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Information technology – Home electronic system (HES) architecture –

Part 3-7: Media and media dependent layers – Radio frequency for network based control of HES Class 1

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EP 1 239 648 A1

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International Standard ISO/IEC 14543-3-7 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This International Standard is a product family standard. It shall be to be used in conjunction with ISO/IEC 14543-2-1, 14543-3-3, 14543-3-4, 14543-3-5 and 14543-3-6.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the title page.

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

INTRODUCTION

The Reference model for Open System Interconnection (OSI), specified in ISO/IEC 7498, assigns the functions that are needed for communications between two entities that are connected by medium to seven logical layers. This International Standard specifies interconnection of entities used for home and building control via the medium radio frequency. According to the OSI reference model, the Physical Layer consists of the medium, the cable, the connectors, the transmission technology, etc., which are hardware requirements. However, the focus of this International Standard lies first and foremost on the description of the "communication medium".

Currently, ISO/IEC 14543, *Information technology – Home Electronic System (HES) architecture*, consists of the following parts:

Part 2-1: *Introduction and device modularity*
Part 3-1: *Communication layers – Application layer for network based control of HES Class 1*
Part 3-2: *Communication layers – Transport, network and general parts of data link layer for network based control of HES Class 1*
Part 3-3: *User process for network based control of HES Class 1*
Part 3-4: *System management – Management procedures for network based control of HES Class 1*
Part 3-5: *Media and media dependent layers – Power line for network based control of HES Class 1*
Part 3-6: *Media and media dependent layers – Twisted pair for network based control of HES Class 1*
Part 3-7: *Media and media dependent layers – Radio frequency for network based control of HES Class 1*
Part 4: *Home and building automation in a mixed-use building (technical report)*
Part 5-1: *Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Core protocol (under consideration)*
Part 5-2: *Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Device certification (under consideration)*

Additional parts may be added later.

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 3-7: Media and media dependent layers – Radio frequency for network based control of HES Class 1

1 Scope

This part of ISO/IEC 14543 defines the mandatory and optional requirements for the medium-specific Physical and Data Link Layers of radio frequency for network based control of HES Class 1 products and systems. It describes a multi-application bus system where the functions are decentralised, distributed and linked through a common communication process.

NOTE: Data Link Layer interface and general definitions, which are medium independent, are given in ISO/IEC 14543-3-1.

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.

IEC 60870-5-1, *Telecontrol equipment and systems – Part 5-1: Transmission protocols – Transmission frame formats*

IEC 60870-5-2, *Telecontrol equipment and systems – Part 5-2: Transmission protocols – Link transmission procedures*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this International Standard, the definitions given in ISO/IEC 14543-3-1 apply.

3.2 Abbreviations

BER	bit error rate
DLL	Data Link Layer
ERP	effective radiated power
FSK	frequency shift keying
PhL	Physical Layer
RF	radio frequency
Rx	Receiver
TRx	Transceiver
Tx	Transmitter

4 Conformance

A device conforming to this International Standard shall support the physical medium as specified in clause 5 and provide transmission capability as specified in 6.1 to 6.4.

In addition to 6.1 to 6.4 retransmitters shall support 6.5.

In addition to 6.1 to 6.4 medium couplers shall support 6.6.

5 Physical layer type RF

5.1 General

Table 1 lists the general requirements for Physical Layer Type RF based on a centre frequency of 868,3 MHz.

NOTE 1 National regulatory authorities may require the use of other frequencies for HES Class 1 usage.

NOTE 2 Table 1 applies to network based control of HES Class 1 products and systems only.

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
Maximum Tx ERP	25 mW or the respective national limit
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 HES RF Tx to HES RF Rx [a, b] ± 60 ppm metering Tx to HES 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 (see Bibliography) 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 minimum −80 dB. In typical cases, this will be –95 dB. A link budget of –100 dB is recommended.	

5.2 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 next three rows in this table
Preamble	min. 15x chip sequence "01" sent by Tx	learning sequence for Rx, number of preamble chips is not checked by Rx
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

6 Data Link Layer Type RF

6.1 Differences from existing (bi-directional) HES protocol

6.1.1 Extended Group Address

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

The consequence of 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 into account if the receiver knows the Extended Group Address of the sender.

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

The HES RF frame shall contain the HES 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 HES 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 HES 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”.

6.1.2 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 shall 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).

6.1.3 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 HES 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 HES 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”.

6.1.4 RF Broadcast and RF System Broadcast

RF Broadcasts may be propagated beyond a given RF installation (= domain)can be broadcasts within an installation or system broadcasts. In this case broadcast becomes a system broadcast which 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).

6.2 Data Link Layer Frame

6.2.1 General

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

6.2.2 Structure

The frame format builds on the FT3 Data Link Layer (see 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).