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Stanovanjski in stavbni elektronski sistemi (HBES) - 5-3. del: Mediji in nivoji, odvisni od medijev - Radijska frekvenca za HBES razreda 1

Home and Building Electronic Systems (HBES) - Part 5-3: Media and media dependent layers - Radio Frequency for HBES Class 1

Elektrische Systemtechnik für Heim und Gebäude (ESHG) - Teil 5-3: Medien und medienabhängige Schichten - Signalübertragung über Funk für ESHG Klasse 1

Systèmes électroniques pour les foyers domestiques et les bâtiments (HBES) - Partie 5-3: Médias et couches dépendantes des médias - Radio Fréquence pour HBES Classe 1

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Home and Building Electronic Systems (HBES) - Part 5-3: Media and media dependent layers - Radio Frequency for HBES Class 1

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European foreword

This document (EN 50090-5-3:2016) has been prepared by CLC/TC 205 "Home and Building Electronic Systems (HBES)".

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2016-11-02
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This document supersedes EN 50090-5-3:2006.

EN 50090-5-3:2016 includes the following significant technical changes with respect to EN 50090-5-3:2006:

- the difference between this version and the previous version of Part 5-3 is that the previous version contained only a description of the HBES RF Ready solution, where the current version was extended with the upward compatible HBES RF Multi solution.

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Introduction

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1 Scope

This European Standard defines the mandatory and optional requirements for the medium specific Physical and Data Link Layer of HBES Radio Frequency.

Data Link Layer interfaces and general definitions that are medium independent are given in EN 50090-4-1.

This European standard defines the requirements for HBES RF Ready and HBES RF Multi devices. HBES RF Ready is a single RF channel system. HBES RF Multi is an RF multichannel evolution of HBES RF Ready system with 2 additional RF channels for fast reaction time products and 2 RF channels for slow reaction time products.

HBES RF Multi, specified below provides the following features:

- more reliability in Frame transmissions in presence of interferers.
- more efficiency when more HBES RF products are installed at the same location.
- mixing of permanent and non-permanent receiving products.
- mixing of fast and slow reaction time devices.
- Listen Before Talk.

Fast RF channels are mainly intended to be used with human controlled applications like for example lights, shutters… Slow RF channels are mainly intended to be used with non-permanent receivers for automatic applications like sensors (smoke, temperature, wind, etc.), heating control, etc.

Compatibility issues with products in compliance with the former HBES RF specification (HBES RF 1.1) and the new versions are considered in Clause 7 at the end of this document.

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.

EN 50090-1:2011, *Home and Building Electronic Systems (HBES) — Part 1: Standardization structure*

EN 50090-4-1, *Home and Building Electronic Systems (HBES) — Part 4-1: Media independent layers — Application layer for HBES Class 1*

EN 50090-4-2, *Home and Building Electronic Systems (HBES) — Part 4-2: Media independent layers — Transport layer, network layer and general parts of data link layer for HBES Class 1*

ETSI EN 300 220 (all parts), *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*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 50090-1:2011 and the following apply.

3.1.1
RF channel hopping
action to change the RF channel during or after transmitting a frame

3.1.2
budget link
budget link of a device is the difference expressed in dB between the max radiated power and the radiated sensitivity. The higher the budget link, the better the radio range is

3.2 Abbreviations

AFA Adaptive Frequency Agility

BER Bit Error Rate

D.C. Duty Cycle

DLL Data Link Layer

EOA End of Ack

ERP Effective Radiated Power

F1 F1 RF channel with a preamble of 15 ms in the transmitted Frame

F1r F1 RF channel with a preamble of 4,8 ms in the transmitted Frame

F1sh F1 RF channel with a preamble of 1ms in the transmitted Frame

FSK Frequency Shift Keying

F_x One of F1, F2 or F3 RF channels

GFSK Gaussian Frequency Shift Keying

LBT Listen Before Talk

NPRM Non-Permanent Reception Mode

PhL Physical Layer

PRM Permanent Reception Mode

Rx Receiver

RSSI Received Signal Strength Indication

SN HBES Serial Number

S_x One of S1 or S2 RF channels

TRx Transceiver

Tx Transmitter

4 General

As described in the scope, this European standard defines the RF Physical Layer requirements for:

- HBES RF Ready;
- HBES RF Multi.

For HBES certification in Europe, the products shall be in compliance with at least one of the following clauses.

Table 1 — Guide for compliance

System	Physical Layer	Data Link Layer
HBES RF Ready	5.1	6.1 and 6.2
HBES RF Multi	5.2	6.1 and 6.3

5 HBES RF Physical Layer

5.1 Physical Layer for HBES RF Ready

5.1.1 Signalling for HBES RF Ready

Table 2 — General requirements for Physical Layer Type HBES RF Ready

Characteristic	Value or applicable standard
Tx centre frequency	f_c = 868,300 MHz
Bandwidth	600 kHz
Max. Tx frequency tolerance	± 25 ppm [a]
Tx duty cycle max	1 %
Tx modulation type	FSK
FSK deviation	f_{DEV} = ± 48 kHz to ± 80 kHz typically 60 kHz
Tx chip rate	32 768 chips per second
Maximum Tx chip rate tolerance	± 1,5 %
Maximum Tx jitter per transition	± 5 µs
Tx ERP	Typical : 0 dBm Min : -3 dBm Max: +14dBm
Rx blocking performance	according to ETSI EN 300 220-1, category 2 receivers [b]
Rx centre frequency	f_c = 868,300 MHz
Rx frequency tolerance	± 25 ppm HBES Tx to HBES Rx [a, b] ± 60 ppm Metering Tx to HBES Rx [a, b]
Minimal Rx chip rate tolerance	±2,0 % [b]
Rx radiated sensitivity	typical: -95 dBm [b] minimal: -80 dBm [b]
Minimal operating temperature range	0°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] HBES Physical Layer parameters shall be met for the entire product temperature range declared by the manufacturer. (e.g. : -10°C to 70°C for outdoor usage).

A link budget of 100 dB is recommended.

5.1.2 Telegram structure for RF Ready

Table 3 — HBES Ready systems Telegrams 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	79x chip sequence "01" sent by Tx	learning sequence for Rx, number of preamble chips is not checked by Rx (~4.8 ms)
Manchester violation	chip sequence "000111"	necessary for capture effect
Sync word	chip sequence "011010010110"	useful for synchronization 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

5.1.3 Medium access RF Ready

5.1.3.1 Definition and use

Medium access control shall serve for prevention of collisions on the RF medium. For two reasons medium access cannot be completely controlled on RF.

1) Unidirectional senders access the medium at non-predictable times.
2) Non HBES RF devices access the medium at non-predictable times.

Bidirectional devices shall be able to sense whether the medium is free before they transmit. The inter-Frame time shall be the time interval during which a bidirectional device shall wait for a free medium (regardless of whether it is addressed by a preceding Frame or not). If no preamble is detected during this interFrame time the device may start sending.

If a Frame is received while the Physical Layer gets a request to send, the interFrame time shall start after the Frame reception is completed, this is after the last CRC is received. The same shall apply for sending: if the Physical Layer gets a send request while it is sending, the interFrame time shall start when the last CRC is transmitted.

NOTE RF supports no collision avoidance; therefore the transmission priorities are not coded in the Frame.

5.1.3.2 Medium Access Time

Table 4 – Medium access times

Type of frame	InterFrame time [Tint]	Random time [Trd]	Total medium access Time [Tma]
REPEATED Ready frame	5 ms	0 ms ≤ Trd < 10 ms	5 ms ≤ Tma < 15 ms
Ready frame Bidirectional devices	15 ms	0 ms ≤ Trd < 15 ms	15 ms ≤ Tma < 30 ms
Ready frame Unidirectional devices	150 ms	0 ms ≤ Trd < 10 ms	150 ms ≤ Tma < 160 ms

The assumed typical 'blind time' for devices is 1 ms.

The step for the random time shall be 1 ms.

5.2 Physical Layer for HBES RF Multi

5.2.1 General requirements (HBES RF Multi)

The RF channels used in the HBES RF Multi shall be composed of the following 3 + 2 RF channels.

Table 5 – RF channels of the HBES RF Multi Physical Layer

RF channel name	Abbreviation	signalling speed kbps	encoding	preamble length ms
Primary fast RF channel	F1	16,384	Manchester	15
Second fast RF channel	F2	16,384	Manchester	15
Third fast RF channel	F3	16,384	Manchester	15
Primary slow RF channel	S1	8,192	Manchester	500
Second slow RF channel	S2	8,192	Manchester	500

The RF channels shall be divided in two categories.

1) The first category shall contain RF channels for "fast" RF Telegrams. The fast Telegrams shall be composed of a short **15 ms** wake-up at **16,384 kbps** signalling speed.

2) The second category contains RF channels for "slow" RF Telegrams. The slow Telegrams are composed of a long **500 ms** wake-up at **8,192 kbps** signalling speed.

The two categories of RF channels define explicitly two application domains.

EXAMPLE 1 Non-permanent receivers: smoke sensors, heating control.

EXAMPLE 2 Permanent receivers: all devices concerning human interaction

The first three Fast RF channels are primarily used in application for fast permanent and non-permanent receivers and the last two RF channels are primarily used for slow non-permanent Rx devices. The receiver reception capability determines the preamble length.

Devices from both categories can coexist independently without link or with links done by specific mains powered products receiving all the 5 RF channels.

Fast Telegrams are Telegrams transmitted on any of the Fast RF channels; slow Telegrams are Telegrams transmitted on a Slow RF channel.

Typically NPRM devices using slow Telegrams can only receive RF Telegrams with long wake-up. This enables the NPRM devices to stay in low power mode most of the time and to become periodically active for the reception of a long preamble. It is suggested that battery powered devices use mainly the RF channels S1 and S2 with the lower data rate.

PRM devices supporting the Fast RF channels shall be in permanent scanning and receiving mode.

NPRM devices supporting the Fast RF channels shall scan each RF channel every 15 ms (1 ms for hopping, 1 ms for scanning one RF channel). If a preamble is detected, it shall listen to the Frame, if not it shall jump to next RF channel.

A receiver on only one RF channel without scanning any other is not permitted.

In the first three Fast RF channels, the first RF channel is the one used by RF HBES Ready devices and the two other Fast RF channels are escape RF channels used in case of a busy RF channel.

In the two Slow RF channels, the first one is S1 for slow products and the other Slow RF channels is an escape RF channel used in case of a busy RF channel.

Devices will mainly use F1, F2, F3 or S1, S2: 5 RF channels will only in very seldomly be supported in applications.

5.2.2 Physical Layer type RF Multi

5.2.2.1 HBES RF1 channel definitions for RF channels F1, F2 and F3

Table 6 – RF channel definitions for RF1 channels F1, F2 and F3

Parameter	Value		Comment
Tx centre frequency	Channel F1	868,300 MHz	**HBES Tx to HBES Rx** [b] Tx : ± 25 ppm Rx : ± 25 ppm **Metering Tx to HBES RF Multi** [c] Tx : ± 60 ppm Rx : ± 60 ppm
	Channel F2	868,950 MHz	
	Channel F3 [a]	869,850 MHz	
TX radiated power	Typical: 0 dBm Min: -3 dBm Max: +14 dBm		
Deviation	± 48 kHz to ± 80 kHz		Typical : 60 kHz
Max allowed bandwidth	500 kHz 300 kHz		For F1 and F2 For F3 [a]
Tx max duty cycle	1 % for F1 0,1 % for F2 100 % for F3		For F3 only, Duty Cycle is 100 % up to a maximum radiated power of 5 mW and restricted to 1 % from 5 mW to 25 mW
Tx chip rate	32 768 chips per second		
Maximum Tx chip rate tolerance	±1,5 %		
Maximum Tx jitter per transition	±5 µs		
Sensitivity max	-95 dBm typical -80 dBm min		Radiated test [d] BER : 10^{-4}
Minimal Rx chip rate tolerance	± 2 %		
Preamble length	247x chip sequence “01”		~15 ms, number of preamble chips is not checked by Rx
Receiver blocking performance	Minimum category 2		Category 2 according ETSI EN 300 220 (all parts)
Minimal operating range	0°C to 45°C [e]		

[a] RF channel F3 is optional. It might not be implemented by hardware.

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

[c] Frequency error correction may be needed in the case of Tx metering to HBES Rx specific products. Metering only applies to RF channel F1.

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

[e] HBES Physical Layer parameters shall be met on the entire product temperature range declared by the manufacturer. (e.g. : -10°C to +70°C for outdoor usage).