SLOVENSKI STANDARD

SIST EN 61334-5-1:2002

prva izdaja
oktober 2002

Distribution automation using distribution line carrier systems - Part 5-1: Lower layer profiles - The spread frequency shift keying (S-FSK) profile (IEC 61334-5-1:2001)

ICS 29.240.99; 33.040.40; 35.100.05

Referenčna številka
SIST EN 61334-5-1:2002(en)

EUROPEAN STANDARD **EN 61334-5-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM July 2001

ICS 33.200

English version

Distribution automation using distribution line carrier systems
Part 5-1: Lower layer profiles –
The spread frequency shift keying (S-FSK) profile
(IEC 61334-5-1:2001)

Automatisation de la distribution à l'aide de systèmes de communication à courants porteurs
Partie 5-1: Profils des couches basses - Profil S-FSK (modulation par saut de fréquences étalées)
(CEI 61334-5-1:2001)

Verteilungsautomatisierung mit Hilfe von Trägersystemen auf Verteilungsleitungen
Teil 5-1: Profile der unteren Schichten - Profil für erweiterte Frequenz-sprungmodulation (S-FSK)
(IEC 61334-5-1:2001)

This European Standard was approved by CENELEC on 2001-06-01. 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and 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 61334-5-1:2001 E

Foreword

The text of document 57/512/FDIS, future edition 2 of IEC 61334-5-1, prepared by IEC TC 57, Power system control and associated communications, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61334-5-1 on 2001-06-01.

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) 2002-03-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2004-06-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annexes A and ZA are normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61334-5-1:2001 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 61334-4-41:1996 NOTE: Harmonized as EN 61334-4-41:1996 (not modified).

IEC 61334-4-42:1996 NOTE: Harmonized as EN 61334-4-42:1996 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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 61334-1-4	1995	Distribution automation using distribution line carrier systems Part 1: General considerations – Section 4: Identification of data transmission parameters concerning medium and low-voltage distribution mains	-	-
IEC 61334-4-1	1996	Part 4: Data communication protocols – Section 1: Reference model of the communication system	EN 61334-4-1	1996
IEC 61334-4-32	1996	Section 32: Data link layer - Logical link control (LLC)	EN 61334-4-32	1996
IEC 61334-4-511	2000	Part 4-511: Data communication protocols - Systems management - CIASE protocol	EN 61334-4-511	2000
IEC 61334-4-512	- [1]	Part 4-512: Data communication protocols - Systems management using profile 61334-5-1-MIB	-	-
ISO/IEC 7498-1	1994	Information technology - Open systems interconnection - Basic reference model The basic model	-	-
ISO/IEC 7498-3	1997	Information technology - Open systems interconnection - Basic reference model Naming and addressing	-	-
-	-	Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz Part 1: General requirements, frequency bands and electromagnetic disturbances	EN 50065-1 A1 A2 A3	1991 1992 1995 1996

[1] To be published.

NORME INTERNATIONALE

INTERNATIONAL STANDARD

CEI IEC 61334-5-1

Deuxième édition
Second edition
2001-05

Automatisation de la distribution à l'aide de systèmes de communication à courants porteurs –

Partie 5-1: Profils des couches basses – Profil S-FSK (modulation par saut de fréquences étalées)

Distribution automation using distribution line carrier systems –

Part 5-1: Lower layer profiles – The spread frequency shift keying (S-FSK) profile

International Electrotechnical Commission 3, rue de Varembé Geneva, Switzerland
Telefax: +41 22 919 0300 e-mail: inmail@iec.ch IEC web site http://www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE XB

Pour prix, voir catalogue en vigueur
For price, see current catalogue

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

DISTRIBUTION AUTOMATION USING DISTRIBUTION LINE CARRIER SYSTEMS –

Part 5-1: Lower layer profiles – The spread frequency shift keying (S-FSK) profile

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61334-5-1 has been prepared by IEC technical committee 57: Power system control and associated communications.

This second edition cancels and replaces the first edition which was issued as a technical report in 1996. It constitutes a technical revision and now has the status of an International Standard.

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

FDIS	Report on voting
57/512/FDIS	57/523/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 3.

Annex A forms an integral part of this standard.

The committee has decided that the contents of this publication will remain unchanged until 2010. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

DISTRIBUTION AUTOMATION USING DISTRIBUTION LINE CARRIER SYSTEMS –

Part 5-1: Lower layer profiles – The spread frequency shift keying (S-FSK) profile

1 General

1.1 Scope and object

This part of IEC 61334 describes the requirements of S-SFK (frequency shift keying modulation) in conjunction with the services provided by the physical layer entity and the MAC sublayer. The transmission medium is assumed to be the distribution network on both MV or LV level. The MAC sublayer described in this standard interfaces with the logical link control layer described in IEC 61334-4-32.

The three parts – modulation, physical layer and MAC sublayer – are matched to each other so that an optimum cost-performance relation can be achieved.

The profile described in this standard is one of several profiles (described in series IEC 61334-5) which are all designed for data transmission via the distribution network. Considering the ongoing technical development in this field, the profiles are published first as technical specifications with the intention to transform into standards those profiles which are successful in practice.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61334. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61334 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC/TR 61334-1-4:1995, *Distribution automation using distribution line carrier systems – Part 1: General considerations – Section 4: Identification of data transmission parameters concerning medium and low voltage distribution mains*

IEC 61334-4-1:1996, *Distribution automation using distribution line carrier systems – Part 4: Data communication protocols – Section 1: Reference model of the communication system*

IEC 61334-4-32:1996, *Distribution automation using distribution line carrier systems – Part 4: Data communication protocols – Section 32: Data link layer – Logical link control (LLC)*

IEC 61334-4-511:2000, *Distribution automation using distribution line carrier systems – Part 4-511: Data communication protocols – Systems management – CIASE protocol*

IEC 61334-4-512, *Distribution automation using distribution line carrier systems – Part 4-512: Data communication protocols – Systems management using profile 61334-5-1 MIB* [1)]

ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model – The Basic Model*

ISO/IEC 7498-3:1997, *Information technology – Open Systems Interconnection – Basic Reference Model – Naming and addressing*

EN 50065-1:1991, *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz – Part 1: General requirements, frequency bands and electromagnetic disturbances*

1.3 Definitions

For the purpose of this part of IEC 61334, the definitions of ISO/IEC 7498-1 and EN 50065-1 apply.

2 Modulation

2.1 Purpose

S-FSK is a modulation and demodulation technique which combines some of the advantages of a classical spread spectrum system (for example, immunity against narrowband interferers) with the advantages of a classical FSK system (low-complexity, well-investigated implementations).

2.2 Spread frequency shift keying (S-FSK) principle

The transmitter assigns the space frequency f_S to "data 0" and the mark frequency f_M to "data 1". The difference between S-FSK and the classical FSK lies in the fact that f_S and f_M are now placed far from each other (spreading). By placing the signal for "space" far from the signal for "mark", their transmission quality becomes independent (the strengths of the small-band interferences and the signal attenuations are both independent at the two frequencies).

The receiver performs conventional FSK demodulation at the two possible frequencies (the half-channels) resulting in two demodulated signals d_S and d_M. If the average reception quality of the two half-channels is similar (see figure 1), then the decision unit decides on the higher of the two demodulated channels ("data 0" if $d_S > d_M$, "data 1" if $d_S < d_M$). If, however, the average reception quality of one half-channel is significantly better than the quality of the other half-channel (see figure 2), then the decision unit compares the demodulated signal of the better channel with a threshold T, thus ignoring the worse channel.

The quality measurements and the threshold computation may be based on a predefined preamble which precedes the transmission of the actual data frame.

---

1) To be published.

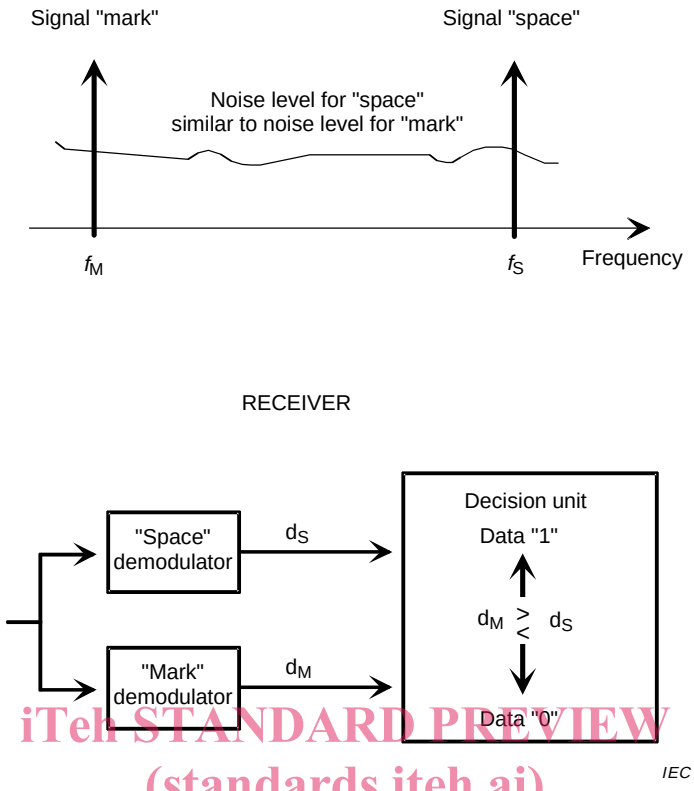

Figure 1 – Quality "space" similar to quality "mark"

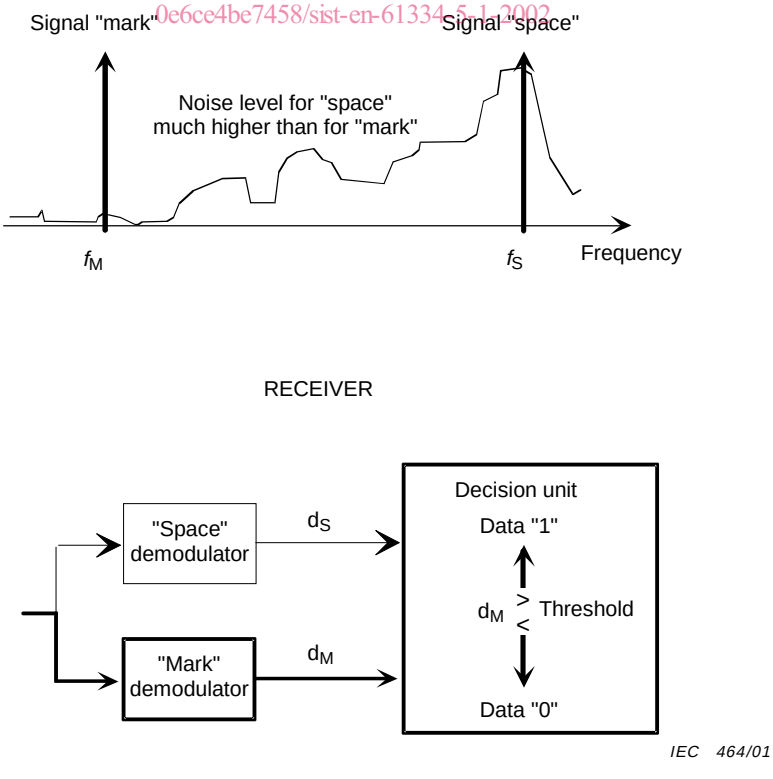

Figure 2 – Quality "mark" much better than quality "space"

2.3 Spreading

The values for the absolute frequency deviation $|f_M - f_S|$ should be such that the signal transmission qualities at f_M and at f_S are independent of each other. Taking into account the measurements presented in IEC 61334-1-4, it is recommended that $|f_M - f_S| > 10$ kHz be used.

f_M and f_S shall be situated in the frequency band defined in EN 50065-1.

2.4 Performance tests

2.4.1 Purpose

The quality of the implementation is guaranteed by different performance tests. The tests can be performed under laboratory conditions and shall be reproducible.

The BER (bit error rate) measurements are made by transmitting a preamble, a frame delimiter followed by a block of 38 bytes of data. It is assumed that no frame synchronization errors are encountered. The BER is measured by counting the errors in the block of data.

The tests which will be described in the following subclauses shall be accomplished for receiver input signals in the range of 2 mV_{rms} to 2 V_{rms}.

Different kinds of interferences are added to the transmitted signal.

2.4.2 White noise BER tests

White Gaussian noise is added to the transmitted signal.

N_0 [W/Hz] denotes the noise power spectral density measured at the input of the receiver at frequencies $f_c - f_d$, f_c and $f_c + f_d$. It shall be ensured that the noise spectrum is flat between $f_c - f_d$ and $f_c + f_d$.

E_b [Ws] denotes the received signal energy per bit. $E_b = V^2_{signal}(\text{r.m.s.})$, where $V_{signal}(\text{r.m.s.})$ is the true r.m.s. (root mean square) value of the transmitted signal at the receiver input. The bandwidth of the r.m.s. voltmeter shall be such that the entire frequency range of the signal is considered.

Because the channel may behave differently for the two transmitted frequencies (different noise levels and/or different attenuation) the AWGN (additive white Gaussian noise) tests are made using different signal levels. E_{b1} is the energy of the received signal if "logical 1" is transmitted, E_{b0} is the energy of the received signal if "logical 0" is transmitted. The average energy per bit then becomes $E_b = (E_{b1} + E_{b0})/2$.

The ratio between the two signal energy levels is denoted as energy ratio x, where $x = E_{b1}/E_{b0}$.

The following E_b/N_0 values shall not be exceeded while achieving the given BERs.

Table 1 – Maximum E_b/N_0 allowed to achieve a given BER

BER	–5 dB < *x* < 5 dB	*x* = ±10 dB	*x* = ±20 dB
10^{-5}	E_b/N_0 < 21 dB	E_b/N_0 < 17 dB	E_b/N_0 < 7 dB
10^{-4}	E_b/N_0 < 19 dB	E_b/N_0 < 15 dB	E_b/N_0 < 5 dB
10^{-3}	E_b/N_0 < 17 dB	E_b/N_0 < 13 dB	E_b/N_0 < 3 dB
10^{-2}	E_b/N_0 < 14 dB	E_b/N_0 < 11 dB	E_b/N_0 < 1 dB
10^{-1}	E_b/N_0 < 10 dB	E_b/N_0 < 7 dB	E_b/N_0 < –3 dB
2×10^{-1}	E_b/N_0 < 8 dB	E_b/N_0 < 4 dB	E_b/N_0 < –5 dB
NOTE The E_b/N_0 limits should serve as guidelines. They are at least 3 dB above the theoretically achievable values.			

2.4.3 Narrowband interferer BER tests

One sinusoidal interferer of frequency f_N is added to the transmitted signal. The average interferer power is $S_N = V^2_{interferer}$(r.m.s.). The average signal power is $S_S = V^2_{signal}$(r.m.s.).

For S_N/S_S < 30 dB, no errors shall be encountered (BER < 10^{-5}) for any frequency 20 kHz < f_N < 95 kHz.

2.4.4 Impulsive noise BER tests

Periodic impulsive noise with an amplitude of 5 V peak to peak, a frequency *f* and duty cycles between 10 % and 50 % is used. The signal amplitude is set to 20 mV_{rms}. The BER shall be lower than 10^{-5} for *f*=100 Hz and *f*=1 000 Hz.

3 Physical layer

3.1 Purpose

This clause covers the services required of the DCP physical layer entity at the logical interfaces with the MAC sublayer. It also defines the transmission methods which are used to provide the information flow through the physical channel (LV power distribution network).

3.2 Transmission method

Distribution line signalling equipment will interface with distribution power-line wiring systems with the following characteristics:

a) AC single-phase or three-phase;

b) 50 Hz or 60 Hz ± 10 %;

c) 230 V_{rms} (190 V_{rms} min., 250 V_{rms} max.).

3.2.1 Coding

Non-return-to-zero (NRZ) coding is used.

3.2.2 Bit timing

At 50 Hz, the maximum duration of a data (transmission moment) is 3,333 ms. The defined bit duration corresponds to a minimum transmission speed of 300 bits/s at 50 Hz, and 360 bits/s at 60 Hz.