

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



**Industrial communication networks – High availability automation networks –  
Part 5: Beacon Redundancy Protocol (BRP)**

**Réseaux de communication industriels – Réseaux d'automatisme à haute  
disponibilité –  
Partie 5: Protocole de redondance à balise (BRP)**



**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2016 IEC, Geneva, Switzerland**

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

#### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

#### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

#### IEC Catalogue - [webstore.iec.ch/catalogue](http://webstore.iec.ch/catalogue)

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

#### IEC publications search - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

#### IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [csc@iec.ch](mailto:csc@iec.ch).

#### A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

#### A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

#### Catalogue IEC - [webstore.iec.ch/catalogue](http://webstore.iec.ch/catalogue)

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

#### Recherche de publications IEC - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

#### Glossaire IEC - [std.iec.ch/glossary](http://std.iec.ch/glossary)

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

#### Service Clients - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: [csc@iec.ch](mailto:csc@iec.ch).

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



**Industrial communication networks – High availability automation networks –  
Part 5: Beacon Redundancy Protocol (BRP)**

**Réseaux de communication industriels – Réseaux d'automatisme à haute  
disponibilité –  
Partie 5: Protocole de redondance à balise (BRP)**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 25.040; 35.040

ISBN 978-2-8322-3148-7

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	7
3 Terms, definitions, abbreviations, acronyms, and conventions .....	7
3.1 Terms and definitions .....	7
3.2 Abbreviations and acronyms.....	8
3.3 Conventions.....	8
4 BRP overview.....	8
5 BRP principle of operation .....	8
5.1 General.....	8
5.2 Network topology .....	8
5.3 Network components.....	11
5.4 Rapid reconfiguration of network traffic.....	12
6 BRP stack and fault detection features.....	12
7 BRP protocol specification .....	14
7.1 MAC addresses.....	14
7.2 EtherType .....	14
7.3 Fault detection mechanisms .....	14
7.4 BRP end device .....	14
7.4.1 State diagram .....	14
7.4.2 Start-up .....	15
7.4.3 Normal operation .....	15
7.4.4 Fault detection .....	16
7.4.5 State-Event-Action table.....	16
7.5 Beacon device .....	26
7.5.1 State diagram .....	26
7.5.2 Start-up .....	27
7.5.3 Normal operation .....	27
7.5.4 Fault detection .....	28
7.5.5 Changing BRP parameters.....	28
7.5.6 State-Event-Action table.....	29
8 BRP message structure .....	36
8.1 General.....	36
8.2 ISO/IEC/IEEE 8802-3 (IEEE 802.3) Tagged common message header .....	36
8.3 Beacon message.....	37
8.4 Path_Check_Request message .....	37
8.5 Path_Check_Response message.....	38
8.6 Learning_Update message .....	38
9 BRP fault recovery time .....	38
10 BRP service definition.....	39
10.1 Supported services .....	39
10.2 Common service parameters .....	39
10.3 Set_Node_Parameters service .....	40
10.4 Get_Node_Parameters service .....	41

10.5 Get_Node_Status service .....	43
11 BRP Management Information Base (MIB).....	44
Bibliography .....	47
Figure 1 – BRP star network example.....	9
Figure 2 – BRP linear network example .....	10
Figure 3 – BRP ring network example.....	11
Figure 4 – BRP stack architecture .....	12
Figure 5 – State diagram for end device .....	15
Figure 6 – State diagram for beacon device.....	17
Table 1 – Parameter values for end device.....	17
Table 2 – State-Event-Action table for end device.....	18
Table 3 – Parameter values for beacon device .....	29
Table 4 – State-Event-Action table for beacon device .....	30
Table 5 – Destination MAC addresses.....	36
Table 6 – Common message header .....	37
Table 7 – Beacon message format .....	37
Table 8 – Path_Check_Request message format.....	37
Table 9 – Path_Check_Response message format .....	38
Table 10 – Learning_Update message format.....	38
Table 11 – BRP Set_Node_Parameters service parameters.....	40
Table 12 – BRP Get_Node_Parameters service parameters.....	42
Table 13 – BRP Get_Node_Status service parameters .....	43

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –  
HIGH AVAILABILITY AUTOMATION NETWORKS –****Part 5: Beacon Redundancy Protocol (BRP)**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). 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. 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 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, accept IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

International Standard IEC 62439-5 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2010. This edition constitutes a technical revision.

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

- a) The protocol is now independent of application (Path\_Check\_Request is sent periodically);
- b) Failure\_Notify message has been removed;
- c) Frame format had been changed;
- d) New MAC address had been added.

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 of 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.

**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 publication 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/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 61558 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 patents concerning fault-tolerant Ethernet provided through the use of special interfaces providing duplicate ports that may be alternatively enabled with the same network address. Switching between the ports corrects single faults in a two-way redundant system. This is given in Clauses 5 and 6.

These patents are listed in the table below, where the [xx] notation indicates the holder of the patent rights:

US 7,817,538 B2	[RA]	Fault-tolerant Ethernet network
US 8,493,840	[RA]	Fault-tolerant Ethernet network

IEC takes no position concerning the existence, validity and scope of these patent rights.

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:

[RA] Rockwell Automation Technologies, Inc.  
1 Allen-Bradley Drive  
Mayfield Heights  
Ohio 44124, USA

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.

# INDUSTRIAL COMMUNICATION NETWORKS – HIGH AVAILABILITY AUTOMATION NETWORKS –

## Part 5: Beacon Redundancy Protocol (BRP)

### 1 Scope

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

This part of the IEC 62439 series specifies a redundancy protocol that is based on the duplication of the network, the redundancy protocol being executed within the end nodes, as opposed to a redundancy protocol built in the switches. Fast error detection is provided by two beacon nodes, the switchover decision is taken in every node individually. The cross-network connection capability enables singly attached end nodes to be connected on either of the two networks.

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

ISO/IEC TR 8802-1, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 1: Overview of Local Area Network Standards*

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

ISO/IEC 10164-1, *Information technology – Open Systems Interconnection – Systems Management: Object Management Function*

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

IEEE 802.1Q, *IEEE Standard for Local and metropolitan area networks: Media Access Control (MAC) Bridges and Virtual Bridged Local Area Networks*

### 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 in IEC 62439-1, apply.