IEC 60870-5-104

Edition 2.1 2016-06

CONSOLIDATED VERSION

VERSION CONSOLIDÉE

colour inside

Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles

Matériels et systèmes de téléconduite – Partie 5-104: Protocoles de transmission – Accès aux réseaux utilisant des profils de transport normalisés pour l'IEC 60870-5-101



IEC 60870-5-104:2006-06+AMD1:2016-06 CSV(en-fr)



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 Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
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
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
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
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
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
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
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: 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
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
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
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
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
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
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

IEC 60870-5-104

Edition 2.1 2016-06

CONSOLIDATED VERSION

VERSION CONSOLIDÉE

colour inside

Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles

Matériels et systèmes de téléconduite – Partie 5-104: Protocoles de transmission – Accès aux réseaux utilisant des profils de transport normalisés pour l'IEC 60870-5-101

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 33.200

ISBN 978-2-8322-3459-4

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.

® Registered trademark of the International Electrotechnical Commission
Marque déposée de la Commission Electrotechnique Internationale

IEC 60870-5-104

Edition 2.1 2016-06

REDLINE VERSION

VERSION REDLINE

colour inside

Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles

Matériels et systèmes de téléconduite – Partie 5-104: Protocoles de transmission – Accès aux réseaux utilisant des profils de transport normalisés pour l'IEC 60870-5-101



IEC 60870-5-104:2006-06+AMD1:2016-06 CSV(en-fr)

CONTENTS

FOREWORD....9
INTRODUCTION....7
1 Scope and object....8
2 Normative references....8
3 General architecture....9
4 Protocol structure....11
5 Definition of Application Protocol Control Information (APCI)....12
5.1 Protection against loss and duplication of messages....15
5.2 Test procedures....17
5.3 Transmission control using Start/Stop....19
5.4 Portnumber....23
5.5 Maximum number of outstanding I format APDUs (k)....23
6 Selection of ASDUs defined in IEC 60870-5-101 and additional ASDUs....23
7 Mapping of selected application data units and functions to the TCP services....27
7.1 Station initialization (6.1.5 to 6.1.7 of IEC 60870-5-5)....27
7.2 Data acquisition by polling (6.2 of IEC 60870-5-5)....32
7.3 Cyclic data transmission (6.3 of IEC 60870-5-5)....32
7.4 Acquisition of events (6.4 of IEC 60870-5-5)....32
7.5 General interrogation (6.6 of IEC 60870-5-5)....32
7.6 Clock synchronization (6.7 of IEC 60870-5-5)....33
7.7 Command transmission (6.8 of IEC 60870-5-5)....34
7.8 Transmission of integrated totals (6.9 of IEC 60870-5-5)....34
7.9 Parameter loading (6.10 of IEC 60870-5-5)....35
7.10 Test procedure (6.11 of IEC 60870-5-5)....36
7.11 File transfer (6.12 of IEC 60870-5-5) Control and monitor direction....36
8 ASDUs for process information in control direction with time tag....37
8.1 TYPE IDENT 58: C_SC_TA_1 Single command with time tag CP56Time2a....38
8.2 TYPE IDENT 59: C_DC_TA_1 Double command with time tag CP56Time2a....39
8.3 TYPE IDENT 60: C_RC_TA_1 Regulating step command with time tag CP56Time2a....40
8.4 TYPE IDENT 61: C_SE_TA_1 Set-point command with time tag CP56Time2a, normalized value....41
8.5 TYPE IDENT 62: C_SE_TB_1 Set-point command with time tag CP56Time2a, scaled value....42
8.6 TYPE IDENT 63: C_SE_TC_1 Set-point command with time tag CP56Time2a, short floating point number....43
8.7 TYPE IDENT 64: C_BO_TA_1 Bitstring of 32 bit with time tag CP56Time2a....44
8.8 TYPE IDENT 107: C_TS_TA_1 Test command with time tag CP56Time2a....45
8.9 TYPE IDENT 127: F_SC_NB_1 QueryLog – Request archive file....46
9 Interoperability....47
9.1 System or device....47
9.2 Network configuration....47
9.3 Physical layer....48
9.4 Link layer....48
9.5 Application layer....49
9.6 Basic application functions....54

10 Redundant connections 58
10.1 General 58
10.2 General requirements 58
10.3 Initialisation of controlling station 60
10.4 Initialisation of controlled station 62
10.5 User data from controlling station 64
10.6 User data from controlled station 66
10.7 State transition diagrams 68

Figure 1 – General architecture (example) 10
Figure 2 – Selected standard provisions of the defined telecontrol companion standard 11
Figure 3 – Selected standard provisions of the TCP/IP protocol suite RFC 2200 (example) 12
Figure 4 – APDU of the defined telecontrol companion standard 13
Figure 5 – APCI of the defined telecontrol companion standard 13
Figure 6 – Control field of type Information transfer format (I format) 14
Figure 7 – Control field of type numbered supervisory functions (S format) 14
Figure 8 – Control field of type unnumbered control functions (U format) 14
Figure 9 – Undisturbed sequences of numbered I format APDUs 15
Figure 10 – Undisturbed sequences of numbered I format APDUs acknowledged by an S format APDU 16
Figure 11 – Disturbed sequence of numbered I format APDUs 16
Figure 12 – Time-out in case of a not acknowledged last I format APDU 17
Figure 13 – Undisturbed test procedure 18
Figure 14 – Unconfirmed test procedure 18
Figure 15 – Start data transfer procedure 19
Figure 16 – Stop data transfer procedure 20
Figure 17 – State transition diagram for Start/Stop procedure (controlled station) 21
Figure 18 – State transition diagram for Start/Stop procedure (controlling station) 22
Figure 19 – TCP connection establishment and close 28
Figure 20 – Initialization of the controlling station 29
Figure 21 – Local initialization of the controlled station 30
Figure 22 – Remote initialization of the controlled station 31
Figure 23 – ASDU: C_SC_TA_1 Single command with time tag CP56Time2a 38
Figure 24 – ASDU: C_DC_TA_1 Double command with time tag CP56Time2a 39
Figure 25 – ASDU: C_RC_TA_1 Regulating step command with time tag CP56Time2a 40
Figure 26 – ASDU: C_SE_TA_1 Set-point command with time tag CP56Time2a, normalized value 41
Figure 27 – ASDU: C_SE_TB_1 Set-point command with time tag CP56Time2a, scaled value 42
Figure 28 – ASDU: C_SE_TC_1 Set-point command with time tag CP56Time2a, short floating point number 43
Figure 29 – ASDU: C_BO_TA_1 Bitstring of 32 bit with time tag CP56Time2a 44
Figure 30 – ASDU: C_TS_TA_1 Test command with time tag CP56Time2a 45
Figure 31 – ASDU: F_SC_NB_1 QueryLog – Request archive file 46

Figure 32 – Initialisation of controlling station with redundant connections 61
Figure 33 – Initialisation of controlled station with redundant connections 63
Figure 34 – Redundant connections – User data from controlling station 65
Figure 35 – Redundant connections – User data from controlled station 67
Figure 36 – State transition diagram for redundant connections (controlled station) 69
Figure 37 – State transition diagram for redundant connections (controlling station) 70

Table 1 – Process information in monitor direction 24
Table 2 – Process information in control direction 25
Table 3 – System information in monitor direction 26
Table 4 – System information in control direction 26
Table 5 – Parameter in control direction 26
Table 6 – File transfer 26

INTERNATIONAL ELECTROTECHNICAL COMMISSION

TELECONTROL EQUIPMENT AND SYSTEMS –

Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles

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, access to 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.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

DISCLAIMER
This Consolidated version is not an official IEC Standard and has been prepared for user convenience. Only the current versions of the standard and its amendment(s) are to be considered the official documents.

This Consolidated version of IEC 60870-5-104 bears the edition number 2.1. It consists of the second edition (2006-06) [documents 57/812/FDIS and 57/819/RVD] and its amendment 1 (2016-06) [documents 57/1613/CDV and 57/1667/RVC]. The technical content is identical to the base edition and its amendment.

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. 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 IEC 60870-5-104 Ed.2 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

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

IEC 60870-5 consists of the following parts, under the general title *Telecontrol equipment and systems – Part 5: Transmission protocols*

Part 5:	Transmission protocols – Section One: Transmission frame formats
Part 5:	Transmission protocols – Section 2: Link transmission procedures
Part 5:	Transmission protocols – Section 3: General structure of application data
Part 5:	Transmission protocols – Section 4: Definition and coding of application information elements
Part 5:	Transmission protocols – Section 5: Basic application functions
Part 5-6:	Guidelines for conformance testing for the IEC 60870-5 companion standards
Part 5-101:	Transmission protocols – Companion standard for basic telecontrol tasks
Part 5:	Transmission protocols – Section 102: Companion standard for the transmission of integrated totals in electric power systems
Part 5-103:	Transmission protocols – Companion standard for the informative interface of protection equipment
Part 5-104:	Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles
Part 5-601:	Conformance test cases for the IEC 60870-5-101 companion standard

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

IEC 60870-5-101 provides a communication profile for sending basic telecontrol messages between a central telecontrol station and telecontrol outstations, which uses permanent directly connected data circuits between the central station and individual outstations.

In some applications, it may be required to send the same types of application messages between telecontrol stations using a data network containing relay stations which store and forward the messages and provide only a virtual circuit between the telecontrol stations. This type of network delays messages by varying amounts of time depending on the network traffic load.

In general, the variable message delay times mean that it is not possible to use the link layer as defined in IEC 60870-5-101 between telecontrol stations. However, in some cases it is possible to connect telecontrol stations having all three layers of the companion standard IEC 60870-5-101 to suitable data networks using Packet Assembler Disassembler (PAD) type stations to provide access for balanced communication.

In all other cases this companion standard, which does not use the link functions of IEC 60870-5-101, may be used to provide balanced access via a suitable transport profile.

TELECONTROL EQUIPMENT AND SYSTEMS –

Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles

1 Scope and object

This part of IEC 60870 applies to telecontrol equipment and systems with coded bit serial data transmission for monitoring and controlling geographically widespread processes. It defines a telecontrol companion standard that enables interoperability among compatible telecontrol equipment. The defined telecontrol companion standard utilizes standards of the IEC 60870-5 series. The specifications of this part present a combination of the application layer of IEC 60870-5-101 and the transport functions provided by a TCP/IP (Transmission Control Protocol/Internet Protocol). Within TCP/IP, various network types can be utilized, including X.25, FR (Frame Relay), ATM (Asynchronous Transfer Mode) and ISDN (Integrated Service Data Network). Using the same definitions, alternative ASDUs (Application Service Data Unit) as specified in other IEC 60870-5 companion standards (for example, IEC 60870-5-102) may be combined with TCP/IP, but this is not described further in this part.

NOTE Security mechanisms are outside the scope of this standard.

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 60870-5-3:1992, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 3: General structure of application data*

IEC 60870-5-4:1993, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 4: Definition and coding of application information elements*

IEC 60870-5-5:1995, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 5: Basic application functions*

IEC 60870-5-101:2003, *Telecontrol equipment and systems – Part 5-101: Transmission protocols – Companion standard for basic telecontrol tasks*

IEC 60870-5-102:1996, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 102: Companion standard for the transmission of integrated totals in electric power systems*

ITU-T Recommendation X.25:1996, *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*

IEEE 802.3:1998, *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*

RFC 791, *Internet Protocol, Request for Comments 791 (MILSTD 1777) (September, 1981)*

RFC 793, *Transmission Control Protocol, Request for Comments 793 (MILSTD 1778) (September, 1981)*

RFC 894, *Internet Protocol on Ethernet Networks*

RFC 1661, *Point-to-Point Protocol (PPP)*

RFC 1662, *PPP in HDLC Framing*

RFC 1700, *Assigned Numbers, Request for Comments 1700 (STD 2) (October, 1994)*

RFC 2200, *Internet Official Protocol Standards, Request for Comments 2200 (June, 1997)*

3 General architecture

This standard defines the use of an open TCP/IP-interface to a network, containing for example a LAN for telecontrol equipment, which transports IEC 60870-5-101 ASDUs. Routers which include the different WAN-types (for example, X.25, Frame Relay, ISDN, etc.) may be connected via a common TCP/IP-LAN-interface (see figure 1). Figure 1 shows a redundant configuration in the central station in addition to a non-redundant system.

Motivations:

The use of separate routers offers the following advantages.

– There is no need for network-specific software in end systems.

– There is no need for routing functionality in end systems.

– There is no need for network management in end systems.

– It facilitates obtaining end systems from manufacturers that specialize in telecontrol equipment.

– It facilitates obtaining individual separate routers, to suit a variety of networks from manufacturers specializing in this non-telecontrol specific field.

– It is possible to change the network type by replacing only the router type, without affecting the end systems.

– It is particularly suitable for converting existing end systems that conform to IEC 60870-5-101.

– It is suitable for present and future implementations.