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Tractors and machinery for agriculture and forestry — Serial control and communications data network —

Part 7: Implement messages application layer

Tracteurs et matériels agricoles et forestiers — Réseaux de commande et de communication de données en série —

Partie 7: Couche d'application de base

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

This third edition cancels and replaces the second edition (ISO 11783-7:2009) which has been technically revised.

ISO 11783 consists of the following parts, under the general title *Tractors and machinery for agriculture and forestry — Serial control and communications data network*:

— *Part 1: General standard for mobile data communication*

— *Part 2: Physical layer*

— *Part 3: Data link layer*

— *Part 4: Network layer*

— *Part 5: Network management*

— *Part 6: Virtual terminal*

— *Part 7: Implement messages application layer*

— *Part 8: Power train messages*

— *Part 9: Tractor ECU*

— *Part 10: Task controller and management information system data interchange*

— *Part 11: Mobile data element dictionary*

— *Part 12: Diagnostics services*

— *Part 13: File server*

— *Part 14: Sequence control*

Introduction

ISO 11783 specifies a communications system for agricultural equipment based on the ISO 11898-1[1] protocol. SAE J1939[2] documents, on which parts of ISO 11783 are based, were developed jointly for use in truck and bus applications and for construction and agriculture applications. Joint documents were completed to allow electronic units that meet the truck and bus SAE J1939 specifications to be used by agricultural and forestry equipment with minimal changes.

General information on ISO 11783 is to be found in ISO 11783-1. The purpose of ISO 11783 is to provide an open, interconnected system for on-board electronic systems. It is intended to enable electronic control units (ECUs) to communicate with each other, providing a standardized system.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this part of ISO 11783 may involve the use of a patent concerning the controller area network (CAN) protocol referred to throughout the document.

ISO takes no position concerning the evidence, validity and scope of this patent.

The holder of this patent has ensured ISO that he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Information may be obtained from:

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Attention is drawn to the possibility that some of the elements of this part of ISO 11783 may be the subject of patent rights other than those identified above. ISO shall not be held responsible for identifying any or all such patent rights.

Tractors and machinery for agriculture and forestry — Serial control and communications data network —

Part 7: Implement messages application layer

SAFETY PRECAUTIONS — Caution is to be taken with any automatic control of implements carried out using a message defined in this part of ISO 11783. See ISO 11783-9 for safe-mode operations.

1 Scope

ISO 11783 as a whole specifies a serial data network for control and communications on forestry or agricultural tractors and mounted, semi-mounted, towed or self-propelled implements. Its purpose is to standardize the method and format of transfer of data between sensors, actuators, control elements and information storage and display units, whether mounted on, or part of, the tractor or implement. This part of ISO 11783 describes the implement messages application layer of the network, specifying the message set and defining the messages used for communication with and between tractors and connected implements.

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 639 (all parts), *Codes for the representation of names of languages*

ISO 11783-1:2007, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 1: General standard for mobile data communication*

ISO 11783-3, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 3: Data link layer*

ISO 11783-5, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 5: Network management*

ISO 11783-6, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 6: Virtual terminal*

ISO 11783-9, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 9: Tractor ECU*

ISO 11783-10, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 10: Task controller and management information system data interchange*

ISO 11783-12, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 12: Diagnostics services*

IEC 61162-3, *Maritime navigation and radio communication equipment and systems — Digital interfaces — Part 3: Serial data instrument network*

3 General requirements and recommendations

3.1 General

The message set specified by this part of ISO 11783 is designed to support the basic needs of an implement for information from a tractor, as well as limited controls enabling coordination between implement and tractor. The message set supports messages containing information on

— time,

— ground speed,

— distance,

— navigation,

— PTO (power take-off) parameters,

— three-point hitch,

— general process data, and

— lighting function parameters.

Some of the messages are regularly repeated at fixed intervals and others are transmitted upon request only. The specific transmission requirements for each message are defined in Annex B.

The message parameters are defined in Annex A; the parameter groups are specified in Annex B.

See Annex C for examples of tractor control messages.

3.2 Signal characterization

The ISO 11783 network has been designed with the intent of providing current data from a control function (CF) that is located in an electronic control unit (ECU) to, and for use by, other CFs that are located in the same or in other ECUs on the network. ISO 11783-1 lists the definitions of the CF and ECU terms.

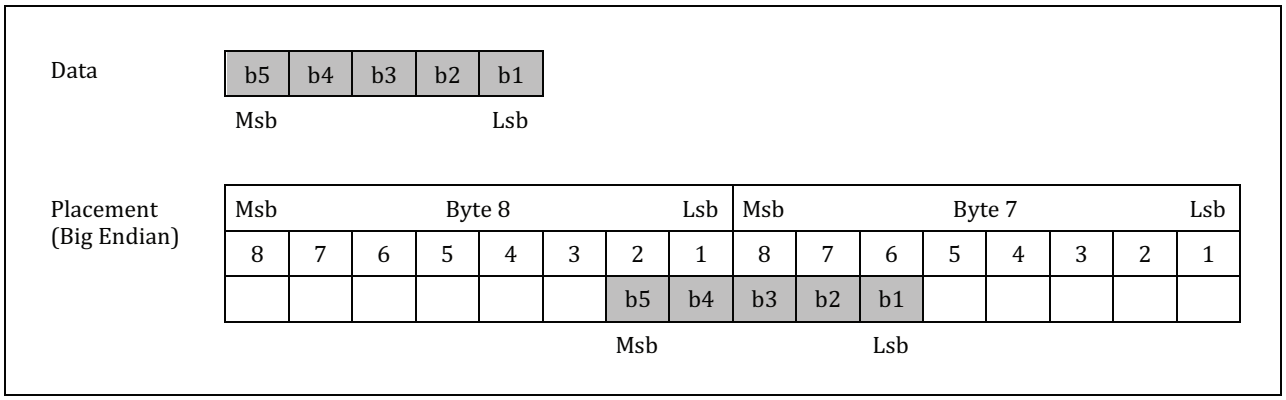
It is recommended that the time between physical data acquisition of a signal and the transmission of the data not exceed twice the repetition rate defined for the data.

3.3 Message format

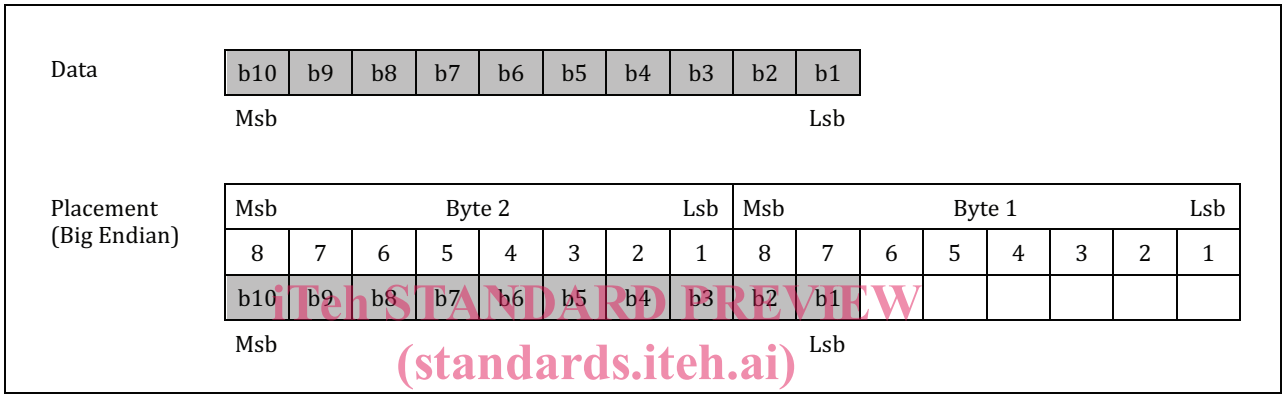
3.3.1 General

The ISO 11783 network message format uses the parameter group number as the label for a group of parameters. Each parameter within the group can be expressed as characters, as scaled data defined by the ranges given in 3.3.3, or as function states consisting of one or more bits. Characters are transmitted with the left-most character first.

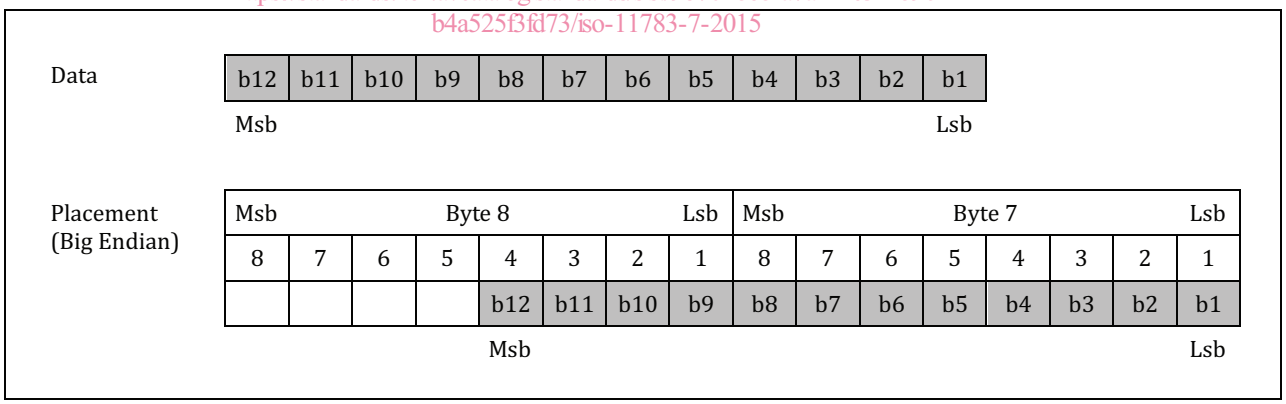
Numerical parameters consisting of two or more data bytes shall be transmitted least significant byte first. When a parameter is placed in more than one byte because of its location in the data field, the least significant bits (Lsb) of the parameter are placed in the least significant byte with the remaining most significant bits (Msb) placed in the next higher byte starting at the first bit. See Figure 1.



a) Data parameter of less than one byte crossing a byte boundary



b) Data parameter larger than one byte ending on a byte boundary



c) Data parameter larger than one byte starting on a byte boundary

Figure 1 — Placement of data parameters in more than one byte

3.3.2 Data types

Each parameter is identified as being of either the command or measured data type.

— **Command**

Command data specifies the desired state of a multistate parameter, function or numerical value of a set point as requested by a transmitting CF. Specific confirmation of a command is not necessarily

ensured. For example, the command may request that a solenoid be activated, yet no measurement be taken to ensure the solenoid has accomplished its function.

The tractor is not expected to automatically execute any given command. Commands for control affect the change or introduction of motion or power into the system, and may be issued in parallel with other commands from within various tractor systems. Each command must be considered with other tractor controls and operating conditions, and only executed if the tractor control system considers it to be appropriate.

EXAMPLE 1 Engage PTO, extend auxiliary valve state, activate headlight high-beam, move rear hitch.

— **Measured**

Measured data conveys the current value of a parameter, as measured or observed by the transmitting CF, determining the condition of the defined parameter.

EXAMPLE 2 Ground-based speed, hitch position, PTO engagement, implement in-work state.

3.3.3 Parameter ranges

Table 1 defines the ranges used to determine the validity of a transmitted signal, Table 2 those ranges used to denote the state of a discrete parameter, and Table 3 those used to denote the state of a control mode command. The values in the range "error indicator" provide the means for a CF to immediately indicate that valid parametric data are not currently available due to some type of error in the sensor, subsystem or CF.

If a CF failure prevents transmission of valid data for a parameter, the appropriate error indicator given in Tables 1 or 2 shall be used in place of that parameter's data. However, if the measured or calculated data has yielded a value that is valid, yet which exceeds the defined parameter range, the error indicator shall not be used. The data shall be transmitted using the appropriate minimum or maximum parameter value. If the sensor cannot determine if the measured or calculated data are valid, it shall send the error indicator.

3.3.4 Adding to parameter groups

Several of the parameter groups contain bytes that are undefined and which may be replaced with new parameters defined at a future date. If existing parameter group definitions do not permit the inclusion of new parameters, then a new parameter group may be defined.

See ISO 11783-1 for additional definitions and the abbreviations of instructions for requesting that parameters be added to parameter groups and new parameter group numbers be created.

Table 1 — Transmitted signal ranges

Range name	1 byte	2 bytes	4 bytes	ASCII
Valid signal	0 to 250 00_{16} to FA_{16}	0 to 64 255 0000_{16} to $FAFF_{16}$	0 to 4 211 081 215 00000000_{16} to $FAFFFFFF_{16}$	1 to 254 01_{16} to FE_{16}
Parameter-specific indicator	251 FB_{16}	64 256 to 64 511 $FBxx_{16}$	4 211 081 216 to 4 227 858 431 $FBxxxxxx_{16}$	None
Reserved range for future indicator bits	252 to 253 FC_{16} to FD_{16}	64 512 to 65 023 $FC00_{16}$ to $FDFF_{16}$	4 227 858 432 to 4 261 412 863 $FC000000_{16}$ to $FDFFFFFF_{16}$	None
Error indicator	254 FE_{16}	65 024 to 65 279 $FExx_{16}$	4 261 412 864 to 4 278 190 079 $FExxxxxx_{16}$	0 00_{16}
Not available, not installed, not requested or take no action (leave function as is)	255 FF_{16}	65 280 to 65 535 $FFxx_{16}$	4 278 190 080 to 4 294 967 294 $FFxxxxxx_{16}$	255 FF_{16}

Table 2 — Transmitted values for discrete parameters (measured)

Range name	Transmitted value
Disabled (Off, passive, etc.)	00
Enabled (On, active, etc.)	01
Error indicator	10
Not available or not installed	11

Table 3 — Transmitted values for control commands

Range name	Transmitted value
Command to disable function (turn Off, etc.)	00
Command to enable function (turn On, etc.)	01
Reserved	10
Don't care/take no action (leave function as is)	11

For future compatibility, except where noted in the particular message definition, reserved bits within a message are to be set to "all 1's" to indicate "Not Available".

Unique to Part 7 are several messages which utilize single-bit parameters such as availability of individual features. Portions of these messages may be reserved and additional single-bit indicators. It is important to note the expected value of these reserved parameters in the message definitions as they may differ from the rules defined above. In some cases, the default value is zero ("0") for forward compatibility. The value of zero indicates "not supported" in these messages.

3.4 Implement configuration offsets

The configuration of a tractor/implement connection and the offset to and from the tractor and implement reference points are used in the navigational parameters and in the implement configuration of process data messages. See ISO 11783-10.

Annex A
(normative)

Parameter definitions

A.1 Time (UTC)

The following three parameters provide the current time at the Universal Time Coordinate (UTC). If the local hour offset parameter (A.4) is equal to 125 (FA_{16}), then the time parameter is the local time instead of UTC.

Data length:	3 bytes
Resolution:	Byte 1 = 0,25 s/bit, 0 s offset - SPN 959
	Byte 2 = 1 min/bit, 0 min offset - SPN 960
	Byte 3 = 1 h/bit, 0 h offset - SPN 961
Operating range:	Byte 1 = 0 s to 59,75 s; Byte 2 = 0 min to 59 min; Byte 3 = 0 h to 23 h
Type:	Measured

A.2 Date

The following three parameters provide the current date at the Universal Time Coordinate (UTC). If the local hour offset parameter (A.4) is equal to 125 (FA_{16}), then the date parameter is the local date instead of UTC date.

Data length:	3 bytes
Resolution:	Byte 1 = 1 month/bit, 0 month offset - SPN 963
	Byte 2 = 0,25 d/bit, 0 day offset - SPN 962
	Byte 3 = 1 y/bit, 1985 year offset - SPN 964
Operating range:	Byte 1 = 1 month to 12 months
	Byte 2 = 0,25 d to 31,75 d
	Byte 3 = 1985 (year) to 2235 (year)
Type:	Measured

NOTE A value of 0 for the month (byte 1) is null. The value 1 identifies January, 2 identifies February, etc. A value of 0 for the day (byte 2) is null. The values 1, 2, 3 and 4 are used to identify the first day of the month; 5, 6, 7 and 8 identify the second day of the month, etc. A value of 0 for the year (byte 3) identifies the year 1985; a value of 1 identifies 1986, etc.

A.3 Local minute offset

Local minute offset is the number of minutes between the Universal Time Coordinate (UTC) time and date and a local time and date. This value is added to UTC time and date to determine the local time and date. The local offset is a positive value for times east of the Prime Meridian to the International Date Line. The local offset is a negative value for times west of the Prime Meridian to the International Date Line. The local minute offset is only applicable when the time and date parameters are reported as UTC time and date.

Data length: 1 byte

Resolution: 1 min/bit, –125 min offset

Operating range: –59 min to 59 min

Type: Measured

SPN: 1601

Note: This parameter was harmonized with SAE in a technical corrigenda published 2004-10-15. Prior to that Technical Corrigenda the parameter was defined as follows:

Local time offset in minutes from a reference time (UTC).

Data length: 1 byte

Resolution: 1 min/bit, 0 min offset

Operating range: 0 min to 59 min

Type: Measured

A.4 Local hour offset

Local hour offset is the number of hours between the Universal Time Coordinate (UTC) time and date and a local time and date. This value is added to UTC time and date to determine the local time and date. The local offset is a positive value for times east of the Prime Meridian to the International Date Line. The local offset is a negative value for times west of the Prime Meridian to the International Date Line.

Data length: 1 byte

Resolution: 1 h/bit, –125 h offset

Operating range: –23 h to 23 h

Type: Measured

SPN: 1602

The time and date parameters shall be Universal Time Coordinate (UTC) time, to be used with the local hour offset value for determining the local time. See Table A.1 for interpretations of time and date parameters for local hour offset non-operating ranges.

Table A.1 — Local hour offset interpretations

Local hour offset value	Interpretation of received parameters	
	Time and date	Local offsets
–125 to –24 (00_{16} to 65_{16})	Time standard unknown	Unknown
–23 to 23 (66_{16} to 94_{16})	UTC time and date	Local time offsets
24 to 123 (95_{16} to $F8_{16}$)	Time standard unknown	Unknown
124 ($F9_{16}$)	UTC time and date	No offset provided
125 (FA_{16})	Local time and date	No offset provided
126 to 130 (FB_{16} to FF_{16})	Time standard unknown	Unknown

NOTE This parameter was harmonized with SAE in a technical corrigenda published 2004–10–15. Prior to that Technical Corrigenda the parameter was defined as follows:

Local time offset in hours from a reference time (UTC).

Data length: 1 byte

Resolution: 1 h/bit, –24 h offset

Operating range: – 24 h to 23 h

Type: Measured

A.5 Ground-based machine speed

Actual ground speed of a machine, measured by a sensor such as radar.

Data length: 2 bytes

Resolution: 0,001 m/s/bit, 0 m/s offset; upper byte resolution = 0,256 m/s/bit

Data range: 0 m/s to 64,255 m/s

Type: Measured

SPN: 1859

A.6 Ground-based machine distance

Actual distance travelled by a machine, based on measurements from a sensor such as radar.

When the distance exceeds 4 211 081,215 m, the value shall be reset to zero and incremented as additional distance accrues.

Data length: 4 bytes

Resolution: 0,001 m/bit

Data range: 0 m to 4 211 081,215 m

Type: Measured

SPN: 1860

A.7 Ground-based machine direction

Measured signal indicating either forward or reverse as the direction of travel.

When the speed is zero, indicate the last travel direction until a different direction is detected.

NOTE Forward and reverse refer to the normal directions of travel of the tractor or implement chassis. The direction does not change when the operator's perspective is changed (i.e. when operator station is reversed).

EXAMPLE Operator station reversed.

Data length: 2 bits

Value	Meaning
00	Reverse
01	Forward
10	Error indication
11	Not available

Type: Measured

SPN: 1861

A.8 Wheel-based machine speed

The value of the speed of a machine as calculated from the measured wheel or tail-shaft speed.

Data length: 2 bytes

Resolution: 0,001 m/s/bit, 0 m/s offset

upper byte resolution = 0,256 m/s/bit

Data range: 0 m/s to 64,255 m/s

Type: Measured

SPN: 1862

A.9 Wheel-based machine distance

Distance travelled by a machine as calculated from wheel or tail-shaft speed.