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

Part 5: Network management

Tracteurs et matériels agricoles et forestiers — Réseaux de commande et de communication de données en série —
Partie 5: Gestion du réseau

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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.

ISO 11783-5 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

This second edition cancels and replaces the first edition (ISO 11783-5:2001), which has been technically revised. It also incorporates the Technical Corrigendum ISO 11783-5:2001/Cor.1:2002.

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*

In this corrected version, a reference to Subclause 0 at the end of the sixth paragraph in 4.1 has been replaced by a reference to Subclause 4.5.

Introduction

Parts 1 to 14 of ISO 11783 specify a communications system for agricultural equipment based on ISO 11898-1[1] and ISO 11898-2[2]. SAE J1939[3] 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. This part of ISO 11783 is harmonized with SAE J1939/81[4]. 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 right 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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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 5: **Network management**

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 management of source addresses (SAs) for control functions (CFs) of electronic control units (ECUs), the association of addresses with the functional identification of a device and the detection and reporting of network-related errors. It also specifies procedures, and minimum requirements, for initialization and response to brief power outages of network-connected ECUs.

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

ISO 11783-4, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 4: Network layer*

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

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

3 Terms and definitions

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

3.1
control function
CF
function that performs operations to complete a specific function on or within devices

NOTE A CF has one unique address on the network.

3.2
current NAME
CF NAME that is transmitted in its address-claimed message

3.3
NAME management
NM
method for changing the NAME of a CF at run time

3.4
pending NAME
NAME temporarily stored by a particular CF as the result of NAME management messages received from a qualified source

3.5
random transmit delay
RT×D
delay period calculated by multiplying a random number in the range 0 to 255 by 0,6 ms

NOTE A seed to the random number generator can use the identity number in the NAME, or other unique information within the CF.

3.6
suspect parameter number
SPN
19-bit number used to identify a particular element, component, or parameter associated with a CF

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 Technical requirements

4.1 General

Network management for an ISO 11783 network provides the definitions and procedures necessary to uniquely identify CFs on the network, manage the assignment of addresses and manage network errors.

A CF's ability to select an address depends on the CF's address configuration capabilities as described in 4.2.

Each CF shall be capable of providing its unique 64-bit NAME. The rules for creating this NAME, associating it with an address and giving the ability or non-ability to change that address are specified in 4.3.

CFs shall successfully claim an address in accordance with the procedures detailed in 4.4 prior to sending any other messages on the network. Multiple CFs can work together to perform a function, provided each CF claims its own address following the rules in 4.4.2.3.

The inability to successfully claim an address in accordance with the procedure shall be handled and reported to the network following a standard method detailed in 4.4.2.4.

Network initialization sequences associated with the address-claiming process are described in 4.5.

A set of physical requirements which extends the requirements of ISO 11783-2 is listed in 4.6.

Where timeouts are not otherwise specified, the timeout defaults defined in ISO 11783-3 apply.

4.2 Address configuration capabilities

4.2.1 General

Address configuration is the method by which a particular CF determines the SA it will use for an address claim. For the purposes of the address-claiming process, there are two basic address configuration capabilities: non-configurable address and self-configurable address. These are distinguished by the value in the self-configurable address field in the most significant bit position in the CF's NAME.

CFs conforming to ISO 11783 shall be self-configurable-address-capable. Non-configurable-address-capable CFs shall be tolerated on the network to allow compatibility with CFs conforming to the previous edition of this part of ISO 11783 and CFs conforming to SAE J1939.

There are also two extended address configuration capabilities: command-configurable address and service-configurable address. A CF may implement one or more of the extended address configuration capabilities.

4.2.2 Non-configurable address

A non-configurable address CF cannot change its initial address during the address-claiming process. If multiple non-configurable address CFs are claiming the same address, then only the CF with the highest-priority NAME can obtain the address. The others shall announce their inability to claim an address.

The self-configurable address field is the most significant bit in the CF's NAME and therefore a non-configurable address CF always has higher priority than a self-configurable address CF. This implies that a non-configurable address CF forces a self-configurable address CF to claim another address.

4.2.3 Self-configurable address

A self-configurable address CF is one that can select its initial address based on proprietary algorithms and then claim that address. This CF, in cases of address conflict, is also able to re-calculate its address and re-claim (unless all 120 of the addresses between 128 and 247 are used). The value in the self-configurable address field in the NAME (see 4.3.2) indicates whether or not a CF has this capability.

The CF shall only change its initial address when it loses address arbitration, and it shall only use addresses in the range 128 to 247 inclusive. But if the CFs function is one that has an assigned preferred address, then it may also use the preferred address.

4.2.4 Service-configurable address

A service-configurable address CF is one whose source address can be changed in the field by a service technician. The address can be altered by any one of a number of proprietary techniques or by using the commanded-address message, while in a “service” mode of operation. A service tool may be used for this operation.

4.2.5 Command-configurable address

A command-configurable address CF is one whose source address can be altered using the commanded-address message. The change can take place at any time, without the intervention of a service tool or the requirement of a special service mode of operation. It does require the presence on the network of a CF that can send the appropriate command to cause the address change.

4.3 NAME and address requirements

4.3.1 General

A NAME is a 64-bit entity composed of the fields defined in Table 1. Every CF transmitting messages on an ISO 11783 network shall have a unique NAME. A CF's NAME describes the function that a CF performs, and its numerical value is used in the arbitration for address (see Annex A for examples of NAMEs). NAMEs are normally established during initial network configuration on a machine or when a CF in an ECU is added to an existing network.

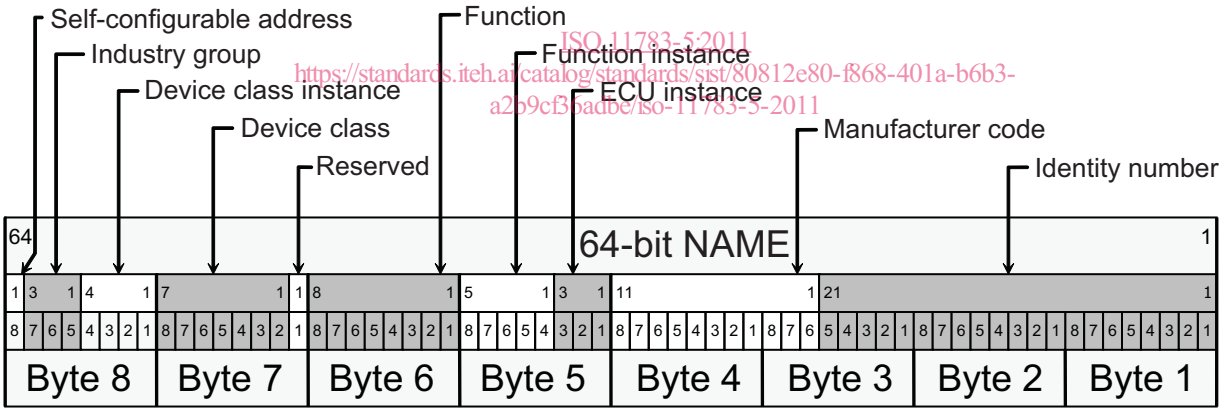
An address is used on an ISO 11783 network to provide a unique message identifier and to determine a message source which is known as a source address (SA). The procedures for address management in the protocol specified in this part of ISO 11783 enable individual SAs to be associated with particular CFs (see 4.4.2). In the case of an ECU that implements several CFs, a different address-configuration capability can exist for each of the CFs and each CF shall claim a unique SA.

An address-claimed message containing both a NAME and an SA is used to associate the two on the network. The association of a unique NAME and address also associates the address with the corresponding function. However, regardless of the SA with which it is associated, a NAME will retain a consistent definition.

4.3.2 NAME

Network integrators and ECU manufacturers shall ensure that each CF on a particular network has a unique NAME not possessed by another CF on that network.

The relationship between the 64-bit value used for arbitration priority (see 4.5.3), the data bytes in the address-claimed message (see 4.4.2.3) and the NAME fields (see Table 1) is shown in Figure 1.



NOTE The 64-bit value is sent with byte 1 first and byte 8 last when transmitted on the network.

Figure 1 — NAME bit fields in controller area network (CAN) message data bytes

Table 1 — NAME fields

Field	SPN	Definition	No. of bits	Byte No.	Byte ordering[a]
Self-configurable address	2844	Indicates whether a CF is self-configurable (1) or not (0); needs always to be known and set to the appropriate value	1	8	Bit 8: Self-configurable address
Industry group[b]	2846	Defined and assigned by ISO, identifies NAMEs associated with industries (e.g. agricultural equipment)	3		Bit 7 to bit 5: Industry group (most significant at bit 7)
Device class instance	2843	Indicates occurrence of a particular device class in a connected network; definition depends on industry group field contents (see Figure 2)	4		Bit 4 to bit 1: Device class instance (most significant at bit 4)[c]
Device class[b]	2842	Defined and assigned by ISO; provides a common NAME for a group of functions within a connected network; when combined with an industry group, can be correlated to a common NAME, e.g. “planter” with “agricultural equipment”	7	7	Bit 8 to bit 2: Device class (most significant at bit 8)
Reserved		Reserved for future definition by ISO	1		Bit 1: Reserved
Function[b]	2841	Defined and assigned by ISO; when value between 0 and 127, independent of any other field for definition; when > 127 but < 254, definition depends on device class; when combined with industry group and device class, can be correlated to a common NAME for specific CF, though not implying any specific capabilities	8	6	Bit 8 to bit 1: Function (most significant at bit 8)
Function instance	2839	Indicates specific occurrence of a function on a particular device system of a network	5	5	Bit 8 to bit 4: Function instance (most significant at bit 8)
ECU instance	2840	Indicates which of a group of ECUs associated with a given function is referenced	3		Bit 3 to bit 1: ECU (most significant at bit 3)
Manufacturer code[b]	2838	Assigned by committee (see ISO 11783-1); indicates manufacturer of ECU for which the NAME is being referenced; independent of any other NAME field	11	4	Bit 8 to bit 1: Most significant eight bits of manufacturer code (most significant at bit 8)
				3	Bit 8 to bit 6: Least significant three bits of manufacturer code (most significant at bit 8)
Identity number	2837	Assigned by the ECU manufacturer	21		Bit 5 to bit 1: Most significant five bits of identity number (most significant at bit 5)
				2	Bit 8 to bit 1: Second byte of identity number code (most significant at bit 8)
				1	Bit 8 to bit 1: Least significant byte of identity number (most significant at bit 8)[d]

[a] The byte ordering of the NAME fields is arranged so that the NAME can be treated as a number, consistent with ISO 11783-7.

[b] See ISO 11783-1 for numerical values of industry groups, device classes, functions and manufacturer codes.

[c] Bit 1 is the last of the data bits sent and closest to the cyclic redundancy code (CRC) in the message.

[d] Bit 8 is the bit closest to the data length code (DLC) in the message.

Table 1 defines and specifies the fields that comprise a NAME, listing them in order of priority, from the self-configurable address bit to the identity number's least significant byte.

The reserved bit shall be set to zero.

Any instance field in the NAME can be changed and reconfigured when an ECU is installed or, where there are multiple instances, on the network by the NAME management message (see 4.5.3).

An agreement can be reached, where appropriate, between the manufacturer and the system integrator on the interpretation and use of function instances. For example, a manufacturer or other parts of ISO 11873 may use the function instance to indicate position or special functionality of a CF.

EXAMPLE In the case of two engines and transmissions, agreement is reached that engine instance 0 be physically connected to transmission instance 0, and engine instance 1 to transmission instance 1.

Where a function is managed by two separate ECUs, each attached to the same ISO 11783 network, the ECU instance field should be set to 0 for the first ECU and to 1 for the second.

The ECU manufacturer shall ensure that the NAME is unique and non-varying when power is removed. Where all other fields are identical to the NAME of another CF, the NAME shall be made unique by setting the identity number (e.g. a serial number or a data/time code on the product).

Figure 2 shows the relationships between the fields, as well as the dependence of the upper 128 functions on device class and industry group, the dependence of identity number on manufacturer code, and the independence of function 0 to function 127 from either industry group or device class. The number of bits that each field comprises is noted above each field.

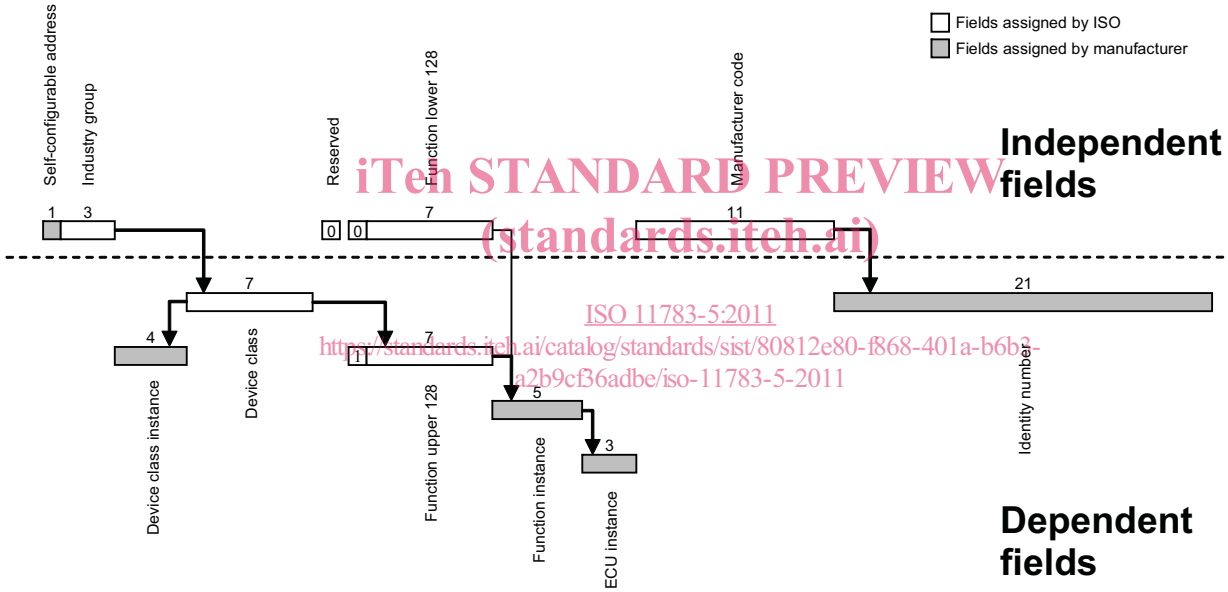


Figure 2 — NAME-field relationships and dependencies

4.3.3 Address

4.3.3.1 General

An address is a one-byte value identifying a particular CF on a network. The address of a CF is incorporated into the controller area network (CAN) identifier of every message sent by that CF and is used to provide uniqueness to messages that are sent by the CF. After initial power-up and when the network is operating, each CF shall have a unique SA. An SA can be associated with a different CF after each power-up of the network and can also vary from one network connection to another network connection. The NAME which is associated with a source address includes the identification of the function the CF performs and retains this consistent definition regardless of the SA that the CF uses.