INTERNATIONAL STANDARD

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

Part 2:
Application layer for braking equipment

Véhicules routiers — Connexions électriques entre véhicules tracteurs et véhicules tractés — Échange de données numériques —

Partie 2: Couche application pour l'équipement de freinage

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.

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.

International Standard ISO 11992-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

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

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

— *Part 2: Application layer for braking equipment*

— *Part 3: Application layer for non-braking equipment*

Annex A of this part of ISO 11992 is for information only.

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Introduction

This part of ISO 11992 is subject to additions which will become necessary to keep pace with experience and technical advances. Care has been taken to ensure that these additions can be introduced in a compatible way, and care will have to be taken in the future that such additions remain compatible with previous versions. In particular, it may become necessary to standardize new parameters and parameter groups. ISO members may request that such new parameters and parameter groups be included in future editions of ISO 11992 by completing the "Parameter identification form" in annex A and submitting it to ISO/TC 22/SC 3.

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

Part 2:
Application layer for braking equipment

1 Scope

This part of ISO 11992 specifies the data content for electronically controlled braking systems to ensure the interchange of digital information between road vehicles with a maximum authorised total mass greater than 3 500 kg, and their towed vehicles, including communication between towed vehicles.

The objective of the data structure is to optimise the use of the interface, while preserving a sufficient reserve capacity for future expansion.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 11992. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 11992 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3833:1977, *Road vehicles — Types — Terms and definitions.*

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

ISO 11992-1:1998, *Road vehicles — Electrical connections between towing and towed vehicles — Interchange of digital information — Part 1: Physical layer and data link layer.*

3 Definitions

For the purpose of this part of ISO 11992, the definitions given in ISO 11992-1 and the following apply.

3.1 commercial vehicle
motor vehicle which, on account of its design and appointments, is used mainly for conveying goods. It may also tow a trailer [ISO 3833:1977]

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 [ISO 3833:1977]

3.3 towing vehicle
power-driven or a non-power-driven vehicle which tows a succeeding vehicle, both being part of a road train

4 General specifications

The data link and the physical layer shall be in accordance with ISO 11992-1.

To minimise bus loading on the towing/towed vehicle interface, appropriate messages are specified. These messages may be filtered by a device (node) on each vehicle which shall also provide address assignment and electrical isolation from the in-vehicle sub-network.

The architecture was chosen to allow any combination of new and old towing and towed vehicles. Multiple towed vehicles can be connected in any combination; the network shall be capable of addressing any towed vehicle, including dollies. The truck operator can disconnect and connect towed vehicles at any time and any order and the network shall adjust and respond accordingly.

5 Application layer

5.1 Message frame format

The application layer provides a string of information that is assimilated into a protocol data unit (PDU). The PDU provides a framework for organizing the information which will be sent by the CAN data frame.

The 29 bit identifier shall be in accordance with ISO 11898.

The PDU shall consist of seven fields in addition to the specific CAN fields (see figure 1).

The PDU fields are Priority (P), Reserved (R), Data Page (DP), PDU Format (PF), PDU Specific (PS), which can be a Destination Address (DA) or a Group Extension (GE), Source Address (SA) and data field.

Figure 1 — 29-bit CAN identifier

5.1.1. Priority

The three priority bits are used to optimise message latency for transmission onto the bus only. They should be globally masked off by the receiver (ignored). The priority of any message may be set from highest, 0 (000_2), to lowest, 7 (111_2). The default for all control oriented messages is 3 (011_2). The default of all other informational messages is 6 (110_2).

5.1.2 Reserved bit (R)

The reserved bit is reserved for future expansion. This bit should be set to zero for transmitted messages.

5.1.3 Data page (DP)

The data page bit selects an auxiliary page of parameter group descriptions.

5.1.4 PDU format (PF)

The PDU format field is an eight-bit field that determines the PDU format and is one of the fields used to determine the parameter group number assigned to the data field. Parameter group numbers shall be used to identify or label a set of commands and data.

5.1.5 PDU specific (PS)

The PDU specific field is an eight-bit field that depends on the PDU format. Depending on the PDU format, it can be a destination address or a group extension. If the value of the PDU format (PF) field is below 240, then the PDU specific field is a destination address. If the value of the PF field is 240 to 255, then the PDU specific field contains a group extension (GE) value (see table 1).

5.1.5.1 Destination address (DA)

The group extension field contains the specific address of the towing and towed vehicle to which the message is being sent. Any other device shall ignore this message. The global destination address (255) requires all devices to listen.

Table 1 — PDU specific field

	PDU format (PF) field	PDU specific (PS) field
PDU 1 field	0 to 239	Destination address
PDU 2 field	240 to 255	Group extension

5.1.5.2 Group extension (GE)

The group extension field, in conjunction with the four least significant bits of the PDU format field provide for 4 096 parameter groups per data page.

When the four most significant bits of the PDU format field are set, it indicates that the PS field is a group extension.

5.1.6 Source address (SA)

The source address field is eight-bits long. There shall only be one device on the network with a given source address. Therefore, the source address field assures that the CAN identifier will be unique, as required by CAN.

5.1.7 Data field

A single CAN data frame provides a maximum of eight data bytes. All eight bytes shall be used, even if fewer than eight bytes are required for expressing a given parameter group number. This provides a means to easily add parameters and while remaining compatible with previous revisions which only specified part of the data field.

5.1.8 Parameter group number (PGN)

The parameter group number is a 24-bit number which contains: Reserved bit, Data page bit, PDU Format field (eight bits), and PDU specific field (eight bits) (see table 2).

If the PF value is less than 240 (F0H; PDU 1 type message), then the lower byte of the PGN is set to zero.

Table 2 — Content of the parameter group number

Byte 1 (MSB)			**Byte 2**	**Byte 3**
Bits 8..3	Bit 2	Bit 1		
00000b	Reserved	Data Page	PDU format	PDU specific

5.1.9 PDU 1 format

The PDU format allows for applicable messages to be sent to either a specific or global destination. PDU 1 format messages are determined by the PDU format (PF) field. When the PDU format messages field value is 0 to 239, the message is a PDU 1 format.

5.1.10 PDU 2 format

The PDU 2 format may only be used to communicate global messages. PDU 2 format messages are those where the PDU format (PF) value is equal to 240 to 255.

5.2 Address assignment

A road train consists of one commercial vehicle and one or more towed vehicle(s). Dolly axles within the road train are treated as towed vehicles as well (see figure 2).

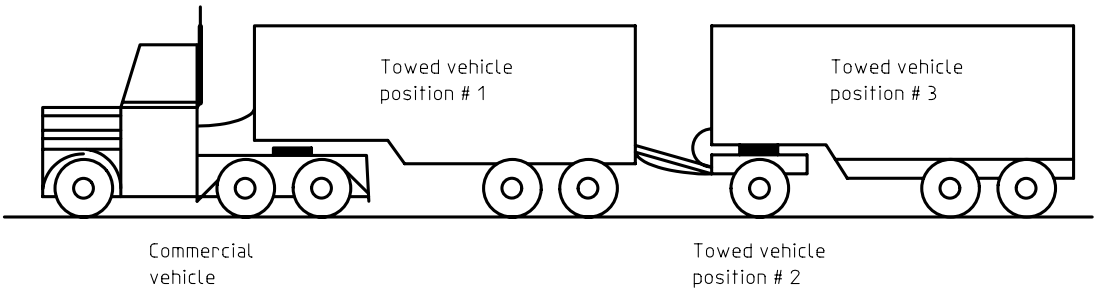


Figure 2 — Example of possible road train configuration

The address of the commercial vehicle is fixed.

The respective address of a towed vehicle corresponds to its position within the road train and has to be newly assigned each time

— communication starts,

— a towed vehicle has been connected.

For towing vehicle/towed vehicle communication, the addresses shown in table 3 shall be used as source addresses (SA) and destination addresses (DA). To avoid any transmission conflict during the dynamic address assignment phase (power-up), the PDU 2 type message shall have even PS (GE) in predecessor transmission direction and odd PS (GE) in successor transmission direction. If the same message has to be sent in both transmission directions, two PS (GE) are necessary.

The dynamic address assignment shall be handled by the respective towing vehicle/towed vehicle node and concerns the determination of the individual position within the road train. The global destination address shall be only used by the commercial vehicle to broadcast information to all towed vehicles simultaneously.

The dynamic address assignment is based on the transmission of the standard initialization message (see 5.5) by the respective predecessor within the road train.

Within a road train, the address assignment procedure shall be initiated by the commercial vehicle, using its standard address for the standard initialization message (see table 3). A powered-up towed vehicle node shall use the towed vehicle #1 address as the default address to transmit available information, until the standard initialization has been received and a valid address can be assigned.

Table 3 — Commercial vehicle/towed vehicle addresses

Name	Address	Predecessor	Successor
Towed vehicle position #1	200d = C8h	Commercial vehicle (position #0)	Towed vehicle position #2
Towed vehicle position #2	192d = C0h	Towed vehicle position #1	Towed vehicle position #3
Towed vehicle position #3	184d = B8h	Towed vehicle position #2	Towed vehicle position #4
Towed vehicle position #4	176d = B0h	Towed vehicle position #3	Towed vehicle position #5
Towed vehicle position #5	168d = A8h	Towed vehicle position #4	undefined
Global destination address	255d = FFh	undefined	undefined

This allows the towed vehicle node to communicate and to identify its presence to its predecessor immediately after power-up. This means that several towed vehicles can use the same address, until the address assignment procedure has been completed.

An assigned address shall be valid as long as the standard initialization message is received from the predecessor with the corresponding source address and specified message timing.

To provide address assignment for itself and for possible successors, a node shall be capable of permanently sending the standard initialization message with its own source address (see figure 3)

Permanent sending of the initialization message is necessary to allow immediate towed vehicle address assignment at any time a towed vehicle might be connected.

In addition, a towed vehicle node shall be capable of

— identifying its predecessor by the source address of the standard initialization message;

— assigning its own address based on the predecessors address;

— identifying potential receiver(s) by the destination address and by the message type.

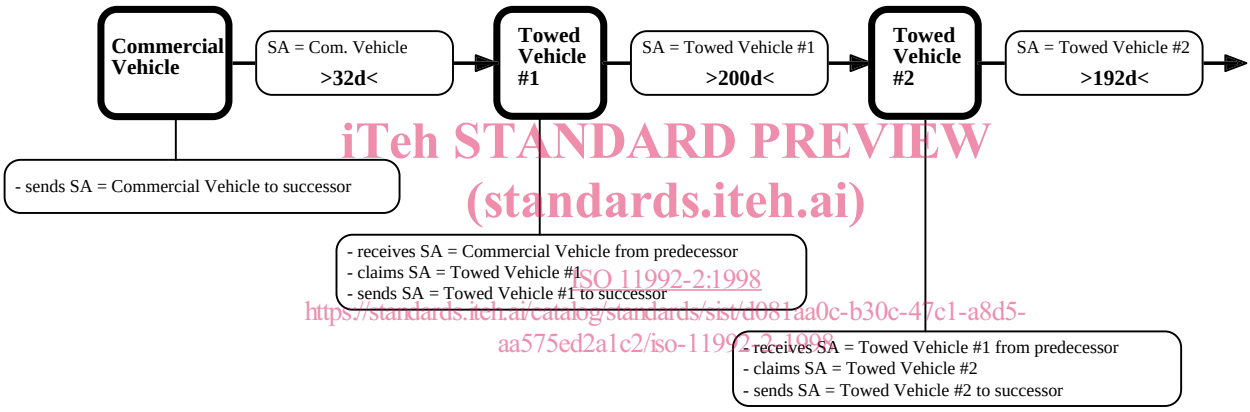


Figure 3 — Address assignment

5.3 Message routing

To allow communication between towing and towed vehicles, a node shall be capable of

— receiving messages from its predecessor and successor within the road train;

— identifying receiver(s) by the destination address (PDU 1 type messages) or the PDU format (PDU 2 type messages);

— routing all messages from its predecessor(s) to its successor(s) within the road train by sending them with the unchanged source and destination address to its successor[1)] within a maximum delay time of t_d = 13 ms;

— routing all messages from its successor(s) to its predecessor(s) within the road train by sending them with the unchanged source and destination address to its predecessor[1)] within a maximum delay time of t_d = 13 ms.

1)

A towed vehicle node shall not route messages to its successor or predecessor within the road train, if the source address of a message received from its

— predecessor corresponds to a road train position higher or equal to its own;

— successor corresponds to a road train position lower or equal to its own.

Figures 4 to 9 illustrate the PDU type message sent in different directions.

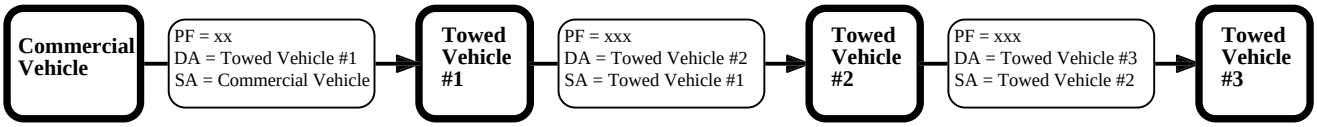


Figure 4 — Example of PDU 1 type messages from towing vehicle to succeeding towed vehicle

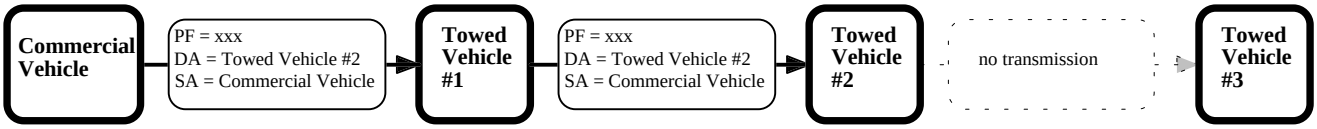


Figure 5 — Example of PDU 1 type message from towing vehicle to towed vehicle #2

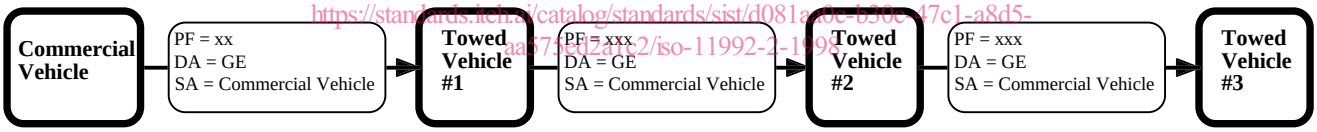


Figure 6 — Example of PDU 2 type message from commercial vehicle to all towed vehicles

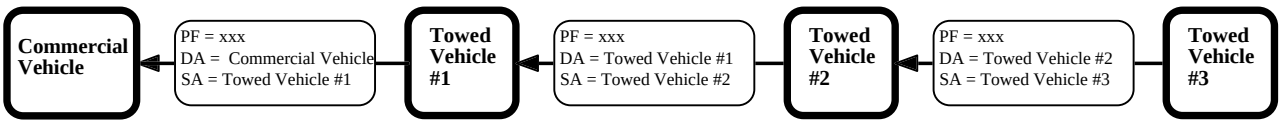
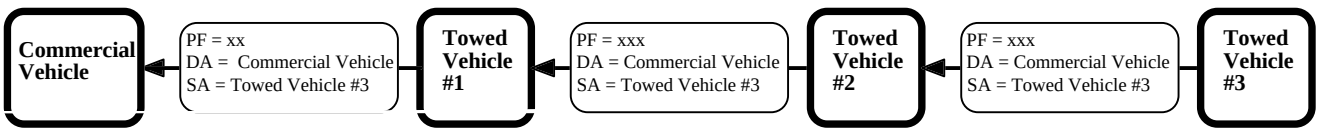


Figure 7 — Example of PDU 1 type messages from towed vehicle to preceding towing vehicle



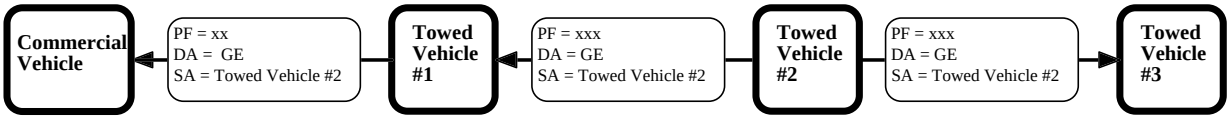


Figure 9 — Example of PDU 2 type message from towed vehicle #2

5.4 Parameters

5.4.1 Parameter ranges

Table 4 specifies the ranges used to determine the validity of transmitted signal.

Table 5 specifies the ranges used to denote the state of a discrete parameter and table 6 defines the ranges used to denote the state of a control mode command.

The values in the range "error indicator" provide a means for a module to immediately indicate that valid parameter data is not currently available due to some type of error in the sensor, sub-system, or module. Additional information about the failure may be available using diagnostic requests.

The values in the range "not available" provide a means for a module to transmit a message which contains a parameter that is not available or not supported in that module. This value does not replace the "error indication".

The values in the range "not requested" provide a means for a device to transmit a command message and identify those parameters where no response is expected from the receiving device.

After power on, a node should internally set the "availability bits" of received parameters as not available and operate with default values until valid data is received. When transmitting, undefined bytes should be sent as 255Dec (FFHex) and undefined bits should be sent as "1".

If a component failure prevents the transmission of valid data for a parameter, the error indicator, as described in tables 4 and 5, shall be used in place of that parameter data. However, if the measured or calculated data has yielded a value that is valid yet exceeds the defined parameter range, the error indicator shall not be used. The data should be transmitted using the appropriate minimum or maximum parameter value.

A word (16 bit) parameter shall be sent, least significant byte first, most significant byte second.

Table 4 — Transmitted signal ranges

Parameter	Unit	Value range	
		1 byte	2 bytes
Signal range	Dec	0 to 250	0 to 64255
	Hex	00 to FA	0000 to FAFF
Reserved range for future indicator bits	Dec	251 to 253	64256 to 65023
	Hex	FB to FD	FB00 to FDFF
Error indicator	Dec	254	65024 to 65279
	Hex	FE	FExx
Not available or not requested	Dec	255	65280 to 65535
	Hex	FF	FFxx