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Stanovanjski in stavbni elektronski sistemi (HBES) – 5-3. del: Mediji in nivoji, odvisni od medijev – Radijske frekvence

Home and Building Electronic Systems (HBES) -- Part 5-3: Media and media dependent layers - Radio frequency

Elektrische Systemtechnik für Heim und Gebäude (ESHG) Teil 5-3: Medien und medienabhängige Schichten - Signalübertragung über Funk

Systemes électroniques pour les foyers domestiques et les bâtiments (HBES) Partie 5-3: Medias et couches dépendantes des medias - Radio fréquence

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Home and Building Electronic Systems (HBES)
Part 5-3: Media and media dependent layers - Radio frequency

Systèmes électroniques pour les foyers domestiques et les bâtiments (HBES)
Partie 5-3: Medias et couches dépendantes des medias -
Radio fréquence

Elektrische Systemtechnik
für Heim und Gebäude (ESHG)
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Signalübertragung über Funk

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

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 205, Home and Building Electronic Systems (HBES) joined by the co-operating partner Konnex Association.

The text of the draft was submitted to the Unique Acceptance Procedure (UAP) and was approved by CENELEC as EN 50090-5-3 on 2006-10-01.

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)	2007-10-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2009-10-01

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EN 50090-5-3 is part of the EN 50090 series of European Standards, which will comprise the following parts:

Part 1: Standardization structure

Part 2: System overview

Part 3: Aspects of application

Part 4: Transport layer and network layer

Part 5: Media and media dependent layers

Part 6: Interfaces

Part 7: Management

Part 8: Conformity assessment of products

Part 9: Installation requirements

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Introduction

According to the OSI reference model, the Physical Layer consists of the medium, the cable, the connectors, the transmission technology, etc. which refers to the hardware requirements. However, the focus of this European Standard lies first and foremost on the description of the “communication medium”.

1 Scope

This European Standard defines the mandatory and optional requirements for the medium specific Physical and Data Link Layer of Radio Frequency for HBES products and systems, a multi-application bus system where the functions are decentralised, distributed and linked through a common communication process.

This European Standard is used as a product family standard. It is not intended to be used as a stand-alone standard.

Data Link Layer interface and general definitions, which are medium independent, are given in EN 50090-4-1.

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.

EN 50090-1	-[1)]	*Home and Building Electronic Systems (HBES)* *Part 1: Standardization structure*
EN 300 220-1	2000	*ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Short Range Devices (SRD);Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW* *Part 1: Technical characteristics and test methods*
EN 301 489-3	2000	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services* *Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz*
IEC 60870-5-1	1990	*Telecontrol equipment and systems* *Part 5: Transmission protocols - Section One: Transmission frame formats*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purpose of this European Standard, the definitions given in EN 50090-1 apply.

3.2 Abbreviations

BER	bit error rate
DLL	Data Link Layer
ERP	effective radiated power
FSK	frequency shift keying

1) At draft stage.

PhL Physical Layer

Rx Receiver

TRx Transceiver

Tx Transmitter

4 Physical Layer Type RF

4.1 General

Table 1 - General requirements for Physical Layer Type RF

Characteristic	Value or applicable standard
Tx centre frequency	f_c = 868,300 000 MHz
Maximum Tx frequency tolerance	± 35 ppm [a]
Maximum Tx duty cycle	1 %
Tx modulation type	FSK
FSK deviation	f_{DEV} = ± 40 kHz to ± 80 kHz typically 50 kHz
Tx chip rate	32 768 cps
Maximum Tx chip rate tolerance	± 1,5 %
Maximum Tx jitter per transition	± 1 µs
Minimum Tx ERP	0 dBm
Rx blocking performance	according EN 300 220-1, 9.3.3 for class 2 receivers [b]
Rx centre frequency	f_c = 868,30 MHz
Rx frequency tolerance	± 35 ppm HBES RF Tx to HBES RF Rx [a, b] ± 60 ppm Metering Tx to HBES RF Rx [a, b]
Minimal Rx chip rate tolerance	±2,0 % [b]
Rx sensitivity	typical: -95 dBm [b] minimal: -80 dBm [b]
Operating temperature range	-5 °C to 45 °C [c]

[a] This frequency tolerance includes tolerances due to temperature variations within the operating temperature range and tolerances due to crystal aging.

[b] At Bit Error Rate (BER) 10^{-4} in optimum antenna direction.

[c] The tests according to EN 300 220-1 shall be performed at 55 °C upper limit (temperature classes, Subclause 5.4.1.2).

NOTE Compliance to the above requirements guarantees a link budget of minimal -80 dB. In typical cases, this will be –95 dB. A link budget of –100 dB is recommended.

4.1.1 Frame structure related

Table 2 - Frame definition

Characteristics	Value	Notes
Data encoding	Manchester	chip "0" means f_{LO} (= f_C - f_{DEV}) chip "1" means f_{HI} (= f_C + f_{DEV}) bit "0" is coded as f_{HI} to f_{LO} transition, chip sequence "10" bit "1" is coded as f_{LO} to f_{HI} transition, chip sequence "01"
Preheader	consists of Preamble, Manchester violation, Sync word	see below
Preamble	min. 15x chip sequence "01"	learning sequence for Rx, number of preamble chips is not checked by

Characteristics	Value	Notes
	sent by Tx	Rx
Manchester violation	chip sequence "000111"	necessary for capture effect
Sync word	chip sequence "011010010110"	Useful for synchronisation on chip rate
Postamble	2 chips to 8 chips	software reasons, mandatory for all Tx, number of postamble not checked by Rx.
Capture effect	optional	Preheader allows it; Rx may use it

5 Data Link Layer Type RF

5.1 Differences to existing (bi-directional) HBES protocol

5.1.1 Extended Group Address

The Extended Group Address (8 octets) in a HBES RF frame shall be the combination of the standard HBES Group Address (2 octets) with the HBES Serial Number of the sender of the frame (6 octets). Every group addressed HBES RF frame shall contain an Extended Group Address.

The consequence from this is that groups consist of one sender and n receivers, hence form a 1-to-n relationship. If several senders control a group of actuators, each of these actuators shall listen to the sending addresses of all senders.

The receiver shall only take a received frame in account if the receiver knows the Extended Group Address of the sender.

NOTE According to the HBES RF frame definition, these 8 octets are not transmitted consecutively.

The HBES RF frame shall contain the HBES Serial Number of the sender for the following communication modes:

- point-to-multipoint, connectionless (multicast) and
- point-to-system, connectionless (system broadcast).

This shall be indicated by the value 0 of the field AddrExtensionType in the second block of the HBES RF frame. Multicast frames received with the wrong value of the AddrExtensionType shall be discarded by the receiving Data Link Layer instance.

For other communication modes, the HBES RF Domain Address shall be used.

In any frame in system broadcast communication mode the Destination Address shall be 0000h and the Address Type shall be “group”.

5.1.2 Predefined Extended Group Addresses for transmit-only devices

Transmit only devices shall use Extended Group Addresses. As transmit-only devices only have sending Datapoints (only one Group Address per Datapoint), all addresses can and shall be factory set.

- For Group Addresses

  For all unidirectional sensors, Datapoint 1 shall have Group Address = 0001h, Datapoint 2 shall have Group Address = 0002h, Datapoint N will have Group Address = N, with as result on the bus Extended Group Address (Serial Number of sensor, 0001h) , (Serial Number of sensor, 0002h) and (Serial Number of sensor, N). These Group Addresses shall be unique for each sender.

- For Individual Addresses

  All devices shall have the default Individual Address (05FFh).

5.1.3 RF Domain Address

The RF Domain Address shall be a 6 octet number. The RF Domain Address in an RF installation shall always be identical to the HBES Serial Number of one of the devices in the installation. This shall guarantee that the RF Domain Address is a unique number.

The RF frame shall contain the RF Domain Address for the following communication modes:

- point-to-point, connectionless,
- point-to-point, connection-oriented and
- point-to-all-points, connectionless (broadcast).

This shall be indicated by the value 1 of the field AddrExtensionType in the second block of the RF frame. Point-to-point connectionless and point-to-point connection-oriented frames received with the wrong value of the AddrExtensionType shall be discarded by the receiving Data Link Layer instance.

For other communication modes, the HBES Serial Number shall be used.

In any frame in broadcast communication mode the Destination Address shall be 0000h and the Address Type shall be “group”.

5.1.4 RF Broadcast and RF System Broadcast

Broadcasts can be broadcasts within an installation or system broadcasts. Whether a broadcast is a system broadcast shall be indicated by the AddrExtensionType field in the second block of the RF frame.

0: system broadcast (shall not be restricted to the RF installation = domain; the frame shall contain the Serial Number of the sender).

1: broadcast (shall be restricted to the installation = domain; the frame shall contain the Domain Address).

5.2 Data Link Layer Frame

5.2.1 General

This clause specifies the frame format of the HBES-RF system.

NOTE No difference is made in coding Standard Frames and Extended Frames as on the other media.

5.2.2 Structure

The frame format builds on the FT3 Data Link Layer (IEC 60870-5). The frame shall consist of a preamble (Physical Layer), several data blocks, each followed by 2 octets CRC, and a postamble (Physical Layer).

The first data block shall have a fixed length of 10 data octets. The following blocks shall contain 16 data octets, except the last block, which may contain less than 16 octets (the remainder).

The HBES RF-Ctrl octet in the second data block contains the 4 bits “frame format”.

	10 octets	2 octets	16 octets	2 octets		2 octets	
preamble	data block 1	CRC	Data block 2	CRC	…	CRC	postamble

Figure 1 - Overview of the link layer frame

5.2.3 Bit and octet order

Data shall be transmitted most significant bit (msb) first.

For data fields consisting of multiple octets (e.g. HBES Serial Number/Domain Address and Device Addresses) the most significant octet (MSB) shall be transmitted first.

5.2.4 First block

5.2.4.1 General

1 octet	1 octet	1 octet	1 octet	6 octets	2 octets	
Length	C-field	Esc	RF-Info	SN/DoA	CRC	CRC

Figure 2 - Structure of the first block

5.2.4.2 Significance of the fields in the first block

Length: in accordance with IEC 60870-5, the total number of user octets counted from the C-field (excluding the CRCs).

C-field: in accordance with IEC 60870-5, HBES RF only uses SEND/NO REPLY (C = 44h).

Esc: this field shall have the fixed value FFh.

RF-Info

Table 3 - Coding of the RF info field

Bit	Name	Possible codings and their significance
7 (msb)	reserved	shall be set to 0
6	-	shall be set to 0b by the sender
4/5	-	shall be set to 00b by the sender
2/3	received signal strength. May be filled in by the retransmitter with the lowest received signal strength. Senders always send 00h, Retransmitter shall not change the value if it cannot measure it.	00b void (no measurement) 01b weak 10b medium 11b strong
1	battery state of the sender	0: battery is weak 1: battery is ok
0 (lsb)	Unidir	0: frame sent by bidirectional device, 1: frame sent by unidirectional device

SN/DoA: Serial Number or Domain Address of the sender. The field AddrExtensionType in the L/NPCI in the second block shall indicate whether this field contains the HBES Serial Number or the Domain Address.

CRC: according to IEC 60870-5-1

For information: The CRC according to FT3 of IEC 60870-5-1 uses

$$2^{16}+2^{13}+2^{12}+2^{11}+2^{10}+2^{8}+2^{6}+2^{5}+2^{2}+2^{0}$$

as a generator polynomial. It starts with zero and treats the data msb first. The CRC result is complemented. The MSB of the 16-Bit CRC is transmitted first.

Example: the sequence 01 02 03 04 05 06 07 08 has the CRC FCBC.