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Road vehicles — Controller area network (CAN) —

Part 2:
High-speed medium access unit

Véhicules routiers — Gestionnaire de réseau de communication (CAN) —

Partie 2: Unité d'accès au support à haute vitesse

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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.

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ISO 11898-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

ISO 11898 consists of the following parts, under the general title *Road vehicles — Controller area network (CAN)*:

— *Part 1: Data link layer and physical signalling*

— *Part 2: High-speed medium access unit*

— *Part 3: Low-speed fault tolerant physical medium attachment*

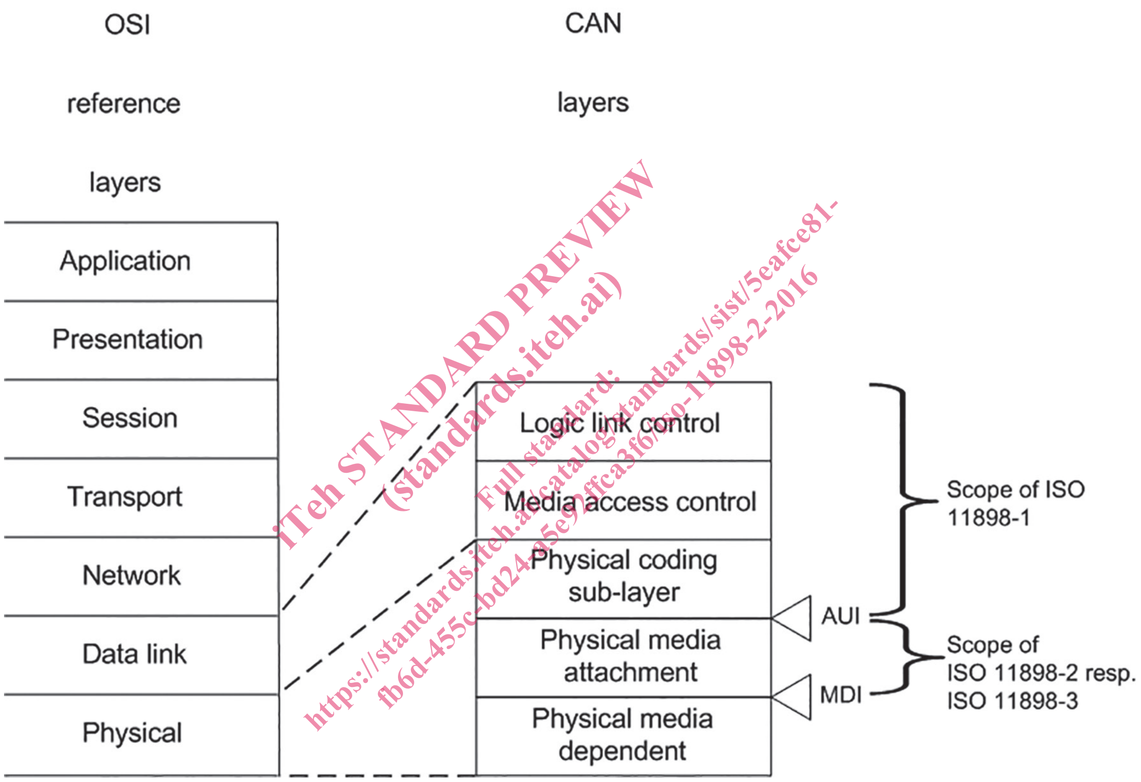
— *Part 4: Time-triggered communication*

Introduction

ISO 11898 was first published as one document in 1993. It covered the CAN data link layer as well as the high-speed physical layer. In the reviewed and restructured ISO 11898- series parts 1 and 4 defined the CAN protocol and time-triggered CAN (TTCAN) while the parts 2, 5 and 6 defined the high-speed physical layer, and part 3 defined the low-speed fault tolerant physical layer.

ISO 11898-2:2003, ISO 11898-5:2007 and ISO 11898-6:2013 have been withdrawn and replaced by this version of ISO 11898-2.

Figure 1 shows the relation of the OSI (Open System Interconnection) layers and its sub-layers to the ISO 11898 part 1 and part 2 as well as part 3.



Key

AUI attachment unit interface

MDI media dependant interface

OSI open system interconnection

Figure 1 — Overview of ISO 11898 specification series

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Road vehicles — Controller area network (CAN) —

Part 2: High-speed medium access unit

1 Scope

This part of ISO 11898 specifies the high-speed physical media attachment (HS-PMA) of the controller area network (CAN) a serial communication protocol that supports distributed real-time control and multiplexing for use within road vehicles. This includes HS-PMAs without and with low-power capability as well as with selective wake-up functionality. The physical media dependant sub-layer is not in the scope of this part.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this part 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 7498-1:1994, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model — Part 1*

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

ISO 16845-2:2014, *Road vehicles — Controller area network (CAN) conformance test plan — Part 2: High-speed medium access unit with selective wake-up functionality*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 11898-1 and the following apply. See figure A.1 in Annex A for a visualization of the definitions.

3.1
attachment unit interface (AUI)
The attachment unit interface is the interface between the PCS that is specified in part 1 of ISO 11898 and the PMA that is specified in this of ISO 11898.

3.2
ground (GND)
electrical signal ground

3.3
medium attachment unit (MAU)
unit that comprises the physical media attachment and the media dependent interface

3.4
media dependent interface (MDI)
interface that ensures proper signal transfer between the media and the physical media attachment

3.5
physical coding sublayer (PCS)
sub-layer that performing bit encoding/decoding and synchronization

3.6
physical media attachment (PMA)
sub-layer that converts physical signals into logical signals and vice versa

3.7
transceiver
implementation that comprises one or more physical media attachments

4 Symbols and abbreviated terms

For the purpose of this part, the symbols and abbreviated terms given in ISO 11898-1 and the following apply. Some of these abbreviations are also defined in ISO 11898-1. If the definition of the term here is different from the definition in ISO 11898-1, this definition applies.

AUI attachment unit interface

EMC electro-magnetic compatibility

ESD electro static discharge

GND ground

HS-PMA high-speed PMA

MAU medium attachment unit

MDI media dependent interface

PCS Physical coding sub-layer

PMA physical media attachment

PMD physical media dependent

WUF wake-up frame

WUP wake-up pattern

5 Functional description of the HS-PMA

5.1 General

The HS-PMA comprises one transmitter and one receiving entity. It shall be able to bias the connected physical media – an electric two-wire cable – relative to a common ground. The transmitter entity shall drive a differential voltage between the CAN_H and CAN_L signals to signal a logical 0 (dominant) respectively a logical 1 (recessive) to be received by other nodes connected to the very same media. These two-signals are the interface to the physical media dependent sub-layer.

The HS-PMA shall provide an AUI to the physical coding sub-layer as specified in ISO 11898-1. It comprises the TXD and RXD signals as well as the GND signal. The TXD signal receives from the physical coding sub-layer the bit-stream to be transmitted on the MDI. The RXD signal transmits to the physical coding sub-layer the bit-stream received from the MDI.

Implementations that comprise one or more HS-PMAs shall at least support the “normal” mode of operation. Optionally, a “low-power mode” may be implemented.

Some of the items specified in the following depend on the operation mode of the (part of the) implementation, in which the HS-PMA is included.

Table 1 shows the possible combinations of HS-PMA operational modes and expected behaviour.

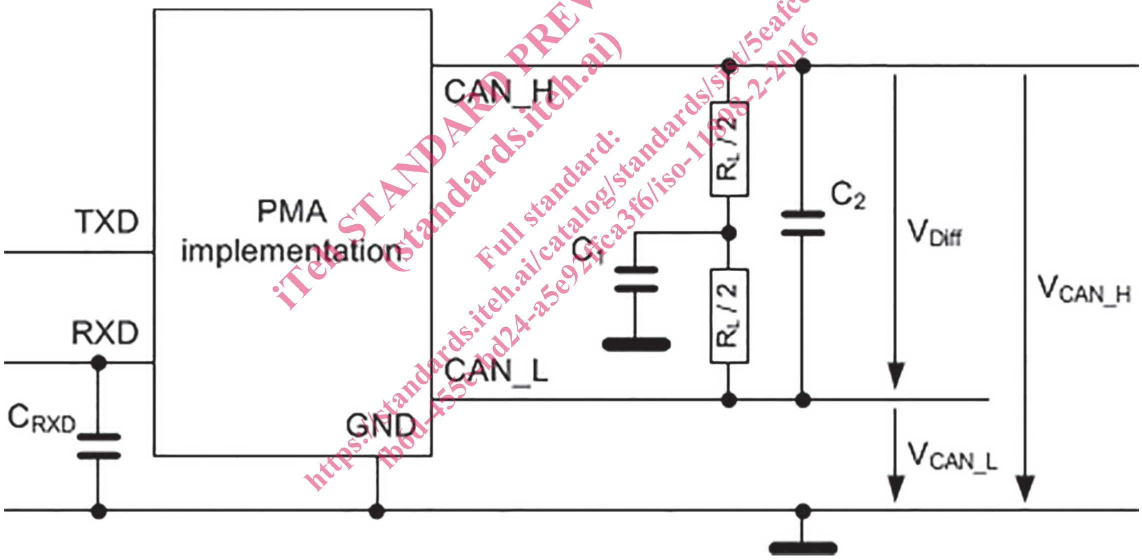
Table 1 — HS-PMA operating modes and expected behaviour

Operating mode	Bus biasing behaviour	Transmitter behaviour
Normal	Bus biasing active	Dominant or recessive[a]
Low-power	Bus biasing active or inactive [a]	Recessive
[a] Depends on input conditions as described in this document		

All parameters given in this clause of this part shall be fulfilled throughout the operating temperature range and supply voltage range (if not explicitly specified for unpowered) as specified individually for every HS-PMA implementation.

5.2 HS-PMA test circuit

The outputs of the HS-PMA implementation to the CAN signals are called CAN_H and CAN_L, TXD is the transmit data input and RXD the receive data output. Figure 2 shows the external circuit that defines the measurement conditions for all required voltage and current parameters. R_L represents the effective resistive load (bus load) for a HS-PMA implementation, when used in a network and C_1 represents an optional split-termination capacitor. The values of R_L and C_1 vary for different parameters that the PMA implementation needs to meet and are given as condition in the following tables.



Key

V_{Diff}: Differential voltage between CAN_H and CAN_L wires

V_{CAN_H}: Single ended voltage on CAN_H wire

V_{CAN_L}: Single ended voltage on CAN_L wire

C_{RXD}: Capacitive load on RXD

Figure 2 — HS-PMA test circuit

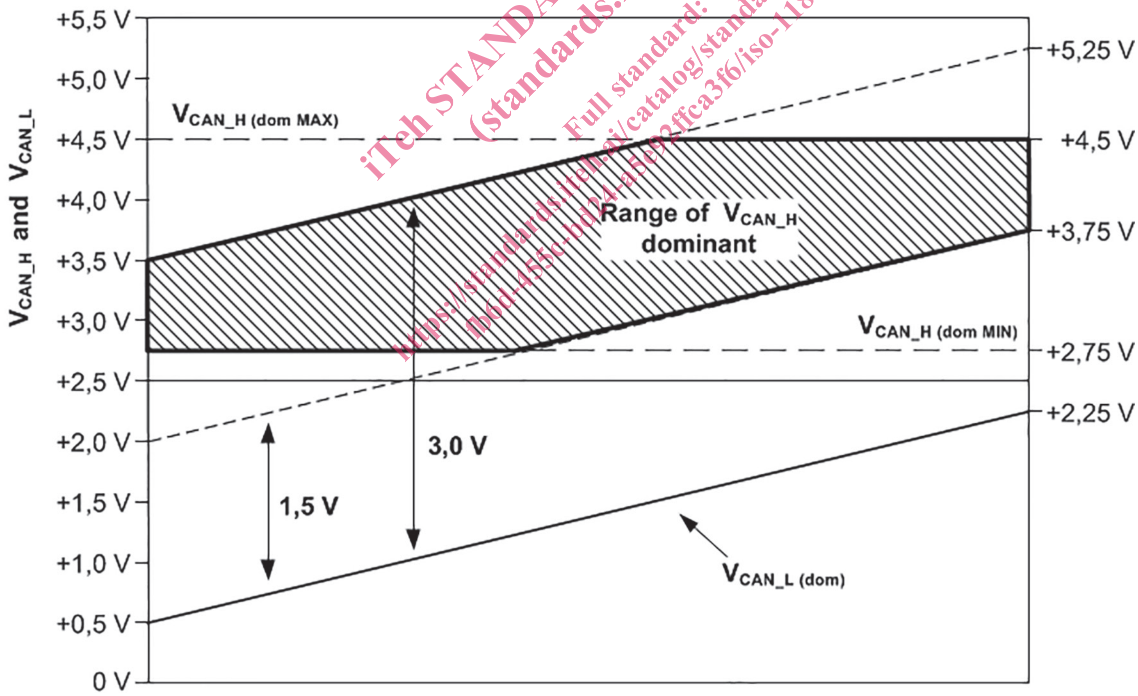
5.3 Transmitter characteristics

This section specifies the transmitter characteristics of a single HS-PMA implementation under the conditions as depicted in Figure 2; so no other HS-PMA implementations connected to the media. The behaviour of a HS-PMA implementation connected to other HS-PMAs is out of scope in this sub-section. Refer to section A.2 for consideration when multiple HS-PMAs are connected to the same media. The voltages and currents that are required on the CAN_L and CAN_H signals are specified in Table 2 to Table 6. Table 2 specifies the output characteristics during dominant state.

Figure 3 illustrates the voltage range for the dominant state.

Table 2 — HS-PMA dominant output characteristics

Parameter	Notation	Value			Condition
		Min V	Nom V	Max V	
Single ended voltage on CAN_H	V_{CAN_H}	+2,75	+3,5	+4,5	R_L = 50 ... 65
Single ended voltage on CAN_L	V_{CAN_L}	+0,5	+1,5	+2,25	R_L = 50 ... 65
Differential voltage on normal bus load	V_{Diff}	+1,5	+2,0	+3,0	R_L = 50 ... 65
Differential voltage on effective resistance during arbitration	V_{Diff}	+1,5	Not defined	+5,0	R_L = 2240
Optional: Differential voltage on extended bus load range	V_{Diff}	+1,4	+2,0	+3,3	R_L = 45 ... 70
All requirements in this table apply concurrently. Therefore, not all combinations of V_{CAN_H} and V_{CAN_L} are compliant with the defined differential voltage (see Figure 3). Measurement setup according to Figure 2 (only one HS-PMA present) R_L: see "Condition" - column above C_1 = 0 pF (not present) C_2 = 0 pF (not present) C_{RXD} = 0 pF (not present)					



Key

V_{Diff}: differential voltage between CAN_H and CAN_L wires

V_{CAN_H}: single ended voltage on CAN_H wire

V_{CAN_L}: single ended voltage on CAN_L wire

Figure 3 — Voltage range of V_{CAN_H} during dominant state of CAN node, when V_{CAN_L} varies from minimum to maximum voltage level (50 Ω...65 Ω bus load condition)

In order to achieve a level of RF emission that is acceptably low, the transmitter shall meet the driver signal symmetry as required by Table 3.

Table 3 — HS-PMA driver symmetry

Parameter	Notation	Value		
		Min	Nom	Max
Driver symmetry[a]	v_{SYM}	+0,9	+1,0	+1,1

[a] $V_{SYM} = (V_{CAN\_H} + V_{CAN\_L}) / V_{CC}$, with V_{CC} being the supply voltage of the transmitter.

V_{SYM} shall be observed during dominant and recessive state and also during the transition from dominant to recessive and vice versa, while TXD is stimulated by a square wave signal 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) (HS-PMA in normal mode).

Measurement setup according to Figure 2
R_L = 60 (tolerance ≤ ±1 %)
C_1 = 4,7 nF (tolerance ≤ ±5 %)
C_2 = 0 pF (not present)
C_{RXD} = 0 pF (not present)

The maximum output current of the transmitter shall be limited according to Table 4.

Table 4 — Maximum HS-PMA driver output current

Parameter	Notation	Value		Condition
		Min mA	Max mA	
Absolute current on CAN_H	I_{CAN_H}	not defined	115	-3 V ≤ V_{CAN_H} ≤ +18 V
Absolute current on CAN_L	I_{CAN_L}	not defined	115	-3 V ≤ V_{CAN_L} ≤ +18 V

Measurement setup according to Figure 2 with either V_{CAN_H} or V_{CAN_L} enforced to voltage levels as mentioned in the conditions by connection to an external voltage source, while the HS-PMA is driving the output dominant. The absolute maximum value does not care about the direction in that the current flows.

$R_L > 10^{10}$ (not present)
C_1 = 0 pF (not present)
C_2 = 0 pF (not present)
C_{RXD} = 0 pF (not present)

NOTE It is expected that the implementation does not stop driving its output dominant when the voltages on CAN_H and CAN_L are outside the limits mentioned in Table 8.

Table 5 specifies the recessive output characteristics, when bus biasing is active.

Table 5 — HS-PMA recessive output characteristics, bus biasing active

Parameter	Notation	Value		
		Min V	Nom V	Max V
Single ended output voltage on CAN_H	V_{CAN_H}	+2,0	+2,5	+3,0
Single ended output voltage on CAN_L	V_{CAN_L}	+2,0	+2,5	+3,0
Differential output voltage	V_{Diff}	-0,5	0	+0,05