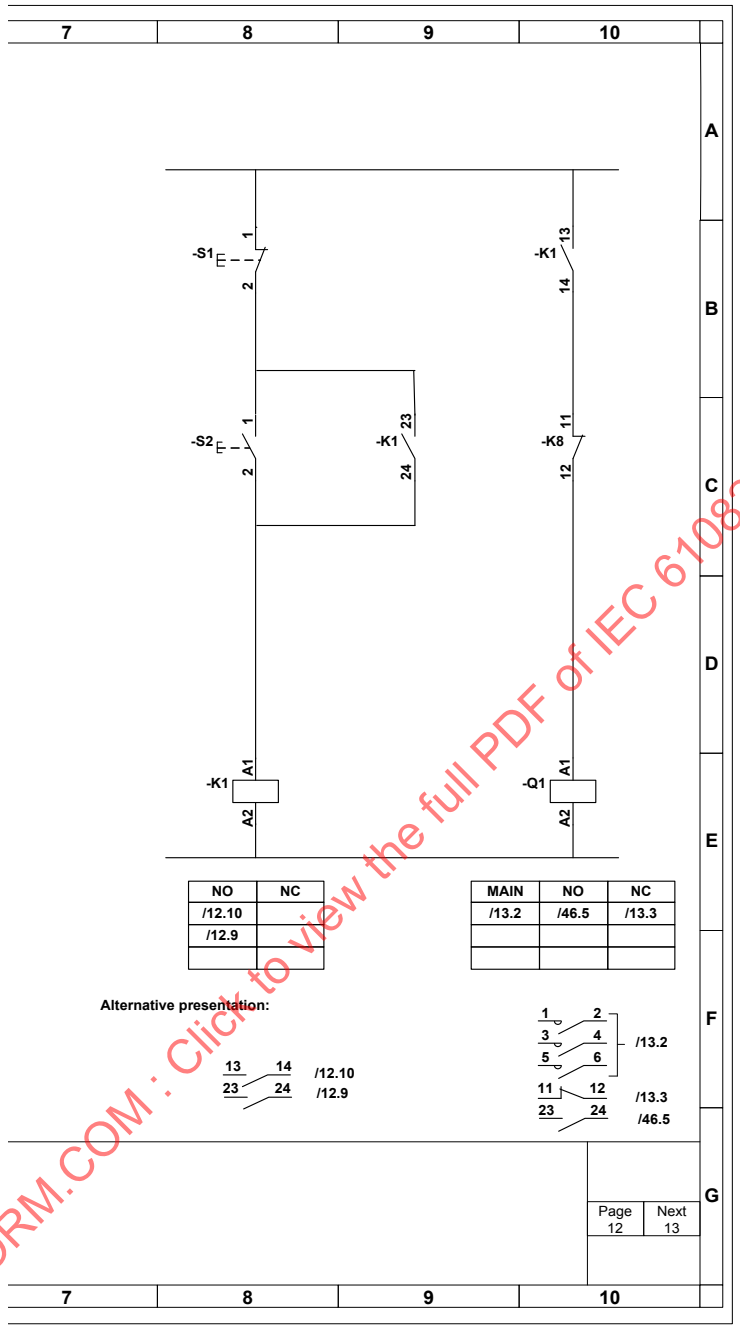
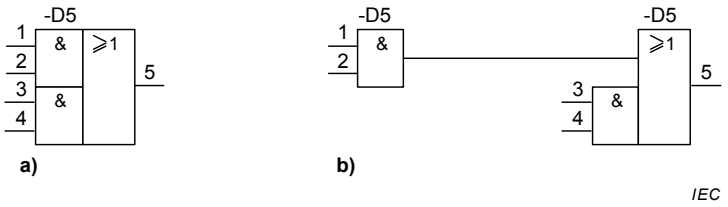


Figure 68 – Example of the use of inset tables

Cross-references shall be made between the attached presentation or the inset diagrams or tables and the detached presented symbols in accordance with 5.8.

If the functioning of an object is not understandable without showing the “internal” connection between the different representations of parts of the object, such connections shall be indicated applying the symbol S01479, S01480, S01481 or S01482 in IEC 60617, see Figure 69.



a) attached presentation

b) presentation shown with internal connection

Figure 69 – Example of presentation of internal connection

7.4.3.4 Repeated presentation of symbols

Repeated presentation of the symbols for the represented component may also (as the detached presentation) be used to achieve a clear layout without crossing circuits.

A connect node of the symbol shall only be connected at one of the locations of the symbol within the diagram.

Each appearance of the symbol shall be provided with the reference designation of the component. All connect nodes or terminal lines shall be provided with their terminal designations, see Figure 70.

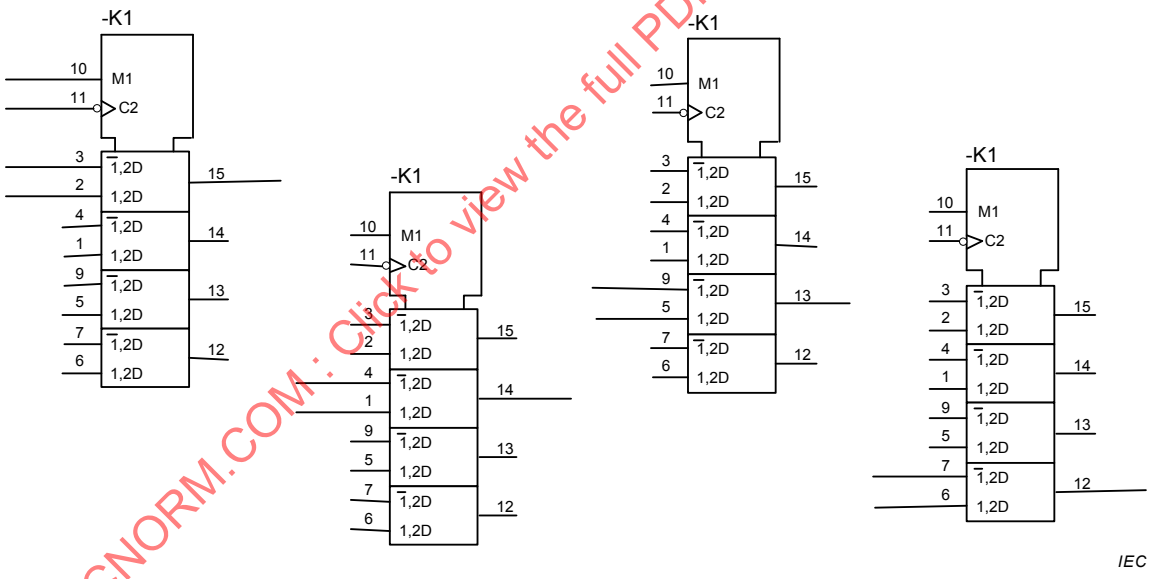
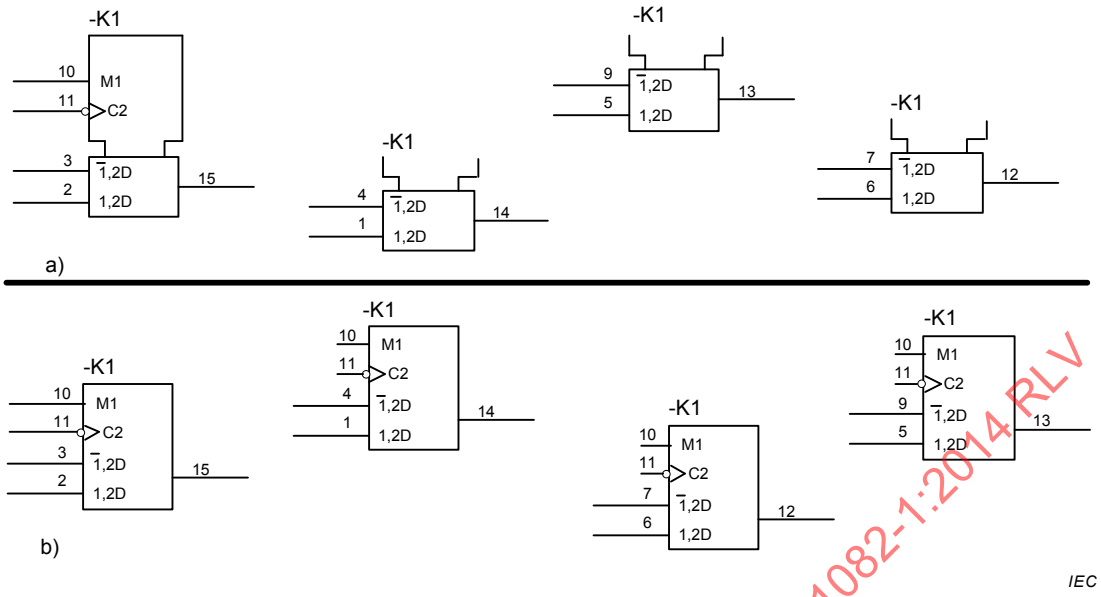


Figure 70 – Repeated presentation of a symbol for a quadruple multiplexer

Symbols repeatedly presented may be simplified by presenting only a part of the complete symbol with the indication that just a part of the symbol is shown, see Figure 71.



a) The common control block not shown for each presentation

b) The common control block indicated for each presentation

Figure 71 – Simplified repeated presentation of a symbol for a quadruple multiplexer

If the symbol representing a component is repeated in different documents or on different pages of a document, cross-references to all presentation places shall be provided by applying one of the presentation methods as provided for the detached presentation (see 7.4.3.3), i.e. attached presentation at one place with cross-references to other places of presentation or applying inset tables.

7.4.4 Representation of components with movable parts

7.4.4.1 Operational state

Symbols for components having a movable part, for example, a contact, shall be shown in a position or state as follows unless otherwise specified in the diagram or in supporting documentation:

- monostable manually operated or electromechanical components, for example relays, contactors, brakes, and clutches, in the non-actuated or de-energized state;
- circuit-breakers and disconnectors in the open (OFF) position;
- for other switching devices that can rest in any one of two or more positions or states, an explanation shall be given in the diagram, if necessary;
- multi-stable manually operated control switches with a position designated OFF, in that position;
- control switches without a position designated OFF, in a position specified in the diagram;
- control switches for emergency operation, stand-by, alarm, test, etc., should be shown in the position they occupy during normal service of the equipment, or in another position that is specified in the diagram;
- pilot switches operated by a cam, a variable such as position, level, speed, pressure, temperature, etc., in a position specified in the diagram.

7.4.4.2 Functional description

For manually operated control switches with a complex function, a graph shall be included in the diagram, if necessary to understand the function, see Figure 72.

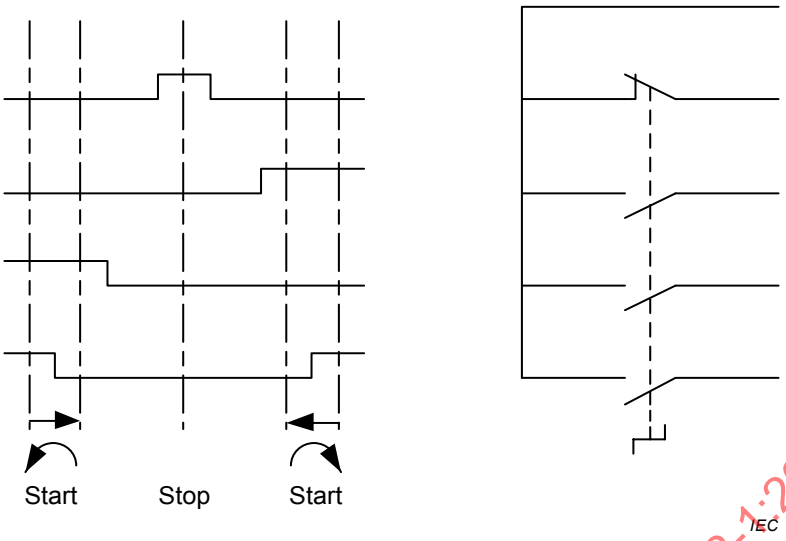
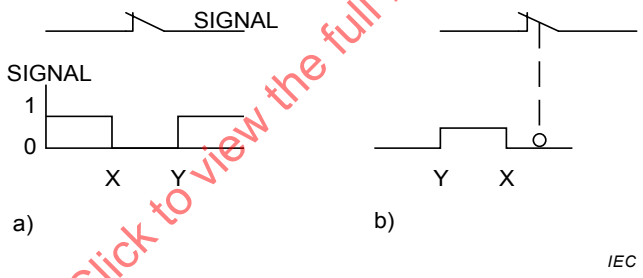


Figure 72 – Symbol of a five-position switch supplemented with a graph

For pilot switches, the diagram shall contain a description of the operation, adjacent to the symbol. This description may consist of:

- a graph, see Figure 73
- a note, see Figure 74.



Explanation: Contact is open between position X and position Y

a) using a symbol of a switch supplemented by a graph

b) using a cam symbol supplemented with a graph

Figure 73 – Examples of pilot switch

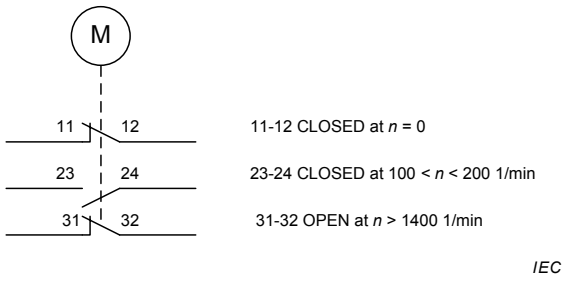


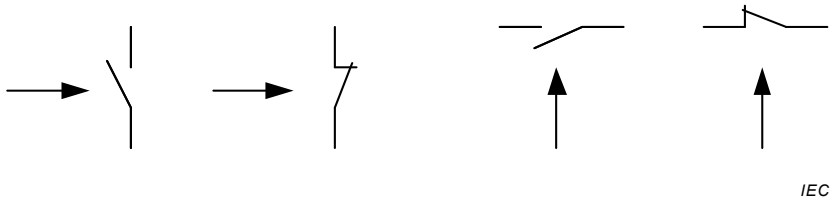
Figure 74 – Symbol of a pilot switch supplemented with a note

7.4.4.3 Representation of semi-conductor switches by contact symbols

Semi-conductor switches shall be shown in the initial state, i.e. at the moment the auxiliary voltage supply has been switched on.

7.4.4.4 Orientation of contact symbols

Contact symbols should be oriented so that the imaginary direction of movement is consistent, for example, movement upwards with horizontal connecting lines or to the right with vertical connecting lines when the component is actuated. See Figure 75.



~~NOTE~~ The arrows in Figure 75 indicate the imaginary direction of movement and are not part of the symbol.

Figure 75 – Orientation of contact symbols

7.4.5 Representation of supply circuits

Connecting lines representing power supplies should be shown in the following sequence top to bottom or left to right:

- for a.c. circuits: L1, L2, L3, N, PE, see Figure 76;
- for d.c. circuits: L+, M, L-, i.e. from positive to negative polarisation, see Figure 77.

The connecting lines should be shown adjacent to each other, or placed at opposite sides of the circuit branches in order to fulfil the requirements of 7.4.2, see Figure 76, Figure 77 and the right hand sides of

~~a) detached presentation of multiple-symbol representation of components~~

~~b) semi-attached representation of multiple-symbol representation of components~~

Figure 64 and of Figure 65.

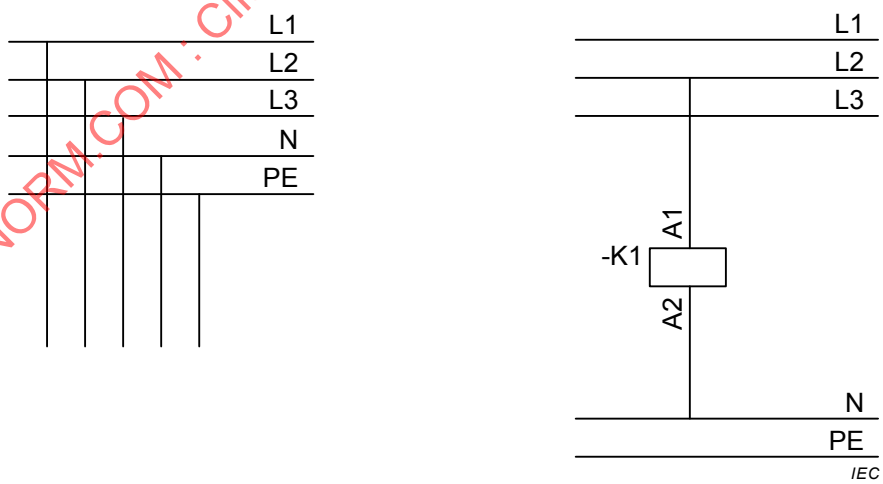


Figure 76 – Representation of a.c. supply circuits

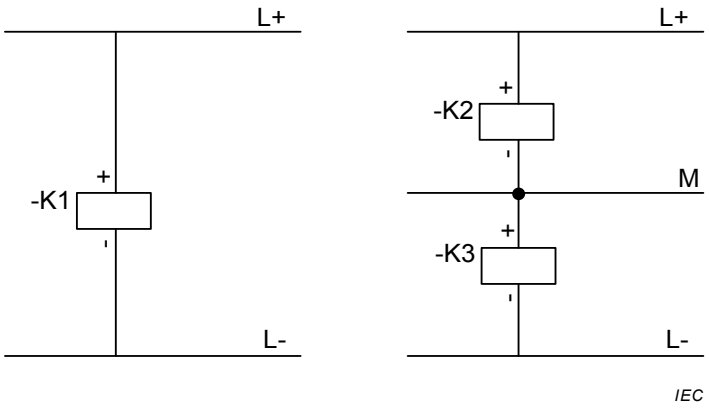


Figure 77 – Representation of d.c. supply circuits

7.4.6 Representation of binary logic elements

Binary logic symbols should be chosen so that the logic polarity or negation indication at an input is the same as that at the source of a signal feeding that input. See Figure 78.

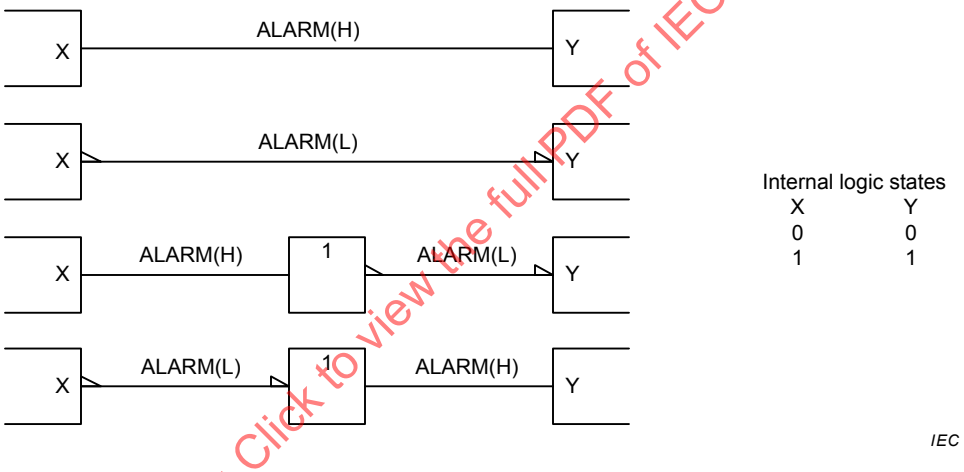


Figure 78 – Examples of use of logic polarity indication

If there is a mismatch between the logic polarity or negation indication at the source of a signal and the indication at the destination, a short perpendicular line shall be shown across the connecting line. The signal name associated with a connection shall be related to the relevant portion of the connecting line, i.e. consistent with the polarity indication, see Figure 79.

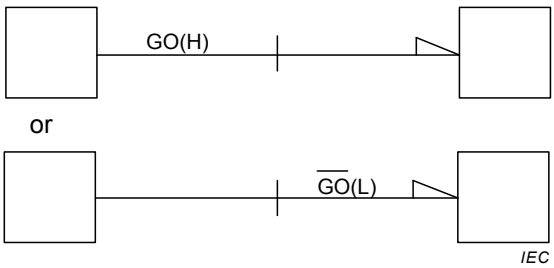


Figure 79 – Examples of mismatched polarity indications

7.4.7 Symbols with a large number of terminals

If the symbol used to represent a device contains a large number of terminals so it is not possible to show the symbol on one page of a diagram and if no other representation of the device is possible, the symbol ~~should~~ may be split at suitable places and the different parts of the symbol shown on different pages following the rules for the detached presentation in 7.4.3.3, see Figure 80

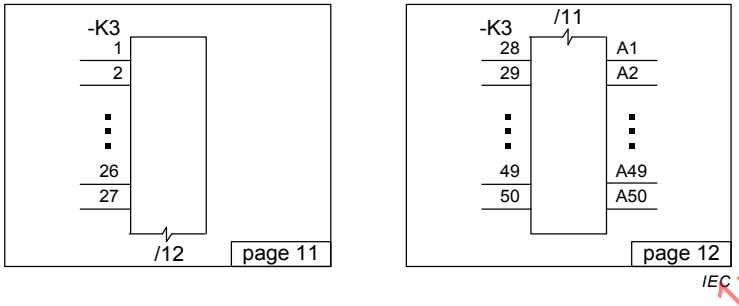


Figure 80 – Example of a split presentation of a symbol

7.4.8 Wired functions (wired-AND, wired-OR)

A wired AND-function shall be shown:

- with the qualifying symbol for the AND-function (&) adjacent to the junction point; or
- by replacing the junction by applying the symbol for the AND-function (symbol S01567 in IEC 60617) together with the character OPEN-CIRCUIT-OUTPUT-SYMBOL (◊) of IEC 61286 as a qualifying symbol indicating the wired function.

A wired OR-function shall be shown:

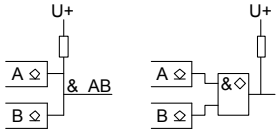
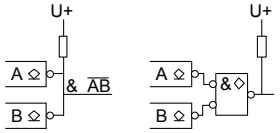
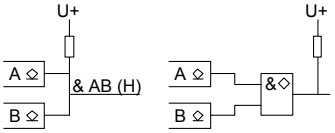
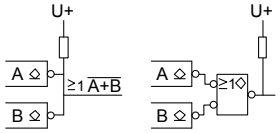
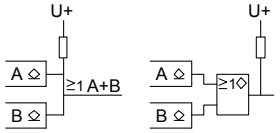
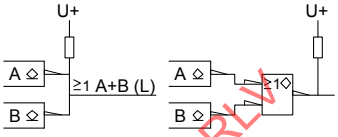
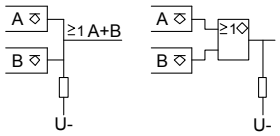
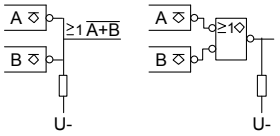
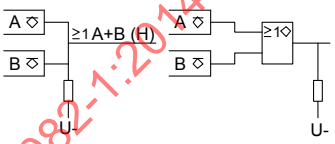
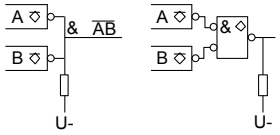
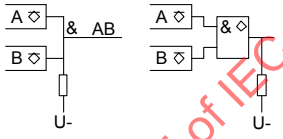
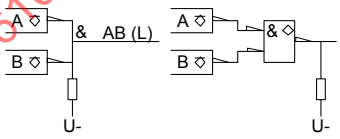
- with the qualifying symbol for the OR-function (≥1) adjacent to the junction point; or
- by replacing the junction by the symbol for the OR-function (symbol S01566 in IEC 60617) together with the character OPEN-CIRCUIT-OUTPUT-SYMBOL (◊) of IEC 61286 as a qualifying symbol indicating the wired function.

All terminals of the binary logic elements involved in a wired function must apply the same qualifying symbol for negation or logic polarity, if needed.

Table 1 shows the possible presentations of wired functions with positive or negative convention (see 7.1.4.2) and with direct logic polarity indication (see 7.1.4.~~1~~3).

NOTE L-type open-circuit outputs (for example, NPN open collectors) connected together perform either active-high ANDing or active-low ORing. H-type open-circuit outputs (for example, NPN open emitters) connected together perform either active-high ORing or active-low ANDing.

Table 1 – Possible distributed logic connections

No	Description	Positive logic	Negative Logic	Direct logic polarity indication
1	AND connection formed by interconnecting L-type open-circuit outputs e.g. NPN open collectors			
2	OR connection formed by interconnecting L-type open-circuit outputs e.g. NPN open collectors			
4	OR connection formed by interconnecting H-type open-circuit outputs e.g. NPN open emitters			
3	AND connection formed by interconnecting H-type open-circuit outputs e.g. NPN open emitters			

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The two presentations within each field of the table are their equivalents

7.5 Connection diagrams

7.5.1 General

Connection diagrams provide information on:

- physical connections (internal) among components of a unit or assembly; or
- physical connections (external) among different units or assemblies (see Figure 81); or
- physical connections (external) to one unit.

The connection points shown in the diagram shall be identified by their terminal designations, and the conductors and/or cables used shall be identified by their reference designation or by another agreed identifier (see also IEC 62491).

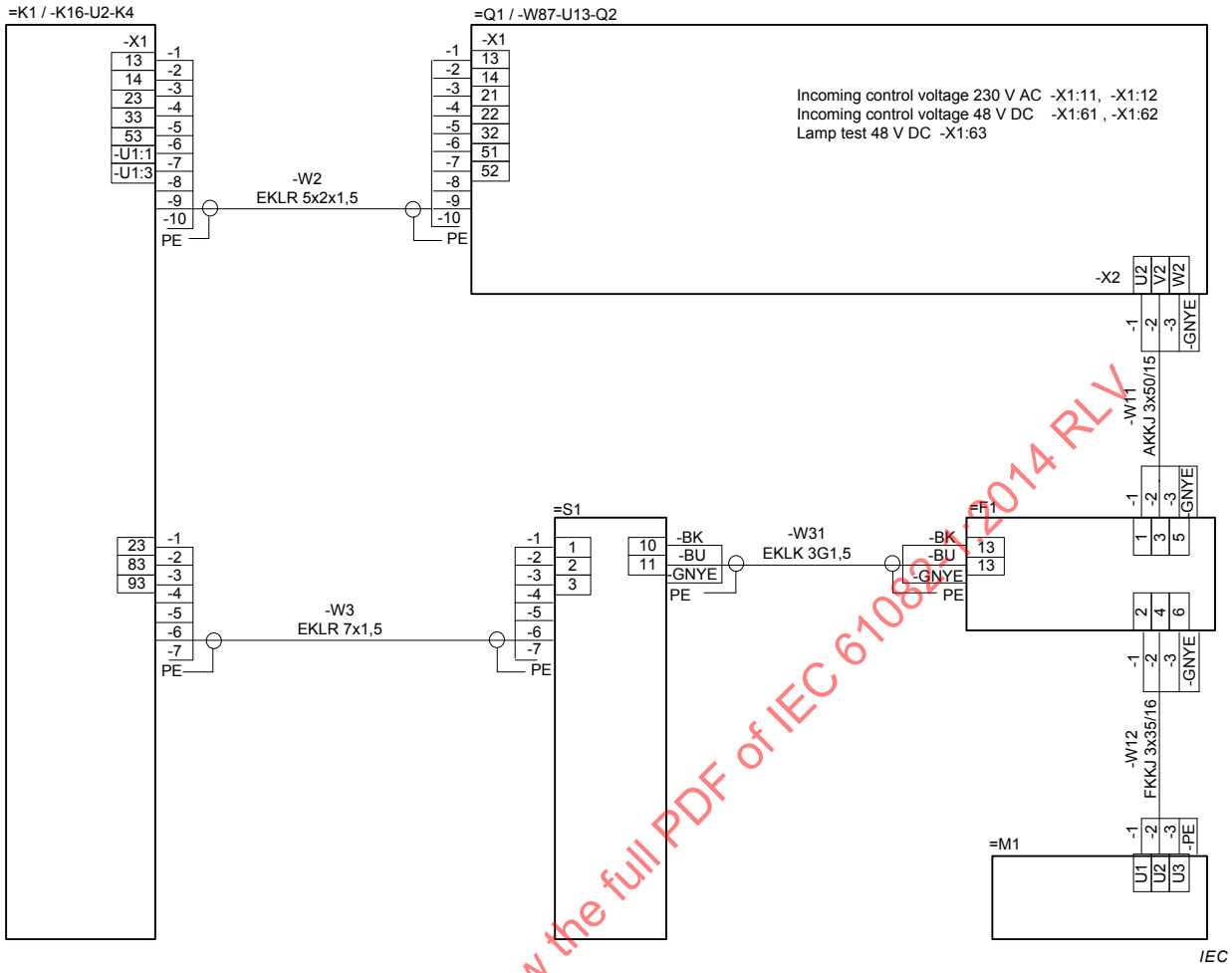


Figure 81 – Example of a connection diagram

Additional information may be included as required for the intended use of the document, such as:

- conductor or cable type information (for example, a recognized type designation, article or part number, material, construction, size, colour of insulation, voltage rating, number of conductors, other technical data);
- conductor, cable number or reference designation;
- instruction for, or methods of, laying, routing, termination, attachment, twisting, screening, etc.;
- length of conductor or cable.

NOTE IEC 60446 specifies the basic safety rules for identification of conductors by colours or numerals.

7.5.2 Representation of devices, units or assemblies

Devices, units or assemblies to be connected should be represented by simple outlines, such as squares, rectangles, or circles, or by simplified pictorial representations. Graphical symbols in accordance with IEC 60617 may also be used.

The presentations of the devices, units or assemblies shall be arranged to facilitate the intended use of the diagram.

~~NOTE~~ This implies for example that it is not necessary for the presentations to be shown according to the physical locations of the devices, units or assemblies.

7.5.3 Representation of terminals

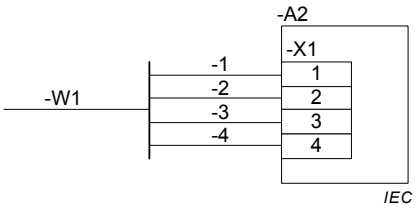
The identification of each terminal presented shall be shown.

The presentations of the terminals shall be ordered to facilitate the intended use of the diagram.

~~NOTE~~ This implies for example that it is not necessary for the presentations to be shown according to the physical location of the terminals.

7.5.4 Representation of cables and its constituent cores

If a multi-core cable is represented by a single connection line and its constituent cores shall be shown connected to the representation of physical terminals, the connection line representing the cable shall be terminated at a cross-line, and the connection lines representing the cores shall go from this cross-line to the representation of the physical terminals. The cable and its cores shall be clearly identified, for example by their reference designations, see Figure 82.



Reference designation Cable cores	Terminal designations
-W1-1	-A2X1:1
-W1-2	-A2X1:2
-W1-3	-A2X1:3
-W1-4	-A2X1:4

Figure 82 – Example of presentation of termination of a multi-core cable

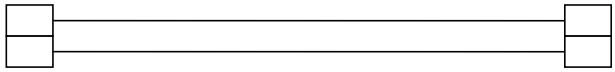
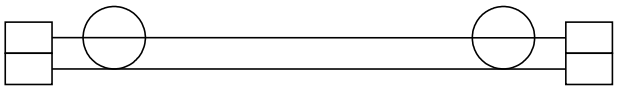
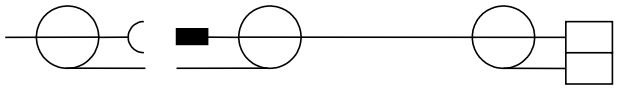
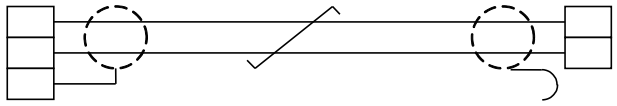
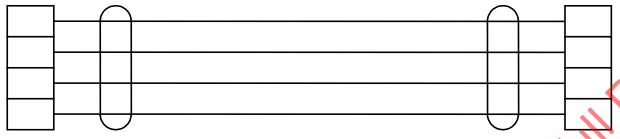
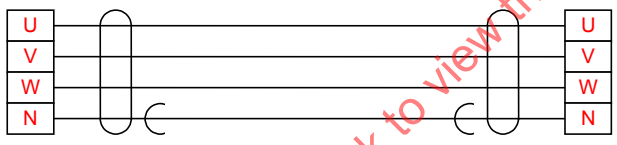
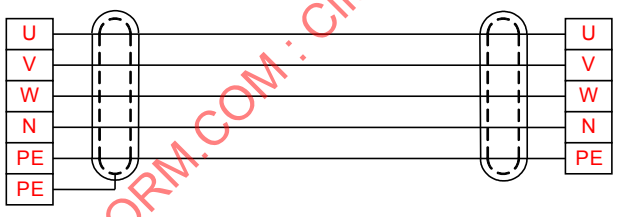
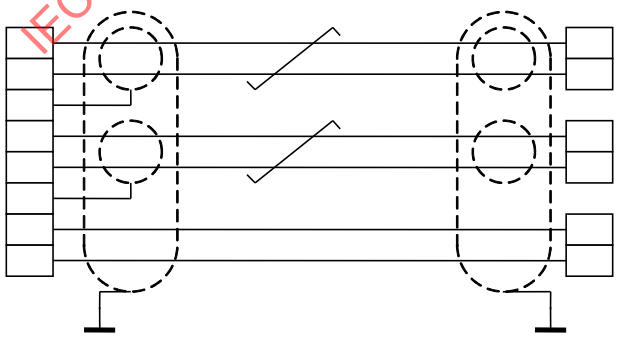
7.5.5 Representation of conductors

Conductors shall be represented using connecting lines in accordance with 7.1.3.

Symbols for T-connections (symbols S00019 and S00020 in IEC 60617) shall not be used unless there is a physical junction.

Figure 83 shows a number of examples of how connections to various types of cables may be represented using symbols of IEC 60617.

~~NOTE The representation of cables shown may also be applied in other kinds of diagrams.~~

	Connection with two conductors (symbol S00001 in IEC 60617 (2001-07))
	Connection with a coaxial cable (symbol S00011 in IEC 60617 (2001-07))
	Connection of a coaxial cable with plug and socket (symbol S00042 in IEC 60617 (2001-07)) in one end
	Connection of screened cable (symbol S00013 in IEC 60617 (2001-07)). The screen connected to functional earth (symbol S01410 in IEC 60617 (2001-07)) in one end and not connected in the oher (symbol S00014 in IEC 60617 (2001-07))
	Screened twisted-pair cable (symbol S00008 in IEC 60617 (2001-07)). The screen connected in one end only.
	Four conductors in a cable (symbol S00009 in IEC 60617 (2001-07)).
	Four conductors in a power cable. The neutral conductor being concentric (symbol S01807 in IEC 60617 (2001-07)).
	Five conductors in a power cable. The cable is provided with a metallic shield connected to protective earth in one end.
	Cable with two screened twisted pairs and two further conductors, with the external screen connected to function earth in both ends.

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NOTE The representation of cables shown can also be applied in other kinds of diagrams.

Figure 83 – Example of cable connections

7.5.6 Simplified presentation

The presentation may be simplified by:

- lining up the presentation of the terminals of each unit, device or assembly vertically [horizontally]; and
- lining up the interconnected terminals of the different devices, units and assemblies horizontally [vertically]; and
- omitting the presentations of their outline.

Figure 84 shows a complete connection diagram for a sub-rack, while Figure 85 shows a simplified presentation for the same.

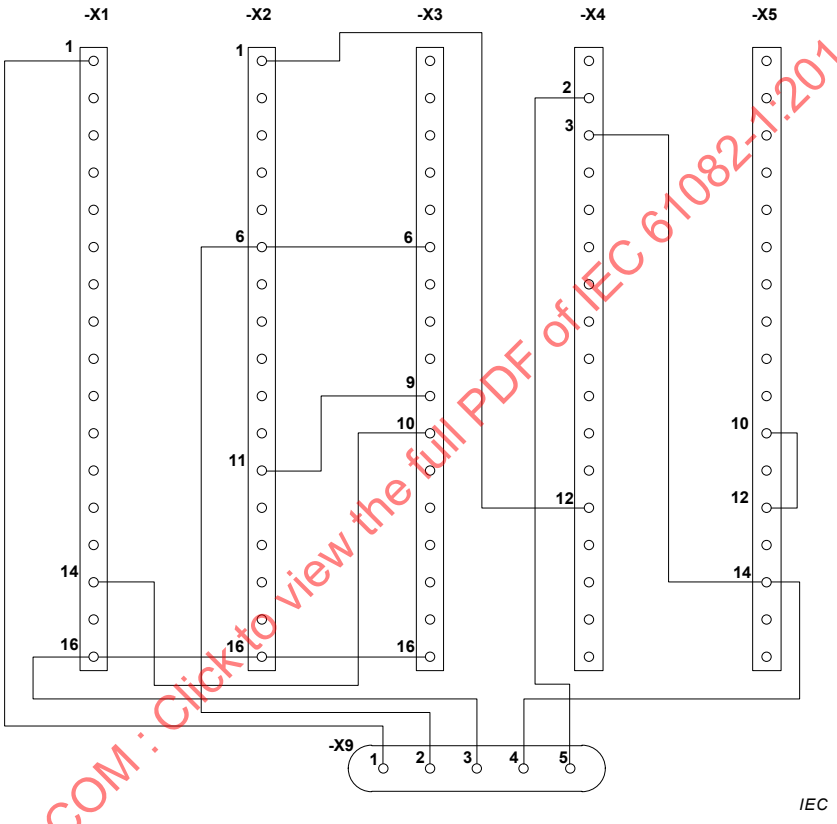


Figure 84 – Example of connection diagram for a sub-rack

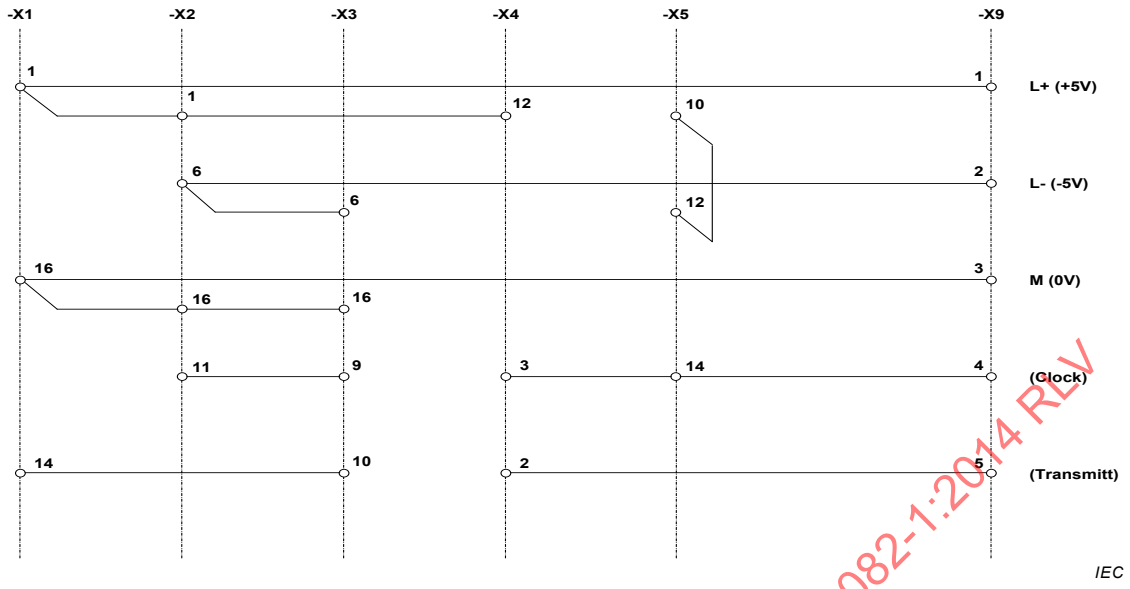


Figure 85 – Example of simplified presentation of a connection diagram

8 Drawings

8.1 General

Drawings mainly describe the topographical or geometrical position of objects often based on 2D- and/or 3D-models, following the rules of relevant ISO standards.

This International Standard specifies rules for arrangement drawings used in electro-technology, often developed by applying a base document.

8.2 Requirements on base documents

Base document, such as

- site plans;
- building drawings;
- dimension drawings (for mechanical units),

shall be drawn to scale.

The content of the base document becomes an integral part of the arrangement drawing.

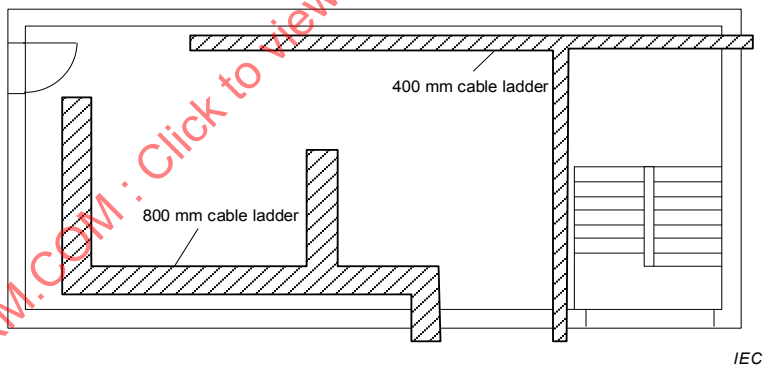
Base drawings shall show all necessary information for the preparation of arrangement drawings for locating electrical equipment, such as:

- geographical orientation points;
- north-direction indicator;
- location and outline of buildings, traffic areas, service networks, access facilities and site boundaries;
- outline and constructional details of rooms, cabins, corridors, openings, windows, doors, etc., in plans and sectional views;
- obstacles related to constructions, for example structural beams, stanchions;
- the load capacity of floors or decks and any limitations on cutting, drilling or welding;

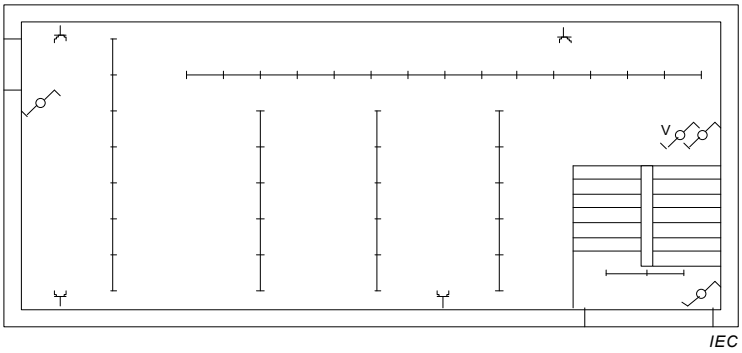
- clearances for special installations like lifts, cranes, heating, cooling and ventilation systems;
- hazardous areas;
- existing earthing points;
- space available and access required;
- limitations on fixing arrangements;
- ~~conductor~~ cable routing areas;
- existing access points and transport routes;
- ~~insulation~~ environmental conditions.
- ~~enclosure specifications (moisture, dust).~~

Figure 86 shows how a base document can be applied in different arrangement drawings.

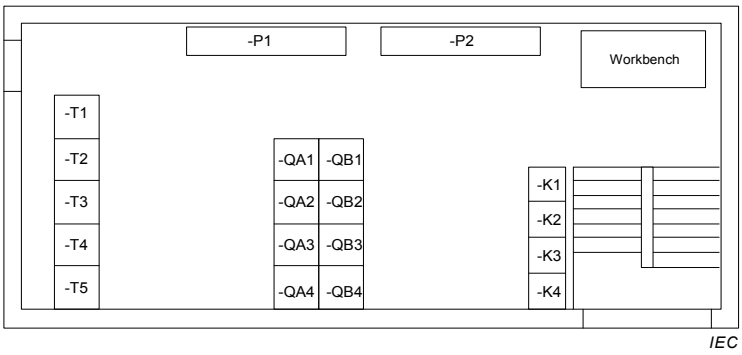
a) Architectural base drawing



b) Base drawing with cable routes added



c) Base drawing with lighting installation added



d) Base drawing with arrangement of switchgear and telecommunication cubicles added

Figure 86 – Example of the use of a base document

8.3 Arrangement drawings

An arrangement drawing is showing the relative or absolute location and/or dimensions of objects.

Objects are represented by:

- their shape or simplified outlines;
- their main dimensions; or
- by symbols in accordance with IEC 60617.

Detailed information may be necessary in the form of exact distances and/or dimensions.

The information shall be presented together with necessary information on the environment in which the objects are (to be) located.

Information on identification of objects ~~and designations~~ shall be included.

Technical data of an object, if needed, may be shown adjacent to the symbol or outline that represents the object, see Figure 87.

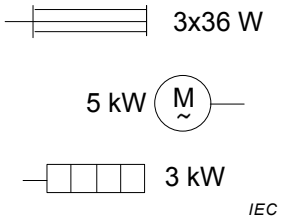


Figure 87 – Presentation of technical data

~~Mounting methods and/or directions may be stated in the document.~~ If single objects require different mounting methods or directions, this may be specified by presenting qualifying symbols in accordance with IEC 60617 or letter codes adjacent to the object representation ~~see 88 . The letter codes used shall be explained in the document or in supporting documentation. The recommended letters~~. Examples of letter codes for mounting of components are:

- H = horizontal (components mounted side by side)

- V = vertical
- F = flush (recessed)
- S = surface
- B = floor (bottom)
- T = ceiling (top)
- UB = mounting in false floor
- UT = mounting in false ceiling.

Letter codes for mounting methods are subject to be standardized in IEC 60617 in relation to specific symbols by means of an application note. Some symbols refer, for example, to an application note designated A00266 that establishes letter codes used in the above list.

If non-standardized letter codes are used, these shall be explained in the document or in supporting documentation.

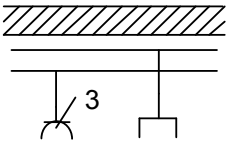
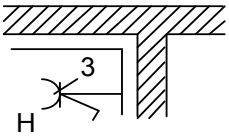
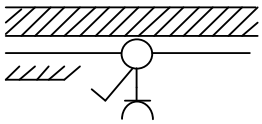
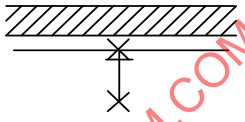
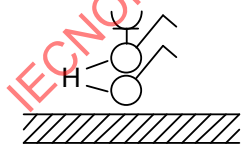
	Triple-socket-outlet mounted beside telecommunication socket-outlet
	Triple-socket-outlet with switches placed on a side wall."H" indicates horizontal mounting
	Single-pole switch and socket outlet connected to a transversing lead, conductor mounted under surface
	Two lighting outlets, one mounted in a wall with branch-off to another mounted in the ceiling
	Two switches, horizontally mounted, and a socket-outlet

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Figure 88 – Examples of the use of symbols for indication mounting methods

Arrangement drawings may include representation of connections. Connecting lines shall be clearly distinguishable from lines of the base document, and follow the rules given in 7.1.3 with the addition that curved lines may be used.

Connecting line shall show which components that are connected to each circuit and in which order. In the case of surface mounting or when ducts and conduits are used, the actual routing of the connection shall be shown.

Multi-phase circuits may be presented using single-line presentation in accordance with 7.1.9.

Multiple parallel connecting lines may be represented by using simplified presentation in accordance with 7.1.3.6.

Figure 89 shows an example of an arrangement drawing of a mounting panel of a cubicle, while Figure 90 shows an example of an arrangement drawing of industrial plant.

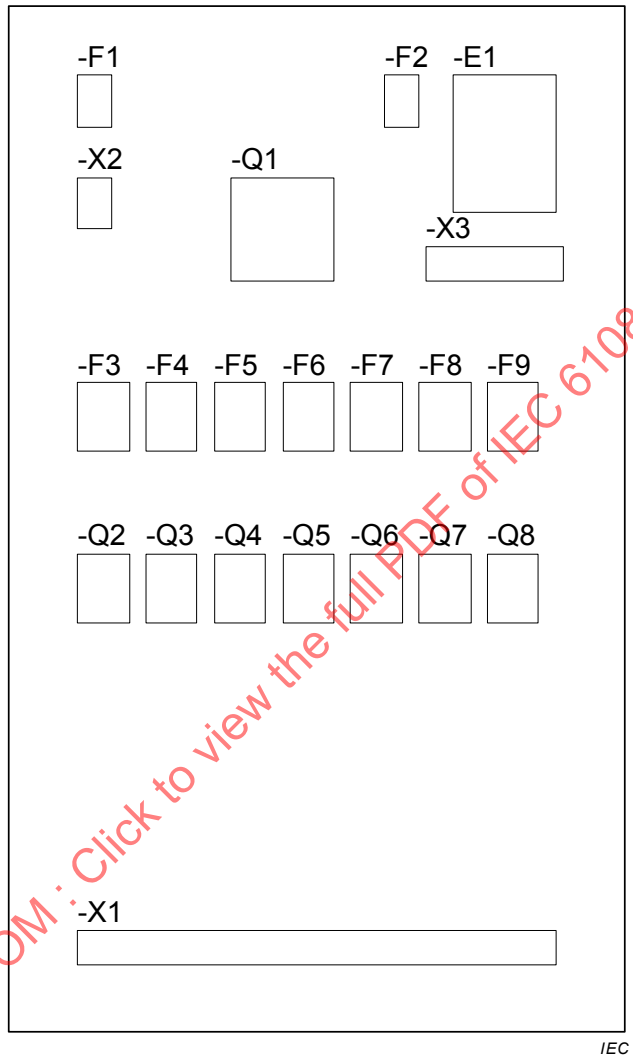


Figure 89 – An arrangement drawing the mounting panel of a cubicle

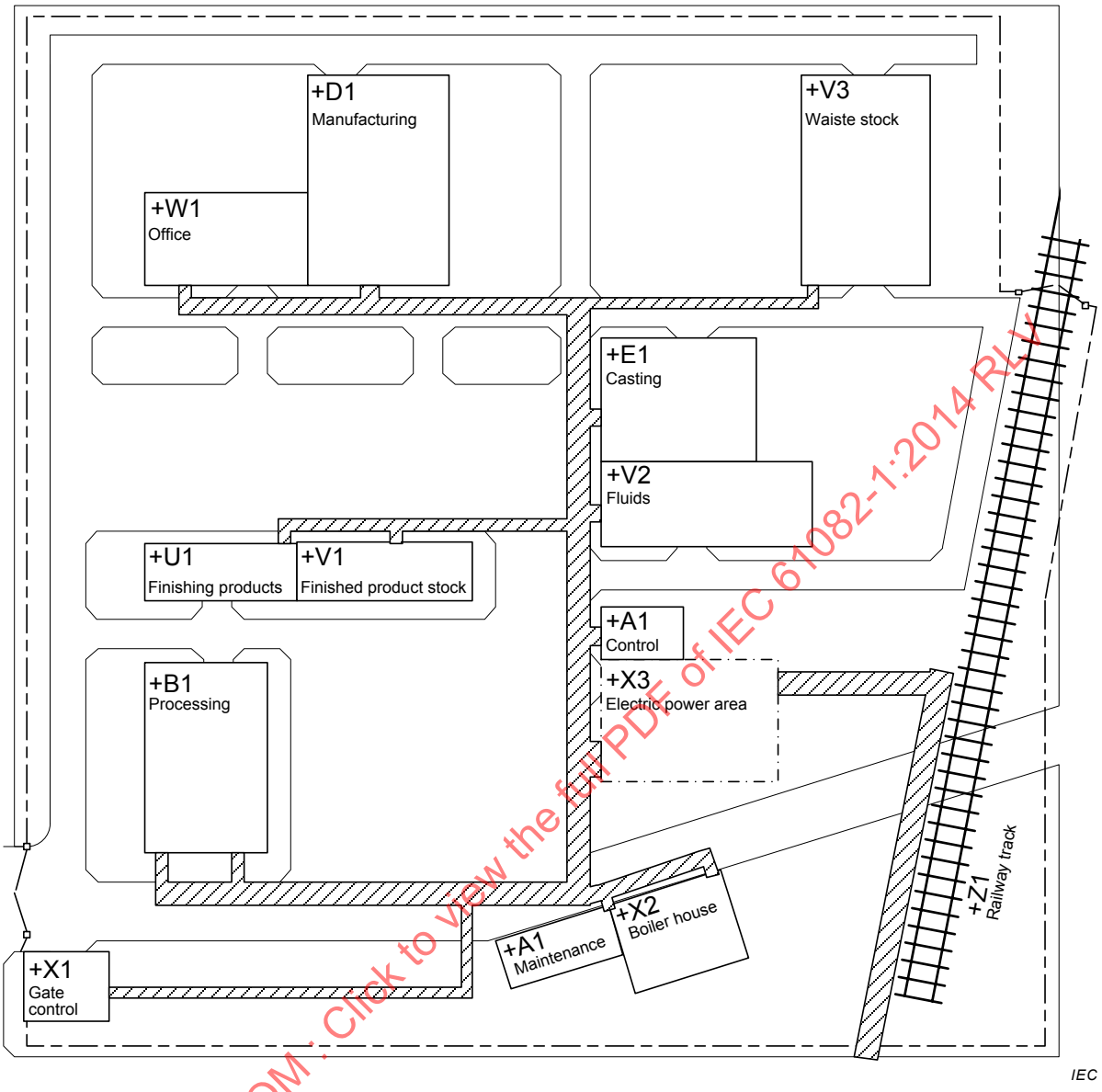


Figure 90 – An arrangement drawing of an industrial plant

9 Tables

9.1 General

Each row of a table shall be clearly distinguishable from the other rows, and each column of a table shall be clearly distinguishable from the other columns.

The kind of information presented in each column and row shall be clearly indicated. This indication, for example a heading row or heading column, shall be provided on each page of the presentation.

9.2 Presentation of reference designations

For presentation of reference designations and identifiers (for example terminal designation including the reference designation, signal designations) in a table, the following rules apply:

- Identifiers within a column of a table may be simplified presented by showing the common initial portion (see 5.20.2) in the header for the column of the table, omitting the common initial portion from the presentation of object identifiers in that column, see Figure 91;
- Identifiers in the column not to be preceded by the common initial portion given for that column shall be preceded by the character “GREATER-THAN” (>), see Figure 91;
- Identical identifiers on successive rows within a column of a table, may be presented on the first relevant row only, see Figure 92.

Reference designation **-AB1**			**Reference designation**	
-C2			-AB1C2	
-R1		**Corresponds**	-AB1R1	
-R2		**to**	-AB1R2	
-AR11			-AB1AR11	
-K9			-AB1K9	
>-AB2-C1			-AB2C1	
>-XY7-R9			-XY7R9	

Figure 91 – Example setting the common initial portion in the table header

Reference designation			**Reference designation**	
-AB1	-C2		-AB1C2	
	-R1	**Corresponds**	-AB1R1	
	-R2	**to**	-AB1R2	
	-AR11		-AB1AR11	
	-K9		-AB1K9	
-AB2	-C1		-AB2C1	
-XY7	-R9		-XY7R9	

Figure 92 – Example omitting the common initial portion on successive lines

9.3 Connection tables

Connection tables provide information on:

- physical connections (internal) among components of a unit or assembly; or
- physical connections (external) among different units or assemblies; or
- physical connections (external) to one unit.

The connection points shown in the connection table shall be identified by their identification, for example reference designation and terminal designation. The cables and objects being connected shall be clearly identified, for example by their reference designation. Cable cores shall be identified by their core identifier provided by the cable manufacturer, for example core number or colour code, or by any other identifier provided for it. Additional information may be included as required for the intended use of the document, such as:

- conductor or cable type information (for example, a recognized type designation, article or part number, material, construction, size, colour of insulation, voltage rating, number of conductors, other technical data);
- ~~conductor,~~ cable number or reference designation;

- conductor and cable core designation;
- instruction for, or methods of, laying, routing, termination, attachment, twisting, screening, etc.;
- length of conductor or cable.

Connection tables should be prepared by using one of the following sorting methods:

- terminal-oriented, in which the sequence of the connections presented shall be sorted in accordance with the identification of the terminals, see Figure 93 and Figure 94;
- connection-oriented, in which the sequence of the connections presented shall be sorted in accordance with the identification of the conductors, for example reference designation of the cable and the core identifier, see Figure 95.

Object-A4	Terminal	Cable	Core
-X1	:11	-W136	-1
	:12	-W137	-1
	:13	-W137	-2
	:14	-W137	-3
	:15	-W137	-4
	:16	-W137	-5
	:17	-W136	-2
	:18	-W136	-3
	:19	-W136	-4
	:20	-W136	-5
	:PE	-W136	-GNYE
	:PE	-W137	-GNYE

Figure 93 – Example of a terminal-oriented connection table

Terminal -A4-X1			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		N	PE	Not connected
Remote end	Cable des.	No. of cores																										
-B4-X1	-W136	6											1						2	3	4	5					GNYE	
-B4-X2	-W137	7												1	2	3	4	5									GNYE	6

Figure 94 – Example of a connection table with remote end designations

Cable designation	Core designation	Terminal-A4-X1	Remote End-B4	Remarks
-W136	-GNYE	:PE	-X1:PE	
	-1	:11	-X1:33	
	-2	:17	-X1:34	
	-3	:18	-X1:35	
	-4	:19	-X1:36	
	-5	:20	-X1:37	Spare
-W137	-GNYE	:PE	-X2:PE	
	-1	:12	-X2:26	
	-2	:13	-X2:27	
	-3	:14	-X2:28	
	-4	:15	-X2:29	
	-5	:16		Spare
	-6			Not connected

Figure 95 – Example of a connection-oriented connection table

10 Charts, graphs

10.1 General

Charts, graphs may be used for providing explanatory information for the understanding of the functional behaviour of a component or a system, often as addition to other document kinds. The details of the presentation shall be clearly related to the objects they explain, for example by the use of:

- reference designations
- signal designations
- terminal designations
- descriptive text
- ~~Location of presentation~~

10.2 Function charts

For function charts describing the functions and behaviour of a control system by means of steps and transitions, see IEC 60848.

10.3 Sequence charts and time sequence charts

Sequence charts shall show the succession of operations or status of the units of a system.

Time sequence charts shall provide information on operational or functional sequences in relation to time and/or different operational or functional sequences related to each other, see Figure 96.

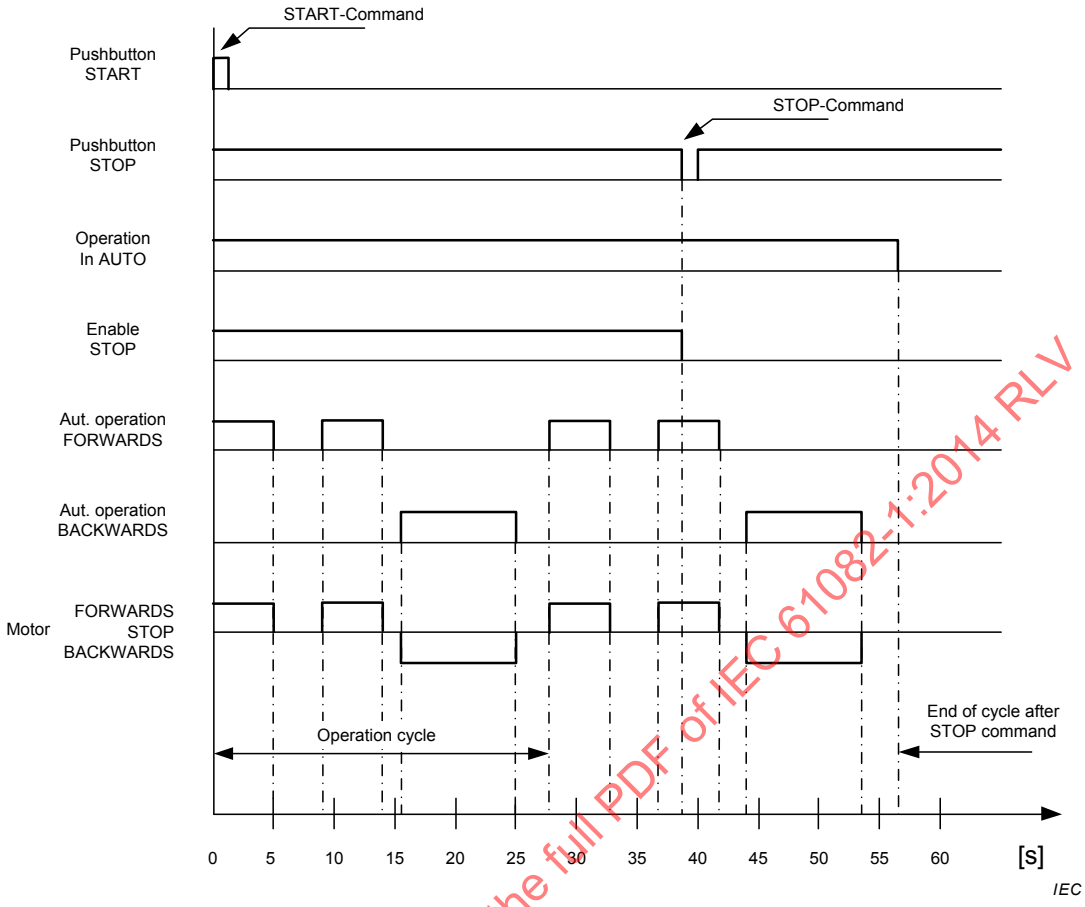


Figure 96 – Example of a time sequence chart

11 Structured documentation

11.1 General

~~IEC 61346-1~~ IEC 81346-1 specifies how an aspect of an object can be subdivided into aspects of other objects. The subdivision can be performed recursively, thus resulting in a tree-like structure showing how an object, i.e. aspect of an object, is constructed of others. Each node in such a tree-like structure represents an object. Each object may be associated with documentation that describes the object as it is.

IEC 62023 specifies how documentation can be structured based on a main document. This publication utilizes how a type description of an object may be referenced from different places in the tree-like structures.

An explanation of type and occurrence of an object is provided in the introduction to ~~IEC 61346-1~~ IEC 81346-1. An object type represents all of objects that are identical with respect to their characteristics and behaviour. An object occurrence represents one specific use of the object type.

In order to facilitate reuse of documentation associated with an object type, the following items need to be considered carefully in the preparation of documents:

- Presentation of an object type at its occurrences, see 11.2;
- Referencing from the object occurrences to the documentation associated with the object type, see 11.3;
- Metadata to be presented in the identification area of documents, see 11.4.

11.2 Presentation of occurrences of an object type in diagrams

11.2.1 General

The presentation of an occurrence of an object type may be performed either using:

- an instance diagram of the object type; or
- a single symbol representing the object type.

11.2.2 Using an instance diagram

An instance diagram is a representation of the object type by a simplified diagram where external connections are made to terminals of internal constituent objects, see Figure 97. An instance diagram shall be enclosed by a boundary frame in accordance with 7.1.5.

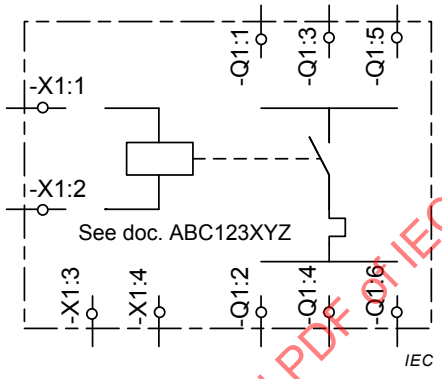


Figure 97 – Example of an instance diagram of a motor starter

11.2.3 Using a single symbol

When using a single symbol, for example based on the general symbol S00060, representing the occurrence of the object type, this symbol shall provide all necessary information for the understanding of the diagram in which the symbol is applied.

Figure 98 shows a symbol for the motor starter shown in Figure 97.

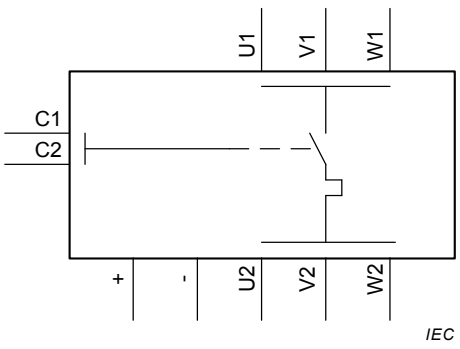


Figure 98 – A symbol for a motor starter

Any terminal designation assigned to the symbol shall be designations of the terminals of the object type, and thus be described in the underlying documentation associated with the object type. Figure 99 shows a document using the table form of presentation for providing such a description.

The terminal designations of an object type are not necessarily identical to the designation assigned by the manufacturer of a specific product. They constitute a neutral, manufacturer-independent designation introduced by the designer of the complete system.

NOTE The symbol shown in Figure 98 ~~may~~ can also be considered as a functional description of the motor starter, thus the terminal designations indicated are the functional terminal designations. The mapping table shown in Figure 99 shows the mapping between the functional terminals and the physical terminals of the internal constituent objects.

(External) Terminal	Internal constituent object terminal	Remark
:C1	-X1:1	
:C2	-X1:2	
:U1	-Q1:1	
:V1	-Q1:3	
:W1	-Q1:5	
:U2	-Q1:2	
:V2	-Q1:4	
:W2	-Q1:6	
:+	-X1:3	
:–	-X1:4	

~~NOTE 2~~ The mapping table ~~shown in Figure 99~~ may be used by CAx-tools to associate the external terminal shown at the symbols to those terminals to where the physical connections are made.

Figure 99 – Example of a document in table form describing the relations between external terminals of a motor starter to the internal terminals of its components

The same object type may be associated with different symbols depending on the context of where it is represented. Figure 100 shows another symbol for the motor starter shown in Figure 97, intended to be used in a diagram with single line representation. The terminal designations shown at the symbol represent terminal groups. Figure 101 shows the table describing the terminals shown in Figure 100 and the relations to terminals shown in Figure 98 and Figure 97.

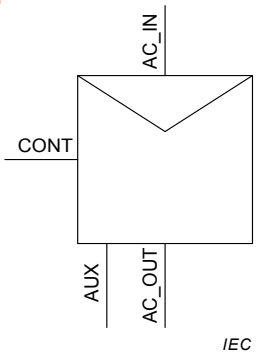


Figure 100 – A symbol for the motor starter, for single-line presentations

(External) Terminal group	(External) Terminal	(Internal) constituent object terminal	Remark
CONT	:C1	-X1:1	
	:C2	-X1:2	
AC_IN	:U1	-Q1:1	
	:V1	-Q1:3	
	:W1	-Q1:5	
AC_OUT	:U2	-Q1:2	
	:V2	-Q1:4	
	:W2	-Q1:6	
AUX	:+	-X1:3	
	:-	-X1:4	
NOTE The symbol for single line presentation can be considered as a functional description of the motor starter, thus the terminal designations indicated are the designation of the functional terminal group. This mapping table shows the mapping between the functional terminals and the physical terminals of the internal constituent objects			

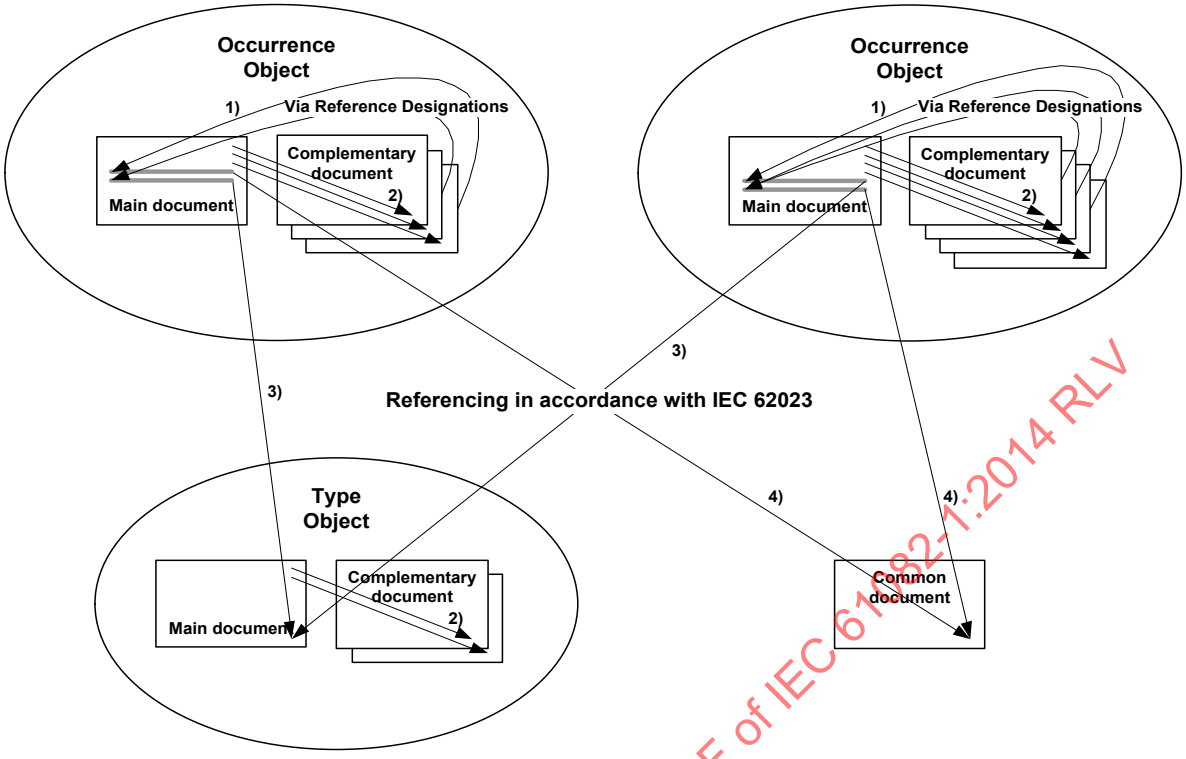
Figure 101 – Example of a document in table form describing the relations between external terminals of a motor starter to the internal terminals of its components

11.3 Referencing

When object occurrences are shown in a document, it is necessary to provide mechanisms in order to easily get to the detailed description of the corresponding object type.

If the documentation follows the principles in IEC 62023, the reference from the object occurrence representation to the object type documentation may be performed by means of the main document associated with the object occurrence, see Figure 102.

NOTE 1 This mechanism can be supplemented with a direct reference from the object occurrence to the relevant object type document.



Explanations:
1) Referencing from the occurrence representation to the main document.
2) Referencing from the main document for an object to complementary documents.
3) Referencing from the main document for an object to main document of the object type applied within the first.
4) Referencing from the main document for an object to shared document.

IEC

Figure 102 – Referencing in accordance with IEC 62023

If the documentation does not apply the main document principle, as specified in IEC 62023, the reference from the object occurrence representation to the object type documentation shall be performed by a direct reference to the relevant object type document, see Figure 103.

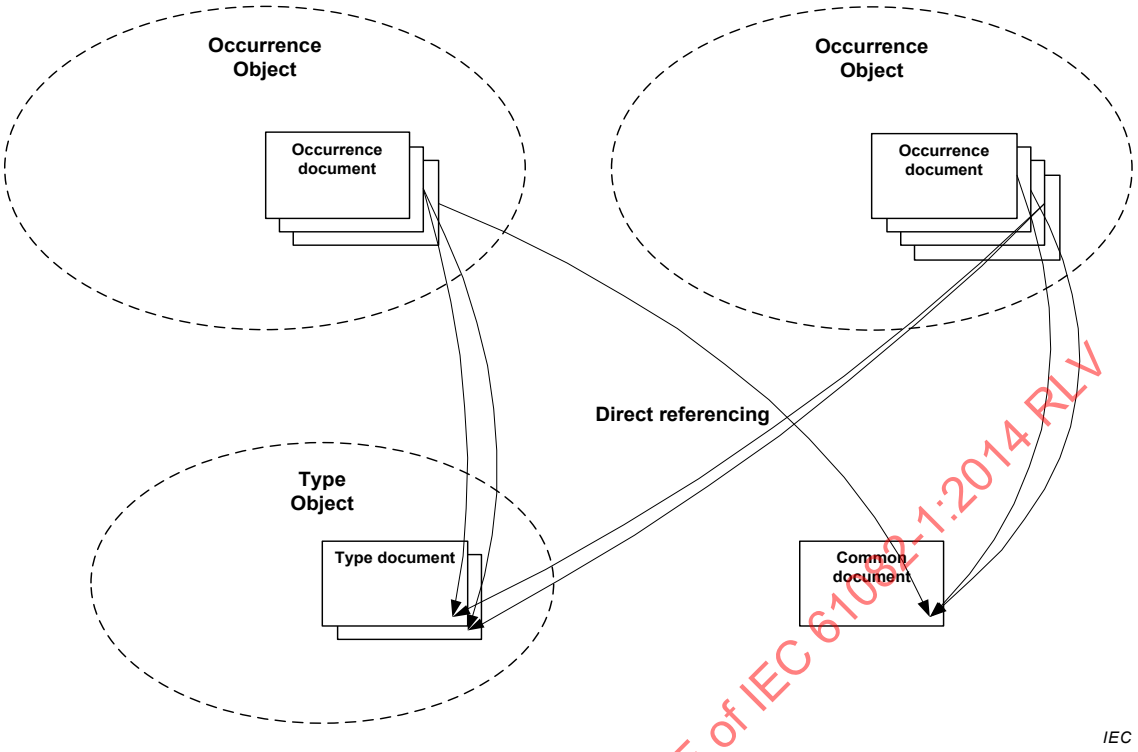


Figure 103 – Direct referencing

Within the object type documentation there should be no explicit references to any presentation of occurrences of that object type.

NOTE 2 Where changes are made to a single occurrence of an object type, documentation for a new object type has to be created.

11.4 Document metadata

Documents shall be associated with metadata in accordance with ~~ISO~~ IEC 82045-1 and IEC 82045-2. Some of these data are presented in the identification area of the document (i.e. the title block). See also Annex B.

Metadata of documents associated with an object type shall only be related to that object type. No references shall be made to objects external to the object type or to occurrences of the object type.

~~NOTE~~ It is important to notice that any reference designations occurring in the documents refer to the described object as the top node of its tree-like structures.

12 CAx conformance requirements

Computer-aided tools stated to be in compliance with this International Standard shall comply with the relevant standards from the following list:

- IEC 60617 for the shapes of graphical symbols for diagrams;
- IEC 60848 for the preparation of sequential function charts;
- IEC 61175 for the designation of signals;
- ~~IEC 61346 for reference designations;~~
- IEC 61355-1 for the management of documents by means of document classification and designation;

- IEC 61666 for the identification of terminals within a system;
- IEC 62023 for the structuring of information;
- IEC 62027 for the preparation of parts lists;
- ~~IEC 62079 for the preparation of instructions;~~
- IEC 62491 for labelling of cables and cores
- IEC 81346-1 and IEC 81346-2 for reference designations;
- ISO 81714-1 for the design of graphical symbols;
- IEC 81714-2 for graphical symbols;
- IEC 82045 for the management of administrative data related to documents~~.~~;
- IEC 82079-1 for the preparation of instructions for use.

Annex A
(normative)

Construction of a symbol for an object which does not have a symbol in IEC 60617

A.1 General rules

When the graphical symbol required is not found in IEC 60617, the symbols S00059, S00060 or S00061 can be applied (see Figure A.1), or it may be possible to create one from the existing ones as explained below.

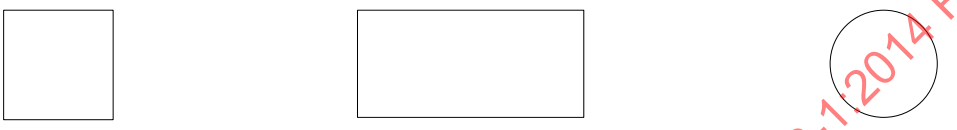


Figure A.1 – The general symbols for an object in IEC 60617 ~~DB~~

Pick a basic symbol (i.e. an existing symbol that expresses best the basic concept) and then combine it with one or more appropriate supplementary symbol.

Supplementary symbols are:

- primarily symbols in IEC 60617 explicitly depicted as "Qualifiers" in their application class; or
- any other symbol in IEC 60617, if necessary suitably modified in size; or
- other symbols or identifiers specified in supporting documentation.

The supplementary symbols can be placed inside, outside or across the basic symbol. No simple rule can be given, since the placement to a high degree depends on the shapes of the symbols, available space in or around the basic symbol, etc.

Do not overload the symbol. Limit the number of supplementary symbols to what is required to emphasise the wanted concept.

For further guidance on the design of symbols refer to the ISO 81714-1 and IEC 81714-2.

IEC 60617 contains numerous examples on how this is done. In IEC 60617 ~~database,~~ look at a complex symbol and follow the links under the attribute "Applying" to see how the symbol is built from a set of more simple ones.

A symbol created as a combination of already existing symbols and in line with the rules given in ISO 81714-1 and IEC 81714-2 is considered to be in accordance with IEC 60617.

A.2 Example – Miniature circuit-breaker

There is no symbol in IEC 60617 ~~DB~~ that specifically represents a miniature circuit-breaker. In many application areas such a symbol has been requested, and it is therefore considered useful to describe how a symbol for such a device can be constructed utilising the existing symbols in IEC 60617 ~~DB~~.

a) A miniature circuit-breaker is, as the term says, a small circuit-breaker. Thus the symbol for a circuit-breaker, i.e. symbol S00287 in IEC 60617, can be applied. By using this symbol, however, it is not possible to distinguish between a “normal” circuit-breaker and a miniature circuit-breaker by the graphical symbols. The symbol for a miniature circuit-breaker will then be as shown in Figure A.2.

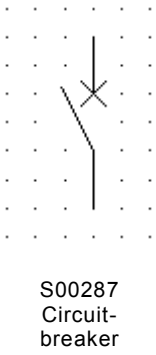


Figure A.2 – Miniature circuit-breaker shown with the symbol for a circuit-breaker

b) The main function of a miniature circuit-breaker is that it shall open (i.e. break) the circuit in which it is located. The main concept is switching. The general symbol for a switch is S00227. However, a miniature circuit-breaker shall trip automatically, and IEC 60617 ~~DB~~ contains a qualifying symbol for indicating an automatic tripping function, i.e. symbol S00222 in IEC 60617. This symbol may therefore be applied in addition to the general switch symbol, and the symbol assembly will be as shown in Figure A.3.

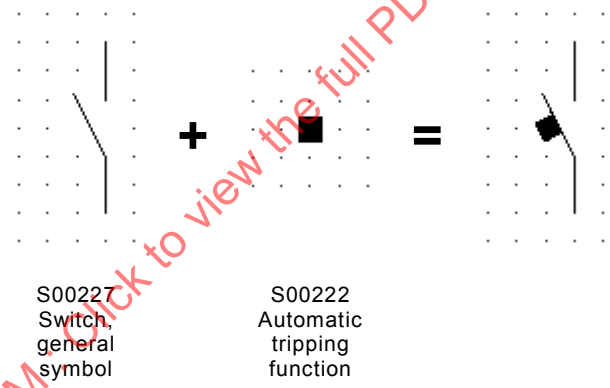


Figure A.3 – Miniature circuit-breaker shown with the general symbol for a switch qualified with the symbol for automatic tripping

This symbol does not exactly indicate that the breaker has a circuit-breaker function. It only shows that the breaker has an automatic tripping function.

c) Another alternative would be to use the symbol for a circuit-breaker as the base symbol instead of the general symbol for a switch (breaker), see Figure A.4, then illustrating a circuit-breaker with automatic tripping.

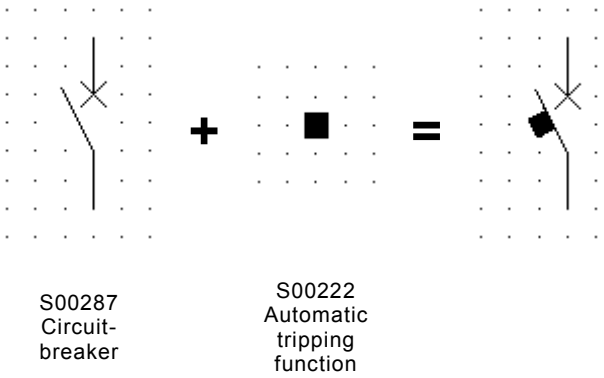


Figure A.4 – Miniature circuit-breaker shown with the symbol for a circuit-breaker qualified with the symbol for automatic tripping

d) The operating mechanism of a miniature circuit-breaker is based on two tripping mechanism, one based on a thermal effect, and one based on an electromagnetic effect. In order to illustrate a breaker based on these two mechanisms, the general symbol for a switch (breaker), i.e. S00227, can be used as a base. The qualifying symbol indicating the thermal effect, i.e. S00120, and the qualifying symbol indicating the electromagnetic effect, i.e. S00121, can then be added, see Figure A.5.

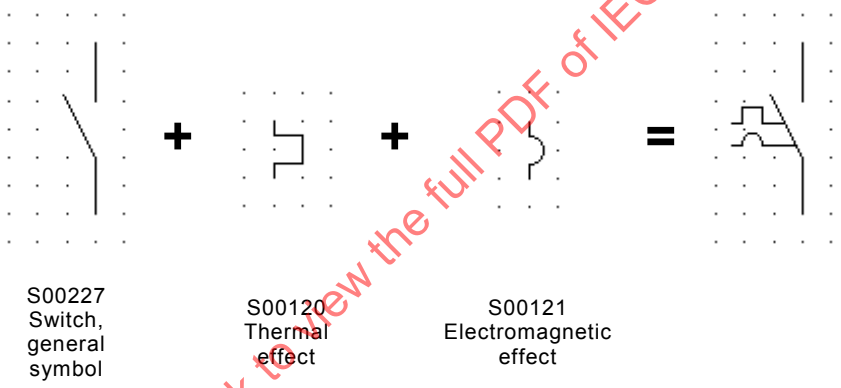


Figure A.5 – Miniature circuit-breaker shown with the general symbol for a switch qualified with the symbols for thermal and electromagnetic effects

Another alternative would be to replace the general switch symbol, i.e. S00227, as used in alternative d) with the symbol for a circuit-breaker, i.e. S00287. The symbol assembly may look somewhat overloaded, see Figure A.6.

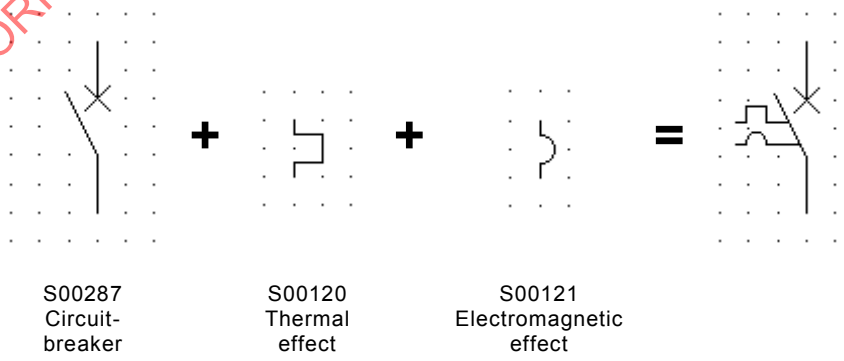


Figure A.6 – Miniature circuit-breaker shown with the symbol for a circuit-breaker qualified with the symbol for thermal and electromagnetic effects

A.3 Example – miniature circuit-breaker with an RCD (Residual Current Device)

A miniature circuit-breaker can also be combined with an RCD. In such cases it will be a need to also illustrate this functionality by the symbol.

a) Use the symbol designed in alternative d) above, add the qualifying symbol indicating the earth fault current, i.e. S00333, see Figure A.7, thus illustrating a miniature circuit-breaker that is also tripping on earth fault currents.

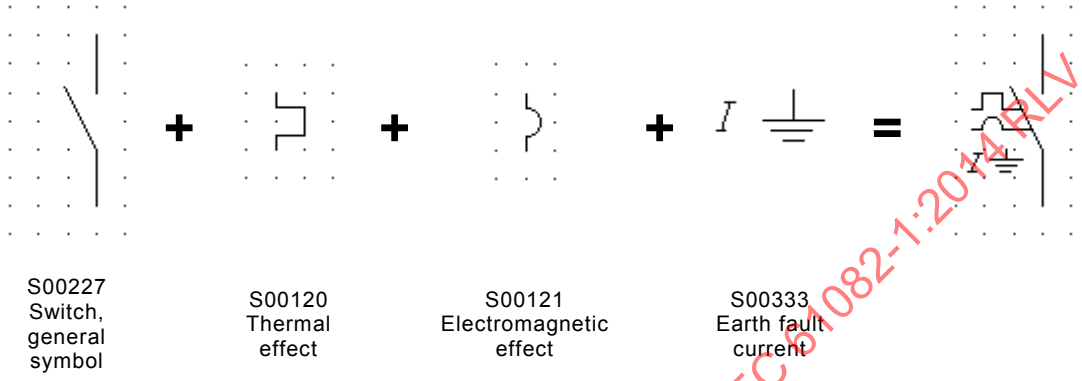


Figure A.7 – Symbol for a miniature circuit-breaker with an RCD, version 1

b) Use the symbol designed in alternative d) above, add a qualifying symbol telling about the additional tripping mechanism. An RCD is actually a protection device tripping when the sum of the currents flowing through the device is higher than a pre-set value. The tripping is actually based on a difference in the currents. Therefore, a qualifying symbol for differential current, i.e. S00331, could be added, see Figure A.8.

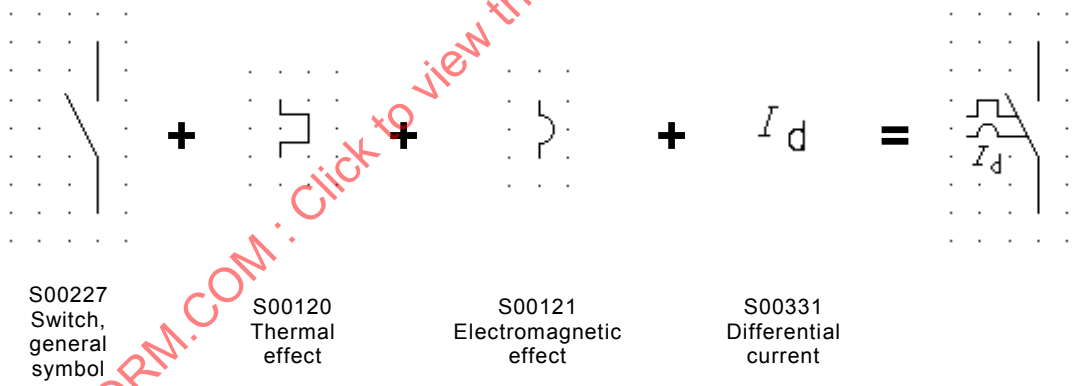
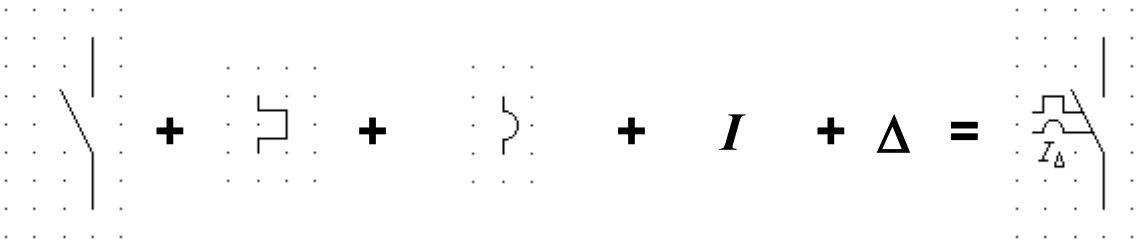


Figure A.8 – Symbol for a miniature circuit-breaker with an RCD, version 2

c) A third possibility is to apply the letter symbol for current, indexed with the letter symbol for difference. The letter symbols shall be in accordance with IEC 60027 and ISO 31, see Figure A.9.



S00227 Switch, general symbol | S00120 Thermal effect | S00121 Electromagnetic effect | IEC 60027, No. 67 ISO 31, No. 5-1 | IEC 60 027, No. s.0406

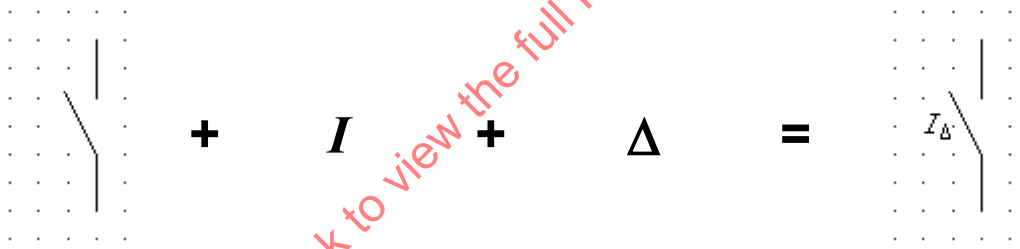
Figure A.9 – Symbol for a miniature circuit-breaker with an RCD, version 3

A.4 Example – RCD (residual current device) / RCM (residual monitoring device)

IEC 60617-DB does not contain a symbol representing an RCD and an RCM. Following the principles shown in A.1, A.2 and A.3, the following symbol assembly may be achieved:

- RCD

  An RCD shall provide an opening of the circuit in which it is located when the sum of the currents passing through the RCD differs from a preset value. Figure A.10 shows an example of a symbol for an RCD based on the symbols shown in Figure A.9

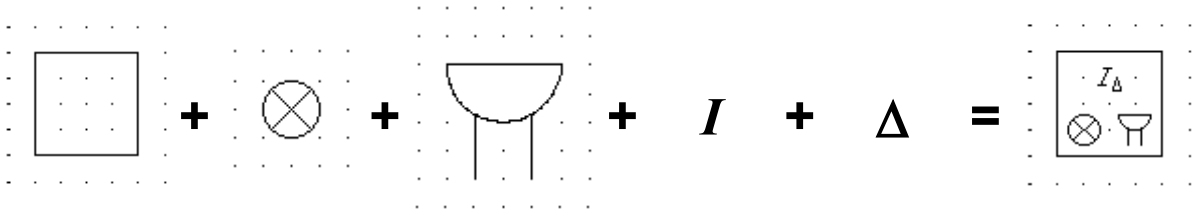


S00227 Switch, general symbol | IEC 60027, No. 67 ~~ISO 31, No. 5-1~~ ISO 80000-6, No. 6-1 | IEC 60027, No. s.0406

Figure A.10 – Example of a symbol for an RCD

- RCM

  An RCM shall not provide any opening of the circuit in which it is located. The RCM shall provide an audible and visible signal. It is therefore natural to use the general symbol S00059 as a base and add qualifying symbols indicating a signal lamp, i.e. S00965, a buzzer, i.e. S00973 and the additional information on differential currents see Figure A.11.

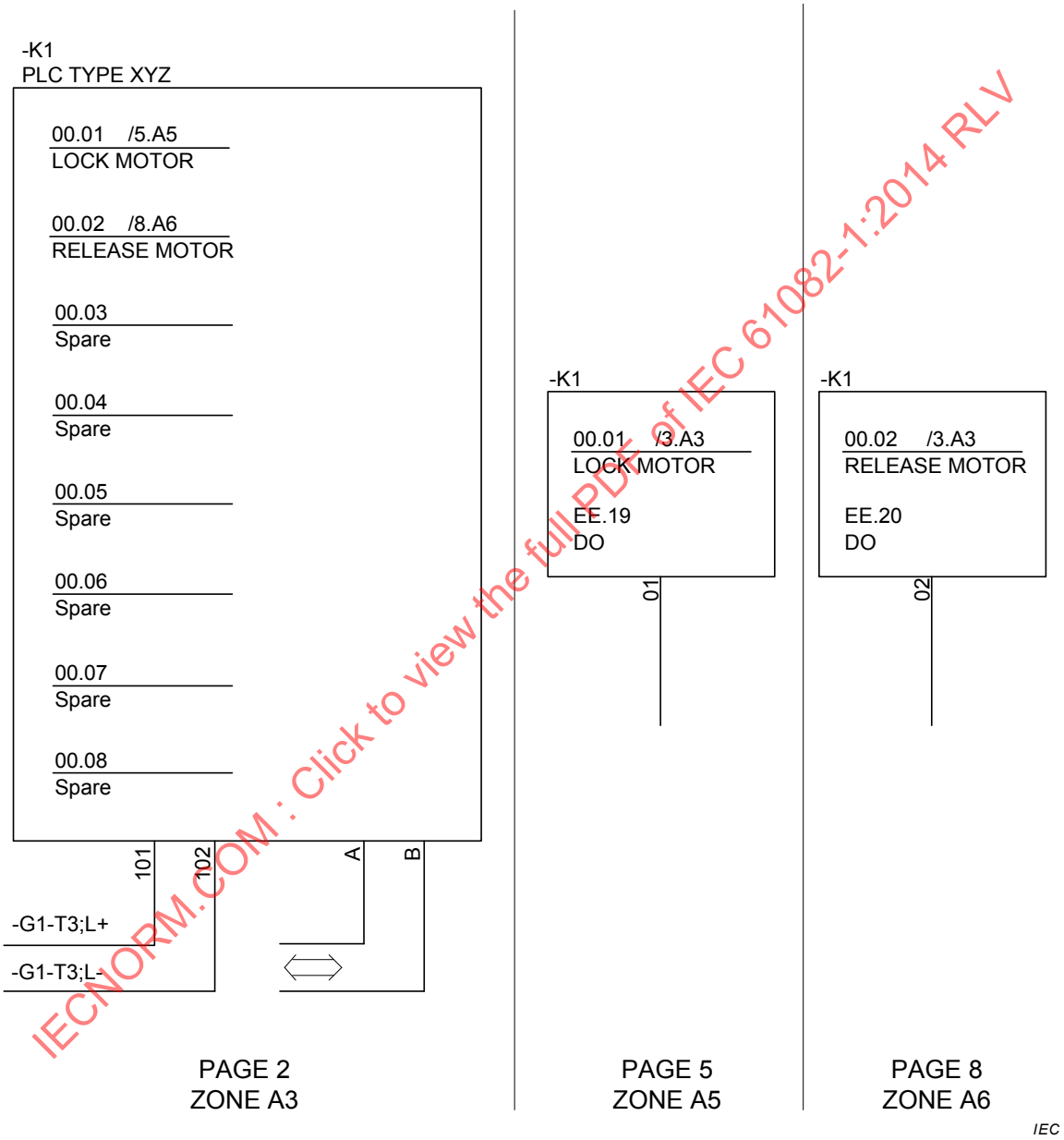


S00059 Object | S00965 Signal lamp, general symbol | S00973 Buzzer | IEC 60027, No. 67 ISO 31, No. 5-1 | IEC 60027, No. s.0406

Figure A.11 – Example of a symbol for an RCM

A.5 Example – PLC

Figure A.12 shows examples of a specific presentation of symbols for a PLC (Programmable Logical Controller). The symbols show the PLC in detached presentation, with different parts presented on individual pages.



~~NOTE~~ The example is intended to show how symbols can be constructed in accordance with this standard and introduced in the documentation. It does not intend to regularise the graphical design of symbols illustrating a PLC.

Figure A.12 – Symbols for a PLC

The general symbol S00059 is used as a basis. Each channel is represented by a line inside the symbols together with the internal PLC addresses 00.01, ..., 00.08. An additional text illustrates the function related to the each channel (for example "LOCK MOTOR"). Cross references between different presentations of the channels are given (for example "/5.A5"). Further information on the operand (ex. "EE.19") and the kind of signal (ex. "DO", abbreviation for Digital Output) are given within the symbols only representing a channel.

In order for the reader to understand the symbols a complete description shall be given in the document or supporting documentation.

Figure A.13 shows an example of a circuit diagram applying a symbol for a PLC.

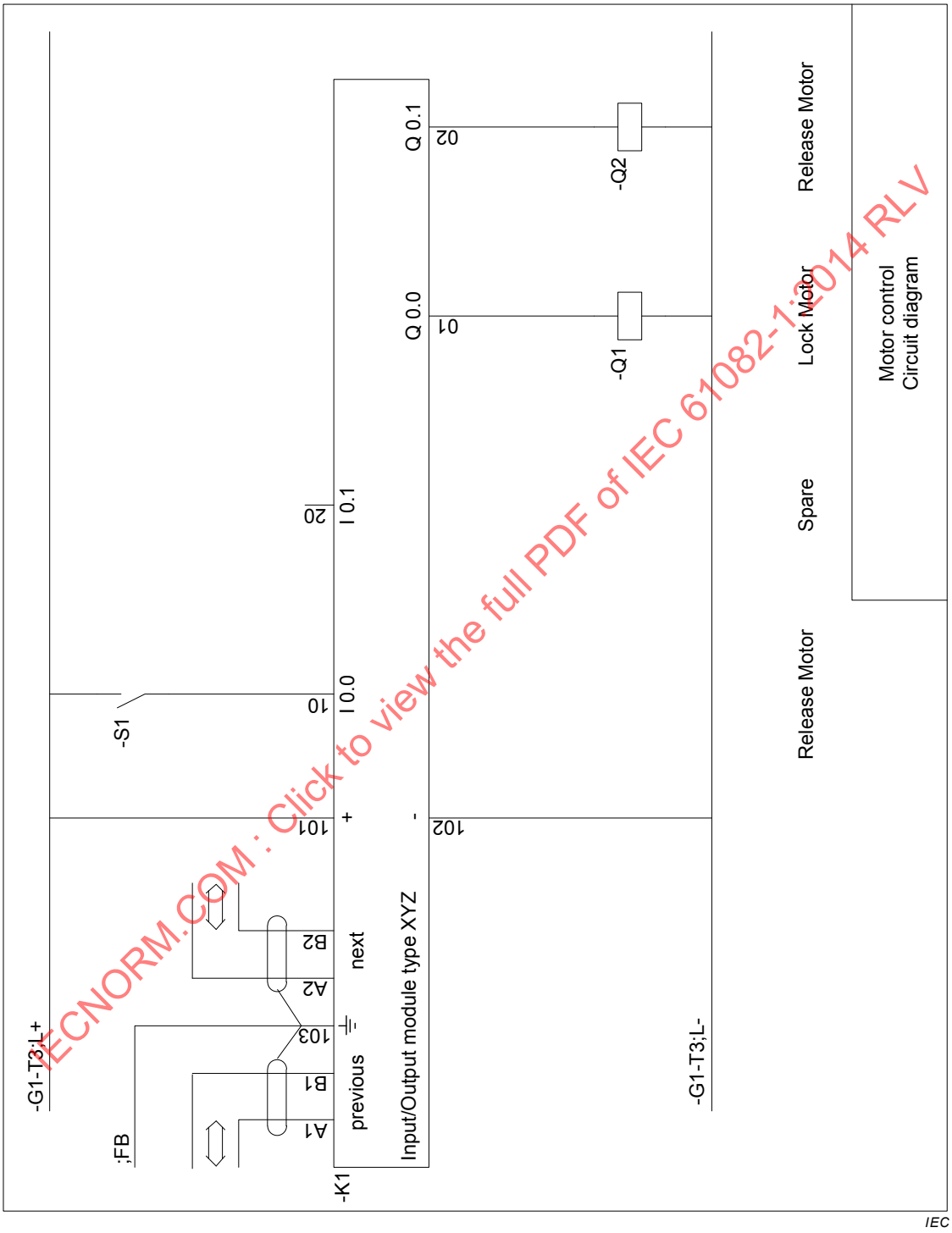


Figure A.13 – A circuit diagram with a symbol of a PLC

Annex B
(informative)

Document management information and title blocks

B.1 Presentation of document management information

A title block shown in the identification area on a document page includes for example information in accordance with the metadata element names defined in IEC 82045-2, see Table B.1.

Table B.1 – Metadata element names

No.	IEC 82045-2	ISO 7200	Metadata identifier	Name in ISO 7200 (M) = mandatory	Label in the title block example
1	2	5.1.3	DocumentId	Identification number (M)	Document Id
2	4	5.1.4	RevisionId	Revision index	Rev.
3	11	5.1.6	DocumentPartId	Segment/sheet number (M)	Page number
4	106	5.3.10	RepresentationNumberOfPages	Number of pages	Number of pages
4a	---	---	---	---	Continuing page (see Note 3)
5	53	5.1.5	ReleaseDate	Date of issue	Release date
6	5	5.1.8	LanguageCode	Language code	Lang.
7	67	--	ReferenceObjectId	---	Object designation
8	19	--	DocumentClassIdIEC61355	---	DCC
9	11	5.1.6	DocumentPartId	Segment/sheet number	Page counting number (IEC 61355)
10	18	5.3.6	DocumentClassName	Document type (M)	(Document kind)
11	12	5.2.2	Title	Title (M)	(Title)
12	86	5.1.2	OrganizationOwner	Legal owner	(Owner organization)
13	30	5.3.2	OrganizationalUnit	Responsible department	Responsible department
14	---	5.3.3	---	Technical reference	Technical reference
15	36	5.3.5	CreatorName	Creator (M)	Created by
16	48	5.3.4	ApprovedByPerson	Approval person (M)	Approved by
17	69	---	ProjectId	---	Project Id
18	95	---	OrganisationCustomer	---	Customer
19	70	---	ProjectName	---	Project name
20	81	---	SupersedingDocumentId	---	Replacing
21	79	---	BasedOnDocumentId	---	Based on
22	80	---	BasedOnDocRevisionId	---	(Based on)

NOTE 1 The metadata element names are language independent unambiguous identifiers which are not to be translated into other languages.

NOTE 2 Names of labels may be presented in abbreviated form or omitted if the context is clear.

NOTE 3 “Continuing page” can be used optionally instead of “Number of pages” if the numbering is not done sequentially.

B.2 Example of the layout of a title block

Figures B.1 and B.2 show an example of the arrangement of document-related information in a title block for size A3 pages, based on the examples given in ISO 7200. The numbers in parenthesis shown in Figure B.1 refer to the information listed in Table B.1.

~~NOTE~~ The examples shown in the figures are intended to show how document management information may be introduced in the title block of a technical document. It does not present all information necessary for document management, nor does it intend to regularise the graphical design of title blocks.

<table>
<tr><td>Responsible department
(13)</td><td>Technical reference
(14)</td><td>(10)</td><td colspan="4">Document designation
(7) (8) (9)</td></tr>
<tr><td rowspan="2">(12)</td><td>Created by
(15)</td><td rowspan="2">(11)</td><td colspan="4">Document ID
(1)</td></tr>
<tr><td>Approved by
(16)</td><td>Rev.
(2)</td><td>Release date
(5)</td><td>Lang.
(6)</td><td>Page
(3)(4)</td></tr>
</table>

Possible extension for example to the left:

<table>
<tr><td></td><td>Project ID
(17)</td></tr>
<tr><td>Replacing
(20)</td><td rowspan="2">(18)
(19)</td></tr>
<tr><td>Based on
(21) (22)</td></tr>
</table>

IEC

Figure B.1 – Example of the arrangement of information in a title block

<table>
<tr><td>Responsible department
ENG1-4</td><td>Technical reference</td><td>Circuit diagram</td><td colspan="4">Document designation
=G1K1&EFS/MA1</td></tr>
<tr><td rowspan="2">ABC Company</td><td>Created by
C. Name</td><td rowspan="2">Pumping of supply water,
Control</td><td colspan="4">Document ID
X1-Y2-123456-78</td></tr>
<tr><td>Approved by
A. Name</td><td>Rev.
A</td><td>Release date
2004-07-15</td><td>Lang.
en</td><td>Page
14/27</td></tr>
</table>

Extension to the left:

<table>
<tr><td></td><td>Project ID
WSS-95-123</td></tr>
<tr><td>Replacing</td><td rowspan="2">XYZ Company
Water Supply North</td></tr>
<tr><td>Based on
X1-Y2-123456-100-C</td></tr>
</table>

IEC

Figure B.2 – Example of a filled-in title block

Other document related information (like copyright note, CAD software and version used, archive reference) can be presented, outside the title block, in one of the identification areas, see Clause B.3.

B.3 Examples of the location of identification areas

Figure B.3 shows examples of possible locations of identification areas and a possible title block (TB) related to different page sizes and orientations.

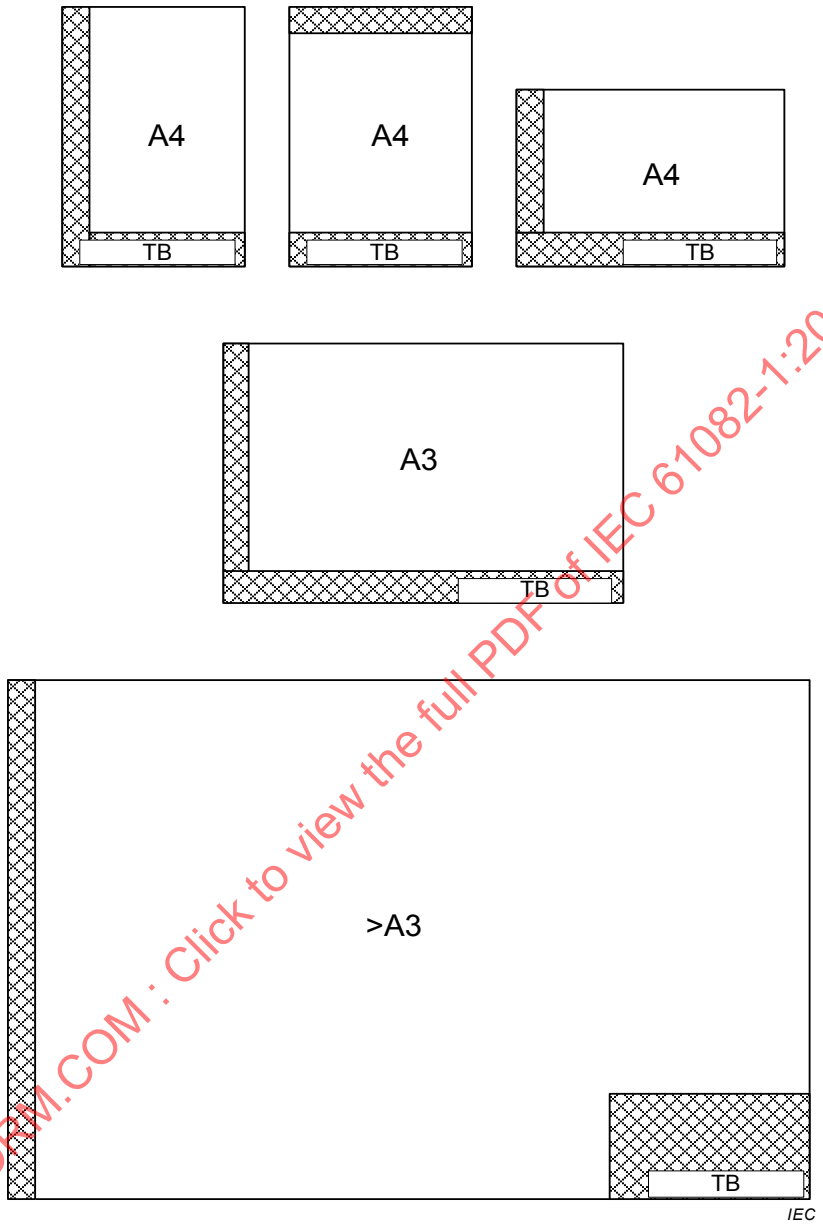


Figure B.3 – Examples of locations of identification areas and possible title blocks

Annex C
(informative)

Document kind designations and content of information

Table C.1 lists basic and specific document kinds dealt with in this International Standard together with a short description and information on their content of information. Reference to the relevant clause is provided as well as the document kind classification code (DCC) in accordance with IEC 61355-~~1:1997~~.

It is recommended to use only these document kind designations and specify the object to which it applies, and/or the purpose for which it is prepared or generated separately in the document title.

EXAMPLE

- A “network map” is an “overview diagram” for the object “network”. A map is used as base document – this is however not of importance for the document kind’s designation.
- A “cable routing drawing” is an “arrangement drawing” for the object “cabling system” and the task “laying of cables”.

Table C.2 shows a non-exhaustive list of document designations in use. Recommended replacements are shown.

Table C.1 – Recommended document kind designations *(1 of 2)*

Document kind designation	Subclause	DCC	Description and content of information
Overview diagram	7.2	_FA _FB	Diagram providing a comprehensive view of an object with a low degree of detailing [3.3.1] Mandatory: • Graphical symbols representing the objects • Main interrelations or connections • Designations and references to more detailed documents Optional: • Location information • Parts of process flow diagrams • Implementation dependant information, e.g. technical data, measuring points • Explanatory information, such as data on supply and service limits
Function diagram	7.3	_FF	Diagram providing information on the functional behaviour of a system [3.3.2] Mandatory: • Graphical symbols for objects representing functions • Graphical symbols representing functional connections or interrelations • Interface terminals and designations • Signal designations Optional: • Reference designations • Terminal designations • Address information (software) • Explanatory information
Circuit diagram	7.4	_FS	Diagram providing information on the circuitry of an object [3.3.3] Mandatory: • Graphical symbols representing the objects • Graphical symbols representing the connections among objects • Reference designations • Terminal designations • Signal level conventions (applicable to logic signals) • Information necessary to trace paths and circuits (signal designations, location references) • Supplementary information necessary for the understanding of functions Optional: • Technical data • Reference to other documents • Information on wiring performance • Cable and cable core identification

Document kind designation	Subclause	DCC	Description and content of information
Connection diagram	7.5	_MA _MB	Diagram providing information on the physical connections among components or units [3.3.4] Mandatory: • Conductor or cable type information (e.g. recognized type designation, catalogue or part number, material, construction, size, insulation, voltage rating, colour, number of conductors, other technical data) • Reference designation or conductor or cable number • Identification or representation of the connected objects (e.g. reference and/or terminal designation) Optional: • Instruction for or methods of laying, routing, termination, attachment, twisting, screening, etc. • Length of connection • Signal designation and/or technical data about the signal • Special classification or information
Arrangement drawing	8.3	_LD _LH _LU	Drawing providing information on the relative or absolute location of objects [3.3.7] Mandatory: • Simplified shapes or symbols of objects • Reference designations or other identifications of objects • Distances Optional: • Main dimensions of objects • Symbols for cables and conductors • Indication of reference points • Technical data • Installation instructions
Connection table	9.3	_MA _MB	Table providing information on the physical connections among components or units [3.3.8] Mandatory: • Conductor or cable type information (e.g. recognized type designation, catalogue or part number, material, construction, size, insulation, voltage rating, colour, number of conductors, other technical data) • Reference designation or conductor or cable number • Identification or representation of the connected objects (e.g. reference and/or terminal designation) Optional: • Instruction for or methods of laying, routing, termination, attachment, twisting, screening, etc. • Length of connection • Signal designation and/or technical data about the signal • Special classification or information
Sequence chart	10.2	_FF	Chart providing information on the succession of operations or status of the units of a system [3.3.9]
Time sequence chart	10.2	_FF	Sequence chart with the time axis plotted to scale [3.3.10]

Table C.2 – Current document kind designations and replacements *(1 of 2)*

Current document kind designation	Recommended document kind designation	DCC	Description
Single-line diagram	Overview diagram	_FA	Overview diagram using single-line presentation for the polyphase circuits.
			A system diagram in which the polyphase links are represented by their equivalent single line. (~~IEV~~ IEC 60050-601:1985: definition 601-02-04)
Network map	Overview diagram	_FA	Overview diagram showing a network on a map, for example generating and transforming stations and power lines, telecommunication equipment and transmission lines.
Topological diagram of a network	Overview diagram	_FA	The graphical representation of the network topology. (~~IEV~~ IEC 60050-603:1986: definition 603-02-05)
System diagram	Overview diagram	_FA	A topological representation of a system in which the information content depends on a specific requirement. (~~IEV~~ IEC 60050-601:1985: definition 601-02-01)
System operational diagram	Overview diagram	_FA	A system diagram representing a particular operational condition. (~~IEV~~ IEC 60050-601:1985: definition 601-02-02)
Three-phase system diagram	Overview diagram	_FA	Overview diagram using multi-line presentation for the polyphase circuits.
			A *diagram* of a three-phase system in which all phases and neutral conductors are each represented by separate lines. (~~IEV~~ IEC 60050-601:1985: definition 601-02-03)
Voltage map	Overview diagram	_FA	Consistent presentation of the voltages at the major nodes of a network under specified operating conditions. (~~IEV~~ IEC 60050-603:1986: definition 603-04-24)
Block diagram	Overview diagram	_FA _FB	Overview diagram predominantly using block symbols
Function chart	Function diagram	_FF	Chart describing the functions and behaviour of a control system, using steps and transitions (see also IEC 60848)
Equivalent-circuit diagram	Function diagram	_FF	Function diagram providing information on an electric and/or magnetic behaviour model of an object [3.3.5]
Logic-function diagram	Function diagram	_FF	Function diagram that predominantly uses symbols for binary logic elements [3.3.6]
Terminal function diagram	Circuit diagram	_FS	Circuit diagram for a functional unit in a simplified form of presentation showing the terminals for the interface connections and a description of the internal behaviour.
Terminal connection diagram	Connection diagram	_MA	Connection diagram for connections internal and/or external to terminals
Unit connection diagram	Connection diagram	_MA	Connection diagram for connections within a unit.
Interconnection diagram	Connection diagram	_MA _MB	Connection diagram providing information on the physical connections among different units.
Cable diagram	Connection diagram	_MB	Connection diagram providing information on cables between and among various objects.

Current document kind designation	Recommended document kind designation	DCC	Description
Site plan (base document for electrical installation)	Arrangement drawing	_LD	Base document for an arrangement drawing showing the location, in relation to “setting-out-points”, of construction works, service networks, and roadwork and information on landscape, means of access and general layout of site (Requirements see 8.2)
Earthing diagram	Arrangement drawing	_LD	Arrangement drawing of an earthing system.
Installation diagram	Arrangement drawing	_LD _LH	Arrangement drawing showing the location of components of an electrical installation together with connections
Cable routing drawing	Arrangement drawing	_LD _LH	Arrangement drawing on which the location of cable tunnels, trays, ducts, trunking systems, supports etc. are presented.
Earthing drawing	Arrangement drawing	_LD _LH	Arrangement drawing showing the location of components of an earthing system
Earthing plan	Arrangement drawing	_LD _LH	Arrangement drawing showing the location of components of an earthing system
Installation drawing	Arrangement drawing	_LD _LH	Arrangement drawing showing the location of components of an electrical installation
Installation plan	Arrangement drawing	_LD _LH	Arrangement drawing showing the location of the components of an installation
Building drawing (base document for electrical installation)	Arrangement drawing	_LH	Base document for an arrangement drawing showing the ground-plan and sectional views of a building together with information important for electrical installation (Requirements see 8.2)
Assembly drawing	Arrangement drawing	_LU	Arrangement drawing representing the spatial position and shape of a group of assembled parts, normally to scale
Terminal connection list	Connection table	_MA	Connection table providing information on the physical connections internal and/or external to terminals
Terminal connection table	Connection table	_MA	Connection table providing information on the physical connections internal and/or external to terminals
Unit connection list	Connection table	_MA	Connection table providing information on the physical connections within a unit.
Unit connection table	Connection table	_MA	Connection table providing information on the physical connections within a unit.
Interconnection list	Connection table	_MA	Connection table providing information on the physical connections among different units.
Interconnection table	Connection table	_MA	Connection table providing information on the physical connections among different units.
Cable list	Connection table	_MB	Connection table providing information required for laying of cables among objects
Cable table	Connection table	_MB	Connection table providing information required for laying of cables among objects

Bibliography

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IEC 60073:2002, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indication devices and actuators*

IEC 60204-1:~~1997~~2009, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60417~~-DB:2002~~, *Graphical symbols for use on equipment. Available from: <http://std.iec.ch/iec60417>*

IEC 60445:~~1999~~2010, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

~~IEC 60446:1999, *Basic and safety principles for man-machine interface, marking and identification – Identification of conductors by colours or numerals*~~

IEC 61506:1997, *Industrial–process measurement and control – Documentation of application software*

ISO/IEC 2382-1:1993, *Information technology – Vocabulary – Part 1: Fundamental terms*

ISO/IEC 8613-1:1994, *Information technology – Open Document Architecture (ODA) and interchange format – Part 1: Introduction and general principles*

ISO 128-21:1997, *Technical drawings – General principles of presentation – Part 21: Preparation of lines by CAD systems*

ISO 128-23:1999, *Technical drawings – General principles of presentation – Part 23: Lines on construction drawings*

ISO 128-24:1999, *Technical drawings – General principles of presentation – Part 24: Lines on mechanical engineering drawings*

ISO 128-25:1999, *Technical drawings – General principles of presentation – Part 25: Lines on shipbuilding drawings*

ISO 128-34:2001, *Technical drawings – General principles of presentation – Part 34: Views on mechanical engineering drawings*

ISO 128-40:2001, *Technical drawings – General principles of presentation – Part 40: Basic conventions for cuts and sections*

ISO 128-44:~~2000~~2001, *Technical drawings – General principles of presentation – Part 44: Sections on mechanical engineering drawings*

ISO 128-50:~~1984~~2001, *Technical drawings – General principles of presentation – Part 50: Basic conventions for representing areas on cuts and sections*

ISO 129-1:2004, *Technical drawings – Indication of dimensions and tolerances – Part 1: General principles*

ISO 3864-1:2002, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs in workplaces and public areas*

ISO 5807, *Information processing – Documentation symbols and conventions for data, program and system flowcharts, program network charts and system resources charts*

ISO 6428:1982, *Technical drawings – Requirements for microcopying*

ISO 7200:2004, *Technical product documentation – Data fields in title blocks and document headers*

ISO 10209:2012, *Technical product documentation – Vocabulary – Terms relating to technical drawings, product definition and related documentation*

~~ISO 10209-1:1992, *Technical product documentation – Vocabulary – Part 1: Terms relating to technical drawings: general and types of drawings*~~

ISO 10628 (all parts), *Diagrams for the chemical and petrochemical industry*

ISO 14084 (all parts), *Diagrams for power plants*

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

IEC 61082-1

Edition 3.0 2014-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

HORIZONTAL STANDARD
NORME HORIZONTALE

Preparation of documents used in electrotechnology – Part 1: Rules

Établissement des documents utilisés en électrotechnique – Partie 1: Règles

IEC 61082-1:2014-10(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PREPARATION OF DOCUMENTS USED IN ELECTROTECHNOLOGY –

Part 1: Rules

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.
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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 61082-1 has been prepared by IEC technical committee 3: Information structures, documentation and graphical symbols.

It has the status of a horizontal standard in accordance with IEC Guide 108.

This third edition cancels and replaces the second edition published in 2006. This edition constitutes a technical revision and includes the following main technical changes:

a) inclusion of presentation rules for wireless interconnections
b) description of exceptional cases for the application of rules for positioning of reference designations in diagrams
c) correction of errors and update of the normative references
d) harmonization of definitions with respect to referenced publications.

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

FDIS	Report on voting
3/1189/FDIS	3/1196/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.

A list of all the parts in the IEC 61082 series, under the general title *Preparation of documents used in electrotechnology*, can be found on the IEC website.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC 61082-1 deals with the presentation of information in documents. Part of this information is described in other International Standards. Figure 1 provides an overview on the interrelation between some of these standards.

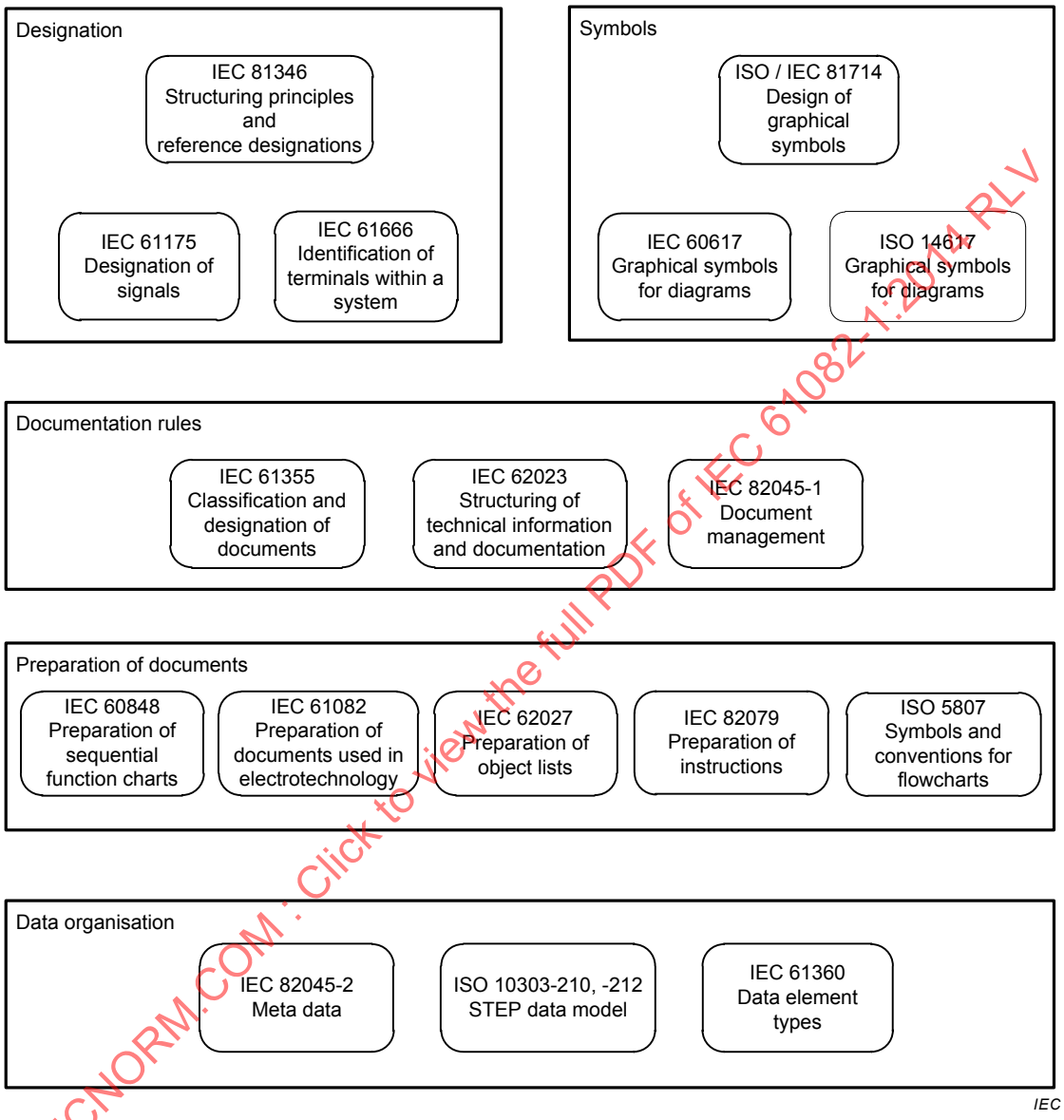


Figure 1 – Overview of standards related to the presentation of information in documents

Examples in this part of IEC 61082 are intended to illustrate a given rule and are not necessarily representative of complete documents.

PREPARATION OF DOCUMENTS USED IN ELECTROTECHNOLOGY –

Part 1: Rules

1 Scope

This part of IEC 61082 establishes general rules and guidelines for the presentation of information in documents, and specific rules for diagrams, drawings and tables used in electrotechnology.

Excluded from this part of IEC 61082 are rules and guidelines for all kind of audio or video or tactile presentations.

This horizontal standard is primarily intended for use by technical committees in the preparation of standards in accordance with the principles laid down in IEC Guide 108.

One of the responsibilities of a technical committee is, wherever applicable, to make use of horizontal standards in the preparation of its publications. The contents of this horizontal standard will not apply unless specifically referred to or included in the relevant publications.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 60375, *Conventions concerning electric and magnetic circuits*

IEC 60757, *Code for designation of colours*

IEC 60617, *Graphical symbols for diagrams.* Available from: <http://std.iec.ch/iec60617>

IEC 60848, *GRAFCET specification language for sequential function charts*

IEC 61175, *Industrial systems, installations and equipment and industrial products- Designation of signals*

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

IEC 61293, *Marking of electrical equipment with ratings related to electrical supply – Safety requirements*

IEC 61355-1:2008, *Classification and designation of documents for plants, systems and equipment – Part 1: Rules and classification tables*

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

IEC 62023, *Structuring of technical information and documentation*

IEC 62027, *Preparation of object lists, including parts lists*

IEC 62491, *Industrial systems, installations and equipment and industrial products – Labelling of cables and cores*

IEC 81346-1, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules*

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*

IEC 82045-1:2001, *Document management – Part 1: Principles and methods*

IEC 82045-2, *Document management – Part 2: Metadata elements and information reference model*

IEC 82079-1, *Preparation of instructions for use – Structuring, content and presentation – Part 1: General principles and detailed requirements*

ISO 128-22, *Technical drawings – General principles of presentation – Part 22: Basic conventions and applications for leader lines and reference lines*

ISO 128-30, *Technical drawings – General principles of presentation – Part 30: Basic conventions for views*

ISO 2594, *Building drawings – Projection methods*

ISO 3098-5, *Technical product documentation – Lettering – Part 5: CAD- lettering of the Latin alphabet, numerals and marks*

ISO 5455, *Technical drawings – Scales*

ISO 5456-2, *Technical drawings – Projection methods – Part 2: Orthographic representations*

ISO 5457:1999, *Technical product documentation – Sizes and layout of technical drawing sheets*

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

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

3 Terms and definitions

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

NOTE Annex C provides further information on different document kinds.

3.1 Basic terms

3.1.1
document
fixed and structured amount of information intended for human perception that can be managed and interchanged as a unit between users and systems

Note 1 to entry: The term document is not restricted to its meaning in a legal sense.

Note 2 to entry: A document can be designated in accordance with the type of information and the form of presentation, for example overview diagram, connection table, function chart.

[SOURCE: ISO/IEC 8613-1:1994, 3.58, modified – Notes 1 and 2 to entry have been added.]

3.1.2
document kind
type of document defined with respect to its specified content of information and form of presentation

Note 1 to entry: Sometimes the term document type is used for the same concept.

[SOURCE: IEC 61355-1:2008, 3.6]

3.1.3
documentation
collection of documents related to a given subject

Note 1 to entry: This may include technical, commercial and/or other documents.

Note 2 to entry: The term subject may refer to objects in the sense of IEC 81346 or to other things to be addressed.

Note 3 to entry: A documentation can consist of documents, composite documents and document sets.

Note 4 to entry: The number and kinds of documents in a documentation can differ according to purpose.

[SOURCE: IEC 61355-1:2008, 3.5]

3.1.4
database
collection of data organized according to a conceptual structure describing the characteristics of the data and the relationships among their corresponding entities, supporting one or more application areas

[SOURCE: ISO/IEC 2382-1:1993, 01.08.05]

3.1.5
hyperlink
active link from one place in a presentation to another place in the same presentation or in another presentation

Note 1 to entry: A hyperlink is only active when the presentation of the document is managed by a computer.

Note 2 to entry: The hyperlink implies that a user can activate the link in order to get to the other point.

3.1.6
object
entity treated in a process of development, implementation, usage and disposal

Note 1 to entry: The object may refer to a physical or non-physical “thing”, i.e. anything that might exist, exists or did exist

Note 2 to entry: The object has information associated to it.

[SOURCE: IEC 81346-1:2009, 3.1]

3.1.7
object designation
identifier of a specific object in a given context

Note 1 to entry: Examples of such designations are: reference designation, type number, serial number, name.

[SOURCE: IEC 61355-1:2008, 3.13]

3.1.8
reference designation
identifier of a specific object formed with respect to the system of which the object is a constituent, based on one or more aspects of that system

[SOURCE: IEC 81346-1:2009, 3.11]

3.1.9
single-level reference designation
reference designation assigned with respect to the object of which the specific object is a direct constituent

Note 1 to entry: A single-level reference designation does not include any reference designations of upper level or lower level objects.

[SOURCE: IEC 81346-1:2009, 3.12]

3.1.10
reference designation set
collection of two or more reference designations assigned to an object of which at least one unambiguously identifies this object

[SOURCE: IEC 81346-1:2009, 3.14]

3.1.11
product
intended or accomplished result of labour, or of a natural or artificial process

[SOURCE: IEC 81346-1:2009, 3.6]

3.1.12
component
product used as a constituent in an assembled product, system or plant

[SOURCE: IEC 81346-1:2009, 3.7]

3.2 Terms related to the forms of presentation of information

3.2.1
drawing form
presentation of information using graphical means

3.2.2
pictorial form
presentation of information using images or geometrically absolute depictions irrespective of the actual perspective used

Note 1 to entry: Pictorial forms can be two- or three-dimensional.

3.2.3
textual form
presentation of information using words and numerals

3.2.4
drawing
presentation mainly using the drawing form by showing, usually to scale, the objects and their relative position to each other

3.2.5
diagram
presentation mainly using the drawing form and showing the functions of the objects composing a system and their interrelations using graphical symbols

3.2.6
chart
graph
presentation mainly using the drawing form expressing the relationship between two or more variable quantities, operations or states

[SOURCE: ISO 10209-1:1992, 2.1, modified – "usually within a coordinate system" has been deleted and "operations or states" has been added.]

3.2.7
table
list
presentation in which the information is presented in columns and rows

Note 1 to entry: A list is a specific kind of a table.

Note 2 to entry: A presentation in a table cell can be of any form.

3.3 Terms related to specific document kinds

3.3.1
overview diagram
diagram providing a comprehensive view of an object with a low degree of detailing

3.3.2
function diagram
diagram providing information on the functional behaviour of an object

3.3.3
circuit diagram
diagram providing information on the interaction of the components of electric circuits together with information on physical connections

3.3.4
connection diagram
diagram providing information on the physical connections among components or units

3.3.5
equivalent-circuit diagram
function diagram providing information on an electric and/or magnetic behaviour model of an *object*

3.3.6
logic-function diagram
function diagram that predominantly uses symbols for binary logic elements

3.3.7
arrangement drawing
drawing providing information on the relative or absolute location of objects

3.3.8
connection table
table providing information on the physical connections among components or units

3.3.9
sequence chart
chart providing information on the succession of operations or status of the units of a system

3.3.10
time sequence chart
sequence chart with the time axis plotted to scale

4 Documentation principles

4.1 General considerations

Technical documentation is essential for the planning, design, manufacture, installation, commissioning, use, maintenance and demolition of a product or a system.

The purpose of the documentation is to provide information in the most appropriate form. In addition it is an essential means to proof and guarantee that safety, environmental and quality requirements related to a product or a system are met.

Technical documentation represents as significant a part of a contract as the supply of equipment, and constitutes an essential element of the after-sales processes.

4.2 Structure of documentation

In IEC 81346-1 it is stated that information on products and systems can be organised in tree-like structures. The structures represent the way in which an object is subdivided into constituent objects, for example the process into smaller processes or a product into sub-products.

In accordance with IEC 61355-1, a document should describe and be clearly related to relevant objects. The relationship of a document to the object described is normally given by use of the object designation as part of a document designation.

NOTE The object designation can be either a reference designation (for occurrence related documents) or a type designation (for type related documents). For further information see Clause 11.

The use of structure leads to hierarchy in the presentation of information, see IEC 62023. This means that information is presented in subsequent levels, each showing a different degree of details. For example, documents related to the object represented by the top node in a structure consist of overall information of the complete system, while documents related to the other objects represented in the structure consist of more detailed information of the constituents, see also Clause 11.

The structuring principles also support design and manufacturing based on division of labour or subcontracting. The manufacturer of a component provides all information necessary for the understanding and use of his delivery without taking care of external matters. The documentation for such component or subsystem can then be integrated in any system on the appropriate level of that system structure.

4.3 Presentation of information

The presentation of information, in a document shall be unambiguous and aimed at practical use. This implies that the same information may be presented in different documents applying the same or a different document kind. The information shall be consistent throughout all places of presentation.

When information is stored in a database independent from any form of presentation, this information can be made accessible by distinct views in the moment it is needed and in the form most suitable for the intended purpose, provided adequate tools are available applying the rules of this International Standard (see Figure 2).

Document kinds represent possible and predefined forms of presentations (see IEC 61355-1 and Annex C).

When information is stored dependent on a form of presentation, i.e. as a document, the rules of this International Standard applies when the document is being prepared, see Figure 3. The document could be prepared by means of a CAx-system or directly on paper or equivalent.

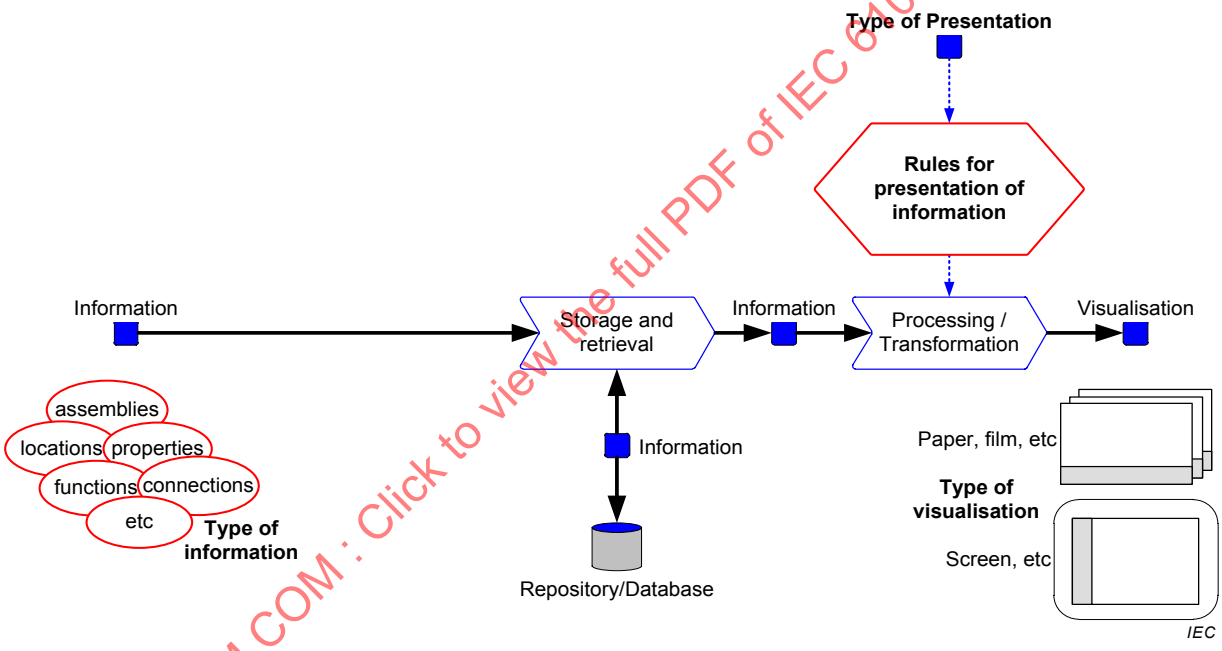


Figure 2 – Documents generated from information stored in a database

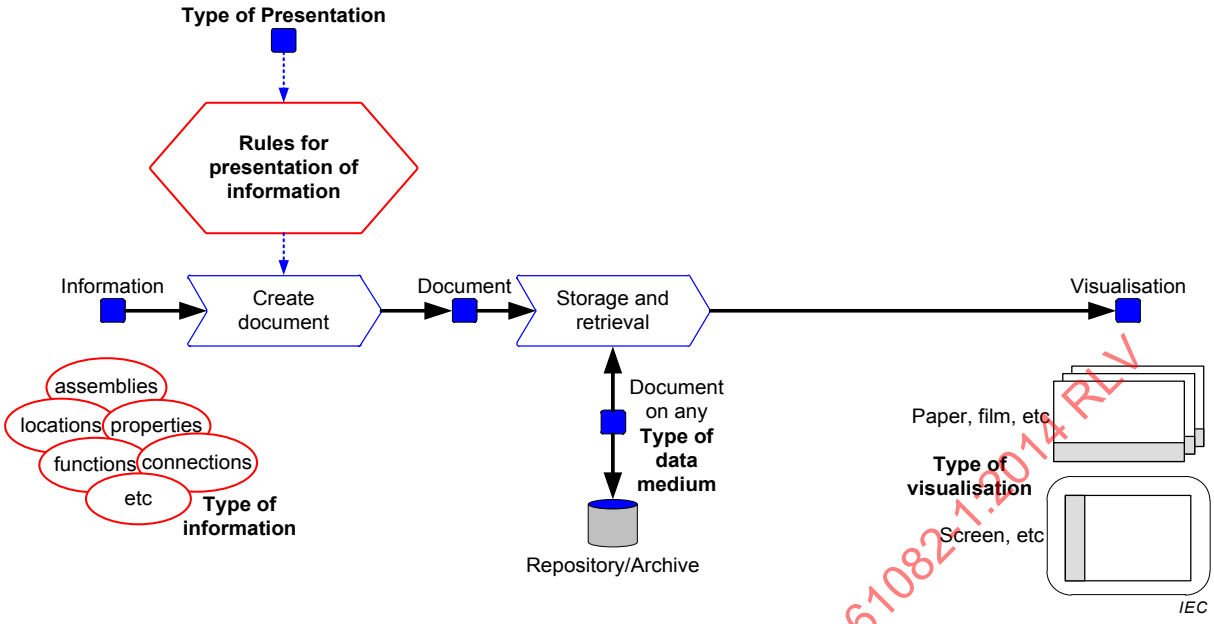


Figure 3 – Documents prepared and stored in a database

4.4 Document identification and designation

Each document shall be identified with at least one identifier, which shall be unambiguous within a given context. As a document may be unambiguously identified within several contexts, the valid context shall be explained in the document or in supporting documentation.

NOTE 1 The context in which a document identifier is valid could be indicated by stating:

– the organization responsible for that document identifier, e.g. the company preparing the document;

– the internationally recognized document or article numbering system, e.g. ISBN, ISSN, EAN, UPC.

In order to relate parts of the documentation to the described objects, a document may be designated in accordance with IEC 61355-1:2008, Clause 5.

NOTE 2 In accordance with IEC 61355-1 a document designation consists of the parts "object designation" and "document classification code (DCC)". An object designation as described in IEC 61355-1 is either a reference designation in accordance with IEC 81346-1 or any other unambiguous identifier.

If the object designation is not a reference designation, it shall be clearly distinguishable from any reference designation.

5 Rules for presentation of information

5.1 Legibility

Whenever information is presented to a user, the presentation shall be legible under the intended conditions of use. The legibility depends on:

- the used forms of presentation and their combinations;
- the arrangement of symbols in relation to each other;
- how the presentation is split into different pages;
- the sizes of a page, see 5.4;
- the foreseen size modifications of a page;
- the use of simplification techniques, see 5.20.3, 7.1.2.3 and 7.1.3.6;
- the use of hyperlinks, see 5.9;

- the use of static or dynamic presentations;
- the used medium for information presentation, for example paper or screens.

The information can be presented by combinations of:

- symbols, see 5.12 and 7.1.2;
- lines, see 5.10, 5.17, 5.18 and 7.1.3;
- text and text strings, see 5.11, and 5.16;
- pictures, see 5.14;
- outlines of objects;
- colours, shading and patterns, see 5.3.

5.2 Text orientation

A text within a document shall be oriented horizontally or vertically and intended to be read from the bottom edge or from the right-hand edge, see Figure 4.

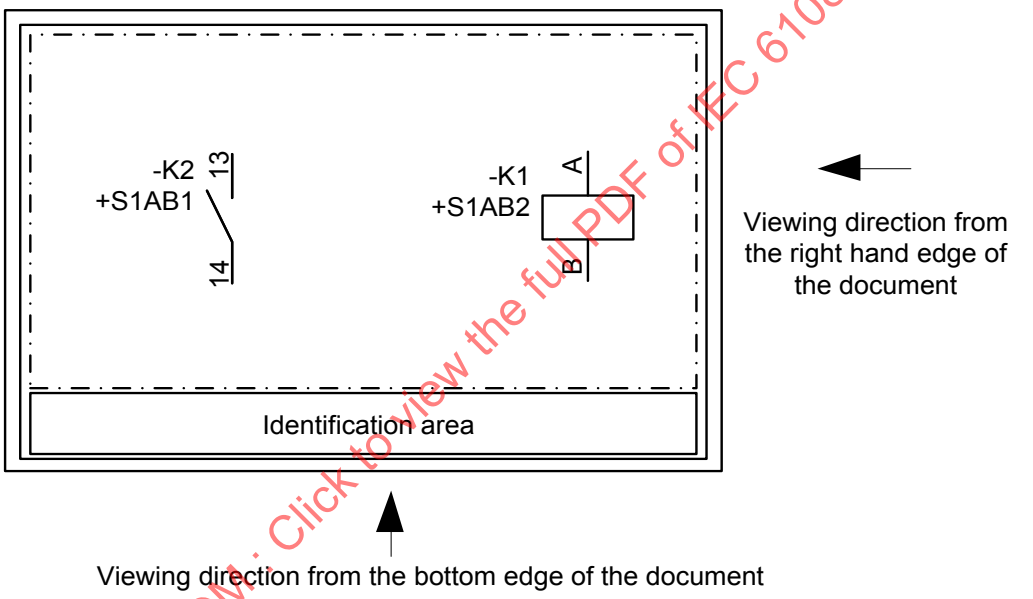


Figure 4 – Viewing directions of a document

5.3 Colours, shading and patterns

Colours should be used only as complementary information. Perception of different colours shall not be the only means for understanding presentations.

NOTE The uses of colours for specific purposes are given in ISO 3864-1, IEC 60204-1, and IEC 60073.

The meaning of the colours used shall be stated in the document or in supporting documentation.

Shadings and patterns may be used to differentiate various areas or surfaces. For documents on paper or equivalent media, the use of colours, shading and/or patterns should be usable for black and white printing.

5.4 Paper page sizes

The size of paper pages or equivalent shall conform to ISO 5457:1999, 3.1. Size A3 is recommended when mainly pictorial or diagram forms of presentation are used;

The elongated sizes defined in ISO 5457:1999, Clause 3 shall not be used.

5.5 Paper page reproduction

For documents on paper or equivalent media intended to be reproduced or microfilmed, centring marks complying with 4.3 of ISO 5457:1999 may be added to facilitate reproduction or microfilming.

5.6 Page identification

A document may consist of more than one page. In order to identify each page, for example for referencing purposes, a page identifier needs to be applied in addition to the document identifier. A single document page is identified by the combination of the document identifier and the page identifier. See Figure 5.

NOTE 1 The page counting number as described in IEC 61355-1 can be used as such a page identifier which is related to a document designation code.

If a page of a document is associated with more than one document identifier, the page shall be given different page identifiers for the different document identifiers. See Figure 6.

NOTE 2 The page identifier related to different document identifiers can look the same.

The page identifier shall be presented adjacent to the document identifier with which it is associated (example, see Clause B.2).

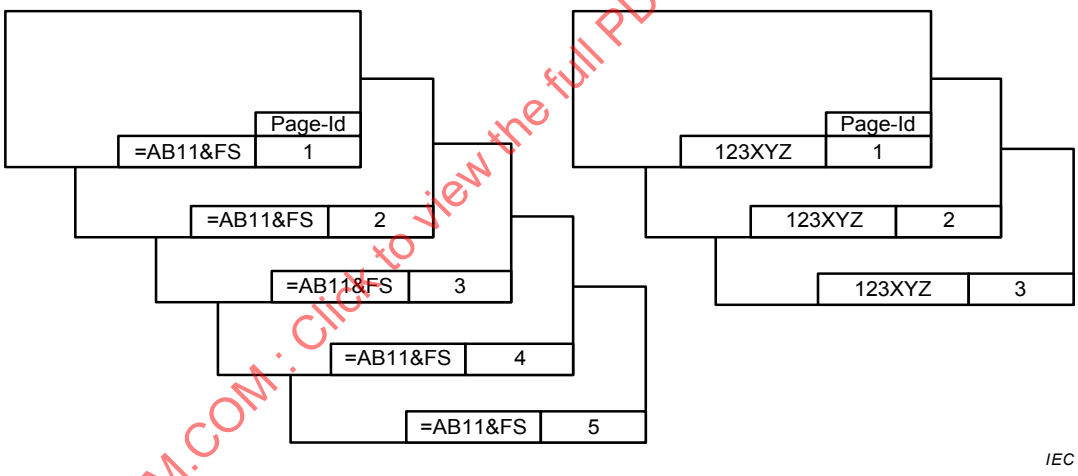
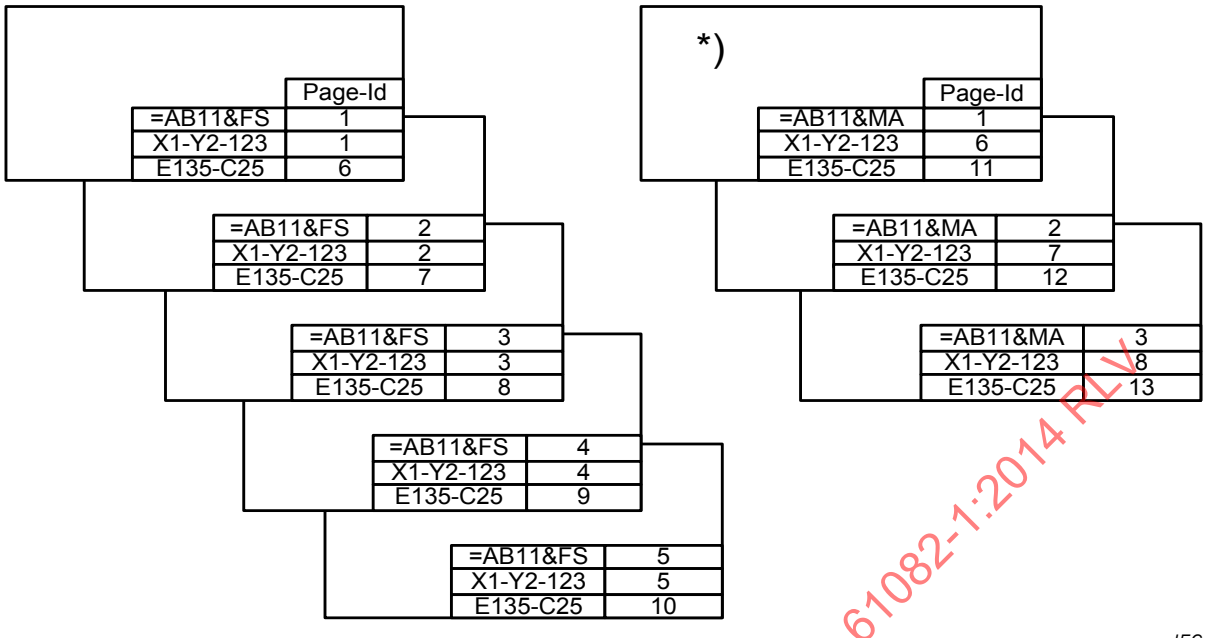


Figure 5 – Examples of documents with document and page identifications



Explanation for page marked with *)

Document designation (IEC 61355)	=AB11&MA page 1
Document number of the supplier	X1-Y2-123 page 6
Document number of the customer	E135-C25 page 11

Figure 6 – Example of documents with multiple document identifiers

5.7 Page layout

5.7.1 General

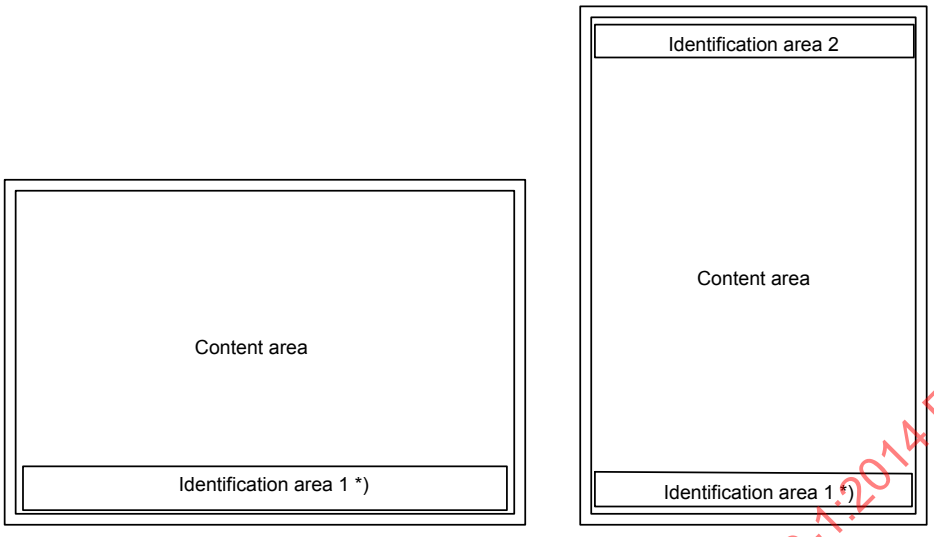
Pages may be portrait or landscape oriented.

A page is divided into:

- one or more identification areas (see 5.7.2); and
- one content area (see 5.7.3).

Each page of a document shall have at least one identification area clearly separated from the content area, for example by a frame.

Figure 7 shows examples of pages with one or more identification areas.



a) a landscape-oriented page with one identification area

b) a portrait-oriented page with two identification areas

Figure 7 – Examples of pages with defined identification areas

5.7.2 Identification area

5.7.2.1 General

The information to be presented in the identification area should contain document metadata relevant for the reader. The metadata should comply with IEC 82045-2.

Clause B.1 lists an extract of the collection of metadata of IEC 82045-2 that should be considered for inclusion.

5.7.2.2 Identification area for documents using the drawing form of presentation

One identification area shall be located at the bottom of the page. Additional identification areas may be located along the other sides of the page, see Figure 7.

Within the identification area located at the bottom, the information related to the identification and classification of the document, for example a title block in accordance with ISO 7200, shall be located in the rightmost part of the identification area. Clause B.2 shows an example of the layout of a title block.

Clause B.3 shows examples of the location of the identification areas for different page sizes and orientations.

Binder techniques and possible punching holes should be considered when locating the identification area and the information within an identification area.

5.7.3 Content area

5.7.3.1 General

The information on the object of interest shall be shown within the content area.

5.7.3.2 Module

The unit M is used as the module for harmonising graphical presentation of objects, for example reference grids, location reference systems, drawing grids, and symbol sizes.

The unit M should for paper presentations or equivalent take one of the following values in millimetres:

1,8 (2,0) mm; 2,5 mm; 3,5 mm; 5 mm; 7 mm; 10 mm; 14 mm; 20 mm.

It is recommended not to use a module size less than 2,5 mm. If the module size 1,8 (2,0) mm is used, special care should be taken to ensure the legibility of the document.

NOTE IEC 81714-2 specifies that the minimum module size for the design of graphical symbols is 2,0 mm instead of 1,8 mm.

For further information concerning scaling, modification of the module size, see IEC 81714-2.

5.7.3.3 Drawing grid

For the purpose of positioning of symbols, lines and text, content areas and identification areas may be provided with a drawing grid of 1M. This drawing grid is an auxiliary means when preparing the document and should not be visible or at least not disturb the reading of the content presented in the document version that is intended to be exchanged between parties.

For the value of M see 5.7.3.2.

5.7.3.4 Reference grid

For reference purposes, see 5.8, documents presenting information in pictorial or diagram form on paper or equivalent should have a reference grid in accordance with ISO 5457 with a grid size of 10M, 16M or 20M.

NOTE 1 The division of the rows and columns does not need to be equal e.g. the rows could be 20M each and the columns 16M each.

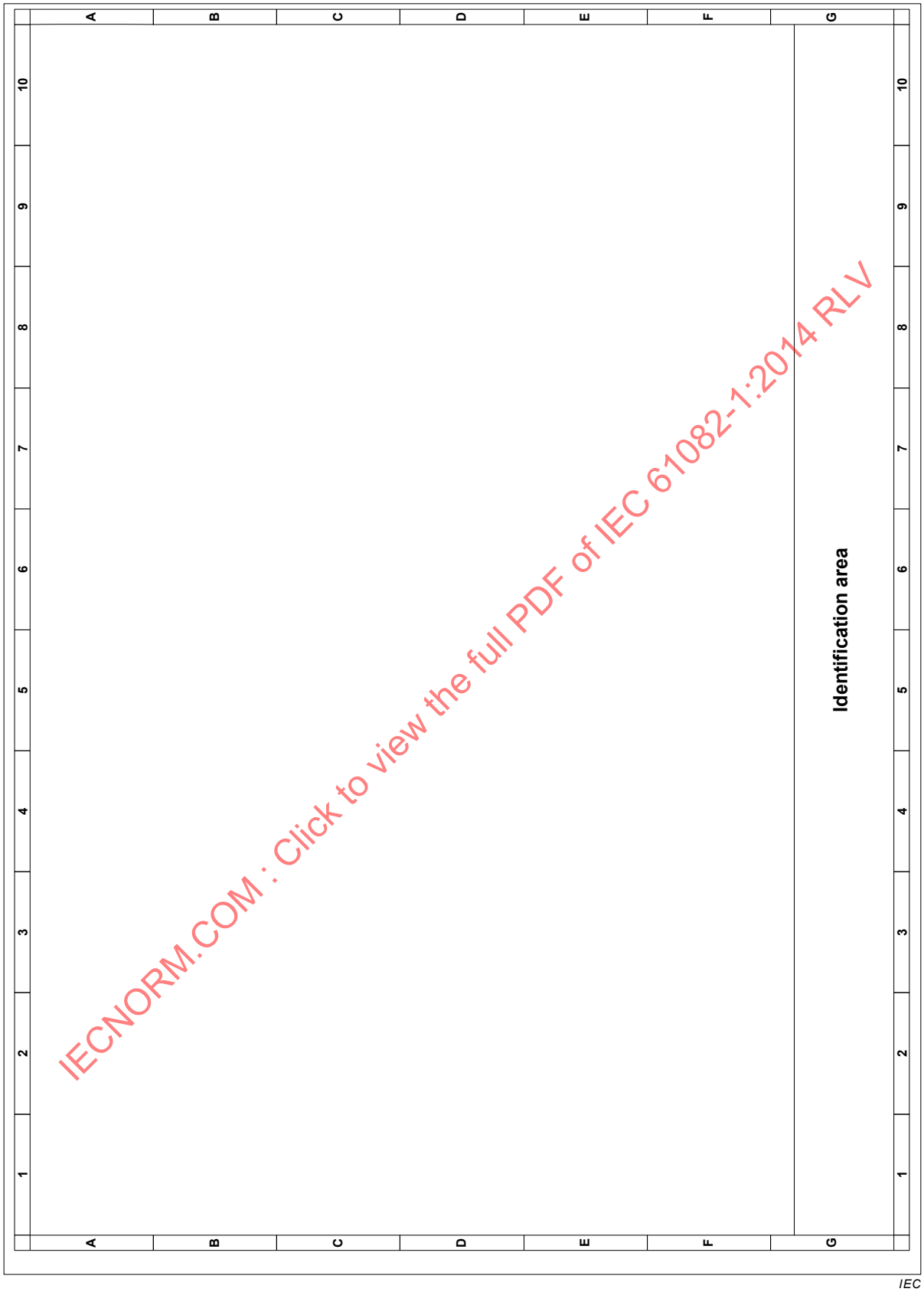
For the value of M see 5.7.3.2.

NOTE 2 For example if M is chosen to 2,5 mm, the reference grid will be 40 mm or 50 mm.

The grid numbering should start at the upper-left corner of the area of the page that is available for the content area. For grid numbering purposes capital Latin letters A, B, C, ... excluding I and O, or numbers starting from 0 or 1 shall be used.

The rows of the grid should be identified by capital Latin letters, and the columns of the grid should be sequentially numbered (see Figure 8), or vice versa.

The grid numbering at one side of the page, for example at the shorter side, may be omitted if this is considered sufficient for referencing. It may also be considered sufficient to show the grid numbering at one side/two sides only and to omit its presentations at the opposite sides.



(Page A3 landscape, module size 2,5 mm, reference grid 16 M)

Figure 8 – Example of a reference grid

5.8 Cross-references

A cross-reference may refer to a document, to a page of a document or to a zone on a page. It shall be presented in the following sequence:

- Document
- Page
- Column, row or zone.

The document is identified in accordance with 4.4. If different document identifiers are presented on the document page and confusion is likely, it shall be clearly stated in the document or in supporting documentation which document identifier is used for cross-references.

A page is identified in accordance with 5.6 preceded by the character “SOLIDUS” (/).

A zone is identified by the sign “FULL STOP” (.) followed by the coordinates built in accordance with 5.7.3.4.

If confusion is likely, the cross-reference shall be included in square brackets [...] or brackets (...).

Examples:

=EA2=S1&FS/3.B2	:	Reference to zone B2 on page 3 of a document of type FS (i.e. a circuit diagram) describing the object =EA2=S1
ZAB&FS/3.B2	:	Reference to zone B2 on page 3 of a document of type FS (i.e. a circuit diagram) describing the object type ZAB.
XYZ123456/3.B2	:	Reference to zone B2 on page 3 of document XYZ123456
XYZ123456/3	:	Reference to page 3 of document XYZ123456
XYZ123456	:	Reference to document XYZ123456
[XYZ123456]	:	Reference to document XYZ123456 (if XYZ123456 could be misinterpreted otherwise)

If the reference is in the same document, the reference to the document may be omitted.

Examples:

&FS/3.B2	:	Reference to zone B2 on page 3 of a document of type FS (i.e. a circuit diagram) describing the same object
&FS	:	Reference to a set documents of type FS (i.e. circuit diagrams) of the same object
/3.B2	:	Reference to zone B2 on page 3 of the same presentation
/2	:	Reference to page 2
[/2]	:	Reference to page 2 (if /2 alone could be misinterpreted otherwise)

If the reference is in the same page, the reference to the document and page may be omitted. In this case, the row, column or zone identification shall be preceded by the character “SOLIDUS” /.

Examples:

/.B2	:	Reference to zone B2 on the same page
/.2	:	Reference to column 2 on the same page

Figure 9 shows examples of the application of cross-references.

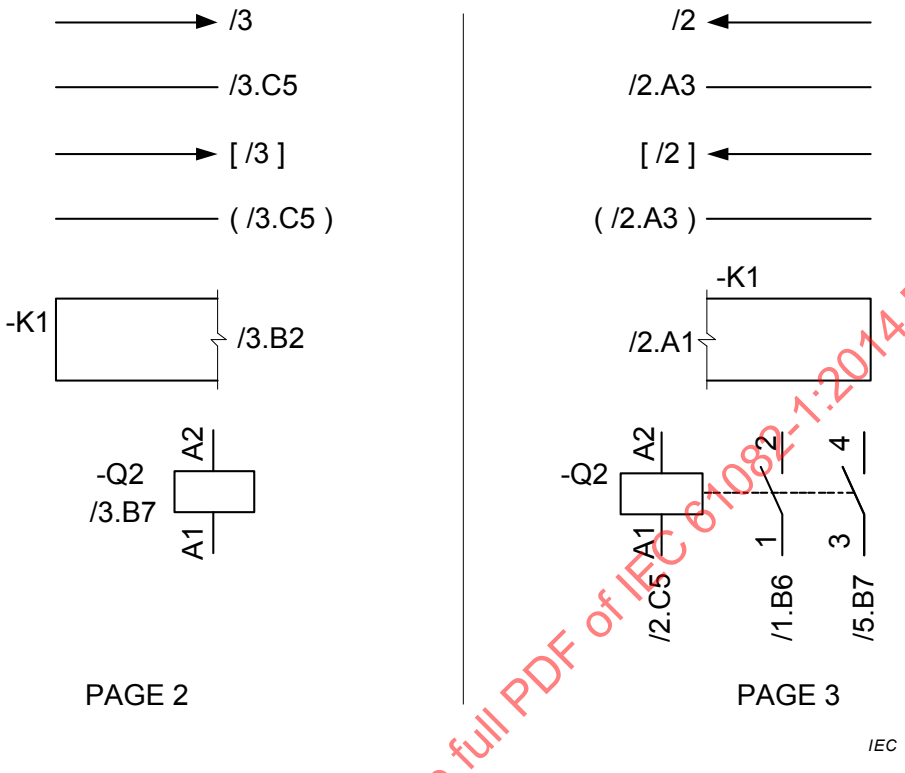


Figure 9 – Examples of the application of cross-references

5.9 Hyperlinks

Hyperlinks may be used as a means for improving the navigation between different sets of information, for example to positions in or to pages of a document, between documents or to external information sources.

The navigation shall not by itself be dependent on the functioning of hyperlinks.

Consequently, the basic navigation within a document needs to be possible, for example via content lists, indexes, explicit page or section references.

Hyperlinks may also be used for linking documents or document parts that constitute a document. However, special care should be taken when the document is under version control, see IEC 82045-1:2001, 4.5.

5.10 Line widths

For drawings the possible line widths are derived from: $0{,}1 \times (\sqrt{2})^n \times \mathrm{M}$, with n = 0, 1, 2, 3, ...

For the value of M see 5.7.3.2.

EXAMPLE If M is chosen to 2,5 mm, the line width would be 0,25 mm, 0,35 mm, etc.

NOTE 1 For presentation on paper or equivalent media the possible line widths are 0,18 mm (0,2 mm), 0,25 mm, 0,35 mm, 0,5 mm, 0,7 mm and 1,0 mm.

If two or more lines of the same line type but with different widths are used, the ratio between these line widths shall be at least 2:1.

NOTE 2 ISO 6428 provides rules for micro copying of presentations that can have influence on the choice of line widths.

5.11 Text fonts

For presentations in drawing form, the lettering type CB, vertical (V) of ISO 3098-5 should be used. Both tabular and proportional lettering in accordance with ISO 3098-5 may be used. In addition the following rules apply in this case:

- The character spacing factor should be zero, see E.2.7 of IEC 81714-2:2006. When tabular lettering is used the character aspect ratio should be 0,81 in accordance with 6.7.2 of IEC 81714-2:2006.
- The text height is derived from: $(\sqrt{2})^n \cdot M$, with n = 0, 1, 2, 3, ... For the value of M see 5.7.3.2.

  EXAMPLE If M is chosen to 2,5 mm, the text height would be 2,5 mm, 3,5 mm, etc.

  NOTE For presentation on paper or equivalent media the possible text heights are 1,8 mm, 2,5 mm, 3,5 mm, 5,0 mm, 7,0 mm and 10,0 mm.
- Sloped (inclined) lettering (also called *Italic*), type CB (S) of ISO 3098-5, may be used for letter symbols for quantities, see Figure 62 and Figures A.7, A.8, A.9.
- If another text font than one of the lettering types of ISO 3098-5 is used, the text font of characters shall be scalable and distinct, similar to the stroke style presented in ISO 3098-5.
- For documents intended to be exchanged between CAx-systems the rules of IEC 81714-2 shall be considered.

5.12 Symbols

5.12.1 Choice of symbols

Symbols shall conform to relevant IEC, ISO or IEC/ISO standards, for example:

- IEC 60617 for electrical objects in diagrams and installation drawings
- ISO 14617 for non-electrical objects in diagrams
- ISO 5807 for basic flow charts

also taking ISO 81714-1 into consideration.

Symbols that depict functions may be used independent of technology, for example fibre optics may use symbols from IEC 60617. See Figure 10.

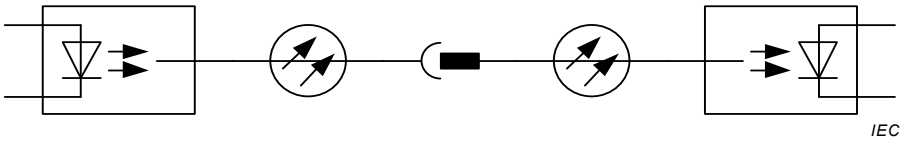


Figure 10 – Example of the use of symbols for fibre optics

Symbols to be used in CAx-applications shall in addition conform to IEC 81714-2.

When symbols have alternative forms, the forms appropriate to the purpose of the presented information shall be chosen.

When an appropriate symbol does not exist, either the general symbols S00059, S00060 or S00061 in IEC 60617 shall be applied, or a symbol may be constructed following the rules of IEC 60617 and ISO 81714-1, see also the normative Annex A.

A symbol may be replaced by one of the general symbols S00059, S00060 or S00061 in IEC 60617 with:

- the considered symbol inscribed as a qualifying symbol in the general symbol; or
- a describing text inscribed in the general symbol.

See also 5.12.2 and Figure 11.

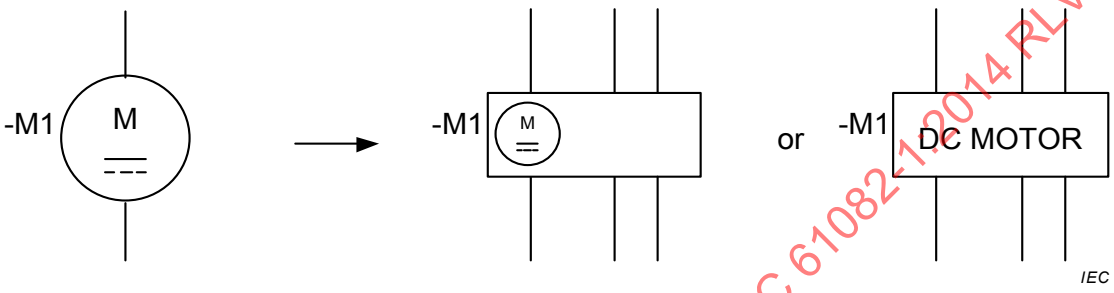


Figure 11 – Example of replacing a symbol with a general symbol

5.12.2 Symbol size

The meaning of a symbol is conveyed to the reader by its shape and by its content. The size and line thickness does not affect the meaning.

The symbols in IEC 60617 are shown on a grid pattern with a module M to specify symbol proportions. Symbols used in documentation should preferably retain the same size related to the module M.

A symbol may be enlarged, reduced or replaced by one of the general symbols S00059, S00060 or S00061 in IEC 60617 with qualifying symbol, in order to:

- increase the number of inputs or outputs;
- facilitate the inclusion of additional information;
- emphasise certain aspects;
- facilitate the use of a symbol as qualifying symbol or
- suit the scale of a drawing, plan or map.

When enlarged or reduced the general shape of the symbol shall be maintained, see also Figure 12.

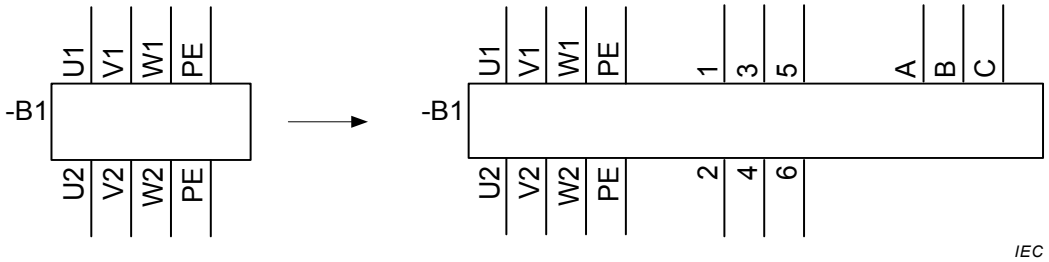
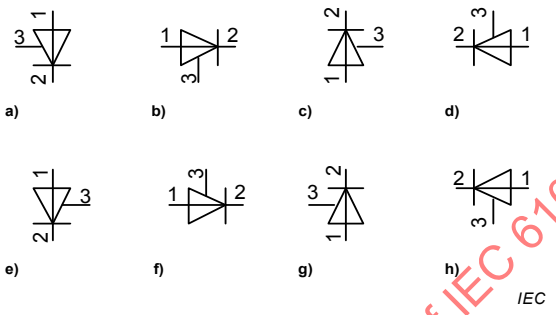


Figure 12 – Example of enlarging a symbol

5.12.3 Orientation of symbols

Symbols should be shown to support the chosen principal direction of flow in the diagram. When the orientation of a symbol to be placed in the diagram thereby deviates from the orientation the symbol has in the symbol standards, the symbol taken from the symbol standard, may be turned or mirror-imaged if the meaning thereby will not be changed, see Figure 13. In some cases it may be necessary to redesign the symbol following the rules of ISO 81714-1.

Letters, graphs or input/output labels of symbols shall be oriented individually, separate from the orientation of the symbol, so that the final reading direction is from the bottom edge or from the right-hand edge of the page, see Figure 13.



The symbol in position a) is as the symbol is shown in IEC 60617. The positions b), c) and d) are obtained by turning the symbol in step of 90° anti-clockwise. The positions e), f), g) and h) are obtained by mirroring the symbols in position a), b), c), and d) by the horizontal axis respectively.

Figure 13 – Turning and/or mirroring of symbol S00055 in IEC 60617

5.13 Scales

For information presented to scale, the scale should be chosen in accordance with ISO 5455.

A scale bar may be included for information purposes, and shall then be shown in the content area.

5.14 Pictorial presentation

Information in two-dimensional pictorial forms shall be presented in accordance with ISO 128-30 following the orthographic projection method in accordance with ISO 5456-2.

For information on buildings in two-dimensional forms, the rules in ISO 2594 apply.

5.15 Quantities, units, values and colour codes

Quantities, units and values should be represented by letter symbols in accordance with IEC 60027, IEC 80000 or other appropriate IEC standards for letter symbols. For items not covered by IEC standards, ISO 80000 should be considered. Examples of the application of letter symbols are shown in Clauses A.3 and A.4.

Codes for designation of colours shall be in accordance with IEC 60757.

5.16 Presentation of ranges and set of elements

A range representing an infinite number of values shall be presented by using the “HORIZONTAL ELLIPSIS” character … (three dots) between the lower and upper limits.

NOTE 1 The parenthesis shown in the following are not part of the character sequence.

EXAMPLE 1 The range 1 A to 5 A can be written: 1 A ... 5 A.

A set of elements, i.e.an integer number of elements, shall be presented using:

- the character “COMMA” and “SPACE” (,) between each element of the set; or
- the characters “COMMA”, “SPACE”, “HORIZONTAL ELLIPSIS”, “COMMA” and “SPACE” (, ...,) between the lower and upper limits when the set consists of numbers and the increment is one; or
- the characters “COMMA”, “SPACE”, “HORIZONTAL ELLIPSIS”, “COMMA” and “SPACE” (, ...,) between the lower and upper limits when the set consists of consecutive ascending letters of the Latin alphabet;
- the characters “COMMA”, “SPACE” and “HORIZONTAL ELLIPSIS” (, ...) after the lower limit when the upper limit is undefined and the increment is one;
- the characters “HORIZONTAL ELLIPSIS”, “COMMA” and “SPACE” (...,) before the upper limit when the lower limit is undefined and the increment is one.

EXAMPLE 2:

- The numerical set of elements 1, 2, 3, 4, 5 and 6 can be written 1, ..., 6.
- The numerical set of unlimited elements starting from 25 can be written 25, ...
- The numerical set of unlimited elements ending with 25 can be written ..., 25
- The alphabetical set of elements C, D, E, F and G can be written C, ..., G
- The alphabetical set of elements a, b, c, d and e can be written a, ..., e

Combinations of upper–case and lower–case letters in a set of elements, for example A, ..., c shall not be used, due to their possible ambiguous interpretation.

NOTE 2 Upper–case letters I and O are not used, neither in reference designations in accordance with IEC 81346-1 nor in terminal designations in accordance with IEC 60445 and IEC 61666. This implies that in such cases the upper–case letter J follows the upper–case letter H, and the upper–case letter P follows the upper–case letter N.

If a set of numerical elements are prefixed or suffixed by the same letter the elements may be presented as for a numerical set of elements.

EXAMPLE 3

- The set of elements 1U, 2U, 3U, 4U can be written 1U, ..., 4U
- The set of elements R2, R3, R4, R5 can be written R2, ..., R5

If a set of alphabetical elements are prefixed or suffixed by the same number the elements may be presented as for an alphabetical set of elements.

EXAMPLE 4

- The set of elements 1U, 1V, 1W, 1X, 1Y, 1Z can be written 1U, ..., 1Z
- The set of elements R2, S2, T2, U2, V2 can be written R2, ..., V2

Elements of a non-consecutive order may be represented within a sequence. In this case, the representation of the different elements shall be separated by using the character “COMMA” (,) for example 1, 3, 6. If confusion is likely, the group shall be enclosed in parentheses, for example (1, 3, 6).

A group of elements may also be represented as a set of elements.

EXAMPLE 5 The set of elements 1, 8, 9, 10, 11, 12, 14, A, B, C and D can be written 1, 8, ..., 12, 14, A, ..., D

If computer-supported systems are used in presenting information the horizontal ellipsis shall be realised either as:

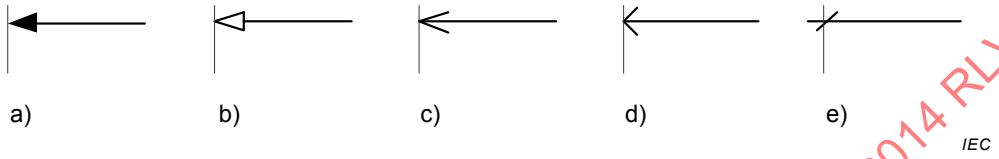
- a sequence of three characters “FULL STOP” .; or

- a single character “HORIZONTAL ELLIPSIS” ... as specified in IEC 61286.

NOTE 3 The rules of 5.16 have been derived from ISO 31-11.

5.17 Dimension lines

Dimension lines including their terminators and the indication of the origin shall be in accordance with ISO 129. Examples of terminators are shown in Figure 14. The choice of the arrowheads in Figure 14 a) to d) has no significant meaning, and only one type should be used within a document.

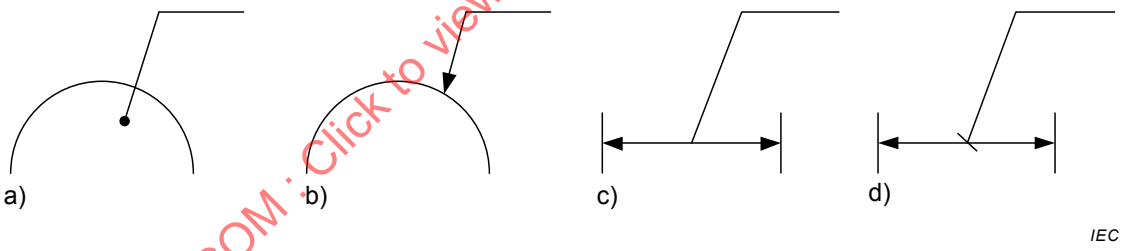


a) Arrowhead, closed and filled 30°
b) Arrowhead, closed 30°
c) Arrowhead, open 30°
d) Arrowhead, open 90°
e) Oblique stroke

Figure 14 – Terminators of dimension lines (from ISO 129)

5.18 Leader lines and reference lines

Leader lines and reference lines shall be presented in accordance with ISO 128-22. Examples are shown in Figure 15.



a) Leader line terminating in an object
b) Leader line terminating on an object
c) Leader line terminating on a line
d) Leader line with a stroke terminating on a line

Figure 15 – Examples of leader lines (from ISO 128-22)

Leader lines ending on a connecting line shall be terminated with an oblique stroke at the connecting line, see Figure 16.

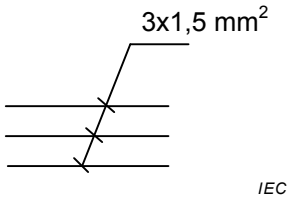


Figure 16 – Example of the use of leader lines to connecting lines

5.19 Explanatory notes and markings

An explanatory note should be used when the meaning cannot otherwise be conveyed. It should be placed adjacent to where it applies, or a reference should be made to a note placed elsewhere in the content area, see Figure 17. In the case of multi-page presentation of information, all notes of a general character should appear on the first page(s).

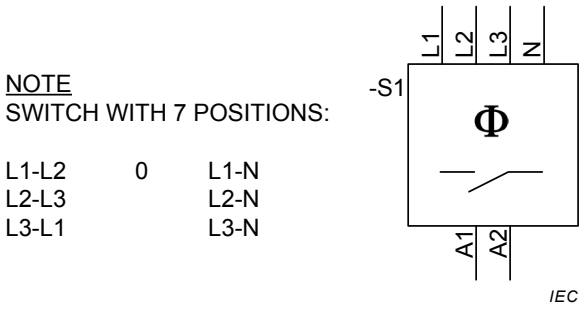


Figure 17 – Example of an explanatory note

If informative markings (for example graphical symbols in accordance with IEC 60417) for man-machine control functions appear on an equipment panel, these same markings should appear adjacent to the corresponding graphical symbol in the related presentation of information in documentation. If the reference direction of the current in a branch, the indication of magnetic flux direction, the reference polarity of voltage, and the correspondence between the voltage polarities of coupled electric circuits, is needed to be shown, the presentation methods shown in IEC 60375 shall be applied.

5.20 Designation of objects

5.20.1 General

For objects having an object designation this shall be consistently shown at each representation of the object.

The object designation shall be readable from the bottom edge of the page. In diagrams, object designations should be located above or to the left of the object representation, see IEC 81714-2 for further details. In other document kinds the object designation shall be clearly related to the object representation with the requirement not to interfere with other presentation elements shown in the document.

An object designation shall be presented on a single line (not split to several lines).

5.20.2 Reference designations

Reference designations in accordance with IEC 81346-1 are object designations for which the requirements provided in 5.20.1 apply.

For objects having a reference designation set in accordance with IEC 81346-1, the following applies (see Figure 18):

- the reference designation set may be presented on a single line or on successive lines;
- if the reference designations are presented on successive lines, each reference designation shall start on a separate line;
- if more than one reference designation is presented on the same line, and if not clearly separated for example as in a table, the character SOLIDUS (/) shall be used as separator sign between the different reference designations;

- the order of the presented reference designations in a reference designation set has no significant meaning;
- At least one unambiguous reference designation out of the set shall consistently be shown at each representation of the object.

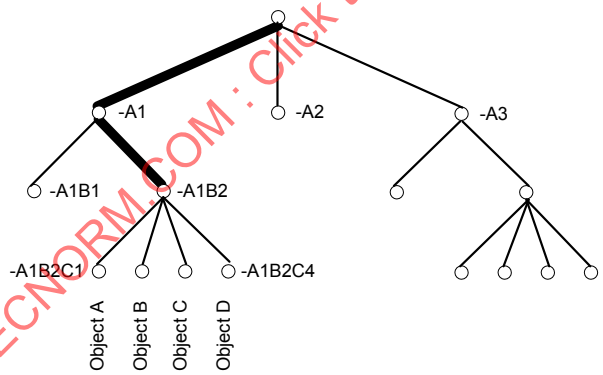
	Reference designations	Possible graphical presentations	
		All presented on the same line	Each presented on one line
Three reference designations in one reference designation set	=A1 -B2 +C3	=A1/-B2/+C3	=A1 -B2 +C3
One reference designation in one reference designation set	=D4-E5+F6	=D4-E5+F6	=D4-E5+F6
Two reference designations in one reference designation set	=G7-H8 +J9	=G7-H8/+J9	=G7-H8 +J9

IEC

Figure 18 – Presentation of reference designations and sets of reference designations

5.20.3 Simplified presentation

A reference designation in accordance with IEC 81346-1 is the representation of a path in a tree-like structure. Different objects may therefore have a common initial portion because they are constituents of the same object, including at least one single-level reference designation, of their paths starting from the top of the structure tree, see Figure 19.



The common initial portion of the reference designation for the objects A, B, C and D is -A1B2

IEC

Figure 19 – The common initial portion of reference designations

If all objects shown on a page of a document have a reference designation with a common initial portion, this portion may be presented once at a defined place, depending on the kind of document, in the content area of a document page and shall not be shown in any of the identification areas of the document. (See also 7.1.6)

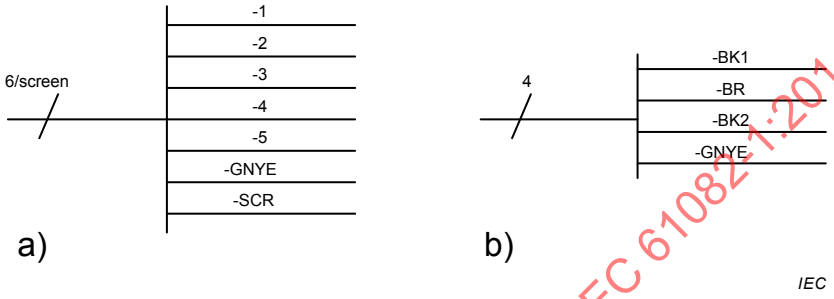
In a series of reference designations, a single level of the reference designations may be presented applying the rules for presentation of set of elements as specified in 5.16, with the indicated set of elements enclosed in parentheses. The complete single level reference designation shall be presented at both the lower and upper limit of the set of elements.

Examples:

- -A2C4F1, -A2C4F2, -A2C4F3 and -A2C4F4 being presented as -A2C4(-F1, ...,-F4)
- =B2-C1, =B2-D3, =B2-F5 being presented as =B2(-C1,-D3,-F5)
- =Q3=1=H1, =Q3=2=H1, =Q3=3=H1 and =Q3=4=H1 being presented as =Q3(=1, ..., =4)=H1

5.20.4 Cable core designations

Cable cores should be identified by their reference designation, for example core numbers or core colour codes, provided by the cable manufacturer, see Figure 20.



a) Cable with numbers printed on the cores, one core marked with colour, and with a concentric lead

b) Cable with colour-marked cores, two cores black

Figure 20 – Examples of cable core designations

If no core identifier is provided by the cable manufacturer, a reference designation for the core should be applied.

NOTE Cables per se are designated in accordance with 5.20.1 and 5.20.2

5.21 Terminal designations

Terminal designations shall be applied in accordance with IEC 61666.

5.22 Signal designations

Signal designations shall be applied in accordance with IEC 61175.

6 Document kinds

This International Standard provides rules for the presentation of four different basic document kinds for electrotechnology:

- Diagrams, see Clause 7;
- Drawings, see Clause 8;
- Tables (lists), see Clause 9.
- Charts and graphs, see Clause 10.

For each basic document kind, more specific rules are provided for specific document kinds to the extent that is necessary for the presentation of these.

Annex C provides a list of specific document kinds with indication of their minimum content and additional content of information to be provided.

For other specific document kinds, relevant IEC and ISO publications exist, for example:

- IEC 60848 for sequential function charts;
- IEC 61131-3 for graphical representations of programming languages for programmable controllers;
- IEC 62027 for parts lists;
- IEC 82079-1 for instructions for use;
- IEC/TS 61804-1 and IEC/PAS 61804-2 for the description of function blocks;
- ISO 5807 for flow charts for information processing;
- ISO 15519-1 for diagrams in process industry (e.g. process flow diagram, piping and instrumentation diagram).

7 Diagrams

7.1 General

7.1.1 Flow of energy, signal, etc.

If the direction of a flow, for example of a signal, is of importance and is not obvious, the corresponding connecting line shall be provided with arrowheads (symbol S00099 in IEC 60617 (2001-07)). See Figure 21.

NOTE The use of signal classification code as per IEC 61175 can also provide information on the flow direction.

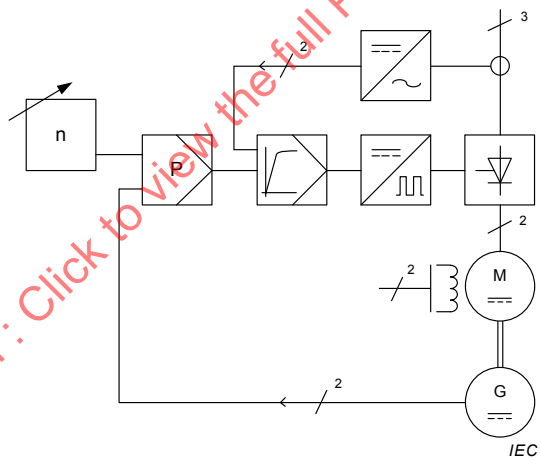


Figure 21 – Example of functional grouping and signal flow directions; a control system

Different flow paths, for example for information, control, energy, and material flow, shall be clearly distinguished and recognizable.

7.1.2 Symbols

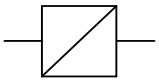
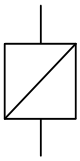
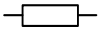
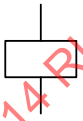
7.1.2.1 Choice of symbols

Symbols shall conform to IEC 60617. For objects outside the scope of IEC 60617, symbols of ISO 14617 should be considered.

NOTE When choosing a symbol representing a component with movable parts, the rule given in 7.4.4.1 applies.

7.1.2.2 Connect nodes

Symbols shall be provided with the appropriate number of connect nodes. The connect nodes shall be positioned on the 1M or 0,5M grid (see ISO 81714-1:2010, 6.11). For standardized symbols that are associated with connect nodes and/or terminal lines (e.g. as in IEC 60617) the position of the connect nodes and terminal lines may be changed as long as the meaning of the symbol is not changed. See Figure 22.

Symbol where different locations of connections do not affect the meaning		**Symbols where the location of connections may affect the meaning** (neglecting the proportions of the symbols)	
			
Symbol S00213 in IEC 60617 (2001-07), Converter, general symbol		Symbol S00555 in IEC 60617 (2001-07), Resistor	Symbol S00305 in IEC 60617 (2001-07), Operating device

IEC

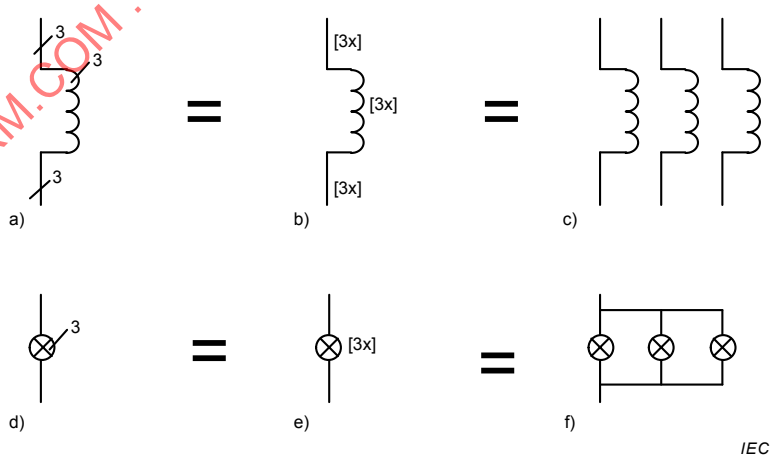
Figure 22 – Example of symbols and different location of connections

7.1.2.3 Simplified presentation

7.1.2.3.1 Identical symbols in a group

A number of identical symbols in a group may be represented by a single symbol, using one of the following methods:

- the single symbol should be provided with a short oblique stroke and a figure indicating the number of symbol elements represented by the single symbol (see Figure 23a) and Figure 23d)); or
- the represented number of symbols by the single symbol should be indicated by a figure followed by a multiplication sign within square brackets, for example [3×] (see Figure 23b) and Figure 23e)).



a) Three independent circuits using an oblique stroke
b) Three independent circuits using the multiplication sign
c) Three independent circuits, complete presentation
d) One circuit with three objects using an oblique stroke
e) One circuit with three objects using the multiplication sign
f) One circuit with three objects, complete presentation

Figure 23 – Simplified presentation

7.1.2.3.2 Parallel connected objects

If identical objects are connected in parallel, they may be simplified presented following the rules in 7.1.2.3 and with the reference designations presented at the symbol shown following the rules for presentation of set of elements in 5.16, see Figure 24. The terminal designations shall be presented at the symbol shown.

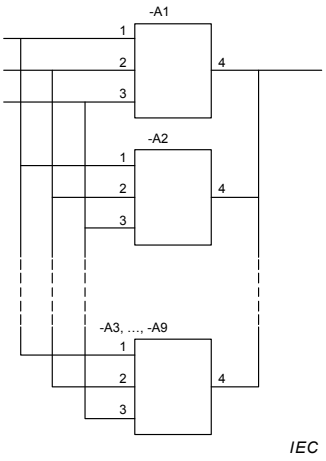


Figure 24 – Simplified presentation of parallel connected identical objects

7.1.2.3.3 Serial connected objects

If identical objects are connected in series and the internal connections among the objects are obvious, they may be simplified presented by showing the symbol for the first and the last symbol of the objects and with a dotted line in between. The reference designations of the objects shall be shown following the rules for presentation of set of elements in 5.16, see Figure 25. The terminal designations shall be presented at the symbols shown.

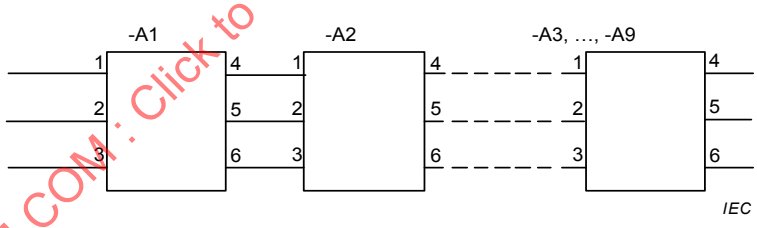


Figure 25 – Simplified presentation of serial connected identical objects

7.1.2.4 Presentation of cross-references related to detached presentations

Cross-references associated with a symbol applying detached representation (see 7.4.3.3) shall be shown adjacent to that symbol. They should be located above the symbol and to the right of the reference designation, when it is shown with mainly horizontal terminal lines or to the left of the symbol and below the reference designation when it is shown with mainly vertical terminal lines. For detailed rules related to symbols used in CAx-systems, see IEC 81714-2.

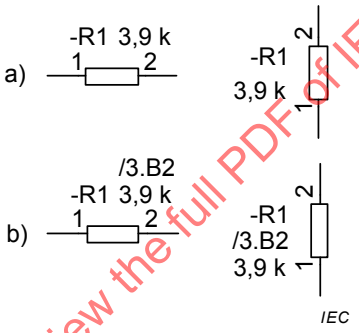
A cross-reference shall not be presented immediately above or to the left of the reference designations presented. See Figure 26.

Figure 26 – Example of cross-references related to detached presentations

7.1.2.5 Presentation of technical data

Technical data associated with the object represented by a symbol shall, if presented, be shown adjacent to that symbol. They shall be located above the symbol when it is shown with mainly horizontal terminal lines or to the left of the symbol when it is shown with mainly vertical terminal lines.

The technical data shall be presented below or to the right of the reference designations presented. See Figure 27.



a) symbol with technical data

b) symbol with cross-reference and technical data

Figure 27 – Example for technical data associated with a symbol

If the meaning of the symbol will not be changed, technical data may also be shown inside the symbol outline. See Figure 28.

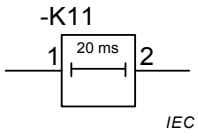


Figure 28 – Example of technical data shown inside a symbol

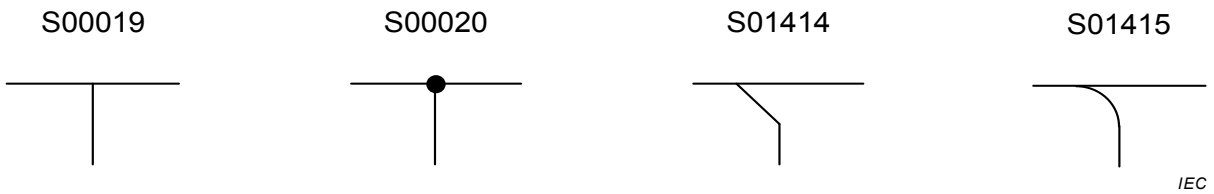
7.1.3 Connecting lines

7.1.3.1 Electrical or functional interconnections

Connecting lines shall be in accordance with symbol S00001 in IEC 60617 (2001-07).

NOTE Symbol S00001 is a continuous line.

When two lines are joined at a specific point, the junction shall be in accordance with symbols S00019, S00020, S01414 or S01415 in IEC 60617 (2001-07), see Figure 29.



Symbols S00019 and S00020 provide information that the interconnections exist but not their location. Symbol S01414 indicates two physical interconnections that are to be attached to the same terminal (not shown) on the left side. Symbol S01415 is used for graphical bundling indicating the direction of the bundle that enters.

Figure 29 – Symbols representing joining of connecting lines

The interconnection of crossing connecting lines shall be shown using the symbol S00022 in IEC 60617 (2001-07), see Figure 30.

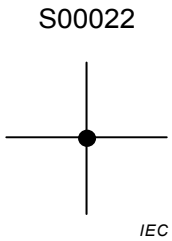


Figure 30 – Symbol representing the interconnection of crossing connecting lines

Figure 31 shows one example where the symbols S00019 and S00020 in IEC 60617 (2001-07) are applied.

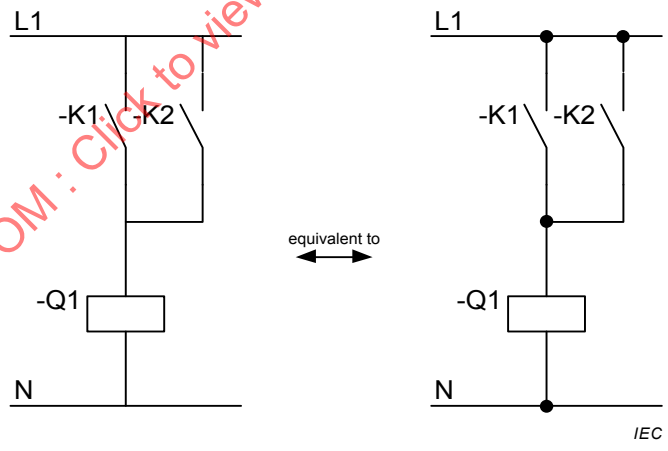


Figure 31 – Examples of the joining of connecting lines

Figure 32 shows an example with the application of symbol S01414 in IEC 60617 (2001-07). The circuit illustrates the same function as in Figure 31, but includes a visualisation of how the wiring shall be done.

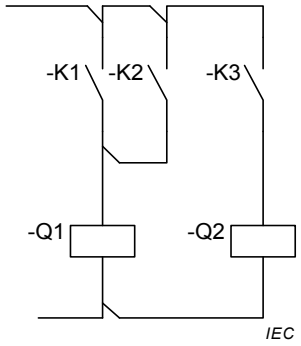


Figure 32 – Example of the joining of connecting lines with indication of where the physical wire goes

Figure 33 shows an example of the application of the symbol S01415 in IEC 60617 (2001-07), illustrating the direction of a bundle when two bundles are joined in a diagram.

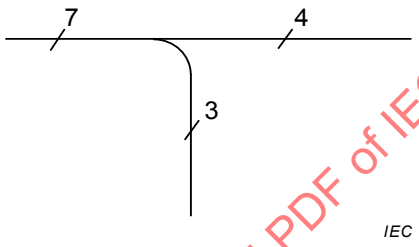


Figure 33 – Example of the joining of connecting lines where the connecting lines represent bundles of wires

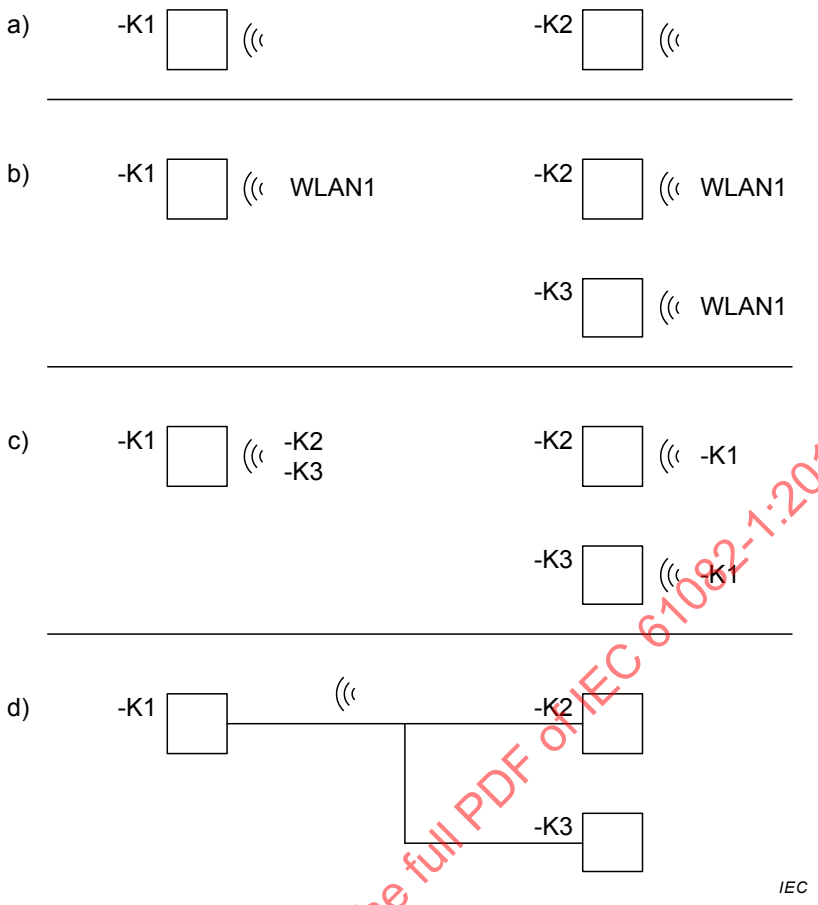
7.1.3.2 Fibre optical interconnections

Fibre optical interconnections shall be shown in accordance with symbol S01318 in IEC 60617 (2001-07), see Figure 10.

7.1.3.3 Wireless interconnections

Wireless interconnections shall be shown in accordance with symbol S01863 (see Figure 34) presented adjacent to the symbols representing the interconnected objects. The direction of waves shall, regardless of the actual information or wave flow direction, be presented as incoming to the object. Any cross-reference to objects that is communicated with or other descriptive indications related to the wireless network shall be presented at the small side of symbol S01318 in IEC 60617 (2001-07).

If required, symbol S00001 (continuous line) representing a connection together with symbol S01863 in IEC 60617 (2001-07) as qualifying symbol may be used to explicitly show the wireless interconnections.



Key

a) Indicates that objects communicate via wireless interfaces

b) Indicates that objects with wireless interfaces communicate via a network with the name WLAN1

c) Reference designation at the wireless interface symbol indicate with which objects is communicated

d) Wireless connections are explicitly presented by qualifying the symbol for a connection (continuous line) with that for a wireless connection

Figure 34 –Different presentation methods for wireless interconnections

Mechanical links

Mechanical links shall be shown in accordance with symbols S00144 or S00147 in IEC 60617 (2001-07), see Figure 35.

NOTE Symbol S00144 is a dashed line. Symbol S00147 is a double continuous line.

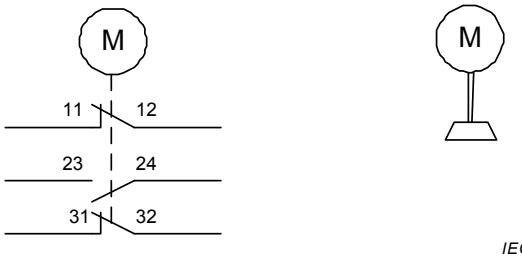


Figure 35 – Example of presentations of mechanical links

7.1.3.4 Arrangement and orientation of connecting lines

Connecting lines shall be oriented horizontally or vertically except in those cases where oblique lines improve the legibility.

Connecting lines should not interfere with other symbols; see IEC 81714-2:2006, 6.11.2.

Bends and crossover of lines should be restricted to a minimum. To avoid bends and crossovers lines may be interrupted. In this case, and also when a line is interrupted on one page and continues on another, the ends of the interrupted line shall be mutually referenced, see 5.8. The ends of the interrupted line should be drawn so that they can easily be recognised, see Figure 36.

NOTE In circuit diagrams, bends and cross-overs can be avoided by regarding the layout principles in accordance with 7.4.2 and the use of detached representation in accordance with 7.4.3.3.

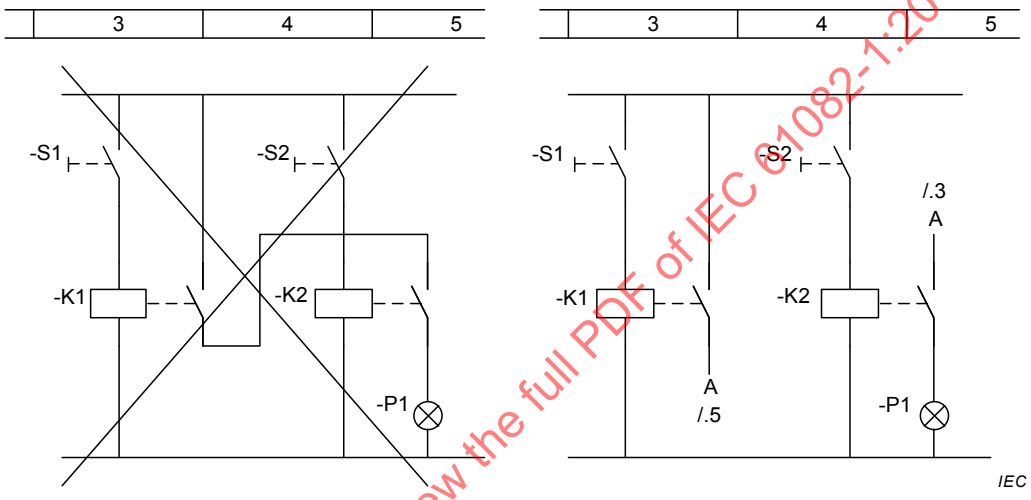


Figure 36 – Example for avoiding bends and cross-overs

The space between two parallel connecting lines shall be at least 1M.

The minimum distance between parallel connecting lines where text is to be shown in between, shall be twice the lettering height and not less than 2M, see Figure 37.

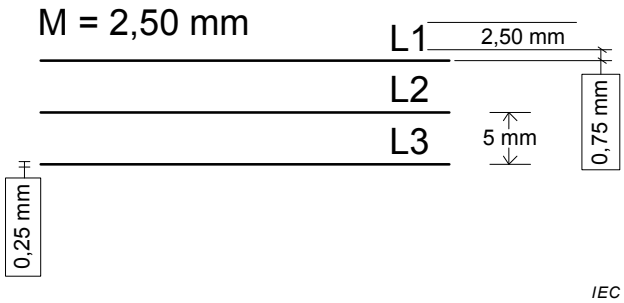


Figure 37 – Spacing of lines

7.1.3.5 Technical data related to connecting lines

Technical data associated with connecting lines:

- shall be clearly related to the associated connecting line;
- shall not touch or cross the connecting line;

- should be located adjacent to – above horizontal and to the left of vertical – connecting lines.

If it is not possible to show the technical data adjacent to the connecting line, it shall be shown elsewhere in the content area together with a leader line or a reference to the connecting line.

The technical data shall be clearly separated from any reference designations, signal designations or terminal designations presented along the connecting line. See Figure 38.

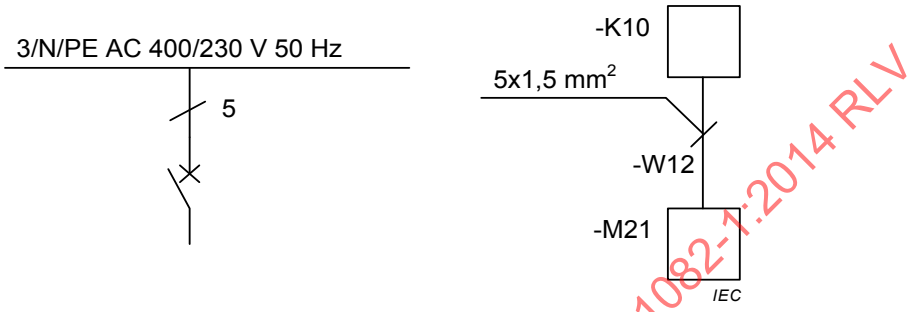


Figure 38 – Examples for technical data associated with connecting lines

Waveforms may be included and should be shown in the way that they normally appear on an oscilloscope screen, detailed as far as necessary for the application.

Electrical ratings of a.c. and d.c. circuits shall be presented in accordance with the examples shown in IEC 61293, preferably in the abbreviated form.

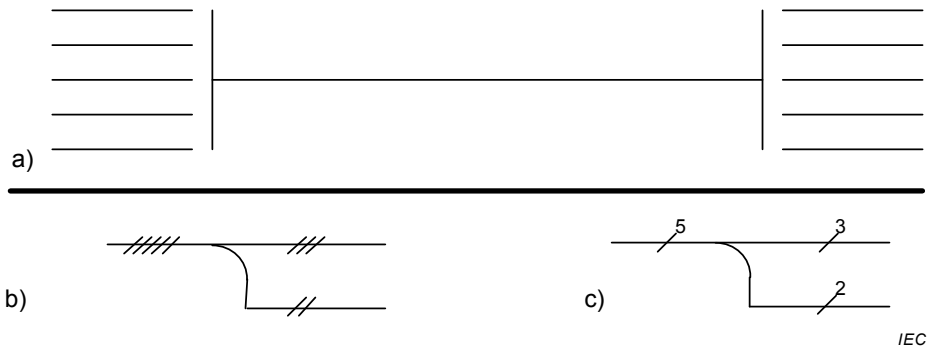
EXAMPLE

- DC 110 V: Direct voltage110 V
- 3 AC 400 V: Three phase, three wire system 400 V
- 3/N/PE AC 400/230 V 50 Hz: Three-phase, five-wire system with N and PE 400/230 V

7.1.3.6 Simplified presentation

Multiple parallel connecting lines may be represented by one line (i.e. bundle) using one of the following methods:

- the parallel lines are interrupted and a cross-line after a short space represents the bundle (See Figure 39.a);
- the number of parallel connecting lines represented by the bundle shall be indicated either by adding as many oblique strokes as the number of connections (see symbol S00002 in IEC 60617 (2001-07) and Figure 39.b), or by adding one stroke followed by the figure for the number of connections (see symbol S00003 in IEC 60617 (2001-07) and Figure 39c).



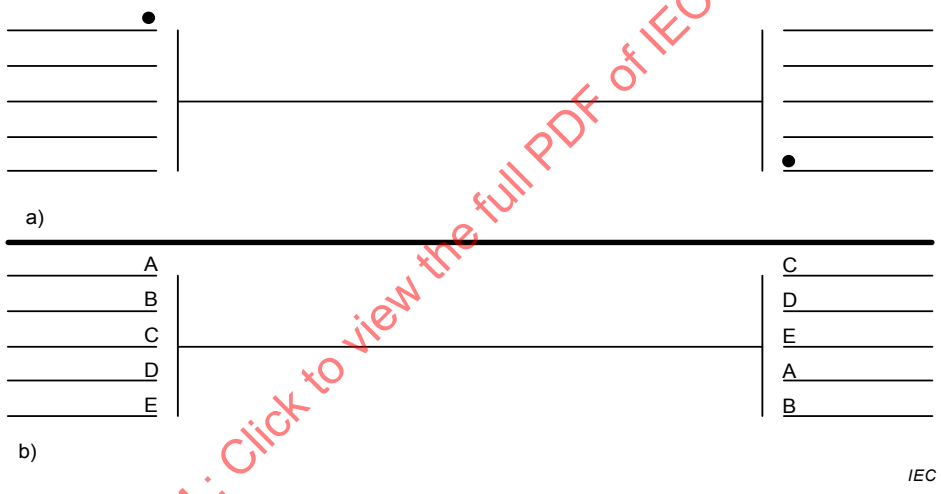
a) Using a cross-line and a space

b) Indication by a number of strokes

c) Indication by numbers

Figure 39 – Presentation of bundles

The sequential order of the parallel lines at both ends of the bundle should be unambiguously indicated, see Figure 40.



a) Using a dot to indicate the first connection

b) Indicating the individual connections

Figure 40 – Indication of sequence within bundles

7.1.4 Representation of binary logic circuits

7.1.4.1 Logic conventions and logic polarity indication

The relationship between logic states and the nominal values (logic levels) of the physical quantities used to represent these states shall be indicated by using one of the following methods in a diagram:

- Single logic convention (relative notation);
- Direct logic polarity convention (absolute notation).

Figure 41 illustrates the terms "states" and "levels", where:

- “Internal logic state” describes a logic state assumed to exist inside a symbol outline at an input or output.
- “External logic state” describes a logic state assumed to exist outside a symbol outline:

  - on an input connecting line prior to any external qualifying symbol at that input; or
  - on an output connecting line beyond any external qualifying symbol at that output.
- "Logic level" describes the physical quality assumed to represent a logic state of a binary variable:
  - IEC 60617 uses the symbols "0" and "1" to identify the two logic states of a binary variable. These states are referred to as 0-state and 1-state.
  - A binary variable may be equated to any physical quantity for which two distinct ranges can be defines. In IEC 60617-DB these distinct ranges are referred to as logic levels and are denoted "H" and "L". "H" is used to denote the logic level with the more positive algebraic value, and "L" is used to denote the logic level with the less positive algebraic level.

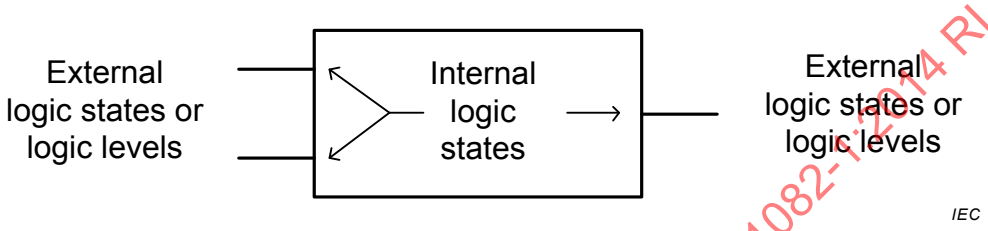


Figure 41 – Illustration of the terms "states" and "levels"

7.1.4.2 Single logic convention

Single logic convention implies that the correspondence between a given external logic state and logic level is the same at all inputs and outputs in the diagram or a portion of a diagram.

The symbol for logic negation (symbols S01466 and S01467 in IEC 60617) shall be used at an input or output terminal to indicate that the internal and external states are the complements of one another for that terminal.

a) Positive logic convention:

The more positive value of the physical quantity (H-level) corresponds to the external 1-state. The less positive value (L-level) corresponds to the external 0-state. If necessary, the positive logic convention may be indicated as:

POSITIVE LOGIC 

b) Negative logic convention:

The less positive value of the physical quantity (L-level) corresponds to the external 1-state. The more positive value (H-level) corresponds to the external 0-state. The use of negative logic convention shall be indicated in the diagram or in supporting documentation as:

NEGATIVE LOGIC 

Figure 42 shows an example of a diagram using positive logic convention.

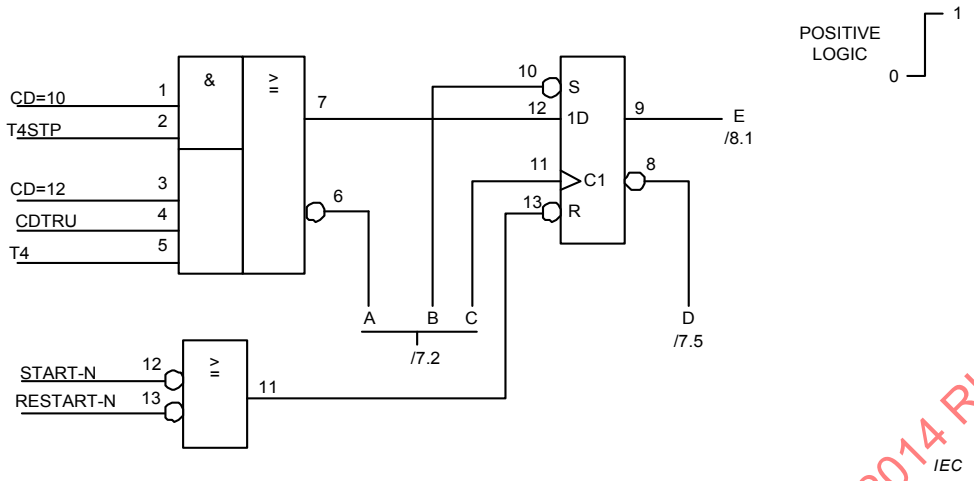


Figure 42 – Detail of a circuit diagram using positive logic convention

7.1.4.3 Direct logic polarity convention

Direct logic polarity convention implies that the relationship between the internal logic state and the (external) logic level of each input of every binary logic element shall be indicated directly by means of the presence or absence of the logic polarity symbol (symbols S01468 through S01471 in IEC 60617 (2001-07)).

The logic polarity symbol shall be used at an input or output terminal to indicate that the (external) low level corresponds to the internal 1-state for that terminal.

NOTE The absence of the logic polarity symbol signifies that the (external) high level corresponds to the internal 1-state for that terminal.

The relationship between the (external) logic level and a signal state shall only by defined by the signal designation in accordance with IEC 61175.

Figure 43 shows an example of a diagram using direct polarity convention.

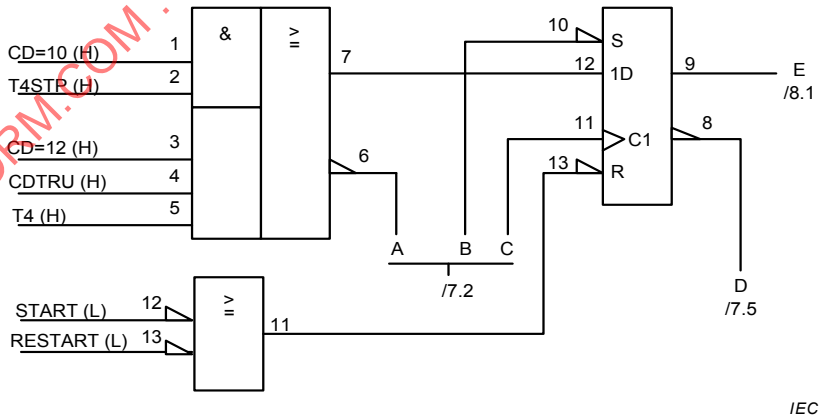


Figure 43 – Detail of a circuit diagram using direct logic polarity convention

For diagrams prepared with direct logic polarity convention, but showing no logic polarity symbols, a statement indicating that direct logic polarity convention is applied shall be placed in the diagram or in supporting documentation.

7.1.5 Boundary frames

A boundary frame shall consist of horizontal and vertical lines using the symbol S00064 in IEC 60617 (2001-07).

NOTE Symbol S00064 is a dashed dotted line. The resulting boundary frame is not a defined symbol itself.

A boundary frame shall represent an object. Objects shown inside the boundary frame shall be constituents of this object and may be represented in a simplified form, provided a reference to a more detailed document is given, see Figure 44.

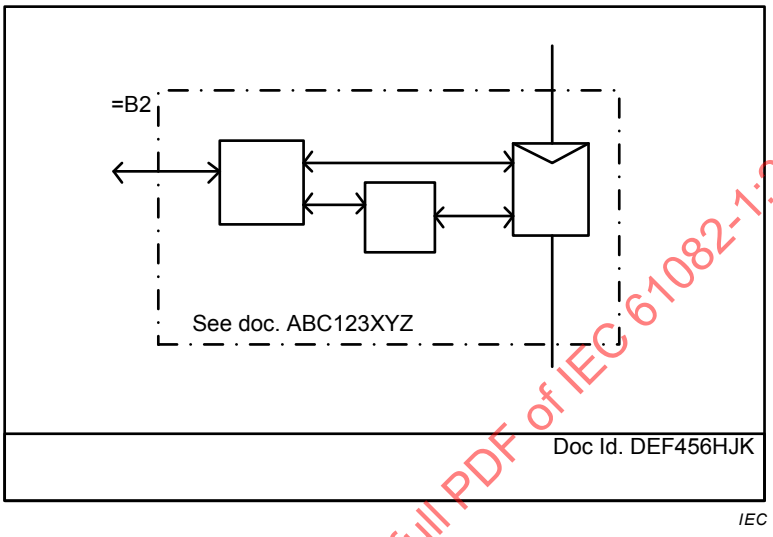


Figure 44 – Boundary frame with a reference to another document

The boundary frame shall be associated with the reference designations of the object it represents.

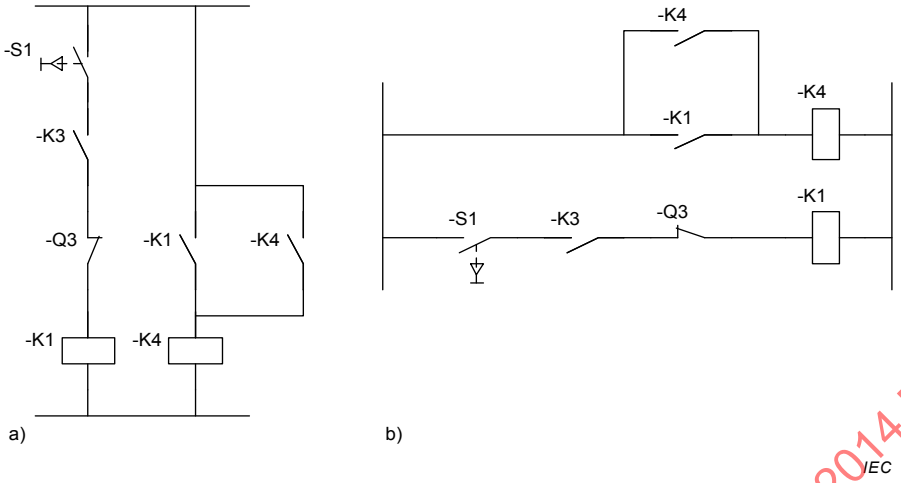
7.1.6 Presentation of reference designations

7.1.6.1 Symbols

Reference designations associated with a symbol shall be located to the left of the symbol when it is shown with mainly vertical terminal lines, see Figure 45a), or above the symbol when it is shown with mainly horizontal terminal lines, see Figure 45b).

NOTE For symbols to be used in CAx-applications more precise rules for the positioning of various text fields in accordance with IEC 81714-2 apply (see also 5.12.1). For example, reference designations or reference designation sets are to be placed in a defined distance above an imagined horizontal centre line or any horizontal terminal line (and also in a defined distance from the symbol outline) when it is shown with mainly vertical terminal lines as indicated in Figure 45a). For symbols with mainly horizontal terminal lines the position of reference designations is to the left of an imagined vertical centre line as indicated Figure 45b).

For reference designations associated with a symbol representing a connection and for boundary frames other rules apply, see 7.1.6.2 and 7.1.6.3.



a) with vertical terminal lines

b) with horizontal terminal lines

Figure 45 – Location of reference designations at a symbol

7.1.6.2 Connecting lines

Reference designations associated with connecting lines:

- shall be clearly related to the associated connecting line;
- shall not touch or cross the connecting line;
- should be located adjacent to – above horizontal and to the left of vertical – connecting lines, and directed along the connecting line.

If it is not possible to show the reference designation adjacent to the connecting line, it shall be shown elsewhere in the content area together with a leader line or a reference to the connecting line. See also Figure 46.

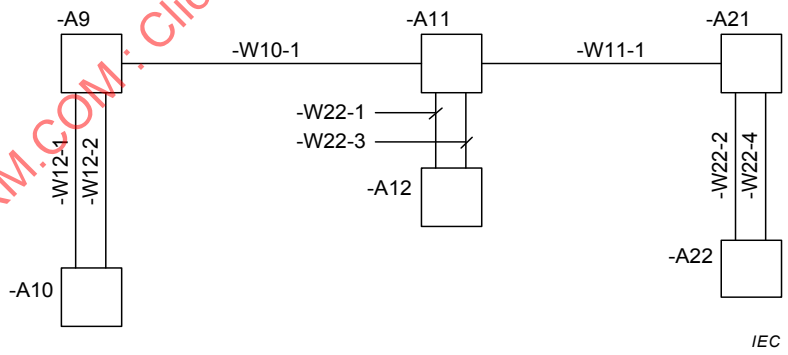


Figure 46 – Examples of reference designations associated with connecting lines

The reference designations shall be clearly separated from any signal designations, terminal designations or technical data associated with the connecting line.

7.1.6.3 Boundary frames

As stated in 7.1.5 each boundary frame represents an object that needs to be identified, for example by a reference designation.

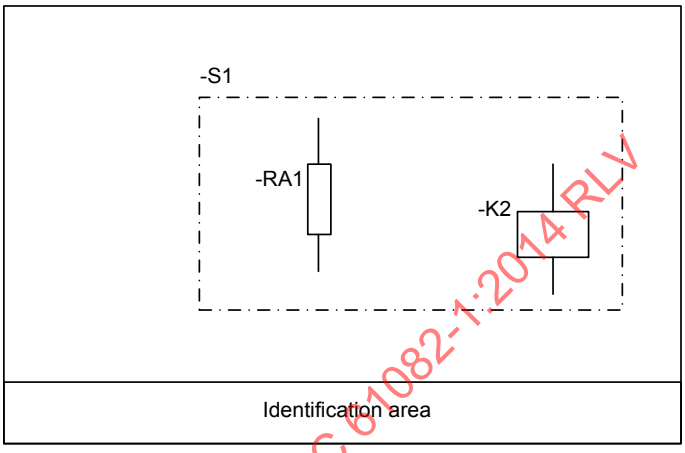
NOTE A boundary frame is a drawing means and not a symbol in accordance with IEC 60617 and IEC 81714-2.

Reference designations associated with a boundary frame shall be located above and at the left edge of the boundary frame, or to the left and at the upper edge of the boundary frame.

For objects presented inside of a boundary frame, the initial portion of their reference designation corresponding to the reference designation of the object represented by the boundary frame shall not be shown at the individual objects, see Figure 47.

Object	Reference designations
Resistor	-S1RA1
Operating device	-S1K2
Boundary frame	-S1

a)



b)

IEC

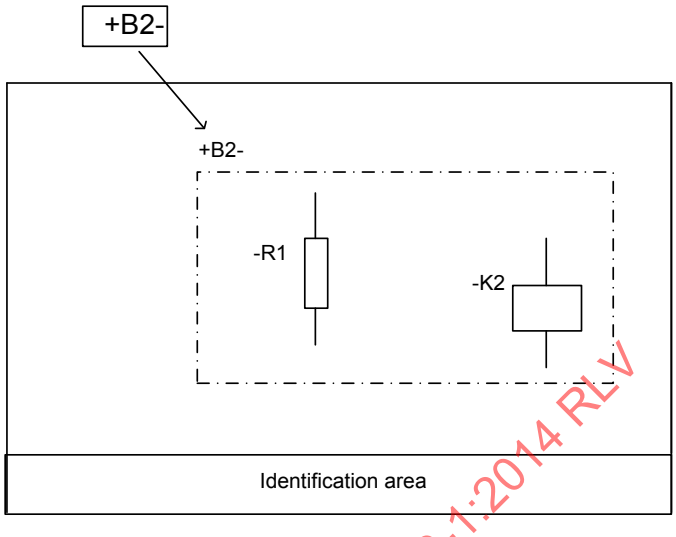
a) The reference designations of the objects

b) The reference designations as shown in a diagram.

Explanation: The reference designation of an object inside the boundary frame is found by concatenating its reference designation with the reference designation presented at the boundary frame.

Figure 47 – Presentation of reference designations at a boundary frame

If the last single-level reference designation associated with the boundary frame is of a different aspect than the first single-level reference designation of the constituent object, the reference designation associated with the boundary frame shall be suffixed with the prefix sign of the latter, see Figure 48.



Object	Reference designations
Resistor	+B2-R1
Operating device	+B2-K2
”Boundary frame”	+B2

a) b)

IEC

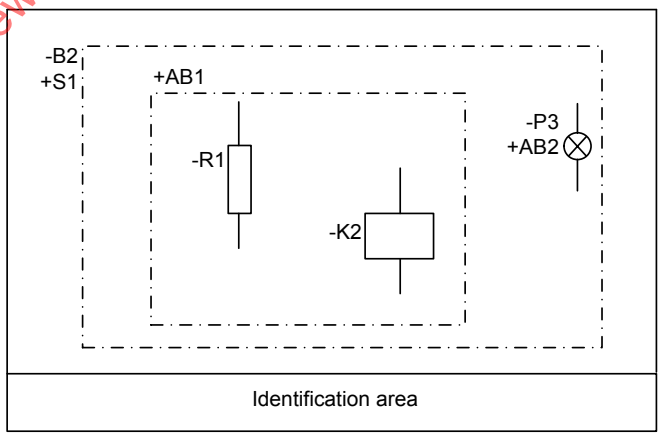
a) The reference designations of the objects

b) The reference designations as shown in a diagram

Explanation: A reference designation of an object inside the boundary frame is found by concatenating its reference designation with the reference designation presented at the boundary frame that is suffixed with the prefix sign shown at the object.

Figure 48 – Presentation of reference designations including different aspect

If the objects presented are associated with more than one reference designation, each reference designation can be simplified presented, see Figure 49.



Object	Reference designations
Resistor	+S1AB1... / -B2R1
Operating device	+S1AB1... / -B2K2
Lamp	+S1AB2 / -B2P3
”Boundary frame”	+S1 / -B2
”Boundary frame”	+S1AB1 / -B2...

a) b)

IEC

a) The reference designations of the objects

b) The reference designations as shown in a diagram

Figure 49 – Presentation of reference designation sets at a boundary frame

7.1.6.4 Document page

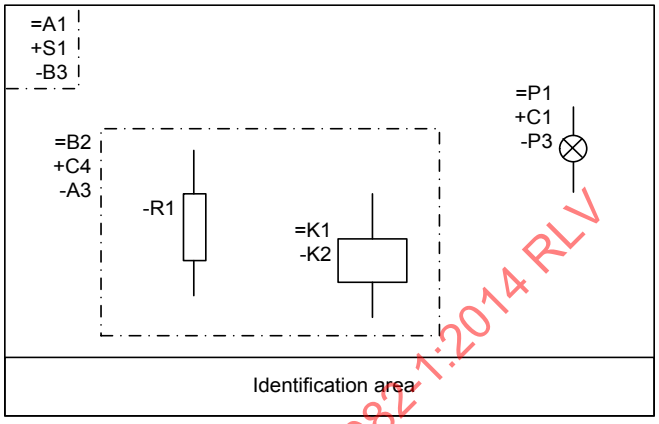
If the reference designation for all objects shown on a page of a document has the same common initial portion, this common initial portion should be shown to the left and preferably at the top within the content area, delimited from the rest of the content area by using the line for a boundary frame, see Figure 50.

The content area will in such cases present information related to a single object and could therefore be enclosed by a boundary frame that does not need to be shown completely.

NOTE Any reference designation shown in the identification area of a document page is part of the document designation and is not a part of the reference designations of the objects shown in the content area.

Object	Reference designations
Resistor	+S1C4 / =A1B2 / -B3A3R1
Operating device	+S1C4 / =A1B2K1 / -B3A3K2
Lamp	+S1C1 / =A1P1 / -B3P3
”Boundary frame”	+S1C4 / =A1B2 / -B3A3
”Page content area”	+S1 / =A1 / -B3

a)



b)

IEC

a) The reference designations of the objects

b) The reference designations as shown in a diagram

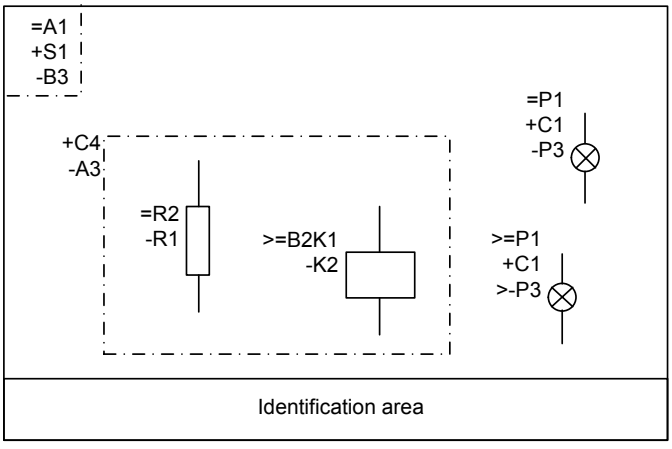
Figure 50 – Presentation of reference designation

7.1.6.5 Exclusion from concatenation

In some cases it may be necessary to show objects inside a boundary frame that are not constituents of the object represented by the boundary frame. In such cases shall the reference designations of these objects in a diagram be presented completely preceded with the character “GREATER THAN” (>), see Figure 51.

Object	Reference designations
Resistor	+S1C4 / =A1R2 / -B3A3R1
Operating device	+S1C4 / =B2K1 / -B3A3K2
Lamp	+S1C1 / =A1P1 / -B3P3
Lamp	+S1C1 / =P1 / -P3
”Page content area”	+S1 / =A1 / -B3

a)



b)

IEC

a) The reference designations of the objects

b) The reference designations as shown in a diagram

Figure 51 – Presentation of reference designations excluded from concatenation

7.1.7 Presentation of terminal designations

Terminal designations shall be located outside the symbol outline, adjacent to the part of the symbol that illustrates the terminal (i.e. a short line at the symbols interface). The presentation shall be above horizontal connecting lines and to the left of vertical connecting lines. Terminal designations shall be oriented along the connecting lines, see IEC 81714-2 for further details. See Figure 52.

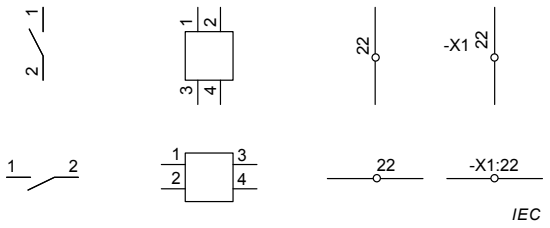


Figure 52 – Examples for the presentation of terminal designations

Simplified presentation of terminal designations can only be performed for terminals belonging to the same object, following the rules for the simplified presentation of series and ranges, see 5.16.

7.1.8 Presentation of signal designations

Signal designations:

- shall be clearly related to the associated connecting line;
- shall not touch or cross the connecting line;
- should be located adjacent to – above horizontal and to the left of vertical – connecting lines, and directed along the connecting line.

If it is not possible to show the signal designation adjacent to the connecting line, it shall be shown elsewhere in the content area together with a leader line or a reference to the connecting line. See Figure 53.

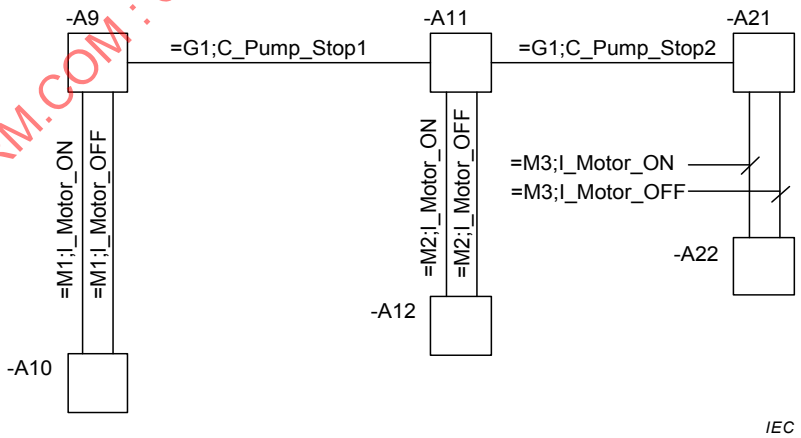


Figure 53 – Examples of signal designations associated with connecting lines

The signal designations shall be clearly separated from any reference designations, terminal designations or technical data associated with the connecting line. See Figure 54.

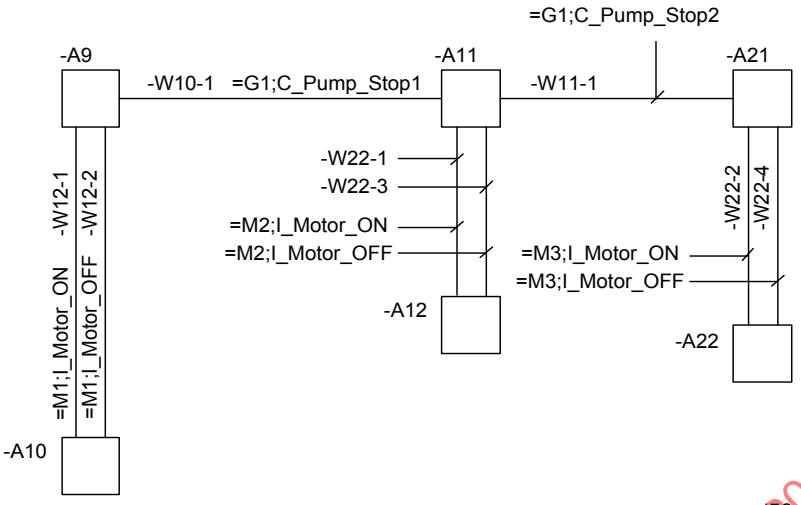


Figure 54 – Examples of reference and signal designations ass. with connecting lines

For signal designations shown inside boundary frames, the reference designation part should be presented following the concatenation rules of 7.1.6.3, 7.1.6.4 and 7.1.6.5. The reference designation shown at a boundary frame or for the document page that is intended to precede the signal designation shown, shall then be suffixed with the character “SEMICOLON” (;), see Figure 55.

NOTE 1 Reference designations shown at a document page or a boundary frame not suffixed with the character “SEMICOLON” (;) do not precede any signal designations.

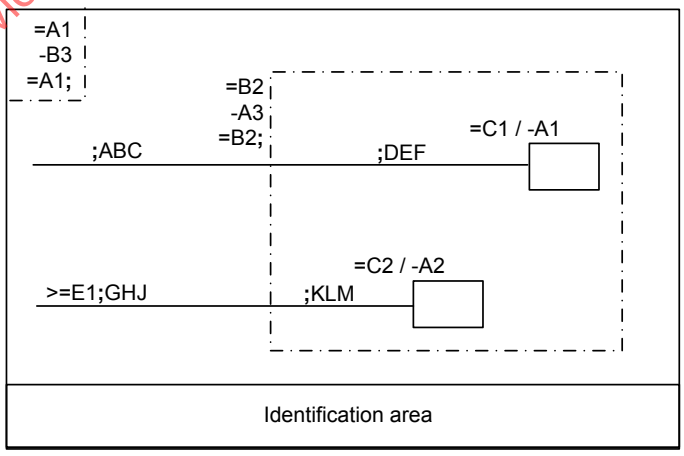
NOTE 2 IEC 61175 specifies different methods of assigning a reference designation to a signal name. The rules for presentation of signal designations are independent of the method applied.

Signal name	Signal designations
ABC	=A1;ABC
DEF	=A1B2;DEF
GHJ	=E1;GHJ
KLM	=A1B2;KLM

a)

Object	Reference designations
Object 1	=A1B2C1 / -B3A3A1
Object 2	=A1B2C2 / -B3A3A2

a)



b)

IEC

a) The signal designations of the signals

b) The signal designations as shown in a diagram

Figure 55 – Presentation of signal designations

7.1.9 Method of presentation of multi-phase circuits

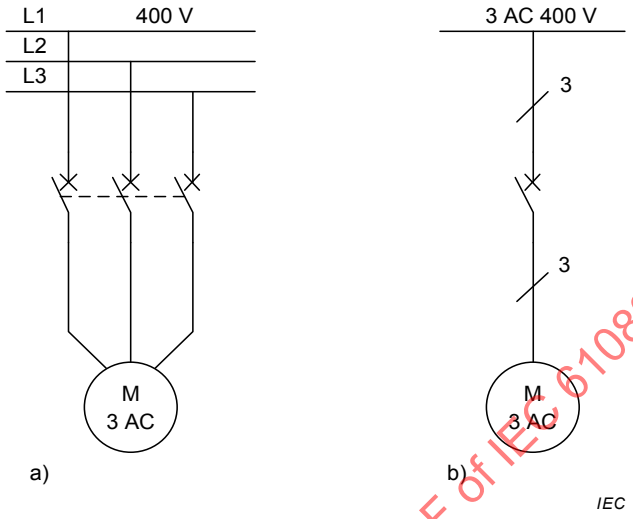
Multi-phase circuits may be presented as a:

- multi-line presentation wherein all phases are presented, see Figure 56a; or

- single-line presentation wherein all phases are represented by a single-phase circuit with indication of the number of phases, see Figure 56b.

The indication of the number of phases may be omitted if no confusion is likely, see Figure 60.

NOTE Single line presentation of multi-phase circuits is not the same as the bundled form of presentation shown in 7.1.3.6.



a) in multi-line presentation

b) single-line presentation

Figure 56 – Example for a multi-phase circuit

7.1.10 Emphasizing of circuits

Emphasizing of circuits may be performed by methods as:

- use of colours; or
- shading; or
- scaling of symbols (see IEC 81714-2); or
- increased line widths, considering the rules in 5.10.

NOTE Increased line widths can be applied to connecting lines, symbols or both.

7.2 Overview diagrams

An overview diagram provides an overall impression of an object, for example a radio receiver, a power plant or a control program, by showing the main constituents of the object and their main interrelations. Detailed information concerning the constituent objects should be shown in documents applying other document kinds.

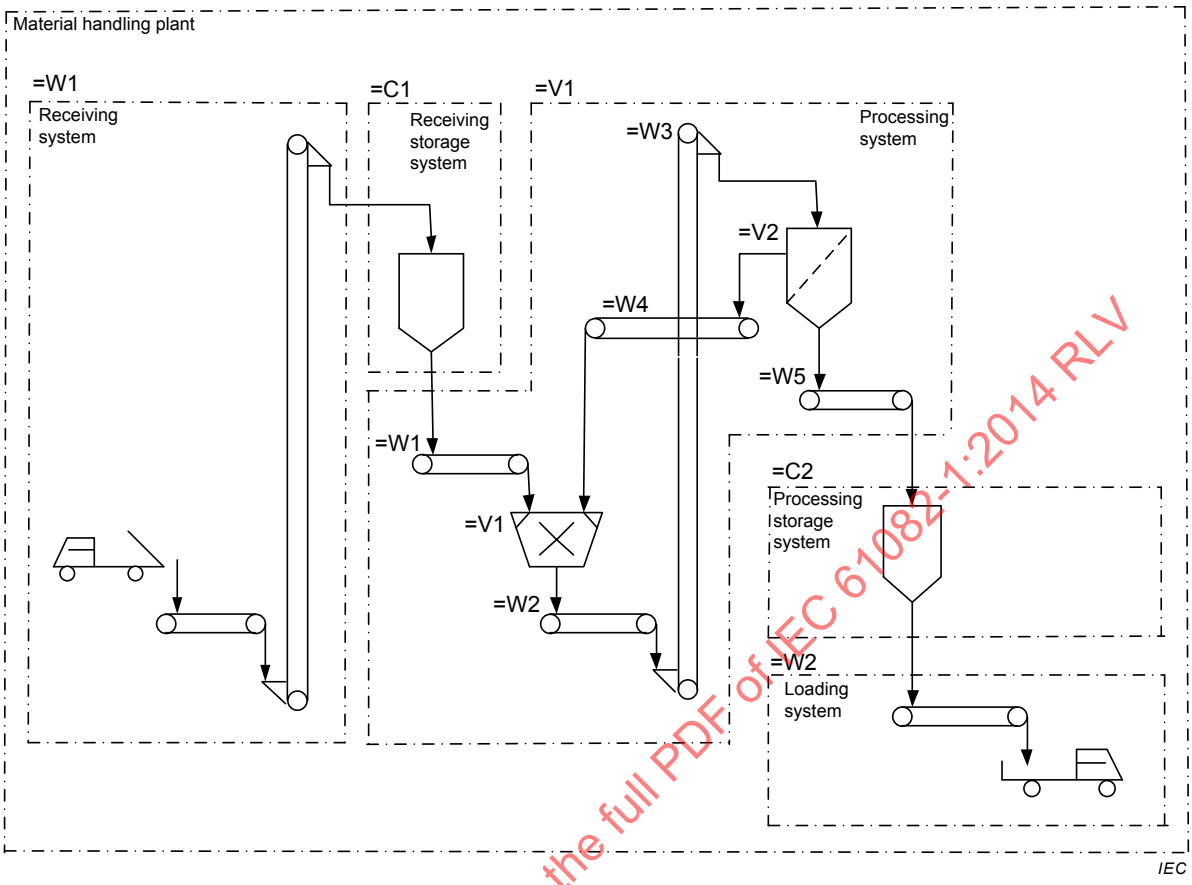
An overview diagram may include non-electrotechnical constituents.

An overview diagram should normally emphasize one aspect of the object described, for example the functional aspect, the topographical aspect, the connectivity aspect.

Any object regardless of its position in a structure can be associated with an overview diagram.

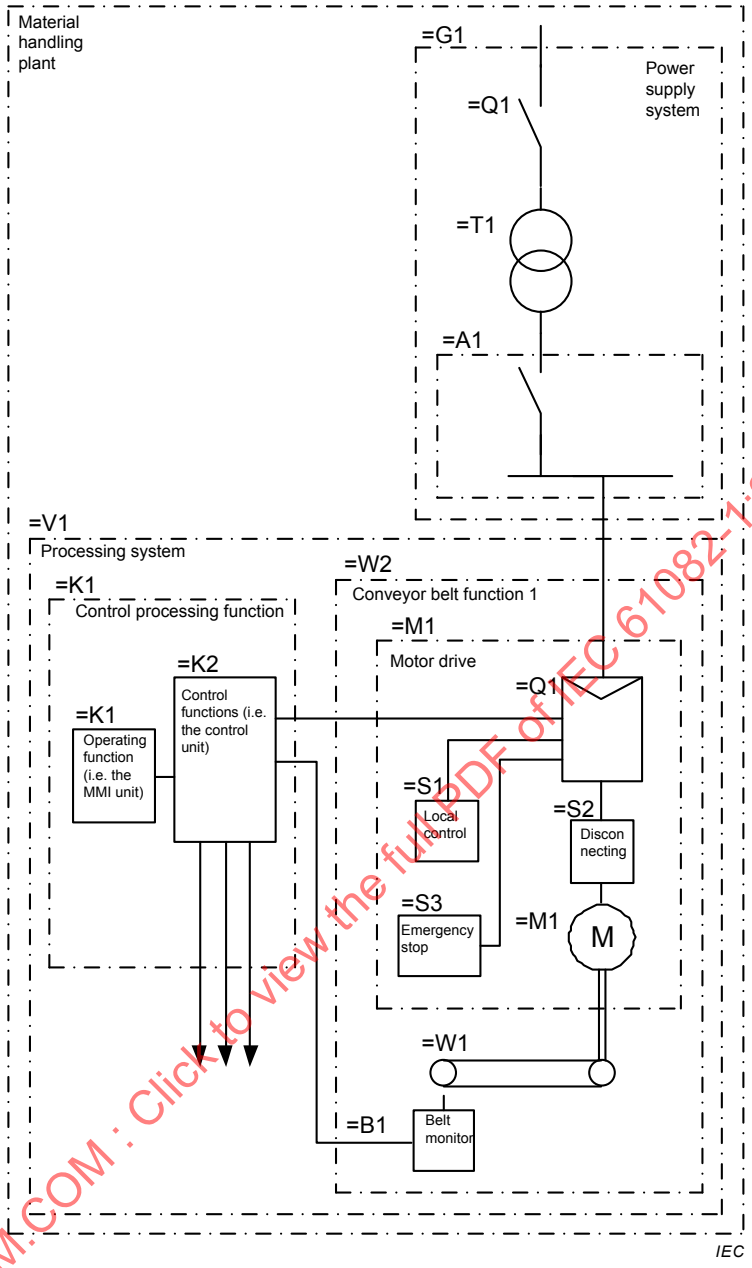
In overview diagrams, multi-phase circuits shall be presented using the single line presentation.

Figure 57, Figure 58, Figure 59 and Figure 60 show examples of different overview diagrams



SOURCE: Figure H.1 of IEC 81346-1:2009

Figure 57 – Overview diagram for a material handling plant



SOURCE: Figure H.2 of IEC 81346-1:2009

Figure 58 – Overview diagram for one conveyer belt function

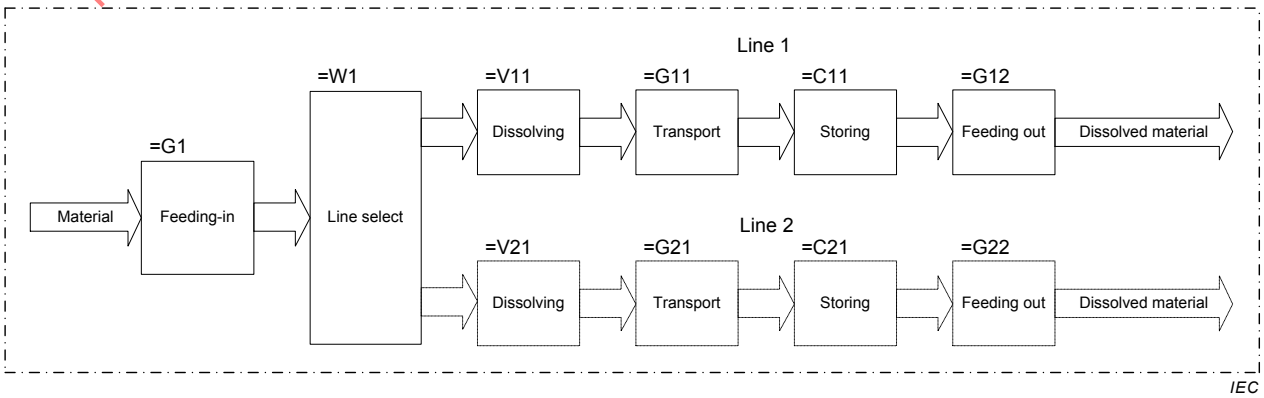


Figure 59 – Overview diagram process plant

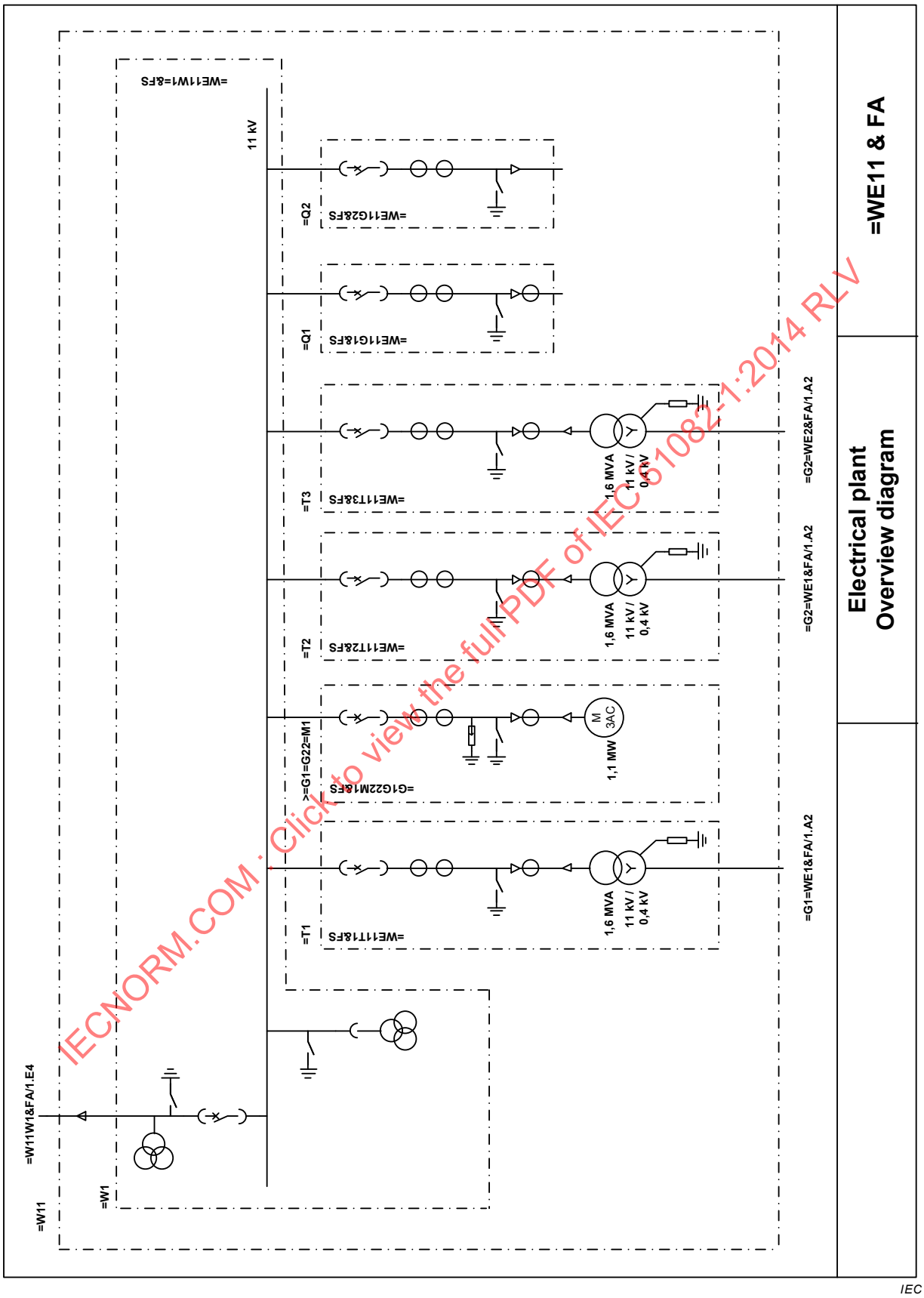


Figure 60 – Overview diagram of an electrical plant

7.3 Function diagrams

7.3.1 General

A function diagram shall describe an object from a functional aspect regardless of its implementation, by showing the functional relations among its constituents.

NOTE IEC 60617 contains both pure functional symbols and symbols to be used for the representation of components.

The principal signal flow in a function diagram should be from left to right and from top to bottom, see Figure 61.

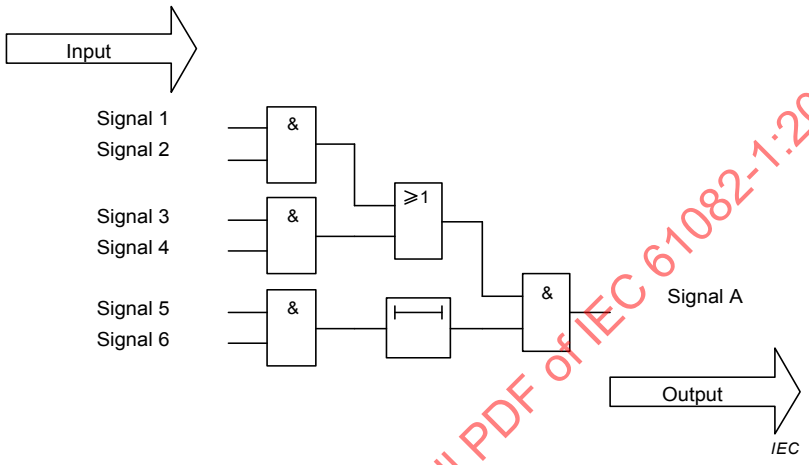


Figure 61 – Signal flow in a function diagram

Function diagrams may include presentations of steps and transitions in accordance with IEC 60848.

7.3.2 Equivalent-circuit diagrams

Equivalent-circuit diagrams shall apply the conventions for electric and magnetic circuits as specified in IEC 60375. See also Figure 62 which shows an example for the calculation of a transformer and its load.

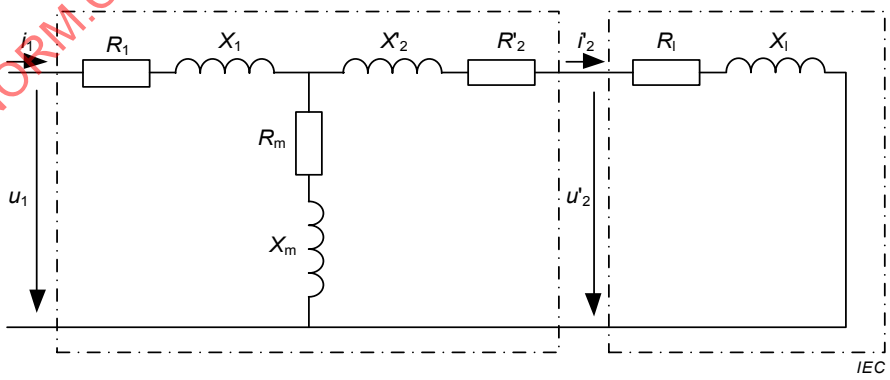
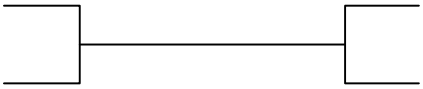
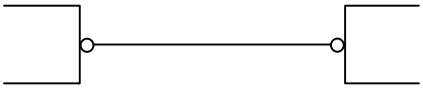
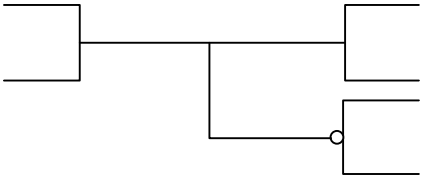
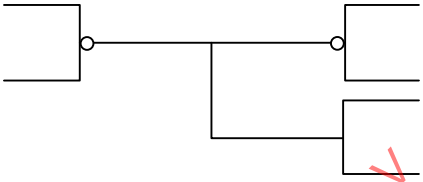


Figure 62 – Example of an equivalent-circuit diagram

7.3.3 Logic-function diagram

In a logic-function diagram the positive single logic convention (see 7.1.4.2) shall be applied. The number of logic negations should be minimized to facilitate the understanding, see Figure 63.

Example	Preferred representation	Non-preferred representation
1		
2		

IEC

Figure 63 – Minimized use of logic negations

7.4 Circuit diagrams

7.4.1 General

A circuit diagram shall show at least the details of the implementation of an object, i.e. the constituent components and their interconnections without taking into account for example physical sizes and shapes of the components. It shall facilitate the understanding of the functioning of the object.

A circuit diagram shall be prepared using:

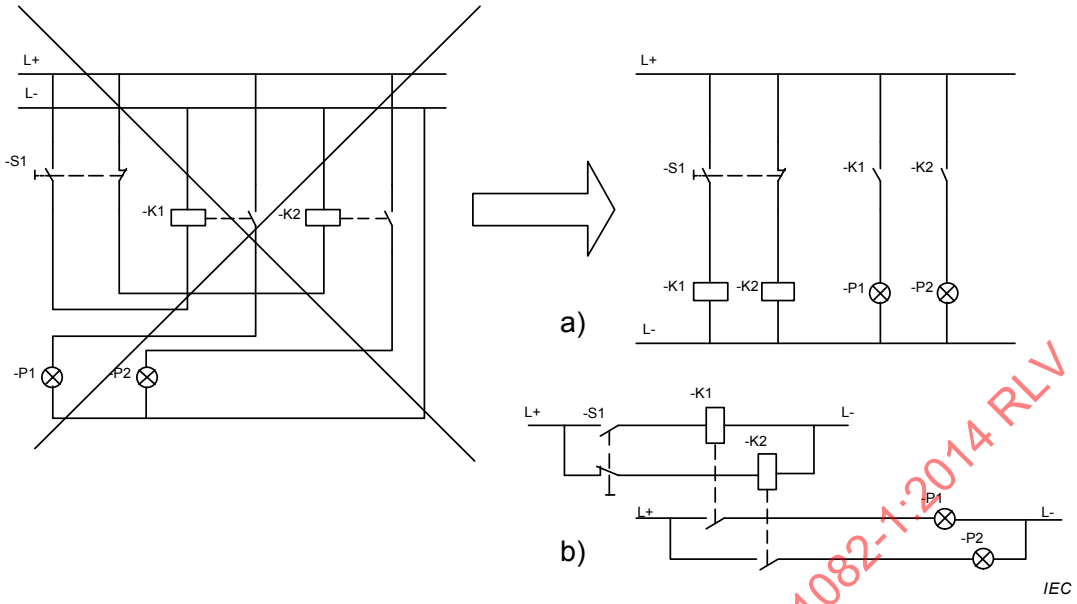
- graphical symbols;
- connecting lines;
- reference designations;
- terminal designations;
- signal-level conventions applicable to logic signals;
- information necessary to trace paths and circuits (signal designations, location references);
- supplementary information necessary for the understanding of the functioning of the object.

7.4.2 Layout

The diagram shall emphasize:

a) the process or signal flow, by lining up symbols and keeping the connection lines of a circuit straight. See Figure 64.

b) the functional relations, by grouping symbols representing functional related components together. See Figure 65.



a) detached presentation of multiple-symbol representation of components

b) semi-attached representation of multiple-symbol representation of components

Figure 64 – Lining-up of symbols

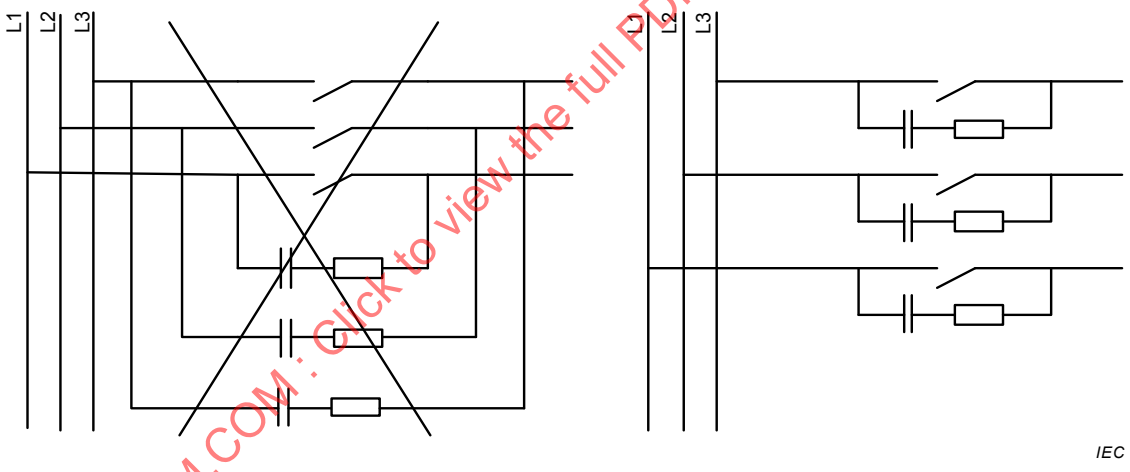


Figure 65 – Grouping of symbols for functionally related components

7.4.3 Methods for representation of components

7.4.3.1 General

A component may be represented by:

- a single symbol; or
- a combination of several symbols.

A single symbol can be shown:

- once; or
- in different locations (repeated presentation).

The combination of symbols can be shown:

- adjacent to each other (attached presentation); or
- apart from each other (detached presentation).

7.4.3.2 Attached presentation of symbols

Attached presentation of symbols for the represented component should only be used for presentation of simple non-extensive circuits.

The interrelation between the symbols can be indicated using a dashed line (symbol S00144 in IEC 60617 (2001-07)), see Figure 66. A double line (symbol S00147 in IEC 60617 (2001-07)) may also be used for mechanical interrelations.

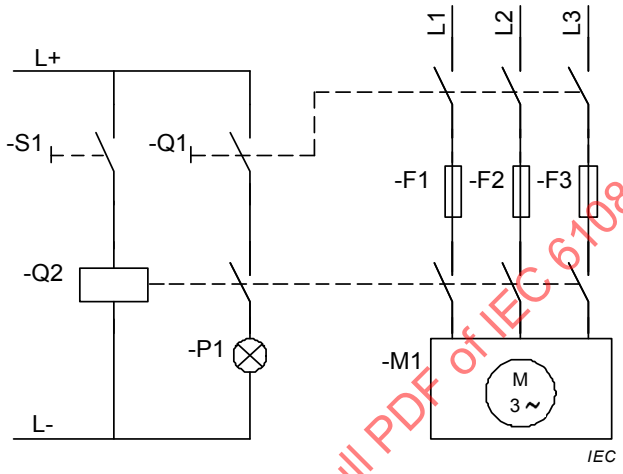


Figure 66 – Attached presentation of symbols

7.4.3.3 Detached presentation of symbols

Detached presentation of symbols for the represented components should be used to focus on specific functional relationships of the components of a system and to achieve a clear layout without crossing circuits.

In order to indicate the interrelation between the symbols the reference designation of the component shall be shown at each symbol, see Figure 67.

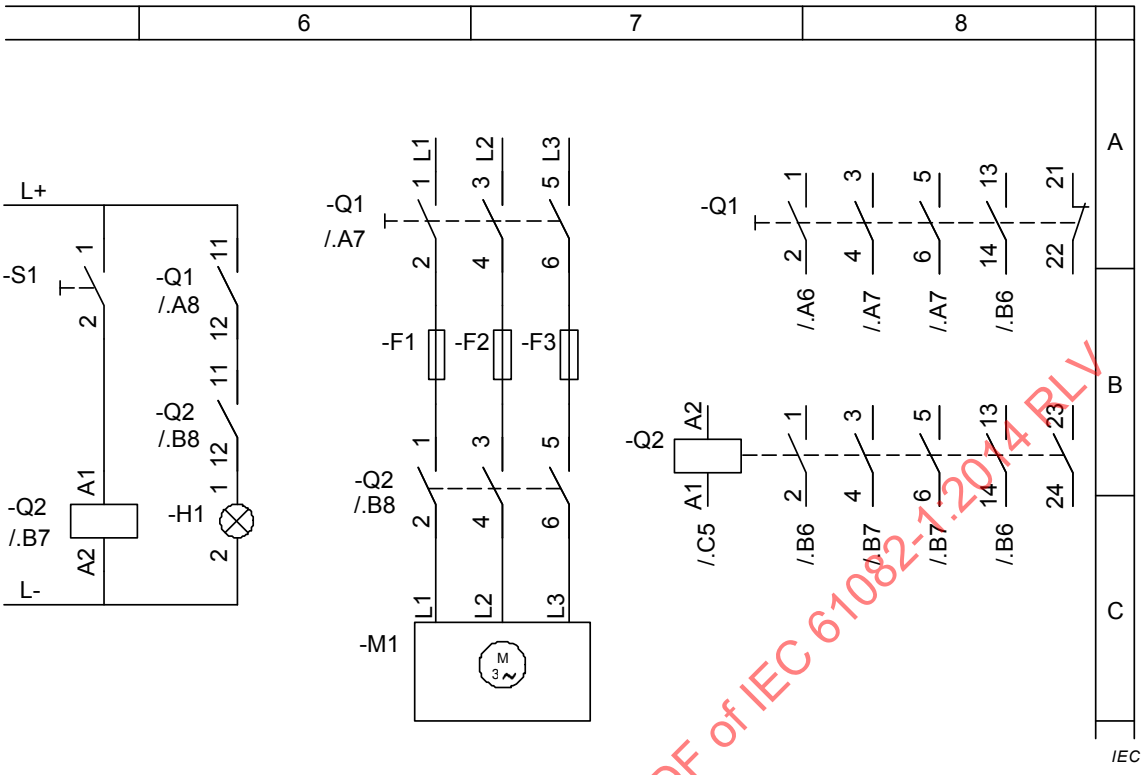


Figure 67 – Detached presentation of symbols

In order to facilitate understanding and navigation within the diagram the component should in addition be:

- represented with attached presentation of all symbols in at least one place of the document (see rightmost symbols for -Q1 and -Q2 in Figure 67); or
- represented by an inset diagram or table located below or to the right of the actuating symbol, or, alternatively by the graphical representation of the constituent parts to be referenced (see Figure 68).

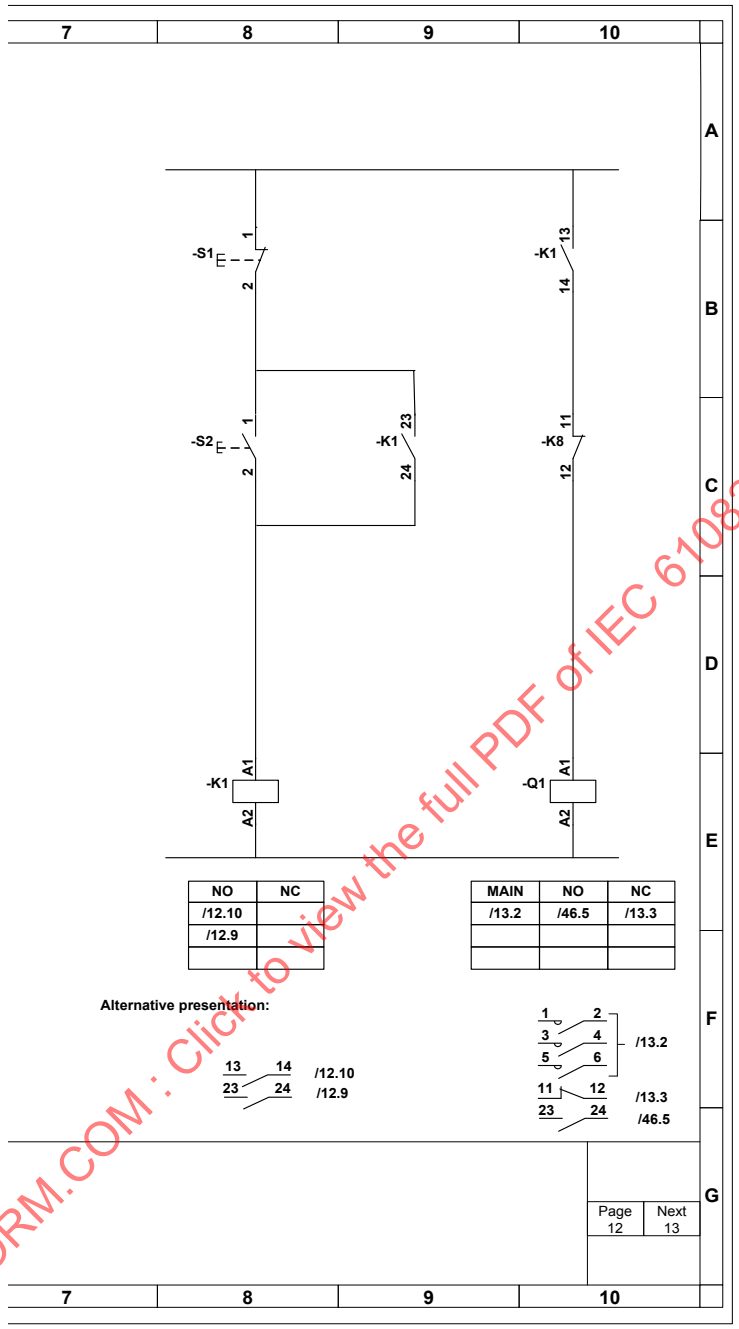
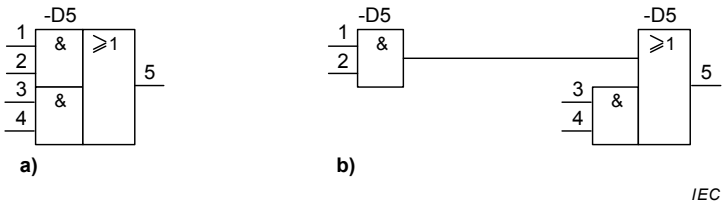


Figure 68 – Example of the use of inset tables

Cross-references shall be made between the attached presentation or the inset diagrams or tables and the detached presented symbols in accordance with 5.8.

If the functioning of an object is not understandable without showing the “internal” connection between the different representations of parts of the object, such connections shall be indicated applying the symbol S01479, S01480, S01481 or S01482 in IEC 60617, see Figure 69.



a) attached presentation

b) presentation shown with internal connection

Figure 69 – Example of presentation of internal connection

7.4.3.4 Repeated presentation of symbols

Repeated presentation of the symbols for the represented component may also (as the detached presentation) be used to achieve a clear layout without crossing circuits.

A connect node of the symbol shall only be connected at one of the locations of the symbol within the diagram.

Each appearance of the symbol shall be provided with the reference designation of the component. All connect nodes or terminal lines shall be provided with their terminal designations, see Figure 70.

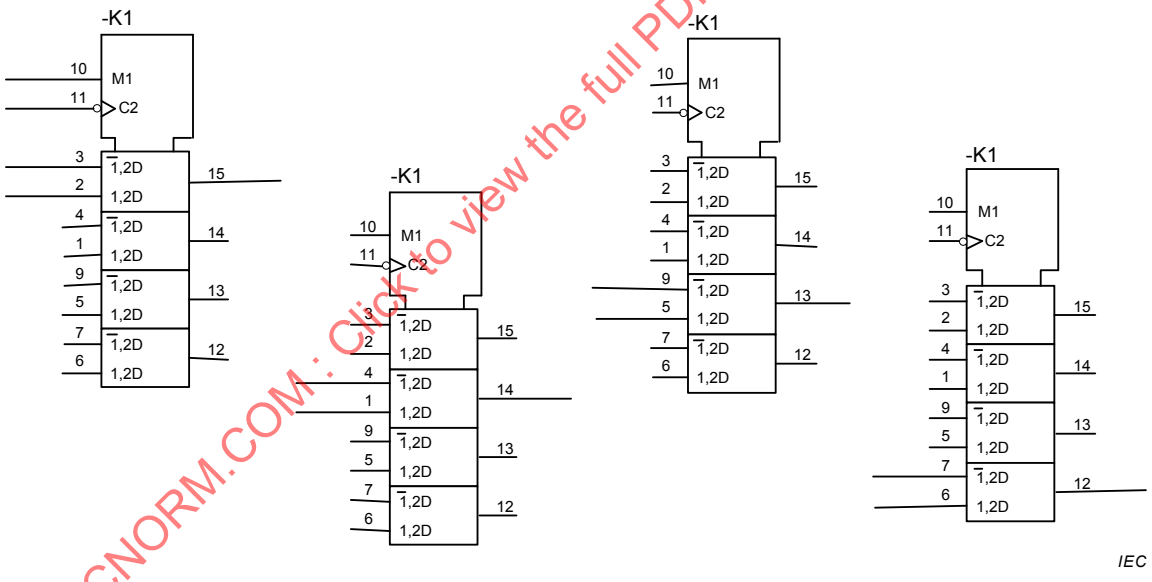
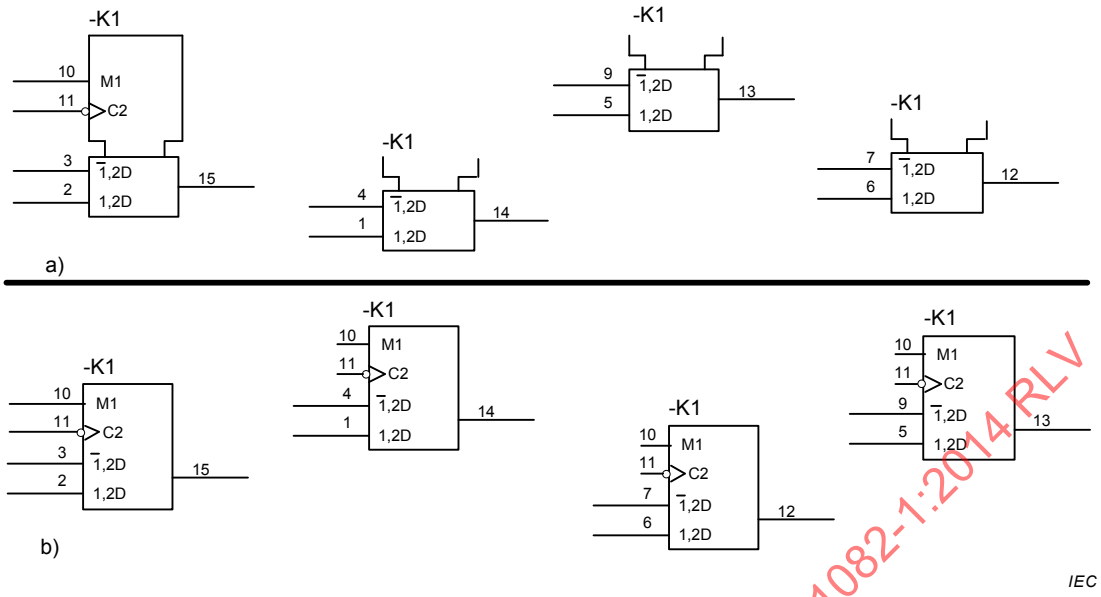


Figure 70 – Repeated presentation of a symbol for a quadruple multiplexer

Symbols repeatedly presented may be simplified by presenting only a part of the complete symbol with the indication that just a part of the symbol is shown, see Figure 71.



a) The common control block not shown for each presentation

b) The common control block indicated for each presentation

Figure 71 – Simplified repeated presentation of a symbol for a quadruple multiplexer

If the symbol representing a component is repeated in different documents or on different pages of a document, cross-references to all presentation places shall be provided by applying one of the presentation methods as provided for the detached presentation (see 7.4.3.3), i.e. attached presentation at one place with cross-references to other places of presentation or applying inset tables.

7.4.4 Representation of components with movable parts

7.4.4.1 Operational state

Symbols for components having a movable part, for example, a contact, shall be shown in a position or state as follows unless otherwise specified in the diagram or in supporting documentation:

- monostable manually operated or electromechanical components, for example relays, contactors, brakes, and clutches, in the non-actuated or de-energized state;
- circuit-breakers and disconnectors in the open (OFF) position;
- for other switching devices that can rest in any one of two or more positions or states, an explanation shall be given in the diagram, if necessary;
- multi-stable manually operated control switches with a position designated OFF, in that position;
- control switches without a position designated OFF, in a position specified in the diagram;
- control switches for emergency operation, stand-by, alarm, test, etc., should be shown in the position they occupy during normal service of the equipment, or in another position that is specified in the diagram;
- pilot switches operated by a cam, a variable such as position, level, speed, pressure, temperature, etc., in a position specified in the diagram.

7.4.4.2 Functional description

For manually operated control switches with a complex function, a graph shall be included in the diagram, if necessary to understand the function, see Figure 72.

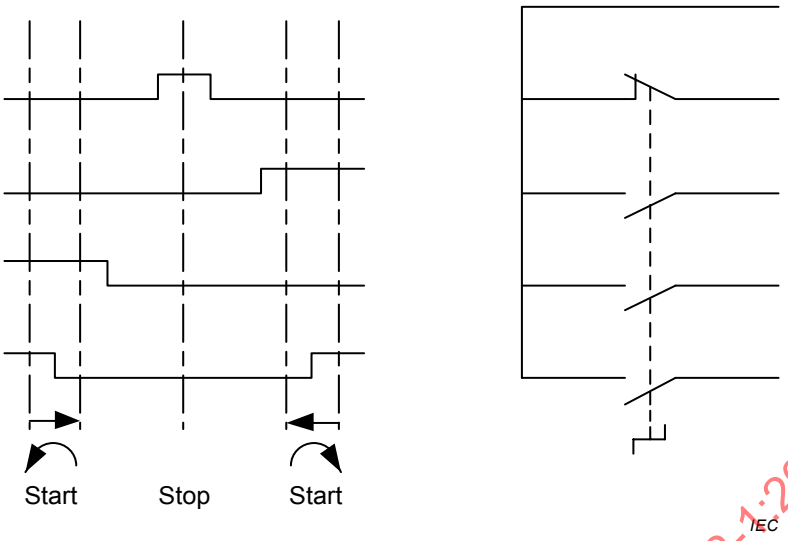
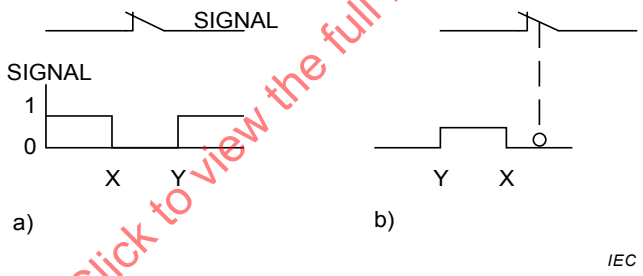


Figure 72 – Symbol of a five-position switch supplemented with a graph

For pilot switches, the diagram shall contain a description of the operation, adjacent to the symbol. This description may consist of:

- a graph, see Figure 73
- a note, see Figure 74.



Explanation: Contact is open between position X and position Y

a) using a symbol of a switch supplemented by a graph

b) using a cam symbol supplemented with a graph

Figure 73 – Examples of pilot switch

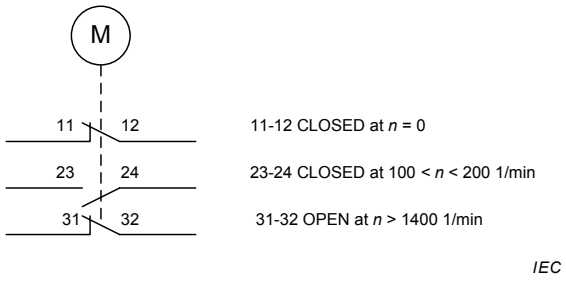


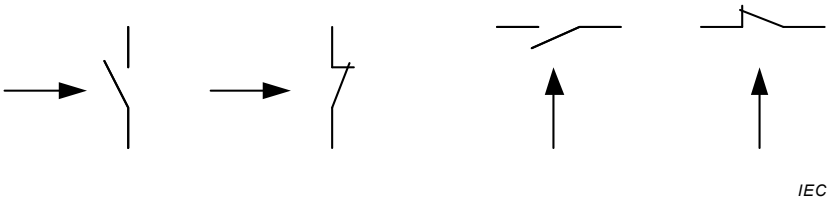
Figure 74 – Symbol of a pilot switch supplemented with a note

7.4.4.3 Representation of semi-conductor switches by contact symbols

Semi-conductor switches shall be shown in the initial state, i.e. at the moment the auxiliary voltage supply has been switched on.

7.4.4.4 Orientation of contact symbols

Contact symbols should be oriented so that the imaginary direction of movement is consistent, for example, movement upwards with horizontal connecting lines or to the right with vertical connecting lines when the component is actuated. See Figure 75.



The arrows in Figure 75 indicate the imaginary direction of movement and are not part of the symbol.

Figure 75 – Orientation of contact symbols

7.4.5 Representation of supply circuits

Connecting lines representing power supplies should be shown in the following sequence top to bottom or left to right:

- for a.c. circuits: L1, L2, L3, N, PE, see Figure 76;
- for d.c. circuits: L+, M, L-, i.e. from positive to negative polarisation, see Figure 77.

The connecting lines should be shown adjacent to each other, or placed at opposite sides of the circuit branches in order to fulfil the requirements of 7.4.2, see Figure 76, Figure 77 and the right hand sides of Figure 64 and of Figure 65.

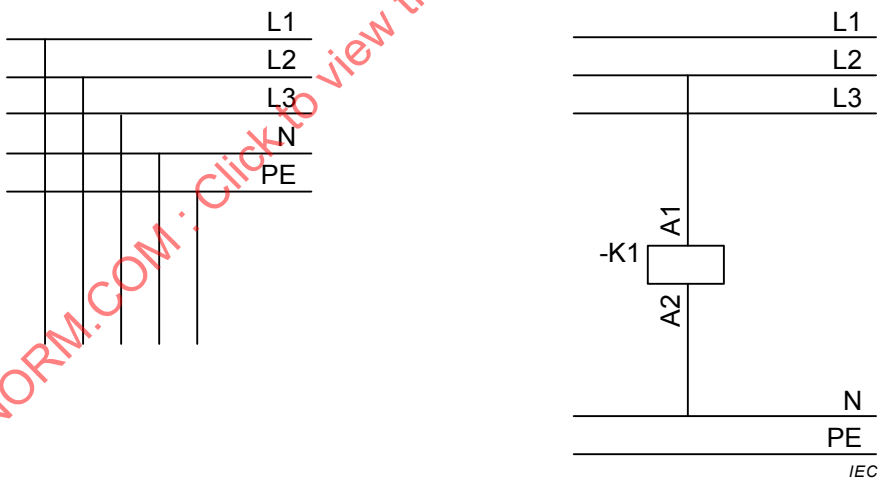


Figure 76 – Representation of a.c. supply circuits

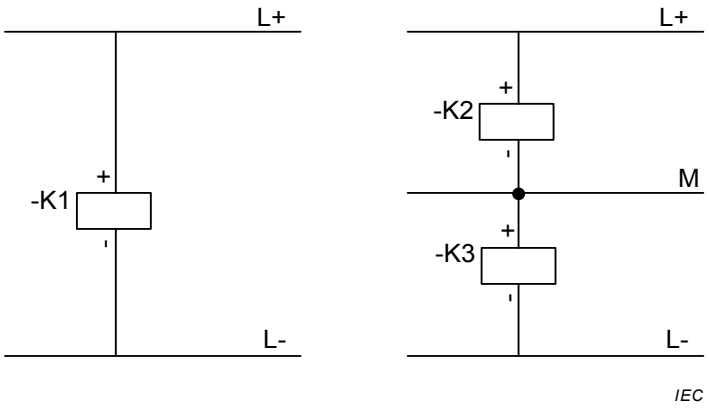


Figure 77 – Representation of d.c. supply circuits

7.4.6 Representation of binary logic elements

Binary logic symbols should be chosen so that the logic polarity or negation indication at an input is the same as that at the source of a signal feeding that input. See Figure 78.

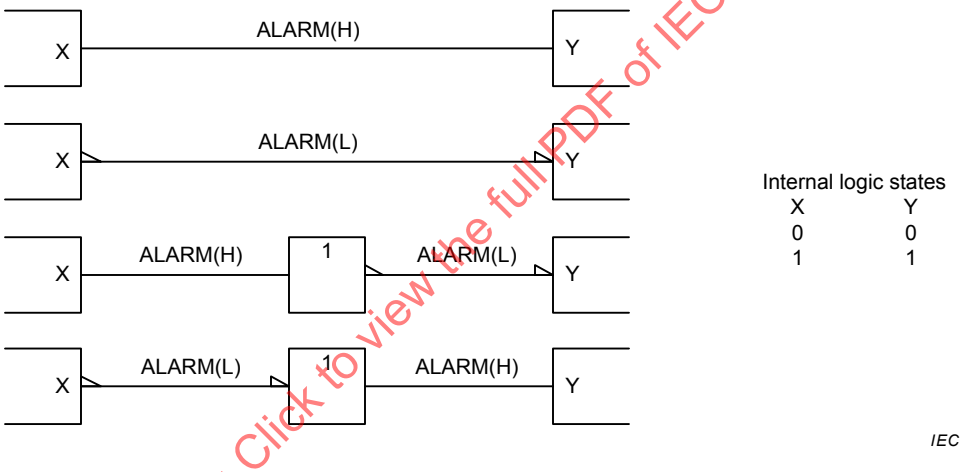


Figure 78 – Examples of use of logic polarity indication

If there is a mismatch between the logic polarity or negation indication at the source of a signal and the indication at the destination, a short perpendicular line shall be shown across the connecting line. The signal name associated with a connection shall be related to the relevant portion of the connecting line, i.e. consistent with the polarity indication, see Figure 79.

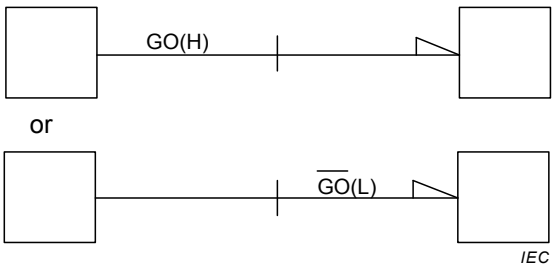


Figure 79 – Examples of mismatched polarity indications

7.4.7 Symbols with a large number of terminals

If the symbol used to represent a device contains a large number of terminals so it is not possible to show the symbol on one page of a diagram and if no other representation of the device is possible, the symbol may be split at suitable places and the different parts of the symbol shown on different pages following the rules for the detached presentation in 7.4.3.3, see Figure 80

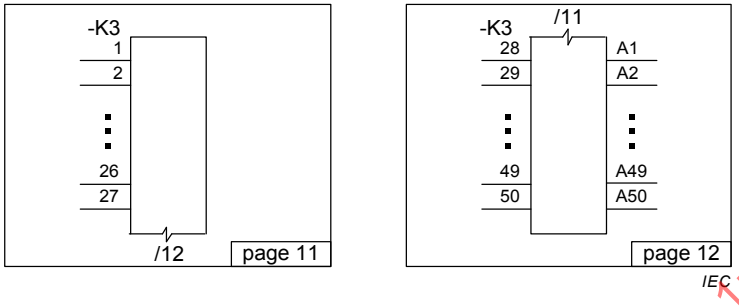


Figure 80 – Example of a split presentation of a symbol

7.4.8 Wired functions (wired-AND, wired-OR)

A wired AND-function shall be shown:

- with the qualifying symbol for the AND-function (&) adjacent to the junction point; or
- by replacing the junction by applying the symbol for the AND-function (symbol S01567 in IEC 60617) together with the character OPEN-CIRCUIT-OUTPUT-SYMBOL (◊) of IEC 61286 as a qualifying symbol indicating the wired function.

A wired OR-function shall be shown:

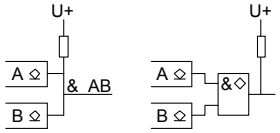
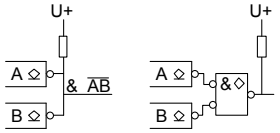
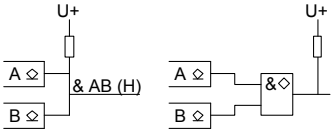
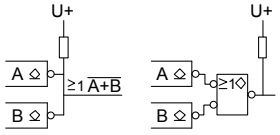
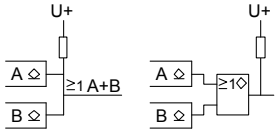
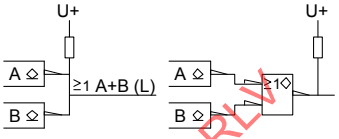
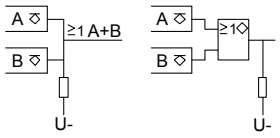
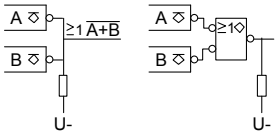
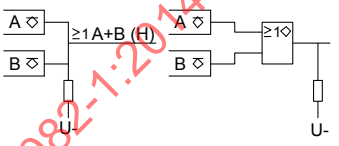
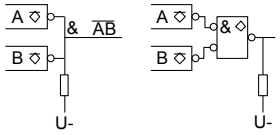
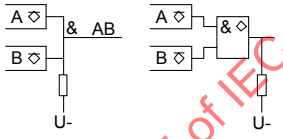
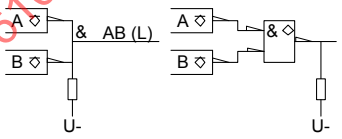
- with the qualifying symbol for the OR-function (≥1) adjacent to the junction point; or
- by replacing the junction by the symbol for the OR-function (symbol S01566 in IEC 60617) together with the character OPEN-CIRCUIT-OUTPUT-SYMBOL (◊) of IEC 61286 as a qualifying symbol indicating the wired function.

All terminals of the binary logic elements involved in a wired function must apply the same qualifying symbol for negation or logic polarity, if needed.

Table 1 shows the possible presentations of wired functions with positive or negative convention (see 7.1.4.2) and with direct logic polarity indication (see 7.1.4.3).

NOTE L-type open-circuit outputs (for example, NPN open collectors) connected together perform either active-high ANDing or active-low ORing. H-type open-circuit outputs (for example, NPN open emitters) connected together perform either active-high ORing or active-low ANDing.

Table 1 – Possible distributed logic connections

No	Description	Positive logic	Negative Logic	Direct logic polarity indication
1	AND connection formed by interconnecting L-type open-circuit outputs e.g. NPN open collectors			
2	OR connection formed by interconnecting L-type open-circuit outputs e.g. NPN open collectors			
4	OR connection formed by interconnecting H-type open-circuit outputs e.g. NPN open emitters			
3	AND connection formed by interconnecting H-type open-circuit outputs e.g. NPN open emitters			

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The two presentations within each field of the table are their equivalents

7.5 Connection diagrams

7.5.1 General

Connection diagrams provide information on:

- physical connections (internal) among components of a unit or assembly; or
- physical connections (external) among different units or assemblies (see Figure 81); or
- physical connections (external) to one unit.

The connection points shown in the diagram shall be identified by their terminal designations, and the conductors and/or cables used shall be identified by their reference designation or by another agreed identifier (see also IEC 62491).

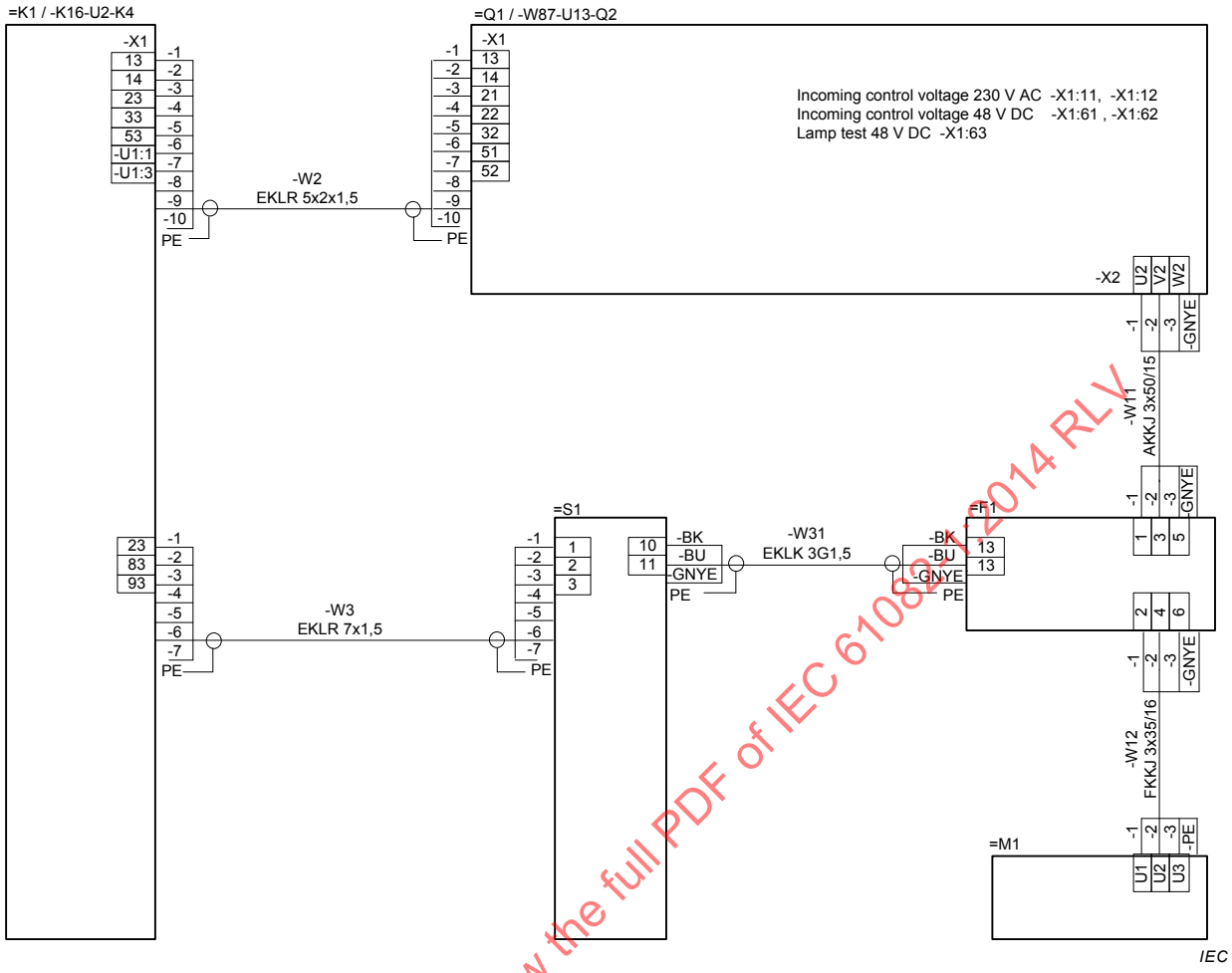


Figure 81 – Example of a connection diagram

Additional information may be included as required for the intended use of the document, such as:

- conductor or cable type information (for example, a recognized type designation, article or part number, material, construction, size, colour of insulation, voltage rating, number of conductors, other technical data);
- conductor, cable number or reference designation;
- instruction for, or methods of, laying, routing, termination, attachment, twisting, screening, etc.;
- length of conductor or cable.

NOTE IEC 60446 specifies the basic safety rules for identification of conductors by colours or numerals.

7.5.2 Representation of devices, units or assemblies

Devices, units or assemblies to be connected should be represented by simple outlines, such as squares, rectangles, or circles, or by simplified pictorial representations. Graphical symbols in accordance with IEC 60617 may also be used.

The presentations of the devices, units or assemblies shall be arranged to facilitate the intended use of the diagram.

This implies for example that it is not necessary for the presentations to be shown according to the physical locations of the devices, units or assemblies.

7.5.3 Representation of terminals

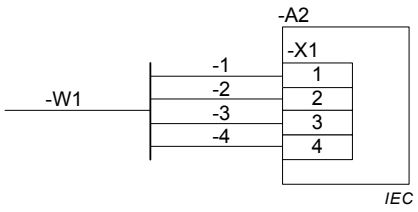
The identification of each terminal presented shall be shown.

The presentations of the terminals shall be ordered to facilitate the intended use of the diagram.

This implies for example that it is not necessary for the presentations to be shown according to the physical location of the terminals.

7.5.4 Representation of cables and its constituent cores

If a multi-core cable is represented by a single connection line and its constituent cores shall be shown connected to the representation of physical terminals, the connection line representing the cable shall be terminated at a cross-line, and the connection lines representing the cores shall go from this cross-line to the representation of the physical terminals. The cable and its cores shall be clearly identified, for example by their reference designations, see Figure 82.



Reference designation Cable cores	Terminal designations
-W1-1	-A2X1:1
-W1-2	-A2X1:2
-W1-3	-A2X1:3
-W1-4	-A2X1:4

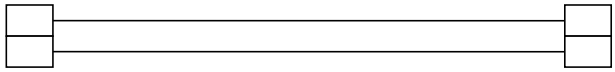
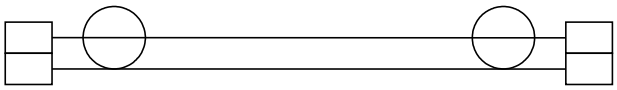
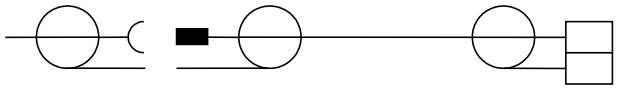
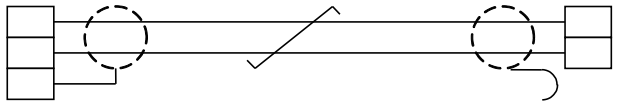
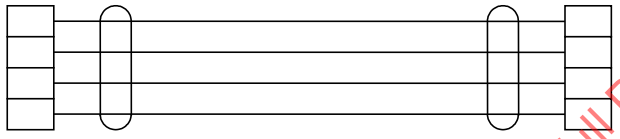
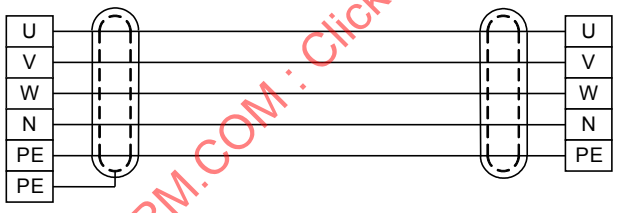
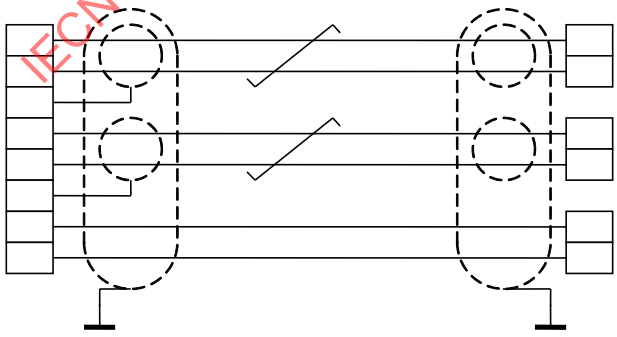
Figure 82 – Example of presentation of termination of a multi-core cable

7.5.5 Representation of conductors

Conductors shall be represented using connecting lines in accordance with 7.1.3.

Symbols for T-connections (symbols S00019 and S00020 in IEC 60617) shall not be used unless there is a physical junction.

Figure 83 shows a number of examples of how connections to various types of cables may be represented using symbols of IEC 60617.

	Connection with two conductors (symbol S00001 in IEC 60617 (2001-07))
	Connection with a coaxial cable (symbol S00011 in IEC 60617 (2001-07))
	Connection of a coaxial cable with plug and socket (symbol S00042 in IEC 60617 (2001-07)) in one end
	Connection of screened cable (symbol S00013 in IEC 60617 (2001-07)). The screen connected to functional earth (symbol S01410 in IEC 60617 (2001-07)) in one end and not connected in the oher (symbol S00014 in IEC 60617 (2001-07))
	Screened twisted-pair cable (symbol S00008 in IEC 60617 (2001-07)). The screen connected in one end only.
	Four conductors in a cable (symbol S00009 in IEC 60617 (2001-07)).
	Four conductors in a power cable. The neutral conductor being concentric (symbol S01807 in IEC 60617 (2001-07)).
	Five conductors in a power cable. The cable is provided with a metallic shield connected to protective earth in one end.
	Cable with two screened twisted pairs and two further conductors, with the external screen connected to function earth in both ends.

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NOTE The representation of cables shown can also be applied in other kinds of diagrams.

Figure 83 – Example of cable connections

7.5.6 Simplified presentation

The presentation may be simplified by:

- lining up the presentation of the terminals of each unit, device or assembly vertically [horizontally]; and
- lining up the interconnected terminals of the different devices, units and assemblies horizontally [vertically]; and
- omitting the presentations of their outline.

Figure 84 shows a complete connection diagram for a sub-rack, while Figure 85 shows a simplified presentation for the same.

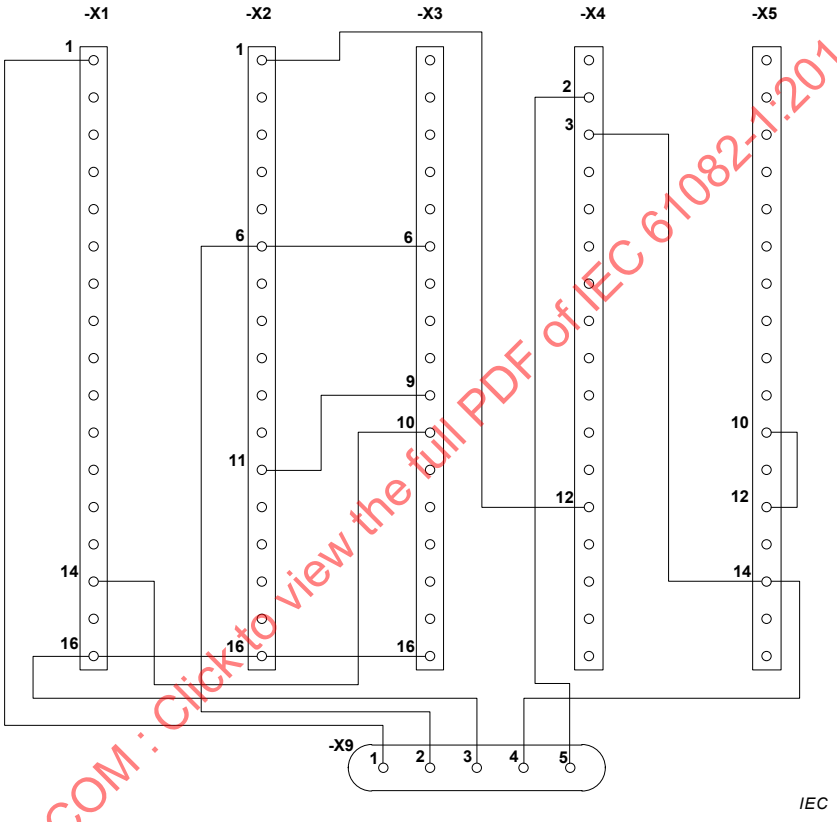


Figure 84 – Example of connection diagram for a sub-rack

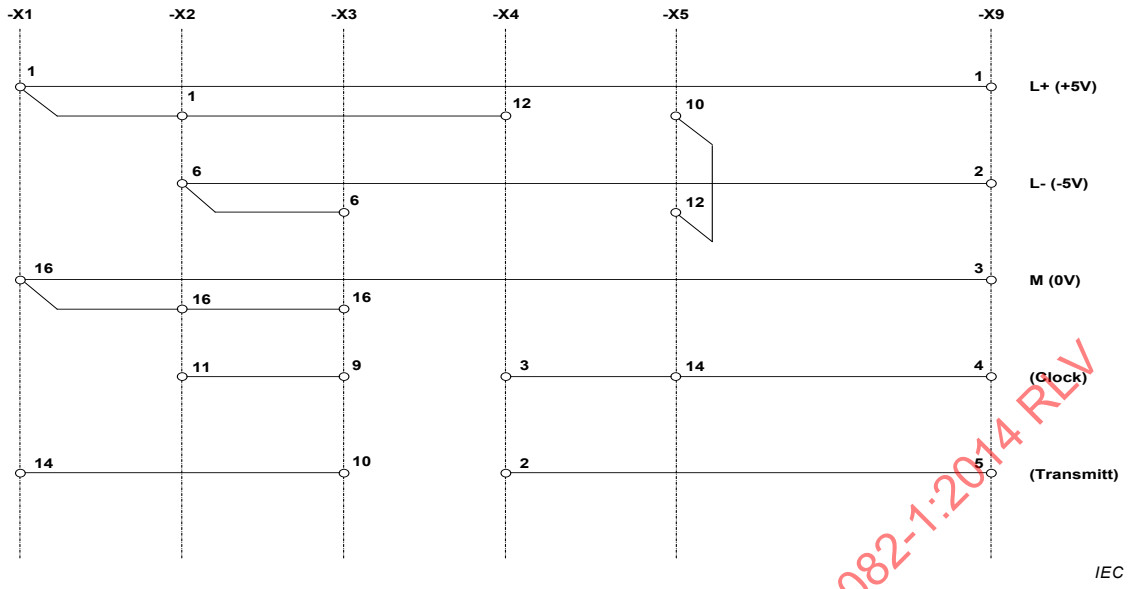


Figure 85 – Example of simplified presentation of a connection diagram

8 Drawings

8.1 General

Drawings mainly describe the topographical or geometrical position of objects often based on 2D- and/or 3D-models, following the rules of relevant ISO standards.

This International Standard specifies rules for arrangement drawings used in electro-technology, often developed by applying a base document.

8.2 Requirements on base documents

Base document, such as

- site plans;
- building drawings;
- dimension drawings (for mechanical units),

shall be drawn to scale.

The content of the base document becomes an integral part of the arrangement drawing.

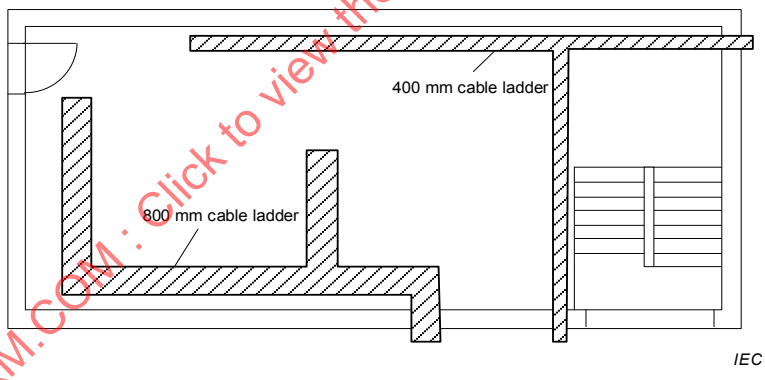
Base drawings shall show all necessary information for the preparation of arrangement drawings for locating electrical equipment, such as:

- geographical orientation points;
- north-direction indicator;
- location and outline of buildings, traffic areas, service networks, access facilities and site boundaries;
- outline and constructional details of rooms, cabins, corridors, openings, windows, doors, etc., in plans and sectional views;
- obstacles related to constructions, for example structural beams, stanchions;
- the load capacity of floors or decks and any limitations on cutting, drilling or welding;

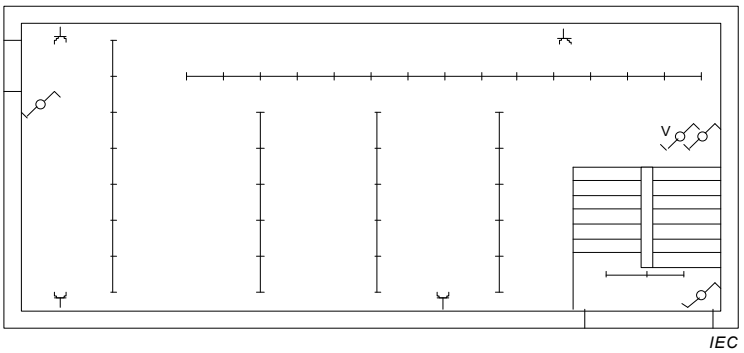
- clearances for special installations like lifts, cranes, heating, cooling and ventilation systems;
- hazardous areas;
- existing earthing points;
- space available and access required;
- limitations on fixing arrangements;
- cable routing areas;
- existing access points and transport routes;
- environmental conditions.

Figure 86 shows how a base document can be applied in different arrangement drawings.

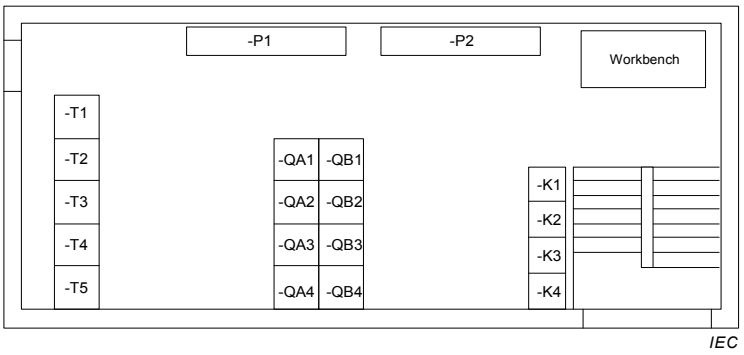
a) Architectural base drawing



b) Base drawing with cable routes added



c) Base drawing with lighting installation added



d) Base drawing with arrangement of switchgear and telecommunication cubicles added

Figure 86 – Example of the use of a base document

8.3 Arrangement drawings

An arrangement drawing is showing the relative or absolute location and/or dimensions of objects.

Objects are represented by:

- their shape or simplified outlines;
- their main dimensions; or
- by symbols in accordance with IEC 60617.

Detailed information may be necessary in the form of exact distances and/or dimensions.

The information shall be presented together with necessary information on the environment in which the objects are (to be) located.

Information on identification of objects shall be included.

Technical data of an object, if needed, may be shown adjacent to the symbol or outline that represents the object, see Figure 87.

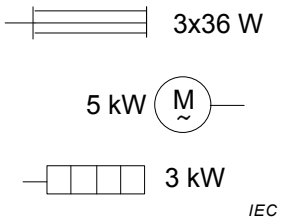


Figure 87 – Presentation of technical data

If single objects require different mounting methods or directions, this may be specified by presenting qualifying symbols in accordance with IEC 60617 or letter codes adjacent to the object representation. Examples of letter codes for mounting of components are:

- H = horizontal (components mounted side by side)
- V = vertical
- F = flush (recessed)

- S = surface
- B = floor (bottom)
- T = ceiling (top)
- UB = mounting in false floor
- UT = mounting in false ceiling.

Letter codes for mounting methods are subject to be standardized in IEC 60617 in relation to specific symbols by means of an application note. Some symbols refer, for example, to an application note designated A00266 that establishes letter codes used in the above list.

If non-standardized letter codes are used, these shall be explained in the document or in supporting documentation.

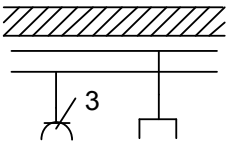
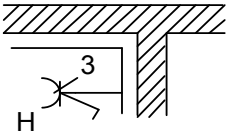
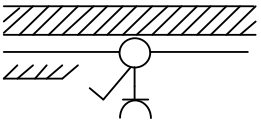
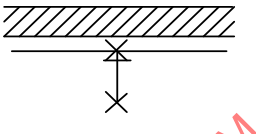
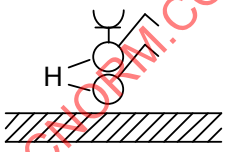
	Triple-socket-outlet mounted beside telecommunication socket-outlet
	Triple-socket-outlet with switches placed on a side wall. "H" indicates horizontal mounting
	Single-pole switch and socket outlet connected to a transversing lead, conductor mounted under surface
	Two lighting outlets, one mounted in a wall with branch-off to another mounted in the ceiling
	Two switches, horizontally mounted, and a socket-outlet

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Figure 88 – Examples of the use of symbols for indication mounting methods

Arrangement drawings may include representation of connections. Connecting lines shall be clearly distinguishable from lines of the base document, and follow the rules given in 7.1.3 with the addition that curved lines may be used.

Connecting line shall show which components that are connected to each circuit and in which order. In the case of surface mounting or when ducts and conduits are used, the actual routing of the connection shall be shown.

Multi-phase circuits may be presented using single-line presentation in accordance with 7.1.9.

Multiple parallel connecting lines may be represented by using simplified presentation in accordance with 7.1.3.6.

Figure 89 shows an example of an arrangement drawing of a mounting panel of a cubicle, while Figure 90 shows an example of an arrangement drawing of industrial plant.

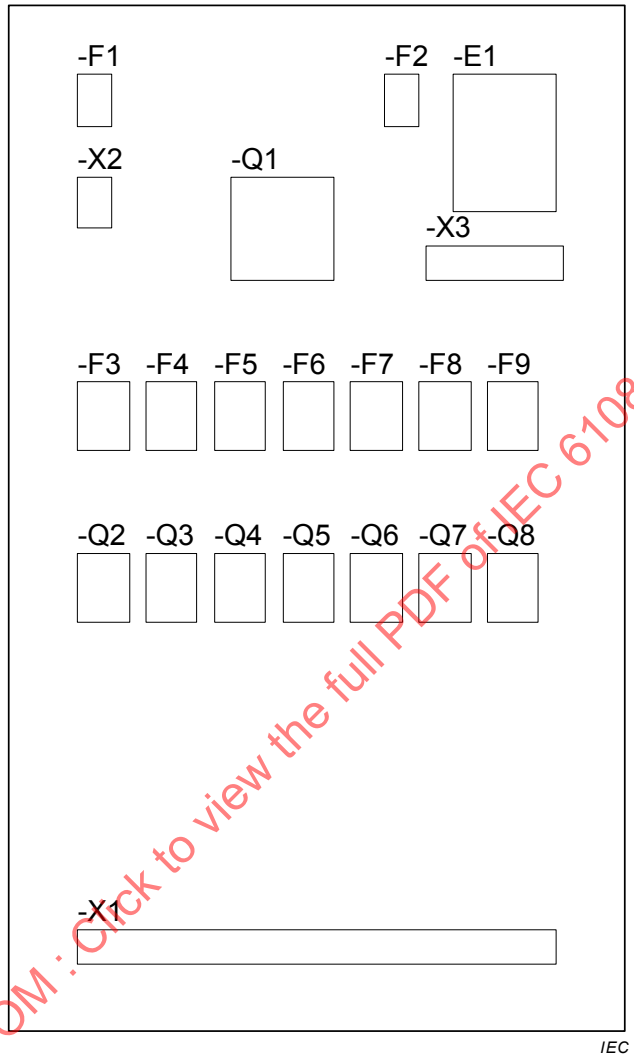


Figure 89 – An arrangement drawing the mounting panel of a cubicle

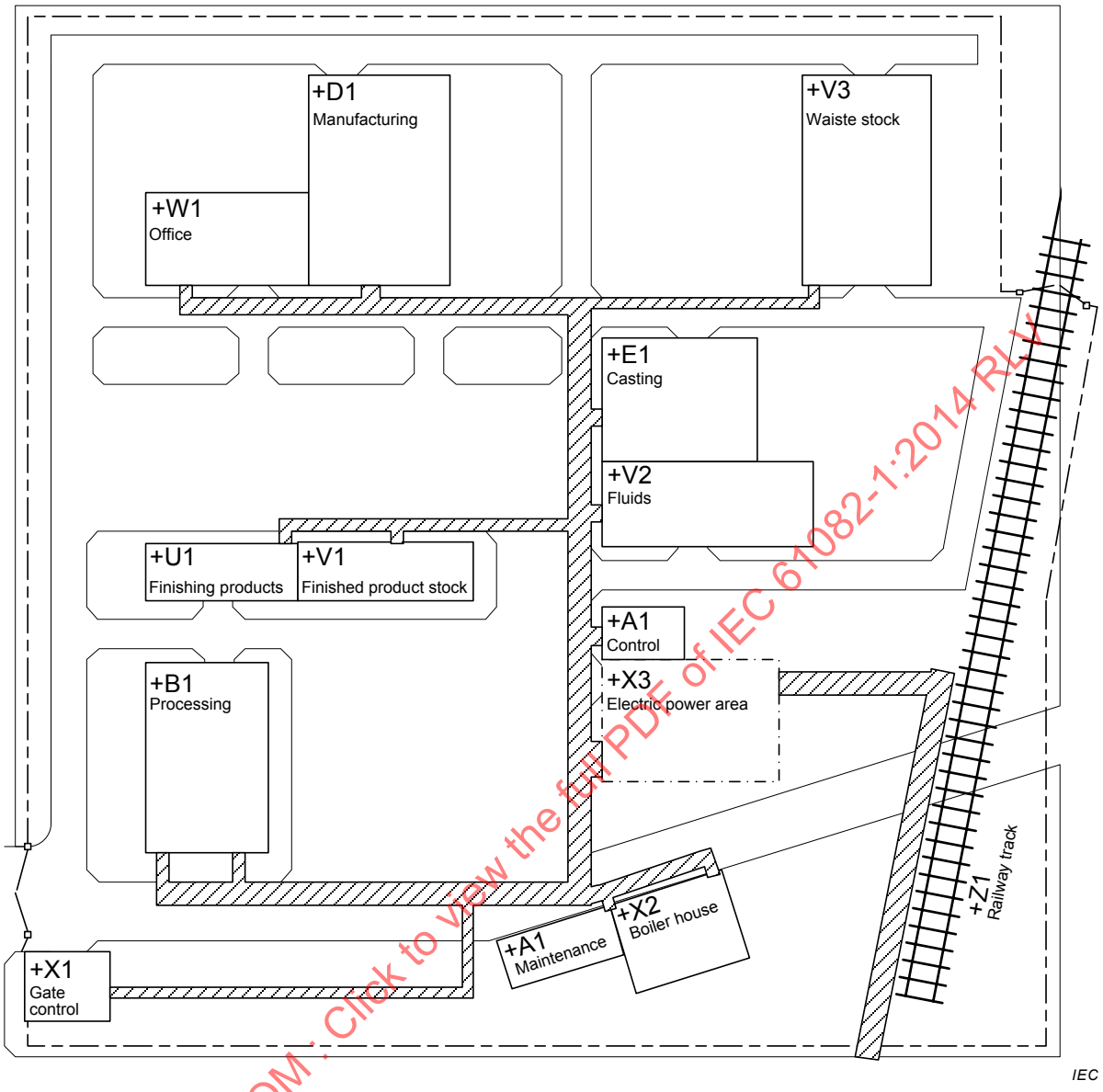


Figure 90 – An arrangement drawing of an industrial plant

9 Tables

9.1 General

Each row of a table shall be clearly distinguishable from the other rows, and each column of a table shall be clearly distinguishable from the other columns.

The kind of information presented in each column and row shall be clearly indicated. This indication, for example a heading row or heading column, shall be provided on each page of the presentation.

9.2 Presentation of reference designations

For presentation of reference designations and identifiers (for example terminal designation including the reference designation, signal designations) in a table, the following rules apply:

- Identifiers within a column of a table may be simplified presented by showing the common initial portion (see 5.20.2) in the header for the column of the table, omitting the common initial portion from the presentation of object identifiers in that column, see Figure 91;
- Identifiers in the column not to be preceded by the common initial portion given for that column shall be preceded by the character “GREATER-THAN” (>), see Figure 91;
- Identical identifiers on successive rows within a column of a table, may be presented on the first relevant row only, see Figure 92.

Reference designation **-AB1**	
-C2	
-R1	
-R2	
-AR11	
-K9	
>-AB2-C1	
>-XY7-R9	

Corresponds to

Reference designation	
-AB1C2	
-AB1R1	
-AB1R2	
-AB1AR11	
-AB1K9	
-AB2C1	
-XY7R9	

Figure 91 – Example setting the common initial portion in the table header

Reference designation		
-AB1	-C2	
	-R1	
	-R2	
	-AR11	
	-K9	
-AB2	-C1	
-XY7	-R9	

Corresponds to

Reference designation	
-AB1C2	
-AB1R1	
-AB1R2	
-AB1AR11	
-AB1K9	
-AB2C1	
-XY7R9	

Figure 92 – Example omitting the common initial portion on successive lines

9.3 Connection tables

Connection tables provide information on:

- physical connections (internal) among components of a unit or assembly; or
- physical connections (external) among different units or assemblies; or
- physical connections (external) to one unit.

The connection points shown in the connection table shall be identified by their identification, for example reference designation and terminal designation. The cables and objects being connected shall be clearly identified, for example by their reference designation. Cable cores shall be identified by their core identifier provided by the cable manufacturer, for example core number or colour code, or by any other identifier provided for it. Additional information may be included as required for the intended use of the document, such as:

- conductor or cable type information (for example, a recognized type designation, article or part number, material, construction, size, colour of insulation, voltage rating, number of conductors, other technical data);
- cable number or reference designation;

- conductor and cable core designation;
- instruction for, or methods of, laying, routing, termination, attachment, twisting, screening, etc.;
- length of conductor or cable.

Connection tables should be prepared by using one of the following sorting methods:

- terminal-oriented, in which the sequence of the connections presented shall be sorted in accordance with the identification of the terminals, see Figure 93 and Figure 94;
- connection-oriented, in which the sequence of the connections presented shall be sorted in accordance with the identification of the conductors, for example reference designation of the cable and the core identifier, see Figure 95.

Object -A4	Terminal	Cable	Core
-X1	:11	-W136	-1
	:12	-W137	-1
	:13	-W137	-2
	:14	-W137	-3
	:15	-W137	-4
	:16	-W137	-5
	:17	-W136	-2
	:18	-W136	-3
	:19	-W136	-4
	:20	-W136	-5
	:PE	-W136	-GNYE
	:PE	-W137	-GNYE

Figure 93 – Example of a terminal-oriented connection table

Terminal -A4-X1			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		N	PE	Not connected
Remote end	Cable des.	No. of cores																										
-B4-X1	-W136	6											1						2	3	4	5					GNYE	
-B4-X2	-W137	7												1	2	3	4	5									GNYE	6

Figure 94 – Example of a connection table with remote end designations

Cable designation	Core designation	Terminal -A4-X1	Remote End -B4	Remarks
-W136	-GNYE	:PE	-X1:PE	
	-1	:11	-X1:33	
	-2	:17	-X1:34	
	-3	:18	-X1:35	
	-4	:19	-X1:36	
	-5	:20	-X1:37	Spare
-W137	-GNYE	:PE	-X2:PE	
	-1	:12	-X2:26	
	-2	:13	-X2:27	
	-3	:14	-X2:28	
	-4	:15	-X2:29	
	-5	:16		Spare
	-6			Not connected

Figure 95 – Example of a connection-oriented connection table

10 Charts, graphs

10.1 General

Charts, graphs may be used for providing explanatory information for the understanding of the functional behaviour of a component or a system, often as addition to other document kinds. The details of the presentation shall be clearly related to the objects they explain, for example by the use of:

- reference designations
- signal designations
- terminal designations
- descriptive text

10.2 Function charts

For function charts describing the functions and behaviour of a control system by means of steps and transitions, see IEC 60848.

10.3 Sequence charts and time sequence charts

Sequence charts shall show the succession of operations or status of the units of a system.

Time sequence charts shall provide information on operational or functional sequences in relation to time and/or different operational or functional sequences related to each other, see Figure 96.

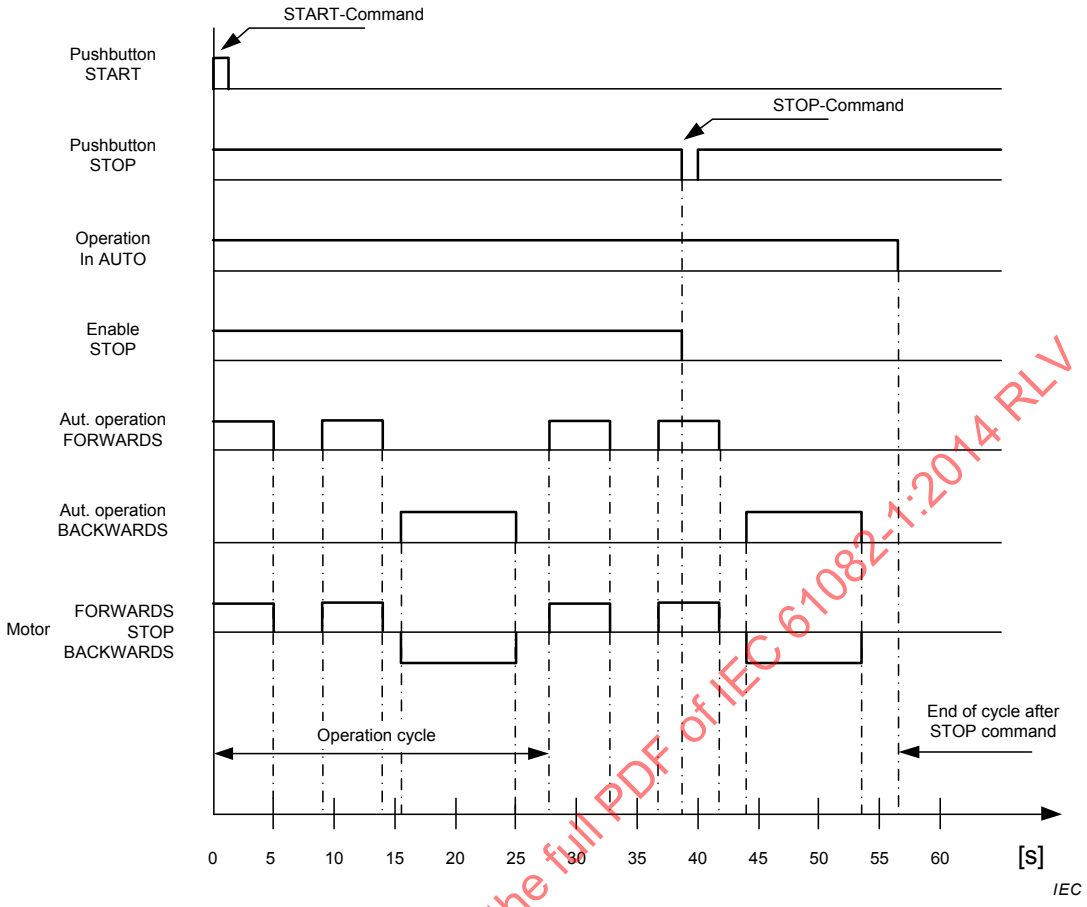


Figure 96 – Example of a time sequence chart

11 Structured documentation

11.1 General

IEC 81346-1 specifies how an aspect of an object can be subdivided into aspects of other objects. The subdivision can be performed recursively, thus resulting in a tree-like structure showing how an object, i.e. aspect of an object, is constructed of others. Each node in such a tree-like structure represents an object. Each object may be associated with documentation that describes the object as it is.

IEC 62023 specifies how documentation can be structured based on a main document. This publication utilizes how a type description of an object may be referenced from different places in the tree-like structures.

An explanation of type and occurrence of an object is provided in IEC 81346-1. An object type represents all of objects that are identical with respect to their characteristics and behaviour. An object occurrence represents one specific use of the object type.

In order to facilitate reuse of documentation associated with an object type, the following items need to be considered carefully in the preparation of documents:

- Presentation of an object type at its occurrences, see 11.2;
- Referencing from the object occurrences to the documentation associated with the object type, see 11.3;
- Metadata to be presented in the identification area of documents, see 11.4.

11.2 Presentation of occurrences of an object type in diagrams

11.2.1 General

The presentation of an occurrence of an object type may be performed either using:

- an instance diagram of the object type; or
- a single symbol representing the object type.

11.2.2 Using an instance diagram

An instance diagram is a representation of the object type by a simplified diagram where external connections are made to terminals of internal constituent objects, see Figure 97. An instance diagram shall be enclosed by a boundary frame in accordance with 7.1.5.

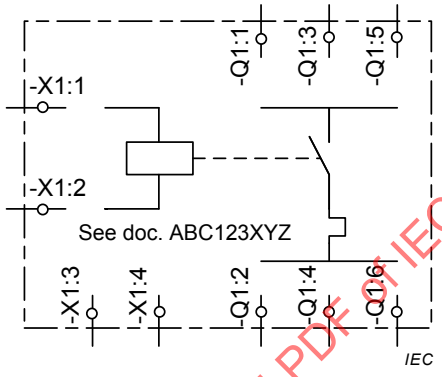


Figure 97 – Example of an instance diagram of a motor starter

11.2.3 Using a single symbol

When using a single symbol, for example based on the general symbol S00060, representing the occurrence of the object type, this symbol shall provide all necessary information for the understanding of the diagram in which the symbol is applied.

Figure 98 shows a symbol for the motor starter shown in Figure 97.

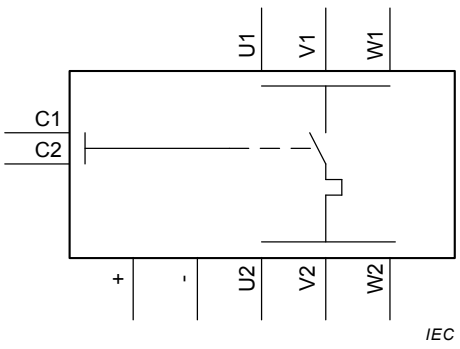


Figure 98 – A symbol for a motor starter

Any terminal designation assigned to the symbol shall be designations of the terminals of the object type, and thus be described in the underlying documentation associated with the object type. Figure 99 shows a document using the table form of presentation for providing such a description.

The terminal designations of an object type are not necessarily identical to the designation assigned by the manufacturer of a specific product. They constitute a neutral, manufacturer-independent designation introduced by the designer of the complete system.

NOTE The symbol shown in Figure 98 can also be considered as a functional description of the motor starter, thus the terminal designations indicated are the functional terminal designations. The mapping table shown in Figure 99 shows the mapping between the functional terminals and the physical terminals of the internal constituent objects.

(External) Terminal	Internal constituent object terminal	Remark
:C1	-X1:1	
:C2	-X1:2	
:U1	-Q1:1	
:V1	-Q1:3	
:W1	-Q1:5	
:U2	-Q1:2	
:V2	-Q1:4	
:W2	-Q1:6	
:+	-X1:3	
:–	-X1:4	

The mapping table may be used by CAx-tools to associate the external terminal shown at the symbols to those terminals to where the physical connections are made.

Figure 99 – Example of a document in table form describing the relations between external terminals of a motor starter to the internal terminals of its components

The same object type may be associated with different symbols depending on the context of where it is represented. Figure 100 shows another symbol for the motor starter shown in Figure 97, intended to be used in a diagram with single line representation. The terminal designations shown at the symbol represent terminal groups. Figure 101 shows the table describing the terminals shown in Figure 100 and the relations to terminals shown in Figure 98 and Figure 97.

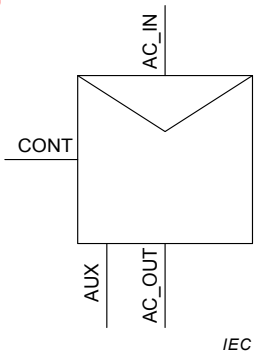


Figure 100 – A symbol for the motor starter, for single-line presentations

(External) Terminal group	(External) Terminal	(Internal) constituent object terminal	Remark
CONT	:C1	-X1:1	
	:C2	-X1:2	
AC_IN	:U1	-Q1:1	
	:V1	-Q1:3	
	:W1	-Q1:5	
AC_OUT	:U2	-Q1:2	
	:V2	-Q1:4	
	:W2	-Q1:6	
AUX	:+	-X1:3	
	:-	-X1:4	
NOTE The symbol for single line presentation can be considered as a functional description of the motor starter, thus the terminal designations indicated are the designation of the functional terminal group. This mapping table shows the mapping between the functional terminals and the physical terminals of the internal constituent objects			

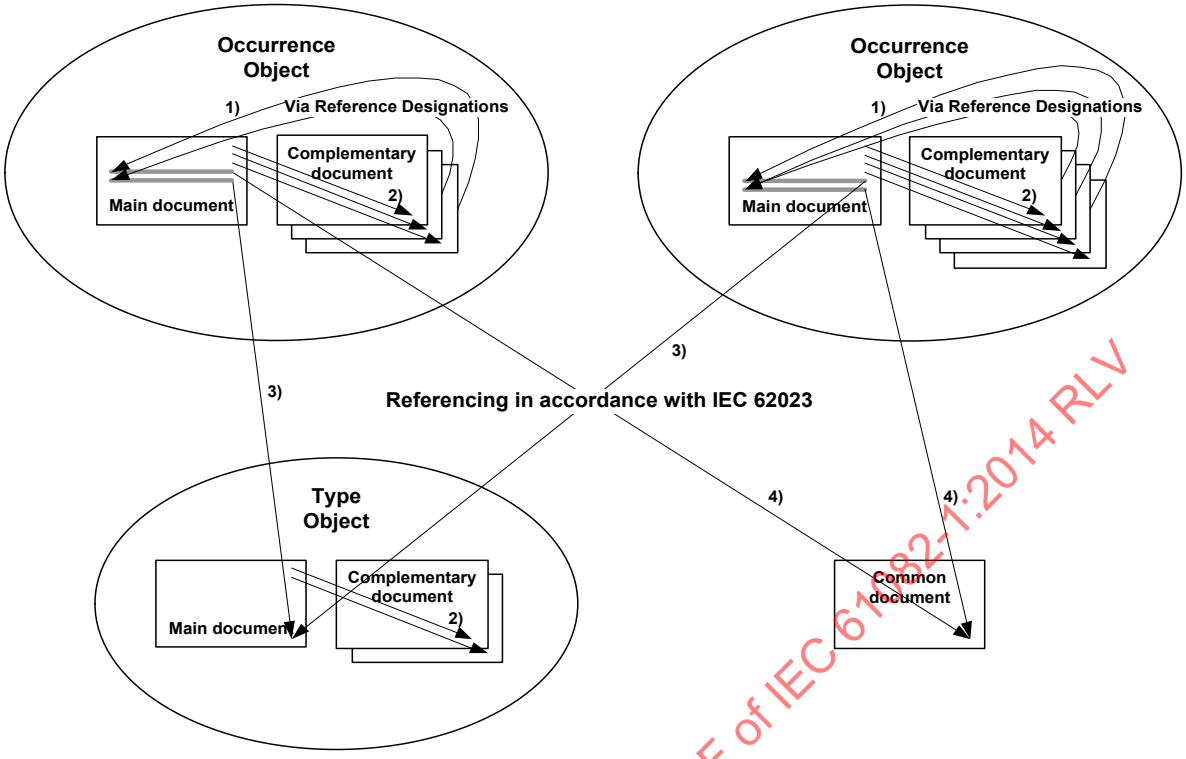
Figure 101 – Example of a document in table form describing the relations between external terminals of a motor starter to the internal terminals of its components

11.3 Referencing

When object occurrences are shown in a document, it is necessary to provide mechanisms in order to easily get to the detailed description of the corresponding object type.

If the documentation follows the principles in IEC 62023, the reference from the object occurrence representation to the object type documentation may be performed by means of the main document associated with the object occurrence, see Figure 102.

NOTE 1 This mechanism can be supplemented with a direct reference from the object occurrence to the relevant object type document.



Explanations:
1) Referencing from the occurrence representation to the main document.
2) Referencing from the main document for an object to complementary documents.
3) Referencing from the main document for an object to main document of the object type applied within the first.
4) Referencing from the main document for an object to shared document.

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Figure 102 – Referencing in accordance with IEC 62023

If the documentation does not apply the main document principle, as specified in IEC 62023, the reference from the object occurrence representation to the object type documentation shall be performed by a direct reference to the relevant object type document, see Figure 103.

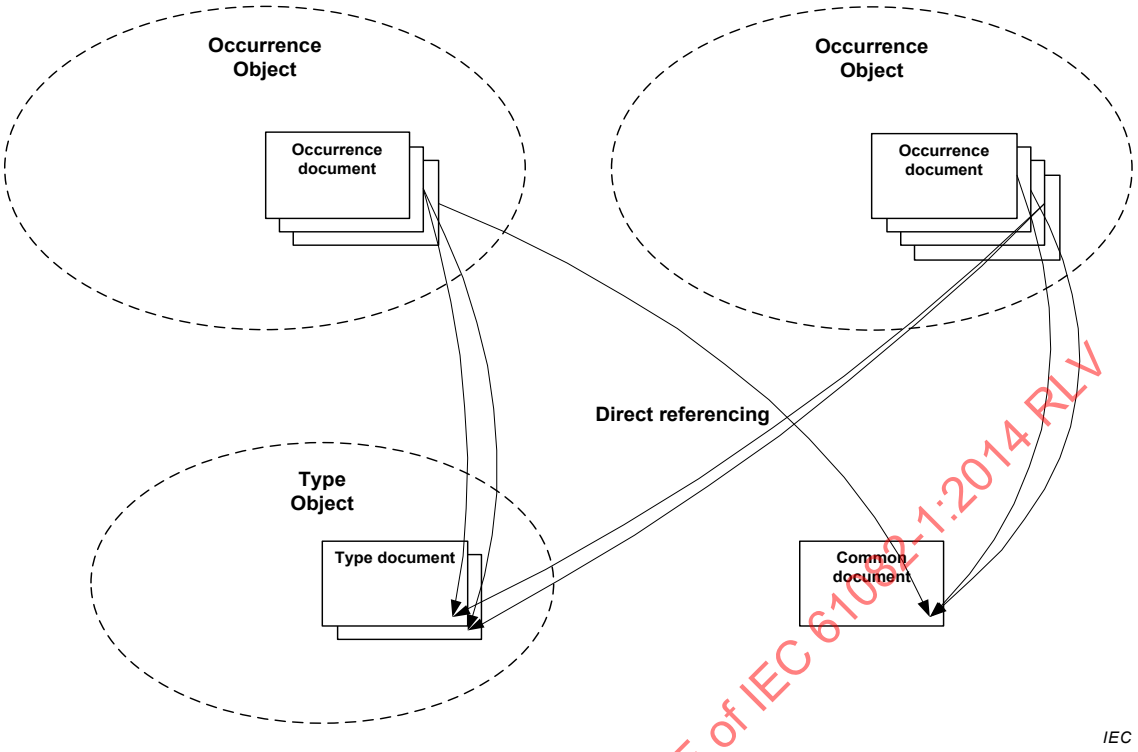


Figure 103 – Direct referencing

Within the object type documentation there should be no explicit references to any presentation of occurrences of that object type.

NOTE 2 Where changes are made to a single occurrence of an object type, documentation for a new object type has to be created.

11.4 Document metadata

Documents shall be associated with metadata in accordance with IEC 82045-1 and IEC 82045-2. Some of these data are presented in the identification area of the document (i.e. the title block). See also Annex B.

Metadata of documents associated with an object type shall only be related to that object type. No references shall be made to objects external to the object type or to occurrences of the object type.

It is important to notice that any reference designations occurring in the documents refer to the described object as the top node of its tree-like structures.

12 CAx conformance requirements

Computer-aided tools stated to be in compliance with this International Standard shall comply with the relevant standards from the following list:

- IEC 60617 for the shapes of graphical symbols for diagrams;
- IEC 60848 for the preparation of sequential function charts;
- IEC 61175 for the designation of signals;
- IEC 61355-1 for the management of documents by means of document classification and designation;
- IEC 61666 for the identification of terminals within a system;

- IEC 62023 for the structuring of information;
- IEC 62027 for the preparation of parts lists;
- IEC 62491 for labelling of cables and cores
- IEC 81346-1 and IEC 81346-2 for reference designations;
- ISO 81714-1 for the design of graphical symbols;
- IEC 81714-2 for graphical symbols;
- IEC 82045 for the management of administrative data related to documents;
- IEC 82079-1 for the preparation of instructions for use.

Annex A
(normative)

Construction of a symbol for an object which does not have a symbol in IEC 60617

A.1 General rules

When the graphical symbol required is not found in IEC 60617, the symbols S00059, S00060 or S00061 can be applied (see Figure A.1), or it may be possible to create one from the existing ones as explained below.

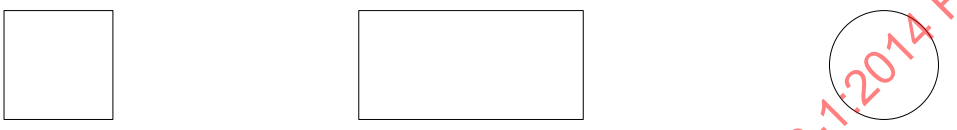


Figure A.1 – The general symbols for an object in IEC 60617

Pick a basic symbol (i.e. an existing symbol that expresses best the basic concept) and then combine it with one or more appropriate supplementary symbol.

Supplementary symbols are:

- primarily symbols in IEC 60617 explicitly depicted as "Qualifiers" in their application class; or
- any other symbol in IEC 60617, if necessary suitably modified in size; or
- other symbols or identifiers specified in supporting documentation.

The supplementary symbols can be placed inside, outside or across the basic symbol. No simple rule can be given, since the placement to a high degree depends on the shapes of the symbols, available space in or around the basic symbol, etc.

Do not overload the symbol. Limit the number of supplementary symbols to what is required to emphasise the wanted concept.

For further guidance on the design of symbols refer to the ISO 81714-1 and IEC 81714-2.

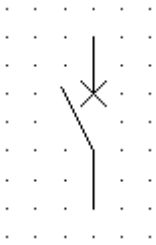
IEC 60617 contains numerous examples on how this is done. In IEC 60617 look at a complex symbol and follow the links under the attribute "Applying" to see how the symbol is built from a set of more simple ones.

A symbol created as a combination of already existing symbols and in line with the rules given in ISO 81714-1 and IEC 81714-2 is considered to be in accordance with IEC 60617.

A.2 Example – Miniature circuit-breaker

There is no symbol in IEC 60617 that specifically represents a miniature circuit-breaker. In many application areas such a symbol has been requested, and it is therefore considered useful to describe how a symbol for such a device can be constructed utilising the existing symbols in IEC 60617.

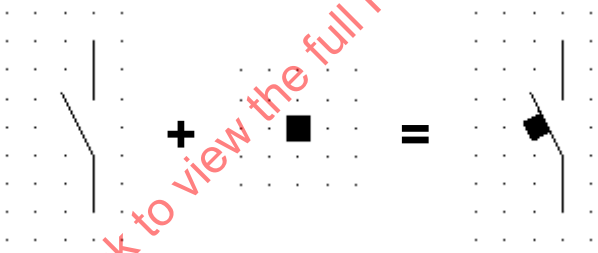
a) A miniature circuit-breaker is, as the term says, a small circuit-breaker. Thus the symbol for a circuit-breaker, i.e. symbol S00287 in IEC 60617, can be applied. By using this symbol, however, it is not possible to distinguish between a “normal” circuit-breaker and a miniature circuit-breaker by the graphical symbols. The symbol for a miniature circuit-breaker will then be as shown in Figure A.2.



S00287
Circuit-
breaker

Figure A.2 – Miniature circuit-breaker shown with the symbol for a circuit-breaker

b) The main function of a miniature circuit-breaker is that it shall open (i.e. break) the circuit in which it is located. The main concept is switching. The general symbol for a switch is S00227. However, a miniature circuit-breaker shall trip automatically, and IEC 60617 contains a qualifying symbol for indicating an automatic tripping function, i.e. symbol S00222 in IEC60617. This symbol may therefore be applied in addition to the general switch symbol, and the symbol assembly will be as shown in Figure A.3.



S00227
Switch,
general
symbol

S00222
Automatic
tripping
function

Figure A.3 – Miniature circuit-breaker shown with the general symbol for a switch qualified with the symbol for automatic tripping

This symbol does not exactly indicate that the breaker has a circuit-breaker function. It only shows that the breaker has an automatic tripping function.

c) Another alternative would be to use the symbol for a circuit-breaker as the base symbol instead of the general symbol for a switch (breaker), see Figure A.4, then illustrating a circuit-breaker with automatic tripping.

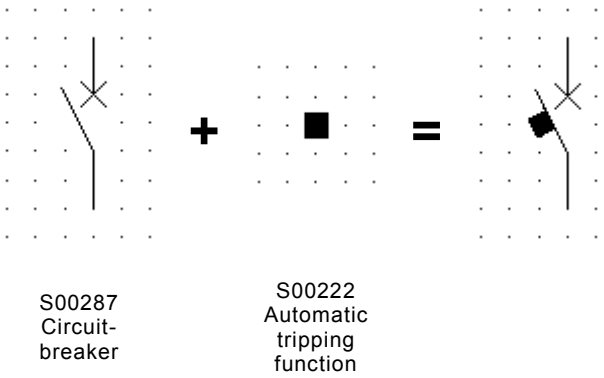


Figure A.4 – Miniature circuit-breaker shown with the symbol for a circuit-breaker qualified with the symbol for automatic tripping

d) The operating mechanism of a miniature circuit-breaker is based on two tripping mechanism, one based on a thermal effect, and one based on an electromagnetic effect. In order to illustrate a breaker based on these two mechanisms, the general symbol for a switch (breaker), i.e. S00227, can be used as a base. The qualifying symbol indicating the thermal effect, i.e. S00120, and the qualifying symbol indicating the electromagnetic effect, i.e. S00121, can then be added, see Figure A.5.

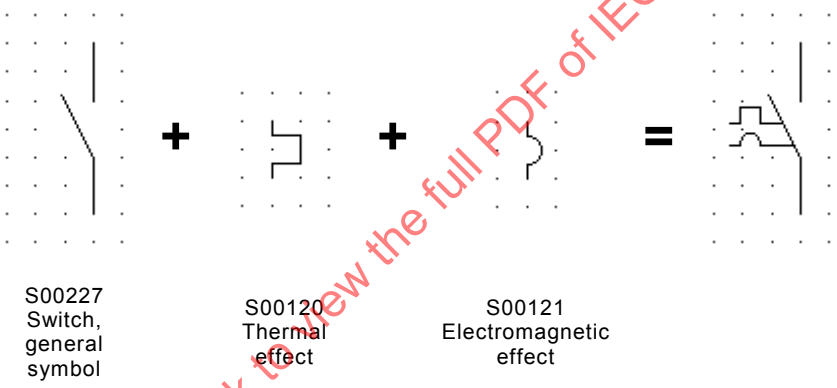


Figure A.5 – Miniature circuit-breaker shown with the general symbol for a switch qualified with the symbols for thermal and electromagnetic effects

Another alternative would be to replace the general switch symbol, i.e. S00227, as used in alternative d) with the symbol for a circuit-breaker, i.e. S00287. The symbol assembly may look somewhat overloaded, see Figure A.6.

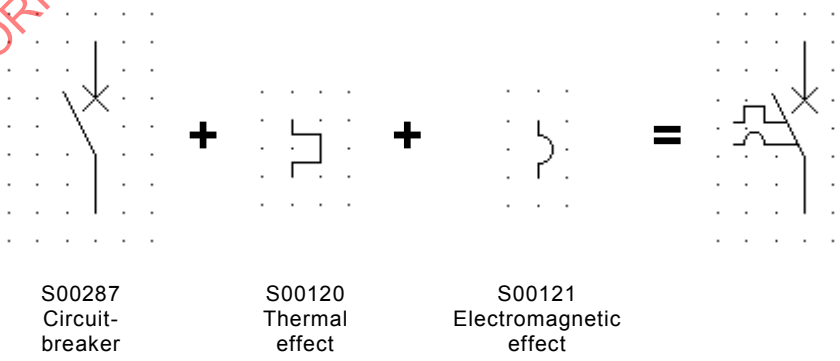


Figure A.6 – Miniature circuit-breaker shown with the symbol for a circuit-breaker qualified with the symbol for thermal and electromagnetic effects

A.3 Example – miniature circuit-breaker with an RCD (Residual Current Device)

A miniature circuit-breaker can also be combined with an RCD. In such cases it will be a need to also illustrate this functionality by the symbol.

a) Use the symbol designed in alternative d) above, add the qualifying symbol indicating the earth fault current, i.e. S00333, see Figure A.7, thus illustrating a miniature circuit-breaker that is also tripping on earth fault currents.

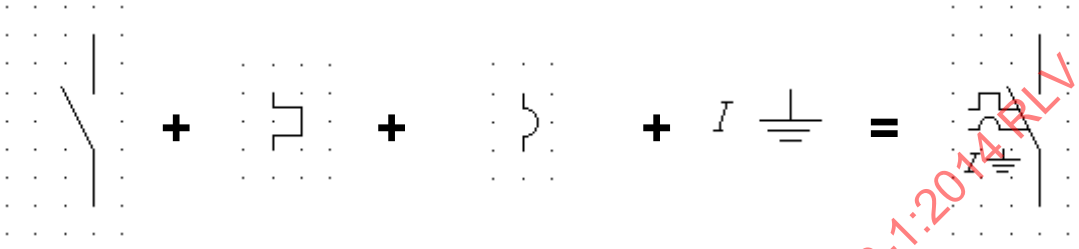


Figure A.7 – Symbol for a miniature circuit-breaker with an RCD, version 1

b) Use the symbol designed in alternative d) above, add a qualifying symbol telling about the additional tripping mechanism. An RCD is actually a protection device tripping when the sum of the currents flowing through the device is higher than a pre-set value. The tripping is actually based on a difference in the currents. Therefore, a qualifying symbol for differential current, i.e. S00331, could be added, see Figure A.8.

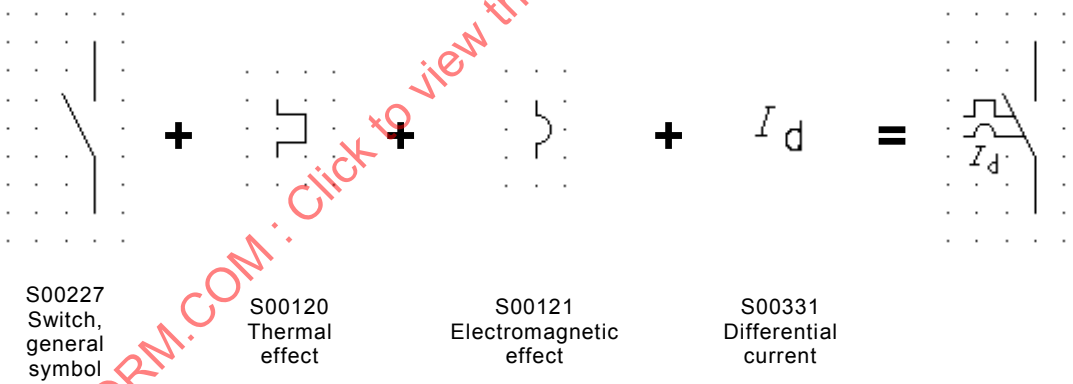


Figure A.8 – Symbol for a miniature circuit-breaker with an RCD, version 2

c) A third possibility is to apply the letter symbol for current, indexed with the letter symbol for difference. The letter symbols shall be in accordance with IEC 60027 and ISO 31, see Figure A.9.

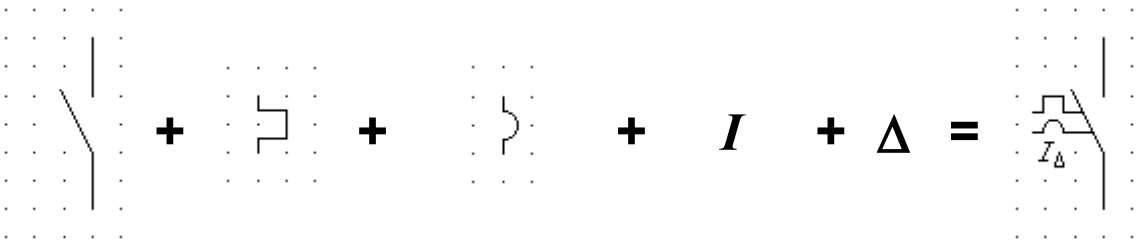


Figure A.9 – Symbol for a miniature circuit-breaker with an RCD, version 3

A.4 Example – RCD (residual current device) / RCM (residual monitoring device)

IEC 60617-DB does not contain a symbol representing an RCD and an RCM. Following the principles shown in A.1, A.2 and A.3, the following symbol assembly may be achieved:

- RCD

  An RCD shall provide an opening of the circuit in which it is located when the sum of the currents passing through the RCD differs from a preset value. Figure A.10 shows an example of a symbol for an RCD based on the symbols shown in Figure A.9

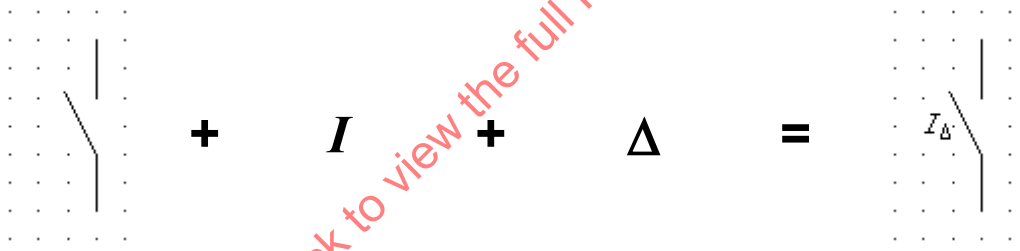


Figure A.10 – Example of a symbol for an RCD

- RCM

  An RCM shall not provide any opening of the circuit in which it is located. The RCM shall provide an audible and visible signal. It is therefore natural to use the general symbol S00059 as a base and add qualifying symbols indicating a signal lamp, i.e. S00965, a buzzer, i.e. S00973 and the additional information on differential currents see Figure A.11.

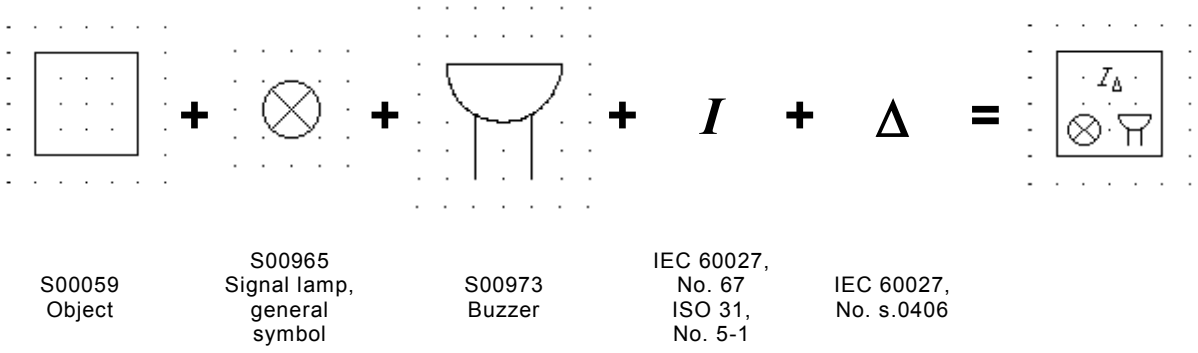
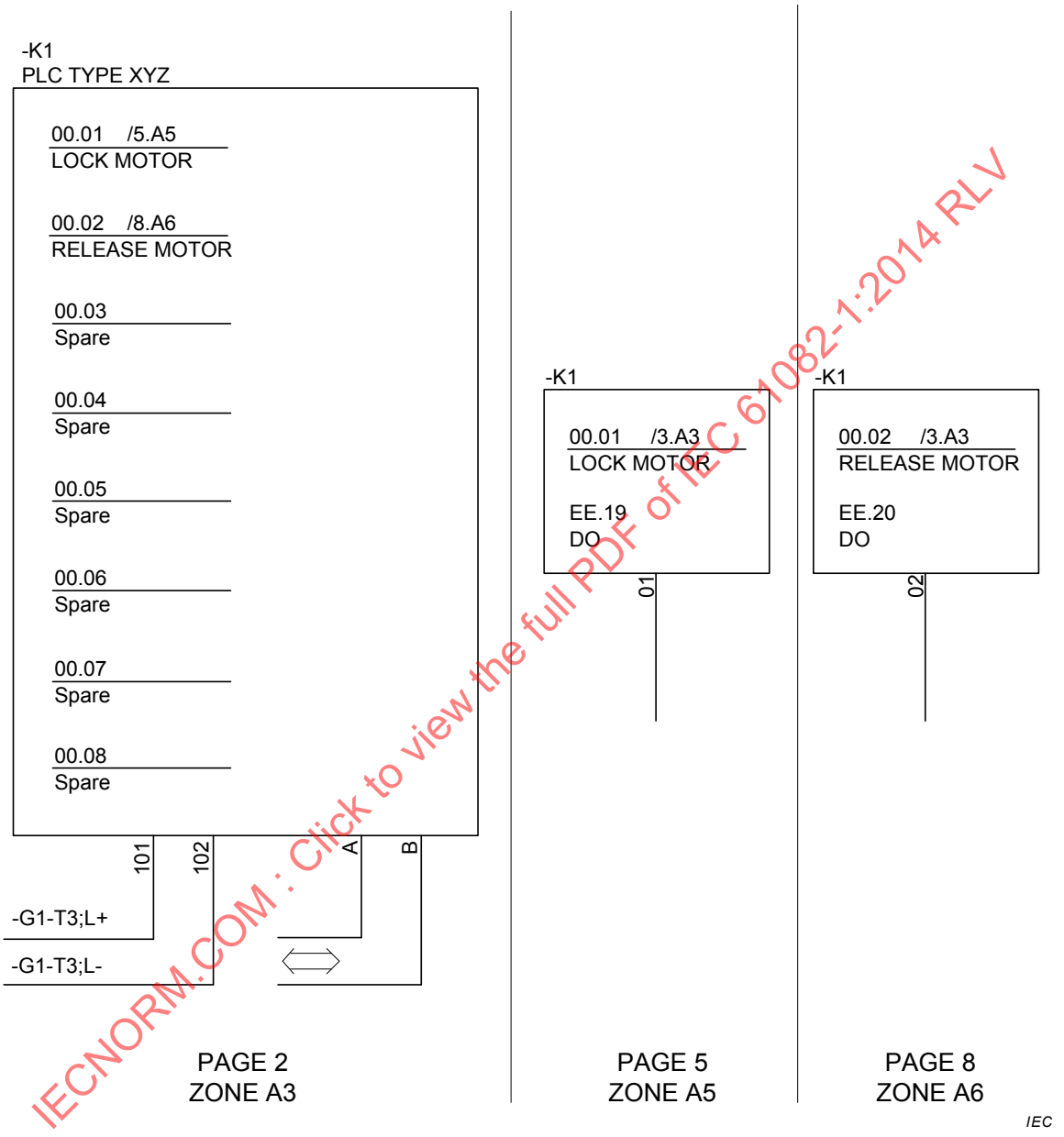


Figure A.11 – Example of a symbol for an RCM

A.5 Example – PLC

Figure A.12 shows examples of a specific presentation of symbols for a PLC (Programmable Logical Controller). The symbols show the PLC in detached presentation, with different parts presented on individual pages.



The example is intended to show how symbols can be constructed in accordance with this standard and introduced in the documentation. It does not intend to regularise the graphical design of symbols illustrating a PLC.

Figure A.12 – Symbols for a PLC

The general symbol S00059 is used as a basis. Each channel is represented by a line inside the symbols together with the internal PLC addresses 00.01, ..., 00.08. An additional text illustrates the function related to the each channel (for example "LOCK MOTOR"). Cross references between different presentations of the channels are given (for example "/5.A5"). Further information on the operand (ex. "EE.19") and the kind of signal (ex. "DO", abbreviation for Digital Output) are given within the symbols only representing a channel.

In order for the reader to understand the symbols a complete description shall be given in the document or supporting documentation.

Figure A.13 shows an example of a circuit diagram applying a symbol for a PLC.

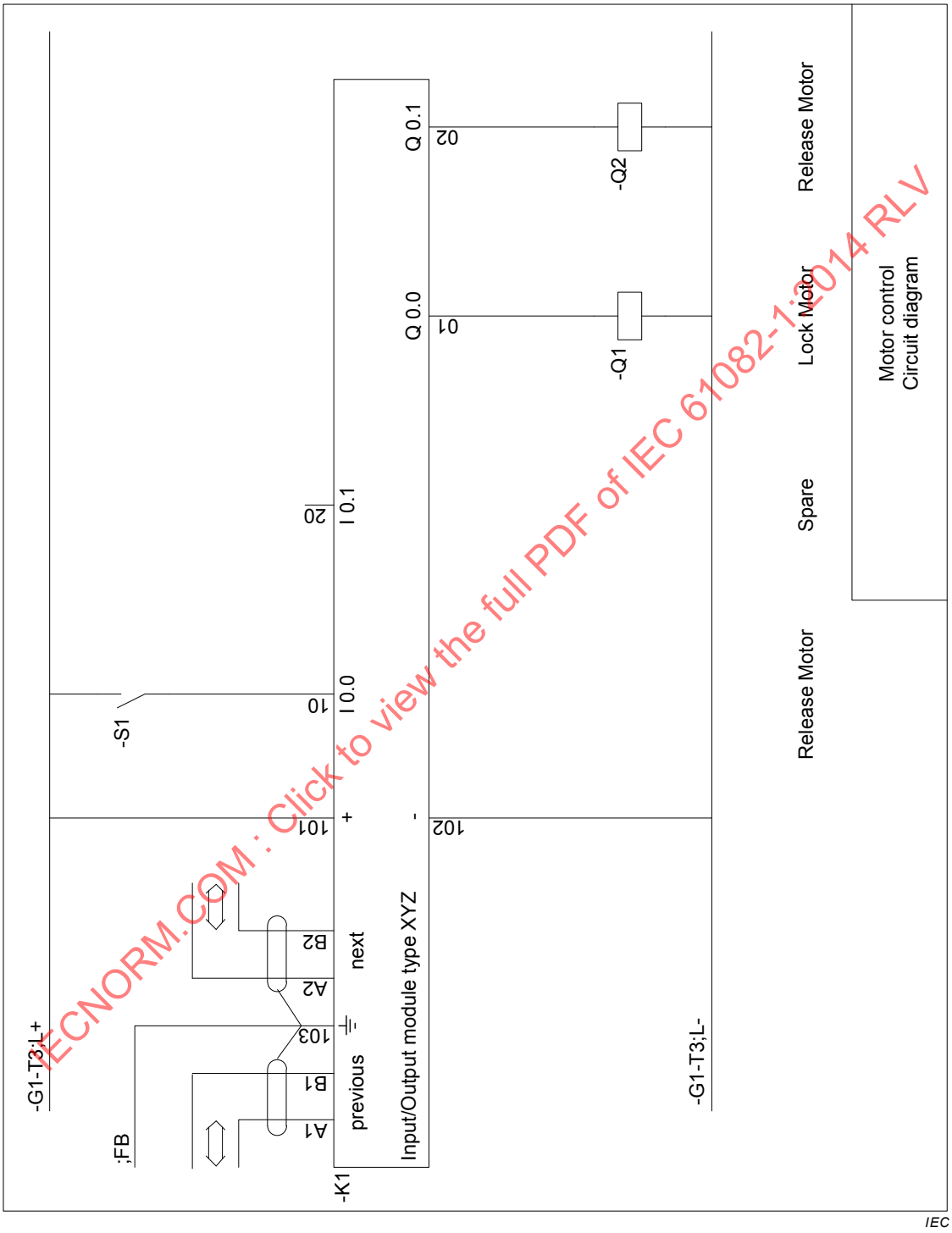


Figure A.13 – A circuit diagram with a symbol of a PLC

Annex B
(informative)

Document management information and title blocks

B.1 Presentation of document management information

A title block shown in the identification area on a document page includes for example information in accordance with the metadata element names defined in IEC 82045-2, see Table B.1.

Table B.1 – Metadata element names

No.	IEC 82045-2	ISO 7200	Metadata identifier	Name in ISO 7200 (M) = mandatory	Label in the title block example
1	2	5.1.3	DocumentId	Identification number (M)	Document Id
2	4	5.1.4	RevisionId	Revision index	Rev.
3	11	5.1.6	DocumentPartId	Segment/sheet number (M)	Page number
4	106	5.3.10	RepresentationNumberOfPages	Number of pages	Number of pages
4a	---	---	---	---	Continuing page (see Note 3)
5	53	5.1.5	ReleaseDate	Date of issue	Release date
6	5	5.1.8	LanguageCode	Language code	Lang.
7	67	--	ReferenceObjectId	---	Object designation
8	19	--	DocumentClassIdIEC61355	---	DCC
9	11	5.1.6	DocumentPartId	Segment/sheet number	Page counting number (IEC 61355)
10	18	5.3.6	DocumentClassName	Document type (M)	(Document kind)
11	12	5.2.2	Title	Title (M)	(Title)
12	86	5.1.2	OrganizationOwner	Legal owner	(Owner organization)
13	30	5.3.2	OrganizationalUnit	Responsible department	Responsible department
14	---	5.3.3	---	Technical reference	Technical reference
15	36	5.3.5	CreatorName	Creator (M)	Created by
16	48	5.3.4	ApprovedByPerson	Approval person (M)	Approved by
17	69	---	ProjectId	---	Project Id
18	95	---	OrganisationCustomer	---	Customer
19	70	---	ProjectName	---	Project name
20	81	---	SupersedingDocumentId	---	Replacing
21	79	---	BasedOnDocumentId	---	Based on
22	80	---	BasedOnDocRevisionId	---	(Based on)

NOTE 1 The metadata element names are language independent unambiguous identifiers which are not to be translated into other languages.

NOTE 2 Names of labels may be presented in abbreviated form or omitted if the context is clear.

NOTE 3 “Continuing page” can be used optionally instead of “Number of pages” if the numbering is not done sequentially.

B.2 Example of the layout of a title block

Figures B.1 and B.2 show an example of the arrangement of document-related information in a title block for size A3 pages, based on the examples given in ISO 7200. The numbers in parenthesis shown in Figure B.1 refer to the information listed in Table B.1.

The examples shown in the figures are intended to show how document management information may be introduced in the title block of a technical document. It does not present all information necessary for document management, nor does it intend to regularise the graphical design of title blocks.

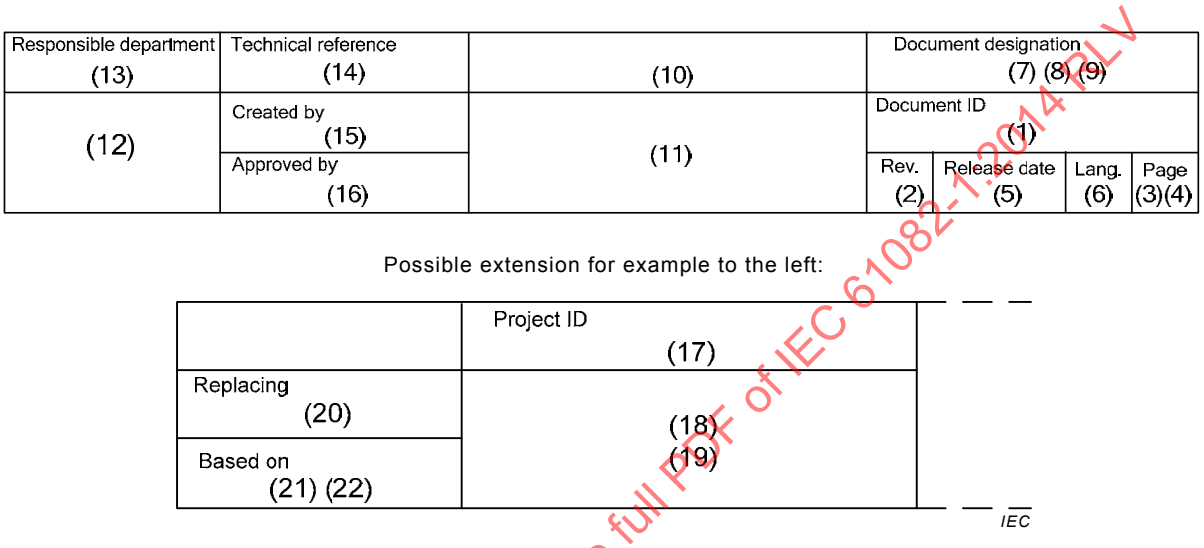


Figure B.1 – Example of the arrangement of information in a title block

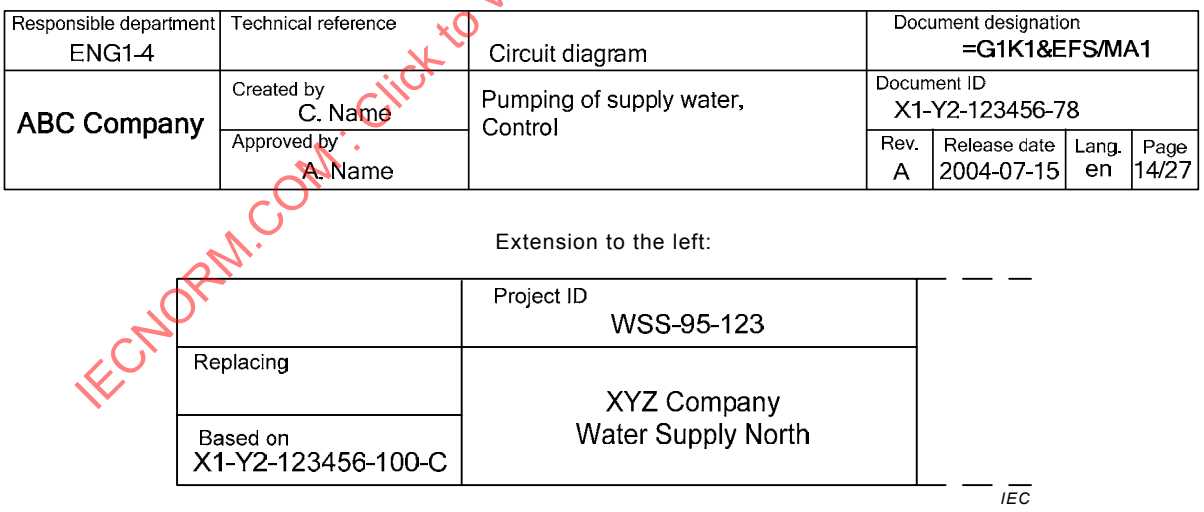


Figure B.2 – Example of a filled-in title block

Other document related information (like copyright note, CAD software and version used, archive reference) can be presented, outside the title block, in one of the identification areas, see Clause B.3.

B.3 Examples of the location of identification areas

Figure B.3 shows examples of possible locations of identification areas and a possible title block (TB) related to different page sizes and orientations.

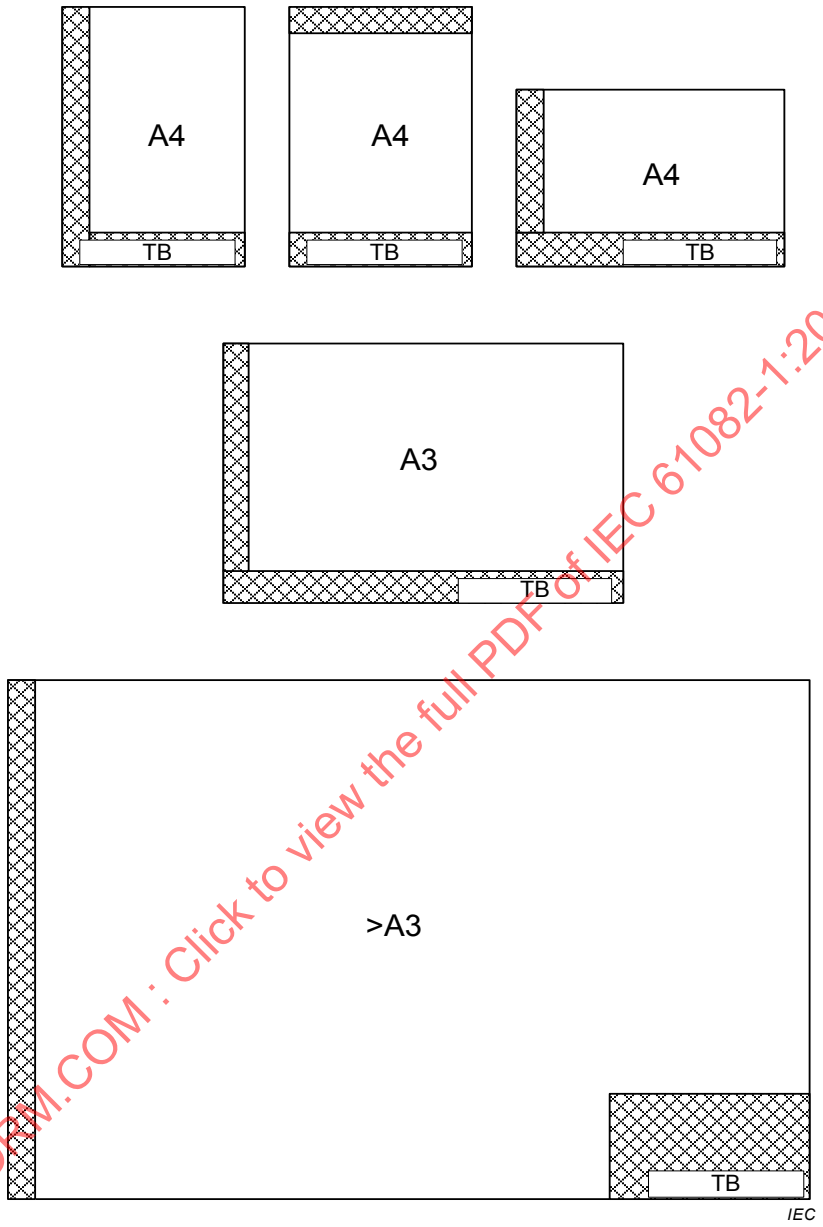


Figure B.3 – Examples of locations of identification areas and possible title blocks

Annex C
(informative)

Document kind designations and content of information

Table C.1 lists basic and specific document kinds dealt with in this International Standard together with a short description and information on their content of information. Reference to the relevant clause is provided as well as the document kind classification code (DCC) in accordance with IEC 61355-1.

It is recommended to use only these document kind designations and specify the object to which it applies, and/or the purpose for which it is prepared or generated separately in the document title.

EXAMPLE

- A “network map” is an “overview diagram” for the object “network”. A map is used as base document – this is however not of importance for the document kind’s designation.
- A “cable routing drawing” is an “arrangement drawing” for the object “cabling system” and the task “laying of cables”.

Table C.2 shows a non-exhaustive list of document designations in use. Recommended replacements are shown.

Table C.1 – Recommended document kind designations *(1 of 2)*

Document kind designation	Subclause	DCC	Description and content of information
Overview diagram	7.2	_FA _FB	Diagram providing a comprehensive view of an object with a low degree of detailing [3.3.1] Mandatory: • Graphical symbols representing the objects • Main interrelations or connections • Designations and references to more detailed documents Optional: • Location information • Parts of process flow diagrams • Implementation dependant information, e.g. technical data, measuring points • Explanatory information, such as data on supply and service limits
Function diagram	7.3	_FF	Diagram providing information on the functional behaviour of a system [3.3.2] Mandatory: • Graphical symbols for objects representing functions • Graphical symbols representing functional connections or interrelations • Interface terminals and designations • Signal designations Optional: • Reference designations • Terminal designations • Address information (software) • Explanatory information
Circuit diagram	7.4	_FS	Diagram providing information on the circuitry of an object [3.3.3] Mandatory: • Graphical symbols representing the objects • Graphical symbols representing the connections among objects • Reference designations • Terminal designations • Signal level conventions (applicable to logic signals) • Information necessary to trace paths and circuits (signal designations, location references) • Supplementary information necessary for the understanding of functions Optional: • Technical data • Reference to other documents • Information on wiring performance • Cable and cable core identification

Table C.1 *(2 of 2)*

Document kind designation	Subclause	DCC	Description and content of information
Connection diagram	7.5	_MA _MB	Diagram providing information on the physical connections among components or units [3.3.4] Mandatory: • Conductor or cable type information (e.g. recognized type designation, catalogue or part number, material, construction, size, insulation, voltage rating, colour, number of conductors, other technical data) • Reference designation or conductor or cable number • Identification or representation of the connected objects (e.g. reference and/or terminal designation) Optional: • Instruction for or methods of laying, routing, termination, attachment, twisting, screening, etc. • Length of connection • Signal designation and/or technical data about the signal • Special classification or information
Arrangement drawing	8.3	_LD _LH _LU	Drawing providing information on the relative or absolute location of objects [3.3.7] Mandatory: • Simplified shapes or symbols of objects • Reference designations or other identifications of objects • Distances Optional: • Main dimensions of objects • Symbols for cables and conductors • Indication of reference points • Technical data • Installation instructions
Connection table	9.3	_MA _MB	Table providing information on the physical connections among components or units [3.3.8] Mandatory: • Conductor or cable type information (e.g. recognized type designation, catalogue or part number, material, construction, size, insulation, voltage rating, colour, number of conductors, other technical data) • Reference designation or conductor or cable number • Identification or representation of the connected objects (e.g. reference and/or terminal designation) Optional: • Instruction for or methods of laying, routing, termination, attachment, twisting, screening, etc. • Length of connection • Signal designation and/or technical data about the signal • Special classification or information
Sequence chart	10.2	_FF	Chart providing information on the succession of operations or status of the units of a system [3.3.9]
Time sequence chart	10.2	_FF	Sequence chart with the time axis plotted to scale [3.3.10]

Table C.2 – Current document kind designations and replacements *(1 of 2)*

Current document kind designation	Recommended document kind designation	DCC	Description
Single-line diagram	Overview diagram	_FA	Overview diagram using single-line presentation for the polyphase circuits. A system diagram in which the polyphase links are represented by their equivalent single line. (IEC 60050-601:1985: definition 601-02-04)
Network map	Overview diagram	_FA	Overview diagram showing a network on a map, for example generating and transforming stations and power lines, telecommunication equipment and transmission lines.
Topological diagram of a network	Overview diagram	_FA	The graphical representation of the network topology. (IEC 60050-603:1986: definition 603-02-05)
System diagram	Overview diagram	_FA	A topological representation of a system in which the information content depends on a specific requirement. (IEC 60050-601:1985: definition 601-02-01)
System operational diagram	Overview diagram	_FA	A system diagram representing a particular operational condition. (IEC 60050-601:1985: definition 601-02-02)
Three-phase system diagram	Overview diagram	_FA	Overview diagram using multi-line presentation for the polyphase circuits. A *diagram* of a three-phase system in which all phases and neutral conductors are each represented by separate lines. (IEC 60050-601:1985: definition 601-02-03)
Voltage map	Overview diagram	_FA	Consistent presentation of the voltages at the major nodes of a network under specified operating conditions. (IEC 60050-603:1986: definition 603-04-24)
Block diagram	Overview diagram	_FA _FB	Overview diagram predominantly using block symbols
Function chart	Function diagram	_FF	Chart describing the functions and behaviour of a control system, using steps and transitions (see also IEC 60848)
Equivalent-circuit diagram	Function diagram	_FF	Function diagram providing information on an electric and/or magnetic behaviour model of an object [3.3.5]
Logic-function diagram	Function diagram	_FF	Function diagram that predominantly uses symbols for binary logic elements [3.3.6]
Terminal function diagram	Circuit diagram	_FS	Circuit diagram for a functional unit in a simplified form of presentation showing the terminals for the interface connections and a description of the internal behaviour.
Terminal connection diagram	Connection diagram	_MA	Connection diagram for connections internal and/or external to terminals
Unit connection diagram	Connection diagram	_MA	Connection diagram for connections within a unit.
Interconnection diagram	Connection diagram	_MA _MB	Connection diagram providing information on the physical connections among different units.
Cable diagram	Connection diagram	_MB	Connection diagram providing information on cables between and among various objects.

Table C.2 *(2 of 2)*

Current document kind designation	Recommended document kind designation	DCC	Description
Site plan (base document for electrical installation)	Arrangement drawing	_LD	Base document for an arrangement drawing showing the location, in relation to "setting-out-points", of construction works, service networks, and roadwork and information on landscape, means of access and general layout of site (Requirements see 8.2)
Earthing diagram	Arrangement drawing	_LD	Arrangement drawing of an earthing system.
Installation diagram	Arrangement drawing	_LD _LH	Arrangement drawing showing the location of components of an electrical installation together with connections
Cable routing drawing	Arrangement drawing	_LD _LH	Arrangement drawing on which the location of cable tunnels, trays, ducts, trunking systems, supports etc. are presented.
Earthing drawing	Arrangement drawing	_LD _LH	Arrangement drawing showing the location of components of an earthing system
Earthing plan	Arrangement drawing	_LD _LH	Arrangement drawing showing the location of components of an earthing system
Installation drawing	Arrangement drawing	_LD _LH	Arrangement drawing showing the location of components of an electrical installation
Installation plan	Arrangement drawing	_LD _LH	Arrangement drawing showing the location of the components of an installation
Building drawing (base document for electrical installation)	Arrangement drawing	_LH	Base document for an arrangement drawing showing the ground-plan and sectional views of a building together with information important for electrical installation (Requirements see 8.2)
Assembly drawing	Arrangement drawing	_LU	Arrangement drawing representing the spatial position and shape of a group of assembled parts, normally to scale
Terminal connection list	Connection table	_MA	Connection table providing information on the physical connections internal and/or external to terminals
Terminal connection table	Connection table	_MA	Connection table providing information on the physical connections internal and/or external to terminals
Unit connection list	Connection table	_MA	Connection table providing information on the physical connections within a unit.
Unit connection table	Connection table	_MA	Connection table providing information on the physical connections within a unit.
Interconnection list	Connection table	_MA	Connection table providing information on the physical connections among different units.
Interconnection table	Connection table	_MA	Connection table providing information on the physical connections among different units.
Cable list	Connection table	_MB	Connection table providing information required for laying of cables among objects
Cable table	Connection table	_MB	Connection table providing information required for laying of cables among objects

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ISO 128-23:1999, *Technical drawings – General principles of presentation – Part 23: Lines on construction drawings*

ISO 128-24:1999, *Technical drawings – General principles of presentation – Part 24: Lines on mechanical engineering drawings*

ISO 128-25:1999, *Technical drawings – General principles of presentation – Part 25: Lines on shipbuilding drawings*

ISO 128-34:2001, *Technical drawings – General principles of presentation – Part 34: Views on mechanical engineering drawings*

ISO 128-40:2001, *Technical drawings – General principles of presentation – Part 40: Basic conventions for cuts and sections*

ISO 128-44:2001, *Technical drawings – General principles of presentation – Part 44: Sections on mechanical engineering drawings*

ISO 128-50:2001, *Technical drawings – General principles of presentation – Part 50: Basic conventions for representing areas on cuts and sections*

ISO 129-1:2004, *Technical drawings – Indication of dimensions and tolerances – Part 1: General principles*

ISO 3864-1:2002, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs in workplaces and public areas*

ISO 5807, *Information processing – Documentation symbols and conventions for data, program and system flowcharts, program network charts and system resources charts*

ISO 6428:1982, *Technical drawings – Requirements for microcopying*

ISO 7200:2004, *Technical product documentation – Data fields in title blocks and document headers*

ISO 10209:2012, *Technical product documentation – Vocabulary – Terms relating to technical drawings, product definition and related documentation*

ISO 10628 (all parts), *Diagrams for the chemical and petrochemical industry*

ISO 14084 (all parts), *Diagrams for power plants*

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

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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ÉTABLISSEMENT DES DOCUMENTS UTILISÉS EN ÉLECTROTECHNIQUE –

Partie 1: Règles

AVANT-PROPOS

1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
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8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets et de ne pas avoir signalé leur existence.

La Norme internationale IEC 61082-1 a été établie par le comité d'études 3 de l'IEC: Structures d'information, documentation et symboles graphiques.

Elle a le statut d'une norme horizontale conformément au Guide 108 de l'IEC.

Cette troisième édition annule et remplace la deuxième édition parue en 2006. Cette édition constitue une révision technique et inclut les principales modifications techniques suivantes:

a) inclusion de règles de présentation pour les interconnexions sans fil
b) description de cas exceptionnels pour l'application de règles pour le positionnement des désignations de référence dans les schémas
c) correction d'erreurs et mise à jour des références normatives

d) harmonisation des définitions par rapport aux publications référencées.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
3/1189/FDIS	3/1196/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Une liste de toutes les parties de la série IEC 61082, publiées sous le titre général *Établissement des documents utilisés en électrotechnique*, peut être consultée sur le site web de l'IEC.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

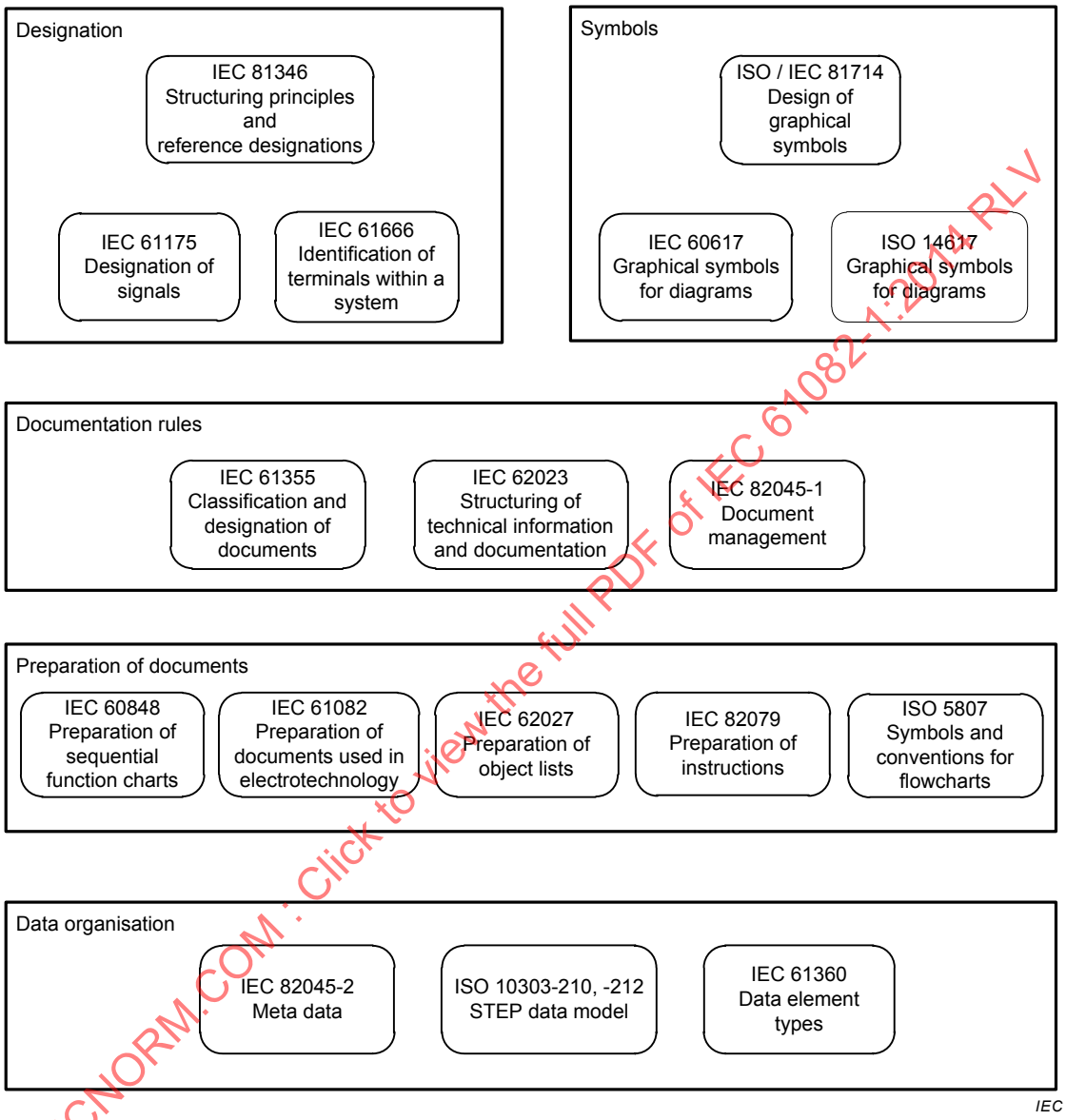
Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. A cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

IMPORTANT – Le logo *"colour inside"* qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

INTRODUCTION

L'IEC 61082-1 traite de la présentation des informations dans les documents. Une partie de ces informations est décrite dans d'autres normes internationales. La Figure 1 donne une vue d'ensemble des relations qui existent entre certaines de ces normes.



IEC

Légende

Anglais	Français
Designation	Désignation
IEC 81346 Structuring principles and reference designations	IEC 81346 Principes de structuration et désignations de référence
IEC 61175 Designation of signals	IEC 61175 Désignation des signaux
IEC 61666 Identification of terminals within a system	IEC 61666 Identification des bornes dans le cadre d'un système
Symbols	Symboles
ISO/IEC 81714 Design of graphical symbols	ISO/IEC 81714 Création de symboles graphiques utilisables
IEC 60617 Graphical symbols for diagrams	IEC 60617 Symboles graphiques pour schémas

Anglais	Français
IEC 14617 Graphical symbols for diagrams	IEC 14617 Symboles graphiques pour schémas
Documentation rules	Règles de documentation
IEC 61355 Classification and designation of documents	IEC 61355 Classification et désignation des documents
IEC 62023 Structuring of technical information and documentation	IEC 62023 Structuration des informations et de la documentation techniques
IEC 82045-1 Document management	IEC 82045-1 Gestion de documents
Preparation of documents	Préparation de documents
IEC 60848 Preparation of sequential function charts	IEC 60848 Établissement des diagrammes fonctionnels en séquence
IEC 61082 Preparation of documents used in electrotechnology	IEC 61082-1 Etablissement des documents utilisés en électrotechnique
IEC 62027 Preparation of object lists	IEC 62027 Établissement des listes d'objets
IEC 82079 Preparation of instructions	IEC 82079 Établissement des instructions d'utilisation
ISO 5807 Symbols and conventions for flowcharts	ISO 5807 Symboles et conventions applicables aux organigrammes d'analyse
Data organisation	Organisation des données
IEC 82045-2 Meta data	IEC 82045-2 Métadonnées
ISO 10303-210, -212 STEP data model	ISO 10303-210, -212 Modèle de données STEP
IEC 61360 Data element types	IEC 61360 Types d'éléments de données

Figure 1 – Vue d'ensemble des normes relatives à la présentation des informations dans les documents

Les exemples donnés dans la présente partie de l'IEC 61082 sont destinés à illustrer une règle donnée et ne sont pas nécessairement représentatifs de documents complets.

ÉTABLISSEMENT DES DOCUMENTS UTILISÉS EN ÉLECTROTECHNIQUE –

Partie 1: Règles

1 Domaine d'application

La présente partie de l'IEC 61082 définit des règles générales et sert de guide pour la présentation des informations dans les documents et définit des règles particulières pour les schémas, les dessins et les tableaux utilisés en électrotechnique.

Les règles et les lignes directrices pour tous les types de présentations audio, vidéo ou tactile sont exclues de la présente partie de l'IEC 61082.

Cette norme horizontale est essentiellement destinée à l'usage des comités d'études dans la préparation des normes, conformément aux principes établis dans le Guide 108 de la CEI.

Une des responsabilités d'un comité d'études est, partout où cela est possible, de se servir des normes horizontales lors de la préparation de ses publications. Le contenu de cette norme horizontale ne s'appliquera pas, à moins qu'il ne soit spécifiquement désigné ou inclus dans les publications concernées.

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60027 (toutes les parties), *Symboles littéraux à utiliser en électrotechnique*

IEC 60375, *Conventions concernant les circuits électriques et magnétiques*

IEC 60757, *Code de désignation de couleurs*

IEC 60617, *Symboles graphiques pour schémas.* Disponible à l'adresse: <http://std.iec.ch/iec60617>

IEC 60848, *Langage de spécification GRAFCET pour diagrammes fonctionnels en séquence*

IEC 61175, *Systèmes, installations, appareils et produits industriels – Désignation des signaux*

IEC 61286, *Technologie de l'information – Jeu de caractères graphiques codés pour emploi dans l'établissement de documents utilisés en électrotechnique et pour échange de l'information*

IEC 61293, *Marquage des matériels électriques avec des caractéristiques assignées relatives à l'alimentation électrique – Prescriptions de sécurité*

IEC 61355-1:2008, *Classification et désignation des documents pour installations industrielles, systèmes et matériels – Partie 1: Règles et tableaux de classification*

IEC 61666, *Systèmes industriels, installations et appareils, et produits industriels – Identification des bornes dans le cadre d'un système*

IEC 62023, *Structuration des informations et de la documentation techniques*

IEC 62027, *Établissement des listes d'objets, y compris les nomenclatures de composants*

IEC 62491, *Systèmes industriels, installations et appareils et produits industriels - Étiquetage des câbles et des conducteurs isolés*

IEC 81346-1, *Systèmes industriels, installations et appareils, et produits industriels – Principes de structuration et désignations de référence – Partie 1: Règles de base*

IEC 81714-2:2006, *Création de symboles graphiques utilisables dans la documentation technique de produits – Partie 2: Spécification pour symboles graphiques sous forme adaptée à l'ordinateur, y compris les symboles pour bibliothèque de références, et exigences relatives à leur échange*

IEC 82045-1:2001, *Gestion de documents – Partie 1: Principes et méthodes*

IEC 82045-2, *Gestion de documents – Partie 2: Éléments de métadonnées et modèle d'information de référence*

IEC 82079-1, *Établissement des instructions d'utilisation – Structure, contenu et présentation – Partie 1: Principes généraux et exigences détaillées*

ISO 128-22, *Dessins techniques – Principes généraux de représentation – Partie 22: Conventions de base et applications pour les traits de rappel de cote et traits de référence*

ISO 128-30, *Dessins techniques – Principes généraux de représentation – Partie 30: Conventions de base pour les vues*

ISO 2594, *Dessin de bâtiment – Méthodes de projection*

ISO 3098-5, *Documentation technique de produits – Écriture – Partie 5: Écriture en conception assistée par ordinateur de l'alphabet latin, des chiffres et des signes*

ISO 5455, *Dessins techniques – Échelles*

ISO 5456-2, *Dessins techniques – Méthodes de projection – Partie 2: Représentations orthographiques*

ISO 5457:1999, *Documentation technique de produits – Formats et présentation des éléments graphiques des feuilles de dessin*

ISO 80000 (toutes les parties), *Grandeurs et unités*

ISO 81714-1, *Création de symboles graphiques à utiliser dans la documentation technique de produits – Partie 1: Règles fondamentales*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

NOTE L'Annexe C donne des informations supplémentaires sur les différentes sortes de documents.

3.1 Termes fondamentaux

3.1.1
document
quantité d'informations fixe et structurée destinée à être perçue par les personnes et qui peut être gérée et échangée comme un tout entre utilisateurs et systèmes

Note 1 à l'article: Le terme document n'est pas réduit à sa signification au sens légal.

Note 2 à l'article: Un document peut être désigné selon le type d'information et la forme de présentation, par exemple schéma d'ensemble, tableau de connexion, diagramme fonctionnel.

[SOURCE: ISO/IEC 8613-1:1994, 3.58, modifiée – Les notes 1 et 2 à l'article ont été ajoutées.]

3.1.2
sorte de document
type de document défini en fonction du contenu de ses informations et de la forme de présentation spécifiés

Note 1 à l'article: Quelquefois, le terme type de document est utilisé pour le même concept.

[SOURCE: IEC 61355-1:2008, 3.6]

3.1.3
documentation
ensemble de documents sur un sujet donné

Note 1 à l'article: Ce terme peut couvrir des documents techniques, commerciaux, ou autres.

Note 2 à l'article: Le terme sujet peut se référer à des objets au sens de la norme IEC 81346 ou à d'autres entités à traiter.

Note 3 à l'article: Une documentation peut être constituée de documents, de documents composites et d'ensembles de documents.

Note 4 à l'article: Le nombre et la sorte de documents dans une documentation peuvent différer selon l'objectif.

[SOURCE: IEC 61355-1:2008, 3.5]

3.1.4
base de données
ensemble de données organisées conformément à une structure conceptuelle décrivant les caractéristiques des données et les relations entre leurs entités correspondantes, supportant un ou plusieurs domaines d'application

[SOURCE: ISO/IEC 2382-1:1993, 01.08.05]

3.1.5
lien hypertexte
lien actif entre un emplacement dans une présentation et un autre emplacement dans la même présentation ou dans une autre présentation

Note 1 à l'article: Un lien hypertexte est actif uniquement lorsque la présentation du document est gérée par un ordinateur.

Note 2 à l'article: Le lien hypertexte implique qu'un utilisateur peut activer le lien pour arriver à un autre point.

3.1.6
objet
entité considérée dans le processus de développement, de mise en œuvre, d'usage et d'élimination

Note 1 à l'article: L'objet peut faire référence à une "chose" physique ou non physique, c'est-à-dire tout ce qui peut exister, existe ou a existé.

Note 2 à l'article: L'objet est associé à des informations.

[SOURCE: IEC 81346-1:2009, 3.1]

3.1.7
désignation d'objet
identificateur d'un objet spécifique dans un contexte donné

Note 1 à l'article: Exemples de telles désignations: désignation de référence, numéro de type, numéro de série, nom.

[SOURCE: IEC 61355-1:2008, 3.13]

3.1.8
désignation de référence
identificateur d'un objet spécifique formé en fonction du système dont cet *objet* est un élément constituant, basé sur un ou plusieurs aspects de ce système

[SOURCE: IEC 81346-1:2009, 3.11]

3.1.9
désignation de référence à niveau unique
désignation de référence assignée en fonction de l'objet dont l'objet spécifique est un constituant direct

Note 1 à l'article: Une désignation de référence à niveau unique n'inclut pas de désignations de référence d'objets de niveau supérieur ou inférieur.

[SOURCE: IEC 81346-1:2009, 3.12]

3.1.10
ensemble de désignations de référence
ensemble d'au moins deux désignations de référence assignées à un objet dont au moins une identifie l'objet sans ambiguïté

[SOURCE: IEC 81346-1:2009, 3.14]

3.1.11
produit
résultat recherché ou réalisé d'un travail ou d'un processus naturel ou artificiel

[SOURCE: IEC 81346-1:2009, 3.6]

3.1.12
composant
produit utilisé comme partie d'un produit assemblé, système ou installation industriel

[SOURCE: IEC 81346-1:2009, 3.7]

3.2 Termes liés aux formes de présentation des informations

3.2.1
forme de dessin
présentation d'informations utilisant un moyen graphique

3.2.2
forme imagée
présentation des informations utilisant des images ou des représentations géométriquement absolues quelle que soit la perspective réelle utilisée

Note 1 à l'article: Les formes imagées peuvent être bi ou tridimensionnelles.

3.2.3
forme rédactionnelle
présentation des informations utilisant des mots et des signes numériques

3.2.4
dessin
présentation utilisant principalement la forme de dessin en représentant, généralement à l'échelle, les objets et leur position relative les uns par rapport aux autres

3.2.5
schéma
présentation utilisant principalement la forme de dessin et montrant les fonctions des objets d'un système et leurs relations à l'aide de symboles graphiques

3.2.6
diagramme
graphique
présentation utilisant principalement la forme de dessin et exprimant la relation entre plusieurs grandeurs, opérations ou états variables

[SOURCE: ISO 10209-1:1992, 2.1, modifiée – "generalement dans un systeme de coordonnees" a été supprimé "opérations ou états variables" a été ajouté.]

3.2.7
tableau
liste
présentation dans laquelle l'information est présentée en lignes et en colonnes

Note 1 à l'article: Une liste est une sorte particulière de tableau.

Note 2 à l'article: Une présentation dans une cellule de tableau peut avoir une forme quelconque.

3.3 Termes liés aux sortes de documents particulières

3.3.1
schéma d'ensemble
schéma donnant une vue complète d'un objet avec un faible degré de détail

3.3.2
schéma fonctionnel
schéma donnant des informations sur le comportement fonctionnel d'un objet

3.3.3
schéma des circuits
schéma donnant des informations sur les interactions des composants des circuits électriques avec des informations sur les connexions physiques

3.3.4
schéma des connexions
schéma donnant des informations sur les connexions physiques entre composants ou unités

3.3.5
schéma d'équivalence des circuits
schéma fonctionnel fournissant une information sur un modèle de comportement électrique et/ou magnétique d'un objet

3.3.6
schéma fonctionnel logique
schéma fonctionnel qui utilise principalement des symboles pour opérateurs logiques binaires

3.3.7
dessin d'installation
dessin fournissant une information sur l'emplacement relatif ou absolu des objets

3.3.8
tableau des connexions
tableau fournissant des informations sur les connexions physiques entre composants ou unités

3.3.9
diagramme de séquence
diagramme fournissant une information sur la succession des opérations ou des statuts des unités d'un système

3.3.10
diagramme de séquence-temps
diagramme de séquence dont les axes de temps sont tracés à l'échelle

4 Principes de documentation

4.1 Considérations générales

La documentation technique est essentielle pour la planification, la création, la fabrication, l'installation, la mise en service, l'utilisation, la maintenance et la démolition d'un produit ou d'un système.

La documentation est destinée à fournir des informations sous la forme la mieux appropriée. En outre, elle constitue un moyen essentiel pour vérifier et garantir que les exigences de sécurité, d'environnement et de qualité applicables à un produit ou à un système sont remplies.

La documentation technique représente, dans un contrat, une partie aussi importante que la fourniture du matériel et elle constitue un élément essentiel des processus après-vente.

4.2 Structure de la documentation

Dans l'IEC 81346-1, il est indiqué que les informations sur les produits et les systèmes peuvent être organisées dans des structures arborescentes. Les structures représentent la manière dont un objet est subdivisé en objets constituants, par exemple un processus en processus de taille plus réduite ou un produit en sous-produits.

Conformément à l'IEC 61355-1, il convient qu'un document décrive et soit clairement lié à des objets définis dans ces structures. La relation d'un document avec l'objet décrit est normalement donnée par l'utilisation de la désignation d'objet comme partie d'une désignation d'un document.

NOTE La désignation d'objet peut être soit une désignation de référence (pour des documents en relation avec l'occurrence) soit une désignation de type (pour des documents en relation avec le type). Pour plus d'information, voir l'Article 11.

L'utilisation de la structure conduit à une hiérarchie dans la présentation des informations, voir l'IEC 62023. Cela signifie que les informations sont présentées par niveaux successifs, chacun présentant un degré différent de détails. Par exemple, les documents liés à l'objet représenté par le nœud supérieur dans une structure contiennent les informations générales concernant le système complet tandis que les documents liés aux autres objets représentés dans la structure contiennent des informations plus détaillées concernant les éléments constituants, voir aussi l'Article 11.

Les principes de structuration sont également utilisés pour la création et la fabrication qui sont basées sur une division du travail ou sur la sous-traitance. Le constructeur d'un composant fournit toutes les informations nécessaires pour la compréhension et l'utilisation de sa livraison sans tenir compte des questions extérieures. La documentation pour un tel composant ou sous-système peut alors être intégrée dans tout système au niveau approprié de la structure du système concernée.

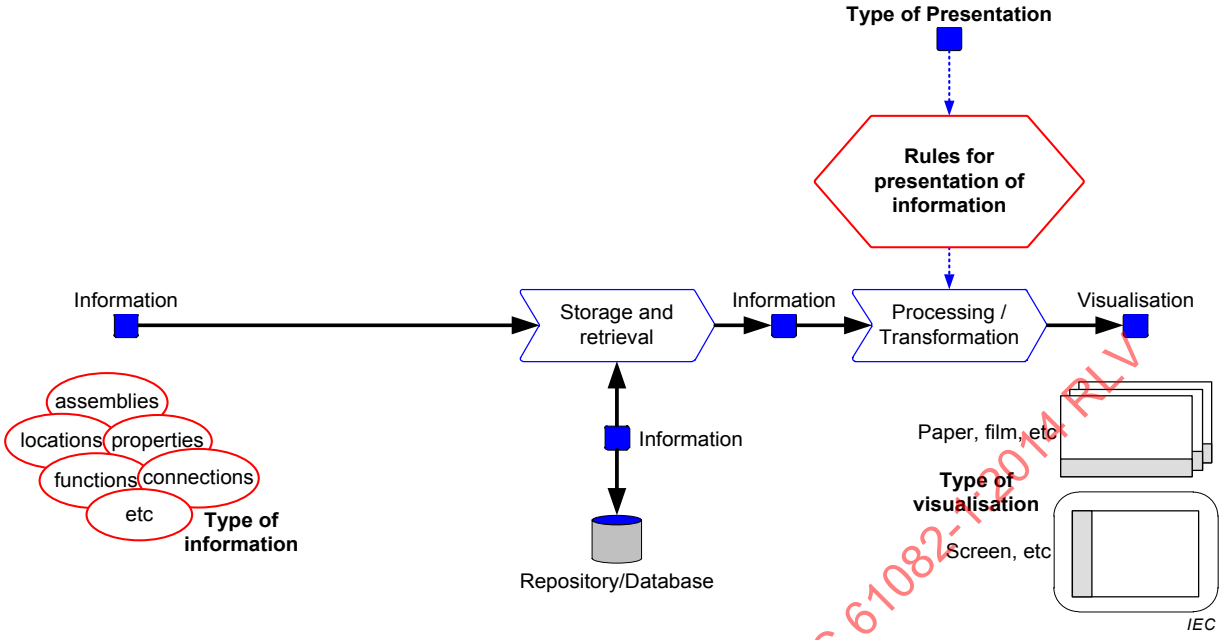
4.3 Présentation des informations

La présentation des informations, dans un document, ne doit laisser aucune ambiguïté et doit viser l'utilisation pratique. Ceci implique que les mêmes informations peuvent être présentées dans différents documents appliquant la même sorte de document ou une sorte différente de document. Les informations doivent être cohérentes partout dans la présentation.

Lorsque des informations sont stockées dans une base de données indépendamment de toute forme de présentation, ces informations peuvent être rendues accessibles par des vues distinctes au moment où elles sont nécessaires et sous la forme la mieux adaptée à l'usage prévu, sous réserve que des outils appropriés soient disponibles en appliquant les règles de la présente Norme internationale (voir la Figure 2).

Les sortes de documents (voir IEC 61355-1 et l'Annexe C) représentent des formes possibles et prédéfinies de présentations.

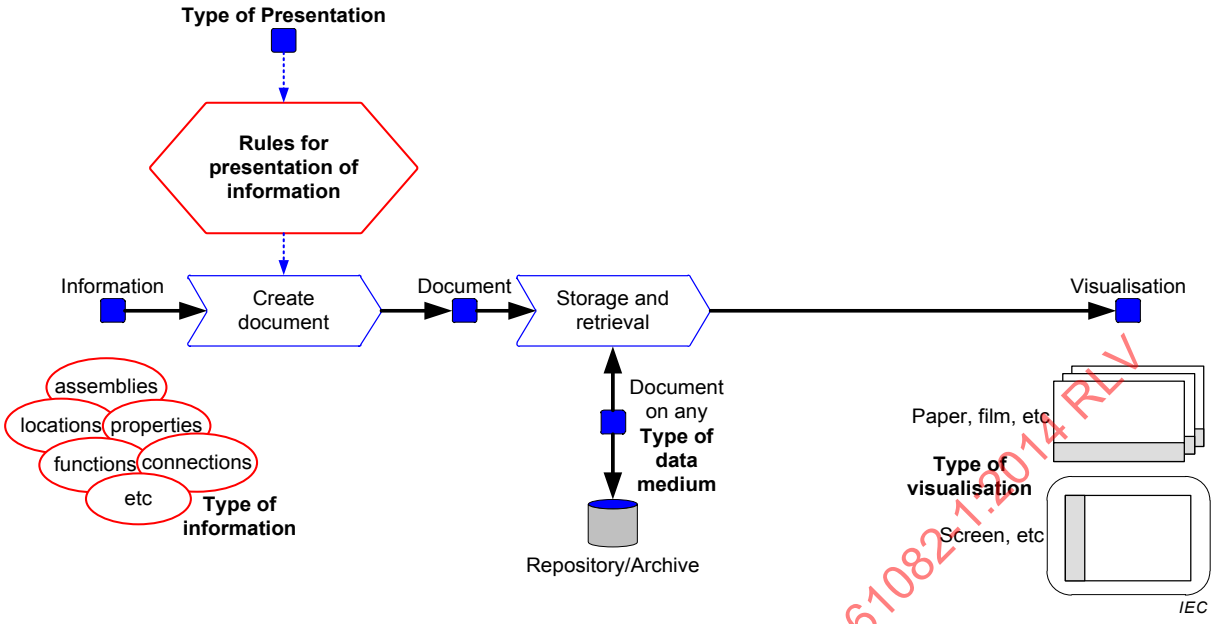
Lorsque les informations sont stockées et sont liées à une forme de présentation, c'est-à-dire comme un document, les règles de la présente Norme internationale s'appliquent lors de l'établissement du document, voir la Figure 3. Ce document peut être établi au moyen d'un système xAO ou directement sur papier ou sur un support équivalent.



Légende

Anglais	Français
Type of presentation	Type de présentation
Rules for presentation of information	Règles de présentation des informations
Information	Informations
Storage and retrieval	Stockage et extraction
Processing / Transformation	Traitement / transformation
Visualisation	Visualisation
Assemblies	Ensembles
Locations	Emplacements
Properties	Propriétés
Functions	Fonctions
Connections	Connexions
Type of information	Type d'informations
Repository/Database	Référentiel de données / base de données
Paper, film, etc.	Papier, film, etc.
Type of visualisation	Type de visualisation
Screen, etc.	Écran, etc.

Figure 2 – Documents générés à partir des informations stockées dans une base de données



Légende

Anglais	Français
Type of presentation	Type de présentation
Rules for presentation of information	Règles de présentation des informations
Information	Informations
Create document	Création de document
Document	Documents
Storage and retrieval	Stockage et extraction
Assemblies	Ensembles
Locations	Emplacements
Properties	Propriétés
Functions	Fonctions
Connections	Connexions
Type of information	Type d'informations
Document on any Type of data medium	Document sur tout type de support de données
Repository/Archive	Référentiel de données / archive
Paper, film, etc.	Papier, film, etc.
Type of visualisation	Type de visualisation
Screen, etc.	Écran, etc.

Figure 3 – Documents établis et stockés dans une base de données

4.4 Identification et désignation de document

Chaque document doit être identifié par un identificateur au moins qui ne doit pas être ambigu dans un contexte donné. Dans la mesure où un document peut être identifié de manière non ambiguë dans plusieurs contextes, le contexte valide doit être expliqué dans le document ou dans la documentation d'accompagnement.

NOTE 1 Le contexte dans lequel un identificateur de document est valide peut être indiqué en mentionnant:

– l'organisme responsable de l'identificateur de document concerné, par exemple la société qui établit le document;

– le système de numérotation de document ou d'article reconnu au plan international, par exemple ISBN, ISSN, EAN, UPC.

Un document peut être désigné selon l'Article 5 de l'IEC 61355-1:2008 pour mettre en relation les parties de la documentation avec les objets décrits.

NOTE 2 Conformément à l'IEC 61355-1, une désignation de document est constituée d'une "désignation d'objet" et d'un "code de classification de document (document classification code – DDC)". Une désignation d'objet telle qu'elle est décrite dans l'IEC 61355-1 est soit une désignation de référence conforme à l'IEC 81346-1 soit tout autre identificateur non ambigu.

Si la désignation d'objet n'est pas une désignation de référence, elle doit pouvoir être clairement distinguée de toute désignation de référence.

5 Règles de présentation des informations

5.1 Lisibilité

Quel que soit le cadre dans lequel les informations sont présentées à un utilisateur, la présentation doit être lisible dans les conditions d'utilisation prévues. La lisibilité dépend:

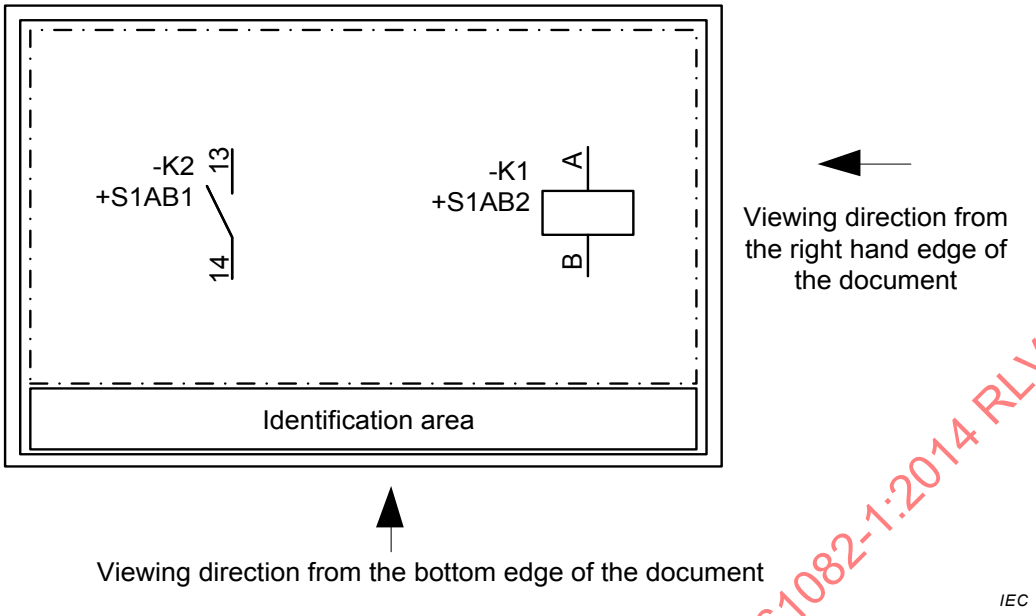
- des formes de présentation utilisées et de leurs combinaisons;
- de l'aménagement des symboles les uns par rapport aux autres;
- de la façon dont la présentation est éclatée sur différentes pages;
- du format d'une page, voir 5.4;
- des modifications de format prévues d'une page;
- de l'utilisation des techniques de simplification, voir 5.20.3, 7.1.2.3 et 7.1.3.6;
- de l'utilisation des liens hypertexte, voir 5.9;
- de l'utilisation de présentations statiques ou dynamiques;
- du support utilisé pour la présentation des informations, par exemple papier ou écrans.

Les informations peuvent être présentées en utilisant des combinaisons:

- de symboles, voir 5.12 et 7.1.2;
- de traits, voir 5.10, 5.17, 5.18 et 7.1.3;
- de texte et de chaînes de texte, voir 5.11, et 5.16;
- d'images, voir 5.14;
- de contours des objets;
- de couleurs, d'ombrage et de motifs, voir 5.3.

5.2 Orientation du texte

Le texte d'un document doit être orienté horizontalement ou verticalement de manière à être lu à partir du bord inférieur ou à partir du bord droit, voir la Figure 4.



Légende

Anglais	Français
Identification area	Zone d'identification
Viewing direction from the right hand edge of the document	Sens de lecture à partir du bord droit du document
Viewing direction from the bottom edge of the document	Sens de lecture à partir du bord inférieur du document

Figure 4 – Sens de lecture d'un document

5.3 Couleurs, ombrage et motifs

Il convient d'utiliser les couleurs uniquement en tant qu'informations complémentaires. La perception des différentes couleurs ne doit pas être l'unique moyen de compréhension des présentations.

NOTE Les utilisations des couleurs pour certains usages spécifiques sont données dans l'ISO 3864-1, l'IEC 60204-1 et l'IEC 60073.

La signification des couleurs utilisées doit être indiquée dans le document ou dans la documentation d'accompagnement.

Des ombrages et des motifs peuvent être utilisés pour différentier des zones ou des surfaces. Dans le cas des documents sur papier ou support équivalent, il convient que l'utilisation de couleurs, d'ombrage et/ou de motifs soit compatible avec l'impression en noir et blanc.

5.4 Formats des pages sur papier

Le format des pages sur papier ou support équivalent doit être conforme à 3.1 de l'ISO 5457:1999. Le format A3 est recommandé lorsque ce sont surtout des formes imagées ou des schémas qui sont utilisés comme formes de présentation.

Les formats allongés définis dans l'Article 3 de l'ISO 5457:1999 ne doivent pas être utilisés.

5.5 Reproduction des pages sur papier

Pour les documents sur papier ou support équivalent qui sont destinés à être reproduits ou microfilmés, des marques de centrage conformes à 4.3 de l'ISO 5457:1999 peuvent être ajoutées pour faciliter la reproduction ou le microfilmage.

5.6 Identification des pages

Un document peut être constitué de plus d'une page. Pour identifier chaque page, par exemple à des fins de références, il est nécessaire d'appliquer un identificateur de page en plus de l'identificateur de document. Une seule page d'un document est identifiée par une combinaison donnée de l'identificateur de document et de l'identificateur de page. Voir la Figure 5.

NOTE 1 Le numéro de comptage de page tel qu'il est décrit dans l'IEC 61355-1, peut être utilisé comme un identificateur de page lié à un code de désignation de document.

Si une page d'un document est associée à plus d'un identificateur de document, la page doit se voir attribuer différents identificateurs de page pour les différents identificateurs de document. Voir la Figure 6.

NOTE 2 L'identificateur de page lié à différents identificateurs de document peut être le même.

L'identificateur de page doit être présenté de manière adjacente à l'identificateur de document auquel il est associé (exemple, voir l'Article B.2).

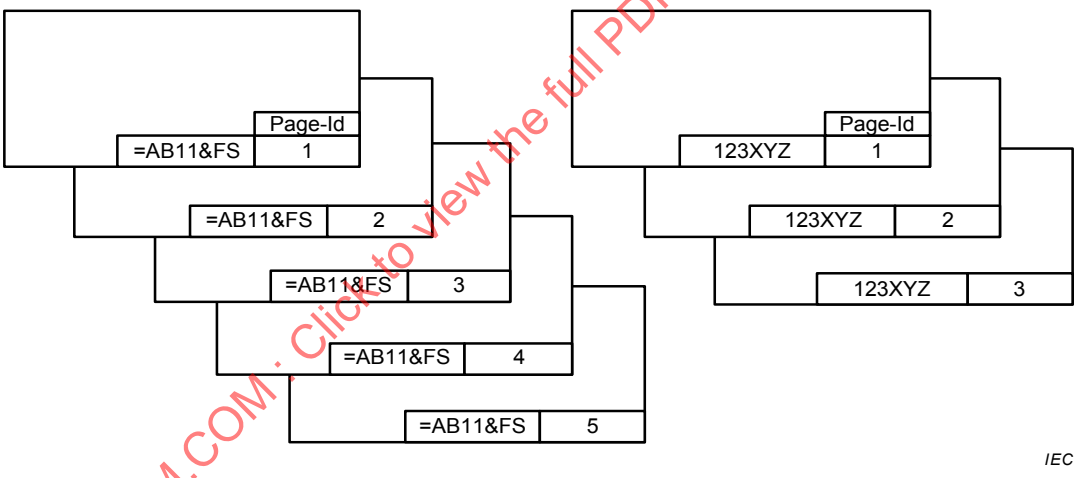
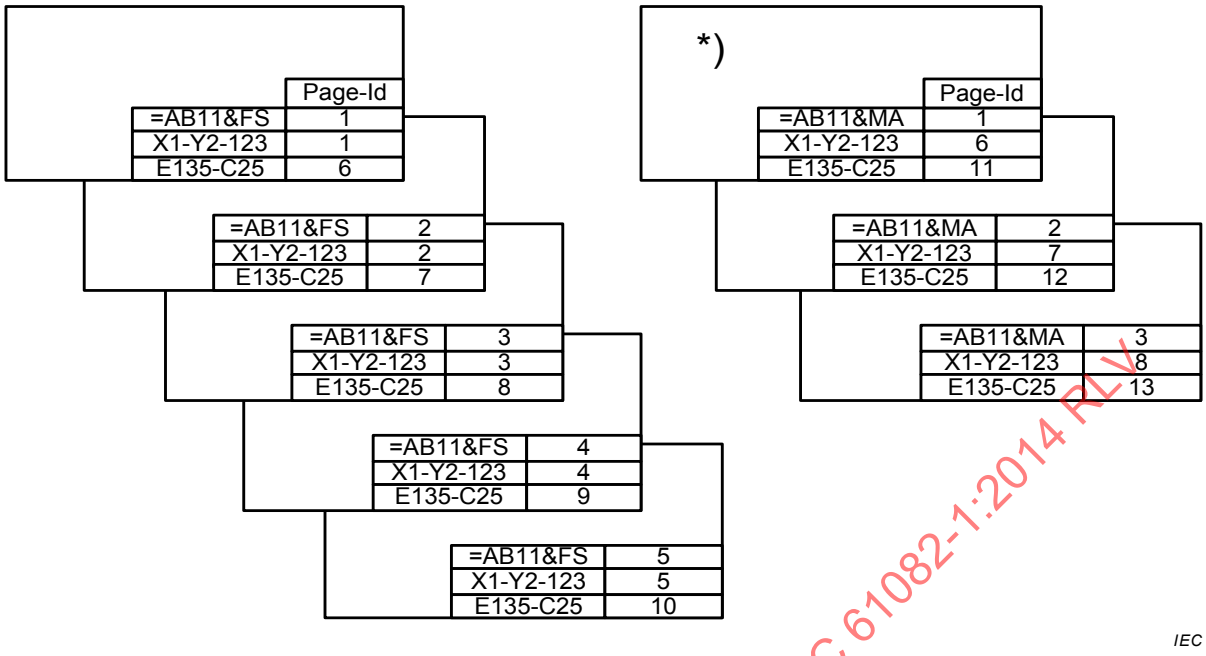


Figure 5 – Exemples de documents avec identifications de document et de page



Explication pour la page marquée par un *)

Désignation de document (IEC 61355)	=AB11&MA page 1
Numéro de document du fournisseur	X1-Y2-123 page 6
Numéro de document du client	E135-C25 page 11

Figure 6 – Exemple de documents avec des identificateurs de documents multiples

5.7 Disposition des pages

5.7.1 Généralités

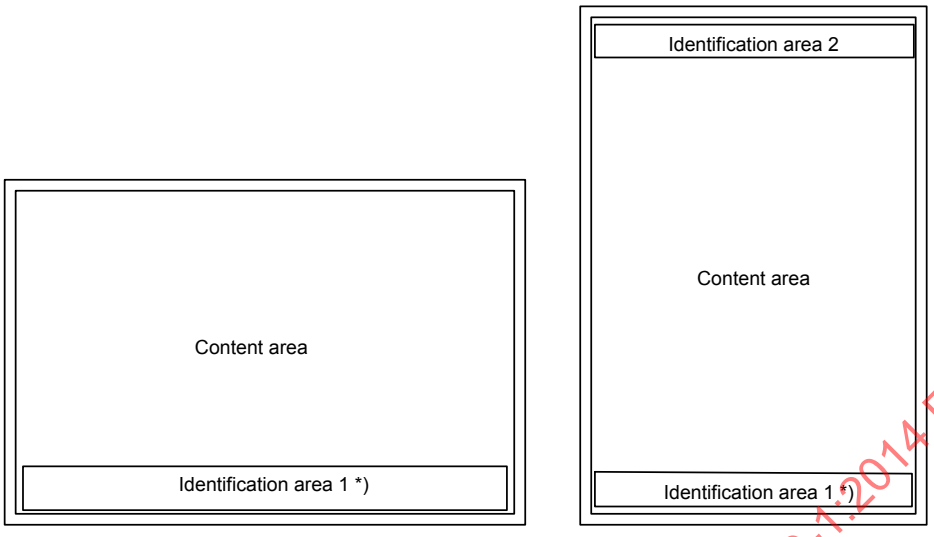
Les pages peuvent présenter une orientation paysage ou portrait.

Une page est divisée en:

- une ou plusieurs zones d'identification (voir 5.7.2); et
- une zone de contenu (voir 5.7.3).

Chaque page d'un document doit avoir au moins une zone d'identification clairement séparée de la zone de contenu, par exemple par un cadre.

La Figure 7 donne des exemples de pages avec une ou plusieurs zones d'identification.



Légende

a) une page en orientation paysage avec une zone d'identification

b) une page en orientation portrait avec deux zones d'identification

Anglais	Français
Identification area 2	Zone d'identification 2
Content area	Zone de contenu
Identification area 1*)	Zone d'identification 1
*) Mandatory for pages using the drawing form of presentation	*) Obligatoire pour les pages utilisant la forme de dessin de présentation

Figure 7 – Exemples de pages avec des zones d'identification définies

5.7.2 Zone d'identification

5.7.2.1 Généralités

Il convient que les informations à présenter dans la zone d'identification contiennent des métadonnées de document pertinentes pour le lecteur. Il convient que les métadonnées soient conformes à l'IEC 82045-2.

L'Article B.1 donne un extrait de la liste des métadonnées de l'IEC 82045-2 qu'il convient d'envisager d'inclure.

5.7.2.2 Zone d'identification pour les documents utilisant la forme de dessin comme forme de présentation

Une zone d'identification doit être située au bas de la page. Les zones d'identification complémentaires peuvent être situées le long des autres bords de page, voir la Figure 7.

À l'intérieur de la zone d'identification située au bas de la page, les informations liées à l'identification et à la classification du document, par exemple un cartouche d'inscriptions conforme à l'ISO 7200, doivent être situées le plus à droite de la zone d'identification. L'Article B.2 montre un exemple de disposition de cartouche d'inscriptions.

L'Article B.3 montre des exemples d'emplacement des zones d'identification pour les différents formats de page et leurs différentes orientations.

Il convient de tenir compte des techniques d'assemblage et d'éventuels trous de perforation lors du placement de la zone d'identification et des informations à l'intérieur d'une zone d'identification.

5.7.3 Zone de contenu

5.7.3.1 Généralités

Les informations sur l'objet considéré doivent apparaître à l'intérieur de la zone de contenu.

5.7.3.2 Module

L'unité M est utilisée comme module pour harmoniser la présentation graphique des objets, par exemple systèmes de coordonnées, systèmes de référence des emplacements, grilles de dessins et tailles des symboles.

Pour les présentations sur papier ou sur support équivalent, il convient que l'unité M prenne l'une des valeurs suivantes en millimètres:

1,8 (2,0) mm; 2,5 mm; 3,5 mm; 5 mm; 7 mm; 10 mm; 14 mm; 20 mm.

Il est recommandé de ne pas utiliser de taille de module inférieure à 2,5 mm. Si la taille de module de 1,8 mm (2,0) mm est utilisée, il convient de veiller à s'assurer de la lisibilité du document.

NOTE L'IEC 81714-2 spécifie que la taille minimale de module pour la création de symboles graphiques est de 2,0 mm au lieu de 1,8 mm.

Se reporter à l'IEC 81714-2 pour avoir plus de renseignements concernant les échelles et la modification de la taille du module.

5.7.3.3 Grille de dessin

Les zones de contenu et d'identification peuvent posséder une grille de dessin de 1M dans le but de positionner les symboles, les traits et le texte. Cette grille de dessin représente un moyen auxiliaire de préparation des documents et il convient qu'elle ne soit pas visible ou qu'au moins elle ne perturbe pas la lecture du contenu présenté dans la version du document destinée à être échangée entre les parties.

Pour la valeur de M, voir 5.7.3.2.

5.7.3.4 Système de coordonnées

Pour les besoins de référence, voir 5.8, il convient que les documents qui présentent des informations sous forme imagée ou de schéma sur support papier ou support équivalent aient un système de coordonnées conforme à l'ISO 5457 avec une taille de système de coordonnées de 10M, 16M ou 20M.

NOTE 1 Il n'est pas nécessaire que la division des lignes et des colonnes soit la même, par exemple les lignes peuvent être de 20M chacune et les colonnes de 16M.

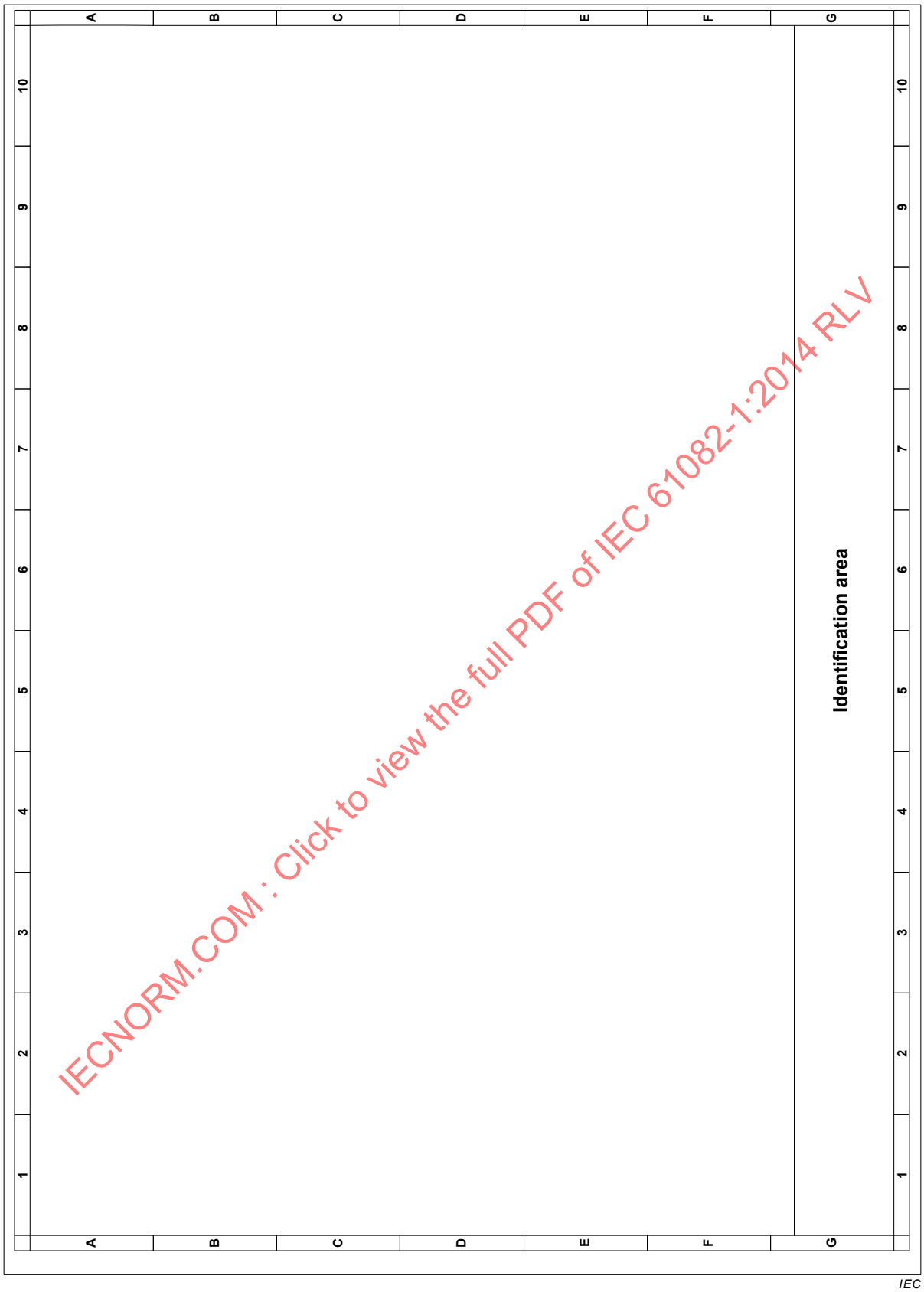
Pour la valeur de M, voir 5.7.3.2.

NOTE 2 Par exemple, si M est choisi avec une valeur de 2,5 mm, le système de coordonnées est de 40 mm ou 50 mm.

Il convient que la numérotation du système de coordonnées commence dans l'angle supérieur gauche de la zone de la page qui est disponible pour la zone de contenu. À des fins de numérotation du système de coordonnées, des lettres majuscules en alphabet latin A, B, C, ... à l'exception de I et O, ou bien une numérotation commençant par 0 ou 1 doivent être utilisées.

Il convient que les lignes du système de coordonnées soient identifiées par des lettres majuscules en alphabet latin et que les colonnes soient numérotées de manière séquentielle (voir la Figure 8), ou inversement.

La numérotation du système de coordonnées peut être omise sur un bord de la page, par exemple sur le plus petit bord, si la numérotation des autres bords suffit à des fins de références. Il peut aussi être suffisant que la numérotation du système de coordonnées apparaisse uniquement sur un côté/deux côtés et qu'elle n'apparaisse pas sur les côtés opposés.



Légende

Anglais	Français
Identification area	Zone d'identification

(Page A3 paysage, taille de module 2,5 mm, système de coordonnées 16M)

Figure 8 – Exemple d'un système de coordonnées

5.8 Correspondances

Une correspondance peut se référer à un document, à une page d'un document ou à une zone sur une page. Elle doit être présentée conformément à la séquence suivante:

- Document
- Page
- Colonne, ligne ou zone.

Le document est identifié selon 4.4. Si différents identificateurs de document sont présentés sur la page du document et que la confusion est probable, l'identificateur de document qui est utilisé pour les correspondances doit être clairement indiqué dans le document ou dans la documentation d'accompagnement.

Une page est identifiée selon 5.6 le tout précédé du caractère "BARRE OBLIQUE" (/).

Une zone est identifiée par le signe "POINT" (.) suivi des coordonnées construites selon 5.7.3.4.

Si la confusion est probable, la correspondance doit être placée entre crochets [...] ou entre parenthèses (...).

Exemples:

=EA2=S1&FS/3.B2	:	Référence à la zone B2 sur la page 3 d'un document de type FS (c'est-à-dire un schéma de circuits) décrivant l'objet =EA2=S1
ZAB&FS/3.B2	:	Référence à la zone B2 sur la page 3 d'un document de type FS (c'est-à-dire un schéma de circuits) décrivant le type d'objet ZAB.
XYZ123456/3.B2	:	Référence à la zone B2 sur la page 3 du document XYZ123456
XYZ123456/3	:	Référence à la page 3 du document XYZ123456
XYZ123456	:	Référence au document XYZ123456
[XYZ123456]	:	Référence au document XYZ123456 (si XYZ123456 est susceptible de faire l'objet d'une erreur d'interprétation)

Si la référence est dans le même document, la référence au document peut être omise.

Exemples:

&FS/3.B2	:	Référence à la zone B2 sur la page 3 d'un document de type FS (c'est-à-dire un schéma de circuits) décrivant le même objet
&FS	:	Référence à un ensemble de documents de type FS (c'est-à-dire un schéma de circuits) du même objet
/3.B2	:	Référence à la zone B2 sur la page 3 de la même présentation
/2	:	Référence à la page 2
[/2]	:	Référence à la page 2 (si seul /2 est susceptible de faire l'objet d'une erreur d'interprétation)

Si la référence est à la même page, la référence au document et à la page peut être omise. Dans ce cas, la ligne, la colonne ou l'identification de zone doit être précédée par le caractère "BARRE OBLIQUE" /.

Exemples:

/.B2 : Référence à la zone B2 sur la même page

/.2 : Référence à la colonne 2 sur la même page

La Figure 9 montre des exemples de l'application des correspondances.

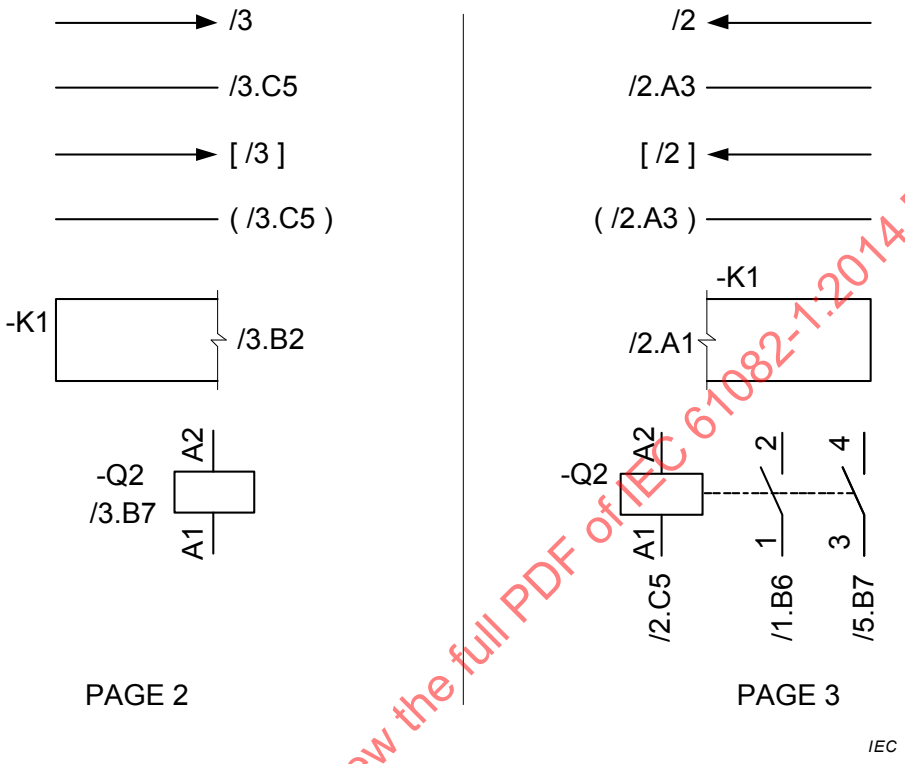


Figure 9 – Exemples de l'application des correspondances

5.9 Liens hypertextes

Les liens hypertextes peuvent être utilisés en tant que moyen facilitant la navigation entre différents ensembles d'informations, par exemple vers des emplacements dans des pages ou vers des pages d'un document, entre documents ou vers des sources d'informations extérieures.

La navigation ne doit pas, par elle-même, dépendre du fonctionnement des liens hypertextes.

Cela signifie qu'il est nécessaire que la navigation de base dans un document soit possible via par exemple des sommaires, des index, des références explicites à des pages ou sections.

Les liens hypertextes peuvent également être utilisés pour lier entre eux des documents ou des parties de document qui constituent un document. Toutefois, il convient de prendre les précautions nécessaires lorsque le document est soumis à un contrôle des versions, voir 4.5 de l'IEC 82045-1:2001.

5.10 Largeur des traits

Pour les dessins, les largeurs de trait possibles sont obtenues à partir de: $0{,}1\times\left(\sqrt{2}\right)^{n}\times M$, où n = 0, 1, 2, 3, ...

Pour la valeur de M, voir 5.7.3.2.

EXEMPLE Si M est choisi avec une valeur de 2,5 mm, la largeur du trait est de 0,25 mm, 0,35 mm, etc.

NOTE 1 Pour une présentation sur support papier ou support équivalent, les largeurs de traits possibles sont 0,18 mm (0,2 mm), 0,25 mm, 0,35 mm, 0,5 mm, 0,7 mm et 1,0 mm.

Si deux traits ou plus du même type mais de largeur différente sont utilisés, le rapport entre leurs largeurs doit être d'au moins 2:1.

NOTE 2 L'ISO 6428 donne les règles pour la micrographie des présentations qui peut avoir une influence sur le choix de la largeur des traits.

5.11 Polices de caractères

Pour les présentations utilisant la forme de dessin, il convient d'utiliser le type de lettres CB, vertical (V) de l'ISO 3098-5. On peut utiliser à la fois l'écriture de type fixe et l'écriture de type proportionnel conformes à l'ISO 3098-5. En outre, les règles suivantes s'appliquent dans ce cas:

- Il convient que le facteur d'espacement des caractères soit de zéro, voir E.2.7 de l'IEC 81714-2:2006. Lorsque l'écriture de type fixe est utilisée, il convient que le rapport d'aspect des caractères soit de 0,81 selon 6.7.2 de l'IEC 81714-2:2006.
- La hauteur du texte est obtenue à partir de: $(\sqrt{2})^n \cdot M$, où n = 0, 1, 2, 3, ... Pour la valeur de M, voir 5.7.3.2.

  EXEMPLE Si M est choisi avec une valeur de 2,5 mm, la hauteur du texte est de 2,5 mm, 3,5 mm, etc.

  NOTE Pour une présentation sur support papier ou support équivalent, les hauteurs de texte possibles sont 1,8 mm, 2,5 mm, 3,5 mm, 5,0 mm, 7,0 mm et 10,0 mm.
- Une écriture inclinée (également appelée *Italique*), type CB (S) de l'ISO 3098-5, peut être utilisée pour les symboles littéraux des grandeurs, voir la Figure 62 et les Figures A.7, A.8, A.9.
- Si une police de caractères n'appartenant pas aux types d'écriture donnés dans l'ISO 3098-5 est utilisée, celle-ci doit être à échelle modifiable et distincte, similaire au type de trait présenté dans l'ISO 3098-5.
- Pour les documents destinés à être échangés entre systèmes xAO, les règles de l'IEC 81714-2 doivent être prises en compte.

5.12 Symboles

5.12.1 Choix des symboles

Les symboles doivent être conformes aux normes IEC, ISO ou ISO/IEC applicables, par exemple:

- l'IEC 60617 pour les objets électriques dans les schémas et les dessins d'installation,
- l'ISO 14617 pour les objets non électriques dans les schémas,
- l'ISO 5807 pour les organigrammes de base,

en tenant compte aussi de l'ISO 81714-1.

Les symboles qui décrivent des fonctions peuvent être utilisés indépendamment de la technologie concernée, par exemple les fibres optiques peuvent utiliser les symboles de l'IEC 60617. Voir la Figure 10.

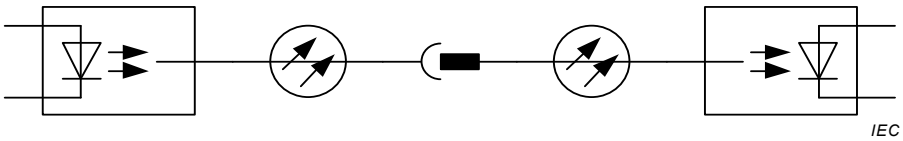


Figure 10 – Exemple de l'utilisation de symboles pour les fibres optiques

Les symboles à utiliser dans les applications xAO doivent de plus être conformes à l'IEC 81714-2.

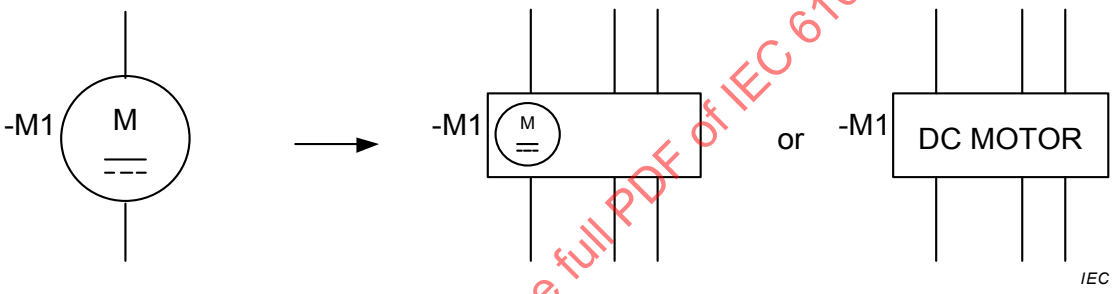
Lorsque des symboles ont plusieurs formes, ce sont celles qui sont adaptées à l'information présentée qui doivent être choisies.

En l'absence de symbole approprié, ce sont les symboles généraux S00059, S00060 ou S00061 de l'IEC 60617 qui doivent être appliqués ou bien un symbole peut être élaboré en suivant les règles de l'IEC 60617 et de l'ISO 81714-1, se reporter également à l'Annexe A normative.

Un symbole peut être remplacé par un des symboles généraux S00059, S00060 ou S00061 de l'IEC 60617 avec:

- le symbole considéré inscrit comme symbole qualifiant dans le symbole général; ou
- un texte descriptif inscrit dans le symbole général.

Voir également 5.12.2 et la Figure 11.



Légende

Anglais	Français
DC MOTOR	MOTEUR COURANT CONTINU

Figure 11 – Exemple de remplacement d'un symbole par un symbole général

5.12.2 Taille du symbole

La signification d'un symbole est indiquée au lecteur par sa forme et son graphisme intérieur. La taille et l'épaisseur des traits n'affectent pas la signification.

Les symboles de l'IEC 60617 sont représentés sur une grille avec un module M pour spécifier les proportions des symboles. Il convient que les symboles utilisés dans la documentation gardent de préférence la même taille liée au module M.

Un symbole peut être agrandi, réduit ou remplacé par un des symboles généraux S00059, S00060 ou S00061 de l'IEC 60617 avec symbole qualifiant afin:

- d'augmenter le nombre d'entrées ou de sorties;
- de faciliter l'inclusion d'informations complémentaires;
- de faire ressortir certains aspects;
- de faciliter l'utilisation d'un symbole en tant que symbole qualifiant ou
- de s'adapter à l'échelle d'un dessin, d'un plan ou d'une carte.

Lorsqu'il est agrandi ou réduit, la forme générale du symbole doit être maintenue, voir également la Figure 12.

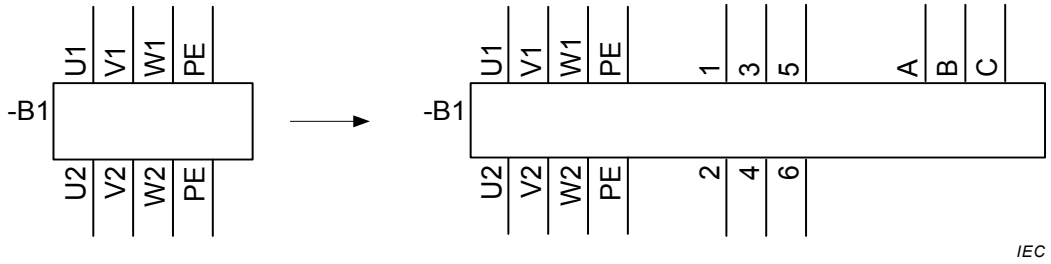
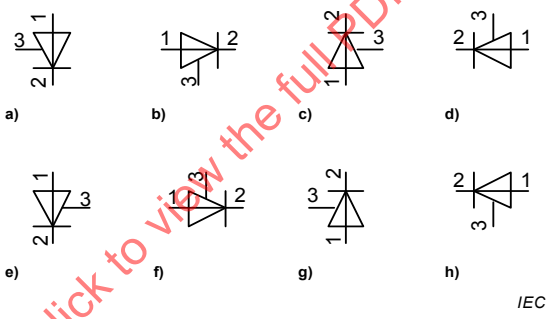


Figure 12 – Exemple d'agrandissement d'un symbole

5.12.3 Orientation des symboles

Il convient de montrer que les symboles supportent le sens de flux principal choisi dans le schéma. Lorsque l'orientation d'un symbole à placer dans un schéma n'est pas celle qu'il a dans les normes de symboles, le symbole pris dans la norme de symboles peut être transposé par rotation ou symétrie si cela ne modifie pas sa signification, voir la Figure 13. Dans certains cas, il peut être nécessaire de recréer le symbole en suivant les règles de l'ISO 81714-1.

Les lettres, les graphiques ou les marquages d'entrée/sortie des symboles doivent être orientés individuellement, séparés de l'orientation du symbole, de sorte que la direction finale de lecture parte du bord inférieur ou du bord droit de la page, voir la Figure 13.



Le symbole en a) est tel qu'il est représenté dans l'IEC 60617. Les positions b), c) et d) sont obtenues en appliquant au symbole plusieurs rotations successives de 90° dans le sens contraire des aiguilles d'une montre. Les positions e), f), g) et h) sont obtenues en transposant par symétrie les symboles des positions a), b), c) et d) selon l'axe horizontal.

Figure 13 – Rotation et/ou transposition par symétrie du symbole S00055 de l'IEC 60617

5.13 Échelles

Pour les informations présentées à l'échelle, il convient que l'échelle soit choisie conformément à l'ISO 5455.

Une échelle graphique peut être incluse à des fins d'information et doit ensuite figurer dans la zone de contenu.

5.14 Présentation imagée

Les informations sous des formes imagées en deux dimensions doivent être présentées conformément à l'ISO 128-30 en suivant la méthode de projection orthographique conforme à l'ISO 5456-2.

Pour les informations sur des bâtiments utilisant des formes à deux dimensions, les règles de l'ISO 2594 s'appliquent.

5.15 Grandeurs, unités, valeurs et codes de couleur

Il convient que les grandeurs, les unités et les valeurs soient représentées par des symboles littéraux conformes à l'IEC 60027, à l'IEC 80000 ou à d'autres normes IEC appropriées aux symboles littéraux. Pour les éléments non couverts par les normes IEC, il convient de se reporter à l'ISO 80000. Des exemples d'application de symboles littéraux sont donnés dans les Articles A.3 et A.4.

Les codes de désignation des couleurs doivent être conformes à l'IEC 60757.

5.16 Présentation de gammes et d'un ensemble d'éléments

Une gamme représentant un nombre infini de valeurs doit être présentée en utilisant le caractère "ELLIPSE HORIZONTALE" … (trois points) entre les limites inférieure et supérieure.

NOTE 1 Les parenthèses représentées ci-après ne font pas partie de la séquence de caractères.

EXEMPLE 1 La gamme 1 à 5 ampères peut être écrite: 1 A … 5 A.

Un ensemble d'éléments, c'est-à-dire un nombre entier d'éléments, doit être présenté en utilisant:

- le caractère "VIRGULE" et "ESPACE" (,) entre chaque élément de l'ensemble; ou
- les caractères "VIRGULE", "ESPACE", "ELLIPSE HORIZONTALE", "VIRGULE" et "ESPACE" (, …,) entre les limites inférieure et supérieure lorsque l'ensemble est constitué de nombres et que l'incrément est de un; ou
- les caractères "VIRGULE", "ESPACE", "ELLIPSE HORIZONTALE", "VIRGULE" et "ESPACE" (, …,) entre les limites inférieure et supérieure lorsque l'ensemble est constitué de lettres de l'alphabet latin dans l'ordre croissant;
- les caractères "VIRGULE", "ESPACE" et "ELLIPSE HORIZONTALE" (, …) après la limite inférieure lorsque la limite supérieure n'est pas définie et que l'incrément est un;
- les caractères "ELLIPSE HORIZONTALE", "VIRGULE" et "ESPACE" (…,) avant la limite supérieure lorsque la limite inférieure n'est pas définie et que l'incrément est un.

EXEMPLE 2:

- L'ensemble numérique des éléments 1, 2, 3, 4, 5 et 6 peut être écrit 1, …, 6.
- L'ensemble numérique des éléments non limités commençant à partir de 25 peut être écrit 25, …
- L'ensemble numérique des éléments non limités finissant à 25 peut être écrit …, 25
- L'ensemble alphabétique d'éléments C, D, E, F et G peut être écrit C, …, G
- L'ensemble alphabétique d'éléments a, b, c, d et e peut être écrit a, …, e

Des combinaisons de lettres majuscules et minuscules, par exemple A, …, c ne doivent pas être utilisées dans un ensemble d'éléments, en raison des risques d'interprétation ambiguë.

NOTE 2 Les lettres majuscules I et O ne sont pas utilisées ni dans les désignations de référence conformément à l'IEC 81346-1 ni dans les désignations des bornes conformément à l'IEC 60445 et à l'IEC 61666. Ceci implique que dans de tels cas, la lettre majuscule J suit la lettre majuscule H et que la lettre majuscule P suit la lettre majuscule N.

Si les préfixes ou suffixes d'un ensemble d'éléments numériques utilisent la même lettre, les éléments peuvent être présentés comme pour un ensemble numérique d'éléments.

EXEMPLE 3

- L'ensemble d'éléments 1U, 2U, 3U, 4U peut être écrit 1U, …, 4U
- L'ensemble d'éléments R2, R3, R4, R5 peut être écrit R2, …, R5

Si les préfixes ou suffixes d'un ensemble d'éléments alphabétiques utilisent le même chiffre, les éléments peuvent être présentés comme pour un ensemble alphabétique d'éléments.

EXEMPLE 4

- L'ensemble d'éléments 1U, 1V, 1W, 1X, 1Y, 1Z peut être écrit 1U, …, 1Z
- L'ensemble d'éléments R2, S2, T2, U2, V2 peut être écrit R2, …, V2

Les éléments qui ne suivent pas un ordre consécutif peuvent être représentés au sein d'une séquence. Dans ce cas, la représentation des différents éléments doit être séparée en utilisant le caractère "VIRGULE" (,) par exemple 1, 3, 6. S'il est vraisemblable qu'il y ait confusion, le groupe doit être placé entre parenthèses, par exemple (1, 3, 6).

Un groupe d'éléments peut également être représenté comme un ensemble d'éléments.

EXEMPLE 5 L'ensemble d'éléments 1, 8, 9, 10, 11, 12, 14, A, B, C et D peut être écrit 1, 8, …, 12, 14, A, …, D.

Si des systèmes informatiques sont utilisés pour présenter les informations, l'ellipse horizontale doit être réalisée comme:

- une séquence de trois caractères "POINT" .; ou
- un seul caractère "ELLIPSE HORIZONTALE" … comme spécifié dans l'IEC 61286.

NOTE 3 Les règles de 5.16 sont tirées de l'ISO 31-11.

5.17 Lignes de cote

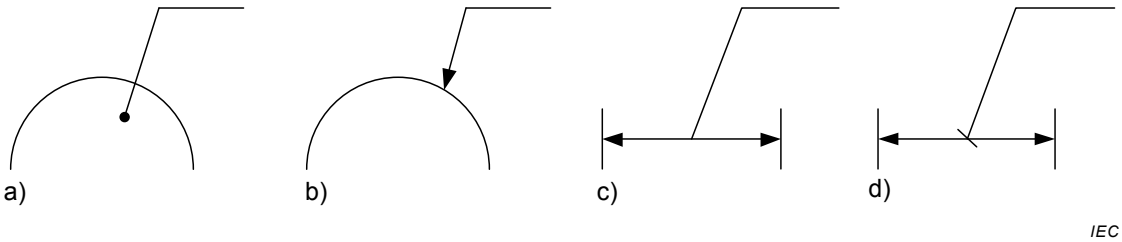
Les lignes de cote ainsi que leurs extrémités et l'indication de leur origine doivent être conformes à l'ISO 129. Des exemples d'extrémités sont donnés à la Figure 14. Le choix des flèches à la Figure 14 a) à d) n'a pas une signification importante et il convient d'en utiliser un seul type dans un même document.

a) Flèche, fermée et remplie angle de 30°
b) Flèche, fermée angle de 30°
c) Flèche, ouverte angle de 30°
d) Flèche, ouverte angle de 90°
e) Barre oblique

Figure 14 – Extrémités des lignes de cote (tiré de l'ISO 129)

5.18 Lignes de repère et lignes de référence

Les lignes de repère et les lignes de référence doivent être présentées conformément à l'ISO 128-22. Des exemples sont donnés à la Figure 15.



a) Ligne de repère se terminant à l'intérieur d'un objet
b) Ligne de repère se terminant sur un objet
c) Ligne de repère se terminant sur une ligne
d) Ligne de repère avec un trait se terminant sur une ligne

Figure 15 – Exemples de lignes de repère (tiré de l'ISO 128-22)

Les lignes de repère se terminant sur une ligne de connexion doivent se terminer par un trait oblique sur la ligne de connexion, voir la Figure 16.

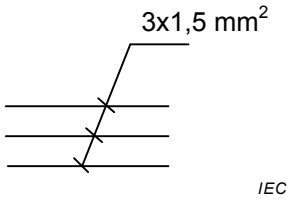
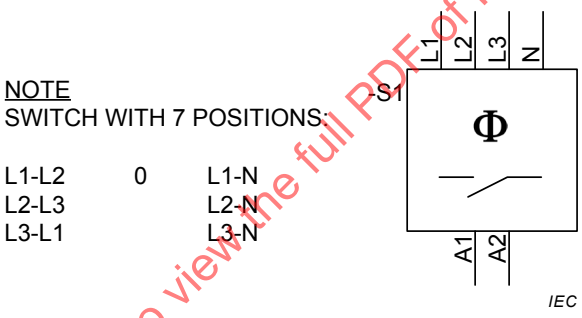


Figure 16 – Exemple d'utilisation de lignes de repère se terminant sur des lignes de connexion

5.19 Notes et inscriptions explicatives

Il convient qu'une note explicative soit utilisée lorsqu'un sens ne peut pas être rendu autrement. Il convient que cette note soit placée à proximité de l'endroit où elle s'applique sinon il convient de faire référence à une note lorsque celle-ci est placée ailleurs dans la zone de contenu, voir la Figure 17. Dans le cas d'une présentation d'informations sur plusieurs pages, il convient que toutes les notes à caractère général apparaissent sur la(les) première(s) page(s).



Légende

Anglais	Français
Switch with 7 positions	Interrupteur à 7 positions

Figure 17 – Exemple de note explicative

Si les marquages informatifs (par exemple les symboles graphiques conformes à l'IEC 60417) pour les fonctions de commande homme-machine apparaissent sur un tableau d'équipement, il convient de faire figurer ces mêmes marquages à côté du symbole graphique correspondant dans la présentation correspondante de l'information dans la documentation. S'il est nécessaire de représenter la direction de référence du courant dans une branche, l'indication de la direction d'un flux magnétique, la polarité de référence de la tension et la correspondance entre les polarités de tension de circuits électriques couplés, les méthodes de présentation indiquées dans l'IEC 60375 doivent s'appliquer.

5.20 Désignation des objets

5.20.1 Généralités

Si les objets ont une désignation d'objet, elle doit être indiquée de façon cohérente pour chaque représentation de l'objet.

La désignation d'objet doit être lisible à partir du bord inférieur de la page. Dans les schémas, il convient que les désignations d'objet soient placées au-dessus ou à la gauche de la représentation de l'objet, voir l'IEC 81714-2 pour plus de détails. Dans d'autres sortes de

documents, la désignation d'objet doit être clairement liée à la représentation d'objet tout en se conformant à l'exigence de ne pas interférer avec d'autres éléments de présentation du document.

Une désignation d'objet doit être présentée sur une seule ligne (et non répartie sur plusieurs lignes).

5.20.2 Désignations de référence

Les désignations de référence conformes à l'IEC 81346-1 sont des désignations d'objet pour lesquelles les exigences de 5.20.1 s'appliquent.

Pour les objets ayant un ensemble de désignations de référence conformes à l'IEC 81346-1, les points suivants s'appliquent (voir la Figure 18):

- l'ensemble de désignations de référence peut être présenté sur une seule ligne ou sur des lignes successives;
- si les désignations de référence sont présentées sur des lignes successives, chaque désignation de référence doit commencer sur une nouvelle ligne;
- si plus d'une désignation de référence est présentée sur la même ligne et en l'absence de séparation claire par exemple comme dans un tableau, le caractère BARRE OBLIQUE (/) doit être utilisé comme séparateur entre les différentes désignations de référence;
- l'ordre de présentation des désignations de référence dans un ensemble n'a pas de signification importante;
- au moins une désignation de référence non ambiguë dans l'ensemble doit être présentée de façon cohérente pour chaque représentation de l'objet.

	Reference designations	Possible graphical presentations	
		All presented on the same line	Each presented on one line
Three reference designations in one reference designation set	=A1 -B2 +C3	=A1/-B2/+C3	=A1 -B2 +C3
One reference designation in one reference designation set	=D4-E5+F6	=D4-E5+F6	=D4-E5+F6
Two reference designations in one reference designation set	=G7-H8 +J9	=G7-H8/+J9	=G7-H8 +J9

IEC

Légende

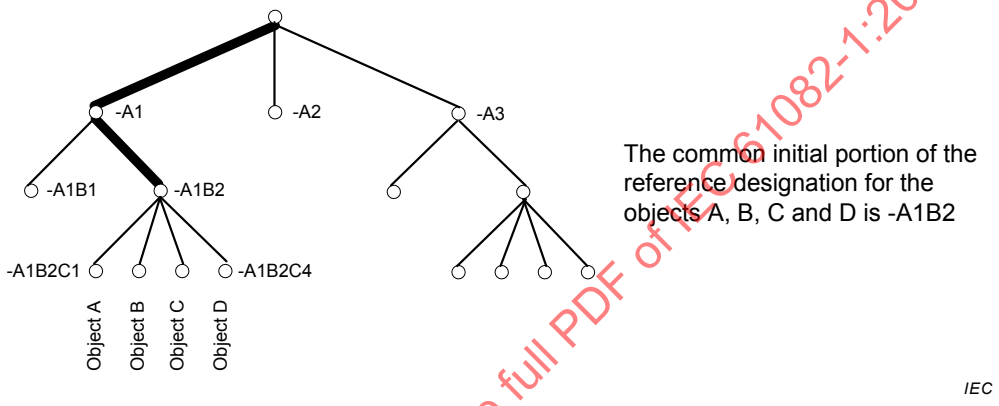
Anglais	Français
Reference designations	Désignations de référence
Possible graphical presentations	Présentations graphiques possibles
All presented on the same line	Toutes sur la même ligne
Each presented on one line	Chacune sur une ligne
Three reference designations in one reference designation set	Trois désignations de référence dans un ensemble de désignations de référence
One reference designation in one reference	Une désignation de référence dans un ensemble

Anglais	Français
designation set	de désignations de référence
Two reference designations in one reference designation set	Deux désignations de référence dans un ensemble de désignations de référence

Figure 18 – Présentation de désignations de référence et d'ensembles de désignations de référence

5.20.3 Présentation simplifiée

Conformément à l'IEC 81346-1, la désignation de référence est la représentation d'un trajet dans une structure arborescente. Différents objets peuvent ainsi avoir une portion initiale commune parce qu'ils sont des éléments constituants du même objet, y compris au moins une désignation de référence à niveau unique, de leurs trajets commençant au sommet de l'arbre, voir la Figure 19.



Légende

Anglais	Français
The common initial portion of the reference designation for the objects A, B, C and D is –A1B2	La portion initiale commune pour la désignation de référence des objets A, B, C et D est –A1B2
Object	Objet

Figure 19 – Portion initiale commune des désignations de référence

Si tous les objets représentés sur une page d'un document ont une désignation de référence avec une portion initiale commune, cette portion peut être présentée une fois à un emplacement défini, en fonction de la sorte de document, dans la zone de contenu d'une page de document et elle ne doit pas être représentée dans une des zones d'identification du document. (Voir aussi 7.1.6)

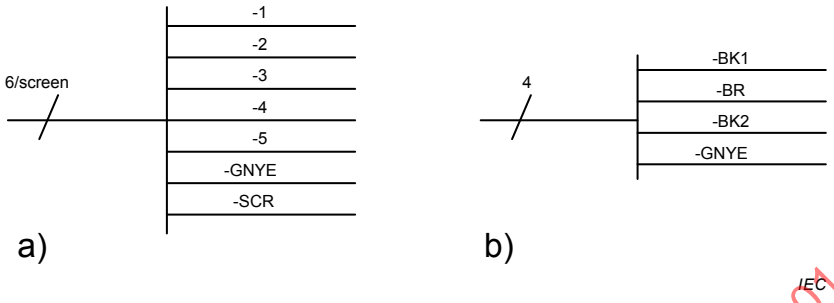
Dans une série de désignations de référence, un seul niveau de désignations de référence peut être présenté en appliquant les règles pour la présentation d'un ensemble d'éléments comme spécifié en 5.16, avec l'ensemble indiqué d'éléments entre parenthèses. La désignation de référence à niveau unique complète doit être présentée à la fois à la limite inférieure et à la limite supérieure de l'ensemble d'éléments.

Exemples:

- -A2C4F1, -A2C4F2, -A2C4F3 et -A2C4F4 étant présentés -A2C4(-F1, ...,-F4)
- =B2-C1, =B2-D3, =B2-F5 étant présentés =B2(-C1,-D3,-F5)
- =Q3=1=H1, =Q3=2=H1, =Q3=3=H1 et =Q3=4=H1 étant présentés =Q3(=1, …, =4)=H1

5.20.4 Désignations des conducteurs des câbles

Il convient que les conducteurs des câbles soient identifiés par leur désignation de référence, par exemple numéro de conducteur ou code de couleur de conducteur fourni par le constructeur du câble. Voir la Figure 20.



a) Câble avec des nombres imprimés sur les conducteurs, un conducteur marqué avec une couleur et un fil concentrique

b) Câble avec des conducteurs marqués avec des couleurs, deux conducteurs noirs

Légende

Anglais	Français
screen	écran

Figure 20 – Exemples de désignations de conducteurs des câbles

Si le constructeur du câble n'a pas fourni d'identificateur de conducteur, il convient d'appliquer une désignation de référence pour le conducteur.

NOTE Les câbles en eux-mêmes sont désignés selon 5.20.1 et 5.20.2.

5.21 Désignations des bornes

Les désignations des bornes doivent être appliquées conformément à l'IEC 61666.

5.22 Désignations des signaux

Les désignations des signaux doivent être appliquées conformément à l'IEC 61175.

6 Sortes de documents

La présente Norme internationale donne des règles pour la présentation de quatre sortes de documents de base différents utilisés en électrotechnique:

- les schémas, voir Article 7;
- les dessins, voir Article 8;
- les tableaux (listes), voir Article 9;
- les diagrammes et les graphiques, voir Article 10.

Pour chaque sorte de document de base, des règles plus spécifiques sont données pour les sortes de documents spécifiques dans la limite de ce qui est nécessaire pour leur présentation.

L'Annexe C donne une liste des sortes de documents spécifiques avec l'indication du contenu d'information minimal et complémentaire à fournir.

Pour d'autres sortes de documents spécifiques, il existe des publications IEC et ISO, par exemple:

- l'IEC 60848 pour les diagrammes fonctionnels en séquence;
- l'IEC 61131-3 pour les représentations graphiques des langages de programmation pour les automates programmables;
- l'IEC 62027 pour les nomenclatures de composants;
- l'IEC 82079-1 pour les instructions d'utilisation;
- l'IEC/TS 61804-1 et l'IEC/PAS 61804-2 pour la description des blocs de fonction;
- l'ISO 5807 pour les organigrammes pour le traitement de l'information;
- l'ISO 15519-1 pour les schémas de l'industrie de traitement (par exemple les schémas de procédés, les schémas de tuyauterie et d'instrumentation).

7 Schémas

7.1 Généralités

7.1.1 Flux d'énergie, signal, etc.

Si la direction d'un flux, par exemple d'un signal, est importante mais n'est pas évidente, le tracé de connexion correspondant doit être complété par des flèches (symbole S00099 de l'IEC 60617 (2001-07)). Voir la Figure 21.

NOTE L'utilisation d'un code de classification de signal conformément à l'IEC 61175 peut également donner des informations sur la direction du flux.

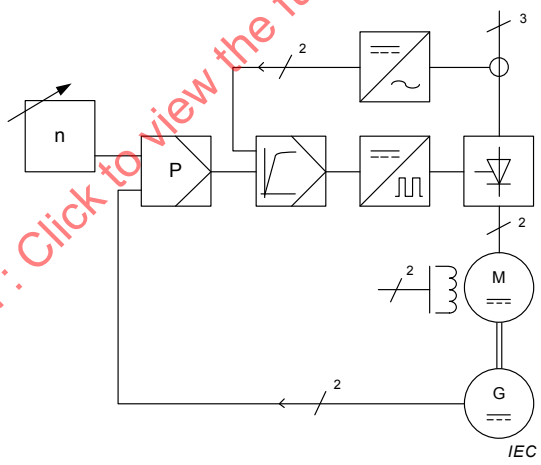


Figure 21 – Exemple de regroupement fonctionnel et de directions de flux de signaux; système de commande

Différents trajets de flux, par exemple pour les flux d'informations, de commande, d'énergie et de matériau, doivent être clairement distingués et reconnaissables.

7.1.2 Symboles

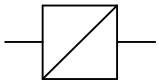
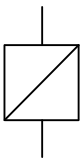
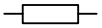
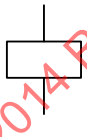
7.1.2.1 Choix des symboles

Les symboles doivent être conformes à l'IEC 60617. Pour les objets qui n'entrent pas dans le domaine d'application de l'IEC 60617, il convient de tenir compte des symboles de l'ISO 14617.

NOTE Lors du choix d'un symbole représentant un composant avec des parties mobiles, la règle indiquée en 7.4.4.1 s'applique.

7.1.2.2 Nœuds de connexions

Les symboles doivent être prévus avec le nombre approprié de nœuds de connexion. Les nœuds de connexion doivent être positionnés sur la grille 1M ou 0,5M (voir ISO 81714-1:2010, 6.11). Pour les symboles normalisés déjà associés à des nœuds de connexion et/ou des lignes terminales (par exemple comme dans l'IEC 60617), la position des nœuds de connexion et des lignes terminales peut être modifiée tant que la signification du symbole n'est pas modifiée. Voir la Figure 22.

Symboles pour lesquels différents emplacements de connexion n'affectent pas la signification		**Symboles pour lesquels l'emplacement des connexions peut affecter la signification (négligeant les proportions des symboles)**	
			
Symbole S00213 de l'IEC 60617 (2001-07), Convertisseur, symbole général		Symbole S00555 de l'IEC 60617 (2001-07), Résistance	Symbole S00305 de l'IEC 60617 (2001-07), Dispositif en fonctionnement

IEC

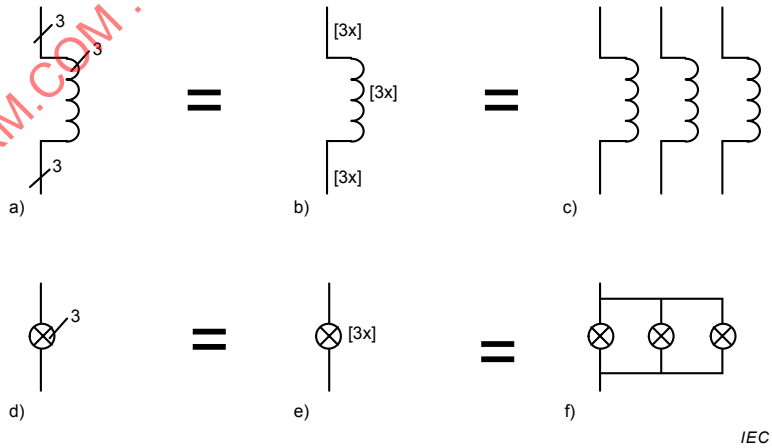
Figure 22 – Exemple de symboles et emplacement différent de connexions

7.1.2.3 Présentation simplifiée

7.1.2.3.1 Symboles identiques dans un groupe

Plusieurs symboles identiques dans un groupe peuvent être représentés par un symbole unique en utilisant une des méthodes suivantes:

- il convient que le symbole unique comporte une barre oblique courte et un chiffre indiquant le nombre d'éléments de symboles représentés par le symbole unique (voir la Figure 23a) et la Figure 23d)); ou
- il convient que le nombre de symboles représentés par le symbole unique soit indiqué par un chiffre suivi du signe de multiplication entre crochets, par exemple [3×] (voir la Figure 23b) et la Figure 23e)).



a) Trois circuits indépendants utilisant un trait oblique
b) Trois circuits indépendants utilisant le signe de multiplication
c) Trois circuits indépendants, présentation complète
d) Un circuit avec trois objets utilisant une barre oblique
e) Un circuit avec trois objets utilisant le signe de multiplication
f) Un circuit avec trois objets, présentation complète

Figure 23 – Présentation simplifiée

7.1.2.3.2 Objets connectés en parallèle

Si des objets identiques sont connectés en parallèle, ils peuvent être présentés sous une forme simplifiée en suivant les règles de 7.1.2.3, les désignations de référence présentées au niveau du symbole étant représentées en suivant les règles de présentation de l'ensemble d'éléments de 5.16, voir la Figure 24. Les désignations de borne doivent être présentées au niveau du symbole.

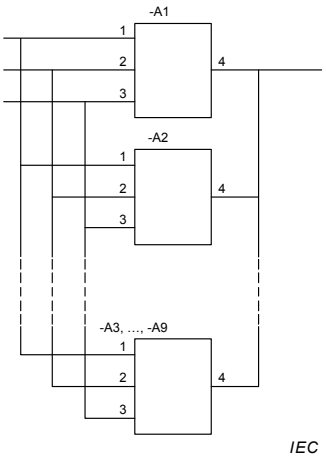


Figure 24 – Présentation simplifiée des objets identiques connectés en parallèle

7.1.2.3.3 Objets connectés en série

Si des objets identiques sont connectés en série et que les connexions internes entre les objets sont évidentes, on peut utiliser une présentation simplifiée en représentant le symbole pour le premier et le dernier symbole et avec une ligne de pointillés entre. Les désignations de référence des objets doivent être représentées en suivant les règles de présentation de l'ensemble d'éléments de 5.16, voir la Figure 25. Les désignations des bornes doivent être présentées au niveau des symboles représentés.

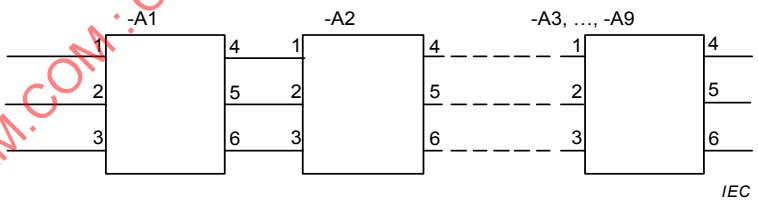


Figure 25 – Présentation simplifiée des objets identiques connectés en série

7.1.2.4 Présentation des correspondances liées aux présentations développées

Les correspondances associées à un symbole appliquant une représentation développée (voir 7.4.3.3) doivent être indiquées à proximité de ce symbole. Il convient qu'elles soient placées au-dessus du symbole et à droite de la désignation de référence lorsqu'il est représenté avec des lignes terminales principalement horizontales ou à sa gauche et sous la désignation de référence lorsqu'il est représenté avec des lignes terminales principalement verticales. Pour le détail des règles relatives aux symboles utilisés dans les systèmes xAO, voir l'IEC 81714-2.

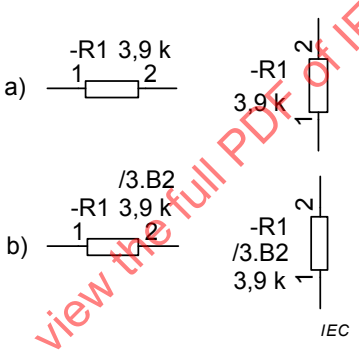
Une correspondance ne doit pas être présentée juste au-dessus ou à gauche des désignations de référence présentées. Voir la Figure 26.

Figure 26 – Exemple de correspondances liées aux présentations développées

7.1.2.5 Présentation des données techniques

Les données techniques associées à l'objet représenté par un symbole doivent être situées à proximité de celui-ci si elles sont présentées. Elles doivent être placées au-dessus du symbole lorsqu'il est représenté avec des lignes terminales principalement horizontales ou à sa gauche lorsqu'il est représenté avec des lignes terminales principalement verticales.

Les données techniques doivent être présentées en dessous ou à droite des désignations de référence présentées. Voir la Figure 27.



a) symbole avec données techniques

b) symbole avec correspondance et données techniques

Figure 27 – Exemple de données techniques associées à un symbole

Si cela n'entraîne pas une modification de la signification du symbole, les données techniques peuvent également être représentées à l'intérieur du contour du symbole. Voir la Figure 28.

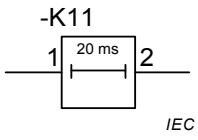


Figure 28 – Exemple de données techniques représentées à l'intérieur d'un symbole

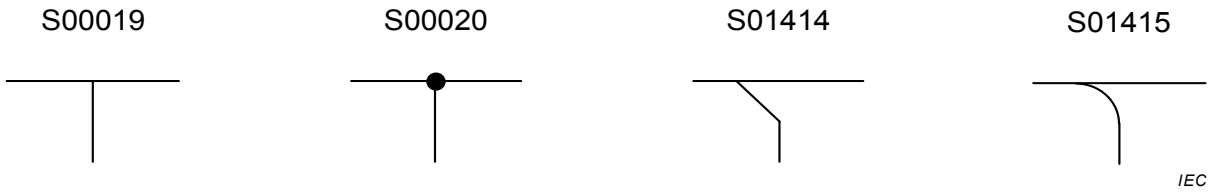
7.1.3 Tracés de connexion

7.1.3.1 Interconnexions électriques ou fonctionnelles

Les tracés de connexion doivent être conformes au symbole S00001 de l'IEC 60617 (2001-07).

NOTE Le symbole S00001 est un tracé continu.

Quand au moins deux tracés de connexion se rejoignent en un point spécifique, la jonction doit être conforme aux symboles S00019, S00020, S01414 ou S01415 de l'IEC 60617 (2001-07), voir la Figure 29.



Les symboles S00019 et S00020 fournissent des informations sur l'existence des interconnexions mais pas sur leur emplacement. Le symbole S01414 indique deux interconnexions physiques à relier à la même borne (non montrée) sur le côté gauche. Le symbole S01415 est utilisé pour l'assemblage graphique indiquant la direction du faisceau qui entre.

Figure 29 – Symboles représentant la jonction de tracés de connexion

L'interconnexion du croisement des tracés de connexion doit être représentée en utilisant le symbole S00022 de l'IEC 60617 (2001-07), voir la Figure 30.

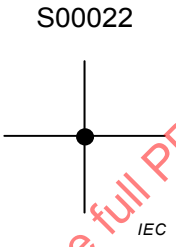
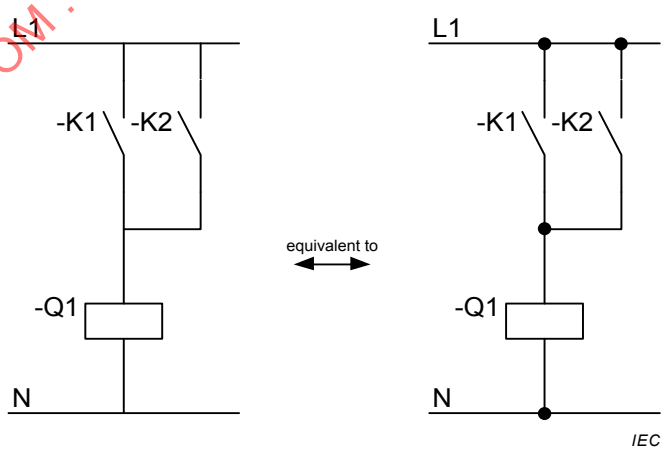


Figure 30 – Symbole représentant l'interconnexion du croisement des tracés de connexion

La Figure 31 représente un exemple où les symboles S00019 et S00020 de l'IEC 60617 (2001-07) sont appliqués.



Légende

Anglais	Français
Equivalent to	Equivalent à

Figure 31 – Exemples de jonction de tracés de connexion

La Figure 32 représente un exemple avec l'application du symbole S01414 de l'IEC 60617 (2001-07). Le circuit illustre la même fonction que dans la Figure 31, mais inclut une visualisation de la manière dont le câblage doit être réalisé.

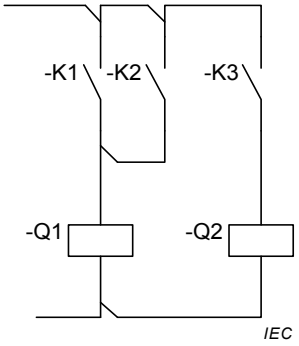


Figure 32 – Exemple de jonction de tracés de connexion avec indication de l'endroit où va le fil physique

La Figure 33 représente un exemple d'application du symbole S01415 de l'IEC 60617 (2001-07), illustrant la direction d'un faisceau lorsque deux faisceaux sont rassemblés dans un schéma.

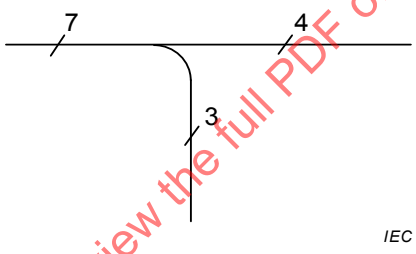


Figure 33 – Exemple de jonction de tracés de connexion à un endroit où les tracés de connexion représentent des faisceaux de fils

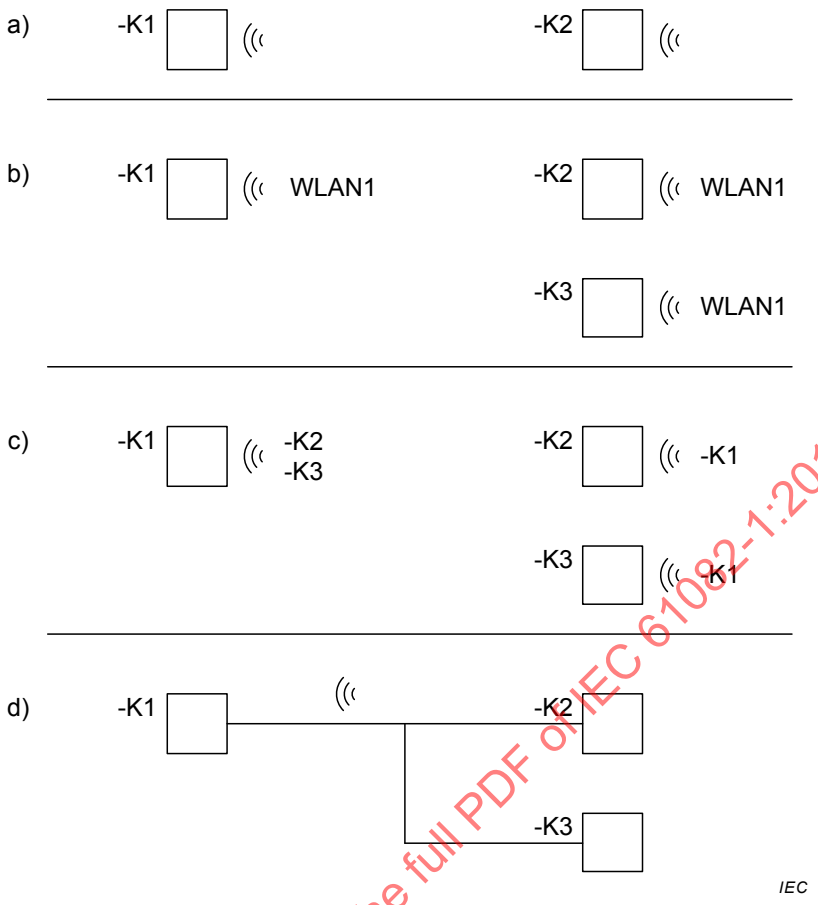
7.1.3.2 Interconnexions de fibres optiques

Les interconnexions de fibres optiques doivent être représentées conformément au symbole S01318 de l'IEC 60617 (2001-07), voir la Figure 10.

7.1.3.3 Interconnexions sans fil

Les interconnexions sans fil doivent être représentées conformément au symbole S01863 (voir la Figure 34) présentées de manière adjacente aux symboles représentant les objets interconnectés. La direction des ondes doit, indépendamment des informations réelles ou de la direction du flux d'ondes, être présentée comme dirigée vers l'objet. Toute correspondance avec les objets avec lesquels elle communique ou autres indications descriptives relatives au réseau sans fil doivent être présentées sur le petit côté du symbole S01318 de l'IEC 60617 (2001-07).

Si nécessaire, le symbole S00001 (tracé continu) représentant une connexion, ainsi que le symbole qualifiant S01863 de l'IEC 60617 (2001-07), peuvent être utilisés pour représenter explicitement les interconnexions sans fil.



Légende

a) Indique que les objets communiquent via des interfaces sans fil

b) Indique que les objets à interfaces sans fil communiquent via un réseau appelé WLAN1

c) La désignation de référence près du symbole de l'interface sans fil indique avec quels objets se fait la communication

d) Les connexions sans fil sont présentées explicitement en qualifiant le symbole d'une connexion (tracé continu) avec celui indiquant une connexion sans fil

Figure 34 – Différentes méthodes de présentation des interconnexions sans fil

Liaisons mécaniques

Les liaisons mécaniques doivent être représentées conformément aux symboles S00144 ou S00147 de l'IEC 60617 (2001-07), voir la Figure 35.

NOTE Le symbole S00144 est un trait interrompu. Le symbole S00147 est un double tracé continu.

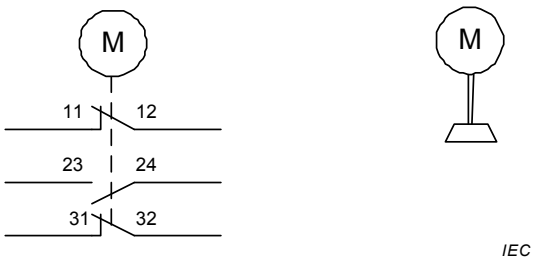


Figure 35 – Exemple de présentations de liaisons mécaniques

7.1.3.4 Disposition et orientation des tracés de connexion

Les tracés de connexion doivent être orientés horizontalement ou verticalement à l'exception des cas où les traits obliques améliorent la lisibilité.

Il convient que les tracés de connexion n'interfèrent pas avec d'autres symboles, voir 6.11.2 de l'IEC 81714-2:2006.

Il convient de réduire au minimum les coudes et les croisements de tracés. Les tracés peuvent être interrompus pour éviter les coudes et les croisements. Dans ce cas, et également lorsqu'un tracé est interrompu sur une page et continue sur une autre, les extrémités du tracé interrompu doivent être mutuellement référencées, voir 5.8. Il convient que les extrémités du tracé interrompu soient dessinées de manière à être facilement reconnaissables, voir la Figure 36.

NOTE Dans les schémas de circuits, les coudes et les croisements peuvent être évités en observant les principes de disposition de 7.4.2 et l'utilisation de la représentation développée selon 7.4.3.3.

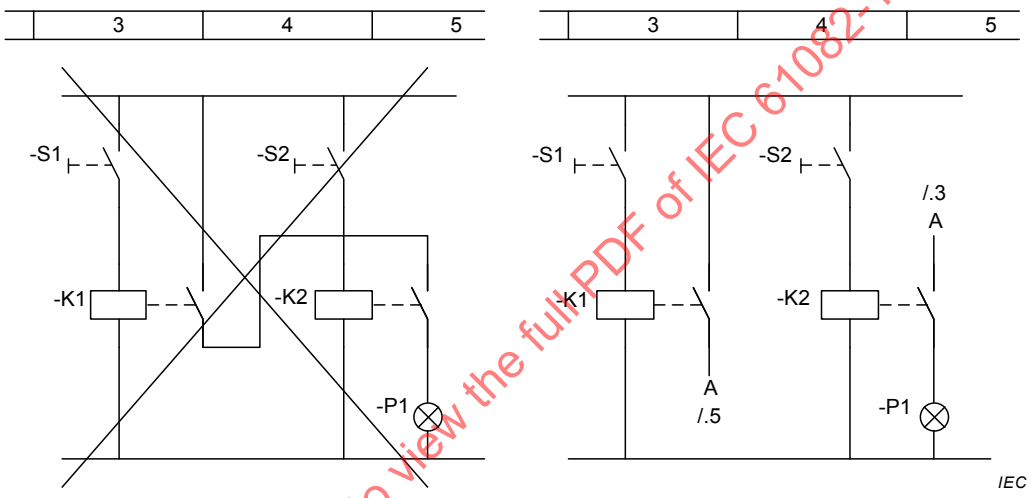


Figure 36 – Exemple pour éviter les coudes et les croisements

L'espacement entre deux tracés de connexion parallèles doit être d'au moins 1M.

La distance minimale entre des tracés de connexion parallèles lorsque du texte est à représenter entre eux, doit être égale au double de la hauteur d'écriture et ne doit pas être inférieure à 2M, voir la Figure 37.

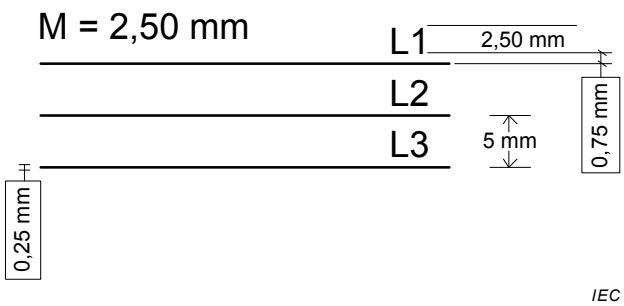


Figure 37 – Espacement des tracés

7.1.3.5 Données techniques liées aux tracés de connexion

Les données techniques associées aux tracés de connexion:

- doivent être clairement liées au tracé de connexion associé;
- ne doivent ni toucher ni couper le tracé de connexion;
- il convient qu'elles soient placées à proximité des tracés de connexion, au-dessus de ceux-ci lorsqu'ils sont horizontaux, à leur gauche lorsqu'ils sont verticaux.

S'il n'est pas possible de représenter les données techniques à proximité du tracé de connexion, elles doivent être représentées ailleurs dans la zone de contenu avec une ligne de repère ou une référence au tracé de connexion.

Les données techniques doivent être clairement séparées de toute désignation de référence ou désignation de signal ou désignation de borne présentée suivant le tracé de connexion. Voir la Figure 38.

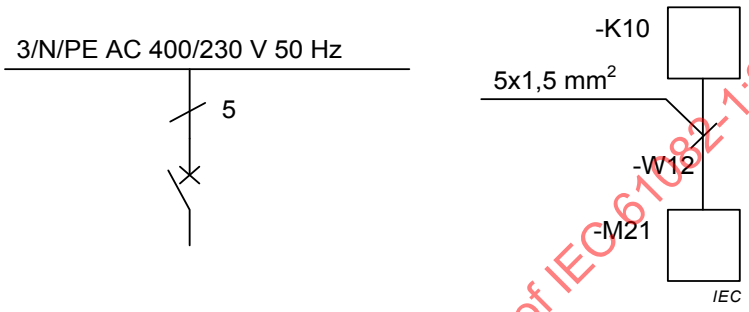


Figure 38 – Exemples de données techniques associées aux tracés de connexion

Les formes d'ondes peuvent être incluses et il convient qu'elles soient représentées de la manière dont elles apparaissent normalement sur l'écran d'un oscilloscope, avec les détails nécessaires pour l'application.

Les caractéristiques électriques assignées des circuits en courant alternatif et en courant continu doivent être présentées selon les exemples représentés dans l'IEC 61293, de préférence sous forme abrégée.

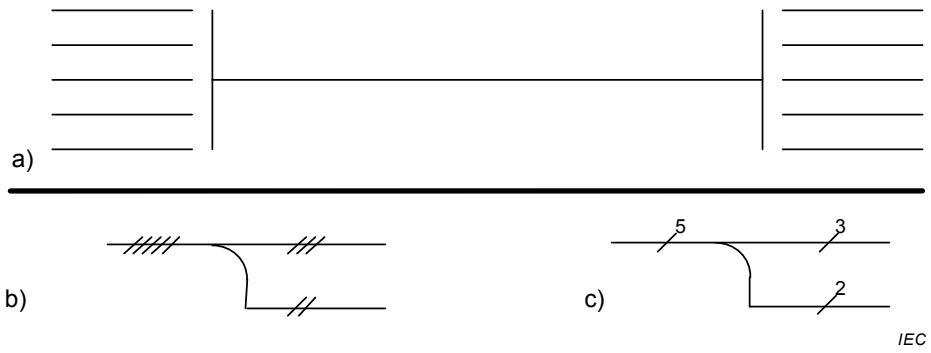
EXEMPLE

- DC 110 V: Tension continue 110 V
- 3 AC 400 V: Triphasé, trois fils 400 V
- 3/N/PE 400/230 V 50 Hz: Triphasé, cinq fils avec N et PE 400/230 V

7.1.3.6 Présentation simplifiée

Des tracés de connexion parallèles multiples peuvent être représentés par un tracé (c'est-à-dire un faisceau) en utilisant une des méthodes suivantes:

- les tracés parallèles sont interrompus et un tracé traversant après un espace court représente le faisceau (voir la Figure 39.a);
- le nombre de tracés de connexion parallèles représentés par le faisceau doit être indiqué soit en ajoutant autant de traits obliques qu'il y a de connexions (voir le symbole S00002 de l'IEC 60617 (2001-07) et la Figure 39.b) soit en ajoutant un trait suivi du chiffre indiquant le nombre de connexions (voir symbole S00003 de l'IEC 60617 (2001-07) et de la Figure 39.c).



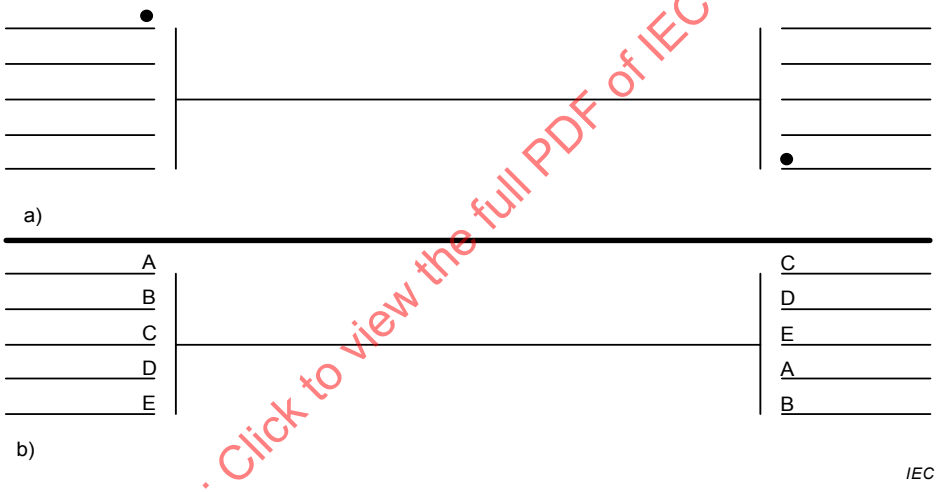
a) En utilisant un trait traversant et un espace

b) Indication par un nombre de traits

c) Indication par des nombres

Figure 39 – Présentation des faisceaux

Il convient que l'ordre séquentiel des tracés parallèles aux deux extrémités du faisceau soit indiqué de manière non ambigüe, voir la Figure 40.



a) En utilisant un point pour indiquer la première connexion

b) En indiquant les connexions individuelles

Figure 40 – Indication de séquence à l'intérieur de faisceaux

7.1.4 Représentation des circuits logiques binaires

7.1.4.1 Conventions logiques et indication de polarité logique

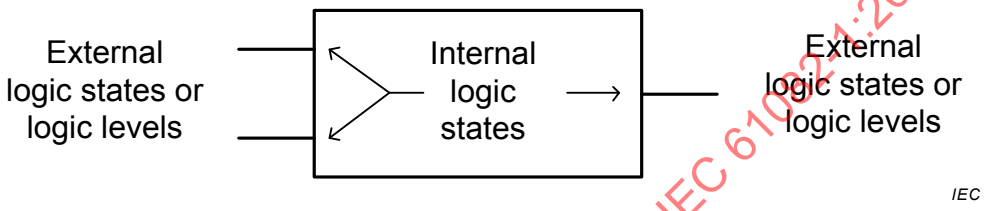
La relation entre les états logiques et les valeurs nominales (niveaux logiques) des grandeurs physiques utilisées pour représenter ces états doit être indiquée en utilisant une des méthodes suivantes dans un schéma:

- Convention de logique unique (notation relative);
- Convention directe de polarité logique (notation absolue).

La Figure 41 illustre les termes "états" et "niveaux", où:

- l'"état logique interne" décrit un état logique qui est considéré comme existant à l'intérieur du contour d'un symbole au niveau d'une entrée ou d'une sortie.
- l'"état logique externe" décrit un état logique qui est considéré comme existant à l'extérieur du contour d'un symbole:

  - sur un tracé de connexion d'entrée avant tout symbole qualifiant externe au niveau de l'entrée considérée; ou
  - sur un tracé de connexion de sortie au-delà de tout symbole qualifiant externe au niveau de la sortie considérée.
- le "niveau logique" décrit la grandeur physique qui est considérée comme représentant un état logique d'une variable binaire:
  - l'IEC 60617 utilise les symboles "0" et "1" pour identifier les deux états logiques d'une variable binaire. Ces états sont désignés état-0 et état-1.
  - une variable binaire peut être égalée avec toute grandeur physique pour laquelle deux gammes distinctes peuvent être définies. Dans la base de données de l'IEC 60617, ces gammes distinctes sont désignées comme des niveaux logiques et sont notées "H" et "L". "H" est utilisé pour noter le niveau logique avec la valeur algébrique la plus positive et "L" est utilisé pour noter le niveau logique avec le niveau algébrique le moins positif.



Légende

Anglais	Français
External logic states or logic levels	États logiques externes ou niveaux logiques
Internal logic states	États logiques internes

Figure 41 – Illustration des termes "états" et "niveaux"

7.1.4.2 Convention de logique unique

La convention de logique unique implique que la correspondance entre un état logique externe donné et le niveau logique est la même au niveau de toutes les entrées et de toutes les sorties dans le schéma ou dans une portion du schéma.

Le symbole de négation logique (symboles S01466 et S01467 de l'IEC 60617) doit être utilisé au niveau d'une borne d'entrée ou de sortie pour indiquer que les états internes et externes sont mutuellement complémentaires pour la borne considérée.

a) Convention de logique positive:

La valeur la plus positive de la grandeur physique (niveau H) correspond à l'état externe 1. La valeur la moins positive (niveau L) correspond à l'état externe 0. Si cela est nécessaire, la convention de logique positive peut être indiquée comme suit:

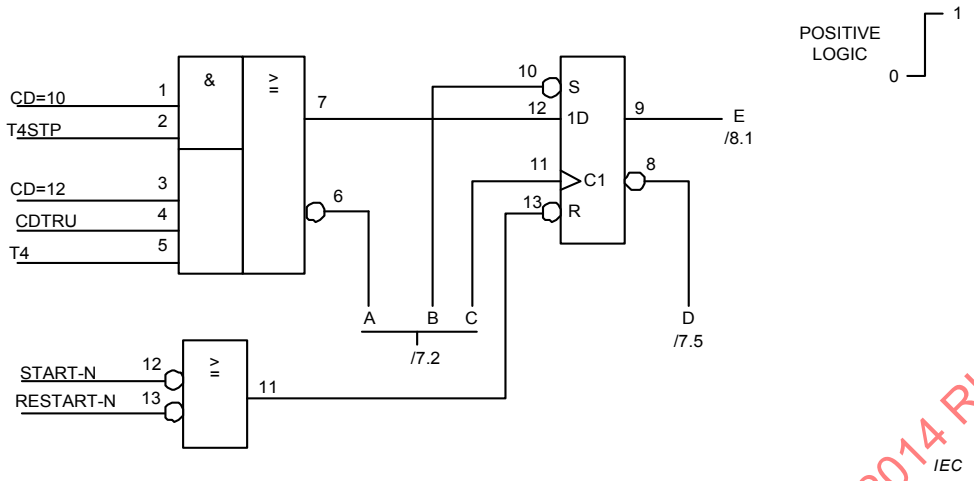
LOGIQUE POSITIVE 

b) Convention de logique négative:

La valeur la moins positive de la grandeur physique (niveau L) correspond à l'état externe 1. La valeur la plus positive (niveau H) correspond à l'état externe 0. L'utilisation de la convention de logique négative doit être indiquée dans le schéma ou dans la documentation d'accompagnement comme suit:

LOGIQUE NÉGATIVE 

La Figure 42 donne un exemple d'un schéma utilisant la convention de logique positive.



Légende

Anglais	Français
START	DEMARRAGE
RESTART	REDEMARRAGE
POSITIVE LOGIC	LOGIQUE POSITIVE

Figure 42 – Détail d'un schéma de circuit utilisant la convention de logique positive

7.1.4.3 Convention directe de polarité logique

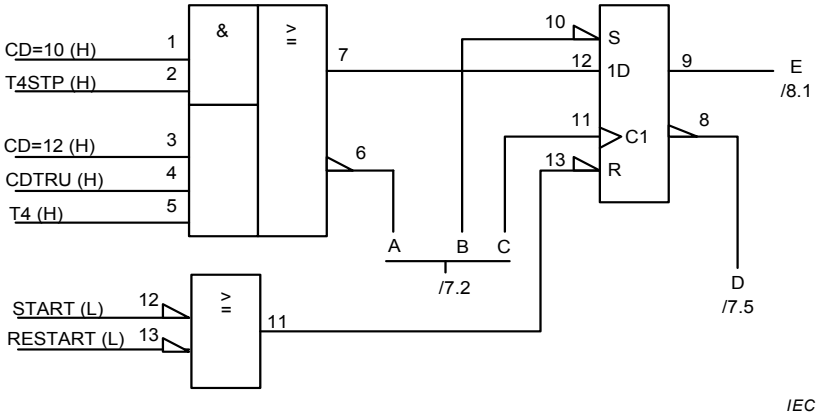
La convention directe de polarité logique implique que la relation entre l'état logique interne et le niveau logique (externe) de chaque entrée de chaque opérateur logique binaire doit être indiquée directement par la présence ou l'absence de symbole de polarité logique (symboles S01468 à S01471 de l'IEC 60617 (2001-07)).

Le symbole de polarité logique doit être utilisé au niveau d'une borne d'entrée ou de sortie pour indiquer que le niveau bas (externe) correspond à l'état interne 1 pour la borne considérée.

NOTE L'absence de symbole de polarité logique signifie que le niveau haut (externe) correspond à l'état interne 1 pour la borne considérée.

La relation entre le niveau logique (externe) et un état de signal doit être uniquement définie par la désignation de signal conformément à l'IEC 61175.

La Figure 43 donne un exemple d'un schéma utilisant la convention directe de polarité.



Légende

Anglais	Français
START	DEMARRAGE
RESTART	REDEMARRAGE

Figure 43 – Détail d'un schéma de circuit utilisant la convention directe de polarité logique

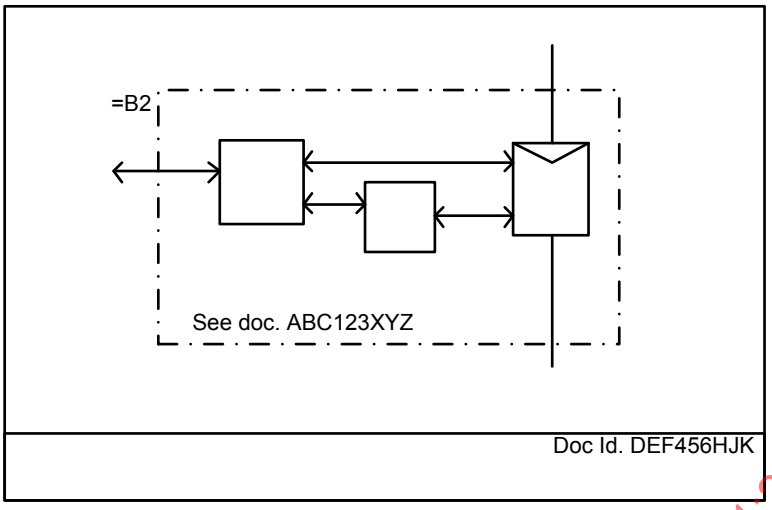
Pour les schémas établis avec la convention directe de polarité logique mais qui ne représentent pas de symboles de polarité logique, une mention indiquant que la convention directe de polarité logique est appliquée doit être placée dans le schéma ou dans la documentation d'accompagnement.

7.1.5 Encadrements de séparation

Un encadrement de séparation doit être constitué par des traits horizontaux et verticaux utilisant le symbole S00064 de l'IEC 60617 (2001-07).

NOTE Le symbole S00064 est un trait interrompu alternant point et tiret. L'encadrement de séparation qui en résulte n'est pas un symbole défini en lui-même.

Un encadrement de séparation doit représenter un objet. Les objets représentés à l'intérieur d'un encadrement de séparation doivent être des éléments constituants de cet objet et peuvent être représentés sous une forme simplifiée, sous réserve qu'il soit fait référence à un document plus détaillé, voir la Figure 44.



Légende

Anglais	Français
See doc.	Voir doc
Doc Id.	Id. de doc

Figure 44 – Encadrement de séparation avec référence à un autre document

L'encadrement de séparation doit être associé aux désignations de référence de l'objet qu'il représente.

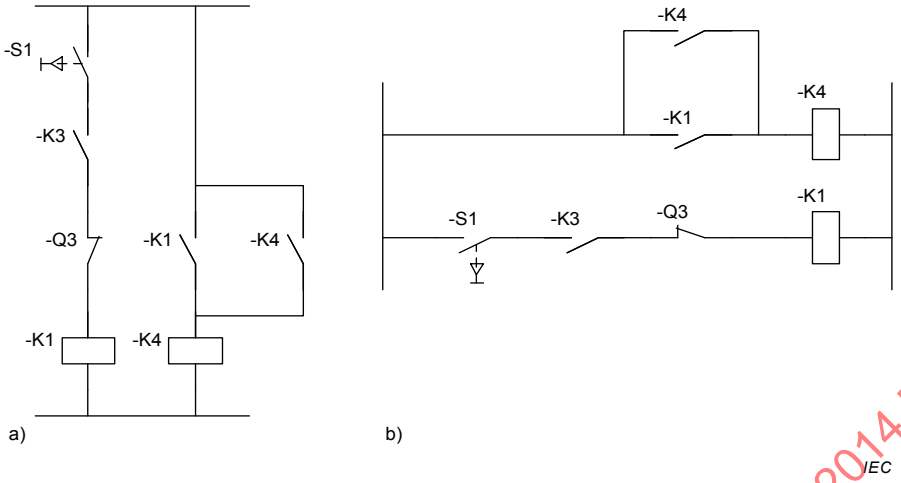
7.1.6 Présentation des désignations de référence

7.1.6.1 Symboles

Les désignations de référence associées à un symbole doivent être placées à gauche du symbole lorsqu'il est représenté avec des lignes terminales principalement verticales, voir la Figure 45a) ou au-dessus du symbole lorsqu'il est représenté avec des lignes terminales principalement horizontales, voir la Figure 45b).

NOTE Pour les symboles à utiliser dans des applications xAO, des règles plus précises pour le positionnement de différents champs textes conformément à l'IEC 81714-2 s'appliquent (voir aussi 5.12.1). Par exemple, les désignations de référence ou les ensembles de désignations de référence sont à placer à une distance définie au-dessus d'une ligne médiane horizontale imaginaire ou d'une ligne terminale horizontale (et aussi à une distance définie du contour du symbole) lorsqu'ils sont présentés avec des lignes terminales principalement verticales, comme indiqué à la Figure 45a). Pour les symboles avec des lignes terminales principalement horizontales, la position des désignations de référence est à la gauche d'une ligne médiane verticale imaginaire, comme indiqué à la Figure 45b).

D'autres règles s'appliquent aux désignations de référence associées à un symbole représentant une connexion et aux encadrements de séparation, voir 7.1.6.2 et 7.1.6.3.



a) avec des lignes terminales verticales

b) avec des lignes terminales horizontales

Figure 45 – Emplacement des désignations de référence au niveau d'un symbole

7.1.6.2 Tracés de connexion

Les désignations de référence associées aux tracés de connexion:

- doivent être clairement liées au tracé de connexion associé;
- ne doivent ni toucher ni couper le tracé de connexion;
- il convient qu'elles soient placées à proximité des tracés de connexion, au-dessus de ceux-ci lorsqu'ils sont horizontaux, à leur gauche lorsqu'ils sont verticaux, et qu'elles aient une direction suivant le tracé de connexion.

S'il n'est pas possible de représenter la désignation de référence à proximité du tracé de connexion, elle doit être représentée ailleurs dans la zone de contenu avec une ligne de repère ou une référence au tracé de connexion. Voir aussi la Figure 46.

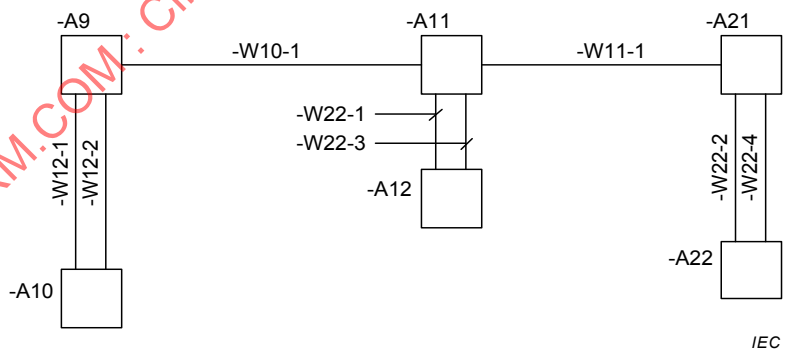


Figure 46 – Exemples de désignations de référence associées aux tracés de connexion

Les désignations de référence doivent être clairement séparées de toute désignation de signal ou de borne ou de toute donnée technique associée au tracé de connexion.

7.1.6.3 Encadrements de séparation

Comme indiqué en 7.1.5, chaque encadrement de séparation représente un objet qu'il est nécessaire d'identifier, par exemple par une désignation de référence.

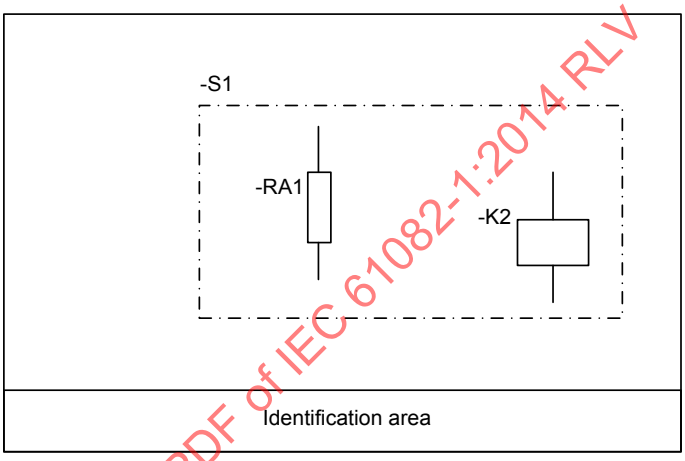
NOTE Un encadrement de séparation est un dessin et non un symbole conformément à l'IEC 60617 et à l'IEC 81714-2.

Les désignations de référence associées à un encadrement de séparation doivent être placées au-dessus et près du bord gauche de l'encadrement de séparation ou à gauche et près du bord supérieur de l'encadrement de séparation.

Pour les objets présentés à l'intérieur d'un encadrement de séparation, la portion initiale de leur désignation de référence correspondant à la désignation de référence de l'objet représenté par l'encadrement de séparation ne doit pas être représentée près des objets individuels, voir la Figure 47.

Object	Reference designations
Resistor	-S1RA1
Operating device	-S1K2
Boundary frame	-S1

a)



b)

IEC

a) Les désignations de référence des objets

b) Les désignations de référence comme indiquées dans un schéma

Explication: La désignation de référence d'un objet à l'intérieur d'un encadrement de séparation est trouvée en concaténant sa désignation de référence avec la désignation de référence présentée près de l'encadrement de séparation.

Légende

Anglais	Français
Object	Objet
Reference designations	Désignations de référence
Resistor	Résistance
Operating device	Dispositif en fonctionnement
Boundary frame	Encadrement de séparation
Identification area	Zone d'identification

Figure 47 – Présentation des désignations de référence près de l'encadrement de séparation

Si la dernière désignation de référence à niveau unique associée à l'encadrement de séparation est d'un aspect différent de la première désignation de référence à niveau unique de l'objet constituant, la désignation de référence associée à l'encadrement de séparation doit prendre comme suffixe le signe de préfixe de cette dernière, voir la Figure 48.