

INTERNATIONAL STANDARD

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**Industrial communication networks – High availability automation networks –
Part 1: General concepts and calculation methods**

**Réseaux de communication industriels – Réseaux de haute disponibilité pour
l'automatisation –**

Partie 1: Concepts généraux et méthodes de calcul

IEC 62439-1:2010

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**INDUSTRIAL COMMUNICATION NETWORKS –
HIGH AVAILABILITY AUTOMATION NETWORKS –**

Part 1: General concepts and calculation methods

FOREWORD

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IEC 62439-1 edition 1.2 contains the first edition (2010-02) [documents 65C/583/FDIS and 65C/589/RVD], its amendment 1 (2012-06) [documents 65C/684/FDIS and 65C/691/RVD] and its amendment 2 (2016-02) [documents 65C/834/FDIS and 65C/841/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendments 1 and 2. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard 62439-1 has been prepared by subcommittee 65C: Industrial Networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This edition includes the following significant technical changes with respect to IEC 62439 (2008):

- adding a calculation method for RSTP (rapid spanning tree protocol, IEEE 802.1Q),
- adding two new redundancy protocols: HSR (High-availability Seamless Redundancy) and DRP (Distributed Redundancy Protocol),
- moving former Clauses 1 to 4 (introduction, definitions, general aspects) and the Annexes (taxonomy, availability calculation) to IEC 62439-1, which serves now as a base for the other documents,
- moving Clause 5 (MRP) to IEC 62439-2 with minor editorial changes,
- moving Clause 6 (PRP) was to IEC 62439-3 with minor editorial changes,
- moving Clause 7 (CRP) was to IEC 62439-4 with minor editorial changes, and
- moving Clause 8 (BRP) was to IEC 62439-5 with minor editorial changes,
- adding a method to calculate the maximum recovery time of RSTP in a restricted configuration (ring) to IEC 62439-1 as Clause 8,
- adding specifications of the HSR (High-availability Seamless Redundancy) protocol, which shares the principles of PRP to IEC 62439-3 as Clause 5, and
- introducing the DRP protocol as IEC 62439-6.

The French version of this standard has not been voted upon.

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

A list of the IEC 62439 series can be found, under the general title *Industrial communication networks – High availability automation networks*, on the IEC website.

The committee has decided that the contents of the base publication and its amendments 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

The IEC 62439 series specifies relevant principles for high availability networks that meet the requirements for industrial automation networks.

In the fault-free state of the network, the protocols of the IEC 62439 series provide ISO/IEC 8802-3 (IEEE 802.3) compatible, reliable data communication, and preserve determinism of real-time data communication. In cases of fault, removal, and insertion of a component, they provide deterministic recovery times.

These protocols retain fully the typical Ethernet communication capabilities as used in the office world, so that the software involved remains applicable.

The market is in need of several network solutions, each with different performance characteristics and functional capabilities, matching diverse application requirements. These solutions support different redundancy topologies and mechanisms which are introduced in IEC 62439-1 and specified in the other Parts of the IEC 62439 series. IEC 62439-1 also distinguishes between the different solutions, giving guidance to the user.

The IEC 62439 series follows the general structure and terms of IEC 61158 series.

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INDUSTRIAL COMMUNICATION NETWORKS – HIGH AVAILABILITY AUTOMATION NETWORKS –

Part 1: General concepts and calculation methods

1 Scope

The IEC 62439 series is applicable to high-availability automation networks based on the ISO/IEC 8802-3 (IEEE 802.3) (Ethernet) technology.

This part of the IEC 62439 series specifies

- the common elements and definitions for other parts of the IEC 62439 series;
- the conformance test specification (normative);
- a classification scheme for network characteristics (informative);
- a methodology for estimating network availability (informative);
- the configuration rules, calculation and measurement method for a deterministic recovery time in RSTP.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-191:1990, *International Electrotechnical Vocabulary – Chapter 191: Dependability and quality of service*

IEC 61158 (all parts), *Industrial communication networks – Fieldbus specifications*

IEC 61158-6-10, *Industrial communication networks – Fieldbus specifications – Part 6-10: Application layer protocol specification – Type 10 elements*

ISO/IEC 8802-3:2000, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

IEEE 802.1Q, *IEEE standards for local and metropolitan area network. Virtual bridged local area networks*

IEEE 802.1D:2004, *IEEE standard for local Local and metropolitan area networks Media Access Control (MAC) Bridges*

IETF RFC 791, *Internet Protocol*; available at <<http://www.ietf.org>>

3 Terms, definitions, abbreviations, acronyms, and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-191, as well as the following, apply

3.1.1

availability (performance)

ability of an item to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided

NOTE 1 This ability depends on the combined aspects of the reliability performance, the maintainability performance, and the maintenance support performance.

NOTE 2 Required external resources, other than maintenance resources, do not affect the availability performance of the item.

[IEV 191-02-05]

3.1.2

channel

layer 2 connection between two end nodes which consists of one or more paths (for redundancy) between end nodes

3.1.3

common mode failure

failure that affects all redundant elements for a given function at the same time

3.1.4

complete failure

failure which results in the complete inability of an item to perform all required functions

[IEV 191-04-20]

3.1.5

connection

logical relationship between two nodes

3.1.6

coverage

probability that a failure is discovered within a time short enough for redundancy to handle it, also expressing the percentage of failures caught up by redundancy vs. total number of failures

3.1.7

cut-through switching

a technology in which a switching node starts transmitting a received frame before this frame has been fully received

3.1.8

degradation failure

failure which is both a gradual failure and a partial failure

[IEV 191-04-22]

**3.1.9
dependability**

collective term used to describe the availability performance and its influencing factors: reliability performance, maintainability performance and maintenance support performance

NOTE Dependability is used only for general descriptions in non-quantitative terms.

[IEV 191-02-03]

**3.1.10
device**

physical entity connected to the network composed of communication element and possibly other functional elements

NOTE Devices are for instance nodes, routers and switches.

**3.1.11
doubly attached node**

node that has two ports for the purpose of redundant operation

**3.1.12
edge port**

port of a switch connected to a leaf link

**3.1.13
end node**

node which is producer or consumer of application data

NOTE For the purpose of the IEC 62439 series, further specification is given in 0.

**3.1.14
error**

discrepancy between a computed, observed or measured value or condition and the specified or theoretically correct value or condition

NOTE 1 An error can be caused by a faulty item, e.g. a computing error made by faulty computer equipment.

NOTE 2 The French term "erreur" may also designate a mistake (see IEV 191-05-25).

[IEV 191-05-24, modified]

**3.1.15
failure**

termination of the ability of an item to perform a required function

NOTE 1 After a failure, the item has a fault.

NOTE 2 "Failure" is an event, as distinguished from "fault", which is a state.

NOTE 3 This concept as defined does not apply to items consisting of software only.

[IEV 191-04-01]

**3.1.16
fault**

state of an item characterized by its inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources

NOTE A fault is often the result of a failure of the item itself, but may exist without prior failure.

[IEV 191-05-01]