

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

Part 1: General standard for mobile data communication

ICS 35.240.99; 65.060.01

National foreword

This British Standard is the UK implementation of ISO 11783-1:2007.

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A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Part 1: General standard for mobile data communication

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et de communication de données en série —*

*Partie 1: Système normalisé général pour les communications de
données avec les équipements mobiles*



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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 11783-1 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

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*

Automated functions 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 ^[1] protocol. SAE J 1939 documents¹⁾, 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 J 1939 specifications to be used by agricultural and forestry equipment with minimal changes. General information on ISO 11783 is to be found in this part of ISO 11783.

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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Germany

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.

1) Society of Automotive Engineers, Warrendale, PA, USA.

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

Part 1: General standard for mobile data communication

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. It is intended to provide open system interconnect (OSI) for electronic systems used by agricultural and forestry equipment. This part of ISO 11783 gives a general overview of ISO 11783. Its annexes contain the identifiers for messages, addresses, control functions, implements and manufacturers, required for the implementation of a compliant network.

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 (all parts), *Tractors and machinery for agriculture and forestry — Serial control and communications data network*

ISO 11898-1, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*

ISO 11898-2, *Road vehicles — Controller area network (CAN) — Part 2: High-speed medium access unit*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

active mask

collection of display elements selected by a working set for display on a virtual terminal

NOTE An active mask may or need not be visible.

3.2

address

eight-bit field used to define the source or destination of a message

3.3

alarm mask

object that defines alarm information for display on a virtual terminal

3.4

auxiliary input unit

electronic control unit providing auxiliary controls for common use

NOTE These may be physically located on the virtual terminal.

3.5

bridge

electronic control unit interconnecting two ISO 11783 network segments that stores and forwards messages between the two or more network segments

NOTE 1 This permits changes of media, the electrical interface, and data rate between segments, but the data link protocol and address space are the same on both connections of a bridge.

NOTE 2 A bridge can selectively filter messages going across it so that the network load is minimized on each segment.

3.6

coding data

data that changes infrequently, such as machine or chemical data, or that does not vary from task to task

3.7

command configurable address

source address of a control function that can be altered using the command address message during normal operations

3.8

control function

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

NOTE A control function has one unique address on the network.

3.9

data dictionary

listing of data variables and their identifiers

NOTE The data dictionary is defined in ISO 11783-11.

3.10

data dictionary entity

process data variable data dictionary identifier, definition, value range, value resolution and units specifications

3.11

data dictionary identifier

16-bit number that uniquely identifies a data dictionary entity

NOTE The data dictionary identifier is used in the process data message to identify the data dictionary entity for which a value or command is communicated.

3.12

data page

bit in the identifier portion of the CAN arbitration field used to select one of two pages of parameter group numbers

3.13

data transfer file

generic term for files in the extensible markup language format, which are used for the data transfer between the farm management information system and the task controller of an ISO 11783 network

3.14**destination address****DA**

protocol data unit-specific field in the CAN identifier used to indicate the address of the intended receiver of the CAN message

3.15**device**

mechanical system such as tractor, trailer or implement, or an independent sensor system

3.16**device element**

any addressable item on a device

EXAMPLE Nozzle on sprayer boom where the nozzle has individually addressable process data variables.

3.17**display**

part of a virtual terminal that presents visible information to an operator

3.18**electronic control unit****ECU**

electronic item consisting of a combination of basic parts, subassemblies and assemblies packaged together as a physically independent entity

EXAMPLE Function controller, network interconnect unit or virtual terminal.

3.19**equipment**

device or machine that performs a specific field operation

NOTE It can be a tractor or an implement attached to a tractor or self-propelled machine.

3.20**farm management information system****FMIS**

office computer system used by a farmer or contractor that includes the software for farm management such as book keeping, payroll, resource management for machines, products, workers, field management, geographical information system, decision support systems and task management

3.21**field**

one or more partfields

NOTE The field is only of importance within the farm management information system for business management considerations and is not necessarily related to a single crop.

3.22**function**

action or activity by which equipment fulfils one of its intended purposes

3.23**gateway**

electronic control unit that permits data to be transferred between two networks with different protocols or message sets

NOTE A gateway provides a means to repackage parameters into new message groups when transferring messages from one network to another.

3.24

grid cell

rectangular areas defined by overlaying a grid on a partfield

3.25

group extension

protocol data unit-specific field that is used as part of the information necessary to determine the parameter group number

3.26

implement

device or machine that performs a specific operation and which is normally attached to a tractor

3.27

industry group

IG

allocation of devices and their functions used by a specific industry

3.28

initial address

source address of a control function in a self-configuring electronic control unit that is determined during initial power up of the ECU and which is used on the subsequent power up

3.29

machine

device that uses or applies mechanical power, which has a definite function and which performs a specific kind or kinds of work

3.30

management computer gateway

electronic control unit that interfaces to the management computer system and to the ISO 11783 network

NOTE A management computer gateway can store data for transmission at a later time.

3.31

mask

top-level object that contains other objects for display on the virtual terminal

3.32

media

physical entity that conveys the electrical transmission (or equivalent means of communication) between ECUs on the network

NOTE ISO 11783 media consists of quad-twisted copper wires.

3.33

message

one or more CAN data frames with the same parameter group number

NOTE The information related to a single parameter group number to be transferred on the network can take several CAN data frames.

3.34

mobile implement control system

devices that are coupled together by, and that use, the ISO 11783 network

3.35

multi-packet message

message used when more than one CAN data frame is required to transmit all data specific to a given parameter group number

NOTE Each CAN data frame has the same CAN identifier but contains different data in each packet.

3.36**NAME**

eight-byte entity which provides an indication of each control function of an ECU

NOTE The NAME is used to provide a description of the control function and to provide a numerical value that can be used for arbitration of conflicting addresses.

3.37**negative-acknowledgement**

response to a message that indicates that it has not been understood or that a requested action cannot be performed

3.38**network interconnection unit**

electronic control unit used for interconnecting networks or network segments

NOTE Specific implementations for forwarding messages include repeaters, bridges, routers and gateways.

3.39**node**

physical connection of an ECU to the network

3.40**non-configurable address**

source address of a control function that can not be altered by any means

3.41**object pool**

collection of objects that define the operator interface, user interface or device description for an implement or single working set

NOTE A complete virtual terminal interface is composed of one or more object pools — one for each implement or working set.

3.42**packet**

single CAN data frame of a multi-frame message

NOTE This can also be a message if the data content to be transferred is in one CAN data frame.

3.43**parameter group****PG**

identification of the data in a single-packet or multi-packet message

NOTE 1 Parameter groups are not dependent on the source address field allowing any source to send any parameter group.

NOTE 2 Parameter groups include data, commands, requests, acknowledgments, and negative-acknowledgments.

NOTE 3 See Annex A for parameter group assignments.

3.44**parameter group number**

three-byte or 24-bit representation of the data page, protocol data unit format and group extension fields that identifies a particular parameter group

3.45**partfield**

area characterized by the cultivation of only one agricultural crop

NOTE Partfield is the XML element to which tasks are allocated to obtain smallest granularity.

3.46

PDU format

eight-bit field in the 29-bit CAN identifier that identifies the format of the protocol data unit

NOTE It is also one of the fields used to determine the parameter group number that labels the data field of the CAN data frame.

3.47

PDU specific

PS

eight-bit field in the 29-bit CAN identifier that is either a destination address or group extension

3.48

PDU1 format

protocol data unit format used for messages which are to be sent to a destination address

NOTE The protocol data unit-specific field contains the destination address (specific or global).

3.49

PDU2 format

protocol data unit format used to send information by the group extension technique

NOTE The protocol data unit specific field contains the group extension.

3.50

preferred address

source address of a control function in electronic control units that cannot be changed after device configuration

NOTE Control functions with preferred address are listed in Annex C.

3.51

pixel

smallest addressable picture element on a virtual terminal display

3.52

polygon

planar surface, defined by one exterior boundary, and by zero or more interior boundaries

NOTE 1 Each interior boundary describes a hole in the surface.

NOTE 2 A single or group of polygons can be used to define a treatment zone.

3.53

priority

three-bit field in the CAN identifier that establishes the arbitration priority of the information communicated

NOTE The highest priority is zero and the lowest priority is seven.

3.54

process data message

message used for the transmission of measured data and/or set point commands to one or more control functions

3.55

process data variable

information unit that describes an individual characteristic

NOTE Process data variables consist of the attributes range, resolution and units, as defined in the data dictionary.

3.56

protocol data unit

PDU

ISO 11783-specific CAN data frame

3.57

repeater

electronic control unit that regenerates the data signal to and from another network segment, permitting more electrical loads (i.e. ECU) to be connected or connection to another type of media (physical layer expansion)

NOTE The data rate, protocol and address space are the same on both sides of the repeater.

3.58

router

electronic control unit that connects network segments with independent address space, data rates and media, but which has the same protocol across all network segments

NOTE A router permits a tractor or an implement to appear as a single ECU to other network segments.

3.59

segment

portion of the network using the same physical media

NOTE 1 There is only one path between any two nodes and the data transmitted by any node are available to all other nodes connected to the same segment.

NOTE 2 Multiple segments are connected together by network interconnect units, including gateways, repeaters, bridges and routers.

3.60

self-configurable address

source address of a control function, determined by internal calculations during initial power up of the electronic control unit, which ECU then claims as that address on the network

3.61

service-configurable address

source address of a control function that is changed in operational service mode by using a service tool and any of a number of proprietary techniques, or by using the commanded-address message

3.62

soft key mask

object that contains key data for display on a virtual terminal

3.63

source address

SA

eight-bit field in the 29-bit CAN identifier that provides for the unique identification of the source of a message

NOTE The source address field contains the address of the control function that is sending the message.

3.64

subnetwork

specific ISO 11783 network segment when multiple segments are used on a device

NOTE 1 Subnetworks can include tractor, implement, hydraulic auxiliary valves and braking system.

NOTE 2 Collectively, the subnetworks are the ISO 11783 system network.

3.65

task

execution or performance of work on one partfield, for one farm or for one customer

NOTE 1 An operator can activate one task that contains process data variable values for one or more working sets.

NOTE 2 A maximum of one task can be active at the one time on a single task controller.

3.66

task controller

electronic control unit on the mobile implement control system that is responsible for the sending, receiving and logging of process data

3.67

terminating bias circuit

TBC

circuit required at each end of an ISO 11783 network segment that provides bias voltages for the CAN_H and CAN_L signals and the common mode impedance termination for the respective conductors

3.68

tractor

machine that is the primary source of power in a connected system

NOTE 1 A connected system consists of a tractor and can include one or more implements.

NOTE 2 Self-propelled agricultural equipment or construction equipment include a primary source of power.

3.69

treatment zone

area to be treated with a constant value of one or more process data variables

NOTE A treatment zone can consist of several grid cells or a polygon with the same treatment parameters.

3.70

vehicle

machine for the transportation of goods and people on land

3.71

virtual terminal

VT

electronic control unit consisting of a graphical display and input controls providing the capability to display information to and retrieve data from an operator for a connected implement or working set

3.72

visible mask

active data or alarm mask that is visible on the display of the virtual terminal

3.73

working set

group of NAMEs in one or more ECUs that collectively provide a control function or group of control functions

NOTE All control functions that are part of a working set, whether or not they are in separate electronic control units, are identified as members by the working-set master.

3.74**working-set master**

coordinator of the communications of a working set

NOTE 1 The source address of the working-set master is used to identify the working set and, for others, to communicate with the working set.

NOTE 2 The working-set master is identified by a specific control function within a specific electronic control unit.

3.75**XML element**

element representing an object of the real world

NOTE The extensible markup language element is characterized by a specific name and a definition. It contains several extensible markup language attributes, each with a name and a definition.

4 Abbreviated terms

ADIS	agriculture data interface syntax	P	page
AID	attribute identifier	PDU	protocol data unit
BMG	bit mapped graphics	PF	PDU format
BNF	Backus-Naur format	PG	parameter group
CAN	controller area network	PGN	parameter group number
DA	destination address	Pri	priority
DID	device identifier	PS	PDU specific
DTD	document type definition	PS_DA	PDU Specific_Destination Address
DP	data page	PS_GE	PDU Specific_Group Extension
DTF	data transfer file	PTO	power take-off
ECU	electronic control unit	R	reserved
FMIS	farm management information system	RAM	random access memory
GE	group extension	RTB	request to broadcast
GIS	geographical information system	SA	source address
GPS	global positioning system	SLOT	scaling, limits, offset and transfer function
IDn	identification	SPN	suspect parameter number
IDr	identifier	SRR	substitute remote request
IDE	identifier extension bit	TBC	terminating bias circuit
IDN	identification number	Un	undefined
IG	industry group	UTC	coordinated universal time
LSB	least significant byte or least significant bit	VT	virtual terminal
MICS	mobile implement control system	WU	world units
MSB	most significant byte/most significant bit	XML	extensible markup language
NA	not allowed	XSD	XML schema definition
OEM	original equipment manufacturer		
OSI	open system interconnect		

5 Application of OSI model to ISO 11783

The open systems interconnection (OSI) specified in ISO 7498 is a model of computer communications architecture having seven layers, as shown in Figure 1 and specified below. It is intended that data communications networks such as the ISO 11783 network be developed to perform the functions of each of the OSI layers, as required.

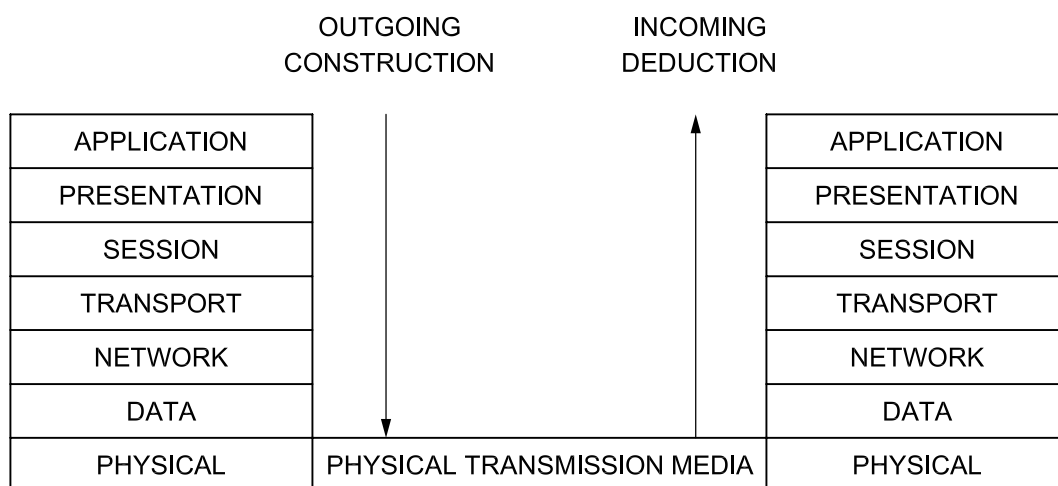


Figure 1 — OSI seven-layer model

Layer 1 — Physical

This layer concerns the transmission of an unstructured bit stream over physical media; it deals with the mechanical, electrical, functional and procedural characteristics for accessing the physical media.

Layer 2 — Data Link

This layer provides for the reliable transfer of information across the physical layer; it sends blocks of data with the necessary synchronization, error control, sequence control and flow control.

Layer 3 — Network

This layer provides upper layers with independence from the data transmission and switching technologies used to connect systems; it is responsible for establishing, maintaining and terminating connections.

Layer 4 — Transport

This layer provides for reliable, transparent transfer of data between end points, end-to-end error recovery and flow control, and segmentation and reassembly of very large messages.

Layer 5 — Session

This layer provides the control structure for communication between applications; it establishes, manages and terminates connections (sessions) between cooperating applications.

Layer 6 — Presentation

This layer provides independence to the application process from differences in data representation (syntax).

Layer 7 — Application

This layer provides access to the OSI environment for users and also provides distributed information services.

It is not required that any standard based on the model, including ISO 11783, be partitioned explicitly into the seven OSI layers, as long as the fundamental functionality is supported. Not all the OSI layers are required for the ISO 11783 network, because this network is a specific communications system, supporting specific sets of applications for a specific industry. Only those layers required for the anticipated use are defined in ISO 11783, with a separate part of ISO 11783 specifying each of the layers, and with other parts providing functionality support for the layers.

6 ISO 11783 network requirements

6.1 General

Most messages can be broadcast on an ISO 11783 network. Therefore, the data are transmitted on the network without directing it to a specific destination. This configuration permits any control function within an ECU to use the data without using additional request messages. ISO 11783 also specifies that a specific destination address be included within the CAN identifier of the message when a message is directed to a particular control function. The destination-specific message format is therefore different from the broadcast message format. Proprietary communication is also permitted in ISO 11783, using either destination-specific messages or broadcast message formats.

6.2 Physical layer

ISO 11783-2 specifies the physical layer of the data network. The network is composed of a single linear quad-twisted wire cable connected to each ECU at a node. A short cable lead provides a node connection to the quad-twisted wire cable for each ECU. Active terminating bias circuits are specified for each end of a network segment.

ISO 11783-2 also specifies the connectors required for connecting implements to tractors, additional ECUs to an existing network installed on equipment, and a service tool to the network.

ISO 11783-2 also specifies the power sources required for operation of the network and their connections.

A typical ISO 11783 control and communication data network is shown in Figure 2.

6.3 Data link layer

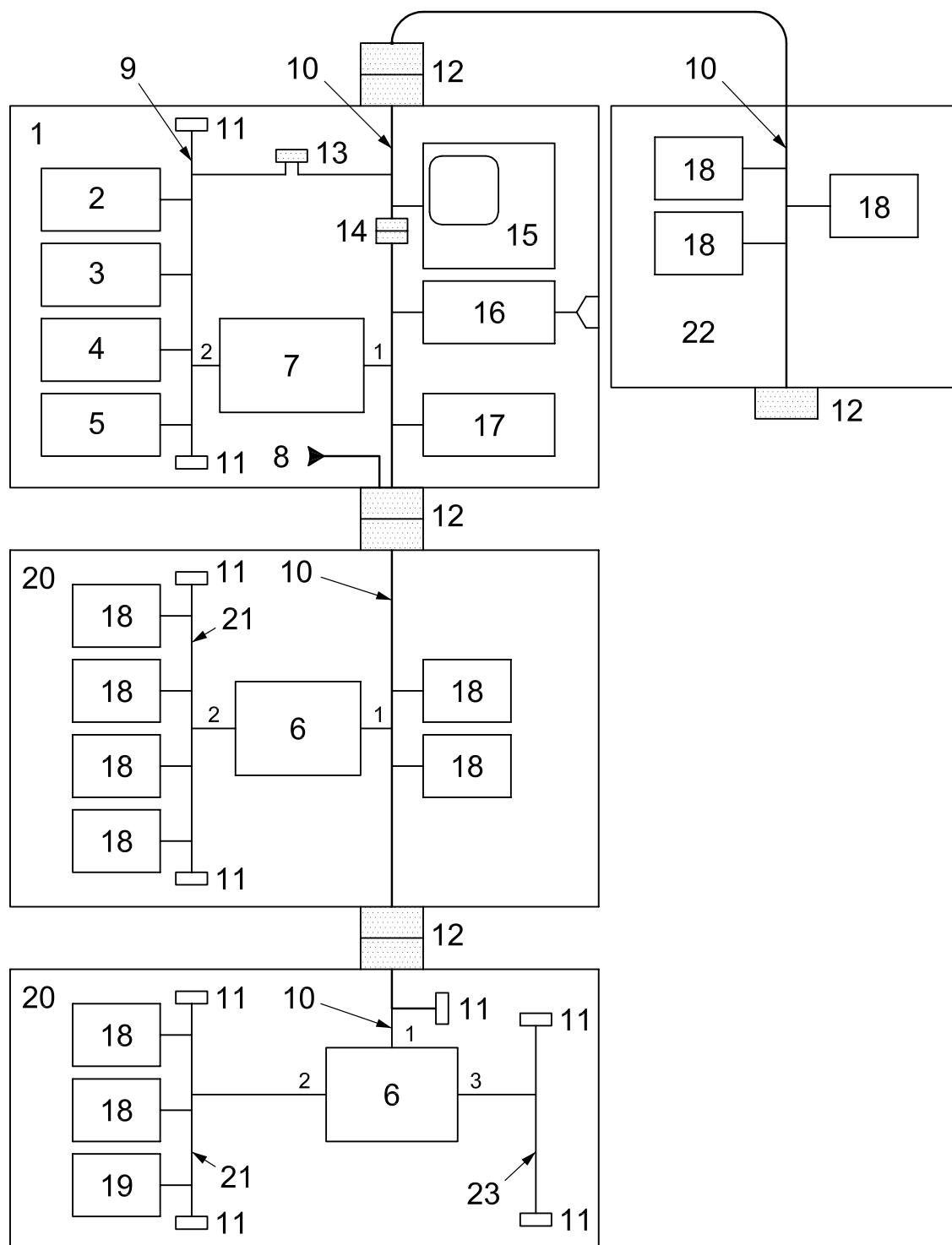
ISO 11783 networks use the CAN extended frame format defined in ISO 11898-1 and ISO 11898-2. ISO 11783-3 defines the structure of the CAN identifier for specifying the message formats.

The message formats or protocol data units are used to identify the content of a message. ISO 11783-3 specifies an eight-bit PDU format field, an eight-bit PDU specific field and a two-bit data page field that is used to identify a PDU. To reduce message overhead, ISO 11783-3 specifies that a number of related data items or parameters are to be grouped together within a PDU.

ISO 11783 specifies additional messages for manufacturer proprietary messages.

Messages that need more than eight bytes of data are sent as multi-packet messages. ISO 11783-3 specifies a transport protocol for transmitting multi-packet messages.

Individual application message format definitions, including the message transmission rate, data frame length, data page, PF, PS or DA, and the default priority, are given in that part of ISO 11783 specifying the particular application.



Key

1	tractor	9	tractor network	17	task controller
2	engine	10	implement network	18	ECU
3	transmission	11	terminator	19	lighting controller
4	brakes	12	implement bus breakaway connector	20	rear-mounted or towed implement
5	hitch controller	13	diagnostic connector	21	ISO 11783 or other network
6	network interconnect unit	14	bus extension connector	22	front- or side-mounted implement
7	tractor ECU	15	virtual terminal	23	other standard's network
8	power input	16	management computer gateway		

NOTE Smaller numbers indicate parts on the interconnect units and tractor ECU.

Figure 2 — Typical tractor/implement network physical connection structure

6.4 Network layer

When two networks with different network architectures are connected, the integrator of the connected system shall use a network interconnect unit to isolate each network segment from the other. Network interconnect units are detailed in ISO 11783-4. It is also possible that complex systems could require more than the 30-node electrical limit, as specified in ISO 11783-2, on an ISO 11783 network. In these cases, the manufacturer of the implement system shall use network interconnect units to maintain required network electrical load limits.

6.5 Network management

Each control function communicating on the ISO 11783 data network requires a source address (SA). There can be a one-for-one relationship of source addresses with ECUs and control functions on the network. If an ECU performs more than one control function, an address is required for each control function.

To uniquely identify each control function, ISO 11783-5 specifies a 64-bit NAME. ISO 11783-5 defines the specific process for determining source addresses and for resolving any address conflicts that can occur. SA are either preset or dynamically claimed by each controller as it powers up.

A NAME shall be assigned to each control function that communicates on an ISO 11783 network. There are examples, such as a virtual terminal and management gateway in a common ECU, where multiple NAMES and addresses coexist within a single ECU. Annex C lists the preset or preferred addresses for non-specific control functions of the industries listed in Annex B. Annex D lists the assigned initial addresses for agriculture and forestry equipment. Annex E and F list the NAMES to be used by control functions on an ISO 11783 data network. Figure 3 illustrates the network topology with different control functions on a tractor and implement. The addresses used by the control functions are also illustrated.

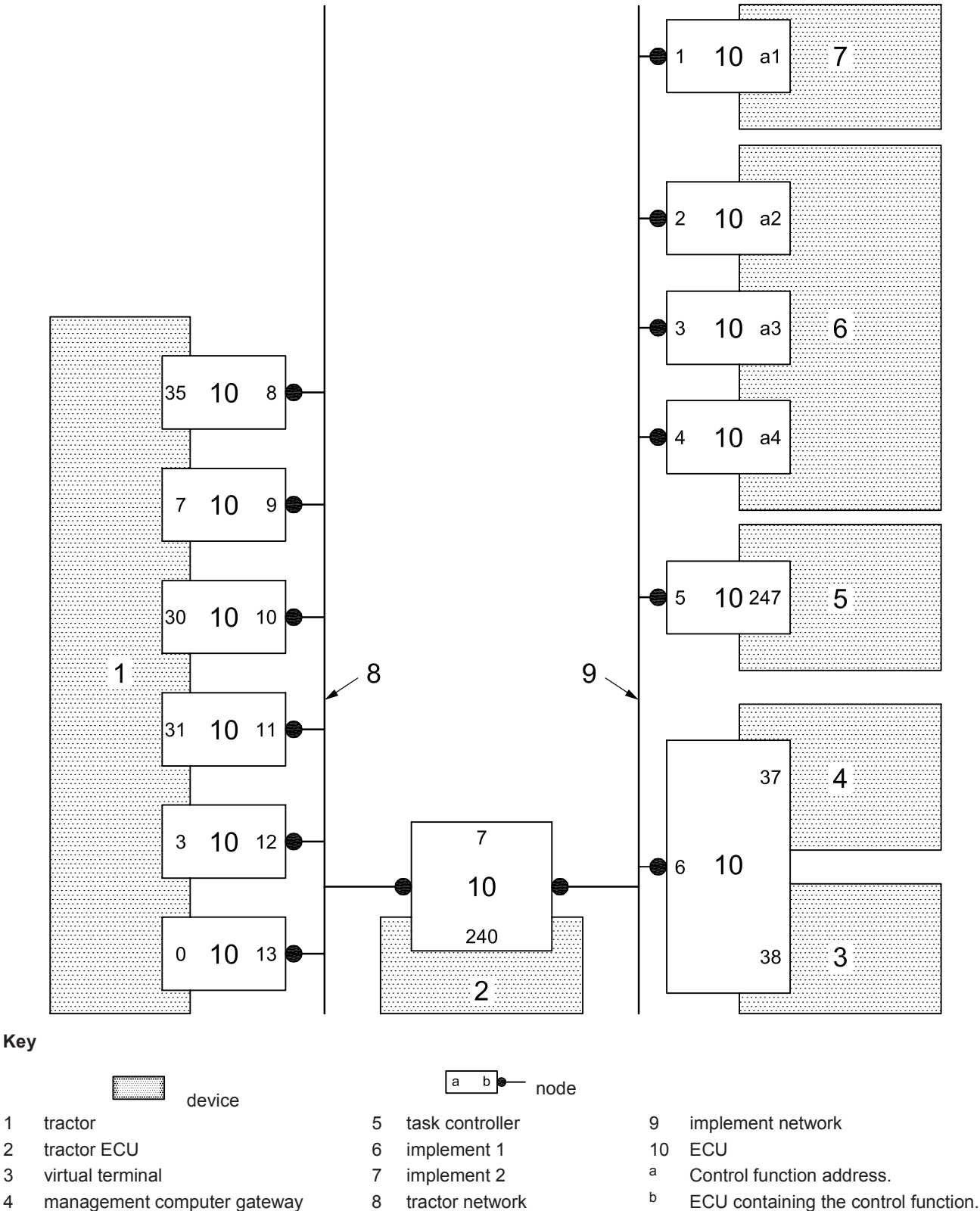
6.6 Network segments

6.6.1 General

ISO 11783 supports two or more network segments. One segment is identified as the tractor network. This segment is intended to provide the control and data communications for the drive train and chassis of the tractor or primary power unit in a system. The second segment is identified as the implement network that provides the control and data communications between implements, and between implements and the tractor or main power unit in the system. A tractor ECU is required to connect the tractor network and the implement network. Figure 3 illustrates the two network segments connected by a tractor ECU.

6.6.2 Tractor network

The tractor network provides the control and data communications between control functions on the drive train and chassis of the tractor. This network segment is controlled by the tractor manufacturer. It is recommended that the tractor network physical layer comply with ISO 11783-2. The tractor network is shown with respect to the implement network on the tractor in Figure 3. Both the tractor network and the implement network can be integrated on-board the tractor. It is intended that control functions not be connected to the tractor network unless consent is given by the tractor manufacturer. The tractor network may use application messages defined in ISO 11783-8 and ISO 11783-7 as well as proprietary messages specified in ISO 11783-3.



NOTE 1 a1, a2, a3, a4 are self-configurable addresses.

NOTE 2 The number in smaller type beside each node connection (or, in the case of the tractor ECU, above-centre between nodes) is the ECU containing the control function, while the number or numbers in smaller type opposite it is the function's address.

Figure 3 — Typical ISO 11783 network topology

6.6.3 Implement network

The implement network shall be designed to support communications between implements and between the tractor and implements. This network segment shall meet the applicable requirements of ISO 11783. The implement network exists on the tractor and on implements as shown in Figure 3. The implement network physical layer connectors shall comply with ISO 11783-2. Application messages for the implement network are defined in ISO 11783-7. Power train messages (see ISO 11783-8) may be used by control function addresses on the implement network.

6.6.4 Recommended configuration

It is recommended that the tractor network control functions use the preferred addresses listed in Annex C. The number of control functions used on connected implements shall be limited to the 119 addresses in the address range from 128 to 247 using self-configurable addresses. Practical limitations exist where multiple implements can be connected to the ISO 11783 network. Implement addresses shall be allocated using the process according to ISO 11783-5. The implement shall provide connections for extending the network to additional implements that would be connected in a serial method, as shown in Figure 2. Implements with several ECUs can use a network interconnection ECU that would isolate the additional ECU from the implement network.

6.7 Virtual terminal

The virtual terminal is an ECU that provides an operator interface for an implement or tractor using the specified standardized messages of an ISO 11783 network. ISO 11783-6 specifies the requirements of a virtual terminal (VT). The VT shown in Figure 2 is attached to the implement network. The tractor ECU or other ECUs within the tractor that are connected to the implement network can utilize the VT using the same method as for the implement ECU.

6.8 Tractor ECU

A network interconnect unit shall be provided between the tractor and the implement networks to assure both electrical and message isolation. If both networks are included in a system, manufacturers of the tractor or main power unit may use the tractor ECU or a similar unit to receive requests for messages listed in ISO 11783-7 from implement control functions. This ECU interprets the requests from the implement network and, in turn, communicates with the ECUs on the tractor network. The tractor ECU shall provide appropriate acknowledgments or responses to the requesting or commanding ECU, and shall provide the basic information and act on command messages in accordance with ISO 11783-9.

6.9 Task controllers

Task controllers provide scheduled control of implement functions via the ISO 11783 network. Task data received by the farm management computer interface is stored in the task controller. These tasks are scheduled by the task controller, which sends control messages to the appropriate control function for execution on the implement network. The task controller also records data received from control functions as tasks are being completed. This data is transferred to the farm management computer through the farm management computer interface on the implement network. The operation of the task controller and the format of messages sent to, and received from, control functions are defined in ISO 11783-10. The definition of the data elements used in the task controller messages is specified in a data dictionary given in ISO 11783-11.

6.10 Farm management computer interface

A farm management computer interface may be provided on the implement network. The physical interface of the gateway for the management computer is not specified in ISO 11783. Messages defined in ISO 11783-10 shall be used to provide data derived from files on a management computer to the management computer interface. See Figures 2 and 3.

6.11 Diagnostics

ISO 11783-12²⁾ specifies the messages to be used to determine the source of any faults that are the cause of malfunctioning of the ISO 11783 serial control and data communications network. The messages are also specified in other referenced diagnostics standards.

6.12 File server

ISO 11783-13³⁾ specifies an ECU that provides storage for data files and a set of commands that a control function on the ISO 11783 serial control and data communications network will use to access or write data from/to these files.

6.13 Process data

The process data message is used for the transmission of data to one or more control functions from the task controller. The message can also be used for transmitting data to another control function connected to the implement network. Process data message structure is defined in ISO 11783-7. The data definitions are in the data dictionary given in ISO 11783-11.

6.14 Working sets

6.14.1 General

A working set allows communications among units on a network where several control functions are acting as distributed processes providing a single application. These several control functions, each with a distinct NAME, can be in different ECUs connected by different nodes. Working sets are used in ISO 11783 where several dissimilar NAMES, possibly within different ECUs, are intended to co-operate as a single implement. The working set allows the use of a single address as a subset of the “global” destination for one-to-many communications, and to permit the receiver of many-to-one communications to associate each of the many control functions with all the others that form the particular working set. The format for the communications becomes one-to-one in each case, with all data for the working set sent to the address of the network NAME that has identified itself as the working-set master. All members of the working set listen to messages addressed to the master as though those messages were individually sent to each member. Messages, such as displayed data, sent by members of the working set are associated with the whole working set. The response to a request by a member of a working set shall be sent to the working-set master and is thereby heard by all of the members of the working set. This relieves the message loading where there is a distribution of functionality and reduces the work required of a control function that needs to send commands or other *destination-specific* messages to all of the members of the working-set. Working-set masters and members require the capability to identify when non-working-set messages, such as programming operations or fault table erasure commands that are specific to the master, are not applied to the entire working set.

EXAMPLE 1 Working sets are used in ISO 11783 when several NAMES (not necessarily within different ECUs) on an implement such as a planter communicate with the virtual terminal so that the VT interprets that all of the working-set NAMES are providing data as a single VT entity.

EXAMPLE 2 A task controller has to command several NAMES to control to a single new set point value. When these NAMES are all members of a working set, sending this command to the working-set master accomplishes the same action as a series of commands sent to each of the individual NAMES in the set.

Two message types are required to define the working set. The first message defines the working set's size, the second identifies the members of the set. The master transmits both of these messages. The two messages are defined in ISO 11783-7.

The term “collaborator” is a network control function — whether in a single ECU or one control function of many within an ECU — that works with working sets and communicates with the set as a separate entity. It is not a member of the working set being described, but can be a member or master of another working set.

2) To be published.

6.14.2 Working-set application rules

The working-set application rules are the following.

- a) A working-set-master message shall always be followed by the appropriate number of working-set-member messages. The number of working-set-member messages is one less than working-set size. A collaborator of the working set that does not receive the correct number of member definitions shall request the working-set-master PGN from the master of the set. This means that the master shall completely define the set on receipt of this request. Applications that do not work with working sets may ignore the working-set messages and communicate directly with all other network devices.
- b) Working sets shall be defined by the NAMES of the working-set members. Working-set-member messages are sent at an interval of about 100 ms. If more than 350 ms has elapsed after a working-set-member message, the receiver shall assume that the working-set master has completed sending all the NAMES of the working-set members.
- c) Working-set members are also individual control functions on the network, and therefore communicate as individual control functions. Fault messages will be sent from the control function's SA, and any commands to clear fault tables, program parameters, and others shall be addressed to the individual SA of the intended control function. Working-set members shall be programmed to allow for such individual communications to the working-set master without having all the working-set members accepting programming not intended for them. While it is possible that programming of common data into all members of the working set is intended, this is not the most likely occurrence and requires that the member NAMES have application software to allow this to happen. Control functions that do not work with working sets may ignore working-set messages and communicate directly with all other network NAMES.
- d) Each NAME on the network shall not be a member of more than one working set. If an existing working-set master issues a new working-set-master message, collaborators of working sets on the network shall replace the old working-set definition with the new definition. A working-set master shall be responsible for re-defining their working set if changes are needed, and it shall send a working-set-master message with data of zero if the working set's purpose is no longer required.
- e) The working-set master shall create a new working set when it changes its NAME. The old working set will no longer exist, but its definition can remain in the memory of the collaborator unit until a clean-up is performed using the method specified in d) by sending a working-set-master message with data of zero. The collaborator of the working set has the responsibility for detecting and correcting duplication of members of a set. Collaborators of working sets shall periodically check for duplications and for unused working sets in order to recover the internal memory used for those sets that are no longer active.
- f) A change in the SA of the working-set master does *not* change the definition of the set. The collaborators shall update the association of SA to NAME when the new address claim is received, and the working-set members shall change the address that they will use to receive working-set communications.
- g) The collaborators of working sets shall associate a new SA with the appropriate working set when a working-set member changes its SA. Since the working-set members are defined by NAME, the SA change, assuming that the NAME is unchanged, can be handled by the working-set collaborators as they receive new address claim messages.
- h) It is the responsibility of the working-set master to account for all of the NAMES of members of the working set. The master shall revise the working-set definition when new members join the network. Collaborators shall create the working set with the total number of members as specified in the working-set-member messages, and then add the SA of members as they claim addresses. This process is similar to the above process of changing the SA of a member that is active but which has changed its SA because of a later address claim by another function.

6.15 Safe mode operation

Control functions, designed according to the requirements of this standard, provide information and controls in messages sent to a virtual terminal, an auxiliary controller or a task controller as specified in this standard. Manufacturers (see Annex G for codes) shall ensure that the controls requested of a virtual terminal, an auxiliary controller or a task controller are designed and constructed according to applicable safety standards. The functions provided by the controller(s) shall be designed such that the desired effect(s) shall occur and not result with a risk of injury.

ISO 11783-9 specifies additional safe mode operations requirements.

6.16 Addition of parameters and messages

Implement messages for communications between implements and a tractor are specified in ISO 11783-7. ISO 11783-8 specifies the messages for the tractor power train.

Message sets developed for specific applications can be added to ISO 11783. Proposed message sets shall be submitted to ISO TC 23/SC 19's Working Group WG 1 using the forms provided in Annex H. The Working Group, after review and any necessary revision, forwards the recommended message set to the Subcommittee as a proposed addition to either ISO 11783-7, ISO 11783-8, ISO 11783-9 or ISO 11783-10³⁾. All ISO 11783 parameters and messages are registered in the SAE J 1939 database at the request of WG 1.

3) To be published.

Annex A (normative)

Parameter group assignments

For the purposes of this annex, the following abbreviations are used:

DP	data page (1 bit)	GE	group extension (8 bits)
PF	PDU format (8 bits)	DA	destination address (8 bits)
PS	PDU specific (8 bits) (either DA or GE)	MP	multi-packet allowed (Yes or No)
PGN	parameter group number (3 bytes) (see ISO 11783-3 for a description)	1939-71	number of applicable SAE J 1939 standard

NOTE The DA cannot be defined before a receiver of the message is determined by the real-time operating software that is sending the message. So this 8-bit frame is simply designated as a DA. GE is the extension added to the PF and the DP to identify the PGN which in turn identifies the message contents. For PFs greater than 139, the GE is used to make up the PGN. PF of 139 and lower use 0 for the GE, as this field is being used for the DA. See ISO 11783-3 for a detailed explanation of the relationship between those elements.

DP	PF	PS	PGN	Parameter Group Label	Acronym	MP	PGN Doc	Description
0	0	DA	0	Torque/Speed Control 1	TSC1	No	1939-71	
0	1	DA	256	Transmission Control 1	TC1	No	1939-71	
0	2	DA	512	Reserved for ISO 11992	EBS11	No	ISO 11992	
0	3	DA	768	Reserved for ISO 11992	EBS21	No	ISO 11992	
0	4	DA	1024	External Brake Request	XBR	No	1939-71	Used for brake control by an external device
0	5	DA	1280	Reserved for CANopen	CAM11	No	ISO 11992	CAN open Application Message #1/1
0	6	DA	1536	Reserved for CANopen	CAM21	No	ISO 11992	CAN open Application Message #2/1
0	7	DA	1792	General Purpose Valve Load Sense Pressure	GPV4	No	ISO 11783-7	Measurement of load sense and pilot pressure of a general-purpose valve

0 170	DA	43520	Client to File Server message		No	ISO 11783-7	File server message from a client on the network
0 171	DA	43776	File Server to client message		No	ISO 11783-7	File server message to a client on the network
0 172	DA	44032	Guidance System Machine Information	GMS	No	ISO 11783-7	Machine system feedback detailing status of machine relative to guidance operation
0 173	DA	44288	Guidance System Command	GMC	No	ISO 11783-7	Steering command expressed as desired curvature
0 174	DA	44544	Tyre Pressure Reference Setting	TPRS	No	1939-71	Message used for setting the tyre pressure reference values
0 175	DA	44800	Parameter Locate Message	PLM	No	1939-74	Message that causes other control functions to respond with the identity of any message that they send in which the particular parameter (identified by specific SPN) is contained
0 176	DA	45056	Configuration Identification Message	CIM	No	1939-74	Message used to identify the data content (by SPN) of one of the configurable messages (identified by PGN)
0 177	DA	45312	Proprietarily Configurable Message #1	PCM1	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 178	DA	45568	Proprietarily Configurable Message #2	PCM2	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 179	DA	45824	Proprietarily Configurable Message #3	PCM3	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 180	DA	46080	Proprietarily Configurable Message #4	PCM4	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 181	DA	46336	Proprietarily Configurable Message #5	PCM5	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 182	DA	46592	Proprietarily Configurable Message #6	PCM6	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 183	DA	46848	Proprietarily Configurable Message #7	PCM7	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 184	DA	47104	Proprietarily Configurable Message #8	PCM8	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 185	DA	47360	Proprietarily Configurable Message #9	PCM9	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 186	DA	47616	Proprietarily Configurable Message #10	PCM10	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 187	DA	47872	Proprietarily Configurable Message #11	PCM11	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 188	DA	48128	Proprietarily Configurable Message #12	PCM12	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 189	DA	48384	Proprietarily Configurable Message #13	PCM13	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74
0 190	DA	48640	Proprietarily Configurable Message #14	PCM14	Yes	1939-74	Proprietarily configuration message for use in SAE J 1939-74

0 191 DA 48896	Proprietary Configurable Message #15	PCM15	Yes	1939-74	Proprietary configuration message for use in SAE J 1939-74
0 192 DA 49152	Proprietary Configurable Message #16	PCM16	Yes	1939-74	Proprietary configuration message for use in SAE J 1939-74
0 193 DA 49408	Diagnostic Readiness 2	DR2	No	1939-73	Message to convey information relevant to the readiness of the OBD system
0 194 DA 49664	Reserved for DM20	DM20	Yes	1939-73	Reserved for DM20
0 195 DA 49920	Clear/Reset Active and Previously Active DTC	DM21	No	1939-73	Individual clear/reset of active and previously active DTC
0 196 DA 50176	General Purpose Valve Command	GPV3	No	ISO 11783-7	Controls the flow through a general purpose valve
0 197 DA 50432	General Purpose Valve Measured Flow	GPV2	No	ISO 11783-7	Measurement of the flow through a general purpose valve
0 198 DA 50688	General Purpose Valve Estimated Flow	GPV1	No	ISO 11783-7	Estimated flow through of a general purpose valve
0 199 DA 50944	Extended Transport Protocol – Data Transfer	ETP.DT	Yes	ISO 11783-6	Defined in ISO 11783-6
0 200 DA 51200	Extended Transport Protocol – Connection Mgt	ETP.CM	No	ISO 11783-6	Defined in ISO 11783-6
0 201 DA 51456	Request 2	RQST2	No	ISO 11783-3	Requests a PGN from network control function or functions and to specify whether the response can or cannot use the Transfer PGN and data set for all control functions it is tasked with reporting.
0 202 DA 51712	Transfer	XFER	No	ISO 11783-3	PGN that provides a mechanism for reporting multiple data sets for a given PGN
0 203 DA 51968	Process Data Message	PD	No	ISO 11783-7	Message defined as destination specific and the sender shall determine which implement receives the message
0 204 DA 52224	Request for Repetition Rate	REQRR	No	ISO 11783-7	Message allowing the system to adapt the network bandwidth to the needs of the user of messages
0 205 DA 52480	Reserved for ISO 15765 KWP2000	KWP4	No	ISO 15765	Mixed functional addressing
0 206 DA 52736	Reserved for ISO 15765 KWP2000	KWP3	No	ISO 15765	Mixed physical addressing
0 207 DA 52992	Continuous Torque & Speed Limit Request	CTL	No	1939-71	
0 208 DA 53248	Cab Illumination Message	CL	No	1939-71	Message contains information that controls illumination sources inside the vehicle's cab
0 209 DA 53504	Air Suspension Control 6	ASC6	No	1939-71	Used for suspension control
0 210 DA 53760	Air Suspension Control 2	ASC2	No	1939-71	Used for suspension control
0 211 DA 54016	Calibration Information	DM19	Yes	1939-73	Information about the calibration to scan tool

0 212 DA	54272	Data Security	DM18	Yes	1939-73	
0 213 DA	54528	Time/Date Adjust	TDA	No	1939-71	
0 214 DA	54784	Boot Load Data	DM17	Yes	1939-73	
0 215 DA	55040	Binary Data Transfer	DM16	Yes	1939-73	
0 216 DA	55296	Memory Access Response	DM15	No	1939-73	
0 217 DA	55552	Memory Access Request	DM14	Yes	1939-73	
0 218 DA	55808	Reserved for ISO 15765	KWP2	No	ISO 15765	
0 219 DA	56064	Reserved for ISO 15765	KWP1	No	ISO 15765	
0 220 DA	56320	Anti-theft Status	ATS	No	1939-71	
0 221 DA	56576	Anti-theft Request	ATR	Yes	1939-71	
0 222 DA	56832	Reset	RESET	No	1939-71	
0 223 DA	57088	Diagnostic Message #13	DM13	No	1939-73	Message that stop or start broadcast messages — can be on networks other than ISO 11783 network
0 224 DA	57344	Cab Message 1	CM1	No	1939-71	Message containing parameters originating from a vehicle cab
0 225 DA	57600	Reserved for ISO 11992	GFM21	No	ISO 11992	
0 226 DA	57856	Reserved for ISO 11992	GFM11	No	ISO 11992	
0 227 DA	58112	Diagnostic Message #7	DM7	No	1939-73	
0 228 DA	58368	Reserved for ISO 11992	RGE11	No	ISO 11992	
0 229 DA	58624	Reserved for ISO 11992	RGE21	No	ISO 11992	
0 230 DA	58880	Virtual Terminal-to-Working Set	VT12	Yes	ISO 11783-6	
0 231 DA	59136	Working Set-to-Virtual Terminal	VT21	Yes	ISO 11783-6	
0 232 DA	59392	Acknowledgment Message	ACKM	No	ISO 11783-3	Acknowledgment PG that provides a handshake mechanism between transmitting and receiving control functions
0 234 DA	59904	Request	RQST	No	ISO 11783-3	Provides the capability to request information globally or from a specific destination as identified by the PGN
0 235 DA	60160	Transport Protocol – Data Transfer	TP.DT	No	ISO 11783-3	Used for the transfer of data associated with parameter groups with more than 8 bytes of data

0 236	DA	60416	Transport Protocol — Connection Mgmt	TP.CM.xx	No	ISO 11783-3	Used for the transfer of parameter groups with 9 or more bytes of data
0 237	DA	60672	Network Layer	N.xx	Yes	ISO 11783-4	
0 238	DA	60928	Address Claimed Message	AC	No	ISO 11783-5	Used to claim an address for a control function
0 239	DA	61184	Proprietary A	PropA	Yes	ISO 11783-3	Proprietary PG using the destination specific PDU format to allow manufacturers to direct their proprietary communications to a specific destination node
0 240	0	61440	Electronic Retarder Controller 1	ERC1	No	1939-71	Message transmitted by several types of retarding controllers
0 240	1	61441	Electronic Brake Controller 1	EBC1	No	1939-71	Used for brake control information
0 240	2	61442	Electronic Transmission Controller 1	ETC1	No	1939-71	
0 240	3	61443	Electronic Engine Controller 2	EEC2	No	1939-71	
0 240	4	61444	Electronic Engine Controller 1	EEC1	No	1939-71	Engine related parameters
0 240	5	61445	Electronic Transmission Controller 2	ETC2	No	1939-71	
0 240	6	61446	Electronic Axle Controller 1	EAC1	No	1939-71	
0 240	7	61447	Forward Lane Image urgent message	FLI1	No	1939-71	
0 240	8	61448	Hydraulic Pressure Governor Info	HPG	No	1939-71	Information used for a hydraulic pressure governing control system
0 240	9	61449	Vehicle Dynamic Stability Control 2	VDC2	No	1939-71	Contains information which relates to the vehicle's movement
0 240	10	61450	Engine Gas Flow Rate	EGF1	No	1939-71	Low rates of air and mixed gasses into the engine cylinders
0 240	11	61451	Electronic Steering Control	ESC1	No	1939-71	PGN that indicates the actual angle and the status of a steerable axle
0 240	12	61452	Electronic Transmission Controller #8	ETC8	No	1939-71	Electronic transmission controller #8
0 240	13	61453	Land Levelling System Operational Information	LOI	No	1939-71	Group of operational parameters associated with the land levelling system, such as switch states
0 240	14	61454	After Treatment Intake Gas 1		No	1939-71	

0 240 15	61455	After Treatment Outlet Gas 1	No	1939-71	
0 240 16	61456	After Treatment Intake Gas 1-b	No	1939-71	
0 240 17	61457	After Treatment Outlet Gas 1-b	No	1939-71	
0 240 18	61458	Fifth Wheel Smart Systems 1	FWSS1	1939-71	Message for determining the status of the tractor to trailer coupling system integrity
0 240 19	61459	Slope Sensor Information	SSI	1939-71	Slope sensor information
0 253 171	64939	Complete Configurable Message Set Request	RCMS	1939-71	Request for all ECUs to send the complete sequence of configuration identification messages for a particular one or all of the configurable messages that they send
0 253 172	64940	Rotational Sensor Angle	RSA	1939-71	Message of the measurement of a rotation angle around a single axis
0 253 173	64941	Reserved		1939-71	Reserved for future assignment
0 253 174	64942	Fifth Wheel Smart Systems 2	FWSS2	1939-71	Message used to convey operator parameters associated with the tractor to trailer coupling control and error state
0 253 175	64943	After Treatment Intermediate Gas 1-b	No	1939-71	
0 253 176	64944	After Treatment Outlet Gas 2-b	No	1939-71	
0 253 177	64945	After Treatment Intake Gas 2-b	No	1939-71	
0 253 178	64946	After Treatment Intermediate Gas 1	No	1939-71	
0 253 179	64947	After Treatment Outlet Gas 2	No	1939-71	
0 253 180	64948	After Treatment Intake Gas 2	No	1939-71	
0 253 181	64949	Previous Active Emission Related Faults	No	1939-71	
0 253 182	64950	SPN Support	No	1939-71	
0 253 183	64951	Expanded Freeze Frame	No	1939-71	
0 253 184	64952	Diagnostic Readiness 3	No	1939-71	
0 253 185	64953	Tyre Pressure Reference Information	TPRI	1939-71	Information on actual tyre pressure reference value for monitoring
0 253 186	64954	Farebox Status	TR6	1939-71	Used to report alarms of the fare collection unit
0 253 187	64955	Farebox Point of Sale	TR5	1939-71	Used to report stop-level point of sale detail