SVENSK STANDARD SS-EN 60870-5-104

Fastställd	Utgåva	Sida	Ansvarig kommitté
2006-12-18	2	1 (1+71)	SEK TK 57

Utrustning för fjärrstyrning – Del 5-104: Nätåtkomst för IEC 60870-5-101 med standardiserade transportprofiler

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

Som svensk standard gäller europastandarden EN 60870-5-104:2006. Den svenska standarden innehåller den officiella engelska språkversionen av EN 60870-5-104:2006.

Nationellt förord

Europastandarden EN 60870-5-104:2006[*)]

består av:

– **europastandardens ikraftsättningsdokument,** utarbetat inom CENELEC

– **IEC 60870-5-104, Second edition, 2006 - Telecontrol equipment and system - Part 5-104: Transmission protocols - Network access for IEC 60870-5-101 using standard transport profiles**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 60870-5-104, utgåva 1, 2002 gäller ej fr o m 2009-09-01.

[*)] EN 60870-5-104:2006 ikraftsattes 2006-12-18 som SS-EN 60870-5-104 genom offentliggörande, d v s utan utgivning av något svenskt dokument.

ICS 33.200

Denna standard är fastställd av SEK Svensk Elstandard,
som också kan lämna upplysningar om **sakinnehållet** i standarden.
Postadress: SEK, Box 1284, 164 29 KISTA
Telefon: 08 - 444 14 00. *Telefax*: 08 - 444 14 30
E-post: sek@elstandard.se. *Internet*: www.elstandard.se

Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a säkerhet, prestanda, dokumentation, utförande och skötsel av elprodukter, elanläggningar och metoder. Genom att utforma sådana standarder blir säkerhetskraven tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

SEK är Sveriges röst i standardiseringsarbetet inom elområdet

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

Stora delar av arbetet sker internationellt

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

SEK Svensk Elstandard
Box 1284
164 29 Kista
Tel 08-444 14 00
www.elstandard.se

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60870-5-104

November 2006

ICS 33.200

Supersedes EN 60870-5-104:2001

English version

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

(IEC 60870-5-104:2006)

Matériels et systèmes de téléconduite
Partie 5-104: Protocoles de transmission - Accès aux réseaux utilisant des profils de transport normalisés pour la CEI 60870-5-101
(CEI 60870-5-104:2006)

Fernwirkeinrichtungen und -systeme
Teil 5-104: Übertragungsprotokolle - Zugriff für IEC 60870-5-101 auf Netze mit genormten Transportprofilen
(IEC 60870-5-104:2006)

This European Standard was approved by CENELEC on 2006-09-01. 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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 60870-5-104:2006 E

SEK Svensk Elstandard

Foreword

The text of document 57/812/FDIS, future edition 2 of IEC 60870-5-104, prepared by IEC TC 57, Power systems management and associated information exchange, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60870-5-104 on 2006-09-01.

This European Standard supersedes EN 60870-5-104:2001.

The main changes with respect to EN 60870-5-104:2001 are as follows: improvement of the sequences and interoperability of the protocol and addition of new functions for the handling of redundant connections.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2007-06-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2009-09-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60870-5-104:2006 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60870-5-3	1992	Telecontrol equipment and systems Part 5: Transmission protocols - Section 3: General structure of application data	EN 60870-5-3	1992
IEC 60870-5-4	1993	Telecontrol equipment and systems Part 5: Transmission protocols - Section 4: Definition and coding of application information elements	EN 60870-5-4	1993
IEC 60870-5-5	1995	Telecontrol equipment and systems Part 5: Transmission protocols - Section 5: Basic application functions	EN 60870-5-5	1995
IEC 60870-5-101	2003	Telecontrol equipment and systems Part 5-101: Transmission protocols - Companion standard for basic telecontrol tasks	EN 60870-5-101	2003
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	EN 60870-5-102	1996
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	1981	Internet Protocol - DARPA Internet Program Protocol Specification	-	-
RFC 793	1981	Transmission Control Protocol - DARPA Internet Program Protocol Specification	-	-
RFC 894	-[1)]	Standard for the Transmission of IP datagrams over Ethernet Networks	-	-

[1)] Undated reference.

Publication	Year	Title	EN/HD	Year
RFC 1661	-[1)]	Point-to-Point Protocol (PPP)	-	-
RFC 1662	-[1)]	PPP in HDLC Framing	-	-
RFC 1700	1994	Assigned Numbers	-	-
RFC 2200	1997	Internet Official Protocol Standards	-	-

CONTENTS

INTRODUCTION 13

1 Scope and object 15
2 Normative references 15
3 General architecture 17
4 Protocol structure 21
5 Definition of Application Protocol Control Information (APCI) 23
5.1 Protection against loss and duplication of messages 29
5.2 Test procedures 33
5.3 Transmission control using Start/Stop 37
5.4 Portnumber 45
5.5 Maximum number of outstanding I format APDUs (k) 45
6 Selection of ASDUs defined in IEC 60870-5-101 and additional ASDUs 45
7 Mapping of selected application data units and functions to the TCP services 53
7.1 Station initialization (6.1.5 to 6.1.7 of IEC 60870-5-5) 53
7.2 Data acquisition by polling (6.2 of IEC 60870-5-5) 63
7.3 Cyclic data transmission (6.3 of IEC 60870-5-5) 63
7.4 Acquisition of events (6.4 of IEC 60870-5-5) 63
7.5 General interrogation (6.6 of IEC 60870-5-5) 63
7.6 Clock synchronization (6.7 of IEC 60870-5-5) 65
7.7 Command transmission (6.8 of IEC 60870-5-5) 67
7.8 Transmission of integrated totals (6.9 of IEC 60870-5-5) 69
7.9 Parameter loading (6.10 of IEC 60870-5-5) 69
7.10 Test procedure (6.11 of IEC 60870-5-5) 71
7.11 File transfer (6.12 of IEC 60870-5-5) Control and monitor direction 71
8 ASDUs for process information in control direction with time tag 73
8.1 TYPE IDENT 58: C_SC_TA_1 Single command with time tag CP56Time2a 75
8.2 TYPE IDENT 59: C_DC_TA_1 Double command with time tag CP56Time2a 77
8.3 TYPE IDENT 60: C_RC_TA_1 Regulating step command with time tag CP56Time2a 79
8.4 TYPE IDENT 61: C_SE_TA_1 Set-point command with time tag CP56Time2a, normalized value 81
8.5 TYPE IDENT 62: C_SE_TB_1 Set-point command with time tag CP56Time2a, scaled value 83
8.6 TYPE IDENT 63: C_SE_TC_1 Set-point command with time tag CP56Time2a, short floating point number 85
8.7 TYPE IDENT 64: C_BO_TA_1 Bitstring of 32 bit with time tag CP56Time2a 87
8.8 TYPE IDENT 107: C_TS_TA_1 Test command with time tag CP56Time2a 89
8.9 TYPE IDENT 127: F_SC_NB_1 QueryLog – Request archive file 91

9 Interoperability 93
9.1 System or device 93
9.2 Network configuration 93
9.3 Physical layer 95
9.4 Link layer 95
9.5 Application layer 97
9.6 Basic application functions 107
10 Redundant connections 115
10.1 General 115
10.2 General requirements 115
10.3 Initialisation of controlling station 119
10.4 Initialisation of controlled station 123
10.5 User data from controlling station 127
10.6 User data from controlled station 131
10.7 State transition diagrams 135

Figure 1 – General architecture (example) 19
Figure 2 – Selected standard provisions of the defined telecontrol companion standard 21
Figure 3 – Selected standard provisions of the TCP/IP protocol suite RFC 2200 (example) 23
Figure 4 – APDU of the defined telecontrol companion standard 25
Figure 5 – APCI of the defined telecontrol companion standard 25
Figure 6 – Control field of type Information transfer format (I format) 27
Figure 7 – Control field of type numbered supervisory functions (S format) 27
Figure 8 – Control field of type unnumbered control functions (U format) 27
Figure 9 – Undisturbed sequences of numbered I format APDUs 29
Figure 10 – Undisturbed sequences of numbered I format APDUs acknowledged by an S format APDU 31
Figure 11 – Disturbed sequence of numbered I format APDUs 31
Figure 12 – Time-out in case of a not acknowledged last I format APDU 33
Figure 13 – Undisturbed test procedure 35
Figure 14 – Unconfirmed test procedure 35
Figure 15 – Start data transfer procedure 37
Figure 16 – Stop data transfer procedure 39
Figure 17 – State transition diagram for Start/Stop procedure (controlled station) 41
Figure 18 – State transition diagram for Start/Stop procedure (controlling station) 43
Figure 19 – TCP connection establishment and close 55
Figure 20 – Initialization of the controlling station 57
Figure 21 – Local initialization of the controlled station 59
Figure 22 – Remote initialization of the controlled station 61
Figure 23 – ASDU: C_SC_TA_1 Single command with time tag CP56Time2a 75
Figure 24 – ASDU: C_DC_TA_1 Double command with time tag CP56Time2a 77
Figure 25 – ASDU: C_RC_TA_1 Regulating step command with time tag CP56Time2a 79

Figure 26 – ASDU: C_SE_TA_1 Set-point command with time tag CP56Time2a, normalized value 81
Figure 27 – ASDU: C_SE_TB_1 Set-point command with time tag CP56Time2a, scaled value 83
Figure 28 – ASDU: C_SE_TC_1 Set-point command with time tag CP56Time2a, short floating point number 85
Figure 29 – ASDU: C_BO_TA_1 Bitstring of 32 bit with time tag CP56Time2a 87
Figure 30 – ASDU: C_TS_TA_1 Test command with time tag CP56Time2a 89
Figure 31 – ASDU: F_SC_NB_1 QueryLog – Request archive file 91
Figure 32 – Initialisation of controlling station with redundant connections 121
Figure 33 – Initialisation of controlled station with redundant connections 125
Figure 34 – Redundant connections – User data from controlling station 129
Figure 35 – Redundant connections – User data from controlled station 133
Figure 36 – State transition diagram for redundant connections (controlled station) 137
Figure 37 – State transition diagram for redundant connections (controlling station) 139

Table 1 – Process information in monitor direction 47
Table 2 – Process information in control direction 49
Table 3 – System information in monitor direction 51
Table 4 – System information in control direction 51
Table 5 – Parameter in control direction 51
Table 6 – File transfer 51

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)*