

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

Part 3: Data link layer

ICS 35.100.20; 65.060.01

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee AGE/31, Agricultural electronic equipment, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the ISO title page, pages ii to iv, pages 1 to 26 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

This British Standard, having been prepared under the direction of the Engineering Sector Board, was published under the authority of the Standards Board and comes into effect on 15 September 1998

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ISBN 0 580 30390 X

Amendments issued since publication

Amd. No.	Date	Comments

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INTERNATIONAL STANDARD

ISO
11783-3

First edition
1998-07-01

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

Part 3: Data link layer

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

Partie 3: Couche liaison de données



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Descriptors: Agricultural machinery, agricultural tractors, forest equipment, mobile equipment, data processing, information interchange, local area networks, controller area networks, data link layer, data transfer, data formats.

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.

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.

International Standard ISO 11783-3 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: Basic applications layer;*
- *Part 8: Power train;*
- *Part 9: Tractor ECU;*
- *Part 10: Process data applications layer;*
- *Part 11: Task controller and management information system data interchange.*

Annex A and Annex B form an integral part of this part of ISO 11783. Annex C and Annex D are for information only.

Introduction

Parts 1 to 11 of ISO 11783 specify a communications system for agricultural equipment based on the CAN 2.0 B protocol. SAE J 1939 documents, on which parts of ISO 11783 are also 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.

The purpose of ISO 11783 is to provide an open interconnected system for on-board electronic systems. It is intended to enable electronic units 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 (manufacturers of CAN devices) throughout the world. For this purpose, the statement of the holder of this patent is registered with ISO. Information may be obtained from:

Robert Bosch GmbH
Wernerstraße 51
Postfach 30 02 20
D-70442 Stuttgart-Feuerbach
Germany

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

1 Scope

This part of ISO 11783 specifies a serial data network for control and communications on forestry or agricultural tractors, mounted, semi-mounted, towed or self-propelled implements. Its purpose is to standardize the method and format of data transfer between sensor, actuators, control elements, information storage and display units whether mounted or part of the tractor, or any implements. This part of ISO 11783 describes the CAN 29 Bit Identifier [5] Data Link Layer [6].

2 General description

The data link layer enables the reliable transfer of data across the physical link. This consists of sending the CAN data frame with the necessary synchronization, error control and flow control. The flow control is accomplished through a consistent message frame format.

3 Technical requirements

3.1 Message frame format

The message frame format shall conform to the CAN requirements. The CAN specification referenced throughout this document is CAN Specification version 2.0 B [5]. It should be noted that when there are differences between the above-mentioned CAN specification and ISO 11783, ISO 11783 is the governing document.

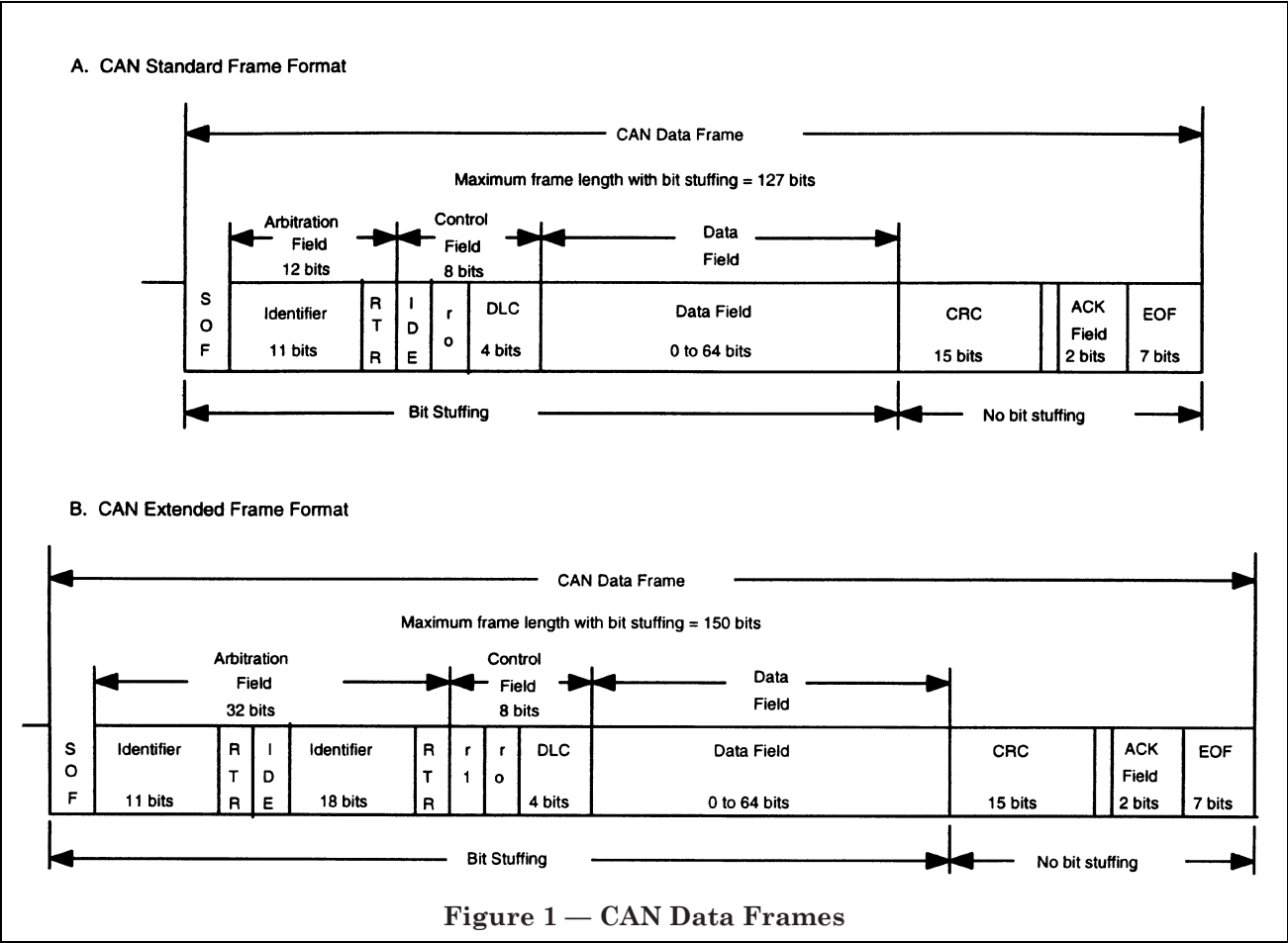
The CAN document specifies, in an information routing related discussion, that controller addresses are not used. While this is true for some applications of CAN, it is not true for ISO 11783. The definition of the network according to ISO 11783 requires that controller addressing be used to prevent multiple controllers from using the same CAN Identifier field. Many additional requirements are given in ISO 11783 that are not specified by CAN.

CAN 2.0 B specifies two message frame formats, Standard Frame and Extended Frame. “CAN 2.0 B compatibility” implies that messages of both format can potentially be present on a single network, by using certain bit codings which allow for the recognition of the different formats. ISO 11783 also accommodates both message frame formats; however, ISO 11783 only defines a full strategy for standardized communications using the Extended Frame format. All standard frame format messages are for proprietary use following the rules defined in this part of ISO 11783.

Therefore, controllers according to ISO 11783 must use the Extended Frame format. Standard Frame format messages can reside on the network, but only as described in this part of ISO 11783.

NOTE Standard frame controllers do not respond to network management messages and will not be able to support the strategy for standardized communications.

The CAN data frame is parsed into different bit fields, as shown in Figure 1. The number and parsing of the bits in the arbitration and control field differ between the CAN Standard and CAN Extended Frame messages. CAN Standard Frame messages, shown in “A”, contain 11 Identifier bits in the arbitration field and CAN Extended Frame messages, shown in “B”, contain 29 Identifier bits in the arbitration field. ISO 11783 further defines the Identifier bits in the arbitration field of the CAN message frame formats. These definitions are given in Table 1.



3.1.1 Message frame format according to ISO 11783 (CAN 2.0 B Extended Frame Format)

The CAN extended frame message, as shown in Figure 1, encompasses a single Protocol Data Unit (PDU). PDUs consists of seven pre-defined fields. These fields are assimilated from information provided by the application layer. They are Priority, Reserved, Data Page, PDU Format, PDU Specific (which can be a destination address, Group Extension, or proprietary), Source Address and Data Fields. They are then packaged into one or more CAN data frames and sent over the physical media to other network controllers. The layers of the OSI model that ISO 11783 supports are shown in Figure 2. It should be recognised that some Parameter Group definitions require more than one CAN data frame to send their information. Table 1 shows the arbitration and control fields of the 29 bit identifier for CAN, 29 bit identifier for ISO 11783, 11 bit identifier for CAN, and the 11 bit identifier for ISO 11783. A complete definition for each of the bit field assignments according to ISO 11783 is given in 3.3.

3.1.2 Parameter Group Number (PGN)

The Parameter Group Number is determined from the following constituent components: Reserved bit, Data Page bit, PDU Format Field (8 bits), and Group Extension Field (8 bits). These 18 bits are used to establish the 24 bit PGN. Whenever it is necessary to identify a Parameter Group in the data-field of a CAN data frame, it is expressed in 24 bits with the most significant bits set to zero. See Table 2 for an illustration of PGNs, their corresponding bits and their conversion to a decimal number.

The procedure for the bit fields to be converted to Parameter Group Numbers is as follows. If the PDU Format (PF) value is less than 240 ($F0_{16}$), then the lower byte of the PGN is set to zero.

NOTE Not all 131 072 combinations (2^{17}) are available to be assigned as PGNs. Only a total of 8 670 combinations are available for assignment (calculated as: 2 pages $\times$ [240 + (16 $\times$ 256)] = 8 670, using the conventions specified in this part of ISO 11783).