BS ISO 17987-4:2016

BSI Standards Publication

Road vehicles — Local Interconnect Network (LIN)

Part 4: Electrical physical layer (EPL) specification 12 V/24 V

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National foreword

This British Standard is the UK implementation of ISO 17987-4:2016.

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This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Part 4: Electrical physical layer (EPL) specification 12 V/24 V

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Partie 4: Spécification de la couche électrique physique (EPL) 12V/24V

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

A list of all parts in the ISO 17987 series can be found on the ISO website.

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Introduction

ISO 17987 (all parts) specifies the use cases, the communication protocol and physical layer requirements of an in-vehicle communication network called Local Interconnect Network (LIN).

The LIN protocol as proposed is an automotive focused low speed universal asynchronous receiver transmitter (UART) based network. Some of the key characteristics of the LIN protocol are signal-based communication, schedule table based frame transfer, master/slave communication with error detection, node configuration and diagnostic service transportation.

The LIN protocol is for low-cost automotive control applications, for example, door module and air condition systems. It serves as a communication infrastructure for low-speed control applications in vehicles by providing:

— signal-based communication to exchange information between applications in different nodes;

— bit rate support from 1 kbit/s to 20 kbit/s;

— deterministic schedule table-based frame communication;

— network management that wakes up and puts the LIN cluster into sleep state in a controlled manner;

— status management that provides error handling and error signalling;

— transport layer that allows large amount of data to be transported (such as diagnostic services);

— specification of how to handle diagnostic services;

— electrical physical layer specifications;

— node description language describing properties of slave nodes;

— network description file describing behaviour of communication;

— application programmer's interface.

ISO 17987 (all parts) is based on the open systems interconnection (OSI) Basic Reference Model as specified in ISO/IEC 7498-1 which structures communication systems into seven layers.

The OSI model structures data communication into seven layers called (top down) *application layer* (layer 7), *presentation layer*, *session layer*, *transport layer*, *network layer*, *data link layer* and *physical layer* (layer 1). A subset of these layers is used in ISO 17987 (all parts).

ISO 17987 (all parts) distinguishes between the services provided by a layer to the layer above it and the protocol used by the layer to send a message between the peer entities of that layer. The reason for this distinction is to make the services, especially the application layer services and the transport layer services, reusable also for other types of networks than LIN. In this way, the protocol is hidden from the service user and it is possible to change the protocol if special system requirements demand it.

ISO 17987 (all parts) provides all documents and references required to support the implementation of the requirements related to the following.

— ISO 17987-1: This part provides an overview of the ISO 17987 (all parts) and structure along with the use case definitions and a common set of resources (definitions, references) for use by all subsequent parts.

— ISO 17987-2: This part specifies the requirements related to the transport protocol and the network layer requirements to transport the PDU of a message between LIN nodes.

— ISO 17987-3: This part specifies the requirements for implementations of the LIN protocol on the logical level of abstraction. Hardware-related properties are hidden in the defined constraints.

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— ISO 17987-4: This part specifies the requirements for implementations of active hardware components which are necessary to interconnect the protocol implementation.

— ISO/TR 17987-5: This part specifies the LIN application programmers interface (API) and the node configuration and identification services. The node configuration and identification services are specified in the API and define how a slave node is configured and how a slave node uses the identification service.

— ISO 17987-6: This part specifies tests to check the conformance of the LIN protocol implementation according to ISO 17987-2 and ISO 17987-3. This comprises tests for the data link layer, the network layer and the transport layer.

— ISO 17987-7: This part specifies tests to check the conformance of the LIN electrical physical layer implementation (logical level of abstraction) according to this document.

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INTERNATIONAL STANDARD ISO 17987-4:2016(E)

Road vehicles — Local Interconnect Network (LIN) —

Part 4: Electrical physical layer (EPL) specification 12 V/24 V

1 Scope

This document specifies the 12 V and 24 V electrical physical layers (EPL) of the LIN communications system.

The electrical physical layer for LIN is designed for low-cost networks with bit rates up to 20 kbit/s to connect automotive electronic control units (ECUs). The medium that is used is a single wire for each receiver and transmitter with reference to ground.

This document includes the definition of electrical characteristics of the transmission itself and also the documentation of basic functionality for bus driver devices.

All parameters in this document are defined for the ambient temperature range from −40 °C to 125 °C.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 61000-4-2, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
BR_Range_20K
LIN systems which operate at speeds up to 20 kbit/s

3.1.2
BR_Range_20K 12 V
12 V LIN systems which operate at speeds up to 20 kbit/s

3.1.3
BR_Range_20K 24 V
24 V LIN systems which operate at speeds up to 20 kbit/s

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3.1.4
BR_Range_10K
LIN systems which operate at speeds up to 10 417 kbits/s

3.1.5
BR_Range_10K 12 V
12 V LIN systems which operate at speeds up to 10 417 kbits/s

3.1.6
BR_Range_10K 24 V
24 V LIN systems which operate at speeds up to 10 417 kbit/s

3.2 Symbols

%	percentage
µs	microsecond
C'_{LINE}	line capacitance
C_{BUS}	total bus capacitance
C_{MASTER}	capacitance of master node
C_{RXD}	RXD capacitance (LIN receiver, RXD capacitive load condition)
C_{SLAVE}	capacitance of slave node
d^2V/dt^2	second derivative of voltage (Volt^2 per second^2)
di/dt	instantaneous rate of current change (amps per second)
D_{ser_int}	serial internal diode at transceiver IC
D_{ser_master}	serial master diode
$F_{TOL_RES_MASTER}$	master bit rate deviation from nominal bit rate
$F_{TOL_RES_MASTER_A}$	master bit rate deviation from nominal bit rate in BR_Range_20K systems
$F_{TOL_RES_MASTER_B}$	master bit rate deviation from nominal bit rate in BR_Range_10K systems
$F_{TOL_RES_SLAVE}$	slave bit rate deviation from nominal bit rate
$F_{TOL_RES_SLAVE_A}$	slave bit rate deviation from nominal bit rate in BR_Range_20K systems
$F_{TOL_RES_SLAVE_B}$	slave bit rate deviation from nominal bit rate in BR_Range_10K systems
$F_{TOL_RES_SLAVE_1}$	slave node 1 bit rate deviation from nominal bit rate
$F_{TOL_RES_SLAVE_2}$	slave node 2 bit rate deviation from nominal bit rate
$F_{TOL_SLAVE_to_SLAVE}$	slave to slave bit rate deviation
F_{TOL_SYNCH}	slave node bit rate deviation from master node bit rate after synchronization
$F_{TOL_SYNCH_A}$	slave node bit rate deviation from master node bit rate after synchronization in BR_Range_20K systems
$F_{TOL_SYNCH_B}$	slave node bit rate deviation from master node bit rate after synchronization in BR_Range_10K systems

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$F_{TOL_SYNCH_1}$	slave node 1 bit rate deviation from master node bit rate after synchronization
$F_{TOL_SYNCH_2}$	slave node 2 bit rate deviation from master node bit rate after synchronization
$F_{TOL_UNSYNCH}$	slave node bit rate deviation from nominal bit rate before synchronization
$F_{TOL_UNSYNCH_A}$	slave node bit rate deviation from nominal bit rate before synchronization in BR_Range_20K systems
$F_{TOL_UNSYNCH_B}$	slave node bit rate deviation from nominal bit rate before synchronization in BR_Range_10K systems
I_{BUS}	current into the ECU bus line
I_{BUS_LIM}	current limitation for driver dominant state driver on $V_{BUS} = V_{BAT_max}$ into ECU bus line
$I_{BUS_NO_BAT}$	current at ECU bus line when V_{BAT} is disconnected
$I_{BUS_NO_GND}$	current at ECU bus line when V_{GND_ECU} is disconnected
$I_{BUS_PAS_dom}$	current at ECU bus line when driver off (passive) at dominant LIN bus level
$I_{BUS_PAS_rec}$	current at ECU bus line when driver off (passive) at recessive LIN bus level
GND_{Device}	GND of ECU
kΩ	kilo ohm
kbit/s	kilo bit per second
LEN_{BUS}	total length of LIN bus line
LIN_{Bus}	LIN network
ms	millisecond
nF	nano farad
pF	pico farad
pF/m	pico farad per meter (line capacitance)
R_{BUS}	total bus-resistor including all slave and master resistors $R_{BUS} = R_{MASTER}\|\|R_{SLAVE_1}\|\|R_{SLAVE_2}\|\|$ to $\|\|R_{SLAVE_N}$
R_{MASTER}	master resistor
R_{pull_up}	pull-up resistor
R_{SLAVE}	slave resistor
t_{BFS}	byte field synchronization time
t_{BIT}	basic bit times
t_{EBS}	earliest bit sample time
t_{rx_pd}	propagation delay of receiver

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t_{rx_sym}	symmetry of receiver propagation delay rising edge propagation delay of receiver
t_{LBS}	latest bit sample time
$t_{rx_pdf(1)}$	propagation delay time of receiving node 1 at falling (recessive to dominant) LIN bus edge
$t_{rx_pdf(2)}$	propagation delay time of receiving node 2 at falling (recessive to dominant) LIN bus edge
$t_{rx_pdr(1)}$	propagation delay time of receiving node 1 at rising (dominant to recessive) LIN bus edge
$t_{rx_pdr(2)}$	propagation delay time of receiving node 2 at rising (dominant to recessive) LIN bus edge
t_{SR}	sample window repetition time
$TH_{Dom(max)}$	max. dominant threshold of receiving node (Volt)
$TH_{Dom(min)}$	min. dominant threshold of receiving node (Volt)
$TH_{Rec(max)}$	max. recessive threshold of receiving node (Volt)
$TH_{Rec(min)}$	min. recessive threshold of receiving node (Volt)
V	voltage
V_{ANODE}	voltage at the anode of the diode
V_{BAT}	voltage across the ECU supply connectors
$V_{BATTERY}$	voltage across the vehicle battery connectors
V_{BUS}	voltage on the LIN bus
V_{BUS_CNT}	centre point of receiver threshold
V_{BUS_rec}	receiver recessive voltage
$V_{CATHODE}$	voltage at the cathode of the diode
$V_{GND_BATTERY}$	battery ground voltage
V_{GND_ECU}	voltage on the local ECU ground connector with respect to vehicle battery ground connector ($V_{GND_BATTERY}$)
V_{HYS}	receiver hysteresis voltage
V_{Rec}	recessive voltage
$V_{SerDiode}$	voltage drop at the serial diodes
V_{Shift_BAT}	battery shift
$V_{Shift_Difference}$	difference between battery shift and GND shift
V_{Shift_GND}	GND shift
V_{SUP}	voltage at transceiver supply pins

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