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Second edition
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Radiofrequency identification of animals — Advanced transponders —

Part 1: Air interface

Identification des animaux par radiofréquence — Transpondeurs évolués —

Partie 1: Interface hertzienne

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Foreword

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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.

ISO 14223-1 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

This second edition cancels and replaces the first edition (ISO 14223-1:2003), which has been technically revised.

ISO 14223 consists of the following parts, under the general title *Radiofrequency identification of animals — Advanced transponders*:

— *Part 1: Air interface*

— *Part 2: Code and command structure*

The following part is under preparation:

— *Part 3: Applications*

Introduction

This part of ISO 14223 specifies the air interface of the radiofrequency (RF) system for advanced transponders for animals. The technical concept of advanced transponders for animal identification described is based upon the principle of radiofrequency identification (RFID) and is an extension of the standards ISO 11784 and ISO 11785. Apart from transmission of the (unique) identification code of animals, the application of advanced technologies facilitates the storage and retrieval of additional information (integrated database), the implementation of authentication methods and the reading of data from integrated sensors, etc.

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Radiofrequency identification of animals — Advanced transponders —

Part 1: Air interface

1 Scope

This part of ISO 14223 specifies the air interface between the transceiver and the advanced transponder used in the radiofrequency identification of animals, this specification being fully backwards-compatible with those of ISO 11784 and ISO 11785.

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 11784, *Radio frequency identification of animals — Code structure*

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

ISO 14223-2:2010, *Radiofrequency identification of animals — Advanced transponders — Part 2: Code and command structure*

ISO 24631-1, *Radiofrequency 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)*

ISO 24631-2, *Radiofrequency identification of animals — Part 2: Evaluation of conformance of RFID transceivers with ISO 11784 and ISO 11785*

3 Conformance

3.1 Transponder

For conformance with this part of ISO 14223 to be claimed, a transponder shall be FDX-ADV or HDX-ADV, as specified in Clauses 7 and 8, and shall be in accordance with ISO 24631-1.

NOTE Nothing in this part of ISO 14223 prevents a transponder being of more than one type, although for technical reasons, it is unlikely that such transponders are ever marketed.

3.2 Transceiver

For conformance with this part of ISO 14223 to be claimed, a transceiver shall support both FDX-ADV and HDX-ADV, as specified in Clauses 7 and 8, and shall be in accordance with ISO 24631-2. When in the inventory mode, the transceiver shall alternate between FDX-ADV and HDX-ADV interrogation. After completion of the advanced operation, the transceiver shall move back to the mode specified by ISO 11785:1996, 6.1, for FDX systems, or ISO 11785:1996, 6.2, for HDX systems.

4 Terms and definitions

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

4.1
advanced transponder
transponder conforming to ISO 14223, downward compatible according to ISO 11784 and ISO 11785, with facilities for storage and retrieval of additional data, integrated sensors, etc.

4.2
advanced mode
operating method of the advanced transponder after reception of a valid command

4.3
bit rate
number of bits transmitted per second

4.4
carrier off time
time interval wherein the interrogation field is switched off

4.5
charge-up time
time taken to charge the capacitor of the HDX transponder

4.6
differential bi-phase encoding
method of encoding in which data bit 0 is represented by a mid-bit transition, data bit 1 by no transition and, additionally, there is always a transition between two bits

4.7
down-link
communication process from the transceiver to the transponder

4.8
encoding
one-to-one relationship between basic information elements and modulation patterns

4.9
FDX-ADV
full duplex advanced
communication protocol for FDX advanced transponders

4.10
frequency shift keying
superimposition of binary information onto an electromagnetic field carrier by shifting between discrete frequencies of the field

4.11
full duplex
FDX
communication protocol in which information is exchanged while the transceiver transmits the interrogation field

4.12
half duplex
HDX
communication protocol in which information is exchanged after the transceiver has stopped transmitting the interrogation field (sequential method)

4.13
HDX-ADV
half duplex advanced
communication protocol for HDX advanced transponders

4.14
interrogation field
magnetic field generated by a transceiver to activate a transponder and transfer data to an advanced transponder

4.15
interrogation frequency
frequency of the magnetic field generated by the transceiver

4.16
interrogation period
time during which the magnetic field is present

4.17
Manchester encoding
method of encoding in which data bit 0 is represented by a positive mid-bit transition and data bit 1 by a negative mid-bit transition

4.18
modulation
method of superimposing information onto an interrogation field by means of varying a specific parameter of the field

4.19
non-return to zero encoding
method of encoding in which data bit 1 is a high signal and data bit 0 a low signal

4.20
pulse interval encoding
method of data encoding in which the transmitted information is represented by the time between the falling edges of fixed length pulses

NOTE The number of received carrier cycles defines data bit values or other code conditions.

4.21
SWITCH command
specific bit pattern which may be used by FDX-ADV transponders to switch to the advanced mode

4.22
switch window
time interval after powering up wherein an FDX-ADV transponder can be switched to the advanced mode

4.23
transceiver
device used to communicate with a transponder

4.24
transceiver request
bit pattern transmitted to the advanced transponder to modify the transponder status or to read and write information

4.25
transponder
radio frequency identification (RFID) device that transmits its stored information when activated by a transceiver and that may be able to store new information

NOTE A transponder can be characterized according to its components (chip, coil, capacitor, etc.), communication protocol, size, shape and packaging, or any additional characteristics that could change its properties. The main types are defined in ISO 24631-1:2009, 4.19.1 to 4.19.4.

[ISO 24631-1:2009, definition 4.19]

5 Abbreviated terms

ASK	amplitude shift keying
CRC	cyclic redundancy check
CRCT	response cyclic redundancy check flag
EOF	end of frame
FDX	full duplex
FDX-ADV	full duplex advanced
FSK	frequency shift keying
HDX	half duplex
HDX-ADV	half duplex advanced
kbps	kilobytes per second: unit for transmission speed (1 000 bit/s or 1 000 Bd)
LSB	least significant bit
MSB	most significant bit
NOS	number of slots in the anti-collision mode
NRZ	non-return to zero
RFID	radio frequency identification
SOF	start of frame

6 Symbols

f_C	carrier frequency of the operating field
f_0	carrier frequency of HDX transponder when transmitting data symbol “0”
f_1	carrier frequency of HDX transponder when transmitting data symbol “1”
T_C	period of carrier frequency ($T_C = 1/f_C \approx 7{,}452$ µs)

T_{CH} transceiver carrier frequency ON time to charge-up the storage capacitor of an HDX transponder

T_{Fd} period of data bit period of transponder to transceiver

T_{Xd0} period of data symbol “0”

T_{Xd1} period of data symbol “1”

T_{Xcv} code violation duration

T_{HcvEOF} code violation duration for HDX-ADV transceivers for the end of frame

T_{HcvSOF} code violation duration for HDX-ADV transceivers for the start of frame

T_{NRT} transponder nominal response time

T_{RCH} transceiver ON time to recharge the storage capacitor of an HDX-ADV transponder

T_{Xd} data element transmission time

T_{X1} transceiver carrier off pulse width

T_{Fsc} stop condition time (identical to T_{FpEOF})

T_{XpSOF} time duration for a transponder to transmit a SOF to the transceiver

T_{XpEOF} time duration for a transponder to transmit an EOF to the transceiver

T_{Xp1} transponder waiting time before starting to transmit response after detection of valid transceiver request

T_{Xp2} transceiver waiting time before starting to transmit subsequent request after receiving transponder response

T_{Xp3} transceiver waiting time before switching to the next slot during an inventory process

Subscripts

F FDX-ADV

H HDX-ADV

X either FDX-ADV or HDX-ADV

NOTE Other symbols specific to F or H are specified in the relevant clauses/subclauses.

p protocol timing (this subscript is followed by letters and/or numbers, as appropriate)

7 General requirements

The advanced transponder shall be compatible with ISO 11785. At the time the advanced transponder is placed in the interrogation field, it shall perform as per the transponders specified by ISO 11785. To identify itself as an advanced transponder, it shall send type information in the reserved bit field to the transceiver as follows:

— Bit 15 of the ISO 11784 frame shall be set to “1”, indicating an advanced transponder;

— Bit 16 of the ISO 11784 frame (additional data flag) shall be set to “1”, indicating that the transponder contains additional data.

To bring the advanced transponder into the advanced mode, the transceiver shall send a valid request or SOF. The details of this procedure for each request are described in the relevant sections of this part of ISO 14223. When the advanced transponder has detected a valid request or SOF, it shall switch to the advanced mode.

In advanced mode, the advanced transponder shall only respond when requested by the transceiver. All communication from transceiver to transponder and vice versa shall be in accordance with ISO 11785 and ISO 14223-2. The identification code, all communication from transceiver to transponder and vice versa, and the CRC error detection bits (if applicable) shall be transmitted starting with LSB first.

In the case where multiple, advanced transponders are in the interrogation field, causing collisions, the transceiver shall start the anti-collision procedure in accordance with ISO 14223-2:2010, Clause 9. Depending on the part of the total identification message, as defined in ISO 11785, in which the collision is detected, the transceiver will start with either the FDX-ADV or HDX-ADV anti-collision request.

The advanced transponder shall switch back to the mode specified in ISO 11785:1996, 6.1 (for FDX systems) or 6.2 (for HDX systems), when

a) no longer in the interrogation field,

b) it has terminated the advanced operations and the interrogation field has been switched off for at least 5 ms afterwards.

This carrier-OFF time shall be extended up to 20 ms, depending on the presence of an HDX(-ADV) transponder.

8 FDX-ADV transponder

8.1 FDX-ADV down-link description

After receiving and decoding the total identification message, as defined in ISO 11785, of the transponder code, the transceiver shall detect the presence of an advanced transponder in the interrogation field. To transfer the FDX-ADV transponder into the advanced mode, the transceiver's interrogation field shall be switched off. After this OFF period, the interrogation field shall be switched on again, and either the SOF at the start of a valid request or the special SWITCH command shall be sent to the transponder within the specified switch time window. The transponder shall switch itself into the advanced mode upon reception of any SWITCH command. In this advanced mode, the FDX-ADV transponder shall respond when requested by the transceiver (transceiver-driven protocol).

As specified above, the advanced transponder switches back to the ISO 11785-specified mode for FDX or HDX after the interrogation field has been switched off for at least 5 ms. The steps necessary for transferring the FDX-ADV transponder into the advanced mode are shown in Figure 1. The down-link communication takes place in the periods of Cycles C and D (the letters A to E represent the cycles described below). The example illustrated by Figure 1 shows two data blocks (#1 and #2) being selected by the transceiver; these are then transmitted by the FDX-ADV transponder.