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

**Part 12:
Diagnostics services**

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

Partie 12: Services de diagnostic

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 11783-12 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

This corrected version of ISO 11783-12:2009 incorporates the following corrections:

- in B.6, the description of the transmission repetition rate has been clarified by additions, and the rate at which DM1 is broadcast has been corrected to 1,0 Hz.

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*

Sequence control is to form the subject of a future part 14.

Introduction

ISO 11783 specifies a communications system for agricultural equipment based on the CAN 2.0 B ^[4] protocol. SAE J1939 ^[5] 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 assured 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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Tractors and machinery for agriculture and forestry — Serial control and communications data network —

Part 12: Diagnostics services

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 network's diagnostic system.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 11783-2, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 2: Physical layer*

ISO 11783-3:2007, *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 11783-7, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 7: Implement messages application layer*

ISO 14229-1, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Specification and requirements*

ISO 14230 (all parts), *Road vehicles — Diagnostic systems — Keyword Protocol 2000*

ISO 15765-3, *Road vehicles — Diagnostics on Controller Area Networks (CAN) — Part 3: Implementation of unified diagnostic services (UDS on CAN)*

SAE J1939-73, *Application Layer — Diagnostics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11783-1, ISO 14229-1 and SAE J1939-73, and the following, apply.

- 3.1 level 0 diagnostics**
diagnostics not completely meeting the requirements of level 1 diagnostics
- 3.2 level 1 diagnostics**
diagnostics as specified in this part of ISO 11783
- 3.3 level 2 diagnostics**
diagnostics based on level 1 diagnostics and specifying a limited level of diagnostics interoperability between the vendor's unique protocols and/or applications

NOTE This level of diagnostics is additional to ISO 15765-3 and SAE J1939-73 diagnostics and is intended to be defined in an amendment to this part of ISO 11783.

- 3.4 suspect parameter number**
SPN
19-bit number used to identify the item for which diagnostics are being reported

NOTE Suspect parameter numbers are assigned to each individual parameter in a parameter group and to items that are relevant to diagnostics, but are not a parameter in a parameter group.

4 Symbols and abbreviated terms

- DM1 Active trouble code message
- DM2 Previously active trouble code message
- DM3 Clear previously active trouble code message
- DTC Diagnostic trouble code
- ECU Electronic control unit
- FMI Failure mode indicator
- OC Occurrence count
- PGN Parameter group number
- SPN Suspect parameter number

5 General description

The standard diagnostic system specified in this part of ISO 11783 requires that all units connected to an ISO 11783 network provide the information specified in this part of ISO 11783 to enable the operator and/or service technician to complete network diagnostics and identify which unit has failed or is operating in a faulty state.

6 Requirements

An interface is required for an operator or service technician in order to diagnose problems and faults on an ISO 11783 network. This diagnostic user interface can be provided by the virtual terminal or another type of user interface connected to the network. The information specified in the following subclauses shall be provided to the operator or service technician by this user interface for diagnosing problems and faults of the suspect connected ECU, sensor or actuator.

6.1 Diagnostics capability level

This part of ISO 11783 specifies the different levels of diagnostics capability of a function controller. These capability levels should be applied to new designs as well as existing or legacy ISO 11783-compliant controllers:

- a) level 0 diagnostics;
- b) level 1 diagnostics;
- c) level 2 diagnostics.

Function controllers capable of level 1 diagnostics may use single-frame messages to provide the requested diagnostic information.

6.2 Network information

All function controllers connected to the ISO 11783 network shall provide level 1 diagnostics information to the diagnostic user interface. This information provides an overview of the status of all communicating function controllers connected to the operating network. It shall include:

- a) the part number, serial number and manufacturer's name of the connected ECU containing the function controller;
- b) the NAME of each function controller as defined in ISO 11783-5;
- c) the version of the software for the controller;
- d) the compliance test data, including the laboratory that performed the test, certificate data and year tested.

All function controllers shall use the messages defined in Annex B to provide the above information when requested by the diagnostic interface. The diagnostic user interface shall also monitor the messages on the network to obtain information from the address claim process and shall request the additional information using the messages specified in Annex B. Parameters for these messages are defined in Annex A. A typical network status screen is shown in Annex D.

6.3 Network statistics

The user interface that displays the network status shall also use its network connection to measure the network bus statistics. These network statistics shall include the bus load and any of the CAN errors detected while sending or receiving messages, as well as the average bus voltages. The voltages shall be averaged over a time period of 250 ms to 5 s.

A typical screen of the network statistics is presented in Annex D.

6.4 Controller information

Each function controller shall provide additional fault information to the level 1 diagnostics user interface when requested. This information provides additional data to enable the operator or service technician to determine the problem or fault on a specific ECU. It includes:

- a) the specific protocol of an ECU required for non-ISO 11783 or ISO 11783 level 2 diagnostics;
- b) active diagnostic trouble codes (suspect parameter numbers and failure mode indicators);
- c) previously active diagnostic trouble codes (suspect parameter numbers and failure mode identifiers);
- d) fault occurrences (if available);
- e) clearing previously active diagnostic trouble codes (if required).

All function controllers including all members of working sets shall use the messages defined in Annex B to provide the above information when requested by the diagnostic user interface. The diagnostic user interface shall request the function controller's suspect parameter number and fault mode indicator information using the messages specified in Annex B. Parameters for these messages are defined in Annex A or in the appropriate part of ISO 11783. A typical screen of the above function controller information is presented in Annex D. In addition, the user interface shall provide an equivalent screen of the network status. Annex E provides the definition of each failure mode indicator.

6.5 Controller diagnostics

Once a problem or fault has been isolated to a particular function controller, as displayed on the controller information screen, a service tool that uses the identified protocol of that particular function controller can be connected to the network via the diagnostic connector specified in ISO 11783-2. The tool can then be used to troubleshoot the problem identified by the displayed diagnostic trouble code.

Annex A (normative)

Diagnostic information parameter definitions

A.1 ECU part number

The part number of the physical ECU connected to the ISO 11783 network. This parameter is the same as SPN 2901 as defined in SAE J1939-71 [6].

Data length:	Variable — up to 200 characters	
Resolution:	ASCII (1 byte), 0 offset	
Data range:	0 to 255 per byte	Operational range: same as data range
Type:	Measured	

The ASCII character “*” shall not be used in the ECU part number because it is used as a parameter delimiter.

A.2 ECU serial number

The serial number of the physical ECU connected to the ISO 11783 network. This parameter is the same as SPN 2902 as defined in SAE J1939-71 [6].

Data length:	Variable — up to 200 characters	
Resolution:	ASCII (1 byte), 0 offset	
Data range:	0 to 255 per byte	Operational range: same as data range
Type:	Measured	

The ASCII character “*” shall not be used in the ECU serial number because it is used as a parameter delimiter.

A.3 Number of software identification fields

Number of software identification designators represented in the software identification parameter group. This parameter is the same as SPN 965 as defined in SAE J1939-71 [6].

Data length:	1 byte	
Resolution:	1 step/bit, 0 offset	
Data range:	0 to 250 steps	Operational range: 0 to 125
Type:	Measured	

A.4 ECU software identification

The identification of the software of an ECU connected to the ISO 11783 network. Individual software module identifications are to be separated by "#". This parameter is similar to SPN 234 as defined in SAE J1939-71 [6].

Data length:	Variable — up to 200 characters	
Resolution:	ASCII (1 byte), 0 offset	
Data range:	0 to 255 per byte	Operational range: same as data range
Type:	Measured	

The ASCII characters "*" and "#" shall not be used in the software identification parameters because they are used as parameter delimiters.

A.5 ECU manufacturer name

The manufacturer name is a human-readable string that can be interpreted by a service technician. The same text as registered with the manufacturer code can be used and may contain branding information as well. It may contain the manufacturer's name as well as the OEM integrator. This information aids the service technician to acquire service help.

Data length:	Variable — up to 200 characters	
Resolution:	ASCII (1 byte), 0 offset	
Data range:	0 to 255 per byte	Operational range: same as data range
Type:	Measured	

The ASCII character "*" shall not be used in the ECU manufacturer name because it is used as a parameter delimiter.

A.6 ECU diagnostic protocol identification

This 8-bit parameter indicates the diagnostic protocol that the ECU supports for ISO 11783 Level 2 or for proprietary troubleshooting of a fault code.

Data length:	8 bits
Value:	Meaning:
00000000	Only ISO 11783 Level 1 diagnostics
00000001	J1939-73
00000010	ISO 14230 (KWP 2000 over K line)
00000100	ISO 15765-3 (UDS on CAN)
00001000	ISO 11783 Level 2
00010000	Reserved for ISO assignment
00100000	Reserved for ISO assignment
01000000	Reserved for ISO assignment
10000000	Reserved for ISO assignment
Type:	Measured

A.7 ECU location

The location on a tractor or implement of the physical ECU connected to the ISO 11783 network. This parameter is the same as SPN 2903 as defined in SAE J1939-71 [6].

Data length:	Variable — up to 200 characters	
Resolution:	ASCII (1 byte), 0 offset	
Data range:	0 to 255 per byte	Operational range: same as data range
Type:	Measured	

The ASCII character “*” shall not be used in the ECU location because it is used as a parameter delimiter.

A.8 ECU type

The type of the physical ECU connected to the ISO 11783 network. An example of an ECU type is the classification of ECU capabilities such as I/O. This parameter is the same as SPN 2904 as defined in SAE J1939-71 [6].

Data length:	Variable — up to 200 characters	
Resolution:	ASCII (1 byte), 0 offset	
Data range:	0 to 255 per byte	Operational range: same as data range
Type:	Measured	

The ASCII character “*” shall not be used in the ECU type because it is used as a parameter delimiter.

Annex B (normative)

Diagnostic information message definitions

B.1 ECU identification information

The ECU identification information message is based on the same message as that defined in SAE J1939-71 [6] with the following specified parameters.

NOTE The fields in this message are separated by an ASCII “*” delimiter.

Transmission repetition rate:	On request
Data length:	Variable
Data page:	0
PDU format:	253
PDU specific:	197
Default priority:	6
Parameter group number:	64965 (00FDC5 ₁₆)

Byte 1 ... m	ECU part number	(See A.1)
Byte m + 1	Delimiter	
Byte m + 2 ... n	ECU serial number	(See A.2)
Byte n + 1	Delimiter	
Byte n + 2 ... p	ECU location	(See A.7)
Byte p + 1	Delimiter	
Byte p + 2 ... q	ECU type	(See A.8)
Byte q + 1	Delimiter	
Byte q + 2 ... r	ECU manufacturer name	(See A.5)
Byte r + 1	Delimiter	

B.2 ECU software identification

The ECU software identification message is based on the same message as that defined in SAE J1939-71 [6] with the following specified parameters.

NOTE The software components in the software identification are separated by an ASCII “*” delimiter and the individual software modules within a software component are separated by an ASCII “#” delimiter.

Transmission repetition rate:	On request
Data length:	Variable
Data page:	0
PDU format:	254
PDU specific:	218
Default priority:	6
Parameter group number:	65242 (00FEDA ₁₆)

Byte 1	Number of software identification fields	(See A.3)
Bytes 2 ... n	ECU software identification	(See A.4)

EXAMPLE Virtual Terminal 2.12#

```
App1 3.1#
App2 2.0#
App3 2.0#
*OpSys XY MMDDYY2.12#
Spooler 2.0#
*Bootloader 2.12
*
```

Or

```
SW-PN654321,01.00#
CFPN1234a#
LG-MK901243#
*SW-456789,050421A#
*SW-456789,050421A#
LG-LK123-20050421#
*LB-LH456
*
```

B.3 ISOBUS certification

The ECU ISOBUS certification message shall be in accordance with ISO 11783-7.

B.4 ECU ISO 11783 NAME

The ECU ISO 11783 NAME shall be in accordance with ISO 11783-5. The industry, device class and function codes are in the address claim message sent by the specific function controller. This information is from the address of the function controller that has sent the specific address claim. The code values are specified in ISO 11783-1.

B.5 ECU diagnostic protocol

The ECU level 1 diagnostic protocol message identifies the diagnostic protocol required for a service tool to troubleshoot a fault from this ECU.

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	253
PDU specific:	50
Default priority:	6
Parameter group number:	64818 (00FD32 ₁₆)
Byte 1	ECU diagnostic protocol identification (See A.6)
Bytes 2–8	Reserved for ISO assignment

B.6 Active diagnostic trouble codes (DM1)

The function controller active diagnostic trouble code message is based on the same message as that defined in SAE J1939-73 with the specified required parameters. The information communicated is limited to the currently active diagnostic trouble codes.

Transmission repetition rate: An active diagnostic trouble code (DM1) message is transmitted whenever a DTC becomes an active fault and at a normal update rate of once per second thereafter. If a fault has been active for 1 s or longer, and then becomes inactive, a DM1 message shall be transmitted to reflect this state change. After that, the DM1 is discontinued for this former error condition. If a different DTC changes state within the 1 s update period, a new DM1 message is transmitted to reflect this new DTC. To prevent a high message rate due to intermittent faults that have a very high frequency, it is recommended that no more than one state change per DTC per second be transmitted.

Thus, a DTC that becomes active/inactive twice within a 1 s interval would have one message identifying the DTC becoming active, and one at the next periodic transmission identifying it being inactive. This message shall be sent every second while one or more error conditions are active or in response to a request.

Data length:	Variable
Data page:	0
PDU format:	254
PDU specific:	202
Default priority:	6

Parameter group number:		65226 (00FECA ₁₆)
Byte: 1		Not specified (set to FF ₁₆)
Byte: 2		Not specified (set to FF ₁₆)
Byte: 3	bits 8–1	SPN, 8 least significant bits of SPN (most significant at bit 8)
Byte: 4	bits 8–1	SPN, second byte of SPN (most significant at bit 8)
Byte: 5	bits 8–6	SPN, 3 most significant bits (most significant at bit 8)
	bits 5–1	FMI (most significant at bit 5)
Byte: 6	bit 8	SPN conversion method (set to zero)
	bits 7–1	Occurrence count

When the occurrence count is not available, it shall be set to 7F₁₆.

DM1 shall be broadcast at 1,0 Hz rate, even when there are no active faults.

Bytes 3 to 6 shall be set to zero for no active faults.

NOTE 1 This parameter group requires the use of the “multipacket transport” broadcast parameter group as specified in ISO 11783-3 when more than one active DTC exists.

NOTE 2 Bytes 1 and 2 are not repeated in “multipacket transport” DTC messages. Bytes 3 to 6 are repeated for each additional active DTC.

B.7 Previously active diagnostic trouble codes (DM2)

The function controller’s previously active diagnostic trouble code message is based on the same message as that defined in SAE J1939-73 with the specified required parameters. The information communicated is limited to the previously active trouble codes. It is used to notify other components on the network of the diagnostic condition of the transmitting electronic component. The data contains a list of diagnostic codes and occurrence counts for previously active trouble codes. Whenever this message is sent, it shall contain all previously active trouble codes with an occurrence count not equal to zero.

Transmission repetition rate:	On request only
	A NACK is required if PGN is not supported (see ISO 11783-3:2007, PGN 59392)
Data length:	Variable
Data page:	0
PDU format:	254
PDU specific:	203
Default priority:	6
Parameter group number:	65227 (00FECB ₁₆)
Byte: 1	Not specified (set to FF ₁₆)
Byte: 2	Not specified (set to FF ₁₆)
Byte: 3	bits 8–1
	SPN, 8 least significant bits of SPN (most significant at bit 8)

Byte: 4	bits 8–1	SPN, second byte of SPN (most significant at bit 8)
Byte: 5	bits 8–6	SPN, 3 most significant bits (most significant at bit 8)
	bits 5–1	FMI (most significant at bit 5)
Byte: 6	bit 8	SPN conversion method (set to zero)
	bits 7–1	Occurrence count

When the occurrence count is not available, it shall be set to $7F_{16}$.

NOTE 1 This parameter group requires the use of the “multipacket transport” parameter group, as specified in ISO 11783-3, only when the message can not be transmitted in a single frame.

Bytes 3 to 6 shall be set to zero for no active faults.

NOTE 2 Bytes 1 and 2 are not repeated in “multipacket transport” DTC messages. Bytes 3 to 6 are repeated for each additional active DTC.

B.8 Diagnostic data clear/reset previously active DTCs (DM3)

All of the diagnostic information pertaining to the previously active trouble codes (DM2) shall be erased when this PG is requested. The diagnostic data associated with active trouble codes are not affected. Upon the completion of this operation or if there are no faults to clear, a positive acknowledgement shall be sent as required (see ISO 11783-3:2007, PGN 59392). If a function controller can not perform the requested action, then it is required to send a negative acknowledgement (see ISO 11783-3:2007, PGN 59392). Designers should be aware that no positive or negative acknowledgement is sent when the request was sent to the global address.

All ECUs shall clear the DTCs and send a positive acknowledgement to this request message.

Transmission rate:	On request only
	A NACK is required if PGN is not supported and it was a destination-specific request for DM3. (See ISO 11783-3:2007, PGN 59392)
Data length:	0
Extended data page:	0
Data page:	0
PDU format:	254
PDU specific:	204
Default priority:	6
Parameter group number:	65228 (00FECC ₁₆)

- EXAMPLE
- 1) An operator or service technician desires to clear the diagnostic data of an ECU.
 - 2) The ECU is able to perform the requested action.

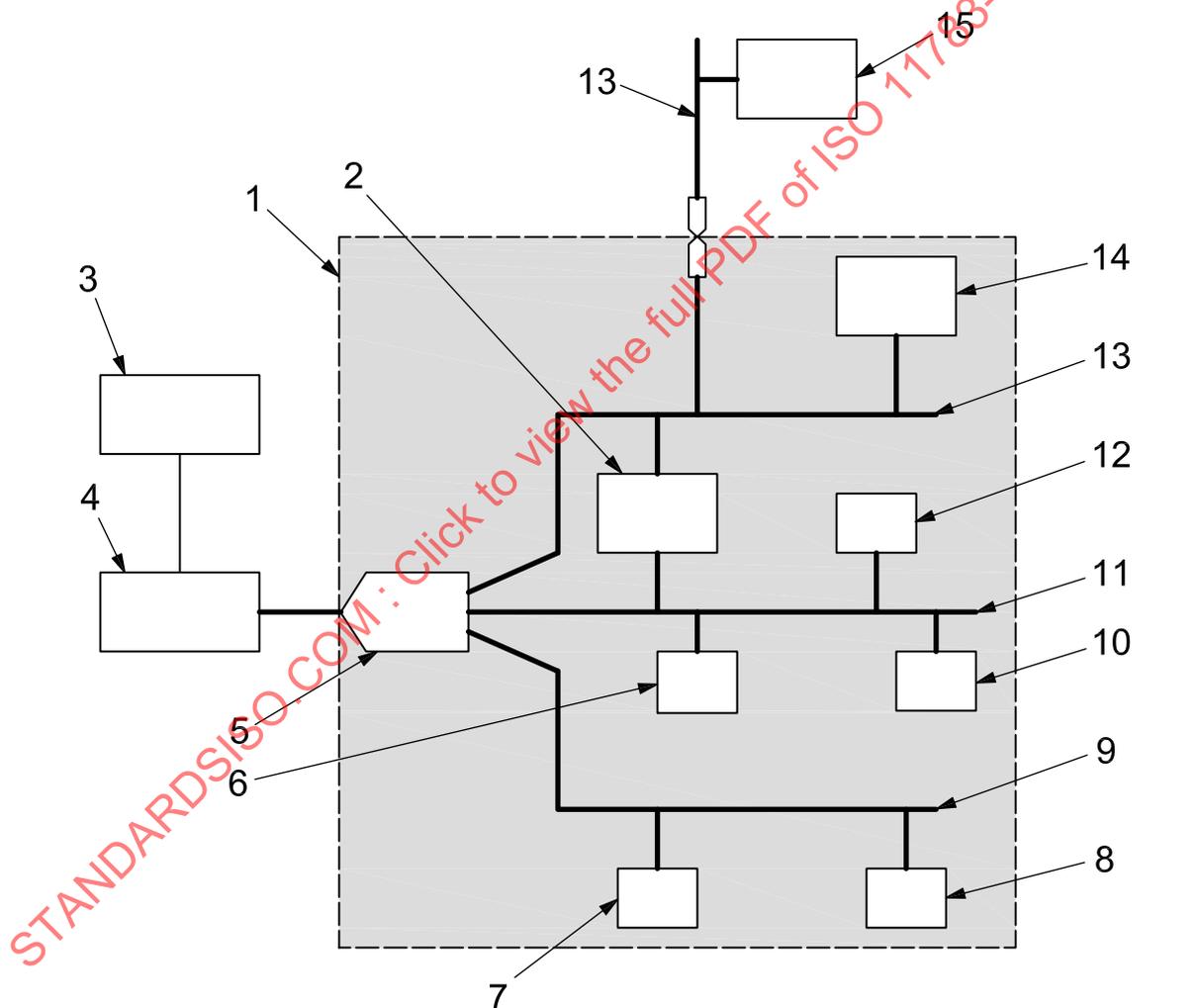
When initiated by the operator or service technician, the diagnostic user interface or a service tool shall send the Request PGN 59904 specifically to the specific ECU with the PGN 65228 as the requested PGN. The ECU shall respond with the Acknowledgement PGN 59392, indicating that the action was successfully completed for PGN 65228.

Annex C
(normative)

Network configuration

C.1 Network configuration

Figure C.1 illustrates the network configuration that shall support the diagnostic system and its connection to the ISO 11783 diagnostic connector.



Key

- | | | |
|---------------------------------------|-------------------------|-------------------------------|
| 1 tractor or self-propelled implement | 6 tractor bus ECU 3 | 11 tractor bus |
| 2 tractor ECU | 7 proprietary bus ECU 1 | 12 tractor bus ECU 1 |
| 3 diagnostic tool | 8 proprietary bus ECU 2 | 13 ISO 11783 bus |
| 4 diagnostic tool interface | 9 proprietary bus | 14 ISO 11783 virtual terminal |
| 5 ISO 11783 diagnostic connector | 10 tractor bus ECU 2 | 15 ISO 11783 implement ECU |

Figure C.1 — Network configuration

C.2 Diagnostic connector

The diagnostic connector and its installation shall be in accordance with ISO 11783-2.

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Annex D
(informative)

Network configuration screen examples

D.1 Network information screens

Figure D.1 illustrates examples of typical network information screens (see 6.2).

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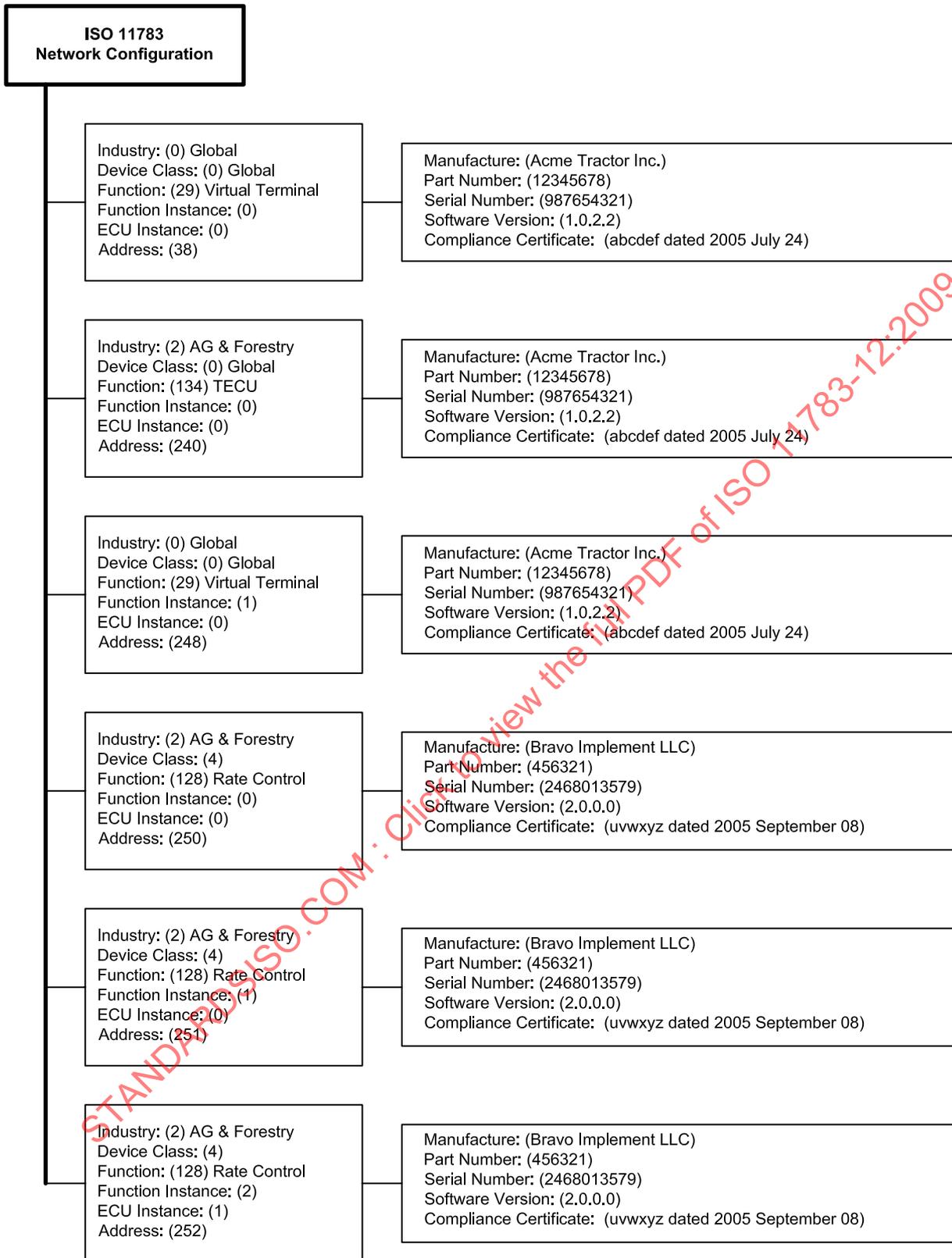


Figure D.1 — Typical network information screens

D.2 Network statistics screens

Figure D.2 illustrates a typical network statistics screen (see 6.3)

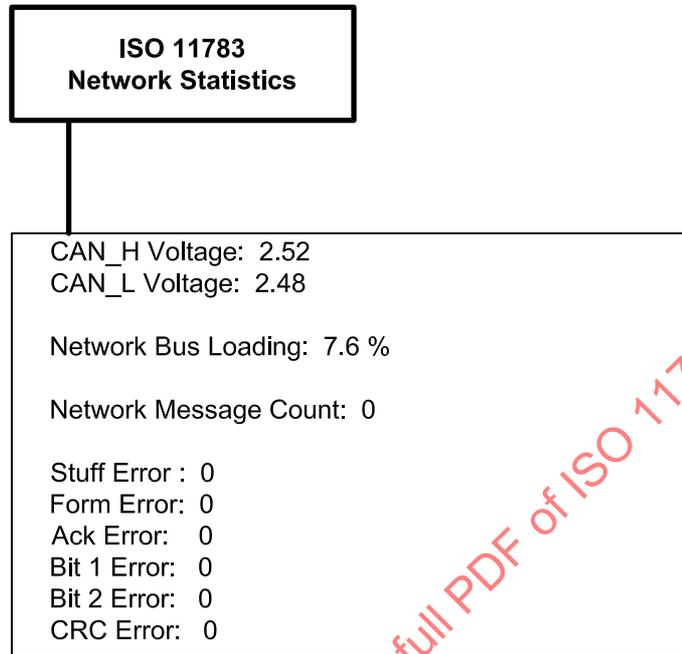


Figure D.2 — Typical network statistics screen

D.3 Controller diagnostic screens

Figure D.3 illustrates examples of typical controller diagnostic information screens (see 6.4).

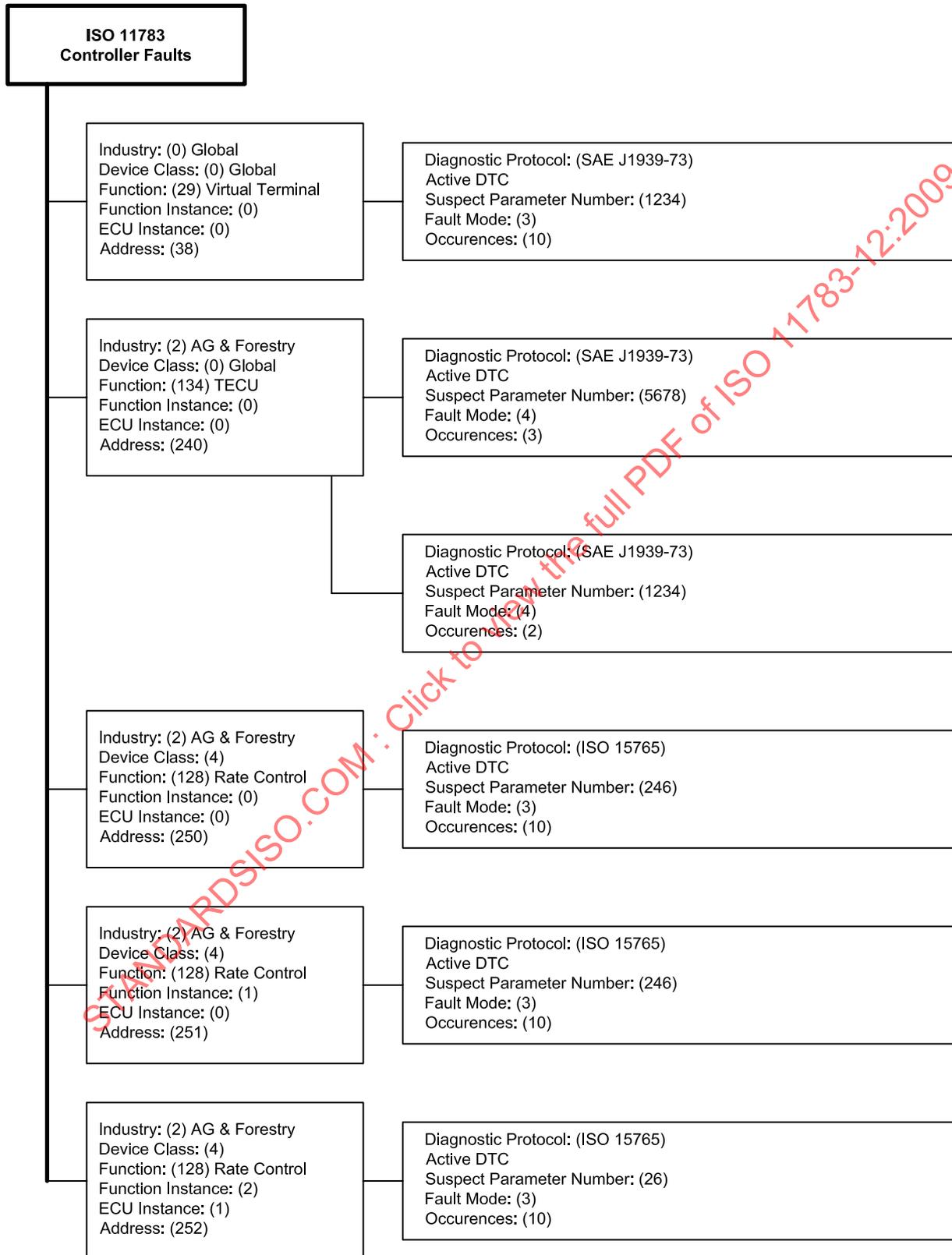


Figure D.3 — Typical controller diagnostic information screen

Annex E (normative)

Failure mode indicator definitions

E.1 Introduction

The following definitions are applicable when using failure mode indicators (FMIs). Examples have been included to help achieve consistent usage of the failure mode identifiers. Not all FMIs are applicable to a given SPN. For example, a controller diagnosing a particular input, such as SPN 1873 (Rear Hitch Position) may use FMIs 3 and 4 and therefore would not use FMIs 5 and 6.

E.2 Definitions used for the FMI descriptions

Data – Any information pertaining to physical conditions that is communicated to an electronic module in the form of voltage, current, PWM signals, or data streams.

Real world – Mechanical parameters or operating conditions that can be measured in the form of voltage, current, PWM signals and data streams.

Signal range – Definitions are shown in Figure E.1, which also gives the definitions for regions a to k.

- | | |
|----------|---|
| Region a | Total signal input range possible that can be measured by an electronic module. |
| Region b | Total signal range physically possible, as defined by an application. |
| Region c | Range defined as normal for a given real-world measurement. |
| Region d | Range defined as below normal, most severe level of what is considered normal for the given real-world measurement. |
| Region e | Range defined as above normal, most severe level of what is considered normal for the given real-world measurement. |
| Region f | Range that is low outside the range of what is considered physically possible for a given system, indicating that a short to a low source has occurred. |
| Region g | Range that is high outside the range of what is considered physically possible for a given system, indicating that a short to a high source has occurred. |
| Region h | Range defined as below normal, least severe level of what is considered normal for a given real-world measurement. |
| Region i | Range defined as above normal, least severe level of what is considered normal for a given real-world measurement. |
| Region j | Range defined as below normal, moderately severe level of what is considered normal for a given real-world measurement. |
| Region k | Range defined as above normal, moderately severe level of what is considered normal for a given real-world measurement. |