IEC 62439-3

Edition 3.0 2016-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial communication networks – High availability automation networks – Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)

Réseaux de communication industriels – Réseaux d'automatisme à haute disponibilité –
Partie 3: Protocole de redondance en parallèle (PRP) et redondance transparente de haute disponibilité (HSR)

IEC 62439-3:2016-03(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 25.040, 35.040

ISBN 978-2-8322-3150-0

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 62439-3 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This third edition cancels and replaces the second edition published in 2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) technical corrections and extension of specifications;
b) consideration of IEC 61588 clock synchronization with end-to-end delay measurement alongside the existing peer-to-peer delay measurement in PRP.

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

FDIS	Report on voting
65C/834/FDIS	65C/841/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 2.

This International Standard is to be read in conjunction with IEC 62439-1.

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

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- withdrawn,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.

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INTRODUCTION

0.1 General

IEC 62439-3 belongs to the IEC 62439 series *"Industrial communication networks – High availability automation networks"*. It specifies the PRP and HSR seamless redundancy protocols. It was adopted by IEC TC57 WG10 as the redundancy method for demanding substation automation networks operating on layer 2 networks, according to IEC 61850-8-1 and IEC 61850-9-2.

The seamless redundancy principle has been extended to clocks operating according to the Precision Time Protocol (IEC 61588) and attached to redundant networks. Two variants are specified: L3E2E for clocks which operate on layer 3 networks with end-to-end link delay measurement (E2E) and L2P2P for clocks that operate on layer 2 with peer-to-peer link delay measurement (P2P).

0.2 Changes with respect to the previous edition

The major changes with respect to IEC 62439-3:2012 are:

– Subclause 4.1.10.3 has been rewritten to explain the calculation of the duplicate rejection for different speeds.

– Annex A has been redrafted as a general concept for doubly attached clocks applicable to end-to-end (E2E) and to peer-to-peer (P2P) link delay measurement; the principle of paired port operation has now been specified in terms of a state machine based on IEC 61588:2009.

– Annex B of IEC 62439-3:2012 has been deleted; its properties are mentioned in 5.3.7.

– Annex B (new) makes the support of redundancy mandatory for IEC/IEEE 61850-9-3 that specifies doubly attached clocks on layer 2, with peer-to-peer delay measurement.

– Annex C specifies two profiles of a precision clock for industrial automation:
L3E2E for layer 3, end-to-end delay measurement and
L2P2P for layer 2, peer-to-peer delay measurement.

– Annex D contains the tutorial information on IEC 61588:2009 for understanding the above annexes. It was contained in IEC 62439-3:2012 Annex A.

– Annex E (MIB) contains the SNMP Management Information Base to be used for singly and doubly attached clocks in all profiles.

0.3 Patent declaration

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning filtering of redundant frames in a network node (Siemens Aktiengesellschaft – EP 2127329, US 8184650, CN 101611615B) given in 5.2.3.3.

IEC takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured the IEC that he/she is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with IEC. Information may be obtained from:

Siemens Aktiengesellschaft
Oto-Hahn-Ring 6
81379 Munich, Germany

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning

Reception of redundant and non-redundant frames (ABB Research Ltd – EP 1825657, US 8582426, CN 101057483, IN 254425) given in 4.2.7, concerning Identifying improper cabling of devices (ABB Technology AG – EP 2163024, US 8344736, CN 101689985) given in 4.3, concerning Critical device with increased availability (ABB Research Ltd – EP 2090950) given in 4.4, concerning Ring coupling nodes for high availability networks (ABB Research Ltd – US 8582424, EP 2327185, CN 102106121) given in 5.2.3.

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ch-ip.patent@abb.com

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INDUSTRIAL COMMUNICATION NETWORKS – HIGH AVAILABILITY AUTOMATION NETWORKS –

Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)

1 Scope

The IEC 62439 series is applicable to high-availability automation networks based on the Ethernet technology.

This part of IEC 62439 specifies two redundancy protocols designed to provide seamless recovery in case of single failure of an inter-bridge link or bridge in the network, which are based on the same scheme: parallel transmission of duplicated information.

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

IEC 61588:2009, *Precision clock synchronization protocol for networked measurement and control systems*

IEC TR 61850-90-4:2013, *Communication networks and systems for power utility automation – Part 90-4: Network engineering guidelines*

IEC 62439-1, *Industrial communication networks – High availability automation networks – Part 1: General concepts and calculation methods*

IEC/IEEE 61850-9-3:—, *Communication networks and systems for power utility automation - Part 9-3: Precision time protocol profile for power utility automation (proposed IEC 61850-9-3)*[1]

ISO/IEC/IEEE 8802-3:2014, *Standard for Ethernet*

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

IEEE 802.1Q:2014, *IEEE Standard for Local and metropolitan area networks – Media Access Control (MAC) Bridges and Virtual Bridge Local Area Network*

IETF RFC 2578, *Structure of Management Information Version 2 (SMIv2)*

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[1] To be published.

IETF RFC 3418, *Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)*

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 and in IEC 62439-1, as well as the following, apply.

3.1.1
grandmaster-capable
ordinary clock or boundary clock that is able to take the role of a grandmaster

Note 1 to entry: A grandmaster-capable clock is not necessarily connected to a recognized time source.

3.1.2
interlink
link that connects two network hierarchies

3.1.3
network time inaccuracy
time inaccuracy evaluated or measured between a particular slave clock and the time reference signal of its grandmaster clock(s), considering the worst network topology

3.1.4
RedBox
device attaching singly attached nodes to a redundant network

3.1.5
QuadBox
quadruple port device connecting two peer HSR rings, which behaves as an HSR node in each ring and is able to filter the traffic and forward it from ring to ring

3.1.6
HSR frame
frame that carries as EtherType the HSR_ethertype

3.1.7
switching logic
hardware that transmits a frame from one port to another port, possibly providing cut-through

3.1.8
time error
deviation from the time reference used for measurement or synchronization, evaluated over a short time span

3.1.9
time inaccuracy
time error not exceeded by 99,7% of the measurements, evaluated over a series of 1 000 measurements (about 20 min) in steady state

Note 1 to entry: In this document, the words “bridge” and“bridging” are synonymous with the words “switch” and “switching” respectively, when they apply to layer 2 connectivity.

3.2 Abbreviations and acronyms

For the purposes of this document, the abbreviations and acronyms given in IEC 62439-1, as well as the following apply.