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Radiofrequency identification of animals —

Part 7: Synchronization of ISO 11785 identification systems

Identification des animaux par radiofréquence —

Partie 7: Synchronisation des systèmes d'identification conformes à l'ISO 11785

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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.

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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.

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ISO 24631-7 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

ISO 24631 consists of the following parts, under the general title *Radio frequency identification of animals*:

— *Part 1: Evaluation of conformance of RFID transponders with ISO 11784 and ISO 11785 (including granting and use of a manufacturer code)*

— *Part 2: Evaluation of conformance of RFID transceivers with ISO 11784 and ISO 11785*

— *Part 3: Evaluation of performance of RFID transponders conforming with ISO 11784 and ISO 11785*

— *Part 4: Evaluation of performance of RFID transceivers conforming with ISO 11784 and ISO 11785*

— *Part 5: Procedure for testing capability of RFID transceivers of reading ISO 11784 and ISO 11785 transponders*

— *Part 6: Representation of animal identification information (visual display/data transfer)*

— *Part 7: Synchronization of ISO 11785 identification systems*

Introduction

Wired synchronization is briefly explained in Clause C.2 of ISO 11785:1996.

This part of ISO 24631 describes in detail the method for synchronizing stationary ISO 11785 transmitters and receivers, as well as the method for allowing mobile readers to read ISO 11785 and Annex A transponders while in physical proximity of stationary readers.

Radiofrequency identification of animals —

Part 7: Synchronization of ISO 11785 identification systems

1 Scope

This part of ISO 24631 specifies rules and procedures for synchronizing RFID transceivers while reading transponders used in individual animal identification complying to ISO 11784 and ISO 11785.

The synchronization scheme described herein may be fully implemented within each reader, and such readers when attached to the synchronization bus create a peer-to-peer network (all readers are equal – there is no dedicated master). Additionally, a cluster of readers, which could be in a master/slave configuration, may also be added to the bus using a dedicated, manufacturer specific Synchronization Interface. The Synchronization Interface presents to the synchronization bus electrical characteristics identical to those of a single peer-to-peer reader.

The transceiver conformance standard ISO 24631-2 permits activation on/off timing tolerances of −0/+1 ms and therefore gives reader manufacturers options as to their preferred method for detecting the HDX header; partial or full. However, when synchronizing readers, irrespective of which header detection method is used, it is critical that all readers adhere strictly to the specific timings and timing tolerances as given in the timing diagrams.

Particular attention should also be given to fault diagnostics which becomes more important when a reader network comprises products from different manufacturers. The obvious case is where a reader which is part of a network has become detached e.g. sync cable break, and it considers it's self to be now standalone and thus permitted to operate asynchronously to the detriment of all other readers.

2 Normative reference

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

ISO 11784:1996, *Radio frequency identification of animals — Code structure*

ISO 11785:1996, *Radio frequency identification of animals — Technical concept*

3 Terms and definitions

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

3.1
transceiver
device used to communicate with the transponder

3.2
transponder
radiofrequency identification (RFID) device that transmits its stored information when activated by a transceiver and that may be able to store new information

Note 1 to entry: See ISO 24631-1 for definitions of the main types.

3.3
transponder code
code as programmed in the transponder and defined in ISO 11784:1996 (Table 1) and ISO 11785

4 Abbreviations

FDX-B full duplex communication protocol (conforming to ISO 11785, excluding protocols mentioned in Annex A of ISO 11785:1996)

HDX half duplex communication protocol

RFID radiofrequency identification

5 Synchronization protocol

For identification systems that conform to ISO 11784 and 11785, it is necessary to synchronize readers when two or more are used in physical proximity. Half duplex transponders convey data using two frequencies, one of which is the same frequency as the activation signal. When two or more readers operate independently (i.e. asynchronously), their respective activation signals can occur during the periods when other readers are attempting to receive HDX transponder signals. Consequently, readers will mutually interfere with one another unless the ON (reading of FDX transponders) and OFF (reading of HDX transponders) periods of the activation signals are synchronized. Synchronized readers transmit activation signals and receive HDX transponder signals in unison and will not interfere with each other.

The ISO 11785 Adaptive Timing protocol describes how a reader should behave when it detects a transponder. The synchronization protocol described in this part of ISO 24631 specifies how this behaviour is conveyed among readers. When a transponder is detected by a reader, this reader is allowed to extend the reading period for a certain time. The extension of the reading period is made known to other readers by means of a synchronization signal.

The ISO synchronization protocol described in Annex C of ISO 11785:1996 defines how readers in one network coordinate the ON and OFF periods of their respective transmitters. These patterns of ON and OFF periods are called cycles. One cycle comprises one ON period followed by one OFF period. These ON and OFF periods can be extended when transponders are detected. Every 10th cycle, a fixed ON/OFF pattern shall be generated. This cycle consists of a 50 ms ON period for receiving FDX transponders and a 20 ms OFF period for receiving HDX transponders. This 10th cycle allows a mobile reader not connected with the wired synchronization network of the stationary readers, to receive the transponders.

5.1 HDX detection

A normal cycle of an idle (non-detecting) reader comprises a 50 ms ON period followed by a 4 ms OFF period. When a reader detects a HDX transponder, it will extend the OFF period to 20 ms. To do this, it will tell the other readers in the network that the period shall be extended by asserting a sync signal on the network. All readers connected to the wired synchronization network see the sync signal and extend their respective OFF periods to 20 ms. In this extended OFF period, the reader can receive the full transponder information. The extended OFF period for HDX receiving is always a fixed 20 ms.

5.2 FDX detection

When a reader detects an FDX transponder, there is generally sufficient time to receive the complete information within the 50 ms ON period of a cycle. However, if the transponder is not received completely, the reader is allowed to extend the ON period. However, the maximum reading period for FDX is 100 ms, and the reader is not allowed to extend the ON period beyond this maximum reading time. As in the HDX case, the reader asserts a sync signal on the network in order to tell the other readers that an extension of the reading time is required.

The 10th cycle is a special case where it is not allowed to extend the FDX period and, additionally, the HDX period is always extended to 20 ms.

5.3 MRS (Mobile Reader Sync)

Every 10th cycle is identified by the MRS pulse on the synchronization network during the 20 ms OFF period. Each reader in the network is capable of asserting this pulse. However, a reader is allowed to generate the pulse only when it determines that there is no other pulse on the synchronization network. Each reader synchronizes on the leading edge of this pulse.

5.4 Synchronization signals

Every reader generates the three possible signals:

1) MRS (Mobile Reader Sync pulse)	20 ms ±0,5 ms
2) HDX extension	$16{,}4\ \text{ms}\ ^{+0{,}6}_{-0{,}1}$ ms
3) FDX extension	n x 2 ms ($1 < n < 25$), ($n \neq 10$) ±0,5 ms

5.5 Reader states

A reader exists in either of two possible states: the initialization state or the operational state. During the initialization state, a reader searches for other readers in the network and will attempt to synchronize with them. During the operational state, a reader is synchronized and is able to read FDX and HDX transponders.

5.5.1 Initialization

Upon powering on, a reader monitors the synchronization network in order to detect either an MRS pulse or an ON/OFF period extension signal. When activity has been detected, the reader searches for the MRS pulse. The end of the MRS pulse marks the beginning of cycle number one. Once synchronized with the other readers, the reader enters the operational state.

NOTE A reader will wait for the MRS pulse after it has detected activity on the sync line. If, however, activity is detected and no MRS pulse identified, an indeterminate situation arises and the reader remains in the initialization state and continues to search for the MRS pulse. If no activity is detected within approximately 1,2 s, the initializing reader will generate an MRS pulse and will enter the operational phase.

5.5.2 Operational

During the operational state, the reader performs the following tasks in order to stay synchronized.

— It starts the cycle counter after detecting an MRS pulse.

— Every 10th cycle, a reader may generate an MRS pulse. Note that only one reader generates the MRS pulse, namely the fastest one.

— It maintains the FDX and HDX periods in accordance with the timing shown in Annex A.

— When the reader expects an MRS pulse, but a longer pulse is detected on the synchronization network, the reader reverts to the initialization state and searches for the MRS pulse (see 5.7.1).

— If a reader sends an MRS pulse and detects an incorrect MRS pulse on the synchronization network, it reverts to the initialization state and searches for the MRS pulse (see 5.7.2)

5.6 Period extensions

5.6.1 General

The MRS pulse shall be unique in its pulse duration. Signals that indicate period extensions are not allowed to be exactly equal to the MRS pulse. Therefore, the following rules apply to these signals.

5.6.2 Extend FDX period

— Start ≤ 49 ms after the beginning of the FDX period.

— It is not allowed to be 20 ms ± 0,5 ms.

— Total FDX period is max. 100 ms.

— Each 10th cycle, the FDX period is not allowed to be extended (fixed 50 ms).

— The extension may use 2 ms increments.

5.6.3 Extend HDX period

— Start extension between 3 ms and 4 ms.

— Total HDX period is 20 ms.

— The extension shall be less than 17 ms.

5.6.4 MRS pulse

— It is 20 ms ±0,5 ms.

— Start immediately after the FDX period.

— Generate every 10th cycle if no sync pulse already present.

5.7 Possible situations

5.7.1 No transponders are present

The transmitter is now ON for 50 ms (the FDX period) and OFF for 4 ms (the HDX period). Each 10th cycle, a fixed pattern is present of 50 ms FDX ON period and 20 ms OFF period. The readers try to generate an MRS pulse if there is no activity on the sync line yet. Reader 1 generates the MRS pulse and reader 2 sees the activity on the sync line and therefore will not generate an MRS pulse. All readers commence the 1st cycle with the FDX cycle on the falling edge of the MRS pulse. An overview of the sync lines and field status is given in Figure 1.

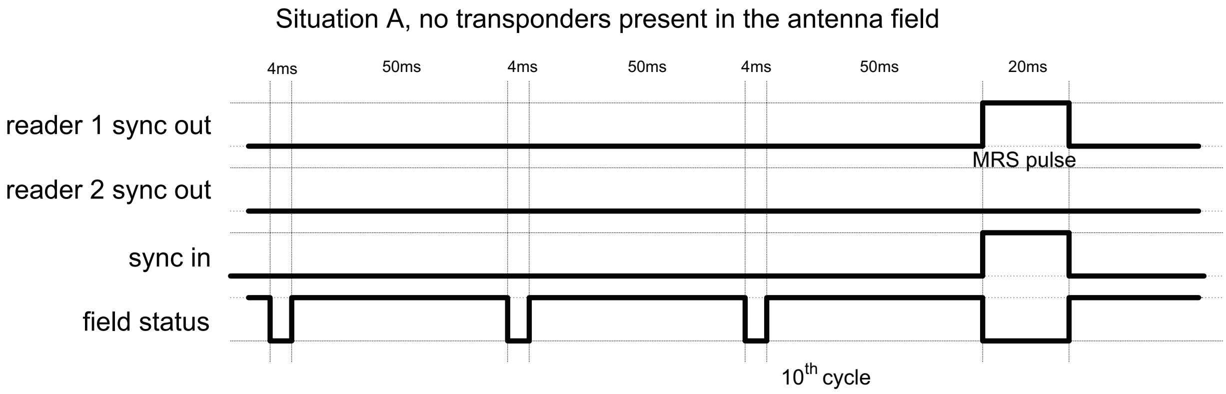

Figure 1 — Overview of the sync lines and field status with no transponder present in the antenna field

5.7.2 FDX transponder is present

A reader detecting an FDX transponder will try to read the information of that transponder. If the reader does not succeed after 49 ms, it will extend the ON period. This is made known to the other readers by asserting the sync signal. The sync signal will be de-asserted when the transponder has been read or when the maximum of the FDX reading period (i.e. 100 ms) has been reached. All readers stop their respective transmitters in response to de-assertion of the sync signal. Note that an extension time of 20 ms is not allowed because of possible confusion with the MRS pulse. Another condition to be met is that the 10th cycle shall be 50 ms and cannot be extended. The extended period may therefore be 52, 54, 56, ... 66, 68, 72, 74, ... 98, 100 ms. An overview of the sync lines and field status is given in Figure 2.

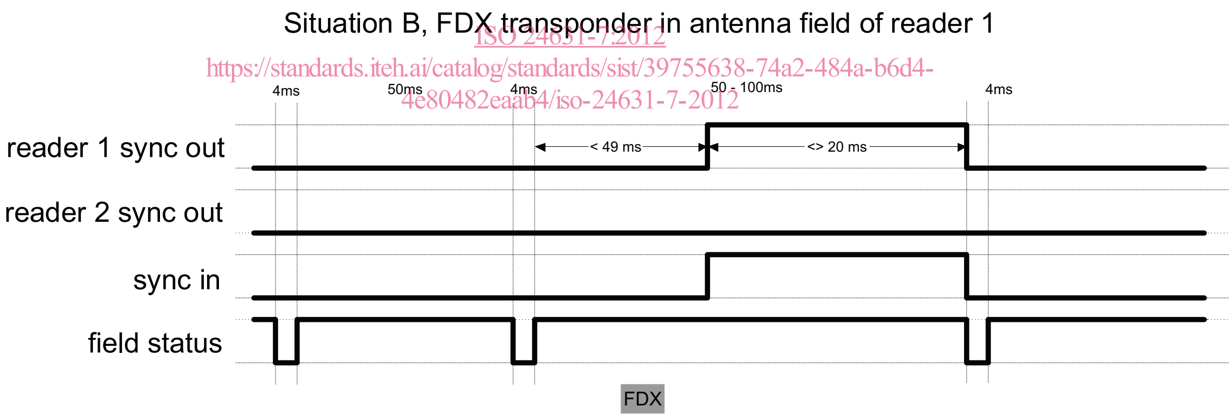

Figure 2 — Overview of the sync lines and field status with a FDX-B transponder present in the antenna field

5.7.3 HDX transponder is present

Detection of a HDX transponder by a reader results in an HDX reading period of 19,4 ms $^{+0,6}_{-0,1}$ ms. The sync signal is now made high between 3 ms and 4 ms after the start of the HDX period. This ensures that the duration of the sync signal is always less than 20 ms. Again, all other readers detect the sync signal and will also extend their respective ON periods to 20 ms. An overview of the sync lines and field status is given in Figure 3.