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

Part 2: Physical layer

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

Partie 2: Couche physique

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Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. The different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 11783-2:2012), which has been technically revised. It also incorporates the Technical Corrigendum ISO 11783-2:2012/Cor 1:2012. The main changes compared to the previous edition are as follows:

— inclusion of physical layer aspects previously listed in other documents of the ISO 11783 series;

— addition of a twisted pair physical layer;

— updates to parameters of the physical layer components to reflect the current state of art;

— updates to test criteria to verify the conformance of implementations to this document.

A list of all the parts in the ISO 11783 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 11783-1 to ISO 11783-14 specify a communications system for agricultural equipment based on the ISO 11898[1] protocol. SAE J1939 documents, on which parts of ISO 11783 are based, were developed jointly for use in truck and bus applications and for construction and agricultural 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 the ISO 11783 series is to be found in ISO 11783-1.

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

Part 2: Physical layer

1 Scope

ISO 11783 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. ISO 11783 also provides an open interconnect system for on-board electronic systems used by agriculture and forestry equipment. It is intended to enable electronic control units (ECUs) to communicate with each other, providing a standardized system.

This document defines and describes the network's 250 kbit/s, twisted, non-shielded, quad-cable physical layer and an alternative cable and architecture named twisted pair physical layer (TPPL) based on a 250 kbit/s, un-shielded, twisted pair cable network layer which is fully backward compatible to twisted quad based machines and devices.

NOTE Where not differently specified, requirements are valid for both twisted quad and TPPL.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1724, *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — 7-pole connector type 12 N (normal) for vehicles with 12 V nominal supply voltage*

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

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
ECU Type I
electronic control unit without internal termination

3.2
ECU Type I WEAK
electronic control unit with a weak split termination centrally coupled to ECU_GND with a capacitor and that can be used for stubs only

Note 1 to entry: See 5.5.3.

3.3
ECU Type II
electronic control unit with internal bus termination that can be used only at one or each end of the bus

Note 1 to entry: See 5.4.3.2.

3.4
twisted pair physical layer
TPPL
250 kbit/s, unshielded, twisted pair cable-based network layer intended to be used as an alternate to the twisted quad physical layer and that is backward compatible with machines based on a twisted quad physical layer

3.5
machine
forestry or agricultural tractor or mounted, semi-mounted, towed or self-propelled implement

3.6
twisted quad physical layer
TQPL
250 kbit/s, unshielded, twisted quad cable-based network layer

4 Abbreviated terms

IBBC Implement Bus Breakaway Connector

IBBP Implement Bus Breakaway Plug

5 General requirements

5.1 Network physical layer

The physical layer of a network is the realization of the electrical connection of several electronic control units (ECUs) to a bus segment of the network. The total number of ECUs connected is limited by the electrical loads on the bus segment. In accordance with the electrical parameters specified by this document, the limit shall be 30 ECUs per segment.

5.2 Physical media

This document defines two types of physical media.

a) TQPL: composed by four conductors, two of them, designated CAN_H and CAN_L, are driven with the communications signals. The names of the ECU pins corresponding to these conductors are also designated CAN_H and CAN_L. The third and fourth conductors, designated TBC_PWR and TBC_RTN, provide power for the terminating bias circuits (TBCs) on the bus segments.

b) TPPL: physical media of twisted pair cable as described in SAE J1939-15. The conductors, designated CAN_H and CAN_L, are driven with the communications signals. The names of the ECU pins corresponding to these conductors are also designated CAN_H and CAN_L.

5.3 Differential voltage

The voltages of CAN_H and CAN_L relative to the ECU_GND of each ECU are denoted by V_{CAN_H} and V_{CAN_L}. The differential voltage, V_{diff}, between V_{CAN_H} and V_{CAN_L} is defined by Formula (1):

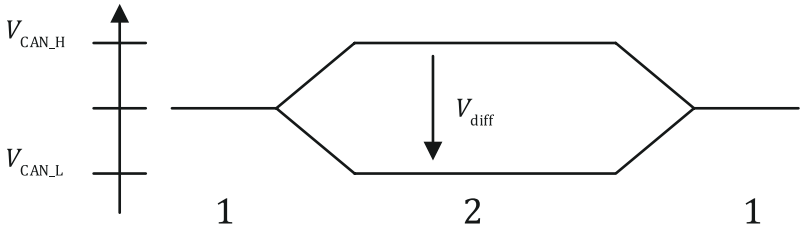
$$V_{diff} = V_{CAN\_H} - V_{CAN\_L} \quad (1)$$

5.4 Bus

5.4.1 Levels

5.4.1.1 General

The bus signal lines can be at one of two levels, and in one or the other of the two logical states, recessive or dominant (see Figure 1). In the recessive state, V_{CAN_H} and V_{CAN_L} are fixed at a bias voltage level. V_{diff} is approximately zero on a terminated bus. The recessive state is transmitted during bus idle when all the nodes CAN drivers are off. The dominant state is transmitted when any of the node CAN drivers is on. The dominate state is represented by a differential voltage greater than a minimum threshold which is detected by the nodes CAN receiver circuits. The dominant state overwrites the recessive state and is transmitted when there is a dominant bit. (See also Clause 6).



Key

1 recessive
2 dominant

Figure 1 — Physical bit representation of recessive and dominant levels or states

5.4.1.2 During arbitration

During arbitration, a recessive and a dominant bit imposed on the bus signal lines during a given bit time by two or more ECUs results in a dominant bit.

5.4.2 Voltage range

The bus voltage range is defined by the maximum and minimum acceptable voltage levels of CAN_H and CAN_L, measured with respect to the ECU_GND of each ECU, for which proper operation is guaranteed when all ECUs are connected to bus signal lines.

5.4.3 Bus termination

5.4.3.1 Twisted quad bus segment

The bus signal lines of a twisted quad bus segment are electrically terminated at each end by a terminating bias circuit. When a nodes CAN driver is on, a current (I) flow is induced that is either sunk by the CAN_H termination or is sourced by the CAN_L termination. This TBC shall be located externally from the ECU, to ensure bus bias and termination when the ECU is disconnected (see Figure 2).