

Industrial communication networks - High availability  
automation networks - Part 2: Media Redundancy  
Protocol (MRP)

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN 62439-2:2017 sisaldab Euroopa standardi EN 62439-2:2017 ingliskeelset teksti.	This Estonian standard EVS-EN 62439-2:2017 consists of the English text of the European standard EN 62439-2:2017.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 24.11.2017.	Date of Availability of the European standard is 24.11.2017.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile [standardiosakond@evs.ee](mailto:standardiosakond@evs.ee).

ICS 25.040, 35.040

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:  
Koduleht [www.evs.ee](http://www.evs.ee); telefon 605 5050; e-post [info@evs.ee](mailto:info@evs.ee)

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Homepage [www.evs.ee](http://www.evs.ee); phone +372 605 5050; e-mail [info@evs.ee](mailto:info@evs.ee)

English Version

## Industrial communication networks - High availability automation networks - Part 2: Media Redundancy Protocol (MRP) (IEC 62439-2:2016)

Réseaux de communication industriels - Réseaux d'automatisme à haute disponibilité - Partie 2: Protocole de redondance du support (MRP) (IEC 62439-2:2016)

Industrielle Kommunikationsnetze: Hochverfügbare Automatisierungsnetze - Teil 2: Medienredundanz-Protokoll (MRP) (IEC 62439-2:2016)

This European Standard was approved by CENELEC on 2016-03-30. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

## European foreword

The text of document 65C/583/FDIS, future edition 2 of IEC 62439-2, prepared by SC 65C "Industrial networks" of IEC/TC 65X "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62439-2:2017.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2018-06-08
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2021-12-08

This document supersedes EN 62439-2:2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

## Endorsement notice

The text of the International Standard IEC 62439-2:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61158-2:2007	NOTE	Harmonized as EN 61158-2:2008 <sup>1</sup> (not modified).
IEC 61158-5-10	NOTE	Harmonized as EN 61158-5-10.
IEC 61784-1:2007	NOTE	Harmonized as EN 61784-1:2008 <sup>2</sup> (not modified).
IEC 61784-2:2007	NOTE	Harmonized as EN 61784-2:2008 <sup>3</sup> (not modified).
IEC 62439-3	NOTE	Harmonized as EN 62439-3.
IEC 62439-4	NOTE	Harmonized as EN 62439-4.
IEC 62439-6	NOTE	Harmonized as EN 62439-6.

<sup>1</sup> Withdrawn publication, the active edition is EN 61158-2:2014 (IEC 61158-2:2014).

<sup>2</sup> Withdrawn publication, the active edition is EN 61784-1:2014 (IEC 61784-1:2014).

<sup>3</sup> Withdrawn publication, the active edition is EN 61784-2:2014 (IEC 61784-2:2014).

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-191	-	International Electrotechnical Vocabulary - Chapter 191: Dependability and quality of service	-	-
IEC 61158-6-10	2014	Industrial communication networks - Fieldbus specifications - Part 6-10: Application layer protocol specification - Type 10 elements	EN 61158-6-10	2014
IEC 61784-1	-	Digital data communications for measurement and control -- Part 1: Profile sets for continuous and discrete manufacturing relative to fieldbus use in industrial control systems	EN 61784-1	-
IEC 61784-2	-	Industrial communication networks - Profiles -- Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3	EN 61784-2	-
IEC 62439-1	2010	Industrial communication networks - High availability automation networks -- Part 1: General concepts and calculation methods	EN 62439-1	2010
+ A1	2012		+A1	2012
ISO/IEC 10164-1	-	Information technology; Open Systems Interconnection; systems management: object management function	-	-
ISO/IEC/IEEE 8802-3-		Standard for Ethernet	-	-
IEEE 802.1D	2004	IEEE Standard for local and metropolitan area networks - Media Access Control (MAC) Bridges	-	-
IEEE 802.1Q	2011	IEEE Standard for Local and metropolitan area networks - Media Access Control (MAC) Bridges and Virtual Bridged Local Area Networks	-	-

## CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	11
2 Normative references.....	11
3 Terms, definitions, abbreviations, acronyms, and conventions .....	12
3.1 Terms and definitions .....	12
3.2 Abbreviations and acronyms.....	12
3.3 Conventions.....	12
4 MRP Overview.....	12
5 MRP Media redundancy behavior.....	16
5.1 General.....	16
5.2 Ring ports .....	16
5.3 Media Redundancy Manager (MRM).....	17
5.4 Media Redundancy Client (MRC).....	19
5.5 Redundancy domain.....	19
5.6 Media Link Check.....	19
5.7 Application of the Continuity Check protocol .....	19
5.7.1 General .....	19
5.7.2 Continuity Check Message Interval.....	20
5.7.3 Maintenance Domain Level .....	20
5.7.4 Maintenance Association ID (MAID).....	20
5.7.5 Maintenance Association End Point ID (MEPID).....	20
5.7.6 Sender ID TLV .....	20
5.7.7 Port Status TLV .....	21
5.7.8 Interface Status TLV .....	21
5.8 Usage with diagnosis and alarms.....	21
5.9 Ring diagnosis .....	21
5.10 Multiple MRM in a single ring: Manager voting option.....	21
5.10.1 General .....	21
5.10.2 Basic principle of the manager voting process .....	22
5.10.3 The manager voting process .....	23
5.11 BLOCKED not supported (Option).....	25
5.12 Interconnection port .....	25
5.13 Media redundancy Interconnection Manager (MIM) .....	26
5.14 Media redundancy Interconnection Client (MIC) .....	29
5.15 Interconnection domain .....	29
5.16 Interconnection diagnosis.....	30
6 MRP Class specification .....	30
6.1 General.....	30
6.2 Template.....	30
6.2.1 Media redundancy template.....	30
6.2.2 Media redundancy Interconnection template .....	31
6.3 Attributes .....	32
7 MRP Service specification .....	36
7.1 Start MRM .....	36

7.2	Stop MRM	38
7.3	State Change	38
7.4	Start MRC	39
7.5	Stop MRC	41
7.6	Read MRM	41
7.7	Read MRC	43
7.8	Start MIM	45
7.9	Stop MIM	46
7.10	Interconnection State Change	47
7.11	Start MIC	48
7.12	Stop MIC	49
7.13	Read MIM	50
7.14	Read MIC	52
8	MRP protocol specification	54
8.1	PDU description	54
8.1.1	Basic data types	54
8.1.2	DLPDU abstract syntax reference	54
8.1.3	Coding of the DLPDU field SourceAddress	54
8.1.4	Coding of the DLPDU field DestinationAddress	55
8.1.5	Coding of the field TagControllInformation	55
8.1.6	Coding of the field LT	56
8.1.7	MRP APDU abstract syntax	56
8.1.8	Coding of the field MRP_TLVHeader	57
8.1.9	Coding of the field MRP_SubTLVHeader	58
8.1.10	Coding of the field MRP_Ed1Type and MRP_Ed1ManufacturerData	58
8.1.11	Coding of the field MRP_Version	59
8.1.12	Coding of the field MRP_SequenceID	59
8.1.13	Coding of the field MRP_SA	59
8.1.14	Coding of the field MRP_OtherMRMSA	59
8.1.15	Coding of the field MRP_Prio	60
8.1.16	Coding of the field MRP_OtherMRMPrio	60
8.1.17	Coding of the field MRP_PortRole	60
8.1.18	Coding of the field MRP_RingState	60
8.1.19	Coding of the field MRP_Interval	61
8.1.20	Coding of the field MRP_Transition	61
8.1.21	Coding of the field MRP_TimeStamp	61
8.1.22	Coding of the field MRP_Blocked	61
8.1.23	Coding of the field MRP_ManufacturerOUI	62
8.1.24	Coding of the field MRP_IECOUI	62
8.1.25	Coding of the field MRP_ManufacturerData	62
8.1.26	Coding of the field MRP_DomainUUID	62
8.1.27	Coding of the field MRP_InState	62
8.1.28	Coding of the field MRP_InID	63
8.2	Protocol machines	63
8.2.1	MRM protocol machine	63
8.2.2	MRC protocol machine	74
8.2.3	MRA protocol machine	80
8.2.4	MRA, MRM and MRC functions	100
8.2.5	FDB clear timer	105

8.2.6	Topology change timer .....	105
8.2.7	MIM protocol machine .....	106
8.2.8	MIC protocol machine .....	115
8.2.9	MIM and MIC functions.....	123
8.2.10	Interconnection Topology Change timer.....	127
8.2.11	Interconnection Link Status Poll timer.....	127
9	MRP installation, configuration and repair .....	128
9.1	Ring port and Interconnection port parameters.....	128
9.2	Ring topology parameters.....	128
9.3	MRM parameters.....	128
9.4	MRC parameters and constraints.....	129
9.5	MRA compatibility to earlier Automanager protocol version .....	129
9.6	Interconnection topology parameters .....	130
9.7	MIM parameters .....	130
9.8	MIC parameters and constraints .....	130
9.9	Calculation of MRP ring recovery time .....	131
9.9.1	Overview .....	131
9.9.2	Deduction of formula.....	131
9.9.3	Worst case calculation for recovery time of 10 ms.....	133
9.9.4	Worst case calculation for 50 devices .....	134
9.10	Calculation of MRP Automanager voting time.....	134
10	MRP Management Information Base (MIB).....	134
10.1	General.....	134
10.2	MRP MIB with a monitoring view.....	134
10.3	MRP MIB with a management and monitoring view .....	147
Annex A (normative)	Optional earlier version of the Automanager protocol.....	162
Bibliography	.....	163
Figure 1	– Two MRP rings redundantly connected via MRP Interconnection .....	14
Figure 2	– MRP stack .....	16
Figure 3	– MRP ring topology with one manager and clients .....	17
Figure 4	– MRP open ring with MRM .....	18
Figure 5	– MRP ring with MRA at network startup .....	22
Figure 6	– MRP ring after the manager voting process.....	22
Figure 7	– Manager voting process .....	24
Figure 8	– MRA located outside the MRP ring.....	25
Figure 9	– MRP Interconnection topology .....	27
Figure 10	– MRP ring interconnection open .....	28
Figure 11	– MRP protocol machine for MRM.....	63
Figure 12	– MRP protocol machine for MRC .....	74
Figure 13	– MRP protocol machine for MRA .....	81
Figure 14	– MRP protocol machine for MIM in RC-mode and LC-mode.....	107
Figure 15	– MRP protocol machine for MIC in RC-mode and LC-mode .....	116
Table 1	– Patent information .....	9
Table 2	– Coding of the Maintenance Association ID (MAID).....	20



Table 3 – MRP Start MRM .....	36
Table 4 – MRP Stop MRM.....	38
Table 5 – MRP Change State .....	39
Table 6 – MRP Start MRC.....	40
Table 7 – MRP Stop MRC .....	41
Table 8 – MRP Read MRM.....	42
Table 9 – MRP Read MRC .....	44
Table 10 – MRP Start MIM.....	45
Table 11 – MRP Stop MIM .....	47
Table 12 – MRP Interconnection Change State.....	47
Table 13 – MRP Start MIC .....	48
Table 14 – MRP Stop MIC.....	50
Table 15 – MRP Read MIM .....	51
Table 16 – MRP Read MIC.....	53
Table 17 – MRP DLPDU syntax for ISO/IEC/IEEE 8802-3 (IEEE 802.3) .....	54
Table 18 – MRP OUI.....	55
Table 19 – MRP MulticastMACAddress .....	55
Table 20 – MRP TagControlInformation.Priority field.....	56
Table 21 – MRP LT field .....	56
Table 22 – MRP APDU syntax.....	56
Table 23 – MRP Substitutions .....	57
Table 24 – MRP_TLVHeader.Type .....	58
Table 25 – MRP_SubTLVHeader.Type .....	58
Table 26 – MRP_Ed1Type and MRP_Ed1ManufacturerData .....	59
Table 27 – MRP_Ed1Type and MRP_Ed1ManufacturerData .....	59
Table 28 – MRP_Version .....	59
Table 29 – Coding of the field MRP_OtherMRMSA .....	60
Table 30 – MRP_Prio.....	60
Table 31 – Coding of the field MRP_OtherMRMPrio.....	60
Table 32 – MRP_PortRole.....	60
Table 33 – MRP_RingState.....	61
Table 34 – MRP_Interval.....	61
Table 35 – MRP_Transition.....	61
Table 36 – MRP_TimeStamp.....	61
Table 37 – MRP_Blocked.....	62
Table 38 – MRP_DomainUUID .....	62
Table 39 – MRP_InState .....	62
Table 40 – MRP Local variables of MRM protocol machine .....	65
Table 41 – MRM State machine .....	66
Table 42 – MRP Local variables of MRC protocol machine.....	75
Table 43 – MRC state machine .....	76
Table 44 – MRP local variables of MRA protocol machine.....	82
Table 45 – MRA state machine.....	83

Table 46 – MRP functions and macros .....	101
Table 47 – MRP FDB clear timer .....	105
Table 48 – MRP topology change timer .....	106
Table 49 – MRP Local variables of MIM protocol machine.....	108
Table 50 – MIM State machine for LC-mode .....	109
Table 51 – MIM State machine for RC-mode .....	112
Table 52 – MRP Local variables of MIC protocol machine .....	117
Table 53 – MIC State machine for LC-mode .....	118
Table 54 – MIC State machine for RC-mode.....	121
Table 55 – MRP Interconnection functions.....	124
Table 56 – MRP Interconnection topology change timer.....	127
Table 57 – MRP Interconnection link status poll timer .....	128
Table 58 – MRP Network/Connection parameters .....	128
Table 59 – MRP MRM parameters.....	129
Table 60 – MRP MRC parameters.....	129
Table 61 – MRP MIM parameters .....	130
Table 62 – MRP MIC parameters .....	131
Table A.1 – Compatible mode MRP_Option for MRP_Test Substitutions .....	162
Table A.2 – Compatible mode MRP_Option frames MRP_TestMgrNAck and MRP_TestPropagate Substitutions .....	162

Preview generated by EVS

## 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/IEEE 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 the IEC 61158 series.

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 ring protocol given in Clause 5. Table 1 gives an overview of the relevant patents.

**Table 1 – Patent information**

No.	Status	Country	Granted Patent Number or Application Number (if pending)	Title
1	granted	US	US 6430151	Local networking with redundancy properties having a redundancy manager
	granted	CA	CA 2323429	
	granted	CN	CN 117195	
	granted	NO	NO 330908	
	granted	EP (AT, BE, CH, DE, DK, ES, FR, GB, IT, NL, SE)	EP 1062787	

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 either free of charge or 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

Otto-Hahn-Ring 6

Munich 81739

Germany

and

Hirschmann Automation and Control GmbH

Stuttgarter Strasse 45-51

Neckartenzlingen 72654

Germany

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. IEC shall not be held responsible for identifying any or all such patent rights.

ISO ([www.iso.org/patents](http://www.iso.org/patents)) and IEC (<http://patents.iec.ch/>) maintain on-line data bases of patents relevant to their standards. Users are encouraged to consult the data bases for the most up to date information concerning patents.

This document is a preview generated by EVS