



BSI Standards Publication

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

Part 7: Implement messages application layer —
Implement messages application layer

National foreword

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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





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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.

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 — 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*

[A1] ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes* **[A1]**

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.

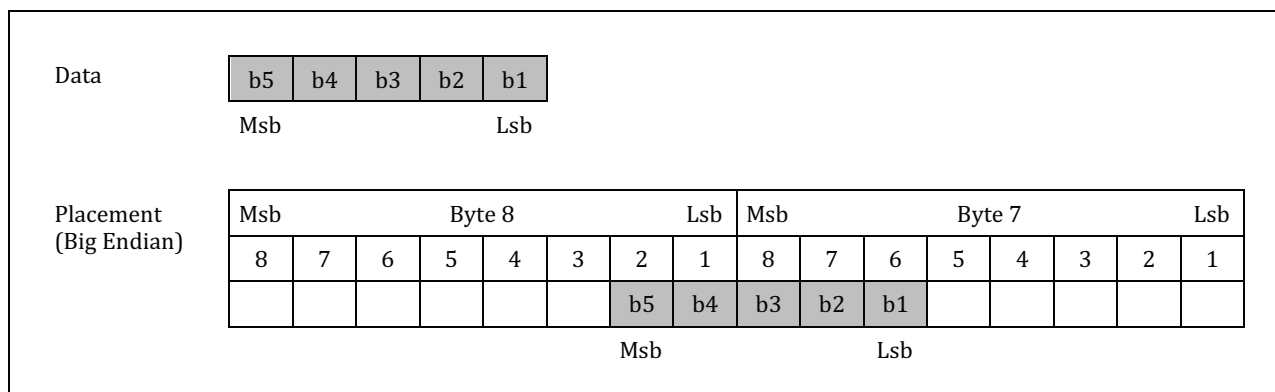
It is recommended that the time between physical data acquisition of a signal and the transmission of the data not exceed twice the repetition rate defined for the data.

3.3 Message format

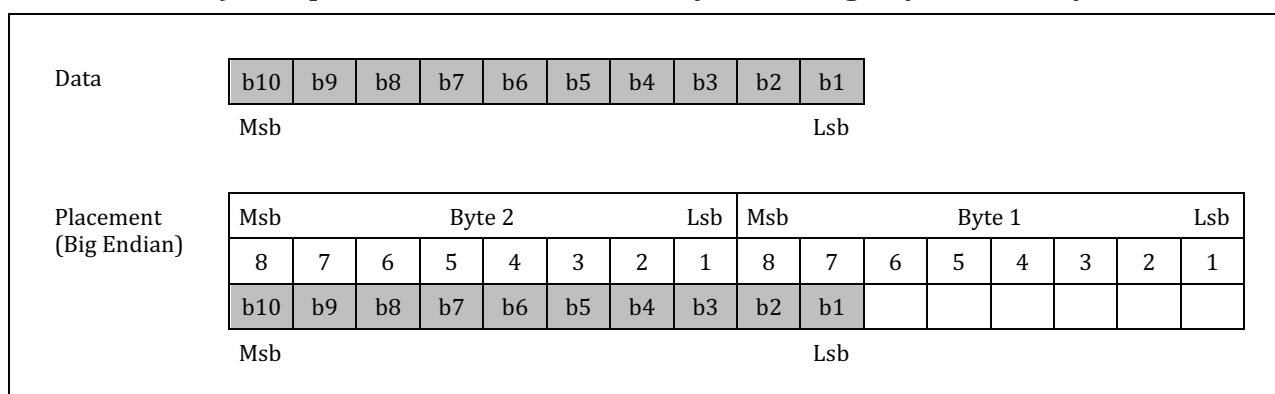
3.3.1 General

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.

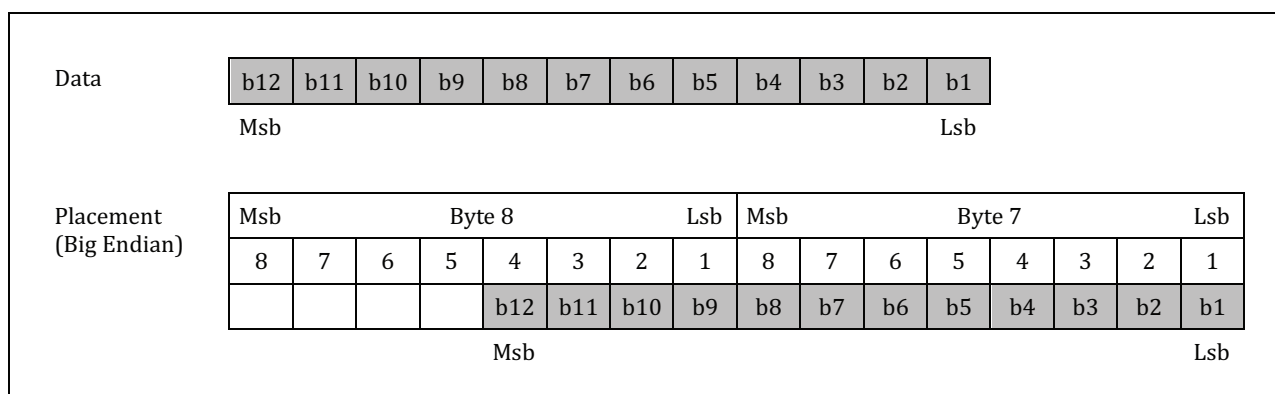
Numerical parameters consisting of two or more data bytes shall be transmitted least significant byte first. When a parameter is placed in more than one byte because of its location in the data field, the least significant bits (Lsb) of the parameter are placed in the least significant byte with the 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 FFFFFFFF 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

Range name	1 byte	2 bytes	4 bytes	ASCII
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 (FA₁₆), 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 (FA₁₆), 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

A1 Actual ground speed of a machine, measured by a sensor such as that is not susceptible to wheel slip (e.g. radar, GPS, LIDAR, or stationary object tracking). **A1**

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

A1 Actual distance travelled by a machine, based on measurements from a sensor such as that is not susceptible to wheel slip (e.g. radar, GPS, LIDAR, or stationary object tracking). **A1**

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.

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: 1863

A.10 Wheel-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 or selected and engaged.

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: 1864

A.11 Key switch state

Indicates the key switch state of the tractor or power unit.

This does not indicate unforeseen power interruptions such as those caused by starting the engine.

Data length: 2 bits

Value	Meaning
00	Key switch Off
01	Key switch not Off
10	Error indication
11	Not available

Type: Measured

SPN: 1865

A.12 Maximum time of tractor power

Maximum time of remaining tractor or power-unit-supplied electrical power at the current load.

This parameter may be estimated rather than being a measured value.

Data length: 1 byte
Resolution: 1 min/bit, 0 offset
Data range: 0 to 250
Type: Measured
SPN: 1866

A.13 Maintain ECU power

Request to the Tractor ECU to maintain ECU_PWR power for the next 2 s.

Data length: 2 bits

Value	Meaning
00	No further requirement for ECU_PWR
01	Requirement for 2 s more of ECU_PWR
10	Reserved
11	Don't care

Type: Command

SPN: 1867

A.14 Maintain actuator power

Request to the Tractor ECU to maintain PWR power for the next 2 s.

Data length: 2 bits

Value	Meaning
00	No further requirement for PWR
01	Requirement for 2 s more for PWR
10	Reserved
11	Don't care

Type: Command

SPN: 1868

A.15 Implement transport state

Indicates the transport state of an implement connected to a tractor or power unit.

Data length: 2 bits

Value	Meaning
00	Implement may not be transported
01	Implement may be transported
10	Error indication
11	Not available

Type: Measured

SPN: 1869

A.16 Implement park state

Indicates the state of an implement where it may be disconnected from a tractor or power unit.

Data length: 2 bits

Value	Meaning
00	Implement may not be disconnected
01	Implement may be disconnected
10	Error indication
11	Not available

Type: Measured

SPN: 1870

A.17 Implement ready-to-work state

Indicates that an implement is connected to a tractor or power unit and is ready for work.

Data length: 2 bits

Value	Meaning
00	Implement is not ready for field work
01	Implement is ready for field work
10	Error indication
11	Not available

Type: Measured

SPN: 1871

A.18 Navigation location parameters

ISO 11783 networks shall use the navigation location parameters specified in IEC 61162-3 [NMEA 2000¹⁾].

NOTE The actual location in the navigation parameters shall be reported for the Navigation Reference Point (NRP) on the tractor/implement. The definition of the Navigation Reference Point and the tractor/implement coordinate system are specified in ISO 11783-10. The NRP may be the antenna location in case only a GNSS receiver is available but it may also be the location of a reference point projected on the ground surface below the tractor/implement in case the GNSS location data are corrected for the roll and pitch of the tractor/implement.

A.19 Hitch parameters

A.19.1 Front hitch position

Measured position of the front three-point hitch; it is expressed as a percentage of full travel: 0 % indicates the full down position; 100 %, the full up position.

Data length:	1 byte
Resolution:	0,4 %/bit, 0 % offset
Data range:	0 % to 100 %
Type:	Measured
SPN:	1872

A.19.2 Rear hitch position

Measured position of the rear three-point hitch; it is expressed as a percentage of full travel: 0 % indicates the full down position; 100 %, the full up position.

Data length:	1 byte
Resolution:	0,4 %/bit, 0 % offset
Data range:	0 % to 100 %
Type:	Measured
SPN:	1873

A.19.3 Front hitch position — Command

Command for allowing the position of the front three-point hitch to be set; it is expressed as a percentage of full travel: 0 % indicates the full down position; 100 %, the full up position.

Data length:	1 byte
Resolution:	0,4 %/bit, 0 % offset
Data range:	0 % to 100 %
Type:	Command
SPN:	1874

A.19.4 Rear hitch position — Command

Command for allowing the position of the rear three-point hitch to be set; it is expressed as a percentage of full travel: 0 % indicates the full down position; 100 %, the full up position.

Data length:	1 byte
--------------	--------

1) National Marine Electronics Association network standard.

Resolution: 0,4 %/bit, 0 % offset
Data range: 0 % to 100 %
Type: Command
SPN: 1875

A.19.5 Front hitch in-work indication

Measured signal indicating that the front hitch is positioned below (in-work) or above (out-of-work) an adjustable switching threshold.

The method of determining the switching threshold is not standardized and is to be determined by the manufacturer.

Data length: 2 bits

Value	Meaning
00	Hitch position is out-of-work
01	Hitch position is in-work
10	Error indication
11	Not available

Type: Measured

SPN: 1876

A.19.6 Rear hitch in-work indication

Measured signal indicating that the rear hitch is positioned below (in-work) or above (out-of-work) an adjustable switching threshold.

The method of determining the switching threshold is not standardized and is to be determined by the manufacturer.

Data length: 2 bits

Value	Meaning
00	Hitch position is out-of-work
01	Hitch position is in-work
10	Error indication
11	Not available

Type: Measured

SPN: 1877

A.19.7 Front draft

Apparent horizontal force applied to the front hitch by an implement.

 A positive value indicates the force applied to the tractor opposed to its forward direction of travel.

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). 

Data length: 2 bytes
Resolution: 10 N/bit, -320 000 N offset
Data range: -320 000 N to 322 550 N

Type: Measured
SPN: 1878

A.19.8 Rear draft

Apparent horizontal force applied to the rear hitch by an implement.

A1 A positive value indicates the force applied to the tractor opposed to its forward direction of travel.

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). **A1**

Data length: 2 bytes
Resolution: 10 N/bit, -320 000 N offset
Data range: -320 000 N to 322 550 N
Type: Measured
SPN: 1879

A.19.9 Front nominal lower link force

Measurement providing an indication of draft at the lower links of the front three-point hitch.

Nominal lower link force may be expected to be approximately linear with respect to draft and may be proportional to draft for a single hitch position. This measurement is typically obtained from a transducer on the lower hitch links and typically used as raw data in draft control. **A1** A positive value indicates the force applied to the tractor opposed to its forward direction of travel.

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). **A1**

Data length: 1 byte
Resolution: 0,8 %/bit, -100 % offset
Data range: -100 % to 100 %
Type: Measured
SPN: 1880

A.19.10 Rear nominal lower link force

Measurement providing an indication of draft at the lower links of the rear three-point hitch.

Nominal lower link force may be expected to be approximately linear with respect to draft and may be proportional to draft for a single hitch position. This measurement is typically obtained from a transducer on the lower hitch links and typically used as raw data in draft control. A positive value indicates the force applied to the tractor opposed to its heading.

Data length: 1 byte
Resolution: 0,8 %/bit, -100 % offset
Data range: -100 % to 100 %
Type: Measured
SPN: 1881

A.19.11 Front hitch position limit status

This parameter is used to report the Tractor ECU's present limit status associated with front hitch position commands that are persistent.

Data length: 3 bits

Value	Meaning
000	Not limited
001	Operator limited/controlled (request cannot be implemented)
010	Limited High (only lower command values result in a change)
011	Limited Low (only higher command values result in a change)
100	Reserved
101	Reserved
110	Non-recoverable fault
111	Not available (parameter not supported)

Note that the limited conditions (limited high and low) could be temporary, for example when a large set point change is limited by a ramp rate. This bit can be set until the ramp is complete to prevent windup (and subsequent overshoot) due to the response of the controlled value.

A non-recoverable fault is non-recoverable from the viewpoint of the implement. Operator action within the tractor may resolve the issue and result in a change to “Operator Limited/Controlled” status.

Type: Measured
 SPN: 5150

A.19.12 Rear hitch position limit status

This parameter is used to report the Tractor ECU's present limit status associated with the rear hitch position commands that are persistent.

Data length: 3 bits

Value	Meaning
000	Not limited
001	Operator limited/controlled (request cannot be implemented)
010	Limited High (only lower command values result in a change)
011	Limited Low (only higher command values result in a change)
100	Reserved
101	Reserved
110	Non-recoverable fault
111	Not available (parameter not supported)

Note that the limited conditions (limited high and low) could be temporary, for example when a large set point change is limited by a ramp rate. This bit can be set until the ramp is complete to prevent windup (and subsequent overshoot) due to the response of the controlled value.

A non-recoverable fault is non-recoverable from the viewpoint of the implement. Operator action within the tractor may resolve the issue and result in a change to "Operator Limited/Controlled" status.

Type: Measured

SPN: 5151

A.19.13 Front hitch exit/reason code

This parameter is used to indicate why the front hitch cannot accept remote commands or has most recently stopped accepting remote commands.

Data length: 6 bits

Value	Meaning
000000	No reason/all clear
000001	Required level of operator presence/awareness not detected
000010	Implement released control of function
000011	Operator override of function
000100	Operator control not in valid position
000101	Remote command timeout
000110	Remote command out of range/invalid
000111	Function not calibrated
001000	Operator control fault
001001	Function fault
001010 to 010011	Reserved
010100	Hydraulic oil level too low
010101	Hitch locked out
010110 to 110000	Reserved
110001 to 111101	Manufacturer specific
111110	Error
111111	Not available (parameter not supported)

Type: Measured

SPN: 5816

A.19.14 Rear hitch exit/reason code

This parameter is used to indicate why the rear hitch cannot accept remote commands or has most recently stopped accepting remote commands.

Data length: 6 bits

Value	Meaning
000000	No reason/all clear
000001	Required level of operator presence/awareness not detected
000010	Implement released control of function
000011	Operator override of function
000100	Operator control not in valid position
000101	Remote command timeout
000110	Remote command out of range/invalid
000111	Function not calibrated
001000	Operator control fault
001001	Function fault
001010 to 010011	Reserved
010100	Hydraulic oil level too low
010101	Hitch locked out
010110 to 110000	Reserved
110001 to 111101	Manufacturer specific
111110	Error
111111	Not available (parameter not supported)

Type: Measured

SPN : 5819

A.19.15 Front hitch roll angle

Measured roll angle of the front three-point hitch expressed in degrees from horizontal alignment with the rear axle of the tractor. Facing the direction of travel, an anti-clockwise rotation would be indicated by a negative number and a clockwise rotation would be indicated by a positive number.

Data length:	2 bytes
Resolution:	0,002 °/bit, –64 degrees offset
Data range:	–64° to 64,51°
Type:	Measured
SPN:	7790

A.19.16 Front hitch roll limit status

Parameter used to report the Tractor ECU's present limit status associated with the front hitch roll commands.

Data length:	3 bits
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Value	Meaning
000	Not limited
001	Operator limited/controlled (request cannot be implemented)
010	Limited High (only lower command values result in a change)
011	Limited Low (only higher command values result in a change)
100	Reserved
101	Reserved
110	Non-recoverable fault
111	Not available (parameter not supported)

Note that the limited conditions (limited high and low) could be temporary, for example when a large set point change is limited by a ramp rate. This bit can be set until the ramp is complete to prevent windup (and subsequent overshoot) due to the response of the controlled value.

A non-recoverable fault is non-recoverable from the viewpoint of the implement. Operator action within the tractor may resolve the issue and result in a change to “Operator Limited/Controlled” status.

Type:	Measured
SPN:	7791

A.19.17 Front hitch roll exit/reason code

This parameter is used to indicate why the front hitch cannot accept remote roll commands or has most recently stopped accepting remote commands.

Data length:	6 bits
--------------	--------

Value	Meaning
000000	No reason/all clear
000001	Required level of operator presence/awareness not detected
000010	Implement released control of function

Value	Meaning
000011	Operator override of function
000100	Operator control not in valid position
000101	Remote command timeout
000110	Remote command out of range/invalid
000111	Function not calibrated
001000	Operator control fault
001001	Function fault
001010 to 010011	Reserved
010100	Hydraulic oil level too low
010101	Hitch locked out
010110 to 110000	Reserved
110001 to 111101	Manufacturer specific
111110	Error
111111	Not available (parameter not supported)

Type: Measured
 SPN: 7792

A.19.18 Front hitch roll sensitivity

The current sensitivity of the front hitch roll control expressed as a percentage of the maximum gain. 0 % indicates minimal gain in the control loop; 100 %, the maximum gain. Values near 0 may result in no reaction by the control loop.

Data length: 1 byte
 Resolution: 0,4 %/bit, 0 % offset
 Data range: 0 % to 100 %
 Type: Measured
 SPN: 7800

A.19.19 Front hitch roll command

Command for setting the roll angle of the front three-point hitch expressed in degrees with 0 being horizontally aligned with the rear axle of the tractor. Facing the direction of travel, an anti-clockwise rotation would be indicated by a negative number and a clockwise rotation would be indicated by a positive number.

Data length: 2 bytes
 Resolution: 0,002 °/bit, -64 degrees offset
 Data range: -64° to 64,51°
 Type: Command
 SPN: 7796

A.19.20 Front hitch roll sensitivity command

Command for setting the sensitivity of the front hitch roll control expressed as a percentage of the maximum gain. 0 % indicates minimal gain in the control loop; 100 %, the maximum gain. Values near 0 may result in no reaction by the control loop.

Data length:	1 byte
Resolution:	0,4 %/bit, 0 % offset
Data range:	0 % to 100 %
Type:	Command
SPN:	7797

A.19.21 Front hitch pitch angle

Measured pitch angle of the front three-point hitch expressed in degrees from vertical alignment of the upper and lower attachment points. Positive is in the anti-clockwise direction when viewed from the left-hand side of the tractor.

Data length:	2 bytes
Resolution:	0,002 °/bit, -64 degrees offset
Data range:	-64° to 64,51°
Type:	Measured
SPN:	7793

A.19.22 Front hitch pitch limit status

Parameter used to report the Tractor ECU's present limit status associated with the front hitch pitch commands.

Data length:	3 bits
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Value	Meaning
000	Not limited
001	Operator limited/controlled (request cannot be implemented)
010	Limited High (only lower command values result in a change)
011	Limited Low (only higher command values result in a change)
100	Reserved
101	Reserved
110	Non-recoverable fault
111	Not available (parameter not supported)

Note that the limited conditions (limited high and low) could be temporary, for example when a large set point change is limited by a ramp rate. This bit can be set until the ramp is complete to prevent windup (and subsequent overshoot) due to the response of the controlled value.

A non-recoverable fault is non-recoverable from the viewpoint of the implement. Operator action within the tractor may resolve the issue and result in a change to “Operator Limited/Controlled” status.

Type: Measured
SPN: 7794

A.19.23 Front hitch pitch exit/reason code

This parameter is used to indicate why the front hitch cannot accept remote pitch commands or has most recently stopped accepting remote commands.

Data length: 6 bits

Value	Meaning
000000	No reason/all clear
000001	Required level of operator presence/awareness not detected
000010	Implement released control of function
000011	Operator override of function
000100	Operator control not in valid position
000101	Remote command timeout
000110	Remote command out of range/invalid
000111	Function not calibrated
001000	Operator control fault
001001	Function fault
001010 to 010011	Reserved
010100	Hydraulic oil level too low
010101	Hitch locked out
010110 to 110000	Reserved
110001 to 111101	Manufacturer specific
111110	Error
111111	Not available (parameter not supported)

Type: Measured
SPN: 7795

A.19.24 Front hitch pitch sensitivity

The current sensitivity of the front hitch pitch control expressed as a percentage of the maximum gain. 0 % indicates minimal gain in the control loop; 100 %, the maximum gain. Values near 0 may result in no reaction by the control loop.

Data length: 1 byte
Resolution: 0,4 %/bit, 0 % offset
Data range: 0 % to 100 %
Type: Measured

SPN: 7801

A.19.25 Front hitch pitch command

Command for setting the pitch angle of the front three-point hitch expressed in degrees from vertical alignment of the upper and lower attachment points. Positive is in the anti-clockwise direction when viewed from the left-hand side of the tractor.

Data length: 2 bytes
Resolution: 0,002 °/bit, -64 degrees offset
Data range: -64° to 64,51°
Type: Command
SPN: 7798

A.19.26 Front hitch pitch sensitivity command

Command for setting the sensitivity of the front hitch pitch control expressed as a percentage of the maximum gain. 0 % indicates minimal gain in the control loop; 100 %, the maximum gain. Values near 0 may result in no reaction by the control loop.

Data length: 1 byte
Resolution: 0,4 %/bit, 0 % offset
Data range: 0 % to 100 %
Type: Measured
SPN: 7799

A.19.27 Front hitch yaw angle

Measured yaw angle of front hitch relative to the reference frame indicated by [A.19.28](#) parameter.

The yaw angle measurement around the yaw (z-axis) of the hitch. The yaw angle is defined to be the angle from the null position on the reference frame. A positive yaw angle results when the hitch is rotated anti-clockwise when viewing the tractor from above.

Data length: 2 bytes
Resolution: 1/128 °/bit, -200 degrees offset
Data range: -200° to 200°
Type: Measured
SPN: 9714

A.19.28 Front hitch yaw angle reference frame

This parameter is used to indicate the reference frame for the yaw angle of the front hitch.

Data length: 4 bits

Value	Meaning
0000	Main body of the machine
0001	Body of the hitch
0010	Direction of travel
0011 to 1101	Reserved
1110	Non-recoverable fault
1111	Not available (parameter not supported)

NOTE Main body of the machine reference is the recommended reference frame for all tractors with front wheel steering. Direction of travel reference frame is suitable for tractors with capability in crab steering mode. Body of the hitch reference frame is suitable for articulated tractors with front hitch.

Type: Measured

SPN: 9721

A.19.29 Front hitch yaw angle actual control mode

This parameter is used to indicate the control mode active in the tractor.

Data length: 4 bits

Value	Meaning
0000	Disabled, yaw angle is locked in a position (e.g. transport).
0001	Direct hydraulic valve control, manual operation
0010	Floating mode
0011	Automatic control: 1:1 to adjacent steering wheels
0100	Automatic control: N:1, basic curvature contour mode
0101	Automatic control: position control
0110 to 1101	Reserved
1110	Error indication
1111	Not available

Type: Measured

SPN: 9716

A.19.30 Front hitch yaw limit status

Parameter used to report the Tractor ECU's present limit status associated with the front hitch yaw commands.

Data length: 3 bits

Value	Meaning
000	Not limited
001	Operator limited/controlled (request cannot be implemented)
010	Limited High (only lower command values result in a change)
011	Limited Low (only higher command values result in a change)

Value	Meaning
100	Reserved
101	Reserved
110	Non-recoverable fault
111	Not available (parameter not supported)

Note that the limited conditions (limited high and low) could be temporary, for example when a large set point change is limited by a ramp rate. This bit can be set until the ramp is complete to prevent windup (and subsequent overshoot) due to the response of the controlled value.

A non-recoverable fault is non-recoverable from the viewpoint of the implement. Operator action within the tractor may resolve the issue and result in a change to “Operator Limited/Controlled” status.

Type: Measured

SPN: 9717

A.19.31 Front hitch yaw exit/reason code

This parameter is used to indicate why the front hitch cannot accept remote yaw commands or has most recently stopped accepting remote commands.

Data length: 6 bits

Value	Meaning
000000	No reason/all clear
000001	Required level of operator presence/awareness not detected
000010	Implement released control of function
000011	Operator override of function
000100	Operator control not in valid position
000101	Remote command timeout
000110	Remote command out of range/invalid
000111	Function not calibrated
001000	Operator control fault
001001	Function fault
001010 to 010011	Reserved
010100	Hydraulic oil level too low
010101	Hitch locked out
010110 to 110000	Reserved
110001 to 111101	Manufacturer specific
111110	Error
111111	Not available (parameter not supported)

Type: Measured

SPN: 9718

A.19.32 Front hitch yaw command

Command for setting the yaw angle of the front three-point hitch like defined in [A.19.27](#) and [A.19.28](#). To enable the command, Front hitch yaw angle actual control mode (see [A.19.29](#)) must be value 0101.

Data length:	2 bytes
Resolution:	1/128 °/bit, -200 degrees offset
Data range:	-200° to 200°
Type:	Measured
SPN:	9719

A.19.33 Rear hitch roll angle

Measured roll angle of the rear three-point hitch expressed in degrees from horizontal alignment with the rear axle of the tractor. Facing the direction of travel, an anti-clockwise rotation would be indicated by a negative number and a clockwise rotation would be indicated by a positive number.

Data length:	2 bytes
Resolution:	0,002 °/bit, -64 degrees offset
Data range:	-64° to 64,51°
Type:	Measured
SPN:	7802

A.19.34 Rear hitch roll limit status

Parameter used to report the Tractor ECU's present limit status associated with the rear hitch roll commands.

Data length:	3 bits
--------------	--------

Value	Meaning
000	Not limited
001	Operator limited/controlled (request cannot be implemented)
010	Limited High (only lower command values result in a change)
011	Limited Low (only higher command values result in a change)
100	Reserved
101	Reserved
110	Non-recoverable fault
111	Not available (parameter not supported)

Note that the limited conditions (limited high and low) could be temporary, for example when a large set point change is limited by a ramp rate. This bit can be set until the ramp is complete to prevent windup (and subsequent overshoot) due to the response of the controlled value.

A non-recoverable fault is non-recoverable from the viewpoint of the implement. Operator action within the tractor may resolve the issue and result in a change to "Operator Limited/Controlled" status.

Type: Measured
SPN: 7803

A.19.35 Rear hitch roll exit/reason code

This parameter is used to indicate why the rear hitch cannot accept remote roll commands or has most recently stopped accepting remote commands.

Data length: 6 bits

Value	Meaning
000000	No reason/all clear
000001	Required level of operator presence/awareness not detected
000010	Implement released control of function
000011	Operator override of function
000100	Operator control not in valid position
000101	Remote command timeout
000110	Remote command out of range/invalid
000111	Function not calibrated
001000	Operator control fault
001001	Function fault
001010 to 010011	Reserved
010100	Hydraulic oil level too low
010101	Hitch locked out
010110 to 110000	Reserved
110001 to 111101	Manufacturer specific
111110	Error
111111	Not available (parameter not supported)

Type: Measured
SPN: 7804

A.19.36 Rear hitch roll sensitivity

The current sensitivity of the rear hitch roll control expressed as a percentage of the maximum gain. 0 % indicates minimal gain in the control loop; 100 %, the maximum gain. Values near 0 may result in no reaction by the control loop.

Data length: 1 byte
Resolution: 0,4 %/bit, 0 % offset
Data range: 0 % to 100 %
Type: Measured
SPN: 7812

A.19.37 Rear hitch roll command

Command for setting the roll angle of the rear three-point hitch expressed in degrees with 0 being horizontally aligned with the rear axle of the tractor. Facing the direction of travel, an anti-clockwise rotation would be indicated by a negative number and a clockwise rotation would be indicated by a positive number.

Data length:	2 bytes
Resolution:	0,002 °/bit, -64 degrees offset
Data range:	-64° to 64,51°
Type:	Measured
SPN:	7808

A.19.38 Rear hitch roll sensitivity command

Command for setting the sensitivity of the rear hitch roll control expressed as a percentage of the maximum gain. 0 % indicates minimal gain in the control loop; 100 %, the maximum gain. Values near 0 may result in no reaction by the control loop.

Data length:	1 byte
Resolution:	0,4 %/bit, 0 % offset
Data range:	0 % to 100 %
Type:	Measured
SPN:	7809

A.19.39 Rear hitch pitch angle

Measured pitch angle of the rear three-point hitch expressed in degrees from vertical alignment of the upper and lower attachment points. Positive is in the anti-clockwise direction when viewed from the left-hand side of the tractor.

Data length:	2 bytes
Resolution:	0,002 °/bit, -64 degrees offset
Data range:	-64° to 64,51°
Type:	Measured
SPN:	7805

A.19.40 Rear hitch pitch limit status

Parameter used to report the Tractor ECU's present limit status associated with the rear hitch pitch commands.

Data length:	3 bits
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Value	Meaning
000	Not limited

Value	Meaning
001	Operator limited/controlled (request cannot be implemented)
010	Limited High (only lower command values result in a change)
011	Limited Low (only higher command values result in a change)
100	Reserved
101	Reserved
110	Non-recoverable fault
111	Not available (parameter not supported)

Note that the limited conditions (limited high and low) could be temporary, for example when a large set point change is limited by a ramp rate. This bit can be set until the ramp is complete to prevent windup (and subsequent overshoot) due to the response of the controlled value.

A non-recoverable fault is non-recoverable from the viewpoint of the implement. Operator action within the tractor may resolve the issue and result in a change to “Operator Limited/Controlled” status.

Type: Measured

SPN: 7806

A.19.41 Rear hitch pitch exit/reason code

This parameter is used to indicate why the rear hitch cannot accept remote pitch commands or has most recently stopped accepting remote commands.

Data length: 6 bits

Value	Meaning
000000	No reason/all clear
000001	Required level of operator presence/awareness not detected
000010	Implement released control of function
000011	Operator override of function
000100	Operator control not in valid position
000101	Remote command timeout
000110	Remote command out of range/invalid
000111	Function not calibrated
001000	Operator control fault
001001	Function fault
001010 to 010011	Reserved
010100	Hydraulic oil level too low
010101	Hitch locked out
010110 to 110000	Reserved
110001 to 111101	Manufacturer specific
111110	Error
111111	Not available (parameter not supported)

Type: Measured
SPN: 7807

A.19.42 Rear hitch pitch sensitivity

The current sensitivity of the rear hitch pitch control expressed as a percentage of the maximum gain. 0 % indicates minimal gain in the control loop; 100 %, the maximum gain. Values near 0 may result in no reaction by the control loop.

Data length: 1 byte
Resolution: 0,4 %/bit, 0 % offset
Data range: 0 % to 100 %
Type: Measured
SPN: 7813

A.19.43 Rear hitch pitch command

Command for setting the pitch angle of the rear three-point hitch expressed in degrees from vertical alignment of the upper and lower attachment points. Positive is in the anti-clockwise direction when viewed from the left-hand side of the tractor.

Data length: 2 bytes
Resolution: 0,002 °/bit, -64 degrees offset
Data range: -64° to 64,51°
Type: Measured
SPN: 7810

A.19.44 Rear hitch pitch sensitivity command

Command for setting the sensitivity of the rear hitch pitch control expressed as a percentage of the maximum gain. 0 % indicates minimal gain in the control loop; 100 %, the maximum gain. Values near 0 may result in no reaction by the control loop.

Data length: 1 byte
Resolution: 0,4 %/bit, 0 % offset
Data range: 0 % to 100 %
Type: Measured
SPN: 7811

A.19.45 Rear hitch yaw angle

Measured yaw angle of rear hitch relative to the reference frame indicated by [A.19.46](#) parameter.

The yaw angle measurement around the yaw (z-axis) of the hitch. The yaw angle is defined to be the angle from the null position on the reference frame. A positive yaw angle results when the hitch is rotated anti-clockwise when viewing the tractor from above.

Data length: 2 bytes
Resolution: 1/128 °/bit, -200 degrees offset
Data range: -200° to 200°
Type: Measured
SPN: 9720

A.19.46 Rear hitch yaw angle reference frame

This parameter is used to indicate the reference frame for the yaw angle of the rear hitch.

Data length: 4 bits

Value	Meaning
0000	Main body of the machine
0001	Body of the hitch
0010	Direction of travel
0011 to 1101	Reserved
1110	Non-recoverable fault
1111	Not available

NOTE Main body of the machine reference is the recommended reference frame for all tractors with front wheel steering or articulated steering. Direction of travel reference frame is suitable for tractors with rear wheel steering capability in crab steering mode. Body of the hitch reference frame is suitable for special tractors.

Type: Measured
SPN: 9721

A.19.47 Rear hitch yaw angle actual control mode

This parameter is used to indicate the control mode active in the tractor.

Data length: 4 bits

Value	Meaning
0000	Disabled, yaw angle is locked in a position (e.g. transport).
0001	Direct hydraulic valve control, manual operation
0010	Floating mode
0011	Automatic control: 1:1 to adjacent steering wheels
0100	Automatic control: N:1, basic curvature contour mode
0101	Automatic control: position control
0110 to 1101	Reserved
1110	Error indication
1111	Not available

Type: Measured

SPN: 9722

A.19.48 Rear hitch yaw limit status

Parameter used to report the Tractor ECU's present limit status associated with the rear hitch yaw commands.

Data length: 3 bits

Value	Meaning
000	Not limited
001	Operator limited/controlled (request cannot be implemented)
010	Limited High (only lower command values result in a change)
011	Limited Low (only higher command values result in a change)
100	Reserved
101	Reserved
110	Non-recoverable fault
111	Not available (parameter not supported)

Note that the limited conditions (limited high and low) could be temporary, for example when a large set point change is limited by a ramp rate. This bit can be set until the ramp is complete to prevent windup (and subsequent overshoot) due to the response of the controlled value.

A non-recoverable fault is non-recoverable from the viewpoint of the implement. Operator action within the tractor may resolve the issue and result in a change to "Operator Limited/Controlled" status.

Type: Measured
SPN: 9723

A.19.49 Rear hitch yaw exit/reason code

This parameter is used to indicate why the rear hitch cannot accept remote yaw commands or has most recently stopped accepting remote commands.

Data length: 6 bits

Value	Meaning
000000	No reason/all clear
000001	Required level of operator presence/awareness not detected
000010	Implement released control of function
000011	Operator override of function
000100	Operator control not in valid position
000101	Remote command timeout
000110	Remote command out of range/invalid
000111	Function not calibrated
001000	Operator control fault
001001	Function fault
001010 to 010011	Reserved

Value	Meaning
010100	Hydraulic oil level too low
010101	Hitch locked out
010110 to 110000	Reserved
110001 to 111101	Manufacturer specific
111110	Error
111111	Not available (parameter not supported)

Type: Measured

SPN: 9724

A.19.50 Rear hitch yaw command

Command for setting the yaw angle of the rear three-point hitch like defined in [A.19.45](#) and [A.19.46](#). To enable the command, Rear hitch yaw angle actual control mode (see [A.19.47](#)) must be value 0101.

Data length: 2 bytes

Resolution: 1/128 °/bit, -200 degrees offset

Data range: -200° to 200°

Type: Measured

SPN: 9725



A.20 PTO parameters

A.20.1 Front PTO output shaft speed

Measured rotational speed of the front power take-off (PTO) output shaft.

For existing tractors that monitor PTO speed prior to the engagement clutch, the PTO speed will only be valid when PTO is engaged, and will be unavailable when disengaged.

Data length: 2 bytes

Resolution: 0,125 1/min/bit, 0 1/min offset

Data range: 0 1/min to 8 031,875 1/min

Type: Measured

SPN: 1882

A.20.2 Rear PTO output shaft speed

Measured rotational speed of the rear power take-off (PTO) output shaft.

For existing tractors that monitor PTO speed prior to the engagement clutch, the PTO speed will only be valid when PTO is engaged, and will be unavailable when disengaged.

Data length: 2 bytes

Resolution: 0,125 1/min/bit, 0 1/min offset

Data range: 0 1/min to 8 031,875 1/min
Type: Measured
SPN: 1883

A.20.3 Front PTO output shaft speed set point

Measured value of the set point of the rotational speed of the front power take-off (PTO) output shaft.

Data length: 2 bytes
Resolution: 0,125 1/min/bit, 0 1/min offset
Data range: 0 1/min to 8 031,875 1/min
Type: Measured
SPN: 1884

A.20.4 Rear PTO output shaft speed set point

Measured value of the set point of the rotational speed of the rear power take-off (PTO) output shaft.

Data length: 2 bytes
Resolution: 0,125 1/min/bit, 0 1/min offset
Data range: 0 1/min to 8 031,875 1/min
Type: Measured
SPN: 1885

A.20.5 Front PTO output shaft speed set point — Command

Command for setting the rotational speed of the front power take-off (PTO) output shaft.

Data length: 2 bytes
Resolution: 0,125 1/min/bit, 0 1/min offset
Data range: 0 1/min to 8 031,875 1/min
Type: Command
SPN: 1886

A.20.6 Rear PTO output shaft speed set point — Command

Command for setting the rotational speed of the rear power take-off (PTO) output shaft.

Data length: 2 bytes
Resolution: 0,125 1/min/bit, 0 1/min offset
Data range: 0 1/min to 8 031,875 1/min
Type: Command
SPN: 1887

A.20.7 Front PTO engagement

Measured signal indicating that the front power take-off (PTO) is engaged or disengaged.

Data length: 2 bits

Value	Meaning
00	PTO disengaged

Value	Meaning
01	PTO engaged
10	Error indication
11	Not available

Type: Measured

SPN: 1888

A.20.8 Rear PTO engagement

Measured signal indicating that the rear power take-off (PTO) is engaged or disengaged.

Data length: 2 bits

Value	Meaning
00	PTO disengaged
01	PTO engaged
10	Error indication
11	Not available

Type: Measured

SPN: 2408

A.20.9 Front PTO mode

Measured signal indicating that the front power take-off (PTO) mode is either 540 r/min or 1 000 r/min.

Data length: 2 bits

Value	Meaning
00	PTO mode is 540 r/min
01	PTO mode is 1 000 r/min
10	Error indication
11	Not available

Type: Measured

SPN: 1889

A.20.10 Rear PTO mode

Measured signal indicating that the rear power take-off (PTO) mode is either 540 r/min or 1 000 r/min.

Data length: 2 bits

Value	Meaning
00	PTO mode is 540 r/min
01	PTO mode is 1 000 r/min
10	Error indication
11	Not available

Type: Measured

SPN: 1890

A.20.11 Front PTO economy mode

Measured signal indicating that the front power take-off (PTO) economy mode is engaged or disengaged.

Economy mode PTO operates at 540 r/min or 1 000 r/min at lower engine revolutions.

Data length: 2 bits

Value	Meaning
00	PTO economy mode is disengaged
01	PTO economy mode is engaged
10	Error indication
11	Not available

Type: Measured

SPN: 1891

A.20.12 Rear PTO economy mode

Measured signal indicating that the rear power take-off (PTO) economy mode is engaged or disengaged.

Economy mode PTO operates at 540 r/min or 1 000 r/min at lower engine revolutions.

Data length: 2 bits

Value	Meaning
00	PTO economy mode is disengaged
01	PTO economy mode is engaged
10	Error indication
11	Not available

Type: Measured

SPN: 1892

A.20.13 Front PTO engagement — Command

Command for engaging or disengaging the front power take-off (PTO).

Data length: 2 bits

Value	Meaning
00	Disengage PTO
01	Engage PTO
10	Reserved
11	Don't care

Type: Command

SPN: 1893

A.20.14 Rear PTO engagement — Command

Command for engaging or disengaging the rear power take-off (PTO).

Data length: 2 bits

Value	Meaning
00	Disengage PTO
01	Engage PTO
10	Reserved
11	Don't care

Type: Command

SPN: 1894

A.20.15 Front PTO mode — Command

Command for selecting the mode of the front power take-off (PTO).

Data length: 2 bits

Value	Meaning
00	Select 540 r/min mode
01	Select 1 000 r/min mode
10	Reserved
11	Don't care

Type: Command

SPN: 1895

A.20.16 Rear PTO mode — Command

Command for selecting the mode of the rear power take-off (PTO).

Data length: 2 bits

Value	Meaning
00	Select 540 r/min mode
01	Select 1 000 r/min mode
10	Reserved
11	Don't care

Type: Command

SPN: 1896

A.20.17 Front PTO economy mode — Command

Command for engaging and disengaging the front power take-off (PTO) economy mode.

Data length: 2 bits

Value	Meaning
00	Disengage PTO economy mode
01	Engage PTO economy mode
10	Reserved
11	Don't care

Type: Command

SPN: 1897

A.20.18 Rear PTO economy mode — Command

Command for engaging and disengaging the rear power take-off (PTO) economy mode.

Data length: 2 bits

Value	Meaning
00	Disengage PTO economy mode
01	Engage PTO economy mode
10	Reserved
11	Don't care

Type: Command

SPN: 1898

A.20.19 Front PTO engagement request status

This parameter is used to report the Tractor ECU's status associated with front PTO engagement requests that are transient/temporary/one-shot.

Data length: 2 bits

Value	Meaning
00	External request accepted. No subsequent operator intervention.
01	Control override (most recent external request ignored because of operator or tractor system override)
10	Error
11	Not available (parameter not supported)

Type: Measured

SPN: 5152

A.20.20 Front PTO mode request status

This parameter is used to report the Tractor ECU's status associated with front PTO mode requests that are transient/temporary/one-shot.

Data length: 2 bits

Value	Meaning
00	External request accepted. No subsequent operator intervention.
01	Control override (most recent external request ignored because of operator or tractor system override)
10	Error
11	Not available (parameter not supported)

Type: Measured

SPN: 5153

A.20.21 Front PTO economy mode request status

This parameter is used to report the Tractor ECU's status associated with front PTO economy mode requests that are transient/temporary/one-shot.

Data length: 2 bits

Value	Meaning
00	External request accepted. No subsequent operator intervention.
01	Control override (most recent external request ignored because of operator or tractor system override)
10	Error
11	Not available (parameter not supported)

Type: Measured

SPN: 5154

A.20.22 Front PTO shaft speed limit status

This parameter is used to report the Tractor ECU's present limit status associated with front PTO shaft speed commands that are persistent.

Data length: 3 bits

Value	Meaning
000	Not limited
001	Operator limited/controlled (request cannot be implemented)
010	Limited high (only lower command values result in a change)
011	Limited low (only higher command values result in a change)
100	Reserved
101	Reserved
110	Non-recoverable fault
111	Not available (parameter not supported)

Note that the limited conditions (limited high and low) could be temporary, for example when a large set point change is limited by a ramp rate. This bit can be set until the ramp is complete to prevent windup (and subsequent overshoot) due to the response of the controlled value.

A non-recoverable fault is non-recoverable from the viewpoint of the implement. Operator action within the tractor may resolve the issue and result in a change to "Operator Limited/Controlled" status.

Type: Measured

SPN: 5155

A.20.23 Rear PTO engagement request status

This parameter is used to report the Tractor ECU's status associated with rear PTO engagement requests that are transient/temporary/one-shot.

Data length: 2 bits

Value	Meaning
00	External request accepted. No subsequent operator intervention.
01	Control override (most recent external request ignored because of operator or tractor system override)

Value	Meaning
10	Error
11	Not available (parameter not supported)

Type: Measured

SPN: 5156

A.20.24 Rear PTO mode request status

This parameter is used to report the Tractor ECU's status associated with rear PTO mode requests that are transient/temporary/one-shot.

Data length: 2 bits

Value	Meaning
00	External request accepted. No subsequent operator intervention.
01	Control override (most recent external request ignored because of operator or tractor system override)
10	Error
11	Not available (parameter not supported)

Type: Measured

SPN: 5157

A.20.25 Rear PTO economy mode request status

This parameter is used to report the Tractor ECU's status associated with rear PTO economy mode requests that are transient/temporary/one-shot.

Data length: 2 bits

Value	Meaning
00	External request accepted. No subsequent operator intervention.
01	Control override (most recent external request ignored because of operator or tractor system override)
10	Error
11	Not available (parameter not supported)

Type: Measured

SPN: 5158

A.20.26 Rear PTO shaft speed limit status

This parameter is used to report the Tractor ECU's present limit status associated with rear PTO shaft speed commands that are persistent.

Data length: 3 bits

Value	Meaning
000	Not limited
001	Operator limited/controlled (request cannot be implemented)
010	Limited high (only lower command values result in a change)
011	Limited low (only higher command values result in a change)

Value	Meaning
100	Reserved
101	Reserved
110	Non-recoverable fault
111	Not available (parameter not supported)

Note that the limited conditions (limited high and low) could be temporary, for example when a large set point change is limited by a ramp rate. This bit can be set until the ramp is complete to prevent windup (and subsequent overshoot) due to the response of the controlled value.

A non-recoverable fault is non-recoverable from the viewpoint of the implement. Operator action within the tractor may resolve the issue and result in a change to “Operator Limited/Controlled” status.

Type: Measured

SPN: 5159

A.20.27 Front PTO exit/reason code

This parameter is used to indicate why the front PTO cannot accept remote commands or has most recently stopped accepting remote commands.

Data length: 6 bits

Value	Meaning
000000	No reason/all clear
000001	Required level of operator presence/awareness not detected
000010	Implement released control of function
000011	Operator override of function
000100	Operator control not in valid position
000101	Remote command timeout
000110	Remote command out of range/invalid
000111	Function not calibrated
001000	Operator control fault
001001	Function fault
001010 to 0010011	Reserved
010100	Invalid PTO gear
010101 to 110000	Reserved
110001 to 111101	Manufacturer specific
111110	Error
111111	Not available (parameter not supported)

Type: Measured

SPN 5817

A.20.28 Rear PTO exit/reason code

This parameter is used to indicate why the rear hitch cannot accept remote commands or has most recently stopped accepting remote commands.

Data length: 6 bits

Value	Meaning
000000	No reason/all clear
000001	Required level of operator presence/awareness not detected
000010	Implement released control of function
000011	Operator override of function
000100	Operator control not in valid position
000101	Remote command timeout
000110	Remote command out of range/invalid
000111	Function not calibrated
001000	Operator control fault
001001	Function fault
001010 to 0010011	Reserved
010100	Invalid PTO gear
010101 to 110000	Reserved
110001 to 111101	Manufacturer specific
111110	Error
111111	Not available (parameter not supported)

Type: Measured

SPN 5820

A.21 Auxiliary valve parameters

A.21.1 Auxiliary valve number

Auxiliary hydraulic valves are numbered beginning with 0 and increase in sequence to the maximum number of auxiliary hydraulic valves in the device. The tractor's auxiliary valves shall be labelled with valve numbers corresponding to these auxiliary valve numbers. In a connected system where auxiliary valve messages are broadcast, the transmitted valve number shall correspond to the number label of the auxiliary valve to which an implement or equipment is connected. The auxiliary valve numbers do not reference any location or mounting of the auxiliary valves.

In systems using “power beyond” technology, valve number 0 shall be used to identify the “power beyond” control valve.

A.21.2 Auxiliary valve number 0 extend port measured flow

Measured flow through the extend port of auxiliary valve number 0 of a tractor, expressed as a percentage of full flow.

Zero percent indicates no flow, 100 % indicates maximum flow, -100 % indicates maximum flow returning to the tractor through this port.

Data length: 1 byte
Resolution: 1 %/bit, -125 % offset
Data range: -125 % to 125 %
Type: Measured