SLOVENSKI STANDARD
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GRAFCET specification language for sequential function charts (IEC 60848:2002)

GRAFCET specification language for sequential function charts

Entwurfssprache GRAFCET für Ablauf-Funktionspläne

Langage de spécification GRAFCET pour diagrammes fonctionnels en séquence

Ta slovenski standard je istoveten z: **EN 60848:2002**

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01.100.25	Risbe s področja elektrotehnike in elektronike	Electrical and electronics engineering drawings
35.060	Jeziki, ki se uporabljajo v informacijski tehniki in tehnologiji	Languages used in information technology

SIST EN 60848:2003 **en**

EUROPEAN STANDARD **EN 60848**

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English version

GRAFCET specification language for sequential function charts
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Langage de spécification GRAFCET
pour diagrammes fonctionnels en séquence
(CEI 60848:2002)

Entwurfssprache GRAFCET
für Ablauf-Funktionspläne
(IEC 60848:2002)

This European Standard was approved by CENELEC on 2002-04-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 60848:2002 E

Foreword

The text of document 3B/344/FDIS, future edition 2 of IEC 60848, prepared by SC 3B, Documentation, of IEC TC 3, Information structures, documentation and graphical symbols, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60848 on 2002-04-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2003-01-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2005-04-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annexes A, B and C are informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60848:2002 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 61131-3	NOTE	Harmonized as EN 61131-3:1993 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60050-351	1998	International Electrotechnical Vocabulary Part 351: Automatic control	-	-
IEC 60617-12	1997	Graphical symbols for diagrams Part 12: Binary logic elements	EN 60617-12	1998

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Langage de spécification GRAFCET pour diagrammes fonctionnels en séquence

GRAFCET specification language for sequential function charts

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

GRAFCET SPECIFICATION LANGUAGE FOR SEQUENTIAL FUNCTION CHARTS

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and can not be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60848 has been prepared by subcommittee 3B: Documentation, of IEC technical committee 3: Information structures, documentation and graphical symbols.

This second edition cancels and replaces the first edition published in 1988 and constitutes a global technical revision with the addition of the following main concepts: input event, internal event, assignation, allocation, forcing, macro-step and enclosure.

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

FDIS	Report on voting
3B/344/FDIS	3B/346/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A, B and C are for information only.

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

The main reason for the revision of this standard is the desire of the users to increase the standardised specification language with new concepts, allowing a structured and hierarchical description.

Otherwise, in addition to the descriptive and functional aspects of the first edition, it now seems necessary to add the formal and behavioural aspects, which are essential for the definition of a real specification language.

For all these reasons, an overall review of the document is required.

This standard is mainly for people (design engineers, realisation engineers, maintenance engineers, etc.) who need to specify the behaviour of a system (control-command of an automatic machine, safety component, etc.). This specification language should also serve as a communication means between designers and users of automated systems.

GRAFCET SPECIFICATION LANGUAGE FOR SEQUENTIAL FUNCTION CHARTS

1 Scope and object

This International Standard defines the GRAFCET[1)] specification language for the functional description of the behaviour of the sequential part of a control system.

This standard specifies the symbols and the rules for the graphical representation of this language, as well as for its interpretation.

This standard has been prepared for automated production systems of industrial applications. However no particular area of application is excluded.

Methods of development of a specification that makes use of GRAFCET are beyond the scope of this standard. One method is for example the "SFC language" specified in IEC 61131-3, which defines a set of programming languages for programmable controllers.

NOTE See annex C for further information on the relations between IEC 60848 and implementation languages such as the SFC of IEC 61131-3.

2 Normative references

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050-351:1998, *International Electrotechnical Vocabulary (VEI – Part 351: Automatic control*

IEC 60617-12:1997, *Graphical symbols for diagrams – Part 12: Binary logical elements*

3 Terms and definitions

For the purposes of this International Standard, the following definitions apply. The definitions of the terms preceded by an asterisk apply only in the context of the GRAFCET specification language. The chosen order is the alphabetic one.

3.1
*** action**
GRAFCET language element associated with a step, indicating an activity to be performed on output variables

———————

1) GRAFCET , GRAphe Fonctionnel de Commande Etape Transition.

3.2
chart, graph
graphical presentation describing the behaviour of a system, for example the relations between two or more variable quantities, operations or states

3.3
*** directed link**
GRAFCET language element indicating the evolution paths between steps by connecting steps to transitions and transitions to steps

3.4
*** grafcet chart**
function chart using GRAFCET

NOTE The “grafcet chart” can, in short form, be called “grafcet”.

3.5
*** input event**
event characterized by the change of at least one value of all input variables of the sequential part of the system

3.6
*** internal event**
event characterized by an input event associated with the situation of the sequential part of the system

3.7
*** interpretation**
part of the GRAFCET enabling the linkage of:

– the input variables and the structure, by the means of the transition-condition;

– the output variables and the structure, by the means of the actions

3.8
*** situation**
name of the state of the system described by grafcet and characterised by the active steps at a given instant

3.9
*** step**
GRAFCET language element used for the definition of the state of the sequential part of the system

NOTE 1 A step can be active or inactive.

NOTE 2 The set of active steps represents the situation of the system.

3.10
*** structure**
part of the GRAFCET enabling the description of the possible evolution between situations

3.11
system
a set of interrelated elements considered in a defined context as a whole and separated from their environment

[IEV 351-11-01]

NOTE 1 Such elements may be material objects and concepts as well as their results (e.g. forms of organisation, mathematical methods, programming languages).

NOTE 2 The system is considered to be separated from the environment and from the other external systems by an imaginary surface, which cuts the links between them and the system.

NOTE 3 The language GRAFCET can be use to describe the logical behaviour of any kind of system.

3.12
*** transient evolution**
evolution characterized by the clearing of several successive transitions on the occurrence of a single input event

3.13
*** transition**
GRAFCET language element indicating a possible evolution of the activity between two or more steps

NOTE The possible evolution is realised by clearing the transition.

3.14
*** transition-condition**
GRAFCET language element associated with a transition indicating the result of a boolean expression

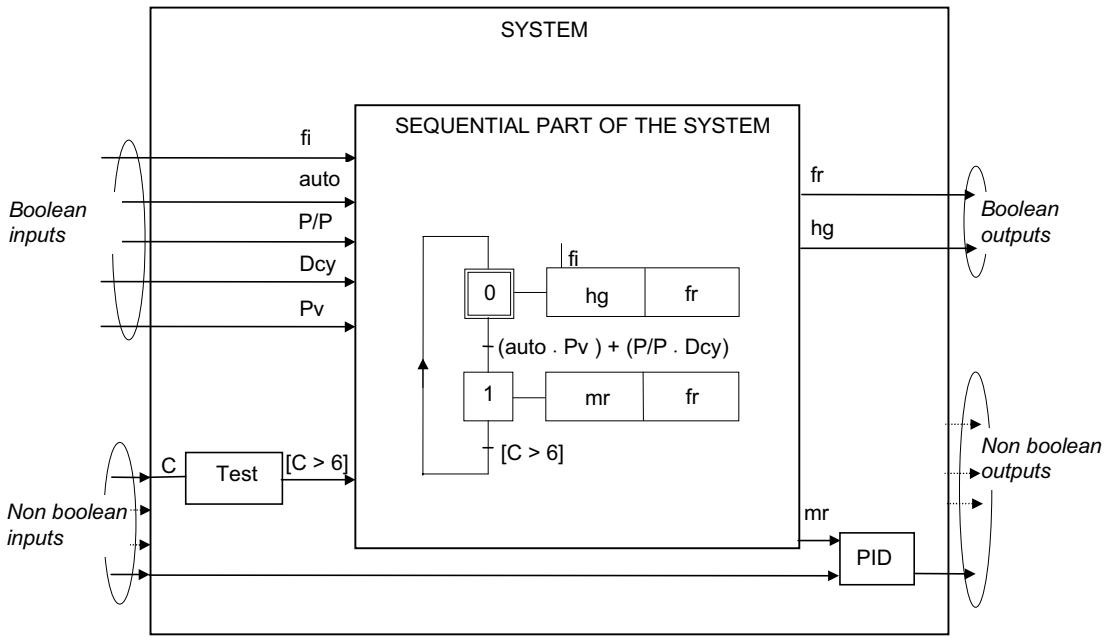
NOTE The transition-condition can be either true or false.

4 General principles

4.1 Context

The implementation of an automated system requires, in particular, a description relating cause and effect. To do this, the logical aspect of the desired behaviour of the system will be described.

The sequential part of the system, which is accessed via Boolean input and output variables, is the logical aspect of this physical system. The behaviour indicates the way in which the output variables depend on the input variables (see note to figure 1). The object of the GRAFCET is to specify the behaviour of the sequential part of the systems.



NOTE The sequential part of the system is characterised by its input variables, its output variables, and its behaviour. This sequential part comprises only input and output boolean variables. However the GRAFCET specification language by extension allows the description of the behaviour of the non Boolean variables (for example: evaluation of an assertion or allocation of a numeric value for a variable).

Figure 1 – Graphical representation of the sequential part of a system

4.2 GRAFCET, a behaviour specification language

The GRAFCET specification language enables a grafcet to be created showing the expected behaviour of a given sequential system. This language is characterized mainly by its graphic elements, which, associated with an alphanumerical expression of variables, provides a synthetic representation of the behaviour, based on an indirect description of the situation of the system.

The behaviour description on states is the following: the "monomarked" states correspond to the GRAFCET *situations*, which implies the uniqueness of the situation at a given instant. The states are connected to each other by means of an evolution condition, which allows the passage from one situation to another one to be described.

For reasons of convenience, the behaviour description based on states is better replaced by a description based on *steps* called GRAFCET. In the GRAFCET, several steps may be active simultaneously, the situation being then characterized by the set of active steps at the considered moment. The evolution of one set of steps to another are translated by one or several transitions, each characterized by:

- its preceding steps,
- its succeeding steps,
- its associated transition-condition.

NOTE These reasons lead to the syntax rule enforcing the alternation step-transition.

4.3 GRAFCET, short presentation

The GRAFCET is used for the design of grafcet charts to provide a graphical and synthetic representation of the sequential systems behaviour. The representation (figure 2) distinguishes:

- the *structure*, which allows possible evolutions between the situations to be described,
- the *interpretation*, which enables the relationship between input, output variables and the structure (evolution, assignation and allocation rules are necessary to achieve this interpretation).

4.3.1 The structure comprises the following basic items

- *Step* (definition: 3.9, symbol 1). A step is either active or inactive, the set of the active steps of a grafcet chart at any given instant represents the *situation* of this grafcet at this instant.
- *Transition* (definition: 3.13, symbol 7). A transition indicates that an evolution of the activity between two or more steps may evolve. This evolution is realized by the clearing of the transition.
- *Directed link* (definition: 3.3, symbol 10). A directed link connects one or several steps to a transition, or a transition to one or several steps.

4.3.2 The following elements are used for the interpretation

- *Transition-condition* (definition: 3.14, symbol 13). Associated with each transition, the transition-condition is a logical expression which is true or false and which is composed of *input variables* and/or internal variables.
- *Action* (definition: 3.1). The action indicates, in a rectangle, what shall be done to the *output variable*, either by assignation (continuous action, symbol 20), or allocation (stored action, symbol 26).

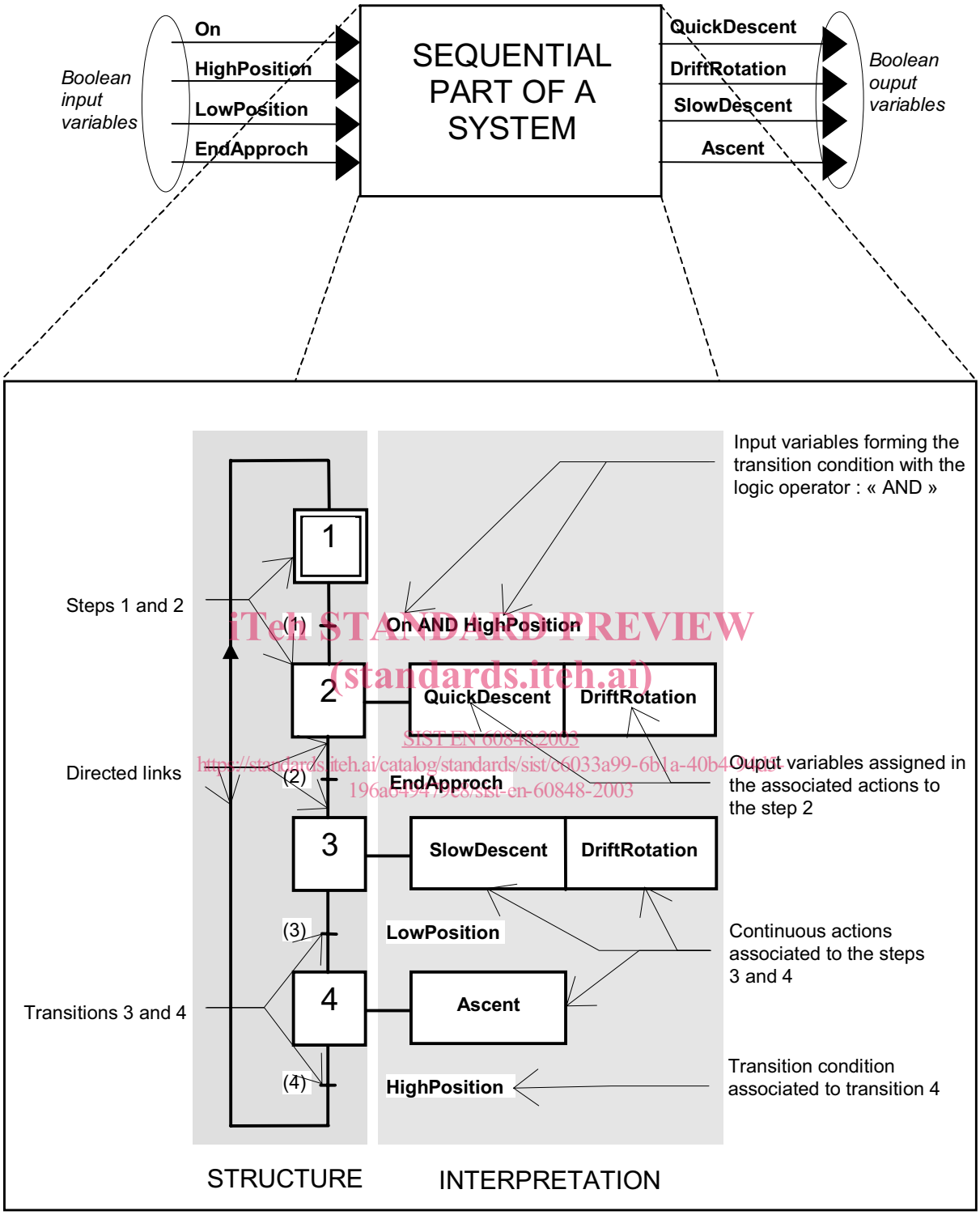


Figure 2 – Structure and interpretation elements used in a grafcet chart to describe the behaviour of a sequential part of the system defined by its input and output variables