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

Part 2:
High-speed medium access unit with selective wake-up functionality

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

Partie 2: Unité d'accès au médium haute vitesse avec fonctionnalité de réveil sélectif

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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 16845 consists of the following parts, under the general title *Road vehicles — Controller area network (CAN) - Conformance test plan*:

— *Part 1: Overview*[1])

— *Part 2: High-speed medium access unit with selective wake-up functionality*

1) Under preparation.

Introduction

ISO 16845 was first published in 2004 to provide the methodology and abstract test suite necessary for checking the conformance of any CAN implementation of the CAN specified in ISO 11898-1. The new restructured ISO 11898 contains ISO 11898-6, which defines the physical layer requirements for partial networking.

ISO 16845-2 provides the methodology and abstract test suite necessary for checking the conformance of any CAN implementation specified in ISO 11898-6.

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

Part 2: High-speed medium access unit with selective wake-up functionality

1 Scope

This part of ISO 16845 establishes test cases and test requirements to realize a test plan verifying if the CAN transceiver with implemented selective wake-up functions conform to the specified functionalities referenced in ISO 11898-6. The kind of testing defined in this part of ISO 16845 is named as conformance testing.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 9646-1, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 1: General concepts*

ISO/IEC 9646-2, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 2: Abstract Test Suite specification*

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

ISO 11898-2:2003, *Road vehicles — Controller area network (CAN) — Part 2: High-speed medium access unit*

ISO 11898-5:2007, *Road vehicles — Controller area network (CAN) — Part 5: High-speed medium access unit with low-power mode*

ISO 11898-6:2013, *Road vehicles — Controller area network (CAN) — Part 6: High-speed medium access unit with selective wake-up functionality*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11898-2:2003, ISO 11898-5:2007 and the following apply.

3.1
implementation under test
IUT
device (e.g. standalone transceiver, SBC) which will be tested according to this conformance test plan

Note 1 to entry: An IUT can be part of an SUT.

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
system under test
SUT
system where the IUT is implemented if the IUT is part of a system or cannot operate as a standalone device

3.4
test system
TS
system which fulfils all requirements to perform the tests defined in ISO 16845-2

3.5
upper tester
UT
part of the test system which emulates the interfaces of the overlying OSI layer from sight of the IUT

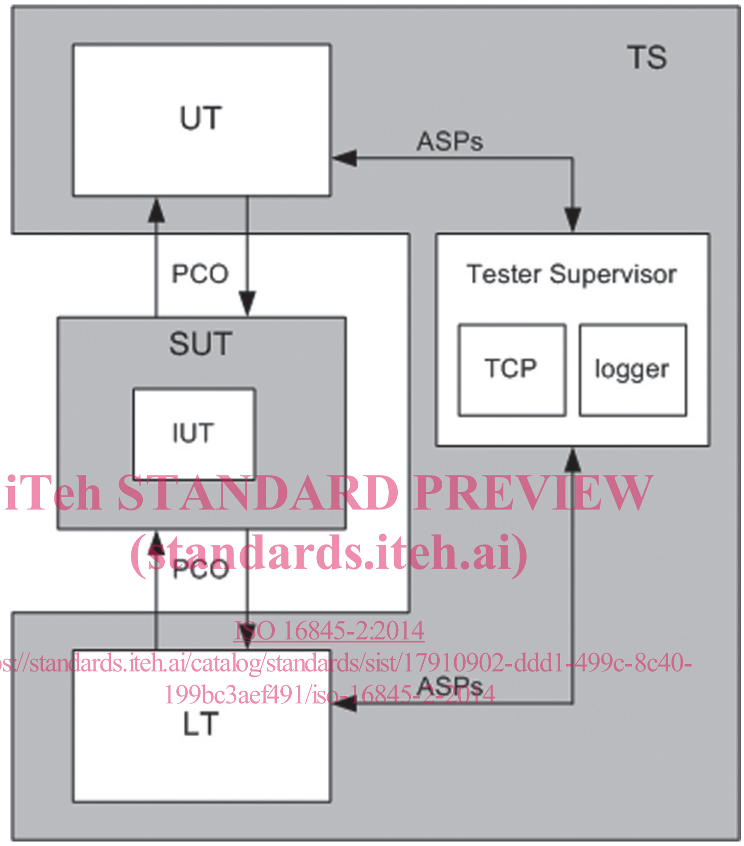
4 Symbols and abbreviated terms

ACK	Acknowledge
ASP	Abstract service primitives
CAN	Controller Area Network
CRC	Cyclic Redundancy Check
DLC	Data Length Code
EOF	End of Frame
ID	Identifier
MAC	Medium Access Control
OSI	Open System Interconnection
PCO	Point of control and observation
PHS	Physical Signalling
PL	Physical Layer
PMA	Physical Medium Attachment
FEC	Frame Error Counter
SOF	Start of Frame
WUF	Wake-up frame
WUP	Wake-up pattern
IMF	Intermission field

5 OSI conformance test method

OSI conformance testing was mainly introduced by the ISO 9646-1and 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 depicts the OSI coordinated test method.



Key

SUT System Under Test

UT Upper Tester

IUT Implementation Under Test

LT Lower Tester

TCP Test Coordination Procedure

TS Test System

Figure 1 — The OSI coordinated test method

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

The coordinated test method is the most suitable for CAN devices. It provides a simple interface to the Implementation Under Test, i.e. the CAN-Bus itself, and a flexible test coordination protocol using CAN messages between the Lower Tester (LT) as part of the Test System and the Upper Tester (UT) in the System Under Test. The Lower Tester controls and observes the Implementations Under Test lower service boundary indirectly via the underlying service provider, using the Abstract Service Primitives (ASPs) of the CAN protocol. The Upper Tester controls and observes the Implementations Under Test upper service boundary. The Test Coordination Procedures (TCPs) ensure the cooperation between the Lower Tester and the Upper Tester.

In case of CAN Transceiver with partial networking functionalities, influencing variables from the upper tester side are the digital CAN signals (RxD and TxD), host interface signals and I/O signals like INH or

Wake. The lower tester 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.

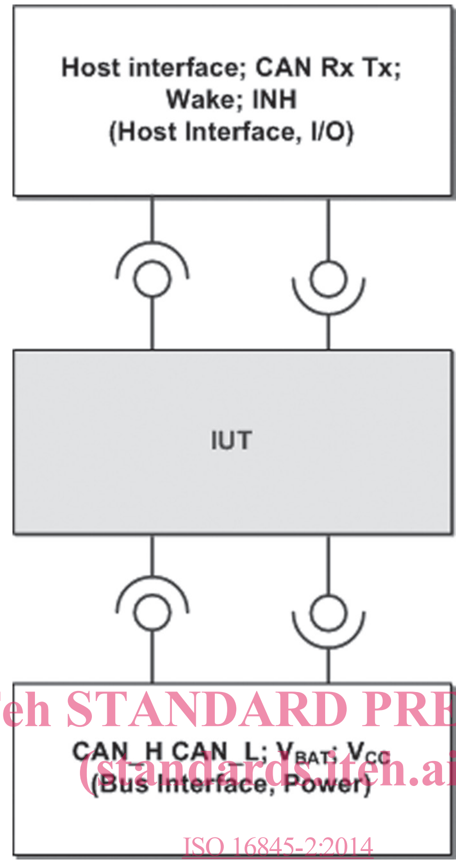


Figure 2 — Influencing variables on IUT

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 depicts abstract logical devices of upper and lower tester.

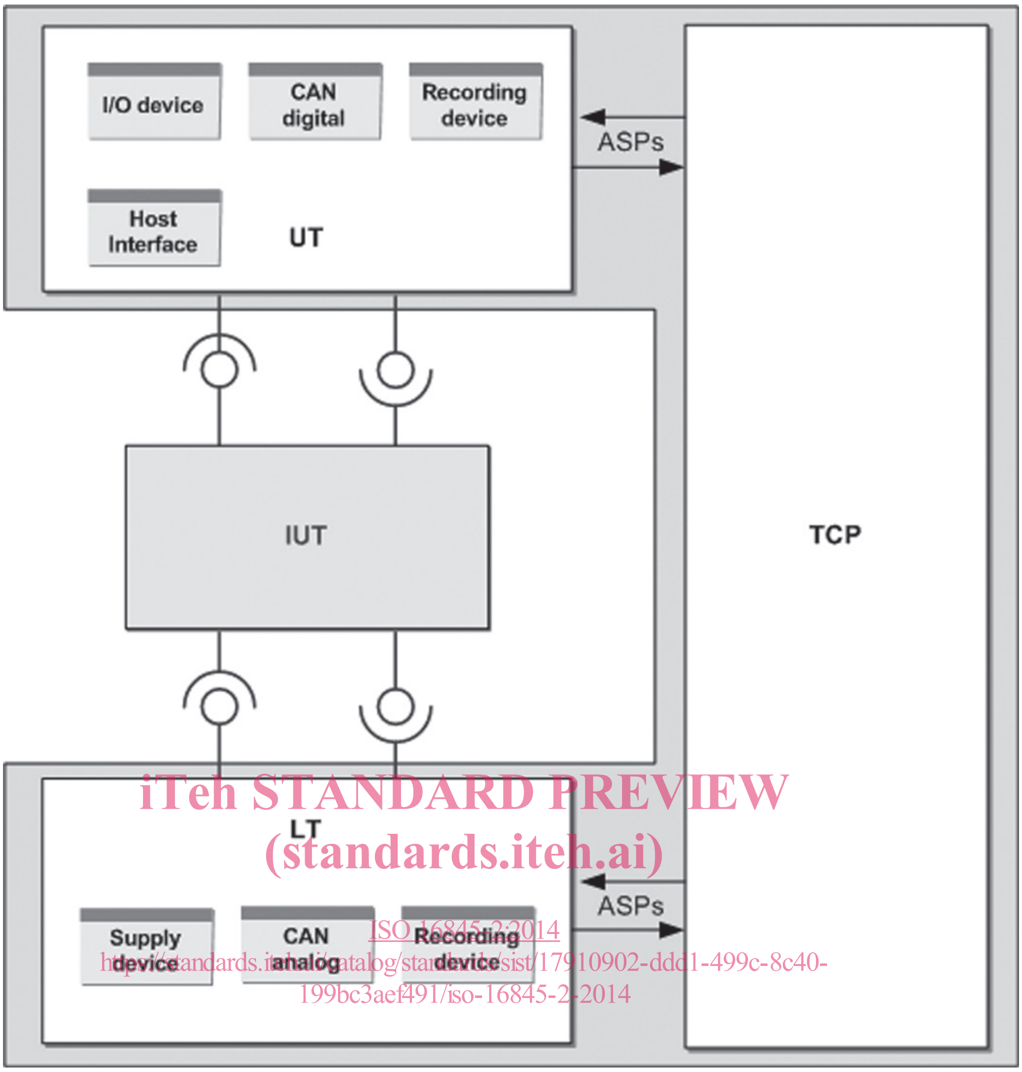


Figure 3 — Abstract logical devices of upper and lower tester

The OSI model divides a communication interface into seven logical layers which contain defined interfaces from / to the upper or lower layer. Following the OSI coordinated test method the test system realises the upper layer with the help of the upper tester and the lower layer with the help of the lower tester. For transceivers without partial networking capability, the transceiver is implemented inside the logical layer 1 – the physical layer with the lower interface as the CAN bus and the upper interface to the 2nd layer, known as the data link- or protocol layer, with logical signals TxD and RxD. In case of a high speed CAN transceiver 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 part of ISO 16845 is split into 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.

6 Organization

6.1 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 specification as defined in ISO 11898-1. Each test case may be executed one after another in any order or alone.

Test cases requiring variations of individual parameters have to 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 part of ISO 16845 is designed in the way to minimize the possibility that a test case produces different test outcomes on different occasions. Therefore, test requirements which have to be met and how the verdicts are to be assigned are defined in an unambiguous way.

6.2 Test case organization

6.2.1 Overview

Each elementary test is made of three states:

— Setup state;

— Test state;

— Verification state.

Before the first elementary test is started the IUT has to be initialised into the default state.

6.2.2 Setup state

6.2.2.1 General

The setup state is a defined and explicitly entered and verified state in which the IUT has to 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 6.2.4.2.

6.2.2.2 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 device documentation shall be followed.

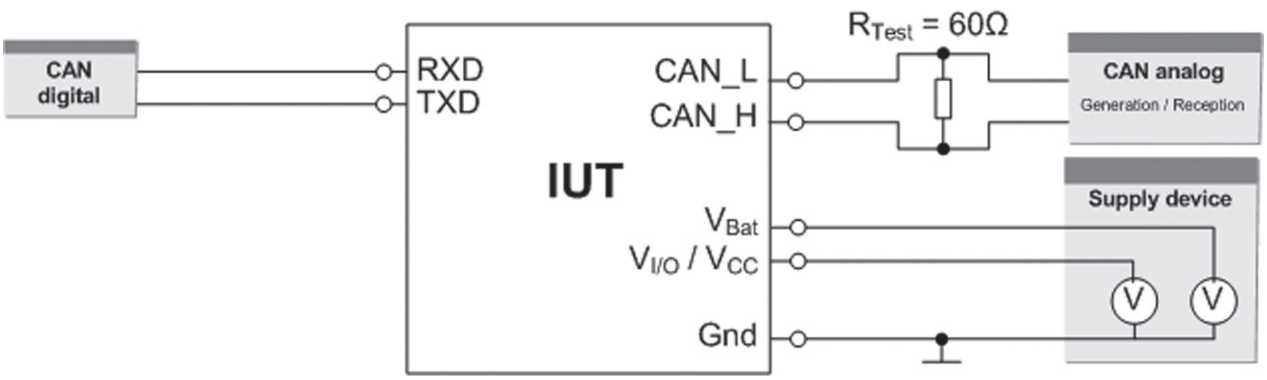


Figure 4 — Default setup for test

6.2.2.3 Default state

The Default state is characterised by the following default value:

— IUT power supply on;

— IUT configured to test bit rate;

— IUT set to Normal mode.

After the end of each Elementary test, the default state must be re-applied.

6.2.3 Test state

The time between two frames on the bus shall be, unless otherwise specified, at least 2 bits of idle after IMF. The idle phase shall not be longer than $t_{SILENCE(min)}$.

6.2.4 Test frame definition for protocol related test cases

6.2.4.1 Elements of test frames

In the protocol related test cases the focus is on correct frame reception and handling. Therefore, test frames or test pattern will be sent to the IUT. The test frames with 11-bit identifiers are structured as depicted in Figure 5. The elements of the test frame are described below.

SOF	ID	RTR	IDE	r0	DLC	Data	CRC	CRC_DEL	ACK	ACK_DEL	EOF	IMF

Figure 5 — 11-bit CAN-ID format frame elements

Figure 6 depicts the structure of the test frames in extended frame format. The elements of the test frame are described below.

SOF	ID(11)	SRR	IDE	ID(18)	RTR	r1	r0	DLC	Data	CRC	CRC_DEL	ACK	ACK_DEL	EOF	IMF

Figure 6 — 29-bit CAN-ID format frame elements

The elements and the default values are defined in Table 1:

Table 1 — Elements of test frames

Element	Meaning	Bit size	Default value
SOF	Start of frame	1	0
ID	11 or 29 bit identifier (29 bit split in to 11 and 18 bit)	11 or 29	refer to sub-clause 6.2.4.2
RTR	Remote transmission request	1	0 = data frame = default 1 = remote frame
SRR	Substitute Remote Request	1	1
IDE	Identifier extended bit	1	0 = 11 bit ID frame (default) 1 = 29 bit ID frame
r0	Reserved bit 0	1	0
r1	Reserved bit 1	1	0
DLC	Data length code	4	refer to sub-clause 6.2.4.2
Data	Data field	0 ... 8 [Byte]	refer to sub-clause 6.2.4.2
CRC	Cyclic redundancy check	15	Correspond to data
CRC_DEL	Cyclic redundancy check delimiter	1	1

Table 1 *(continued)*

Element	Meaning	Bit size	Default value
ACK	Acknowledgement slot	1	refer to sub-clause 6.2.4.2
ACK_DEL	ACK delimiter	1	1
EOF	End of frame	7	1
IMF	Intermission field	3	1

6.2.4.2 IUT configuration and default parameters

Unless otherwise specified in the corresponding test case definition, the used test frame shall be as defined in Table 2.

Table 2 — Definition of the default test frames

Frame format	ID	DLC	Data	ACK
11 bit ID	0x000 (default)000h	1 (default)1	0x01 (default)01h	0
29 bit ID	00000000h	1	01h	0

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

— Used frame type: 11 bit identifier;

— 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;

— t_{WAIT}: 8 recessive bits after intermission field.

6.2.4.3 Sync frame sequence

The sync frame sequence as it is used in several test cases shall be as defined in Table 3.

Table 3 — Definition of the sync frame sequence

Frame	ID	DLC	Data
1 to 5 [a]	555h	1	FFh

[a] 9 in case of data rate > 500 kbit/s.

The frame generator sends each sync frame without a dominant acknowledge field followed by an active error frame with intermission field prolonged by two further bits.

6.3 Hierarchical structure of tests

6.3.1 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;

— the test cases.

6.3.2 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.

6.3.3 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 4 depicts the structure of the defined test cases.

Table 4 — Structure of the defined test cases

Number - Title	Test case number - Title and remarks of the test case
Purpose	Short description of the purpose of the test case
Test variables	The parameter definition of the test case [optional: elementary test case definition] [optional: test frame sequence definition]
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

6.3.4 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.

6.3.5 Applicable test cases for devices with enhanced voltage biasing

It must be distinguished between devices which support the complete requirements or only the enhanced biasing functionalities defined in ISO 11898-6. The following test cases are applicable for devices which support only the enhanced voltage biasing compliant to ISO 11898-6.

Static test cases: Test case 1 – Test case 25.

Dynamic test cases: Test case 91 - Test case 98.

7 Test cases

All defined test cases must be executed in accordance with the supported device specific bit rates defined in the device 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 must be executed using this specific bit rate;

— If the IUT supports two bit rates, then all test cases must be executed with both bit rate;