INTERNATIONAL STANDARD

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Information technology – Home electronic system (HES) architecture –

Part 3-6: Media and media dependent layers – Twisted pair for network based control of HES Class 1

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FOREWORD

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9) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

IEC and ISO draw attention to the fact that it is claimed that compliance with this document may involve the use of a patent primarily concerning activities as described in clause 5: Requirements for HES Class 1, Twisted Pair Type 0 (TP0).

Schneider Electric Industries SAS has informed IEC and ISO that they have the patent applications or granted patents as listed below:

EP 0370 921 B1, EP 0911 777 A1.

IEC and ISO draw attention to the fact that it is claimed that compliance with this document may involve the use of a patent primarily concerning activities as described in 6.2: Requirements for analogue bus signals and 6.3: Medium attachment unit (MAU).

Siemens AG (Regensburg) has informed IEC and ISO that they have the patent applications or granted patents as listed below:

EP 0365 696 B1, EP 0487 759 B1, EP 0489 194 B1, EP 0643 893 B1, EP 0770 285 B1, EP 0854 587 A1, EP 0858 142 A1, EP 0858 194 A1, WO 00/42694 A1.

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EP-B-0'749'070

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International Standard ISO/IEC 14543-3-6 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 used in conjunction with ISO/IEC 14543-2-1, 14543-3-3, 14543-3-4, 14543-3-5 and 14543-3-7.

The list of all currently available parts of ISO/IEC 14543 series, under the general title *Information technology – Home electronic system (HES) architecture,* can be found on the IEC web site.

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 twisted pair. It specifies the medium and medium dependent functions such as the cable, the connectors and the transmission technology in terms of the Physical Layer and the Data Link Layer according to ISO/IEC 7498.

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 – Powerline 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 3-6: Media and media dependent layers – Twisted pair 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 layer for twisted pair for network based control of HES Class 1 in its two variations called TP0 and TP1.

NOTE Data link layer interface and general definitions, which are media independent, are specified in ISO/IEC 14543-3-2.

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.

ISO/IEC 14543-2-1, *Information technology – Home Electronic System (HES) architecture – Part 2-1: Introduction and device modularity*

ISO/IEC 14543-3-2, *Information technology – Home electronic system (HES) architecture – Part 3-2: Communication layers – Transport, network and general parts of data link layer for network based control of HES Class 1*

ISO/IEC 14543-3-3, *Information technology – Home Electronic System (HES) architecture – Part 3-3: User process for network based control of HES Class 1*

ISO/IEC 14543-3-4, *Information technology – Home Electronic System (HES) architecture – Part 3-4: System management – Management procedures for network based control of HES Class 1*

ISO/IEC 14543-3-5, *Information technology – Home Electronic System (HES) architecture – Part 3-4: Media and media dependent layers – Powerline for network based control of HES Class 1*

ISO/IEC 14543-3-7, *Information technology – Home Electronic System (HES) architecture – Part 3-6: Media and media dependent layers – Radio frequency for network based control of HES Class 1*

IEC 60189-2, *Low-frequency cables and wires with PVC insulation and PVC sheath – Part 2: Cables in pairs, triples, quads and quintuples for inside installations*

IEC 60227-2, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 2: Test methods*

IEC 60245-2, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 2: Test methods*

IEC 60332-1 (all subparts), *Tests on electric and optical fibre cables – Part 1: Test for a vertical flame propagation for a single insulated wire or cable*

IEC 60754-2, *Test on gases evolved during combustion of electric cables – Part 2: Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

EN 50090-2-2, *Home and Building Electronic Systems (HBES) – Part 2-2: System overview – General technical requirements*

3 Terms, definitions and abbreviations

3.1 Definitions

For the purposes of this part the terms and definitions given in ISO/IEC 14543-2-1 and the following apply.

3.1.1
HES Class 1 Twisted Pair Type 0
Twisted Pair medium Twisted Pair Type 0 (TP0) is a physical layer specification for data and power transmission on a single twisted pair, allowing asynchronous character-oriented data transfer in a half duplex bi-directional communication mode, using a specifically unbalanced/unsymmetrical base-band signal coding with collision avoidance under SELV conditions

3.1.2
HES Class 1 Twisted Pair Type 1
Twisted Pair medium Twisted Pair Type 1 (TP1) is a physical layer specification for data and power transmission on a single twisted pair, allowing asynchronous character-oriented data transfer in a half duplex bi-directional communication mode, using a specifically balanced/symmetrical base-band signal coding with collision avoidance under SELV conditions

3.1.3
distributed power supply
the bus is powered in a distributed way by a number of the devices connected to the line (compared to a centralised power supply)

3.1.4
Logical Tag Extended HEE
usage of the L_Data_Extended frame dedicated to extended group addressing

3.1.5
Remote Powered Devices
remote Powered Bus Devices (RPD) do not extract their energy for the application circuit and the bus controller from the bus but from another independent source of energy, for example, mains. Owing to the reduced DC power consumption of RPD, a bus line equipped with such devices requires less power from the installed Power Supply Unit (PSU). The connection of bus-controller and application to the same electrical potential reduces the effort of galvanic separation in RPD

3.1.6
TP0 C Factor
to simplify system engineering, the supply current of a TP0 device (both power supply and bus device) is expressed by a factor "C", defined as

$$C = \frac{\text{Actual current}}{\text{Reference device supply current}}$$

The actual current can either be the one provided by a power supply or used by a device

3.1.7
TP0 Character
11 bit set including 8 data bits, 1 check bit (odd parity bit) and two synchronization bits (start and stop bits)

3.1.8
TP0 Distortion
percentage ratio of the deviation time between the instant a transition occurs and the ideal transition instant, and the bit duration (~208 µs); the distortion is measured for each bit of a character, starting with the start bit

3.1.9
TP0 Inter-Frame Time
time between the end of a frame (end of stop bit for the last character) and the beginning of the next frame (beginning of the start bit of the first character)

3.1.10
TP0 Line Load
percentage ratio representing the proportion of actual character transmission during a specified integration time interval

3.1.11
TP0 Odd parity bit
check bit whose value is such that there is an odd number of logic “0” within the data and parity fields

3.1.12
TP0 Repeater
connects a primary segment to a secondary segment

3.1.13
TP1 Backbone Couplers
15 backbone couplers can be used to couple up to 16 zones to a full sized TP1 network

3.1.14
TP1 Backbone Line
the main line of the inner zone is called backbone line

3.1.15
TP1 Bridge
four TP1-64 physical segments can be combined to a line by using bridges; 256 devices can then be connected to such a line

3.1.16
TP1 Line
a TP1 line consists of a maximum of 256 devices, either directly connected in case of TP1-256 or separated over 4 physical segments in case of TP1-64, each with 64 devices

3.1.17
TP1 Line Couplers
routers that combine lines to a zone are called line couplers

3.1.18
TP1 Logical Unit
converts the serial bit stream to octets and octets to the serial bit stream, which is a serial stream of characters

3.1.19
TP1 Medium Access Unit
converts information signals to analogue signals and vice versa, typically extracts DC power from the medium

3.1.20
TP1 Main line
the inner line of a zone is called main line

3.1.21
TP1 Physical Segment
a physical segment is the smallest entity in the TP1 topology. To a physical segment of TP1-64 up to 64 devices can be connected. To a physical segment of TP1-256 up t 256 devices can be connected

3.1.22
TP1 Polling Master
the device transmitting the Poll_Data frame is called the TP1 Polling master or Poll_Data master

3.1.23
TP1 Polling Slave
the device transmitting a Poll_Data character is called the TP1 polling slave or Poll_Data slave

3.1.24
TP1 Router
a router acknowledges frames on data link layer and transmits the received frame on the other side of the router, provided the device associated with the destination address is located on the other side

3.1.25
TP1 Sub-line
the outer lines of a zone are called sub-lines or lines

3.1.26
TP1 Zone
16 TP1 lines can be connected to a zone by using 15 routers

3.2 Abbreviations

AC	Alternating Current
ACK	Acknowledge
APDU	Application layer Protocol Data Unit
AT	Address Type
CSMA/CA	Carrier Sense, Multiple Access with Collision Avoidance
CKS	Checksum
DA	Destination Address
DC	Direct Current
DL TP	Data Link layer Type Twisted Pair
DPS	Distributed Power Supply
CTRL	Control Field
HEE	HVAC Easy Extension
HES Class 1	refers to simple control and command.
HES Class 2	refers to Class 1 plus simple voice and stable picture transmission
HES Class 3	refers to Class 2 plus complex video transfers
IFT	Inter-Frame-Time
LC	Line Coupler
LG	Length information for APDU
LN	Length
LPDU	Link layer Protocol Data Unit
LSDU	Link layer Service Data Unit
LTE-HEE	Logical Tag Extended HEE
MAU	Medium Attachment Unit
NACK	Negative Acknowledge
NPCI	Network layer Protocol Control Information
NRZ	Non-Return-to-Zero
OCP	Over-Current Protection
PELV	Protective Extra Low Voltage
PDU	Protocol Data Unit
PSU	Power Supply Unit
RPD	Remote Powered Bus Devices
RUP	Reverse Polarity Protection
SA	Source Address
SDU	Service Data Unit
SELV	Safety Extra Low Voltage
TP	Twisted Pair
TPDU	Transport layer Protocol Data Unit
UART	Universal Asynchronous Receiver Transmitter
up	power-up