



BSI Standards Publication

Road vehicles — Controller area network (CAN) conformance test plan

Part 2: High-speed medium access unit — Conformance test plan

National foreword

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**Road vehicles — Controller area
network (CAN) conformance test
plan —**

**Part 2:
High-speed medium access unit —
Conformance test plan**

*Véhicules routiers — Gestionnaire de réseau de communication (CAN)
plan d'essai de conformité —*

*Partie 2: Unité d'accès au medium haute vitesse — Plan d'essai de
conformité*



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Foreword

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

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

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For an explanation on the voluntary nature of standards, 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.

This document was prepared by ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

This second edition cancels and replaces the first edition (ISO 16845-2:2014), which has been technically revised and includes the following changes:

- several clauses, subclauses, tables and figures have been technically revised. In particular, the test cases and test requirements to verify if the CAN transceiver with implemented selective wake-up functions conform to the specified functionalities within ISO 11898-6:2013 were extended. This was done to provide a conformance test plan for the whole CAN medium access unit implementations compliant with ISO 11898-2:2016 (which is the result of the merge of ISO 11898-2:2003, ISO 1898-5:2007 and ISO 11898-6:2013).

A list of all the parts in the ISO 16845 series can be found on the ISO website.

Introduction

ISO 16845 was first published in 2004 to provide a test plan for conformance testing of the CAN data link layer and physical signalling as standardized in ISO 11898-1. With ISO 11898-6:2013, CAN high-speed medium access units were standardized, which partly implements a CAN data link layer, in order to provide selective wake-up functionality. This standard was merged together with ISO 11898-5:2007 and ISO 11898-2:2003 to produce ISO 11898-2:2016. In order to provide a conformance test plan for CAN medium access unit implementations compliant with ISO 11898-2:2016, this document has been developed. It comprises static tests and dynamic tests.

Road vehicles — Controller area network (CAN) conformance test plan —

Part 2: High-speed medium access unit — Conformance test plan

1 Scope

This document specifies the conformance test plan for the CAN physical layer as standardized in ISO 11898-2:2016. It specifies static and dynamic tests. The dynamic tests includes the test cases for the partly implemented Classical CAN protocol and CAN FD protocol as standardized in ISO 11898-1:2015. The static tests describe the data to be given in datasheets.

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 11898-1:2015, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*

ISO 11898-2:2016, *Road vehicles — Controller area network (CAN) — Part 2: High-speed medium access unit*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11898-2:2016 and the following 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 <https://www.iso.org/obp>

3.1 implementation under test IUT

HS-PMA which will be conformance tested according to this document

EXAMPLE Standalone transceiver or SBC.

3.2 lower tester LT

part of the test system, which emulates the interfaces of the underlying OSI layer from sight of the IUT

3.3 normal mode

mode, in which biasing as well as RX and TX are enabled and low-power mode is disabled

3.4
system under test
SUT

system, which embeds the IUT as a part or contains the IUT, because it cannot operate as a stand-alone component

3.5
test system
TS

system, which fulfils in this case all requirements to perform the tests defined in this specification

3.6
upper tester
UT

part of the test system, which emulates the interfaces of the overlying OSI layer from sight of the IUT

3.7
valid frame

syntactically correct CAN frame

3.8
invalid frame

syntactically incorrect CAN frame with CAN conform error treatment

3.9
sync frame

syntactically correct CAN frame which is present on the bus while the IUT is in low power mode.

Note 1 to entry: It could be a WUF or non WUF.

3.10
sync sequence

group of sync frames which the IUT may use to calibrate or fine tune internal parameter to be prepared to detect a WUF

4 Symbols and abbreviated terms

The following symbols and abbreviated terms are used in this document:

ACK	acknowledge
ASP	abstract service primitives
CAN	controller area network
CBFF	classical base frame format
CEFF	classical extended frame format
CRC	cyclic redundancy check
DLC	data length code
EOF	end of frame
FBFF	FD base frame format
FEC	frame error counter
FEFF	FD extended frame format

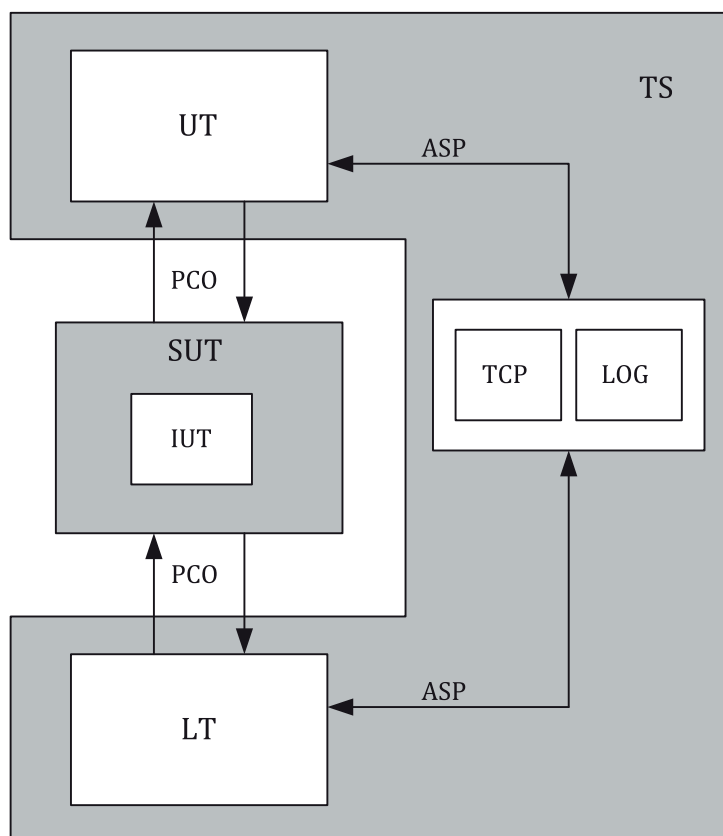
ID	identifier
IMF	intermission field
MAC	medium access control
OSI	open system interconnection
PCO	point of control and observation
PHS	physical signalling
PL	physical layer
PMA	physical medium attachment
SBC	system base chip
SOF	start of frame
WUF	wake-up frame
WUP	wake-up pattern

5 Global overview

5.1 OSI conformance test method

OSI conformance testing was mainly introduced by the ISO 9646, ISO 9646-1 and ISO 9646-2, for the purpose of regulating and harmonizing impartial tests. In general information about the internal structure of the implementation as well as source code is not available to the party performing the tests. This explains why the preferred OSI conformance testing methodology is black box testing and consequently does not take into account any implementation details.

[Figure 1](#) — The OSI coordinated test method depicts the OSI coordinated test method.



Key

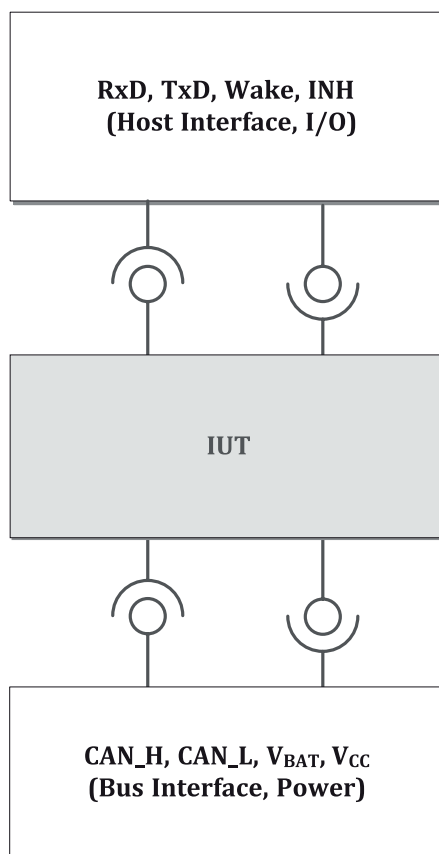
ASP	abstract service primitives
IUT	implementation under test
LOG	logger
LT	lower tester
PCO	point of control and observation
SUT	system under test
TCP	test coordination procedure
TS	test system
UT	upper tester

Figure 1 — The OSI coordinated test method

OSI conformance testing proposes many test methods suitable for different sorts of IUT, providing different points of control and observation.

A coordinated test method which provides a simple interface to the IUT is the most suitable for HS-PMA, i.e. the CAN network itself, and a flexible test coordination protocol using CAN messages between the LT as part of the TS and the UT in the SUT. The LT controls and observes the IUT lower service boundary indirectly via the underlying service provider, using the ASPs of the CAN protocol. The UT controls and observes the IUT upper service boundary. The TCPs ensure the cooperation between the LT and the UT.

In case of IUTs with partial networking functionalities, influencing variables from the UT side are the digital CAN signals (RXD and TXD), host interface signals and I/O signals like INH or wake. The LT influencing variables are the analogue bus interface with the signals CAN_H and CAN_L and the supply power. [Figure 2](#) depicts the influencing variables on the IUT.

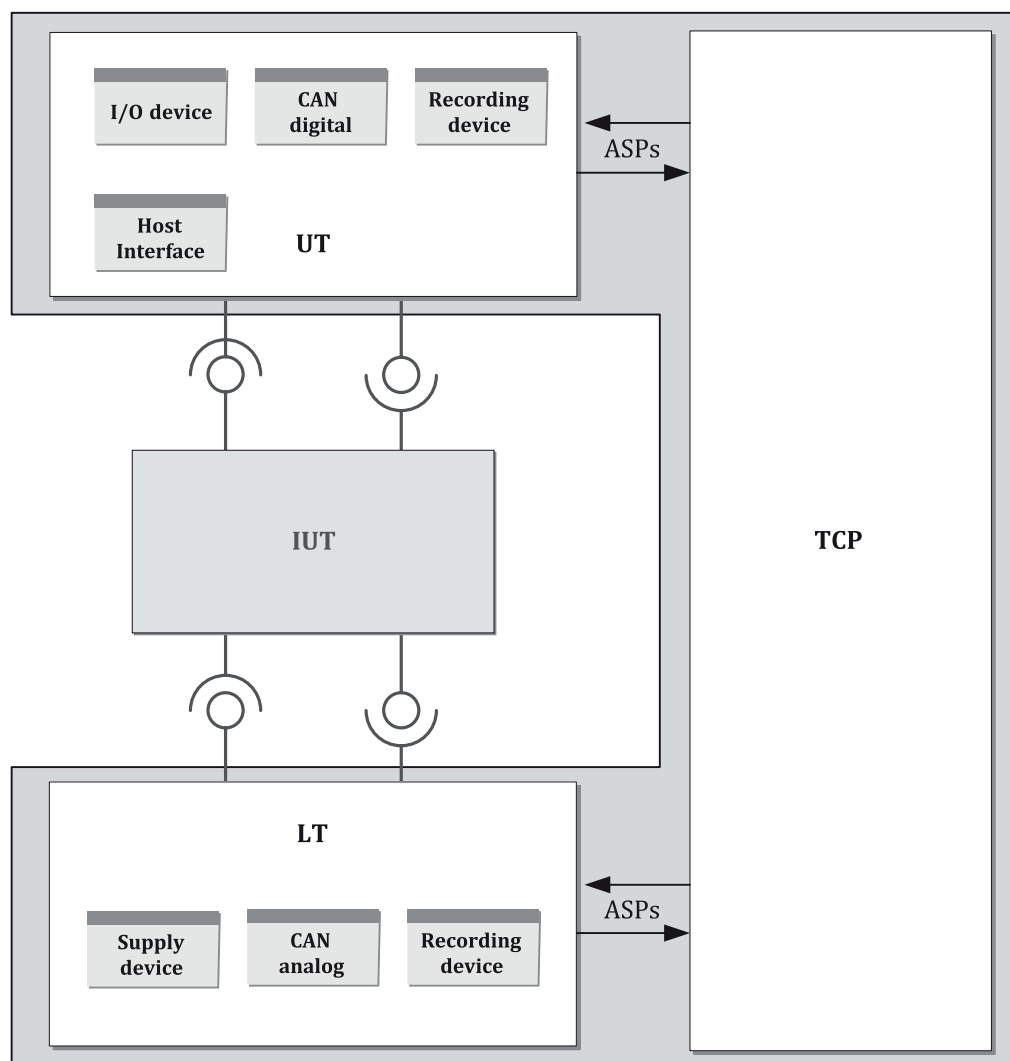
**Key**

CAN_H	CAN high signal
CAN_L	CAN low signal
INH	inhibit output
IUT	implementation under test
I/O	input/output
RXD	receive data output
TXD	transmit data input
V _{BAT}	battery supply input
V _{CC}	supply input
Wake	mode signalling output

Figure 2 — Influencing variables on IUT

To realise all services stimulating the IUT and recording the responses of the IUT regarding all influencing variables, abstract logical devices are defined as followed.

[Figure 3](#) — Abstract logical devices of UT and LT depicts abstract logical devices of UT and LT.



Key

- IUT implementation under test
- LT lower tester
- TCP test coordination procedure
- UT upper tester

Figure 3 — Abstract logical devices of UT and LT

The OSI model divides a communication interface in seven logical layers which contain defined interfaces from / to the upper or lower layer (as introduced by the ISO 7498-1). Following the OSI coordinated test method the TS realises the upper layer with help of the UT and the lower layer with help of the LT. For IUTs without partial networking capability, the IUT is implemented inside the logical layer 1 – the physical layer with the lower interface as the CAN network and the upper interface to the layer 2, known as the data link- or protocol layer, with logical signals TXD and RXD. In case of an IUT supporting partial networking the IUT itself contains functionalities appropriate to the data link layer (partial networking functionalities) and physical layer (typical transceiver functionalities). To follow the OSI coordinated test method this test specification is split in a physical layer part, verifying the transceiver characteristics appropriated to the OSI physical layer and a data link layer part, verifying the protocol implementation necessary for partial networking functionalities.

5.2 General organization

The abstract test suites of the TS are independent to one another. Each abstract test suite checks the behaviour of the IUT for a particular parameter of the CAN protocol as defined in ISO 11898-1:2015. Each test case may be executed one after another in any order or alone.

Test cases requiring variations of individual parameters shall be repeated for each value of the parameter. Each repetition is named elementary test. A test case including different elementary tests is valid only if all tests pass.

The result of executing a test case on an IUT should be the same whenever it is performed. To realize such reproducibility of test results, this document is designed in the way to minimize the possibility that a test case produces different test outcomes on different occasions. Therefore, test requirements, which shall be met, and how the verdicts are to be assigned are defined in an unambiguous way.

All parameters in a test case are given for the electrical interface pins of IUT. The stimulus generator should correctly signal delays and voltage drops of test setup.

If not explicitly different described in test case, all applied stimuli for CAN data and remote frames are built according to the CAN protocol behaviour as expected on a real CAN network.

5.3 Test case organization

5.3.1 Overview

All defined test cases should be executed in accordance with the supported IUT-specific bit rates defined in the IUT's datasheet.

In case the IUT supports other bit rates, the following scenarios are possible.

- if the IUT supports only one bit rate, then all test cases should be executed using this specific bit rate;
- if the IUT supports two bit rates, then all test cases should be executed with both bit rate; and
- if the IUT supports more than two bit rates or a range of bit rates, then all test cases should be executed considering the highest and the lowest bit rate, as well as a bit rate in-between.

5.3.2 Setup state

5.3.2.1 General

The setup state is a defined and explicitly entered and verified state in which the IUT shall be before entering the test state. A test starts with unpowered IUT. The first step is to set IUT power supply on. The IUT, unless otherwise specified, is configured with data as found in [5.3.4.2](#).

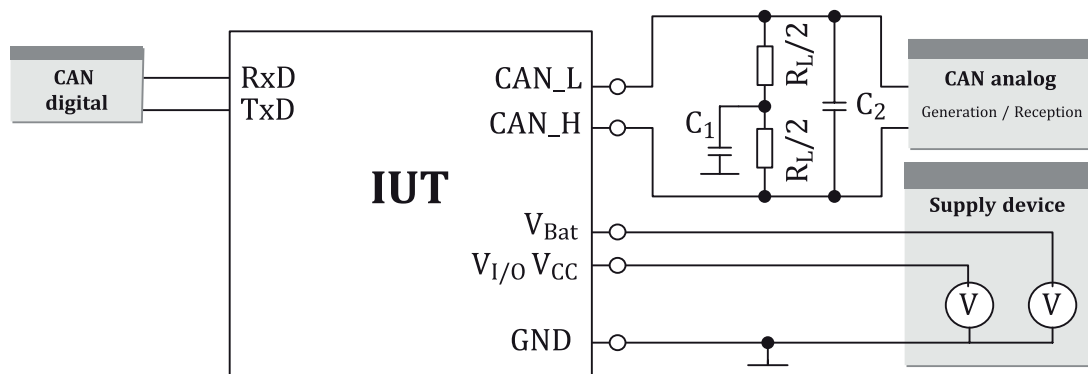
Each elementary test is made of three states:

- setup state;
- test state; and
- verification state.

Before the first elementary test is started, the IUT shall be initialised into the default state.

5.3.2.2 Default setup

[Figure 4](#) describes the default setup for the test, which shall be applied unless otherwise specified in setup of the test case description. Furthermore, the setup information of the related IUT documentation shall be followed.



Key

CAN_H	CAN high signal
CAN_L	CAN low signal
GND	ground
IUT	implementation under test
I/O	input/output
RXD	receive data output
TXD	transmit data input
V _{BAT}	battery supply input
V _{CC}	supply input
V _{I/O}	logic supply input
R _L	test load resistance of $60\ \Omega \pm 0,6\ \Omega$
C ₁	test load capacitance of $4,7\ \text{nF} \pm 0,235\ \text{nF}$ (absent unless otherwise specified)
C ₂	differential test load capacitance if $100\ \text{pF} \pm 1\ \text{pF}$

Figure 4 — Default setup for test

5.3.2.3 Default state

The default state is characterised by the following default value:

- IUT power supply on;
- IUT configured to the bit rate(s) for the particular test; and
- IUT set to Normal mode.

After the end of each elementary test, the default state should be re-applied.

5.3.3 Test state

The time between two frames on the bus shall be zero bits of idle after IMF, unless otherwise specified. The idle phase shall not be longer than $t_{SILENCE(min)}$.

5.3.4 Test frame definition for protocol related test cases

5.3.4.1 Elements of CAN test frames

In the CAN protocol related test cases; the focus is on correct frame handling. Therefore, the test frames or test patterns sent to the IUT are conforming to CAN protocol. In case of valid, syntactically correct frames and also for invalid, syntactically incorrect frames, the treatment around the bus failure shall

be compliant to the CAN Protocol. The test frames and error treatments are structured as depicted in ISO 11898-1:2015.

5.3.4.2 IUT configuration and default parameters

Unless otherwise specified in the corresponding test case definition, the used test frame shall be as defined in [Table 1](#).

Table 1 — Definition of the default test frames

Frame format	CAN ID field	DLC	Data field	ACK bit
CBFF	000 _h	1	01 _h	0 _b
CEFF	00000000 _h	1	01 _h	0 _b

Further default parameters which shall be used unless otherwise specified in the corresponding test case definition:

- Used frame type: CBFF;
- ID configuration: corresponding to the used test frame (wake-up condition fulfilled);
- Data field configuration: corresponding to the used test frame (wake-up condition fulfilled);
- ID mask: set all bits to "care";
- Data mask bit: if implemented, it shall be set to enable; and
- t_{WAIT} : eight recessive bits after intermission field.

5.3.4.3 Sync frame sequence

The sync frame sequence as it is used in several test cases shall be as defined in [Table 2](#).

Table 2 — Definition of the sync frame sequence

Frame	ID	DLC	Data
1	078 _h	1	FF _h
2 to 5 ^a	555 _h	1	FF _h
^a 2 to 9 in case of data rate > 500 kbit/s			

The frame generator sends each sync frame without a dominant ACK bit followed by an active error frame with intermission field. The first frame will be followed by additional idle time of 250 µs for bias reaction time.

5.3.5 Hierarchical structure of tests

5.3.5.1 Overview

All the tests defined in the test plan are grouped into categories in order to aid planning, development, understanding or execution of each test case. There are two levels of categories:

- the test groups; and
- the test cases.

5.3.5.2 Test group structure

The test cases are grouped by different functional blocks of the IUT which will be verified separately. Each test group consists of one or several test cases.

5.3.5.3 Test case structure

Each test case of a test group focuses one particular requirement which will be verified.

Each test case is defined by a specific number and a particular name in order to differentiate the test cases and to easily summarise the goal of the test case.

[Table 3](#) depicts the structure of the defined test cases.

Table 3 — Structure of the defined test cases

Item title	Test case item title and remarks of the test case
Purpose	Short description of the purpose of the test case
CAN version	Classical CAN and / or CAN FD tolerant
HS-PMA	Mode of HS-PMA wakeup capabilities
Test variables	The parameter definition of the test case [optional: test frame sequence definition]
Elementary test cases	Describes the number of tests / measurements
Setup	Setup of the test case
Execution	Test steps dealing with the setup being applied and what is observed and measured
Response	Description about what is expected as the result
Reference	Link to the requirement specification

5.3.6 Elementary tests

Some test cases may be subdivided into elementary tests which are repetitions of the test case for several values of the focussed parameter to test. Each elementary test has its own parameter definition which is defined in the test variables of the test case definition.

5.3.7 Applicable test cases for IUTs with enhanced voltage biasing

It should be distinguished between implementations which support the complete requirements or only the enhanced biasing functionalities defined in ISO 11898-2:2016. The following test cases are applicable for IUTs which support only the enhanced voltage biasing compliant to ISO 11898-2:2016.

- Static test cases: [Clause 6](#)
- Dynamic test cases: [Clause 7](#) to [Clause 10](#)

6 Test type 1, static test cases

The motivation of static test cases is to check the availability and the boundaries in the data sheet of the IUT. For all integrated circuits every related parameter in [Table 4](#) shall be part of the data sheet and fulfil the specified boundaries in terms of physical worst-case condition. Data sheet parameter names may deviate from the names in [Table 4](#), but in this case, a cross-reference list (data sheet versus [Table 4](#)), shall be provided for this test. Parameter conditions may deviate from the conditions in [Table 4](#), if the data sheet conditions are according to the physical worst-case context in [Table 4](#).

Table 4 — Static test case summary

No.	Parameter		Limits			Conditions ^d	Conform- ance test is passed if value		Test case valid for HS- PMA type: ^a			
			Min	Max	Unit		≤	≥	a	b	c	d
1	General maximum rating V_{CAN_H} and V_{CAN_L}	Table 15	-27,0	+40,0	V	-/-	min	max	y	y	y	y
2	Extended maximum rating V_{CAN_H} and V_{CAN_L} (if supported)	Table 15	-58,0	+58,0	V	-/-	min	max	y	y	y	y
3	Maximum rating V_{Diff}	Table 15	-5,0	+10,0	V	The maximum rating for V_{Diff} excludes that all combinations of V_{CAN_H} and V_{CAN_L} are compliant to this standard. $V_{Diff} = V_{CAN_H} - V_{CAN_L}$. This is required regardless whether general or extended maximum rating for V_{CAN_H} and V_{CAN_L} is fulfilled	min	max	y	y	y	y
4	Single ended recessive output voltage on CAN_H (V_{CAN_H}), bus biasing active	Table 5	+2,0	+3,0	V	All requirements in Table 5 apply concurrently. Therefore, not all combinations of V_{CAN_H} and V_{CAN_L} are compliant with the defined differential output voltage. See also ISO 11898-2:2016, Table 5.	max	min	y	y	y	y
5	Single ended recessive output voltage on CAN_L (V_{CAN_L}), bus biasing active	Table 5	+2,0	+3,0	V	All requirements in Table 5 apply concurrently. Therefore, not all combinations of V_{CAN_H} and V_{CAN_L} are compliant with the defined differential output voltage. See also ISO 11898-2:2016, Table 5.	max	min	y	y	y	y
6	Differential recessive output voltage (V_{Diff}), bus biasing active	Table 5	-0,5	+0,05	V	All requirements in Table 5 apply concurrently. Therefore, not all combinations of V_{CAN_H} and V_{CAN_L} are compliant with the defined differential output voltage. See also ISO 11898-2:2016, Table 5.	max	min	y	y	y	y
^a HS-PMA types: a - without low-power mode and partial network, b - with low-power mode, normal biasing and without partial network, c - with low-power mode, automatic biasing and without partial network, d - with low-power mode, automatic biasing and partial network; labelling: y – applicable, n – not applicable. ^b The minimum value of 0,3 ms is accepted for legacy implementations. ^c For legacy implementations a minimum value of 350 µs is acceptable. ^d Parameters within the conditions are aligned with Figure 4 p for test.												

Table 4 (continued)

No.	Parameter		Limits			Conditions ^d	Conformance test is passed if value		Test case valid for HS-PMA type: ^a			
			Min	Max	Unit		≤	≥	a	b	c	d
7	Single ended recessive output voltage on CAN_H (V _{CAN_H}), bus biasing inactive	Table 6	-0,1	+0,1	V	See ISO 11898-2:2016, 5.10 to determine when bias shall be inactive. See also ISO 11898-2:2016, Table 6.	max	min	n	y	y	y
8	Single ended recessive output voltage on CAN_L (V _{CAN_L}), bus biasing inactive	Table 6	-0,1	+0,1	V	See ISO 11898-2:2016, 5.10 and Table 6.	max	min	n	y	y	y
9	Differential recessive output voltage (V _{Diff}), bus biasing inactive	Table 6	-0,2	+0,2	V	See ISO 11898-2:2016, 5.10 and Table 6.	max	min	n	y	y	y
10	Single ended voltage on CAN_H, dominant output (V _{CAN_H})	Table 2	+2,75	+4,50	V	R _L = 50 Ω ... 65 Ω	max	min	y	y	y	y
11	Single ended voltage on CAN_L, dominant output (V _{CAN_L})	Table 2	+0,5	+2,25	V	R _L = 50 Ω ... 65 Ω	max	min	y	y	y	y
12	Differential voltage on normal bus load, dominant output (V _{Diff})	Table 2	+1,5	+3,0	V	R _L = 50 Ω ... 65 Ω	max	min	y	y	y	y
13	Differential voltage on effective resistance during arbitration, dominant output (V _{Diff})	Table 2	+1,5	+5,0	V	R _L = 2 240 Ω	max	min	y	y	y	y
14	Differential voltage on extended bus load, dominant output (V _{Diff}) (if supported)	Table 2	+1,4	+3,3	V	R _L = 45 Ω ... 70 Ω	max	min	y	y	y	y
^a HS-PMA types: a - without low-power mode and partial network, b - with low-power mode, normal biasing and without partial network, c - with low-power mode, automatic biasing and without partial network, d - with low-power mode, automatic biasing and partial network; labelling: y - applicable, n - not applicable. ^b The minimum value of 0,3 ms is accepted for legacy implementations. ^c For legacy implementations a minimum value of 350 μs is acceptable. ^d Parameters within the conditions are aligned with Figure 4 p for test.												

Table 4 (continued)

No.	Parameter		Limits			Conditions ^d	Conform- ance test is passed if value		Test case valid for HS- PMA type: ^a			
			Min	Max	Unit		≤	≥	a	b	c	d
15	Driver symme- try (V_{SYM}), with a frequency that corresponds to the highest bit rate for which the HS-PMA implementation is intended, however, at most 1 MHz (2 MBit/s)	Table 3	+0,9	+1,1	-/-	$R_L = 60 \Omega$; $C_1 = 4,7 \text{ nF}$	max	min	y	y	y	y
16	Absolute cur- rent on CAN_H (I_{CAN_H}), Max- imum driver output current	Table 4	-/-	115	mA	$-3,0 \text{ V} \leq V_{CAN_H} \leq +18,0 \text{ V}$ See also ISO 11898-2:2016, Table 4.	max	-/-	y	y	y	y
17	Absolute cur- rent on CAN_L (I_{CAN_L}), Max- imum driver output current	Table 4	-/-	115	mA	$-3,0 \text{ V} \leq V_{CAN_L} \leq +18,0 \text{ V}$ See also ISO 11898-2:2016, Table 4.	max	-/-	y	y	y	y
18	Transmit dom- inant time out (t_{dom}), (if supported)	Table 7	+0,8 ^b	+10,0	ms	-/-	max	min	y	y	y	y
19	Receiver reces- sive state dif- ferential input voltage range, bus biasing active (V_{Diff})	Table 8	-3,0	+0,5	V	$-12,0 \text{ V} \leq V_{CAN_L} \leq +12,0 \text{ V}$ $-12,0 \text{ V} \leq V_{CAN_H} \leq +12,0 \text{ V}$	min	max	y	y	y	y
20	Receiver dom- inant state dif- ferential input voltage range, bus biasing active (V_{Diff})	Table 8	+0,9	+8,0	V	$-12,0 \text{ V} \leq V_{CAN_L} \leq +12,0 \text{ V}$ $-12,0 \text{ V} \leq V_{CAN_H} \leq +12,0 \text{ V}$	min	max	y	y	y	y
21	Receiver reces- sive state dif- ferential input voltage range, bus biasing inactive (V_{Diff}), (if supported)	Table 9	-3,0	+0,4	V	$-12,0 \text{ V} \leq V_{CAN_L} \leq +12,0 \text{ V}$ $-12,0 \text{ V} \leq V_{CAN_H} \leq +12,0 \text{ V}$	min	max	n	y	y	y
22	Receiver dom- inant state dif- ferential input voltage range, bus biasing inactive (V_{Diff}), (if supported)	Table 9	+1,15	+8,0	V	$-12,0 \text{ V} \leq V_{CAN_L} \leq +12,0 \text{ V}$ $-12,0 \text{ V} \leq V_{CAN_H} \leq +12,0 \text{ V}$	min	max	n	y	y	y

^a HS-PMA types: a - without low-power mode and partial network, b - with low-power mode, normal biasing and without partial network, c - with low-power mode, automatic biasing and without partial network, d - with low-power mode, automatic biasing and partial network; labelling: y - applicable, n - not applicable.

^b The minimum value of 0,3 ms is accepted for legacy implementations.

^c For legacy implementations a minimum value of 350 μs is acceptable.

^d Parameters within the conditions are aligned with [Figure 4 p](#) for test.

Table 4 (continued)

No.	Parameter		Limits			Conditions ^d	Conformance test is passed if value		Test case valid for HS-PMA type: ^a			
			Min	Max	Unit		≤	≥	a	b	c	d
23	Differential internal resistance, receiver input resistance (R_{Diff})	Table 10	12	100	k Ω	$-2,0\text{ V} \leq V_{CAN_H} \leq +7,0\text{ V}$ $-2,0\text{ V} \leq V_{CAN_L} \leq +7,0\text{ V}$	max	min	y	y	y	y
24	Single ended internal resistance, receiver input resistance (R_{CAN_H} , R_{CAN_L})	Table 10	6	50	k Ω	$-2,0\text{ V} \leq V_{CAN_H} \leq +7,0\text{ V}$ $-2,0\text{ V} \leq V_{CAN_L} \leq +7,0\text{ V}$	max	min	y	y	y	y
25	Matching of receiver internal resistance (m_R)	Table 11	-0,03	+0,03	-/-	$V_{CAN_H} = +5,0\text{ V}$ $V_{CAN_L} = +5,0\text{ V}$ "	max	min	y	y	y	y
26	Loop delay (t_{Loop})	Table 12	-/-	255	ns	$R_L = 60\ \Omega$, $C_2 = 100\text{ pF}$, $C_{RXD} = 15\text{ pF}$	max	-/-	y	y	y	y
27	Transmitted recessive bit width @ 2 Mbit/s ($t_{Bit(Bus)}$), (if supported)	Table 13	435	530	ns	$R_L = 60\ \Omega$, $C_2 = 100\text{ pF}$, $C_{RXD} = 15\text{ pF}$	max	min	y	y	y	y
28	Received recessive bit width @ 2 Mbit/s ($t_{Bit(RXD)}$), (if supported)	Table 13	400	550	ns	$R_L = 60\ \Omega$, $C_2 = 100\text{ pF}$, $C_{RXD} = 15\text{ pF}$	max	min	y	y	y	y
29	Receiver timing symmetry @ 2 Mbit/s (Δt_{Rec}), (if supported)	Table 13	-65	+40	ns	$R_L = 60\ \Omega$, $C_2 = 100\text{ pF}$, $C_{RXD} = 15\text{ pF}$	max	min	y	y	y	y
30	Transmitted recessive bit width @ 5 Mbit/s ($t_{Bit(Bus)}$), (if supported)	Table 14	155	210	ns	$R_L = 60\ \Omega$, $C_2 = 100\text{ pF}$, $C_{RXD} = 15\text{ pF}$	max	min	y	y	y	y
31	Received recessive bit width @ 5 Mbit/s ($t_{Bit(RXD)}$), (if supported)	Table 14	120	220	ns	$R_L = 60\ \Omega$, $C_2 = 100\text{ pF}$, $C_{RXD} = 15\text{ pF}$	max	min	y	y	y	y
32	Receiver timing symmetry @ 5 Mbit/s (Δt_{Rec}), (if supported)	Table 14	-45	+15	ns	$R_L = 60\ \Omega$, $C_2 = 100\text{ pF}$, $C_{RXD} = 15\text{ pF}$	max	min	y	y	y	y

^a HS-PMA types: a - without low-power mode and partial network, b - with low-power mode, normal biasing and without partial network, c - with low-power mode, automatic biasing and without partial network, d - with low-power mode, automatic biasing and partial network; labelling: y - applicable, n - not applicable.

^b The minimum value of 0,3 ms is accepted for legacy implementations.

^c For legacy implementations a minimum value of 350 μ s is acceptable.

^d Parameters within the conditions are aligned with Figure 4 p for test.

Table 4 (continued)

No.	Parameter		Limits			Conditions ^d	Conformance test is passed if value		Test case valid for HS-PMA type: ^a			
			Min	Max	Unit		≤	≥	a	b	c	d
33	Leakage current on CAN_H, CAN_L (I_{CAN_H} , I_{CAN_L}), maximum leakage currents, unpowered	Table 16	-10	+10	µA	$V_{CAN_H} = 5\text{ V}$, $V_{CAN_L} = 5\text{ V}$, All supply inputs connected to GND.	max	min	y	y	y	y
34	CAN activity filter time, long (t_{Filter}), (if supported)	Table 20	0,5	5,0	µs	-/-	max	min	n	y	y	y
35	CAN activity filter time, short (t_{Filter}), (if supported)	Table 20	0,15	1,8	µs	-/-	max	min	n	y	y	y
36	Wake-up time-out (t_{Wake}), (if supported)	Table 20	800,0 ^c	10 000,0	µs	-/-	max	min	n	y	y	y
37	Timeout for bus inactivity ($t_{Silence}$)	Table 20	0,6*10 ⁶	1,2*10 ⁶	µs	-/-	max	min	n	n	y	y
38	Bus Bias reaction time (t_{Bias})	Table 20	-/-	250,0	µs	-/-	max	-/-	n	n	y	y
39	Number of recessive bits before a new SOF shall be accepted (n_{Bits_idle}) (if supported)	Table 18	6	10	-/-	-/-	max	min	n	n	n	y
40	CAN FD data phase glitch filter (slow) ($pGlitch_{Slow}$) (if supported)	Table 19	5,00	17,5	% of arbitration bit time	-/-	min	max	n	n	n	y
41	CAN FD data phase glitch filter (fast) ($pGlitch_{Fast}$) (if supported)	Table 19	2,50	8,75	% of arbitration bit time	-/-	min	max	n	n	n	y
^a HS-PMA types: a - without low-power mode and partial network, b - with low-power mode, normal biasing and without partial network, c - with low-power mode, automatic biasing and without partial network, d - with low-power mode, automatic biasing and partial network; labelling: y – applicable, n – not applicable. ^b The minimum value of 0,3 ms is accepted for legacy implementations. ^c For legacy implementations a minimum value of 350 µs is acceptable. ^d Parameters within the conditions are aligned with Figure 4 p for test.												

7 Test type 2, normal CAN communication acceptance

7.1 Test class 1, valid frame format

7.1.1 ID test in CBFF messages

[Table 5](#) specifies the test of different IDs in CBFF messages.

Table 5 — ID test in CBFF messages

Item	Description
Purpose	This test verifies the behaviour of the IUT when presence of correct CBFF messages with different IDs.
CAN version	— Classical CAN — CAN FD tolerant
HS-PMA	— Low-power mode with selective wake-up capability (WUF)
Test variables	All parameters are set to the default parameters as defined in 5.3.4.2 except: Test frame: — ID: Refer to test execution — DLC: 0
Elementary test cases	The CAN-ID shall be element of: $\in [000_h, 7FF_h]$ Different CAN-ID's are used for test. Test Configured wake-up ID #1 000 _h #2 555 _h #3 2AA _h #4 7FF _h #5 randomly generated ID
Setup	— The IUT is configured corresponding test variables. — The IUT is set to low-power mode with configured selective wake-up.
Execution	1) The TS sends "sync frame sequence" as described in 5.3.4.3. 2) The TS generates first ID with a value of 000 _h . 3) If the ID is not equal to the configured wake-up ID, the TS sends test frame with the generated ID; otherwise go to test step 4. 4) If the ID is smaller than 7FF _h , the TS increments the ID by one and goes back to test step 3, otherwise go to test step 5. 5) The TS waits two times the maximum bias reaction time (t_{bias}). 6) The TS sends the test frame with configured wake-up ID.
Response	The last test frame shall cause a wake-up. All previously sent test frames shall not cause a wake-up.
Reference	ISO 11898-1:2015

7.1.2 ID test in CEFF messages

Table 6 specifies the test of different IDs in CEFF messages.

Table 6 — ID test in CEFF messages

Item	Description
Purpose	This test verifies the behaviour of the IUT when presence of a correct data frame with different IDs in CEFF messages.
CAN version	— Classical CAN — CAN FD tolerant
HS-PMA	— Low-power mode with selective wake-up capability (WUF)

Table 6 (continued)

Item	Description												
Test variables	All parameters are set to the default parameters as defined in 5.3.4.2 except: IUT configuration — Configured ID: Refer to elementary test definition Test frame: — ID: Refer to test execution												
Elementary test cases	The CAN ID shall be element of: $\in [00000000_h, 1FFFFFFF_h]$ Different CAN ID's are used for test. <table> <tr> <th>Test</th><th>Configured wake-up ID</th></tr> <tr> <td>#1</td><td>00000000_h</td></tr> <tr> <td>#2</td><td>15540000_h</td></tr> <tr> <td>#3</td><td>0AA80000_h</td></tr> <tr> <td>#4</td><td>1FFC0000_h</td></tr> <tr> <td>#5</td><td>randomly generated ID</td></tr> </table>	Test	Configured wake-up ID	#1	00000000 _h	#2	15540000 _h	#3	0AA80000 _h	#4	1FFC0000 _h	#5	randomly generated ID
Test	Configured wake-up ID												
#1	00000000 _h												
#2	15540000 _h												
#3	0AA80000 _h												
#4	1FFC0000 _h												
#5	randomly generated ID												
Setup	— The IUT is configured corresponding Test variables. — The IUT is set to low-power mode with configured selective wake-up.												
Execution	1) The TS sends "sync frame sequence" as described in 5.3.4.3. 2) The TS generates first ID with a value of 00000000_h. 3) If the ID is not equal to the configured wake-up ID, the TS sends test frame with the generated ID; otherwise go to test step 4. 4) If the ID is smaller than 1FFC0000_h, the TS increment the ID by 00040000_h and goes back to test step 3, otherwise go to test step 5. 5) The TS waits two times the maximum bias reaction time (t_{bias}). 6) The TS sends the test frame with configured wake-up ID.												
Response	The last test frame shall cause a wake-up. All previously sent test frames shall not cause a wake-up.												
Reference	ISO 11898-1:2015												

7.1.3 WUP element of WUF

Table 7 — WUP element of WUF specifies the test of a WUP as element of a WUF.

Table 7 — WUP element of WUF

Item	Description
Purpose	This test verifies the behaviour of the IUT detecting a WUP which is element of a WUF.
CAN version	— Classical CAN — CAN FD tolerant
HS-PMA	— Low-power mode with selective wake-up capability (WUF)
Test variables	All parameters are set to the default parameters as defined in 5.3.4.2 except: Test frame: — DLC: 0 — ID: 078_h containing a bit-sequence of five dominant, five recessive and five dominant bits)
Elementary test cases	There is one elementary test case.

Table 7 (continued)

Item	Description
Setup	— The IUT is configured corresponding test variables. — The IUT is set to low-power mode with configured selective wake-up.
Execution	1) The TS waits for at least $1,1 * t_{SILENCE(max)}$. 2) The TS sends test frame six times each separated by two times the maximum bias reaction time (t_{bias}).
Response	— The WUP inside the first test frame shall be detected; i.e. the biasing is switched on after first test frame (because of presence of a valid WUP). — The IUT shall wake-up latest after the presence of the sixth test frame.
Reference	ISO 11898-1:2015

7.1.4 WUF element of another valid frame — CBFF message

Table 8 specifies the test of a WUF as element of a valid frame.

Table 8 — WUF element of another valid frame — CBFF message

Item	Description																
Purpose	This test verifies the behaviour of the IUT detecting a WUF which is element of a valid frame.																
CAN Version	— Classical CAN — CAN FD tolerant																
HS-PMA	— Low-power mode with selective wake-up capability (WUF)																
Test variables	All parameters are set to the default parameters as defined in 5.3.4.2 except: IUT configuration: — ID: 012_h — DLC: 0																
Elementary test cases	Test frames as defined in table below: <table> <tr> <th>Frame</th><th>Frame definition</th></tr> <tr> <td>#1</td><td>ID = 012_h, DLC = 5, Data = 01_h, 20_h, 0F_h, 76_h, 7F_h</td></tr> <tr> <td>#2</td><td>ID = 0960F012_h, DLC = 0</td></tr> <tr> <td>#3</td><td>ID = 0F4FD012_h, DLC = 0</td></tr> <tr> <td>#4</td><td>ID = 011_h, DLC = 8, Data = 9A_h, 4F_h, 01_h, 20_h, 0F_h, 76_h, 7F_h, FF_h</td></tr> <tr> <td>#5</td><td>ID = 0960F011_h, DLC = 8, Data = 9A_h, 4F_h, 01_h, 20_h, 0F_h, 76_h, 7F_h, FF_h</td></tr> <tr> <td>#6</td><td>ID = 0F4FD011_h, DLC = 8, Data = 9A_h, 4F_h, 01_h, 20_h, 0F_h, 76_h, 7F_h, FF_h</td></tr> <tr> <td>#7</td><td>ID = 012_h, DLC = 0</td></tr> </table>	Frame	Frame definition	#1	ID = 012 _h , DLC = 5, Data = 01 _h , 20 _h , 0F _h , 76 _h , 7F _h	#2	ID = 0960F012 _h , DLC = 0	#3	ID = 0F4FD012 _h , DLC = 0	#4	ID = 011 _h , DLC = 8, Data = 9A _h , 4F _h , 01 _h , 20 _h , 0F _h , 76 _h , 7F _h , FF _h	#5	ID = 0960F011 _h , DLC = 8, Data = 9A _h , 4F _h , 01 _h , 20 _h , 0F _h , 76 _h , 7F _h , FF _h	#6	ID = 0F4FD011 _h , DLC = 8, Data = 9A _h , 4F _h , 01 _h , 20 _h , 0F _h , 76 _h , 7F _h , FF _h	#7	ID = 012 _h , DLC = 0
Frame	Frame definition																
#1	ID = 012 _h , DLC = 5, Data = 01 _h , 20 _h , 0F _h , 76 _h , 7F _h																
#2	ID = 0960F012 _h , DLC = 0																
#3	ID = 0F4FD012 _h , DLC = 0																
#4	ID = 011 _h , DLC = 8, Data = 9A _h , 4F _h , 01 _h , 20 _h , 0F _h , 76 _h , 7F _h , FF _h																
#5	ID = 0960F011 _h , DLC = 8, Data = 9A _h , 4F _h , 01 _h , 20 _h , 0F _h , 76 _h , 7F _h , FF _h																
#6	ID = 0F4FD011 _h , DLC = 8, Data = 9A _h , 4F _h , 01 _h , 20 _h , 0F _h , 76 _h , 7F _h , FF _h																
#7	ID = 012 _h , DLC = 0																
Setup	— The IUT is configured corresponding test variables. — The IUT is set to low-power mode with configured selective wake-up.																
Execution	1) The TS sends “sync frame sequence” as described in 5.3.4.3. 2) The TS sends test frames 1 to 7 as defined in test variables, each separated by two times the maximum bias reaction time (t_{bias}).																
Response	The IUT shall detect the wake-up condition on presence of test frame 7.																
Reference	ISO 11898-1:2015																

7.1.5 WUF element of another valid frame — CEFF message

[Table 9](#) specifies the test of a WUP as element of a WUF.

Table 9 — WUF element of another valid frame — CEFF message

Item	Description
Purpose	This test verifies the behaviour of the IUT detecting a WUP which is element of a WUF.
CAN version	— Classical CAN — CAN FD tolerant
HS-PMA	— Low-power mode with selective wake-up capability (WUF)
Test variables	All parameters are set to the default parameters as defined in 5.3.4.2 except: IUT configuration: — ID: 4C7 _h — DLC: 3 — Data field: FF _h (all bytes)
Elementary test cases	Test frames as defined in table below: Frame Frame definition #1 ID = 0960F4C7 _h , DLC = 3, Data = C7 _h , 8E _h , 68 _h #2 ID = 0F4FD4C7 _h , DLC = 3, Data = C7 _h , 8E _h , 68 _h #3 ID = 18B084C7 _h , DLC = 3, Data = C7 _h , 8E _h , 68 _h #4 ID = 1E9FA4C7 _h , DLC = 3, Data = C7 _h , 8E _h , 68 _h #5 ID = 4C7 _h , DLC = 3, Data = C7 _h , 8E _h , 68 _h
Setup	— The IUT is configured corresponding test variables. — The IUT is set to low-power mode with configured selective wake-up.
Execution	1) The TS sends “sync frame sequence” as described in 5.3.4.3 . 2) The TS sends test frames 1 to 5 as defined in Test variables, each separated by two times the maximum bias reaction time (t_{bias}).
Response	The IUT shall detect the wake-up condition on presence of test frame 5.
Reference	ISO 11898-1:2015

7.1.6 Acceptance of no nominal "SRR" in CEFF message

[Table 10](#) specifies the test of the acceptance of no nominal SRR bit.

Table 10 — Acceptance of no nominal “SRR” CEFF message

Item	Description
Purpose	The purpose of this test is to verify that the IUT accepts the no nominal value of “SRR” bit in CEFF message.
CAN version	— Classical CAN — CAN FD tolerant
HS-PMA	— Low-power mode with selective wake-up capability (WUF)
Test variables	All parameters are set to the default parameters as defined in 5.3.4.2 except: Test frame: — SRR: 0
Elementary test cases	There is one elementary test case.

Table 10 (continued)

Item	Description
Setup	— The IUT is configured corresponding test variables. — The IUT is set to low-power mode with configured selective wake-up.
Execution	1) The TS sends “sync frame sequence” as described in 5.3.4.3. 2) The TS sends test frame as defined in test variables.
Response	The test frame shall cause a wake-up.
Reference	ISO 11898-1:2015

7.1.7 Absent bus idle after data frame

[Table 11](#) specifies the test of two consecutive presence of frames without a bus idle state.

Table 11 — Absent bus idle after data frame

Item	Description						
Purpose	This test verifies the behaviour of the IUT when presence of two consecutive frames not separated by a bus idle state.						
CAN version	— Classical CAN — CAN FD tolerant						
HS-PMA	— Low-power mode with selective wake-up capability (WUF)						
Test variables	All parameters are set to the default parameters as defined in 5.3.4.2 except: Test frame_1: — ID: 10_h; DLC: 0; Length of IMF [bit]: Refer to elementary test definition Test frame_2: — All values are set to default parameters as defined in 5.3.4.2						
Elementary test cases	Elementary tests are defined as follows: <table> <tr> <th>Test</th><th>Length of IMF [bit] of test frame in IFS</th></tr> <tr> <td>#1</td><td>2</td></tr> <tr> <td>#2</td><td>3</td></tr> </table>	Test	Length of IMF [bit] of test frame in IFS	#1	2	#2	3
Test	Length of IMF [bit] of test frame in IFS						
#1	2						
#2	3						
Setup	— The IUT is configured corresponding test variables, test frame 2 for wake-up. — The IUT is set to low-power mode with configured selective wake-up.						
Execution	1) The TS sends “sync frame sequence” as described in 5.3.4.3. 2) The TS sends test frame #1 with shortened IFS as depicted in test variables. 3) The TS sends test frame #2.						
Response	The test frame #2 shall cause a wake-up.						
Reference	ISO 11898-1:2015						

7.1.8 Stuff acceptance test 1

[Table 12](#) — Stuff acceptance test 1 specifies the test of stuff acceptance (CBFF message).