INTERNATIONAL STANDARD

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Road vehicles — Interchange of digital information on electrical connections between towing and towed vehicles —

Part 1: Physical layer and data-link layer

Véhicules routiers — Échange d'informations numériques sur les connexions électriques entre véhicules tracteurs et véhicules tractés —

Partie 1: Couche physique et couche de liaison de données

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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.

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 11992-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This second edition cancels and replaces the first edition (ISO 11992-1:1998), reviewed in the light of changing legislative requirements and which has been technically revised.

ISO 11992 consists of the following parts, under the general title *Road vehicles — Interchange of digital information on electrical connections between towing and towed vehicles*:

— *Part 1: Physical layer and data-link layer*

— *Part 2: Application layer for brakes and running gear*

— *Part 3: Application layer for equipment other than brakes and running gear*

Part 4, *Diagnostics*, is under preparation.

Road vehicles — Interchange of digital information on electrical connections between towing and towed vehicles —

Part 1: Physical layer and data-link layer

1 Scope

This part of ISO 11992 specifies the interchange of digital information between road vehicles with a maximum authorized total mass greater than 3 500 kg, and towed vehicles, including communication between towed vehicles in terms of parameters and requirements of the physical and data link layer of the electrical connection used to connect the electrical and electronic systems.

It also includes conformance tests of the physical layer.

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 4141-1, *Road vehicles — Multicore connecting cables — Part 1: Test methods and requirements for basic performance sheathed cables*

ISO 7637-1, *Road vehicles — Electrical disturbance by conduction and coupling — Part 1: Definitions and general considerations*

ISO 7637-2, *Road vehicles — Electrical disturbance by conduction and coupling — Part 2: Commercial vehicles with nominal 24 V supply voltage — Electrical transient conduction along supply lines only*

ISO 8092-2, *Road vehicles — Connections for on-board electrical wiring harnesses — Part 2: Definitions, test methods and general performance requirements*

ISO 11898:1993[1)], *Road vehicles — Interchange of digital information — Controller area network (CAN) for high-speed communication*

ISO 11992-2, *Road vehicles — Interchange of digital information on electrical connections between towing and towed vehicles — Part 2: Application layer for brakes and running gear*

ISO 11992-3, *Road vehicles — Interchange of digital information on electrical connections between towing and towed vehicles — Part 3: Application layer for equipment other than brakes and running gear*

1) Amended in 1995. Under revision.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
commercial vehicle
motor vehicle which, on account of its design and appointments, is used mainly for conveying goods and which may also tow a trailer

[ISO 3833:1977, definition 3.1.3]

3.2
towed vehicle
non-power-driven road vehicle which, on account of its design and appointments, is used to transport persons or goods and is intended to be towed by a motor vehicle; semi-trailer is included in this category

[ISO 3833:1977, definition 3.2]

3.3
towing vehicle
motor vehicle or non-power-driven vehicle which tows a succeeding vehicle.

3.4
maximum authorized total mass
vehicle mass determined as a maximum by the administrative authority for operating conditions laid down by that authority

[ISO 1176:1990, definition 4.8]

3.5
point-to-point connection
electrical connection between two electronic nodes only

3.6
bus
one or more conductors used for transmitting signals

3.7
line conductor
conductive part of cables used for transmitting signals

3.8
CAN_H, CAN_L
particular cable and/or contact of the communication connection

3.9
differential transmission
transmission of digital information carried by voltage between the two conductors of the electrical connections (two-wire operation)

4 Abbreviations

a.c.	alternating current
CAN	Controller Area Network
d.c.	direct current
ECU	Electronic Control Unit

5 General specification

The data link layer and the fault confinement entity used for the data link layer shall be in accordance with ISO 11898.

6 Physical layer

6.1 General requirements

The physical layer shall be a point-to-point connection, in order to ensure satisfactory operation of both the coupled and the uncoupled trailer.

Stable electrical signals with a high signal-to-noise ratio are required even at extreme external operating conditions (salt, oil, moisture, etc.).

The contact resistance and leakage currents shall not become the weak points of the braking equipment during the lifetime of the vehicles.

For safety reasons the data transmission shall be monitored, and in the case of a failure, at least one emergency operation shall be provided.

The transmission shall be bi-directional and differential.

The nominal supply voltages of the physical layer circuits may be either 12 V or 24 V.

6.2 Physical media

6.2.1 General

The bus consists of an unscreened twisted pair, CAN_H and CAN_L, for the transmission of the differential signals. These cables may be part of a multi-core cable. For this physical layer the characteristic impedance has no significant influence, and is therefore left unspecified.

The total length of the cable is normally split into three parts, l_1, l_2 and l_3, as shown in Figure 1. If more connectors are used on each vehicle (ECU connectors, etc.) the total capacitance shall be less than $C_{\text{bus}x}$ for each length, as specified in Table 1.

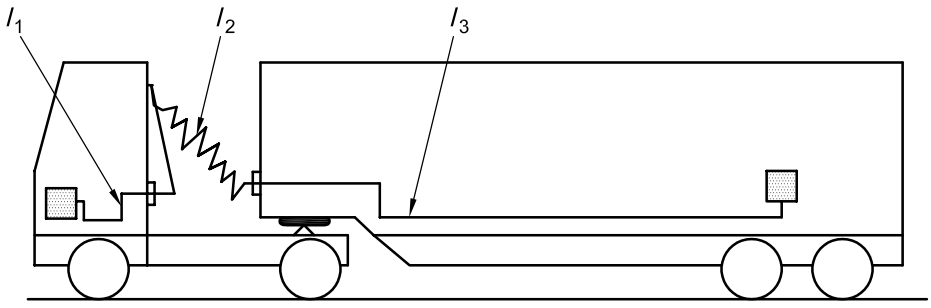


Figure 1 — Cable lengths

Table 1 — Cable parameters

Parameter	Notation	Unit	Value		
			min.	nominal	max.
Overall cable length [a]	l	m	—	—	40
Cable length in towing vehicle	l_1	m	—	—	15
Differential capacitance between CAN_H and CAN_L in towing vehicle [b]	C_{d1}	pF	—	750	—
Input capacitance between CAN_H and ground, CAN_L and ground in towing vehicle [b]	C_{i1}	pF	—	750	—
Bus capacitance in towing vehicle [c]	C_{bus1}	nF	—	—	2,4
Resistance of CAN_H and CAN_L in towing vehicle	R_{l1}	mΩ	—	—	600
Insulation resistance of each CAN_H and CAN_L to ground and V_{bat} in towing vehicle [d]	R_{i11}	MΩ	15	—	—
Insulation resistance between CAN_H and CAN_L in towing vehicle [d]	R_{i21}	MΩ	15	—	—
Coiled cable length	l_2	m	—	—	7
Differential capacitance between CAN_H and CAN_L in coiled cable [b]	C_{d2}	pF	—	560	—
Input capacitance between CAN_H and ground, CAN_L and ground in coiled cable [b]	C_{i2}	pF	—	700	—
Bus capacitance in coiled cable [c]	C_{bus2}	nF	—	—	1,9
Resistance of each CAN_H and CAN_L in coiled cable	R_{l2}	mΩ	—	—	300
Insulation resistance of each CAN_H and CAN_L to ground and V_{bat} in coiled cable [d]	R_{i12}	MΩ	30	—	—
Insulation resistance between CAN_H and CAN_L in coiled cable [d]	R_{i22}	MΩ	30	—	—
Cable length in towed vehicle	l_3	m	—	—	18
Differential capacitance between CAN_H and CAN_L in towed vehicle [b]	C_{d3}	pF	—	900	—
Input capacitance between CAN_H and ground, CAN_L and ground in towed vehicle [b]	C_{i3}	pF	—	900	—
Bus capacitance in towed vehicle [c]	C_{bus3}	nF	—	—	2,9
Resistance of each CAN_H and CAN_L in towed vehicle	R_{l3}	mΩ	—	—	700
Insulation resistance of each CAN_H and CAN_L to ground and V_{bat} in towed vehicle [d]	R_{i13}	MΩ	12	—	—
Insulation resistance between CAN_H and CAN_L in towed vehicle [d]	R_{i23}	MΩ	12	—	—

[a] $l = l_1 + l_2 + l_3$

[b] Test method according to ISO 4141-1.

[c] The capacitive load for the driving circuit resulting from the cable is $C_{busx} = C_{ix} + 2\,C_{dx}$, where x = 1, 2, 3; including the connector capacitance, C_{con}.

[d] Test method similar to that given in ISO 8092-2.

6.2.2 Parameters related to the cables CAN_H and CAN_L

The parameters shall be in accordance with Table 1.

6.3 Contacts

6.3.1 General

The interface provides two contacts for the data transmission, CAN_H and CAN_L.

6.3.2 Parameters related to the contacts CAN_H and CAN_L

The parameters shall be in accordance with Table 2.

Table 2 — Contact parameters

Parameter	Notation	Unit	Value		
			min.	nominal	max.
Contact resistance	R_{con}	mΩ	—	—	10
Insulation resistance between CAN_H and CAN_L [a]	R_{i1}	MΩ	50	—	—
Differential capacitance between CAN_H and CAN_L	C_{cd}	pF	—	5	—
Insulation resistance between CAN_H/CAN_L and ground [a]	R_{i2}	MΩ	50	—	—
Input capacitance between CAN_H/ CAN_L and ground	C_{ci}	pF	—	5	—
Capacitive load of the connector [b]	C_{con}	pF	—	—	20

[a] According to ISO 8092-2.

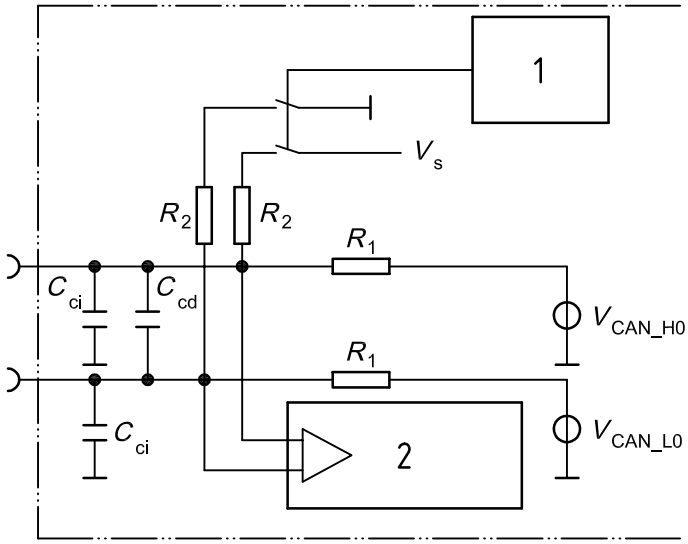
[b] The capacitive load for the driving circuit resulting from the connector is $C_{con} = C_{ci} + 2\,C_{cd}$.

6.4 Physical medium attachment

6.4.1 Electrical equivalent circuit diagram

Figure 2 shows the electrical equivalent circuit diagram of one unit of the data link.

CAN_H and CAN_L shall be connected to the resistances and voltage sources as specified. The data link shall fulfil the limiting values specified in 6.4.2.



Key

1 transmit logic

2 receive and transmit logic

V_{CAN_H0} Voltage source of CAN_H for recessive state (value see 6.4.2.1).

V_{CAN_L0} Voltage source of CAN_L for recessive state (value see 6.4.2.1).

Figure 2 — Electrical equivalent circuit diagram of one data link unit

6.4.2 "Dominant" and "recessive" status, electrical parameters

6.4.2.1 Transmission levels

CAN_H and CAN_L shall be operated with the voltage levels given by Figure 3.

The logic state of the bus may be "dominant" or "recessive", in accordance with Figure 3.

The logic "recessive" state is specified by the following voltage levels of CAN_H and CAN_L:

V_{CAN_H} = 1/3 V_s

V_{CAN_L} = 2/3 V_s

The logic "dominant" state is specified by the following voltage levels of CAN_H and CAN_L:

V_{CAN_H} = 2/3 V_s

V_{CAN_L} = 1/3 V_s

where V_s is the supply voltage of the data link units connected to the bus.

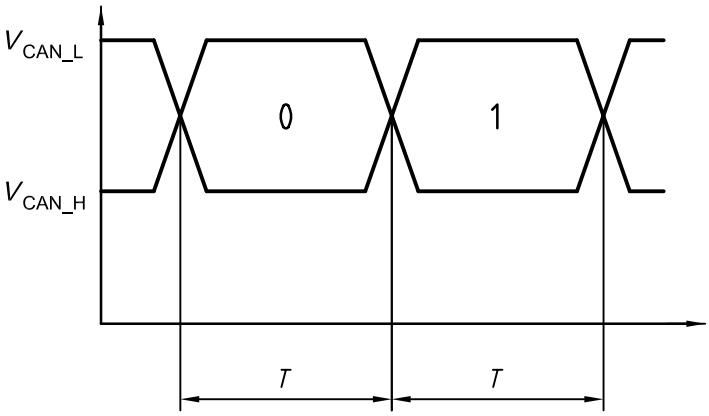
The differential voltage V_{diff} is

$$V_{diff} = V_{CAN\_L} - V_{CAN\_H}$$

This results in a value of

V_{diff} = 1/3 V_s at "recessive" state, and

V_{diff} = – 1/3 V_s at "dominant" state.



Key

0 dominant: Logic “0”

1 recessive: Logic “1”

Figure 3 — Specification of “dominant” and “recessive” state of CAN_H and CAN_L

6.4.2.2 Ratings

The voltage levels of V_s, V_{CAN_H} and V_{CAN_L} shall be within the voltage ranges specified in Tables 3 and 4, as appropriate, and in accordance with Table 5.

The interface operating voltage V_s is the on-board supply voltage for the commercial vehicle and the trailer interface as shown in Figure 4. V_{CAN_H} and V_{CAN_L} shall fulfil the specified requirements of Table 6 and 7, even if internal protection circuits (such as filters) are used. The time constant t_F shown in Figure 5 specifies the delay of voltage change between V_s and V_{CAN_H} or V_{CAN_L} in the case of any changes of V_s. Electrical interference along supply lines, as specified in ISO 7637-1 and ISO 7637-2, may interrupt the communication for less than 10 ms. No failure reaction shall occur during this time.

Table 3 — Voltage ranges for 24 V nominal voltage systems

Parameter	Notation	Unit	Value		
			min.	nominal	max.
Interface operating voltage	V_s	V	16	—	32
Voltage at bus connection	V_{CAN_H} V_{CAN_L}	V	0	—	32
Interface supply current (nominal operation)	I_s	mA	—	—	60

Table 4 — Voltage ranges for 12 V nominal voltage systems

Parameter	Notation	Unit	Value		
			min.	nominal	max.
Interface operating voltage	V_s	V	9	—	16
Voltage at bus connection	V_{CAN_H} V_{CAN_L}	V	0	—	16
Interface supply current (nominal operation)	I_s	mA	—	—	30