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Road vehicles — Local Interconnect Network (LIN) —

Part 6:
Protocol conformance test specification

Véhicules routiers — Réseau Internet local (LIN) —

Partie 6: Spécification du protocole d'essai de conformité

Reference number
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Foreword

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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.

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.

— 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.

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.

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

$T_{H\_INTERBYTE}$	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

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).

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.

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 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;

— 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.

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.

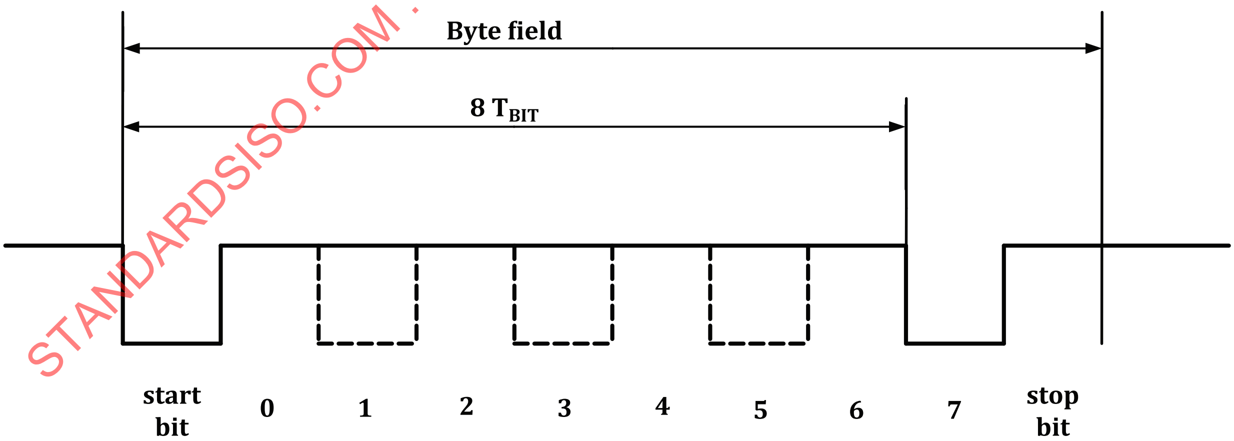

Figure 1 — Byte field for time measurement

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.

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".

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”.

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”.

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.

Table 13 defines the test system for "inconsistent sync byte field error".

Table 13 — Test system: Inconsistent sync byte field error

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_STATUS_SIG
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_STATUS_SIG with sync byte field as defined in Table 14.	
Verification	The IUT shall not respond to TST_FRM_STATUS_SIG.	
Reference	ISO 17987-3:2016, 5.2.2.4	

Table 14 defines the test cases for "inconsistent sync byte field error".

Table 14 — Test cases: Inconsistent sync byte field error

PT-CT-TC	IUT bit rate	Sync Byte Field
[PT-CT 9].1	Default	54_{16}
[PT-CT 9].2	Default	$5D_{16}$

7.8 [PT-CT 10] Verification of the sync byte field, IUT as master

This test verifies if the IUT as master sends a sync byte field with the data "55_{16}".

Table 15 defines the test system for "verification of the sync byte field".

Table 15 — Test system: Verification of the sync byte field

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_0
	bit rate	Default
System Init	Default	
Test	The IUT as master sends TST_FRM_RDBI_0.	
Verification	The IUT shall send the sync byte field without failure.	
Reference	ISO 17987-4:2016, 5.2.2	

7.9 [PT-CT 11] Incomplete frame reception, IUT as slave

This test verifies if the IUT as slave responds to a frame correctly after a incomplete frame and if the response_error signal is set as expected.

Table 16 defines the test system for "incomplete frame reception".

Table 16 — Test system: Incomplete frame reception

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_STATUS_SIG, TST_FRM_IUT_RX
	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 the profile described in Table 17 followed by TST_FRM_STATUS_SIG. The minimum distance between the test profile and TST_FRM_STATUS_SIG should be the frame max. time.	
Verification	The IUT shall respond to TST_FRM_STATUS_SIG by and set the response_error signal as described in Table 17.	
Reference	ISO 17987-3:2016, 5.5.4	

Table 17 defines the test cases for "incomplete frame reception".

Table 17 — Test cases: Incomplete frame reception

PT-CT-TC	Profile test	response_error signal during verification step
[PT-CT 11].1	The test system sends only the break field	FALSE
[PT-CT 11].2	The test system sends only the break field and the sync byte field	FALSE
[PT-CT 11].3	The test system sends just the header of TST_FRM_IUT_RX	FALSE
[PT-CT 11].4	The test system sends just the header of TST_FRM_IUT_RX and the first data byte	TRUE

7.10 [PT-CT 12] Unknown frame reception, IUT as slave

This test verifies if the IUT as slave ignores an unknown complete or unknown incomplete frame and does not set the response_error signal to TRUE.

Table 18 defines the test system for "unknown frame reception".

Table 18 — Test system: Unknown frame reception

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_UNKNOWN, 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_UNKNOWN with the profile described in Table 19 followed by TST_FRM_STATUS_SIG.	
Verification	The IUT shall respond to TST_FRM_STATUS_SIG by sending the mandatory response_error signal = FALSE.	
Reference	ISO 17987-3:2016, 5.5.4	

Table 19 defines the Test cases for "unknown frame reception".

Table 19 — Test cases: Unknown frame reception

PT-CT-TC	Response field
[PT-CT 12].1	No response field
[PT-CT 12].2	Just the first data byte
[PT-CT 12].3	All data bytes (according to TST_FRAME specification or frame length according to LDF/NCF), but wrong checksum

7.11 [PT-CT 13] Length of header, IUT as master

This test verifies the correct length of the header T_{HEADER}.

Table 20 defines the test system for "length of header".

Table 20 — Test system: Length of header

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_RX, TST_FRM_IUT_TX
	bit rate	Default
System Init	Default	
Test	The IUT sends all defined TST_FRM_IUT_RX and all defined TST_FRM_IUT_TX.	
Verification	$T_{HEADER\_MIN} \leq T_{HEADER} \leq T_{HEADER\_MAX}$	
Reference	ISO 17987-3:2016, 5.2.3	

7.12 [PT-CT 14] Variation of length of header, IUT as slave

This test verifies if the IUT as slave recognizes headers with different length T_{HEADER}.

The test consists of four separate test cases. The length of break field low phase T_{BRKFLD}, break delimiter T_{BRKDEL} and the inter byte space between sync byte field and Identifier $T_{H\_INTERBYTE}$ are set according to Table 21.

Table 21 — Test system: Variation of length of header

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 followed by TST_HDR_SR_3D. Both frames use the length of the parts of header as defined in Table 22.	
Verification	The IUT shall answer to the request.	
Reference	ISO 17987-3:2016, 5.2.3	

Table 22 defines the test cases for "variation of length of header".

Table 22 — Test cases: Variation of length of header

PT-CT-TC	T_{BRKFLD}	T_{BRKDEL}	$T_{H\_INTERBYTE}$	$\geq T_{HEADER}$	T_{BIT}
[PT-CT 14].1	T_{BRKFLD_MIN}	T_{BRKDEL_MIN}	0 T_{BIT}	T_{HEADER_MIN}	$T_{BIT\_MIN\_MASTER}$
[PT-CT 14].2	18 T_{BIT}	2 T_{BIT}	6,6 T_{BIT}	$T_{HEADER\_MAX} - 1\ T_{BIT}$	$T_{BIT\_MAX\_MASTER}$
[PT-CT 14].3	15 T_{BIT}	3 T_{BIT}	2 T_{BIT}	40 T_{BIT}	$T_{BIT\_MAX\_MASTER}$
[PT-CT 14].4	T_{BRKFLD_MIN}	T_{BRKDEL_MIN}	12,6 T_{BIT}	$T_{HEADER\_MAX} - 1\ T_{BIT}$	$T_{BIT\_MAX\_MASTER}$

7.13 [PT-CT 15] Bit rate tolerance, IUT as master

This test verifies if the master bit rate tolerance $F_{TOL\_RES\_MASTER} < \pm 0{,}5$ %. For this test, a bit rate measurement is done in the sync byte field.

Table 23 defines the test system for “bit rate tolerance”.

Table 23 — Test system: Bit rate tolerance

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGNIDRANGE
	bit rate	According to the IUT specification
System Init	Default	
Test	The IUT sends TST_FRM_ASSIGNIDRANGE with all bit rates defined in the IUT specification or LDF.	
Verification	(test case bit rate − $F_{TOL\_RES\_MASTER}$) ≤ measured bit rate ≤ (test case bit rate + $F_{TOL\_RES\_MASTER}$)	
Reference	ISO 17987-4 (see Bit rate tolerance 12 V/24 V)	

7.14 [PT-CT 16] Bit rate tolerance, IUT as slave without making use of synchronization

This test verifies if the IUTs bit rate tolerance $F_{TOL\_RES\_SLAVE} < \pm 1{,}5$ %.

For this test, a bit rate measurement is done in the slave answer. The measurement is done according to 5.9.4.

Table 24 defines the test system for “bit rate tolerance”.

Table 24 — Test system: Bit rate tolerance

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_X (Identifier = 2), TST_HDR_SR_3D
	bit rate	According to the IUT specification
System Init	Default	
Test	The test system sends TST_FRM_RDBI_X (Identifier = 2) and TST_HDR_SR_3D according to Table 25 with all bit rate specified in the IUT specification or NCF ± 0,5 % tolerance.	
Verification	The IUT shall answer to the request with negative response (RSID = $7F_{16}$). (test system bit rate − $F_{TOL\_RES\_SLAVE}$) ≤ measured slave bit rate of the slave answer ≤ (test system bit rate + $F_{TOL\_RES\_SLAVE}$)	
Reference	ISO 17987-4 (see Bit rate tolerance 12 V/24 V)	

Table 25 defines the test cases for “bit rate tolerance”.

Table 25 — Test cases: Bit rate tolerance

PT-CT-TC	TST_FRAME	Bit rate tolerance
[PT-CT 16].1	TST_FRM_RDBI_X	+0,5 %
[PT-CT 16].2	TST_FRM_RDBI_X	−0,5 %

7.15 [PT-CT 17] Bit rate tolerance, IUT as slave with making use of synchronization

This test verifies if the IUT as slave is able to synchronize itself with a bit rate tolerance.

F_{TOL_SYNC} < ±2 % (relative value to the master node). For this test, a bit rate measurement is done in the slave answer.

NOTE This test case verifies the tolerance of a synchronized node. A slave node making use of synchronization and direct break detection may have a bit rate tolerance F_{TOL_UNSYNC} of < ±14 % in case of lost synchronization.

The measurement is done according to 5.9.4.

Table 26 defines the test system for "bit rate tolerance".

Table 26 — Test system: Bit rate tolerance

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_X (Identifier = 2), TST_HDR_SR_3D
	bit rate	Min/max bit rates according to the IUT specification
System Init	Default	
Test	The test system sends TST_FRM_RDBI_X (Identifier = 2) followed by TST_HDR_SR_3D according to Table 27 with all bit rate specified in the IUT specification or NCF ± 0,5 % tolerance.	
Verification	The IUT shall answer to the request with negative response (RSID = $7F_{16}$). (test system bit rate − F_{TOL_SYNC}) ≤ measured slave bit rate of the slave answer ≤ (test system bit rate + F_{TOL_SYNC}).	
Reference	ISO 17987-4 (see Bit rate tolerance 12 V/24 V)	

Table 27 defines the test cases: bit rate tolerance.

Table 27 — Test cases: Bit rate tolerance

PT-CT-TC	TST_FRAME	Bit rate tolerance
[PT-CT 17].1	TST_HDR_SR_3D	+0,5 %
[PT-CT 17].2	TST_HDR_SR_3D	−0,5 %

7.16 Length of response

7.16.1 [PT-CT 18] Length of response, IUT as slave

This test verifies if the length of T_{FRAME_MAX} is not exceeded by the IUTs in-frame-response space and inter-byte spaces.

Table 28 defines the test system for "length of response (slave)".

Table 28 — Test system Length of response (slave)

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_TX according Table 29[a]
	bit rate	Default
System Init	Default	
Test	The header length is set to the maximum T_{HEADER_MAX} (worst case). The test system sends the headers of all TST_FRM_IUT_TX with different available data length.	
Verification	The IUT shall respond to the header with $T_{Response} \leq T_{RESPONSE\_MAX}$ The verification shall be done as shown in Figure 2: Frame structure.	
Reference	ISO 17987-3:2016, 5.2.3	

[a] If there is no TST_FRM_IUT_TX available with the data length 8 byte, then use TST_FRM_RDBI_0 according Table 29 and TST_HDR_SR_3D according Table 29 or TST_FRM_RDBI_X according Table 29 and TST_HDR_SR_3D according Table 29.

Table 29 defines the test cases for "length of response (slave)".

Table 29 — Test cases Length of response (slave)

Requirements	Value
header size	maximum
break field low phase length	19 bit
break delimiter length	8 bit
$T_{H\_Interbyte}$	0

Figure 2 shows the frame structure.

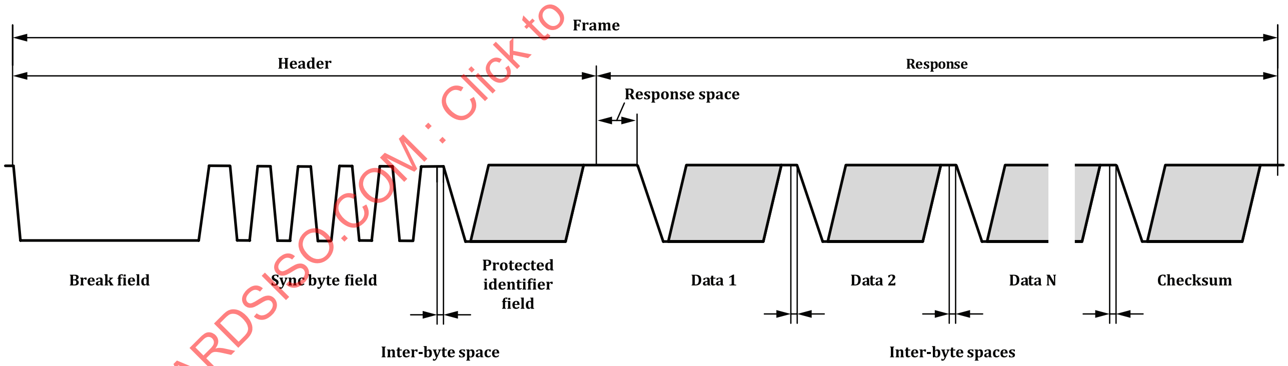

Figure 2 — Frame structure

7.16.2 [PT-CT 19] Length of response, IUT as master

This test verifies if the length of T_{FRAME_MAX} is not exceeded by the IUT in-frame-response space and inter byte spaces.

Table 30 defines the test system for "length of response (master)".

Table 30 — Test system: Length of response (master)

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_TX
	bit rate	Default
System Init	Default	
Test	The IUT as master sends all TST_FRM_IUT_TX with the maximum length of header.	
Verification	The IUT shall send the response with $T_{Response} \le T_{RESPONSE\_MAX}$. The verification shall be done as shown in Figure 2.	
Reference	ISO 17987-3:2016, 5.2.3	

7.16.3 [PT-CT 20] Acceptance of response field, IUT as slave

This test verifies if the IUT accepts frames with different lengths of the response field (variation of length of response space and inter byte space).

Table 31 defines the test system for "acceptance of response field".

Table 31 — Test system: Acceptance of response field

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 the length of the response field as defined in Table 32. The test system sends TST_HDR_SR_3D.	
Verification	The IUT shall answer to TST_HDR_SR_3D.	
Reference	ISO 17987-3:2016, 5.2.3	

Table 32 defines the test cases for "acceptance of response field".

Table 32 — Test cases: Acceptance of response field

PT-CT-TC	Response space	Inter byte space	Comments
[PT-CT 20].1	0 T_{BIT}	each space = 0 T_{BIT}	$T_{RESPONSE\_MIN}$
[PT-CT 20].2	2 T_{BIT}	each space = 4 T_{BIT}	$T_{RESPONSE\_MAX}$ − 2 T_{BIT} (tolerance required due to response verification in LIN controller hardware)
[PT-CT 20].3	0 T_{BIT}	space between data byte data 7 and data 8 = ($T_{RESPONSE\_MAX}$ − $T_{RESPONSE\_MIN}$) − 2 T_{BIT} = 34 T_{BIT}. other spaces = 0 T_{BIT}	$T_{RESPONSE\_MAX}$ − 2 T_{BIT} Maximum inter-byte space if no response space exist (tolerance required due to response verification in LIN controller hardware)
[PT-CT 20].4	($T_{RESPONSE\_MAX}$ − $T_{RESPONSE\_MIN}$) − 2 T_{BIT} = 34 T_{BIT}	each space = 0 T_{BIT}	$T_{RESPONSE\_MAX}$ − 2 T_{BIT} Maximum response space if no inter byte space exist (tolerance required due to response verification in LIN controller hardware)

7.17 Verification of schedule table timing

7.17.1 [PT-CT 21] Verification of jitter, IUT as master

This test verifies the jitter based on one application schedule table defined in the LDF file.

Table 33 defines the test system for "verification of jitter".

Table 33 — Test system: Verification of jitter

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	Defined schedule tables
	bit rate	Default
System Init	Default	
Test	The IUT as master sends out at least 100 consecutive frames of the schedule table.	
Verification	The jitter (see Figure 3) shall be compared with the defined jitter in the LDF. $T_{FRAME\_SLOT\_MEASURE}$ shall be measured between falling edges of the break field. $T_{JITTER\_MEASURE} \leq T_{JITTER\_DEFINED}$	
Reference	ISO 17987-3:2016, 5.2.3	

Figure 3 shows the frame structure and jitter.

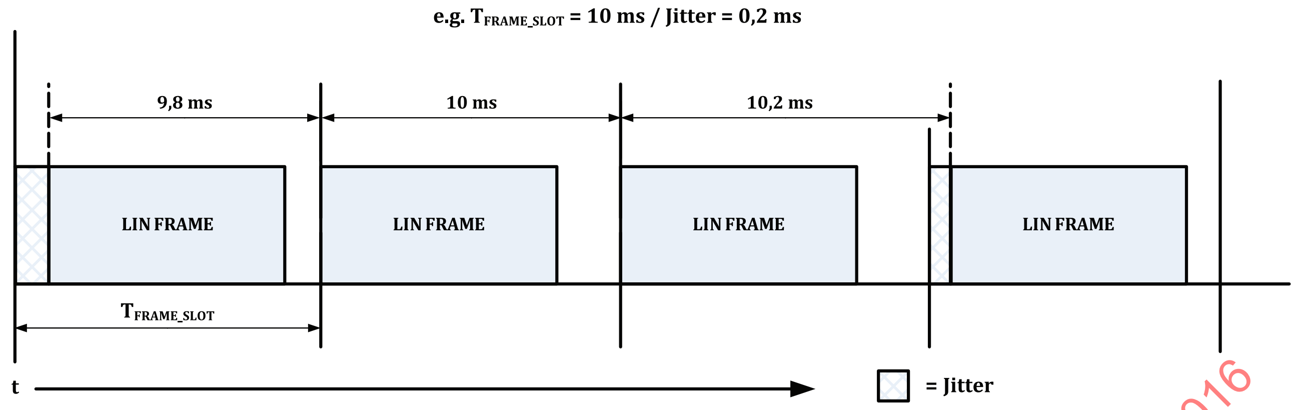

Figure 3 — Frame structure and jitter

7.17.2 [PT-CT 22] Schedule table management, IUT as master

This test verifies if the IUT as master respects T_{FRAME_SLOT} space.

Table 34 defines the test system for "schedule table management".

Table 34 — Test system: Schedule table management

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	Defined schedule tables, TST_FRM_IUT_RX
	bit rate	Default
System Init	Default	
Test	The IUT as master sends out at least 100 consecutive frames of the schedule table. The test system sends the response field of all the TST_FRM_IUT_RX frames as described in Table 35.	
Verification	$T_{FRAME\_SLOT\_SPECIFIED}$ - jitter_ldf < $T_{FRAME\_SLOT\_MEASURE}$ < $T_{FRAME\_SLOT\_SPECIFIED}$ + jitter_ldf jitter_ldf is defined in the LDF file. $T_{FRAME\_SLOT\_MEASURE}$ shall be measured between falling edges of the break field. The IUT as master shall respect T_{FRAME_SLOT} spaces.	
Reference	ISO 17987-3:2016, 5.3.3	

Table 35 defines the test cases for "schedule table management".

Table 35 — Test cases: Schedule table management

PT-CT-TC	Response field of TST_FRM_IUT_RX frame
[PT-CT 22].1	The test system shall not send a response field.
[PT-CT 22].2	The test system sends only the first data byte of the response field.
[PT-CT 22].3	The test system sends the complete response field. The end of the response shall correspond with the start of the next slot.

7.18 [PT-CT 23] Sample point test, IUT as slave

The bits of a byte field shall be sampled according to ISO 17987-4.

Table 36 defines the test system for "sample point test".

Table 36 — Test system: Sample point test

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. After that, the test system sends TST_HDR_SR_3D as in the following: — The test system shall overwrite the recessive level of the PID bit 0 in 1 µs or alternatively 1/16 bit steps starting from the rising edge of the bit until the slave does not respond anymore. — In the second step, the test system shall overwrite the recessive level of the PID bit 0 in 1 µs or alternatively 1/16 bit steps starting from the falling edge of the bit towards the start bit until the slave does not respond any more.	
Verification	The device shall respond to the master node as long as the disturbance is outside the range $t_{EBS} - t_{LBS}$ (see Figure 4). For the execution of the test, t_{LBS} is taken with the fixed value of 10/16 t_{BIT}.	
Reference	ISO 17987-4:2016, 5.2.3	

Figure 4 shows the sample point test.

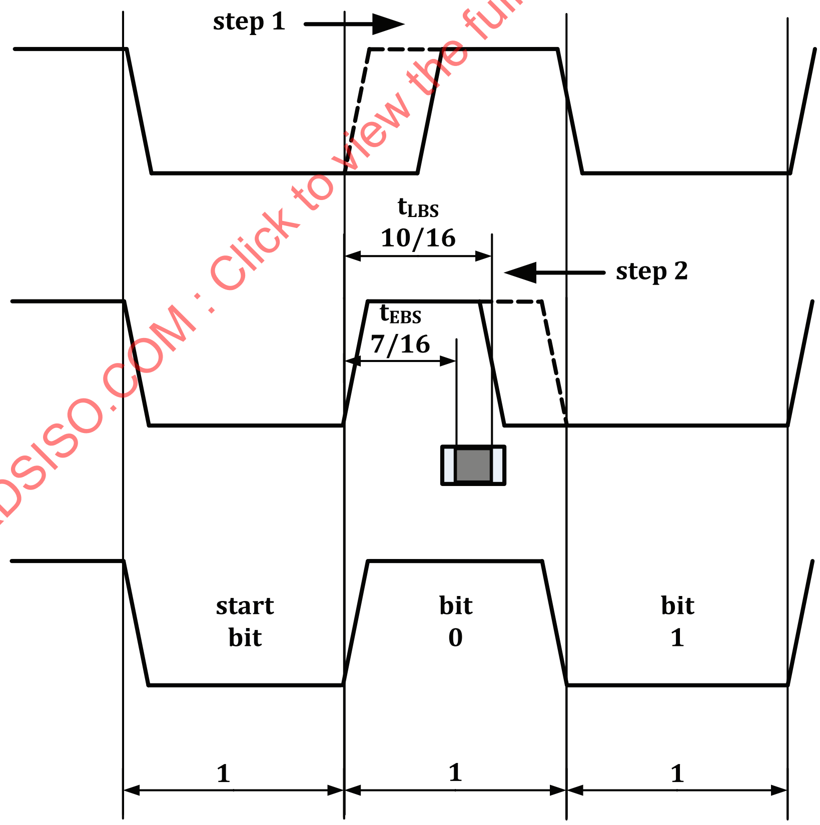

Figure 4 — Sample point test

7.19 [PT-CT 24] Initialization time, IUT as slave

According to ISO 17987-2:2016, Figure 2 after power on the slave shall be initialized within 100 ms.

Table 37 defines the test system for “Initialization time test”.

Table 37 — Test system: Initialization time test

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 switches the power of the slave on and schedules TST_FRM_IUT_TX headers in each frame slot.	
Verification	The IUT shall reply to the first header latest after 100 ms. Verify the time when the slave provides the first response. The IUT shall furthermore respond on each frame header without missing responses after the first responded frame header.	
Reference	ISO 17987-2:2016, 11.2	

8 Communication without failure

8.1 Variation of LIN identifier

8.1.1 [PT-CT 25] Variation of LIN PID, IUT as master

This test verifies if the IUT as master is able to send defined PIDs.

According to the device specification, all in the LDF defined identifiers shall be tested in one schedule table.

Table 38 defines the test system for "variation of LIN PID".

Table 38 — Test system: Variation of LIN PID

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_RX, TST_FRM_IUT_TX, identifier as defined in ISO 17987-3:2016, 5.2.2.5.
	bit rate	Default
System Init	Default	
Test	The IUT sends TST_FRM_IUT_TX or TST_FRM_IUT_RX with all defined PID's.	
Verification	The IUT shall send the PID without failure.[a]	
Reference	ISO 17987-3:2016, 5.2.2.5	

[a] A complete ECU shall only use messages from the LDF. A software driver implementation shall use all PIDs.

8.1.2 [PT-CT 26] Variation of LIN PIDs of subscribed frames, IUT as slave

This test verifies if the IUT as slave is able to recognize all PIDs (ID 0_{10} to 59_{10}) assigned to the first subscribed frame (according NCF, subclause frames).

Table 39 defines the test system for "variation of LIN PIDs of subscribed frames".

Table 39 — Test system: Variation of LIN PIDs of subscribed frames

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGNIDRANGE, TST_FRM_IUT_RX, TST_FRM_STATUS_SIG
	bit rate	Default
System Init	TST_FRM_STATUS_SIG shall be assigned a PID and sent twice by the test system to ensure that the response_error signal is cleared. All assigned PIDs shall be unassigned before testing.	
Test	The test system sends TST_FRM_ASSIGNIDRANGE assigning an ID to TST_FRM_IUT_RX and TST_FRM_STATUS_SIG. The test system sends TST_FRM_IUT_RX with previously assigned ID and corrupted checksum (invert 4th bit). After that, TST_FRM_STATUS_SIG shall be sent by the test system.[a] In the next cycle, a different ID is used until all IDs are tested.	
Verification	The IUT shall respond to TST_FRM_STATUS_SIG by sending the mandatory response_error signal = TRUE.	
Reference	ISO 17987-3:2016, 5.2.2.5	

[a] For the first test cycle, the TST_FRM_STATUS_SIG uses the ID 59_{10}, for the remaining test cycles TST_FRM_STATUS_SIG uses the ID 0_{10}.

8.1.3 [PT-CT 27] Variation of LIN identifier of published frames, IUT as slave

This test verifies if the IUT as slave is able to recognize all PIDs (ID 0_{10} to 59_{10}) assigned to the first published frame (according NCF).

Table 40 defines the test system for 'variation of LIN identifier of published frames'.

Table 40 — Test system: Variation of LIN identifier of published frames

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGNIDRANGE, TST_FRM_IUT_TX
	bit rate	DEFAULT
System Init	All assigned PIDs shall be unassigned before testing.	
Test	The test system sends TST_FRM_ASSIGNIDRANGE with every ID. The test system sends the header of TST_FRM_IUT_TX.	
Verification	The IUT shall respond to the header of TST_FRM_IUT_TX according to the IUT specification.	
Reference	ISO 17987-3:2016, 5.2.2.5	

8.2 Transmission of the checksum byte

8.2.1 [PT-CT 28] Transmission of the checksum byte "classic checksum", IUT as slave

This test verifies if the IUT as slave sends a correct checksum byte.

Table 41 defines the test system for transmission of the checksum byte "classic checksum".

Table 41 — Test system: Transmission of the checksum byte "classic checksum"

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 followed by TST_HDR_SR_3D.	
Verification	The IUT shall answer to the request and the checksum byte shall be correct.	
Reference	ISO 17987-3:2016, 5.2.2.7	

8.2.2 [PT-CT 29] Transmission of the checksum byte "enhanced checksum", IUT as slave

This test verifies if the IUT as slave sends a correct checksum byte.

Table 42 defines the test system for transmission of the checksum byte "enhanced checksum".

Table 42 — Test system: Transmission of the checksum byte "enhanced checksum"

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	All supported TST_FRM_IUT_TX
	bit rate	Default
System Init	Default	
Test	The test system sends the header of all supported TST_FRM_IUT_TX.	
Verification	The IUT shall respond to the header and the checksum byte shall be correct.	
Reference	ISO 17987-3:2016, 5.2.2.7	

8.2.3 [PT-CT 30] Transmission of the checksum byte "classic checksum", IUT as master

This test verifies if the IUT as master sends a correct checksum byte.

Table 43 defines the test system for transmission of the checksum byte "classic checksum".

Table 43 — Test system: Transmission of the checksum byte "classic checksum"

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_0
	bit rate	Default
System Init	Default	
Test	The IUT as master sends TST_FRM_RDBI_0.	
Verification	The IUT shall send the correct checksum.	
Reference	ISO 17987-3:2016, 5.2.2.7	

8.2.4 [PT-CT 31] Transmission of the checksum byte of unconditional frames, IUT as master

This test verifies that the IUT as master sends a correct checksum byte according to the checksum model of the subscribing slave.

Table 44 defines the test system for "transmission of the checksum byte of unconditional frames".

Table 44 — Test system: Transmission of the checksum byte of unconditional frames

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_TX
	bit rate	Default
System Init	Default	
Test	The IUT as master sends all supported TST_FRM_IUT_TX.	
Verification	The IUT shall send the correct checksum.	
Reference	ISO 17987-3:2016, 5.2.2.7	

8.3 Unused bits

8.3.1 [PT-CT 32] Unused bits, IUT as master

This test verifies if the IUT as master sends recessive bits if the TST_FRM_IUT_TX contains unused data bits (bits which are not defined in the LDF).

Table 45 defines the test system for "unused bits (master)".

Table 45 — Test system: Unused bits (master)

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_TX
	bit rate	Default
System Init	Default	
Test	The IUT as master sends all TST_FRM_IUT_TX and unused data bits if applicable.	
Verification	The unused bits of TST_FRM_IUT_TX shall be sent as recessive bits.	
Reference	ISO 17987-3:2016, 5.2.4.1	

8.3.2 [PT-CT 33] Unused bits, IUT as slave

This test verifies if the IUT as slave sends recessive bits if the TST_FRM_IUT_TX contains unused data bits (bits which are not defined in the NCF).

Table 46 defines the test system for "unused bits (slave)".

Table 46 — Test system: Unused bits (slave)

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_TX
	bit rate	Default

Table 46 *(continued)*

State	Description
System Init	Default
Test	The test system sends all TST_FRM_IUT_TX with unused data bits if applicable.
Verification	The unused bits of TST_FRM_IUT_TX shall be sent as recessive bits.
Reference	ISO 17987-3:2016, 5.2.4.1

8.4 Reserved frame

8.4.1 [PT-CT 34] Reserved frame, IUT as slave

This test verifies if the IUT as slave ignores a reserved frame header. The test system sends TST_HDR_RESERVE_3E and TST_HDR_RESERVE_3F.

Table 47 defines the test system for "reserved frame (slave)".

Table 47 — Test system: Reserved frame (slave)

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_HDR_RESERVE_3E and TST_HDR_RESERVE_3F with default delay between the two headers.
	bit rate	Default
System Init	Default	
Test	The test system sends TST_HDR_RESERVE_3E and TST_HDR_RESERVE_3F.	
Verification	The IUT shall not answer to TST_HDR_RESERVE_3E and TST_HDR_RESERVE_3F.	
Reference	ISO 17987-3:2016, 5.2.2.5	

8.5 [PT-CT 35] Diagnostic frame master request, IUT as master

This test verifies if the IUT as master is able to send master request frames. In this test case, the master request frame is checked.

Table 48 defines the test system for "diagnostic frame master request".

Table 48 — Test system: Diagnostic frame master request

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGNIDRANGE or, if not available TST_FRM_SLEEP_CMD
	bit rate	Default
System Init	Default	
Test	The IUT sends TST_FRM_ASSIGNIDRANGE.	
Verification	The IUT shall send the frame without failure. The data field length shall be 8 bytes. The checksum field shall be correct.	
Reference	ISO 17987-3:2016, 5.2.4.5 and 6.3.6.5	

8.6 Supported frames according to the IUT specification

8.6.1 [PT-CT 36] Supported Tx frames according to the IUT specification, IUT as slave

This test verifies if the IUT as slave is able to send all supported frames according to the specification of the IUT.

For preconfigured slaves, this test shall be repeated without TST_FRM_ASSIGNIDRANGE. After power on reset, these slaves shall be operational and use frame IDs according to the LDF.

Table 49 defines the test system for "supported Tx frames according to the IUT specification".

Table 49 — Test system: Supported Tx frames according to the IUT specification

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGNIDRANGE, TST_FRM_IUT_TX
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_ASSIGNIDRANGE. The test system sends all supported frames (TST_FRM_IUT_TX), according to IUT specification.	
Verification	The IUT responds to the requests as specified. The test system verifies by monitoring data length and checksum for received frames.	
Reference	ISO 17987-3:2016, 5.2.2.5	

8.6.2 [PT-CT 37] Supported Rx frames according to the IUT specification, IUT as slave

This test verifies if the IUT as slave is able to receive all supported frames according to the specification of the IUT.

Table 50 defines the test system for "Supported Rx frames according to the IUT specification".

Table 50 — Test system: Supported Rx frames according to the IUT specification

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGNIDRANGE, TST_FRM_IUT_RX, 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_ASSIGNIDRANGE (if more than four RX frames are supported by the IUT the TST_FRM_ASSIGNIDRANGE is repeated with appropiate configuration data). The test system transmits all supported frames TST_FRM_IUT_RX according to IUT specification. Every TST_FRM_IUT_RX is sent twice: first with failure (inverted checksum) then again without failure. TST_FRM_STATUS_SIG shall be sent in between.	
Verification	Recognition of received frames shall be verified by monitoring the response_error signal (in case with failure it shall be TRUE, in case without failure it shall be FALSE).	
Reference	ISO 17987-3:2016, 5.2.2.5	

9 Communication with failure

9.1 General

This clause verifies if the IUT does error and exception handling as specified in ISO 17987-3.

NOTE The fault confinement is not part of the LIN protocol, thus the way of verification is implementation specific.

9.2 [PT-CT 38] Bit error, IUT as slave

This test verifies if the IUT as slave detects a “bit error”, i.e. there is a difference between the bit value sent by the IUT and the corresponding bit value monitored by the IUT.

The test consists of separate test cases in order to test the “bit error” detection of the answer sent by the IUT as slave.

Table 51 defines the test system for “bit error”.

Table 51 — Test system: Bit error

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_X (Identifier = 2), TST_HDR_SR_3D, 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_X (Identifier = 2) followed by TST_HDR_SR_3D. The test system inverts bit in the slave answer sent by the IUT at the position as defined in Table 52. Then TST_FRM_STATUS_SIG shall be sent by the test system to verify the response_error signal.	
Verification	The IUT shall detect the “bit error”, after detection of the “bit error” the transmission shall be aborted latest at the next byte boundary. The response_error signal shall be set.	
Reference	ISO 17987-3:2016, 5.4.3.3	

Table 52 defines the test cases for “bit error”.

Table 52 — Test cases: Bit error

PT-CT-TC	Slave answer component/comments	Bit to be inverted[a]	Inter byte space
[PT-CT 38].1	Data byte 1	Stop bit	0
[PT-CT 38].2	Data byte 1	Bit 1	0
[PT-CT 38].3	Inter-byte data 1–2	Bit 1	≥1[b]
[PT-CT 38].4	Data byte 2	Stop bit	0
[PT-CT 38].5	Data byte 2	Bit 2	0
[PT-CT 38].6	Inter byte data 2–3	Bit 1	≥1[b]
[PT-CT 38].7	Data byte 3	Stop bit	0

a Counting starts with 0 at start bit of the respective slave answer component.

b Testable if the inter byte space is larger or equal than 1 bit. If the inter byte space is larger than 1, bit the inverted bit time shall be at the beginning of the space.

c The part of the verification to abort the transmission cannot be done.

Table 52 *(continued)*

PT-CT-TC	Slave answer component/comments	Bit to be inverted[a]	Inter byte space
[PT-CT 38].8	Data byte 3	Bit 3	0
[PT-CT 38].9	Inter byte data 3–4	Bit 1	≥1[b]
[PT-CT 38].10	Data byte 4	Stop bit	0
[PT-CT 38].11	Data byte 4	Bit 4	0
[PT-CT 38].12	Inter byte data 4–5	Bit 1	≥1[b]
[PT-CT 38].13	Data byte 5	Stop bit	0
[PT-CT 38].14	Data byte 5	Bit 5	0
[PT-CT 38].15	Inter byte data 5–6	Bit 1	≥1[b]
[PT-CT 38].16	Data byte 6	Stop bit	0
[PT-CT 38].17	Data byte 6	Bit 6	0
[PT-CT 38].18	Inter byte data 6–7	Bit 1	≥1[b]
[PT-CT 38].19	Data byte 7	Stop bit	0
[PT-CT 38].20	Data byte 7	Bit 7	0
[PT-CT 38].21	Inter byte data 7–8	Bit 1	≥1[b]
[PT-CT 38].22	Data byte 8	Stop bit	0
[PT-CT 38].23	Data byte 8	Bit 8	0
[PT-CT 38].24[c]	Inter byte data 8-checksum	Bit 1	≥1[b]
[PT-CT 38].25[c]	checksum field	Stop bit	0

[a] Counting starts with 0 at start bit of the respective slave answer component.

[b] Testable if the inter byte space is larger or equal than 1 bit. If the inter byte space is larger than 1, bit the inverted bit time shall be at the beginning of the space.

[c] The part of the verification to abort the transmission cannot be done.

9.3 [PT-CT 39] Framing error in header of published frame, IUT as slave

This test case verifies if a slave does not respond to a header with inverted stop bit of the PID.

Table 53 defines the test system for "framing error in header of published frame".

Table 53 — Test system: Framing error in header of published frame

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_TX, 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 the header of TST_FRM_IUT_TX and inverts the stop bit of the PID. Then the test system sends TST_FRM_STATUS_SIG.	
Verification	TST_FRM_IUT_TX shall not be answered. The response_error signal shall be FALSE.	
Reference	ISO 17987-3:2016, 5.4.3.3	

9.4 [PT-CT 40] Framing error in response field of subscribed frame, IUT as slave

This test case verifies if a slave detects a framing error (inverted stop bit of the first data byte) in a subscribed frame and sets the response_error signal.

Table 54 defines the test system for “framing error in response field of subscribed frame”.

Table 54 — Test system: Framing error in response field of subscribed frame

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_RX, 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_IUT_RX with inverted stop bit of the first data byte. Then the test system sends TST_FRM_STATUS_SIG.	
Verification	The response_error signal shall be set. For UART based implementations, the test case shall be executed on the second data byte (applicable if TST_FRM_IUT_RX has a minimum length of two byte).	
Reference	ISO 17987-3:2016, 5.4.3.3	

9.5 [PT-CT 41] Checksum error by inversion, IUT as slave

This test verifies if the IUT as slave detects a wrong classic checksum.

Table 55 defines the test system for “checksum error by inversion”.

Table 55 — Test system: Checksum error by inversion

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. The test system inverts the first bit of the checksum byte of the command of TST_FRM_RDBI_0. TST_FRM_STATUS_SIG follows to request for response_error signal.	
Verification	The verification is done by monitoring the response_error signal = TRUE.	
Reference	ISO 17987-3:2016, 5.2.2.7	

9.6 [PT-CT 42] Checksum error by carry, IUT as slave

This test verifies if the IUT as slave does not add the carry on the sum of all data bytes and checksum byte during the verification of checksum. The slave shall detect a wrong classic checksum where the checksum calculation over all response bytes and the checksum byte results in $1FE_{16}$.

Table 56 defines the test system for “checksum error by carry”.

Table 56 — Test system: Checksum error by carry

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_STATUS_SIG, TST_FRM_MR_3C_SF
	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_MR_3C_SF. The data content of TST_FRM_MR_3C_SF is defined as follows. Data byte 2 to 8 is 00_{16}. Data byte 1 and checksum is FF_{16}.[a] TST_FRM_STATUS_SIG follows to request the response_error signal.	
Verification	The Verification is done by monitoring the response_error signal = TRUE.	
Reference	ISO 17987-3:2016, 5.2.2.7	

[a] Checksum FF_{16} is the inverted value, the correct checksum is 00_{16}.

9.7 [PT-CT 43] Communication robustness, IUT as slave

This test verifies if the IUT as slave is able to ignore incomplete headers with different (invalid) values for the sync byte fields and contine with communication in the next slot.

Table 57 defines the test system for "Communication robustness".

Table 57 — Test system: Communication robustness

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 an incomplete frame header without PID in a loop with values for the sync byte field in the range 00_{16} to FF_{16}. Next, the test system sends TST_FRM_IUT_TX.	
Verification	The slave shall be able to respond to TST_FRM_IUT_TX after the previous incorrect header.	
Reference	ISO 17987-3:2016, 5.2.2.7	

10 Event triggered frames

10.1 General

These test cases are only applicable if event triggered frames are supported by the IUT.

10.2 [PT-CT 44] Event triggered frame, IUT as slave

This test verifies if the IUT as slave is able to answer to event triggered frames, mandatory if the IUT supports event triggered frames.

Table 58 defines the test system for "event triggered frame".

Table 58 — Test system: Event triggered frame

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_REQ_EVT
	bit rate	Default
System Init	Default	
Test	The test system or a manually stimulation is triggering an update of a signal carried by TST_FRM_REQ_EVT (e.g. by pulling a switch). The test system sends the header of TST_FRM_REQ_EVT. The test system sends again the header of TST_FRM_REQ_EVT.	
Verification	The slave shall respond to the first header of TST_FRM_REQ_EVT with the first data byte equal to the PID of the corresponding unconditional frame. Then, the slave shall not answer to the second header.	
Reference	ISO 17987-3:2016, 5.2.4.3	

10.3 Event triggered frame with collision

10.3.1 [PT-CT 45] Event triggered frame with collision resolving, IUT as slave

This test verifies if the IUT as slave is able to answer to event triggered frames, mandatory if the IUT supports event triggered frames.

Table 59 defines the test system for "event triggered frame with collision resolving".

Table 59 — Test system: Event triggered frame with collision resolving

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_REQ_EVT, TST_FRM_IUT_TX
	bit rate	Default
System Init	Default	
Test	The test system or a manually stimulation is triggering an update of a signal carried by TST_FRM_REQ_EVT (e.g. by pulling a switch). The test system sends the header of TST_FRM_REQ_EVT and produces a bit error in the response of the slave. The test system shall resolve the collision by sending the corresponding TST_FRM_IUT_TX according to the NCF. The test system sends the header of TST_FRM_REQ_EVT without the stimulation of the input triggering.	
Verification	The IUT as slave shall not respond to the second header of the event triggered frame.	
Reference	ISO 17987-3:2016, 5.2.4.3	

10.3.2 [PT-CT 46] Event triggered frame with errors in collision resolving, IUT as slave

This test verifies if the IUT as slave is able to answer to event triggered frames, mandatory if the IUT supports event triggered frames.

The focus of this test case is verifying whether the slave node is able to store the event until it is sent successfully.

Table 60 defines the test system for "event triggered frame with errors in collision resolving".

Table 60 — Test system: Event triggered frame with errors in collision resolving

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_REQ_EVT, TST_FRM_IUT_TX
	bit rate	Default
System Init	Default	
Test	The test system or a manually stimulation is triggering an update of a signal carried by TST_FRM_REQ_EVT (e.g. by pulling a switch). The test system sends the header of TST_FRM_REQ_EVT and produces a bit error in the response of the slave by overwriting the first data byte of the response with 00_{16}. The test system resolves the collision by sending the corresponding TST_FRM_IUT_TX according to the NCF, but it overwrites the first data byte of the slave response with 00_{16}. The test system sends the header of TST_FRM_REQ_EVT again.	
Verification	The IUT as slave shall respond to the second header of the event triggered frame TST_FRM_REQ_EVT with the first data byte equal to the PID of the corresponding unconditional frame, because the event triggered frame could not be sent successfully.	
Reference	ISO 17987-3:2016, 5.2.4.3	

10.3.3 [PT-CT 47] Event triggered frame with collision resolving, IUT as master

This test verifies if the IUT as master is able to resolve collisions in event triggered frames, mandatory if the IUT supports event triggered frames.

Table 61 defines the test system for "event triggered frame with collision resolving (master)".

Table 61 — Test system: Event triggered frame with collision resolving (master)

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_REQ_EVT
	bit rate	Default
System Init	Default	
Test	The IUT as master sends the header of TST_FRM_REQ_EVT. The test system responds with only one data byte with 00_{16}.	
Verification	The IUT as master shall switch to the event triggered resolving schedule table. The collision resolving schedule table is sent once. After the collision resolving schedule table, the master shall switch back to the previous schedule table. The master shall continue with the schedule entry subsequent to the schedule entry where the collision occur.	
Reference	ISO 17987-3:2016, 5.2.4.3	

10.3.4 [PT-CT 48] Error in transmitted frame with collision, IUT as slave

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

The collision shall not effect status reporting.

Table 62 defines the test system for "error in transmitted frame with collision".

Table 62 — Test system: Error in transmitted frame with collision

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_REQ_EVT, TST_FRM_STATUS_SIG
	bit rate	Default
System Init	IUT shall be setup to answer to TST_FRM_REQ_EVT (IUT specific event occurred). 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_REQ_EVT and the response to cause a collision. 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 = FALSE.	
Reference	ISO 17987-3:2016, 5.2.4.3	

11 Status management

11.1 [PT-CT 49] 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 63 defines the test system for "error in received frame (slave)".

Table 63 — Test system: Error in received frame (slave)

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	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_ASSIGNIDRANGE with inverted stop bit of the first data byte. Then, the test system sends TST_FRM_STATUS_SIG.	
Verification	The IUT shall answer to TST_FRM_STATUS_SIG and sends the mandatory response_error signal = TRUE. For UART based implementations, the test case shall be executed on the second data byte.	
Reference	ISO 17987-3:2016, 5.5.4	

11.2 [PT-CT 50] Error in transmitted frame, IUT as slave

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

Table 64 defines the test system for "error in transmitted frame".

Table 64 — Test system: Error in transmitted frame

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_0, TST_HDR_SR_3D, 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, followed by TST_HDR_SR_3D. The test system disturbs the frame response from the slave as defined in Table 65. 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	

Table 65 defines the test cases for “error in transmitted frame”.

Table 65 — Test cases: Error in transmitted frame

PT-CT-TC	TST_HDR_SR_3D
[PT-CT 50].1	One inverted checksum data bit.
[PT-CT 50].2	Inverted stop bit of data byte 1.

11.3 [PT-CT 51] response_error signal handling, IUT as slave

This test verifies if the IUT as slave is able to handle the response_error signal correctly.

Table 66 defines the test system for “response_error signal handling (slave)”.

Table 66 — Test system: response_error signal handling (slave)

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_IUT_RX, 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_IUT_RX and inverts one checksum data bit. Then, the test system sends TST_FRM_IUT_RX correctly. After that, TST_FRM_STATUS_SIG is sent twice from the test system.	
Verification	The IUT shall answer to the first TST_FRM_STATUS_SIG and sends the mandatory response_error signal = TRUE. Then, the IUT shall answer to the second TST_FRM_STATUS_SIG and sends the mandatory response_error signal = FALSE.	
Reference	ISO 17987-3:2016, 5.5.4	

12 Sleep/wake up/power mode tests

12.1 [PT-CT 52] Send “go-to-sleep command”, IUT as master

This test verifies if the IUT as master is able to send a go-to-sleep command.

In this test case, the “go-to-sleep command” is checked.

Table 67 defines the test system for send “go-to-sleep command”.

Table 67 — Test system: Send “go-to-sleep command”

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	TST_FRM_SLEEP_CMD
	bit rate	Default
System Init	Default	
Test	The IUT is caused to send go-to-sleep command.	
Verification	The IUT shall send the frame without failure and the frame content shall be as defined in ISO 17987-2:2016, 5.1.4. The IUT shall stop sending after completion of this message and the LIN bus shall be in recessive state.	
Reference	ISO 17987-2:2016, 5.1.4	

12.2 [PT-CT 53] Receive “go-to-sleep command”, IUT as slave

This test verifies if the IUT as slave is able to receive a go-to-sleep command.

In this test case, the “go-to-sleep command” is checked.

Table 68 defines the test system for receive “go-to-sleep command”.

Table 68 — Test system: Receive “go-to-sleep command”

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_SLEEP_CMD
	bit rate	Default
System Init	Default	
Test	See Table 69	
Verification	See Table 69	
Reference	ISO 17987-2, 5.1.4	

Table 69 defines the test cases for receive “go-to-sleep command”.

Table 69 — Test cases: Receive “go-to-sleep command”

PT-CT-TC	Test	Verification
[PT-CT 53].1	The test system sends TST_FRM_SLEEP_CMD with data bytes 2 to 8 are filled with FF_{16}.	The IUT shall receive the frame without failure. The IUT shall enter sleep state[a] instantly.
[PT-CT 53].2	The test system sends TST_FRM_SLEEP_CMD with data bytes 2 to 8 are filled with 01_{16}, 02_{16}, 03_{16}, 04_{16}, 05_{16}, 06_{16}, 07_{16}.	The IUT shall receive the frame without failure. The IUT shall enter sleep state[a] instantly. The IUT shall ignore the data content of the data byte 2 to 8.

a Verification method should be selected according to 5.7.5.

12.3 [PT-CT 54] Receive a wake up signal, IUT as master

This test verifies if the IUT as master is able to receive a wake up signal and to wake up after having received the request if applicable.

If there is a slave node in the network which is able to send a wake up signal, the master node shall also wake up and, when the slave nodes are ready (according to ISO 17987-2:2016, Clause 5), start transmitting headers to find out the cause (using signals) of the wake up.

Table 70 defines the test system for "receive a wake up signal (master)".

Table 70 — Test system: Receive a wake up signal, IUT as master

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	Wake up signal
	bit rate	Default
System Init	The IUT is in sleep state.	
Test	The test system sends a wake up signal with a dominant state of 250 µs.	
Verification	The IUT shall receive the wake up signal without failure and shall run through the start-up procedure. The IUT shall start to send frame headers according to ISO 17987-2:2016, Clause 5 and as depicted in Figure 5. The time T_{AWAKE} shall be measured.	
Reference	ISO 17987-2:2016, 5.1.3	

Figure 5 shows the wake up signal and start of scheduling, IUT as master.

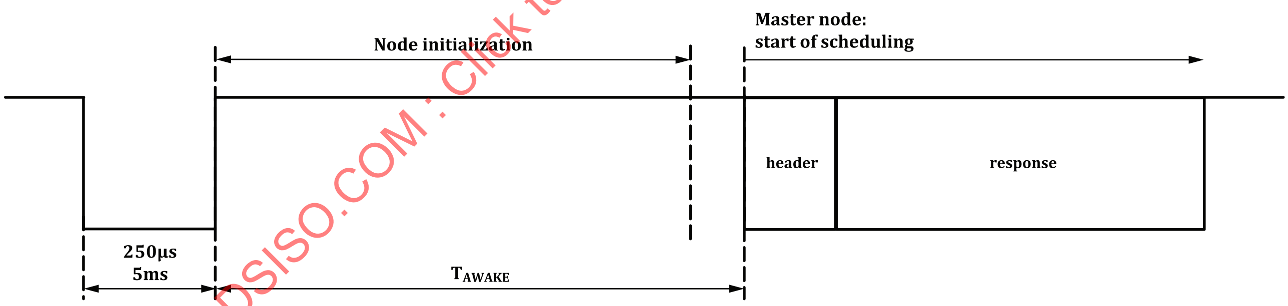

Figure 5 — Receive a wake up signal, IUT as master

12.4 [PT-CT 55] Receive a wake up signal, IUT as slave

This test verifies if the IUT as slave is able to receive a wake up signal and to wake up after having received the request.

Table 71 defines the test system for "receive a wake up signal (slave)".

Table 71 — Test system: Receive a wake up signal, IUT as slave

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	wake up signal, TST_FRM_RDBI_0, TST_HDR_SR_3D
	bit rate	Default
System Init	The IUT is in sleep state.	
Test	The test system sends a wake up signal as defined in Table 72. After 100 ms, TST_FRM_RDBI_0 is sent from the test system, followed by TST_HDR_SR_3D.	
Verification	The IUT shall receive the wake up signal without failure. The IUT shall run through the start-up procedure and answer to master request.	
Reference	ISO 17987-2:2016, 5.1.3	

Table 72 defines the test cases for “receive a wake up signal (slave)”.

Table 72 — Test cases: Receive a wake up signal (slave)

PT-CT-TC	Wake up signal
[PT-CT 55].1	250 µs
[PT-CT 55].2	5 ms
[PT-CT 55].3	5 nominal bit times

12.5 Send a wake up signal

12.5.1 [PT-CT 56] Send a wake up signal, IUT as master and IUT as slave

This test only applies to slaves which are allowed to wake up the bus (see NCF or datasheet) and masters which support the wake up signal.

Table 73 defines the test system for “send a wake up signal (master and slave)”.

Table 73 — Test system: Send a wake up signal (master and slave)

State	Description	
Set Up	IUT as	Slave, master
	Classification	Class B, class C devices
	Configuration	no definitions required
	bit rate	Default
System Init	The IUT is in sleep state.	
Test	The IUT is caused to send a wake up signal.	
Verification	The IUT shall send the wake up signal according to ISO 17987-2:2016, 5.1.3 (250 µs < t < 5 ms)	
Reference	ISO 17987-2:2016, 5.1.3	

12.5.2 [PT-CT 57] Send a block of wake up signals, IUT as slave

This test only applies to slaves which are allowed to wake up the bus (see NCF or datasheet).

This test verifies if the IUT as slave repeats a wake up signal if there is no scheduling started by the master after having sent the wake up signal.

Table 74 defines the test system for “send a block of wake up signals (slave)”.

Table 74 — Test system: Send a block of wake up signals (slave)

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	no definitions required
	bit rate	Default
System Init	The IUT is in sleep state.	
Test	The IUT is caused to send a wake up signal. There is no answer from the test system for the duration of this test.	
Verification	The IUT shall send the wake up signal according to ISO 17987-2:2016, 5.1.3 (250 µs < t < 5 ms) The IUT as slave shall transmit a second and third wake up signal each within a distance of 150 ms to 250 ms as defined in ISO 17987-2:2016, 5.1.3. The verification shall be done for the first 3 wake up pulses only.	
Reference	ISO 17987-2:2016, 5.1.3	

12.5.3 [PT-CT 58] Wait after one block of wake up signals, IUT as slave

This test only applies to slaves which are allowed to wake up the bus (see NCF or datasheet).

This test verifies if the IUT as slave repeats a wake up signal if there is no scheduling started by the master after having sent the wake up signal. The slave node shall not send another wake up signal before 1,5 s after the last block of wake up signals.

Table 75 defines the test system for "wait after one block of wakeup signals".

Table 75 — Test system: Wait after one block of wakeup signals

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	no definitions required
	bit rate	Default
System Init	The IUT is in sleep state.	
Test	The IUT is caused to send a wake up signal. There is no answer from a master for the duration of this test.	
Verification	The IUT shall send the wake up signal according to ISO 17987-2:2016, 5.1.3 (250 µs < t < 5 ms). The IUT as slave shall transmit a second and third wake up signal each within 150 ms to 250 ms distance as defined in ISO 17987-2:2016, 5.1.3. The slave node shall not send another wake up signal before 1,5 s after the last wake up signal.	
Reference	ISO 17987-2:2016, 5.1.3	

12.5.4 [PT-CT 59] Send a wake up signal, frame header from a master following, IUT as slave

This test verifies if the IUT as slave stops repeating wake up signals if there is a frame header from a master.

Table 76 defines the test system for "send a wake up signal, frame header from a master following".

Table 76 — Test system: Send a wake up signal, frame header from a master following

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	The IUT is in sleep state.	
Test	The IUT is caused to send wake up signals. The test system sends TST_FRM_RDBI_0 100 ms after second wake up signal. After that, TST_HDR_SR_3D is sent by the test system.	
Verification	The IUT shall send the wake up signal according to ISO 17987-2:2016, 5.1.3 (250 µs < t < 5 ms). The IUT retransmits a wake up signal after 150 ms – 250 ms. The IUT shall stop retransmission of wake up signals and answer to TST_HDR_SR_3D.	
Reference	ISO 17987-2:2016, 5.1.3	

12.6 [PT-CT 60] ECU power loss, IUT as master

This test only applies to slaves which are allowed to wake up the bus (see NCF or datasheet) and masters which support the wake up signal.

This test verifies if the IUT as master is able to recover communication after a power cycle.

Table 77 defines the test system for "communication recovery after a power cycle".

Table 77 — Test system: Communication recovery after a power cycle

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	—
	bit rate	Default
System Init	Default	
Test	Apply power to the master device. The test system triggers a LIN wake up signal if the network is not woken up by the master node already. After 10 s, remove power from the master long enough to power down and force a reset of the master. Re-apply power to the master. The test system triggers a LIN wake up signal if the network is not woken up by the master node already.	
Verification	Monitor the LIN communication. If a wake up is triggered by the test system, verify that the master does not transmit a second wake up signal. Verify that scheduling is started within the time specified in ISO 17987-2. After a master reset, communication should recover again.	
Reference	ISO 17987-2:2016, Clause 5 SAE J2602-1:2012, 7.10.1	

12.7 [PT-CT 61] Powered up with LIN shorted, IUT as master

This test verifies if the IUT as master is able to reinit LIN communication after a short.

Table 78 defines the test system for “powered up with LIN shorted, IUT as master”.

Table 78 — Test system: Powered up with LIN shorted, IUT as master

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	—
	bit rate	Default
System Init	ECU in power down state.	
Test	Short the LIN bus to ground/V_{Bat}. Apply power to the master and remove the LIN short after T_{BUS_SHORT}. After removing the short wake, the master if not already woken up by the master node. The test is repeated for the following T_{BUS_SHORT} timings: — 1 s, 2 s, 4 s, 10 s, 20 s, 40 s and 1 min. This test cycle is performed first for LIN bus short to ground and then with short to V_{Bat}.	
Verification	Verify LIN Master reinitiates communications according to ISO 17987-2.	
Reference	ISO 17987-2:2016, Clause 5 SAE J2602-1:2012, 7.10.2	

12.8 [PT-CT 62] LIN shorted before scheduling, IUT as master

This test verifies if the IUT as master is able to recover communication when short to ground before start of scheduling.

Table 77 defines the test system for “LIN shorted to ground before scheduling, IUT as master”.

Table 79 — Test system: LIN shorted to ground before scheduling, IUT as master

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	—
	bit rate	Default
System Init	Default	
Test	Apply power to the master and force the master to start communication. Short the LIN bus to ground/V_{Bat} 10 ms before the master node would transmit the first header/frame. The bus short shall be maintained for T_{Short} (the IUT timing for start of scheduling shall be known or measured before). The test shall be executed for the following T_{Short} values: 100 ms, 1 s, 4 s, 10 s, 1 min. It is allowed to wake the master if it has gone to sleep only for the 1 min short duration. This test cycle is performed first for LIN bus short to ground and then with short to V_{Bat}.	
Verification	Verify LIN master reinitiates communications within the application specified time after T_{Short}.	
Reference	ISO 17987-2:2016, Clause 5 SAE J2602-1:2012, 7.10.2	

12.9 [PT-CT 63] LIN shorted after start of scheduling, IUT as master

This test verifies if the IUT as master is able to recover communication when shorted after scheduling has started.

Table 77 defines the test system for “LIN shorted after start of scheduling, IUT as master”.

Table 80 — Test system: LIN shorted after start of scheduling, IUT as master

State	Description	
Set Up	IUT as	Master
	Classification	Class B, class C devices
	Configuration	—
	bit rate	Default
System Init	Default	
Test	Apply power to the master. 10 ms to 20 ms after start of scheduling the LIN bus is shot to ground/V_{Bus}. The bus short shall be maintained for T_{Short}. The test shall be executed for the following T_{Short} values: 100 ms, 1 s, 1 min. It is allowed to wake the master if it has gone to sleep only for the 1 min short duration. This test cycle is performed first for LIN bus short to ground and then with short to V_{Bat}.	
Verification	Verify LIN master reinitiates communications within the application specified time after T_{Short}.	
Reference	ISO 17987-5:2016, Clause 5 SAE J2602-1:2012, 7.10.2	

13 Sleep state after bus idle

13.1 [PT-CT 64] Sleep state after event and bus idle, IUT as slave

This test verifies if the IUT as slave automatically enters sleep state if the bus is inactive for more than 4 s.

Table 81 defines the test system for “sleep state after bus idle”.

Table 81 — Test system: Sleep state after bus idle

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	The IUT is in operational state.	
Test	See Table 82.	
Verification	See Table 82.	
Reference	ISO 17987-2:2016, 5.1.4	

Table 82 defines the test cases: sleep state after bus idle.

Table 82 — Test cases: Sleep state after bus idle

PT-CT-TC	Test	Verification
[PT-CT 64].1	After sending TST_FRM_RDBI_0 and TST_HDR_SR_3D, the test system receives the response from the IUT. The bus is idle after that.	The IUT shall enter the sleep state after t_{SLEEP}, where 4 s < t_{SLEEP} < 10 s[a]
[PT-CT 64].2	The IUT receives a wake up signal (5 T_{BIT}), after that, the IUT is connected to recessive level	After receiving the first wake up signal, the IUT shall enter operational state. The IUT shall enter the sleep state (from the start of the connection to recessive level) after t_{SLEEP}, where 4 s < t_{SLEEP} < 10 s[a]
[PT-CT 64].3	The IUT receives a wake up signal (5 T_{BIT}), after that, the IUT is connected to dominant level for 10 s. Between the wake up signal and the IUT connection to dominant level is a one T_{BIT} recessive level. After that, there is a one ms recessive level. Then, a wakeup signal is sent from the test system.	After receiving the first wake up signal, the IUT shall enter operational state. The IUT shall enter the sleep state (from the start of the connection to dominant level) after t_{SLEEP}, where 4 s < t_{SLEEP} < 10 s.[a] After receiving the second wake up signal, the IUT shall enter operational state.
[PT-CT 64].4	The test system sends a break field and a sync byte field. The bus is recessive after that.	The IUT shall enter the sleep state after t_{SLEEP}, where 4 s < t_{SLEEP} < 10 s.[a]
[PT-CT 64].5	The test system sends a break field and a sync byte field. After that, the IUT is connected to dominant level.	The IUT shall enter the sleep state after t_{SLEEP}, where 4 s < t_{SLEEP} < 10 s.[a]
[PT-CT 64].6	The test system sends TST_FRM_RDBI_0 up to the 3rd data byte and stops sending. The bus is recessive after that.	The IUT shall enter the sleep state after t_{SLEEP}, where 4 s < t_{SLEEP} < 10 s.[a]
[PT-CT 64].7	The test system sends TST_FRM_RDBI_0 up to the 3rd data byte and stops sending. After that, the IUT is connected to dominant level.	The IUT shall enter the sleep state after t_{SLEEP}, where 4 s < t_{SLEEP} < 10 s.[a]

[a] Verification method should be selected according to 5.7.5.

13.2 [PT-CT 65] Sleep state after bus idle with power up and wake up signal, IUT as slave

This test verifies if the IUT as slave automatically enters a sleep state if the bus is inactive for more than 4 s after a wake up signal.

Table 83 defines the test system for "sleep state after bus idle with power up and wake up signal".

Table 83 — Test system: Sleep state after bus idle with power up and wake up signal

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	—
	bit rate	Default
System Init	The IUT gets a power up.	
Test	The test system sends a wake up signal after 100 ms.	
Verification	The IUT shall enter the sleep state after t_{SLEEP}, where 4 s < t_{SLEEP} < 10 s	
Reference	ISO 17987-2:2016, 5.1.4	

13.3 [PT-CT 66] Timeout after bus idle, IUT as slave

This test verifies that the IUT is able to process messages for the time of at least 4 s bus inactivity.

Table 84 defines the test system for "timeout after bus idle".

Table 84 — Test system: Timeout after bus idle

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	The IUT is in operational state.	
Test	The test system sends TST_FRM_RDBI_0 and TST_HDR_SR_3D. After that, there shall be a pause of 4 s – $T_{FRAME\_MAXIMUM}$. Then, the test system sends TST_FRM_RDBI_0 and TST_HDR_SR_3D again (see Figure 6).	
Verification	The IUT shall answer to the request of the test system without entering sleep state.	
Reference	ISO 17987-2:2016, 5.1.4	

Figure 6 shows the timeout after bus idle, IUT as slave.

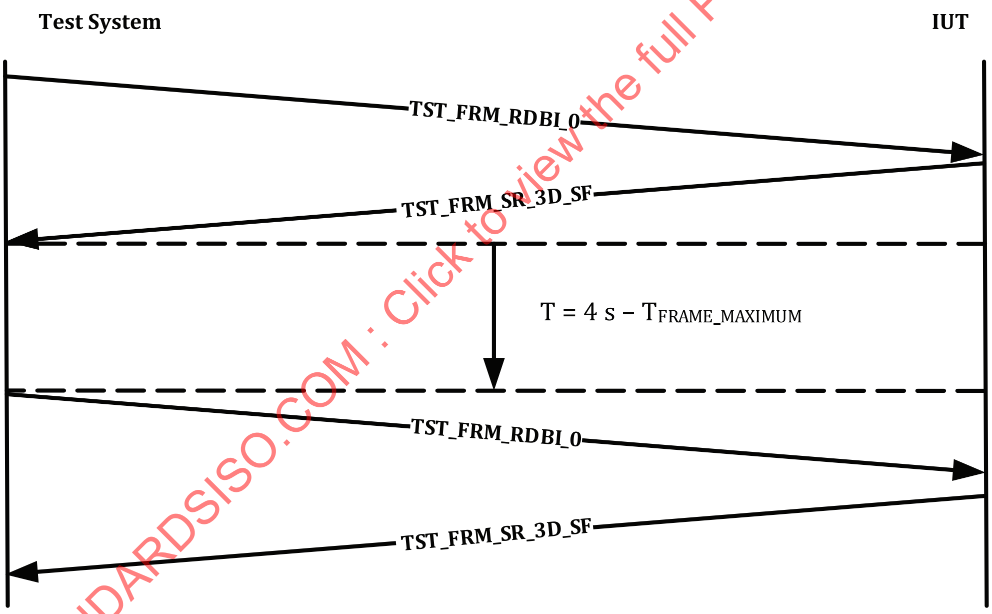

Figure 6 — Timeout after bus idle, IUT as slave

14 Frame ID range assignment

14.1 [PT-CT 67] Frame ID range assignment with indirect response, IUT as slave

This test verifies if the IUT as slave is able to recognize the start indexes. The test is executed indirectly as no mandatory response is defined. No preconfigured PIDs shall be used.

Table 85 defines the test system for "frame ID range assignment with indirect response".

Table 85 — Test system: Frame ID range assignment with indirect response

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGNIDRANGE, TST_FRM_IUT_RX, TST_FRM_IUT_TX, TST_FRM_STATUS_SIG[a]
	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_ASSIGNIDRANGE where TST_FRM_IUT_TX shall be assigned, the other PIDs shall be filled with don't care values. The test system sends TST_FRM_ASSIGNIDRANGE where TST_FRM_IUT_RX shall be assigned, the other PIDs shall be filled with don't care value. The test system sends the assigned TST_FRM_IUT_TX. The test system sends the assigned TST_FRM_IUT_RX with invalid checksum. After that, TST_FRM_STATUS_SIG shall be sent by the test system.	
Verification	The IUT shall respond to TST_FRM_IUT_TX. The IUT shall respond to TST_FRM_STATUS_SIG with response_error signal = TRUE.	
Reference	ISO 17987-3:2016, 6.3.6.5	
[a] The TST_FRM_STATUS_SIG could be identical to TST_FRM_IUT_TX especially if the IUT has only one unconditional transmit frame.		

14.2 [PT-CT 68] Frame ID range unassignment with indirect response, IUT as slave

This test verifies if the IUT as slave is able to unassign PIDs.

Table 86 defines the test system for "frame ID range unassignment with indirect response".

Table 86 — Test system: Frame ID range unassignment with indirect response

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGNIDRANGE, TST_FRM_IUT_RX, TST_FRM_IUT_TX, TST_FRM_STATUS_SIG[a]
	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_ASSIGNIDRANGE. One TST_FRM_IUT_TX and one TST_FRM_IUT_RX shall be unassigned. The test system sends the unassigned TST_FRM_IUT_TX. If TST_FRM_IUT_TX is identical to TST_FRM_STATUS_SIG, the test system shall send TST_FRM_ASSIGNIDRANGE where TST_FRM_STATUS_SIG shall be assigned again a PID, the other PIDs shall be filled with don't care values. The test system sends the unassigned TST_FRM_IUT_RX with invalid checksum. After that, TST_FRM_STATUS_SIG shall be sent by the test system.	
Verification	The IUT shall not respond to the first TST_FRM_IUT_TX. The IUT shall respond to TST_FRM_STATUS_SIG with response_error signal = FALSE.	
Reference	ISO 17987-3:2016, 6.3.6.5	
[a] The TST_FRM_STATUS_SIG could be identical to TST_FRM_IUT_TX especially if the IUT has only one unconditional transmit frame.		

15 Wildcards

15.1 [PT-CT 69] Request with direct response, IUT as slave

This test verifies if the IUT as slave is able to answer to wildcards.

Table 87 defines the test system for "request with direct response".

Table 87 — Test system: Request with direct 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 as defined in Table 88. After that, TST_HDR_SR_3D shall be sent.	
Verification	The IUT shall respond on TST_HDR_SR_3D with the LIN product identification	
Reference	ISO 17987-3:2016, 6.2.3	

Table 88 defines the test cases for "request with direct response".

Table 88 — Test cases: Request with direct response

PT-CT-TC	substitution
[PT-CT 69].1	NAD as wildcard
[PT-CT 69].2	Supplier ID as wildcard
[PT-CT 69].3	Function ID as wildcard
[PT-CT 69].4	Supplier ID and function ID as wildcard

16 ReadByIdentifier command

16.1 LIN product identification

16.1.1 [PT-CT 70] LIN product identification request with direct response, IUT as slave

This test verifies if the IUT as slave is able to answer to the LIN product identification request.

Table 89 defines the test system for "LIN product identification request with direct response".

Table 89 — Test system: LIN product identification request with direct 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

Table 89 *(continued)*

State	Description
System Init	Default
Test	The test system sends TST_FRM_RDBI_0 with correct NAD. After that, TST_HDR_SR_3D shall be sent.
Verification	The IUT shall respond on TST_HDR_SR_3D with the LIN product identification
Reference	ISO 17987-2:2016, 11.2.1.2 ISO 17987-3:2016, 6.2 and 6.3.6.6

16.1.2 [PT-CT 71] LIN product identification — With interleaved unconditional frame, IUT as slave

This test verifies if the IUT as slave is able to answer to the LIN product identification request with a non-diagnostic frame send between master request diagnostic frame and the slave response diagnostic frame.

Table 90 defines the test system for “LIN product identification request — With interleaved unconditional frame”.

Table 90 — Test system: LIN product identification request — With interleaved unconditional frame

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_0, TST_FRM_STATUS_SIG, TST_HDR_SR_3D
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_RDBI_0. After that, the non-diagnostic frame TST_FRM_STATUS_SIG is sent by the test system. TST_HDR_SR_3D is sent by the test system.	
Verification	The IUT shall respond on TST_HDR_SR_3D with the LIN product identification	
Reference	ISO 17987-2:2016, 11.2.1.2 ISO 17987-3:2016, 6.2 and 6.3.6.6	

16.2 [PT-CT 72] ReadByIdentifier command with correct NAD, IUT as slave

The IUT shall be able to respond to all identifiers.

Table 91 defines the test system for “ReadByIdentifier command with correct NAD”.

Table 91 — Test system: ReadByIdentifier command with correct NAD

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_RDBI_X, TST_HDR_SR_3D
	bit rate	Default
System Init	Default	

Table 91 *(continued)*

State	Description
Test	The test system sends TST_FRM_RDBI_X followed by TST_HDR_SR_3D. This sequence is repeated with all RDBI service "identifiers". The request of the test system shall be sent with correct supplier ID and correct function ID. wildcards shall not be used.
Verification	The IUT shall respond positively if the identifier is supported. For all reserved or unsupported ID's, the IUT shall respond with the negative response. User defined area: If the ID is supported, the positive response shall be checked for correct NAD, valid PCI (range 02_{16} – 06_{16}) and RSID
Reference	ISO 17987-3:2016, 6.3.6.6

16.3 [PT-CT 73] ReadByIdentifier command with incorrect addressing, IUT as slave

The ReadByIdentifier command specifies, that an answer shall only be sent if NAD, PCI.length, supplier ID and function ID match.

Table 92 defines the test system for "ReadByIdentifier command with incorrect addressing".

Table 92 — Test system: ReadByIdentifier command with incorrect addressing

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	Wildcards shall not be used. The test system sends TST_FRM_RDBI_0 with parameters according to the IUT specification except the parameter specified in the test case of Table 93. The test system sends TST_HDR_SR_3D.	
Verification	The IUT shall not respond to the request.	
Reference	ISO 17987-3:2016, 6.3.6.6	

Table 93 defines the test cases for "ReadByIdentifier command with incorrect addressing".

Table 93 — Test cases: ReadByIdentifier command with incorrect addressing

PT-CT-TC	ReadByIdentifier
[PT-CT 73].1	Incorrect IUT NAD (but, valid: 1_{16} – $7D_{16}$)
[PT-CT 73].2	Incorrect supplier ID MSB First bit of incorrect field shall be inverted.
[PT-CT 73].3	Incorrect supplier ID LSB First bit of incorrect field shall be inverted.
[PT-CT 73].4	Incorrect function ID MSB First bit of incorrect field shall be inverted.
[PT-CT 73].5	Incorrect function ID LSB First bit of incorrect field shall be inverted.
[PT-CT 73].6	PCI.length = 05_{16}

17 NAD assignment

17.1 General

Assign NAD is used to resolve conflicting node addresses. A response shall only be sent if the NAD, the supplier ID and the function ID match.

The test cases in this clause can only be performed if the IUT supports this optional service, which is listed in the NCF.

17.2 [PT-CT 74] NAD assignment — Followed by ReadByIdentifier service, IUT as slave

Table 94 defines the test system for “NAD assignment — Followed by ReadByIdentifier service”.

Table 94 — Test system: NAD assignment — Followed by ReadByIdentifier service

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGN_NAD, TST_FRM_RDBI_0, TST_HDR_SR_3D
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_ASSIGN_NAD with a valid new configured NAD which shall not be the same value as the initial NAD. The test system sends TST_FRM_RDBI_0 with the new configured NAD followed by TST_HDR_SR_3D. The test system sends TST_FRM_RDBI_0 with initial NAD followed by TST_HDR_SR_3D.	
Verification	The IUT shall answer to the first RDBI request with the newly assigned configured NAD. The IUT shall not answer to the second RDBI request with the initial NAD.	
Reference	ISO 17987-3:2016, 6.3.6 and 6.3.6.1	

17.3 [PT-CT 75] NAD assignment — With positive response, IUT as slave

Table 95 defines the test system for “NAD assignment — With positive response”.

Table 95 — Test system: NAD assignment — With positive response

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_ASSIGN_NAD, TST_HDR_SR_3D
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_ASSIGN_NAD. After that, TST_HDR_SR_3D is sent by the test system.	
Verification	The IUT shall respond with the positive assign NAD response and its initial NAD.	
Reference	ISO 17987-3:2016, 6.3.6 and 6.3.6.1	

17.4 [PT-CT 76] NAD assignment — Initial NAD, IUT as slave

This test case shall detect the error in an IUT as slave, when the IUT does not use the initial NAD (in the first data) for the Assign NAD service.

Table 96 defines the test system for “NAD assignment — Initial NAD, IUT as slave”.

Table 96 — Test system: NAD assignment — Initial NAD, IUT as slave

State	Description	
Set Up	IUT as	Slave
	Classification	slave nodes supporting AssignNAD
	Configuration	TST_FRM_ASSIGN_NAD, TST_HDR_SR_3D
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_ASSIGN_NAD with new configured NAD = initial NAD for initialization. The test system sends TST_HDR_SR_3D. The test system sends TST_FRM_ASSIGN_NAD. The new assigned configured NAD shall not be the initial NAD. The test system sends TST_HDR_SR_3D. The test system sends TST_FRM_ASSIGN_NAD. The new assigned configured NAD shall not be the initial NAD and differ from the previous assignment. The test system sends TST_HDR_SR_3D.	
Verification	The IUT shall respond with the positive assign NAD response in all three cases.	
Reference	ISO 17987-3:2016, 6.3.6 and 6.3.6.1	

18 Save Configuration

18.1 General

When supporting the Save Configuration command, a slave node shall store the current configured NAD and PIDs to NVM when the Save Configuration command is received. After a power on cycle, the NVM NAD and PID configuration shall be used by the slave node instantly.

18.2 [PT-CT 77] Save Configuration — With positive response, IUT as slave

Table 97 defines the test system for “Save Configuration — With positive response, IUT as slave”.

Table 97 — Test system: Save Configuration — With positive response, IUT as slave

State	Description	
Set Up	IUT as	Slave
	Classification	Class B, class C devices
	Configuration	TST_FRM_SAVE_CONFIG, TST_HDR_SR_3D
	bit rate	Default
System Init	Default	
Test	The test system sends TST_FRM_SAVE_CONFIG followed by TST_HDR_SR_3D.	
Verification	The IUT shall respond with the positive Save Configuration response.	
Reference	ISO 17987-3:2016, 6.3.6.4	

18.3 [PT-CT 78] Save Configuration — Save a new NAD, IUT as slave

Table 98 defines the test system for “Save Configuration – save a new NAD, IUT as slave”.

