BS ISO 17987-6:2016

BSI Standards Publication

Road vehicles — Local Interconnect Network (LIN)

Part 6: Protocol conformance test specification

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National foreword

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Part 6: Protocol conformance test specification

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Partie 6: Spécification du protocole d'essai de conformité

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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).

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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 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 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 ISO 17987-4.

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INTERNATIONAL STANDARD ISO 17987-6:2016(E)

Road vehicles — Local Interconnect Network (LIN) —

Part 6: Protocol conformance test specification

1 Scope

This document specifies the LIN protocol conformance test. This test verifies the conformance of LIN communication controllers with respect to ISO 17987-2 and ISO 17987-3.

This document provides all necessary technical information to ensure that test results are identical even on different test systems, provided that the particular test suite and the test system are compliant to the content of this document.

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.

ISO 17987-2:2016, *Road vehicles — Local Interconnect Network (LIN) — Part 2: Transport protocol and network layer services*

ISO 17987-3:2016, *Road vehicles — Local Interconnect Network (LIN) — Part 3: Protocol specification*

ISO 17987-4:2016, *Road vehicles — Local Interconnect Network (LIN) — Part 4: Electrical Physical Layer (EPL) specification 12V/24V*

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
class B device
µC-based LIN device

Note 1 to entry: These are devices where it is possible to take measurements on the Rx and Tx interface circuits between the µC and the transceiver.

3.1.2
class C device
integrated LIN devices (ECU) with µC and transceiver

Note 1 to entry: These are devices where it is not possible to take measurements on the Rx and Tx interface circuits between the µC and the transceiver.

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3.2 Symbols

$F_{TOL_RES_MASTER}$	bit rate tolerance of the master node (absolute value), according to ISO 17987-3	%
$F_{TOL_RES_SLAVE}$	bit rate tolerance of a slave node without making use of synchronization (absolute value), according to ISO 17987-3	%
F_{TOL_SYNC}	bit rate tolerance of a slave node making use of synchronization (relative value to master node after synchronization, valid for the complete message), according to ISO 17987-3	%
F_{TOL_UNSYNC}	bit rate tolerance of a slave node making use of synchronization, according to ISO 17987-3	%
T_{AWAKE}	measured time between end of wake up signal and start of break of a header	s
T_{BIT}	Length of a bit (time), depending on the bit rate	s
$T_{BIT_MAX_MASTER}$	$T_{BIT_MAX_MASTER} = T_{BIT} (1 - F_{TOL_RES_MASTER})$	s
$T_{BIT_MIN_MASTER}$	$T_{BIT_MIN_MASTER} = T_{BIT} (1 + F_{TOL_RES_MASTER})$	s
$T_{BIT_NOM_MASTER}$	$T_{BIT_NOM_MASTER} = T_{BIT}$	s
T_{BRKDEL}	break delimiter, according to ISO 17987-3	1 – 14,6 T_{BIT}
T_{BRKDEL_MAX}	calculated maximum of break delimiter: $T_{HEADER_MAX} - (T_{BRKFLD_MIN} + 20\ T_{BIT})$	14,6 T_{BIT}
T_{BRKDEL_MIN}	minimum of break delimiter, according to ISO 17987-3	1 T_{BIT}
T_{BRKFLD}	break field low phase, according to ISO 17987-3	13 – 26,6 T_{BIT}
T_{BRKFLD_MAX}	calculated maximum of break field low phase: $T_{HEADER_MAX} - (T_{BRKDEL_MIN} + 20\ T_{BIT})$	26,6 T_{BIT}
T_{BRKFLD_MIN}	minimum of break field low phase, according to ISO 17987-3	13 T_{BIT}
T_{FRAME}	length of a 8 byte frame, according to ISO 17987-3 (see frame length) $T_{FRAME} = T_{HEADER} + T_{RESPONSE}$	124 – 173,6 T_{BIT}
T_{FRAME_MAX}	maximum length of a 8 byte frame, according to ISO 17987-3	173,6 T_{BIT}
T_{FRAME_MIN}	minimum length of a 8 byte frame, according to ISO 17987-3	124 T_{BIT}
$T_{FRAME_SLOT_MEASURE}$	shall be measured between falling edges of the break field	s
$T_{FRAME_SLOT_SPECIFIED}$	the length is specified in the LDF	s

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$T_{H_INTERBYTE}$	inter-byte space between sync byte field and protected identifier	0 – 13,6 T_{BIT}
T_{HEADER}	length of the header of a message frame based on T_{BIT} nominal	34 – 47,6 T_{BIT}
T_{HEADER_MAX}	maximum length of the header of a message frame, according to ISO 17987-3	47,6 T_{BIT}
T_{HEADER_MIN}	minimum length of the header of a message frame, according to ISO 17987-3	34 T_{BIT}
$T_{JITTER_DEFINED}$	jitter according LDF or NCF of the IUT	s
$T_{JITTER_MEASURE}$	measured jitter as described in ISO 17987-3 (see frame slot)	s
$T_{RESPONSE_MAX}$	maximum response length	126 T_{BIT}
$T_{RESPONSE_MIN}$	nominal response length	90 T_{BIT}
T_{SLEEP}	measured time after that a slave node enters automatically a sleep state ISO 17987-2:2016, 5.1.4	s

3.3 Abbreviated terms

AC	alternate current
API	application programming interface
BFS	byte field synchronization
CF	transport layer consecutive frame
DC	direct current
EBS	earliest bit sample
EMC	electromagnetic compatibility
EMI	electromagnetic interference
EPL	electrical physical layer
ESD	electrostatic discharge
FF	transport layer first frame
GND	ground
IUT	implementation under test
LBS	latest bit sample
Max	maximum
Min	minimum
NVM	non-volatile memory

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no.	number
OSI	open systems interconnection
PID	protected identifier
PDU	protocol data unit
PT-CT	LIN data link layer, network layer and transport layer protocol conformance test
RSID	response service identifier
Rx	Rx pin of the transceiver
RXD	receive data
SF	transport layer single frame
SID	service identifier
SR	sample window repetition
TC	test case
TRX	transceiver
Tx	Tx pin of the transceiver
TXD	transmit data
Typ	typical
UART	universal asynchronous receiver transmitter

4 Conventions

ISO 17987 and ISO 14229-7 are based on the conventions specified in the OSI service conventions (ISO/IEC 10731) as they apply for physical layer, protocol, network and transport protocol and diagnostic services.

5 General test specification considerations

5.1 General

This test specification is not able to cover all contingencies. Due to the fact of the missing vehicle environment, it is possible that the IUT's behaviour differs.

5.2 Test conditions

The tests shall be done at temperature in the range of 15 °C to 35 °C.

5.3 Mandatory requirements for IUT as master

The LDF is mandatory to perform the LIN conformance tests for IUT as master.

If the LDF is not able to describe all features of the IUT, an additional device specific datasheet is necessary (for example, used diagnostic services).

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Depending on the implementation of the IUT as master, it is allowed to use all possible master request frames (e.g. instead of TST_FRM_ASSIGNIDRANGE) for testing, except mandatory supported frames.

IUT initialization is required before each test case. Deviations are marked in the test case respectively.

5.4 Mandatory requirements for IUT as slave

The NCF or alternatively the LDF is mandatory to perform the LIN conformance tests for IUT as slave.

The used test tool shall verify the syntax of the NCF/LDF for plausibility (not for the content).

The NCF/LDF shall match with the implementation of the device.

If the NCF/LDF is not able to describe all features of the IUT, an additional device specific datasheet is necessary (for example, used diagnostic services).

If an IUT is not fully configured after reset, an IUT initialization is required before each test case, except if the AssignFrameIdentifierRange command is part of the test. Preconfigured slaves are fully configured after reset. Deviations are marked in the test case respectively.

5.5 Test case architecture

In the description of each test case, it is specified for which device type the test case is applicable, for master or slave.

Each specification of a test case consists of five parts:

- Set Up
  - defines the IUT as master or slave;
  - defines settings for the implementation under test (IUT) and the test system (for details, see 5.9.1);
  - defines the bit rate for the respective test case;
- System Init
  - defines to what state the IUT shall have been set before starting the execution of the test. If not otherwise defined, the IUT as master sends requests respective the IUT as slave waits for requests;
  - an initialization of the IUT shall be performed before each test case. To initialize the IUT, a reset is carried out and thereafter, the IUT shall be reconfigured, e.g. by a Frame ID configuration process;
- Test
  - defines the way of stimulating the IUT;
  - if more than one step is defined in this field, the steps shall be executed in the order as they are stated in the document;
- Verification
  - defines the expected behaviour of the IUT when executing the test steps;
- Reference
  - defines the reference to this document or other parts of the ISO 17987 series.

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5.6 Classification

The classification describes the LIN integration level.

Table 1 defines the classification.

Table 1 — Classification

No.	Classification	Description	Comment
1	Class A device	Transceiver devices	Data Link Layer and Node Configuration/ Network Management Tests not applicable
2	Class B device	µC based devices	IUT as master or slave with Rx and Tx pin connectors
3	Class C device	integrated devices (ECU) with µC and transceiver	IUT as master or slave with analog LIN bus connector available

5.7 Test system requirements

5.7.1 Generation of LIN frames

The test system shall ensure the precision of the bit time of a master node defined in ISO 17987-3.

5.7.2 Standard requirements for the test cases

For proper measurement and verification of LIN frames, the test system shall use a minimum over sampling factor of 16, see Formula (1):

$$\text{sample resolution} \leq \frac{T_{BIT}}{16} \tag{1}$$

5.7.3 Special requirements for bit timing testing

For proper measurement and verification of the bit timing tests, the test system shall measure with a minimum over sampling of 10 to the precision of the master tolerance given by the ISO 17987-4 [see Formula (2)]. See 7.13, 7.14, 7.15.

$$\text{bit time sample resolution} \leq \frac{T_{BIT}\,\frac{0,5}{100}}{10} \tag{2}$$

5.7.4 Test system for IUT as slave node

If the IUT is a slave node the test system acts as a master node. The transmission of a frame by the test system is a synonym for the transmission of the frame header if the specific frame is published by the IUT according to the frame definition.

EXAMPLE "The test system sends TST_FRM_IUT_TX" is corresponding to "The test system sends the header of TST_FRM_IUT_TX".

5.7.5 Sleep state verification for IUT as slave node

Some test cases require verification of the slave node bus sleep state after transmission of a go-to-sleep command or bus idle timeout. As a direct verification is not possible due to the design of the test system, an indirect method is needed. Depending on the IUT specification, one of the following verification alternatives shall be selected for the sleep state verification procedure.

— Observing of the current consumption of the IUT. It shall be verified that the current consumption is reduced after sleep state criteria is fulfilled and the ECU specific delay is passed. The ECU specific

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delay between entering sleep state and reduction of ECU current shall be provided by IUT vendor and considered in the test verification.

Prerequisite: ECU enters low power mode after a specified delay when the LIN sleep state is entered.

— The test system forces the sleep state transition. After that, the IUT is stimulated to send a wakeup signal in sleep state. If possible, it should also be verified that a wake up frame can't be triggered during normal communication (a slave node shall not be able to send a wakeup if it is in operational state).

  Prerequisite: ECU wake up can be triggered by an external stimulus.

— The test system forces the sleep state transition. In the next step, the test system sends the header of TST_FRM_STATUS_SIG multiple times without preceding wake up one or more headers are not answered by the slave node because the first SynchBreak is taken as wake up event and the slave node performs its initialization sequence. Latest after 100 ms, the slave shall answer to the headers.

  Prerequisite: ECU enters a low power mode when sleep state is entered and requires more than one header to recover from sleep state (otherwise, it could not be distinguished from operational state).

— A monitor or debugger is used to verify the network management state of the IUT.

  Prerequisite: Accessible port for monitor or debugger.

— An ECU test pin is used to indicate the current network management state.

  Prerequisite: Free and accessible test pin.

— In Class B devices, the LIN transceiver is set into sleep state – verify LIN transceiver state by oscilloscope/logger/…

  Prerequisite: LIN transceiver is set to sleep state (with a specified delay) when the slave node enters sleep state.

— A sleep counter is implemented in the slave node which is incremented anytime the sleep state is entered. The current sleep counter state can be read out by a ReadByIdentifier request. Depending on the ECU power mode, the counter is located in RAM or non-volatile memory. The test system verifies the sleep counter before and after performing the test and derives the verdict from the counter difference.

  Prerequisite: The counter is implemented in the ECU and accessible via ReadByIdentifier request.

Hint: LIN sleep state and ECU power mode are not identical. ECU power mode transitions depend on ECU requirements that can be triggered by LIN sleep state transitions. This test only verifies the valid reception of a sleep state frame and entering LIN sleep state. The ECU power mode may only be used as indicator for the LIN sleep state.

5.8 Test system definition

A detailed test system definition is not part of this document. The test system shall be implemented in a way that the test cases are performed as specified and independent from test persons and from other test cases and of the reproducibility.

5.9 Global predefinitions for the test setup

5.9.1 Configuration of IUT and test system

Before executing the tests, some settings shall be done concerning the following:

— the protected identifier (PID) which shall be sent by a master;

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— the contents of the data of a slave answer;

— the delay between master requests;

— the bit rate which shall be used for the test.

In Table 2, several frames for the IUT and the test system are defined. In each test case specification, there is a row called "configuration" mostly referring to a row in the table below. The configuration described in that row shall be applied to the respective test case.

If there is no reference to Table 2, the settings are described in the test case specification itself.

— If the IUT is not able to support the given PID, the table shall be adapted to the possibilities of the IUT.

— For the delay between the master requests, see 5.9.2.

All used frames shall be valid and according to the device specification. Table 2 defines the configuration of IUT and test system.

Table 2 — Configuration of IUT and test system

TST_Frame	Requirements for the test frame
TST_FRM_ASSIGNIDRANGE	AssignFrameIdentifierRange service
TST_FRM_RDBI_0	ReadByIdentifier (Identifier = 0) all other parameters shall be filled with default values according to the IUT specification and according to the test case specification.
TST_FRM_RDBI_X	ReadByIdentifier (Identifier ≠ 0) shall be used with the correct NAD, supplier ID and function ID according to the IUT specification. The ID is variable and >0
TST_FRM_RDBI_0_NAD	ReadByIdentifier (Identifier = 0) with different NAD
TST_FRM_IUT_TX	device specific transmit frame (IUT is publisher)
TST_FRM_IUT_RX	device specific receive frame (IUT is subscriber)
TST_FRM_REQ_EVT	request for event triggered frame
TST_HDR_SR_3D	slave response header, Identifier = $3D_{16}$
TST_FRM_STATUS_SIG	read response_error signal
TST_HDR_RESERVE_3E	reserved frame header: Identifier = $3E_{16}$
TST_HDR_RESERVE_3F	reserved frame header: Identifier = $3F_{16}$
TST_FRM_SLEEP_CMD	go-to-sleep command
TST_FRM_REQ_FUNC_7E	diagnostic request with functional NAD = $7E_{16}$
TST_FRM_ASSIGN_NAD	assign NAD
TST_FRM_SAVE_CONFIG	save configuraton request
TST_FRM_MR_3C_SF, TST_FRM_MR_3C_FF, TST_FRM_MR_3C_CF	this is a (SF, FF, CF) master request message ($3C_{16}$) which can carry any kind of diagnostic message, except messages of configuration and identification.
TST_FRM_SR_3D_SF, TST_FRM_SR_3D_FF, TST_FRM_SR_3D_CF	this is a (SF, FF, CF) slave response message ($3D_{16}$) which can carry any kind of diagnostic message, except messages of configuration and identification.
TST_FRM_UNKNOWN	all undefined (not configured in the IUTs LDF, NCF) frame IDs from 0_{10} – 59_{10} with all combination of parity bits and all known frame IDs with possible incorrect parity bits Number of data bytes 8, data bytes 1 to 8 shall be filled with 00_{16}, 01_{16}, 02_{16}, 03_{16}, 04_{16}, 05_{16}, 06_{16}, 07_{16}

If it is specified in the "Test" part of the test case description that a TST_FRM_XXXXX is sent by the test system, this can mean that only the header of the frame is sent, but not the entire frame. The response transmission is expected to be sent by the IUT.

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5.9.2 Default delays for frame headers

If not otherwise specified, the delay between the master headers is defined as shown in Table 3.

Table 3 — Default delays for frame headers

Bit rate	Master delay
2 400 bit/s	80 ms
9 600 bit/s	20 ms
10 417 bit/s	20 ms
19 200 bit/s	10 ms

Remark:

Default delay shall be used, unless $P2_{min}$ or min_period for a frame is defined in the NCF. If $P2_{min}$ is longer than the default value, $P2_{min}$ is to be used.

5.9.3 Default bit rate

The default bit rate is set to the highest bit rate that is specified by the specification of the IUT. Test cases with different bit rate settings can only be performed when the required bit rate is in accordance with the specification of the IUT.

5.9.4 Time measurement

The time measurement for master nodes is done at the sync byte field as shown below. For slave nodes, the answer to ReadByIdentifier (ID = 2_{10}) and evaluation of RSID ($7F_{16}$) in the mandatory negative response is used. In this case, the distance between falling edges of "start bit" and bit 7 is measured.

The time measurement shall be done between falling edges of the pattern. The falling edge is available in a distance of 8 bit times, which allow a simple calculation of the basic bit time T_{BIT}.

Figure 1 shows the byte field for time measurement.

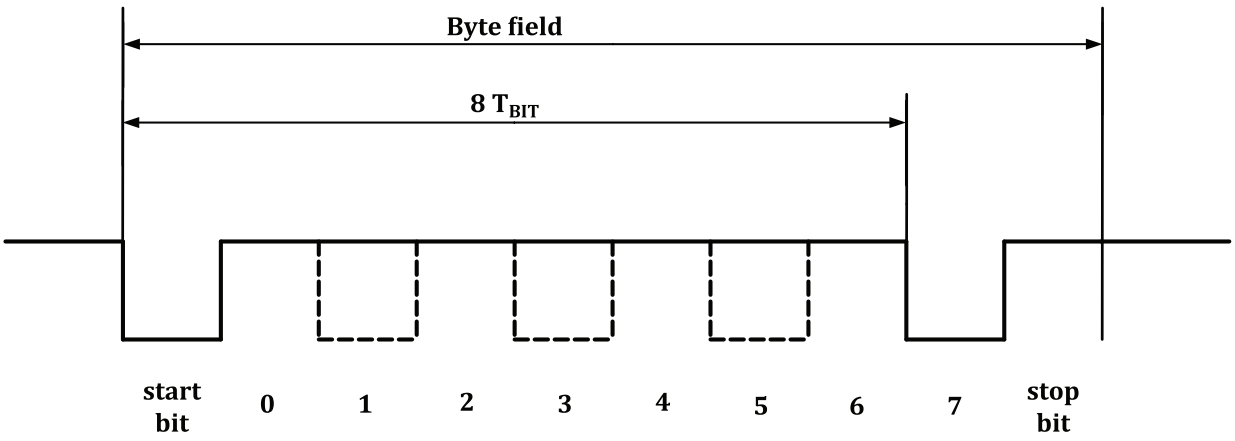

Figure 1 — Byte field for time measurement

5.9.5 Default spaces between the different frame parts of a LIN message

If not otherwise specified in the test cases, inter byte spaces between the header bytes and data fields are set to zero.

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6 Essential test cases before test start

6.1 General

These test cases shall have the result “pass”; otherwise, a further execution of the remaining test cases make no sense.

6.2 [PT-CT 1] Diagnostic frame “master request”, IUT as slave

This test verifies if the IUT as slave is able to receive master request frames. In this test case, the diagnostic frame type “master request” is checked.

Table 4 defines the test system for diagnostic frame “master request”.

Table 4 — Test system: Diagnostic frame “master request”

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGNIDRANGE, TST_FRM_STATUS_SIG
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_ASSIGNIDRANGE assigning a valid PID to TST_FRM_STATUS_SIG. The test system sends TST_FRM_STATUS_SIG.	
Verification	IUT shall answer	
Reference	ISO 17987-3:2016, 5.2.4.5 and 6.3.6.5	

6.3 [PT-CT 2] Diagnostic frame “slave response”, IUT as slave

This test verifies if the IUT as slave is able to answer to a slave response header. In this test case, the “slave response frame” is checked.

Table 5 defines the test system for diagnostic frame “slave response”.

Table 5 — Test system: Diagnostic frame “slave response”

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_0, TST_HDR_SR_3D
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_RDBI_0. The test system sends TST_HDR_SR_3D.	
Verification	The IUT shall answer. The IUT shall receive the request from the test system and the response shall have 8 data bytes and use the classic checksum.	
Reference	ISO 17987-3:2016, 5.2.2.5	

6.4 [PT-CT 3] Error in received frame, IUT as slave

This test verifies if the IUT as slave is able to report its status to the network.

Table 6 defines the test system for “error in received frame”.

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Table 6 — Test system: Error in received frame

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_0, TST_FRM_STATUS_SIG
	bit rate	Default
System Init	TST_FRM_STATUS_SIG shall be sent twice by the test system to ensure that the response_error signal is cleared.	
Test	The test system sends TST_FRM_RDBI_0 with inverted checksum. After that, TST_FRM_STATUS_SIG is sent from the test system.	
Verification	The IUT shall answer to TST_FRM_STATUS_SIG and sends the mandatory response_error signal = TRUE.	
Reference	ISO 17987-3:2016, 5.5.4	

7 Timing parameters

7.1 General

This clause verifies if the timing parameters of the IUT are conforming to the timing parameters that are defined in ISO 17987-3. The IUT is stimulated to transmit or receive defined frames and the resulting behaviour is observed and compared with the expected behaviour.

7.2 [PT-CT 4] Length of break field low phase, IUT as master

This test verifies the correct length of the break field low phase T_{BRKFLD} as defined in ISO 17987-3.

Table 7 defines the test system for “length of break field low phase”.

Table 7 — Test system: Length of break field low phase

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGNIDRANGE
	bit rate	Default
System Init	Default	
Test	The IUT sends TST_FRM_ASSIGNIDRANGE.	
Verification	$T_{BRKFLD_MIN} \leq T_{BRKFLD} \leq T_{BRKFLD_MAX}$. The measurement shall be performed at 0,4 V_{sup} of the slopes. Reference: ISO 17987-4:2016, Param 17.	
Reference	ISO 17987-3:2016, 5.2.2.3	

7.3 [PT-CT 5] Variation of length of break field low phase, IUT as slave

This test verifies if the IUT as slave recognizes a header with different length of break field low phase T_{BRKFLD}.

The test is to be repeated with different lengths of break field low phase T_{BRKFLD} according to the test definition.

Table 8 defines the test system for “variation of length of break field low phase”.

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Table 8 — Test system: Variation of length of break field low phase

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_TX
	bit rate	Default
System Init	Default	
Test	a) The test system sends TST_FRM_IUT_TX with the length of break field low phase T_{BRKFLD} from 0,5 T_{BIT} to 9,3 T_{BIT}, with 0,1 T_{BIT} steps. Every step is repeated five times. b) The test system sends TST_FRM_IUT_TX with the length of break field low phase T_{BRKFLD} from 11 to 26,6 T_{BIT}, with 0,1 T_{BIT} steps. Every step is repeated 5 times.	
Verification	In test part a), the IUT shall not answer any of the headers. In test case b), the IUT shall answer to all of the headers in the range of break field low phase T_{BRKFLD} of 13 T_{BIT} to 26,6 T_{BIT}.[a]	
Reference	ISO 17987-3:2016, 5.2.2.3	

[a] The answer of the IUT to the header with the length of break field of 11 T_{BIT} to 12,9 T_{BIT} shall be documented.

7.4 [PT-CT 6] Length of break delimiter, IUT as master

This test verifies the correct length of the break delimiter T_{BRKDEL}.

Table 9 defines the test system for “length of break delimiter”.

Table 9 — Test system: Length of break delimiter

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C Devices
	Configuration	TST_FRM_IUT_TX, TST_FRM_IUT_RX
	bit rate	Default
System Init	Default	
Test	The IUT sends TST_FRM_IUT_TX or TST_FRM_IUT_RX.	
Verification	$T_{BRKDEL_MIN} \leq T_{BRKDEL} \leq T_{BRKDEL_MAX}$. The measurement should be performed at 0,6 V_{sup} of the slopes. Reference: ISO 17987-4, Param 18.	
Reference	ISO 17987-3:2016, 5.2.2.3	

7.5 [PT-CT 7] Variation of length of break delimiter, IUT as slave

This test verifies if the IUT as slave recognizes a header with different length of break delimiter T_{BRKDEL}.

The test consists of three separate test cases. The length of break delimiter T_{BRKDEL} is set according to Table 11.

The IUT as slave shall accept a break delimiter of 12th/16th bit length. The shortened delimiter on the LIN bus results from capacity loads on LIN.

Table 10 defines the test system for “variation of length of break delimiter”.

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Table 10 — Test system: Variation of length of break delimiter

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_TX
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_IUT_TX with the length of break delimiter T_{BRKDEL} as defined in Table 11.	
Verification	The IUT shall respond to the header. NOTE 10th/16th would reflect the maximum bit sample point. Considering slave nodes which are not synchronized to the master bit rate, an additional margin of 14 % shall be added resulting in 12th/16th T_{BRKDEL}.	
Reference	ISO 17987-3:2016, 5.2.2.3	

Table 11 defines the test cases for "variation of length of break delimiter".

Table 11 — Test cases: Variation of length of break delimiter

PT-CT-TC	T_{BRKFLD}	T_{BRKDEL}	$T_{H_Interbyte}$	Comment
[PT-CT 7].1	T_{BRKFLD_MIN}	T_{BRKDEL_MIN} class B device: 1 T_{BIT} class C device: 0,75 T_{BIT}	0	minimum header length
[PT-CT 7].2	T_{BRKFLD_MIN}	T_{BRKDEL_MAX}	0	—
[PT-CT 7].3	T_{BRKFLD_MIN}	10 Bit	0	—

7.6 [PT-CT 8] Inconsistent break field error, IUT as slave

This test verifies if the IUT as slave detects an inconsistent break field error. The IUT as slave shall not accept a zero byte (00_{16}) as a break field.

Table 12 defines the test system for "inconsistent break field error".

Table 12 — Test system: Inconsistent break field error

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_0, TST_HDR_SR_3D
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_RDBI_0 with 13 bit break field and TST_HDR_SR_3D. After that, the test system sends TST_FRM_RDBI_0 with 9 bit break field and TST_HDR_SR_3D.	
Verification	The IUT shall respond to the first master request. The IUT shall detect the Inconsistent break field error and shall not respond to the second master request.	
Reference	ISO 17987-3:2016, 5.2.2.3	

7.7 [PT-CT 9] Inconsistent sync byte field error, IUT as slave

This test verifies if the IUT as slave detects a sync byte field error, i.e. the edges of the sync byte field are not detected within the given tolerance.

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