INTERNATIONAL STANDARD

ISO 11898-5

First edition
2007-06-15

Road vehicles — Controller area network (CAN) —

Part 5: High-speed medium access unit with low-power mode

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

Partie 5: Unité d'accès au médium haute vitesse avec mode de puissance réduite

Reference number
ISO 11898-5:2007(E)

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Published in Switzerland

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 11898-5 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

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, medium-dependent interface*

— *Part 4: Time-triggered communication*

— *Part 5: High-speed medium access unit with low-power mode*

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:

— Part 1 describes the data link layer including the logical link control (LLC) sub layer and the medium access control (MAC) sub layer as well as the physical signalling (PLS) sub layer;

— Part 2 defines the high-speed medium access unit (MAU);

— Part 3 defines the low-speed fault-tolerant medium access unit (MAU);

— Part 4 defines the time-triggered communication;

— Part 5 defines the power modes of the high-speed medium access unit (MAU).

ISO 11898-1 and ISO 11898-2 have been cancelled and replaced ISO 11898:1993.

Road vehicles — Controller area network (CAN) —

Part 5: High-speed medium access unit with low-power mode

1 Scope

This part of ISO 11898 specifies the CAN physical layer for transmission rates up to 1 Mbit/s for use within road vehicles. It describes the medium access unit functions as well as some medium dependent interface features according to ISO/IEC 8802-2.

This part of ISO 11898 represents an extension of ISO 11898-2, dealing with new functionality for systems requiring low-power consumption features while there is no active bus communication.

Physical layer implementations according to this part of ISO 11898 are compliant with all parameters of ISO 11898-2, but are defined differently within this part of ISO 11898. Implementations according to this part of ISO 11898 and ISO 11898-2 are interoperable and can be used at the same time within one network.

2 Normative references

The following referenced documents are indispensable for the application 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 7637-3, *Road vehicles — Electrical disturbances from conduction and coupling — Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines*

ISO 11898-2:2003, *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 and the following apply.

3.1
VCC
⟨CAN node⟩ supply voltage of the physical layer used for the bus receiver, transmitter and optional split termination voltage V_{Split} during normal mode

NOTE Typical voltage of VCC is 5 V.

3.2
split termination voltage
V_{Split}
⟨CAN node⟩ output voltage of split termination support output relative to ground signal of the module (GND)

3.3
propagation time

t_{Prop}

⟨CAN node⟩ signal propagation time measured from an edge at transmit data (TXD) input to the corresponding edge on receive data (RXD) output of the MAU

3.4
wake-up filter time

t_{Wake}

⟨CAN node⟩ duration of a dominant signal on the bus lines CAN_H and CAN_L for forcing a wake-up to the CAN NODE

3.5
wake-up pattern

⟨CAN node⟩ one or multiple consecutive dominant bus levels for at least t_{Wake}, each separated by a recessive bus level

NOTE Figures within this part of ISO 11898 are using arrows as following: voltages + → –; currents flowing from the positive to the negative pole.

4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO 11898-2 apply.

5 Functional description of medium access unit (MAU) with low-power mode

5.1 General

The following description is valid for a two-wire differential bus. The values of the voltage levels, the resistances and the capacitances as well as the termination network are described in Clause 7.

5.2 Physical medium attachment sub layer specification

5.2.1 General

As shown in Figure 1 the bus line is terminated by termination network A and termination network B. These terminations are intended to suppress reflections.

Besides this reflection-optimized termination structure, centralized single terminations are possible at limited bit rates and topologies.

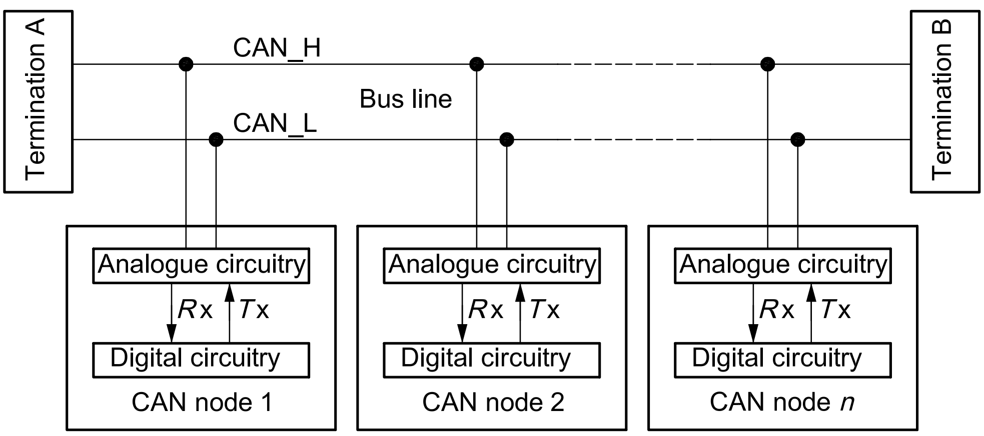
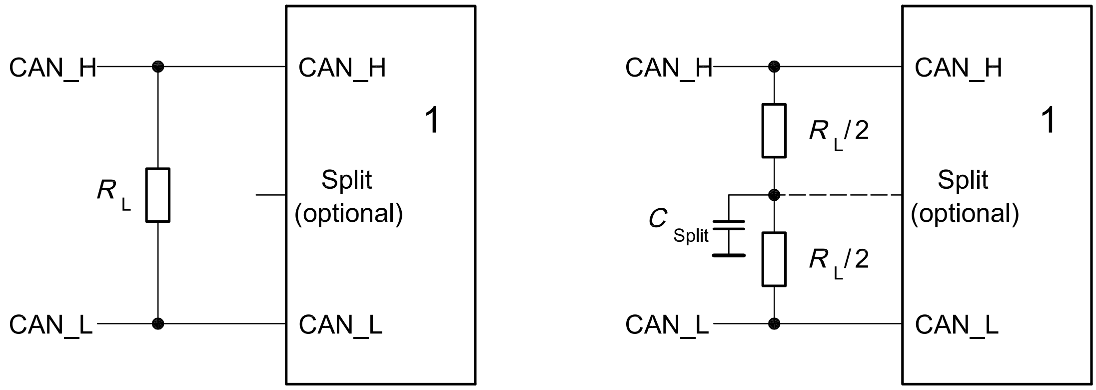


Figure 1 — Suggested electrical interconnection

Two different termination models are recommended within the high-speed medium access unit according to Figures 1 and 2:

— termination with a single resistor between CAN_H and CAN_L, and

— split termination dividing the single resistor into two resistors with the same value in series connection, while the centre tap is connected to a grounding capacitor and optionally to a dedicated split supply.



Key

1 physical layer

Figure 2 — Termination variants, single resistor termination and split termination

In order to support low-power functionality, two different modes of operation are defined as follows.

— Normal mode: The behaviour during normal mode is described within ISO 11898-2.

— Low-power mode: Described within this part of ISO 11898.

5.2.2 Bus levels during normal mode

The bus can have one of the two logical states: recessive or dominant (see Figure 3).

The bus is in the recessive state if the bus drivers of all CAN nodes are switched off. In this case, the mean bus voltage is generated by the termination and by the high internal resistance of each CAN node's receiving circuitry. In the recessive state, $V_{\mathrm{CAN\_H}}$ and $V_{\mathrm{CAN\_L}}$ are fixed to a mean voltage level, determined by the bus termination. V_{diff} is less than a maximum threshold. The recessive state is transmitted during bus idle or a recessive bit. Figure 3 illustrates the maximum allowed differential recessive bus voltage. Typically, the differential voltage is about zero volts.

Optionally the recessive bus state may become stabilized making use of a dedicated split termination voltage (V_{Split}). This optional output voltage of physical layer implementations according to this part of ISO 11898 may be optionally connected to the centre tap of the split termination resistors. Whenever the receiver of a physical layer is not actively biasing towards 2,5 V, the optional V_{Split} shall become floating.

A dominant bit is sent to the bus if the bus driver of at least one unit is switched on. This induces a current flow through the terminating resistors, and consequently a differential voltage between the two wires of the bus. A differential voltage greater than a minimum threshold represents the dominant state. The dominant state overwrites the recessive state, and is transmitted during a dominant bit.

The dominant and recessive states are detected by transforming the differential voltages of the bus to the corresponding recessive and dominant voltage levels within the receive comparator.

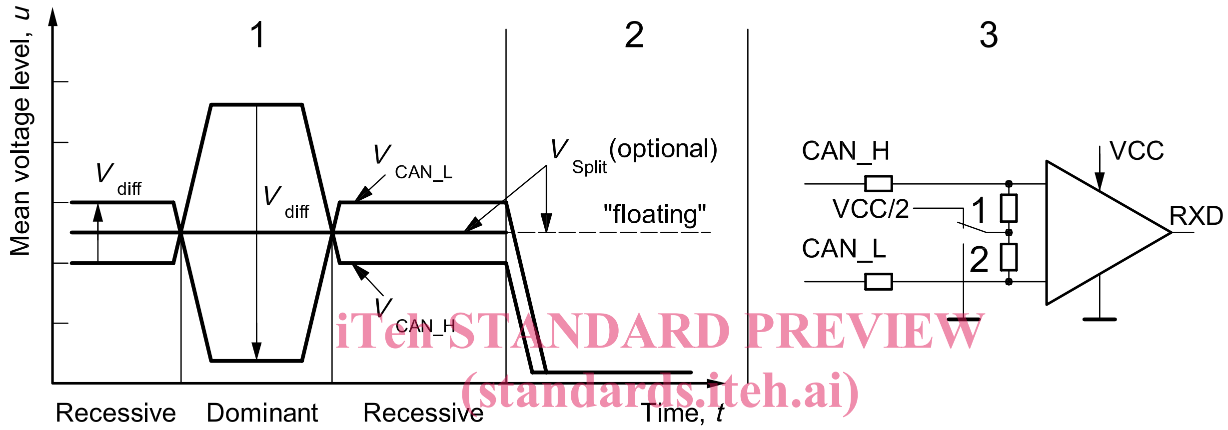
During arbitration, various CAN nodes may simultaneously transmit a dominant bit. In this case, V_{diff} exceeds the V_{diff} seen during a single operation. Single operations means that the bus is driven by one CAN node only.

5.2.3 Bus levels during low-power mode

During low-power mode, the bus drivers are entirely disabled. It is not possible to actively drive a differential level to the bus lines using a physical layer within low-power mode. In contrast to the normal mode behaviour, the bus wires shall be pulled to the ground signal of the module (GND) via the high-ohmic internal input resistors R_{in} of the receiver. Thus, there is no active VCC supply required defining the bus levels during low-power operation.

The optional split termination voltage (V_{Split}) is disabled here and shall behave high-ohmic (floating) in order not to pull the bus into a certain direction.

From a physical point of view, there are only the two defined operating conditions possible. The normal mode with VCC/2 biasing whenever normal bus communication takes place and low-power mode with GND biasing whenever the system becomes shutdown.



Key

1 normal mode

2 low-power mode

3 simplified transceiver bias implementation

Figure 3 — Physical bit representation and simplified bias implementation

5.2.4 Wake-up out of low-power mode

During low-power operation, a physical layer optionally shall monitor the bus lines CAN_H and CAN_L for wake-up events. Implementations supporting this feature shall make use of a differential bus comparator monitoring the bus line. A bus wake-up shall be performed if the bus shows one or multiple consecutive dominant bus levels for at least t_{Wake}, each separated by a recessive bus level.

5.2.5 Systems with unpowered nodes

In order to allow undisturbed CAN communication in systems, which have a couple of nodes intentionally unpowered (e.g. ignition key controlled modules), while other nodes continue to communicate normally, it is important that these unpowered nodes affect the bus levels as little as possible. This requires that transceivers, which are temporarily unpowered, show a lowest possible leakage current to the bus lines inside the still communicating system. The lower the leakage current in the unpowered case, the better the system performance in the permanently supplied part of the network.

Depending on the target application (permanently supplied or temporarily unsupplied) the maximum leakage parameter according to Table 4 can be tolerated (permanently supplied nodes) or should be reduced as far as possible (temporarily unsupplied nodes).

NOTE In contrast to a low-power mode, where the device is still supplied, unpowered means a physical disconnection from the power supply.

6 Conformance tests

6.1 General

All conformance tests for normal mode of operation are specified in ISO 11898-2. Besides these tests, some tests are added dealing with the optional V_{Split} functionality and the low-power mode behaviour.

The figures and the formulae shown within this clause indicate the principles of how the electrical parameters specified in Clause 7 should be verified.

6.2 V_{Split} output function

6.2.1 General

V_{Split} is an optional output voltage supporting recessive bus stabilization. When this function is implemented, the behaviour of that output shall be measured as shown within the following clauses.

6.2.2 V_{Split} during normal mode

The optional output V_{Split} delivers an output voltage of VCC/2 during normal mode.

According to Table 6, an output current of +500 µA to GND (Figure 4 schematic A) and −500 µA to VCC (Figure 4 schematic B) shall be adjusted with the resistor R, while the output voltage V_{Split} shall stay within the limits.

In unloaded condition (Figure 4 schematic C), the output voltage shall be checked according to Table 6 using a load resistance of $\geqslant$ 1 MΩ.

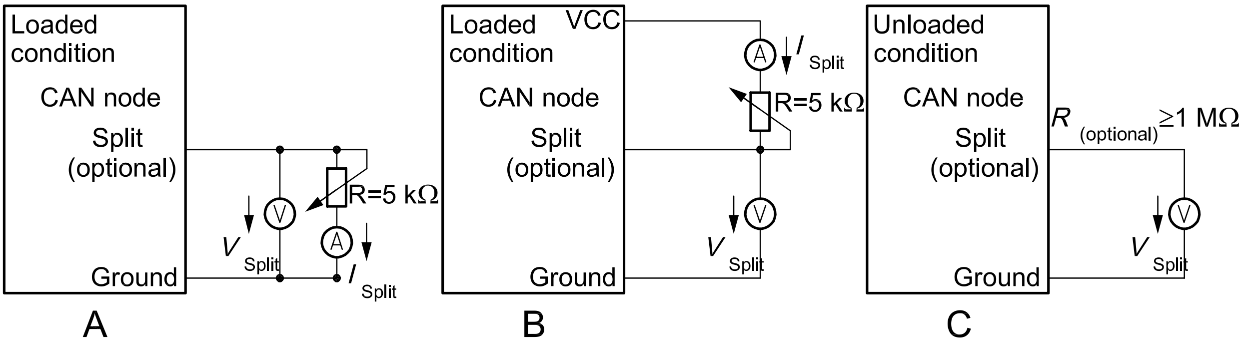


Figure 4 — Measurement of V_{Split} during normal mode

6.2.3 V_{Split} during low-power mode

The optional output V_{Split} shall float during low-power mode (see Figure 5). The leakage current is defined in Table 6.