

Reliability of systems, equipment and components —

Part 9: Guide to the block diagram technique

The European Standard EN 61078:1993 has the status of a
British Standard

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National foreword

This Part of BS 5760 has been prepared under the direction of the Quality, Management and Statistics Standards Policy Committee. It is identical with IEC 1078:1991 *Analysis techniques for dependability — Reliability block diagram method*, published by the International Electrotechnical Commission (IEC).

In 1993 the European Committee for Electrotechnical Standardization (CENELEC) accepted IEC 1078:1991 as European Standard EN 61078:1993. As a consequence of implementing the European Standard this British Standard is renumbered as BS EN 61078 and any reference to BS 5760-9 should be read as a reference to BS EN 61078.

Nine Parts of this standard have been published and these may be summarized as follows:

— *Part 0: Introductory guide to reliability.* This Part provides guidance to directors of companies who need to know why reliability is important to them, to engineers not trained in quality and reliability to show how reliability should influence their technical decision making, and to middle management not specialized in engineering, to explain how measures to achieve reliability should be integrated with other aspects of project management to give optimum results.

— *Part 1: Guide to reliability and maintainability programme management.* This Part discusses the essential features of a comprehensive reliability and maintainability programme for the planning, organization, direction and control of resources to produce systems, equipment and components which will be reliable and maintainable. It includes consideration of the specification and assessment of reliability and maintainability and of arrangements for the collection of reliability data.

— *Part 2: Guide to the assessment of reliability.* This Part recommends general procedures for the assessment of reliability of hardware systems and contains guidance for the reliability practitioner on the quantitative and statistical aspects of reliability, such as reliability modelling, the provision of data, and the concepts of redundancy and simulation.

— *Part 3: Guide to reliability practices: examples.* This part contains authentic practical examples illustrating the principles established in Part 1 and Part 2 of BS 5760.

— *Part 4: Guide to specification clauses relating to the achievement and development of reliability in new and existing items.* This Part provides more detailed guidance on the specification of reliability.

— *Part 5: Guide to failure modes, effects and criticality analysis (FMEA and FMECA).* This Part describes failure modes and effects analysis (FMEA) and failure modes, effects and criticality analysis (FMECA), and gives guidance on the application of these techniques.

— *Part 6: Guide to programmes for reliability growth.* This Part describes procedures to expose and remove weaknesses in hardware and software items in order to achieve acceptable reliability in a product. It explains basic concepts, management and test procedures and describes techniques for analysis and correction of failures.

— *Part 7: Guide to fault tree analysis.* This Part describes fault tree analysis and gives guidance on the application of this technique which may be used to identify factors affecting the reliability, performance and safety characteristics of a system.

— *Part 9: Guide to the block diagram technique.* This Part describes the use of the block diagram technique for modelling and evaluating the reliability of both elementary and more complex systems. The extension of the method to calculate availability is also outlined.

Further Parts are envisaged in order to provide guidance on other techniques of reliability management. At present three further Parts are in the process of being drafted, and these are as follows.

- *Part 8¹⁾: Guide to the assessment of reliability of systems containing software.* This Part will provide guidance on the assessment of reliability of systems containing software.
- *Part 10: Guide to reliability testing.*
- *Part 11: Guide to the collection of reliability, maintainability, availability and maintenance support data from the field.*

NOTE 1 This British Standard makes reference to BS 4778, the Quality Vocabulary, and in particular to BS 4778-3, a glossary which contains definitions relating to reliability concepts applicable to the guide and it is essential that these definitions and concepts should be fully understood if this guide is to be interpreted correctly. For this reason it is recommended that BS 4778 should be read in conjunction with BS 5760.

NOTE 2 Chapter 191 of IEC 50, the International Electrotechnical Vocabulary, now deprecates the use of the terms “failure modes and effects analysis” and “failure modes, effects and criticality analysis” and favours the use of “fault modes and effects analysis” and “fault modes, effects and criticality analysis” respectively. However, the older terms have been retained in BS 5760-5 in order to align it with the current version of IEC 812 which has been adopted by CEN.

Guidance on specific aspects of maintainability is provided in the various Parts of BS 6548 *Maintainability of equipment*.

Cross-reference

International standard	Corresponding British Standard
IEC 50(191):1990	BS 4778 <i>Quality vocabulary</i> Section 3.2:1991 <i>Glossary of international terms</i> (Identical)

Textual error. In **8.2**, in the antepenultimate line of the final paragraph, “et” should read “and”.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, the EN title page, pages 2 to 22, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

¹⁾ Currently published as a Draft for Development, DD 198:1991.

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Descriptors: Dependability, analysis technique, reliability block diagram, availability, system

English version

Analysis techniques for dependability Reliability block diagram method

(IEC 1078:1991)

Techniques d'analyse de la sûreté de fonctionnement
Méthode du diagramme de fiabilité
(CEI 1078:1991)

Techniken für die Analyse der Zuverlässigkeit
Verfahren mit dem
Zuverlässigkeitsblockdiagramm
(IEC 1078:1991)

This European Standard was approved by CENELEC on 1993-09-22. 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, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, 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

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Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 1078:1991 could be accepted without textual changes, has shown that no common modifications were necessary for acceptance as a European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as EN 61078 on 22 September 1993.

The following dates were fixed:

- latest date of publication of
an identical national
standard (dop) 1994-09-01
- latest date of withdrawal of
conflicting national
standards (dow) 1994-09-01

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard, Annex A and Annex ZA are normative and Annex B is informative.

Introduction

Different analytical methods of dependability analysis are available, of which the Reliability Block Diagram (RBD) is one. The purposes of each method and their individual or combined applicability in evaluating the reliability and availability of a given system or component should be examined by the analyst prior to starting work on the RBD. Consideration should also be given to the results obtainable from each method, data required to perform the analysis, complexity of analysis, and other factors identified in this standard.

1 Scope

This International Standard describes procedures for modelling the dependability of a system and for using the model in order to calculate reliability and availability measures.

A standard set of symbols related to reliability parameters is given in Annex A. Some formulae are given in Annex B.

2 Normative references

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50 (191):1990, *International Electrotechnical Vocabulary (IEV), Chapter 191: Dependability and quality of service*.

3 Definitions

Terms and definitions are in accordance with the International Electrotechnical Vocabulary (IEV), Chapter 191.

4 Symbols

Symbols and abbreviations are given in Annex A.

5 Applicability

An RBD is a pictorial representation of a system's reliability performance. It shows the logical connection of (functioning) components needed for system success.

The modelling techniques described are intended to be applied primarily to systems without repair and where the order in which failures occur does not matter. For systems where the order of failures must be taken into account or where repairs are to be carried out, other modelling techniques, such as Markov analysis, are more suitable. At any instant in time, an item is considered to be in only one of two possible states: operational or faulty.

In the symbolic representation, no distinction is made between open circuit, short circuit or other fault modes; however, in the numerical evaluation this is possible.

6 System fault definitions and reliability requirements

6.1 General considerations

A prerequisite for constructing system reliability models is a sound understanding of the ways in which the system can operate. Systems often require more than one fault definition. These should be defined and listed.

In addition there should be clear statements concerning:

- functions to be performed;
- performance parameters and permissible limits on such parameters;
- environmental and operating conditions.