

ISO/IEC 18000-4:2018 (E)

Information technology — Radio frequency identification for item management — Part 4: Parameters for air interface communications at 2,45 GHz

Contents

	Foreword
	Introduction
1	Scope
2	Normative references
3	Terms and definitions
4	Symbols and abbreviated terms
5	General items on 2,45 GHz RFID protocols that support this document
5.1	Protocols
5.2	Frequency
5.2.1	General
5.2.2	Interface definitions
5.2.2.1	RFID system definition
5.2.2.2	Minimum features
5.2.2.3	Conformance
5.3	Tag identification number
5.4	Potential interference
6	MODE 1: Passive backscatter RFID system
6.1	MODE 1: General
6.2	Physical layer and data coding
6.2.1	Interrogator power-up waveform
6.2.2	Interrogator power-down
6.2.3	Frequency hopping carrier rise and fall times
6.2.4	Forward link
6.2.4.1	Carrier modulation
6.2.4.2	Bit coding of forward link fields
6.2.5	FM0 return link
6.2.5.1	General
6.2.5.2	Modulation
6.2.5.3	Data rate
6.2.5.4	Data coding
6.2.5.5	Message format
6.2.5.6	Return preamble
6.2.6	Cyclic redundancy check (CRC)
6.2.7	Protocol concept
6.2.8	Command format
6.2.8.1	General
6.2.8.2	Preamble detect field
6.2.8.3	Preamble
6.2.8.4	Delimiter
6.2.8.4.1	Start delimiter 1
6.2.8.5	CRC
6.2.9	Response format
6.2.9.1	General
6.2.9.2	QUIET
6.2.9.3	CRC
6.2.10	WAIT

6.2.11	Communication sequences at packet level
6.3	Protocol and collision arbitration
6.3.1	Definition of data elements, bit and byte ordering
6.3.1.1	Unique ID
6.3.1.2	CRC
6.3.1.3	FLAGS
6.3.1.3.1	Data Exchange Status Bit (DE_SB)
6.3.1.3.2	WRITE_OK
6.3.1.3.3	BATTERY_POWERED
6.3.1.3.4	BATTERY_OK
6.3.2	Tag memory organization
6.3.3	Block security status
6.3.4	Overall protocol description
6.3.4.1	Tag states
6.3.4.2	Detailed command processing
6.3.5	Collision arbitration
6.3.6	Commands
6.3.6.1	Command types
6.3.6.1.1	Mandatory
6.3.6.1.2	Optional
6.3.6.1.3	Custom
6.3.6.1.4	Proprietary
6.3.6.2	Command codes and format
6.3.6.2.1	Command fields
6.3.6.2.2	Tag responses
6.3.6.2.3	Selection commands
6.3.6.2.3.1	Data comparison for selection command on memory
6.3.6.2.3.2	Data comparison for selection command on flags
6.3.6.2.3.3	GROUP_SELECT_EQ
6.3.6.2.3.4	GROUP_SELECT_NE
6.3.6.2.3.5	GROUP_SELECT_GT
6.3.6.2.3.6	GROUP_SELECT_LT
6.3.6.2.3.7	GROUP_UNSELECT_EQ
6.3.6.2.3.8	GROUP_UNSELECT_NE
6.3.6.2.3.9	GROUP_UNSELECT_GT
6.3.6.2.3.10	GROUP_UNSELECT_LT
6.3.6.2.3.11	MULTIPLE_UNSELECT
6.3.6.2.3.12	GROUP_SELECT_EQ_FLAGS
6.3.6.2.3.13	GROUP_SELECT_NE_FLAGS
6.3.6.2.3.14	GROUP_UNSELECT_EQ_FLAGS
6.3.6.2.3.15	GROUP_UNSELECT_NE_FLAGS
6.3.6.2.4	Identification commands
6.3.6.2.4.1	FAIL
6.3.6.2.4.2	SUCCESS
6.3.6.2.4.3	RESEND
6.3.6.2.4.4	INITIALIZE
6.3.6.2.5	Data Transfer commands
6.3.6.2.5.1	READ
6.3.6.2.5.2	DATA_READ
6.3.6.2.5.3	READ_VERIFY
6.3.6.2.5.4	READ_VERIFY4BYTE
6.3.6.2.5.5	WRITE
6.3.6.2.5.6	WRITE4BYTE
6.3.6.2.5.7	LOCK
6.3.6.2.5.8	QUERY_LOCK
6.3.6.2.5.9	WRITE_MULTIPLE
6.3.6.2.5.10	WRITE4BYTE_MULTIPLE
6.3.6.2.6	Response description (Binary Tree Protocol Type)
6.3.6.2.6.1	ACKNOWLEDGE
6.3.6.2.6.2	ERROR
6.3.6.2.6.3	ACKNOWLEDGE_OK
6.3.6.2.6.4	ACKNOWLEDGE_NOK
6.3.6.2.6.5	ERROR_OK
6.3.6.2.6.6	ERROR_NOK

- 6.3.6.2.6.7 WORD_DATA
- 6.3.6.2.6.8 ID
- 6.3.6.2.6.9 BYTE_DATA
- 6.3.6.2.6.10 4BYTE DATA
- 6.3.7 Transmission errors

7 MODE 2: Long range high data rate RFID system

- 7.1 MODE 2: General
- 7.2 Modulation and coding
 - 7.2.1 Forward link (only for R/W-tag)
 - 7.2.2 Return link for notification (for both types of the tag)
 - 7.2.3 Return link for communication (only for R/W-tag)
- 7.3 General system description
- 7.4 Frame structure
 - 7.4.1 Hierarchical structure
 - 7.4.2 Logical channels
 - 7.4.2.1 Notification channel (for both types of tags): N-CH
 - 7.4.2.2 Communication channel (only for R/W-tag): C-CH
 - 7.4.2.3 Spectrum check channel: SC-CH
 - 7.4.2.4 Priorities between the various logical channels
 - 7.4.2.5 Frame structure for the notification channel in case of an R/W-tag
 - 7.4.2.6 Frame structure for the notification channel in case of an R/O-tag
 - 7.4.2.7 Frame structure for the notification channel in case of an R/O-tag for high speed applications
 - 7.4.2.8 Frame structure for the communication and spectrum check channels
 - 7.4.3 Physical channels
 - 7.4.3.1 Tag Slot identification channel: S-CH (return link)
 - 7.4.3.2 TagID read channel: MIDx-CH (return link, for both tag types)
 - 7.4.3.3 TagData read channel: MINx-CH (return link, only for R/O-tag)
 - 7.4.3.4 Interrogator-ID read channel: SID-CH (forward link, only for R/W-tag)
 - 7.4.3.5 Reserved function forward link channel: RFD-CH (forward link, only for R/W tags)
 - 7.4.3.6 Reserved function return link channel: RFU-CH (return link, for both types of tag)
 - 7.4.3.7 Interrogator training sequence type1 channel: TS1-CH (return link/without logical channel)
 - 7.4.3.8 Command slot channel: CS-CH (forward link)
 - 7.4.3.9 Read channels: R-CH (return link)
 - 7.4.3.10 Write channel: W-CH (forward link)
 - 7.4.3.11 Confirm write channel: CW-CH (return link)
 - 7.4.3.12 Interrogator training sequence type2 channel: TS2-CH (return link/without logical channel)
 - 7.4.3.13 Command slot training sequence: TS3-CH (forward link/without logical channel)
 - 7.4.3.14 Spectrum check channel: SC-CH (return link/without carrier)
- 7.5 Channel coding and sequences
 - 7.5.1 Synchronization and CRC patterns
- 7.6 Command set for the command slot channel: CS-CH (only for R/W-tag)
 - 7.6.1 Command types
 - 7.6.1.1 Mandatory
 - 7.6.1.2 Optional
 - 7.6.1.3 Custom
 - 7.6.1.4 Proprietary
 - 7.6.2 Command set
 - 7.6.2.1 Write
 - 7.6.2.2 Long_Read
 - 7.6.2.3 Short_Read
 - 7.6.2.4 Init
 - 7.6.2.5 Wait
 - 7.6.3 Command codes

8 MODE 3: Active RFID ITF network

- 8.1 General
- 8.2 Operational requirements
- 8.3 Network Physical Layer description
- 8.4 Network description
 - 8.4.1 General

- 8.4.2 Network topology
- 8.5 Star topology
 - 8.5.1 General
 - 8.5.2 Star topology data flow
- 8.6 Trunk topology
 - 8.6.1 Trunk coordinator requirements
 - 8.6.2 Data flow in a trunk topology
- 8.7 Peer-to-peer topology
- 8.8 Mesh topology
 - 8.8.1 Establishing a mesh network
 - 8.8.1.1 General
 - 8.8.1.2 Mesh network initiated by remote device
 - 8.8.1.3 Mesh network initiated by coordinator
- 8.9 Message types
 - 8.9.1 Network discovery beacon (NDB)
 - 8.9.1.1 Alternate channel
 - 8.9.1.1.1 General
 - 8.9.1.1.2 Bit 7 most significant bit (MSB)
 - 8.9.1.1.3 Bit 6
 - 8.9.1.1.4 Bit 5
 - 8.9.1.1.5 Bits 0 to 4
 - 8.9.1.1.6 An example of the alternate channel octet
 - 8.9.1.2 Broadcast interval
 - 8.9.1.3 Response interval
 - 8.9.1.4 Option fields and data
 - 8.9.1.4.1 0x81 Network coordinator date and time stamp (7 octets)
 - 8.9.1.4.2 0x82 Network coordinator identification (20 octets)
 - 8.9.1.4.3 0x84 Network coordinator location (12 octets)
 - 8.9.1.4.4 0x88 Network coordinator date and time stamp, network coordinator identification, Network coordinator location (39 octets)
 - 8.9.1.4.5 0xff Commands pending (multiple of 8 octets)
 - 8.9.1.4.6 0x00 No NDB payload present
 - 8.9.1.5 NDB CRC (cyclical redundancy check)
 - 8.9.2 Network status message (NSM)
 - 8.9.2.1 Network coordinator parameters
 - 8.9.2.1.1 Option field
 - 8.9.2.1.1.1 Sleep value included (bit 0)
 - 8.9.2.1.1.2 Network coordinator acknowledgement request (bit 1)
 - 8.9.2.1.1.3 Trunk coordinator configuration (bit 2)
 - 8.9.2.1.2 Sleep value (1 octet)
 - 8.9.2.2 Server parameters
 - 8.9.2.2.1 Server options (1 octet)
 - 8.9.2.2.1.1 IP address specification (bit 0)
 - 8.9.2.2.1.2 Device Server Connection Method (bits 4 to 6)
 - 8.9.2.2.1.3 Link key request (bit 7)
 - 8.9.2.2.2 Server address (6, 18, or 32 octets)
 - 8.9.2.2.2.1 Email Device Server Connection Method
 - 8.9.2.2.2.2 UDP or TCP/IP Device Server Connection Method
 - 8.9.2.3 Optional extended server parameters
 - 8.9.2.3.1 NSM Key Exchange
 - 8.9.3 Acknowledgement message
 - 8.9.3.1 Acknowledgement message format
 - 8.9.3.1.1 ACK sequence number
 - 8.9.3.1.2 Packet ID
 - 8.9.3.1.2.1 Successful ACK
 - 8.9.3.1.2.2 NAK/error
 - 8.9.3.1.3 Ready
 - 8.9.3.1.4 Command count
 - 8.9.3.1.5 Wake timer
 - 8.9.3.1.6 Network channel
 - 8.9.3.2 Proprietary acknowledgements
 - 8.9.4 Command message
 - 8.9.4.1 Commanding a device operating in a sleep duty cycle
 - 8.9.4.2 Commanding a device operating with its receiver always active

- 8.9.4.3 Commanding in a mesh network
- 8.9.4.4 Command message format
- 8.9.5 Data message
 - 8.9.5.1 Data packets options
 - 8.9.5.2 Commercial proprietary data protection
 - 8.9.5.3 Data message format
- 8.9.6 Mesh request
 - 8.9.6.1 Mesh request message format
- 8.9.7 Mesh data
 - 8.9.7.1 Mesh data message format
- 8.10 Network discovery
 - 8.10.1 Methods of network discovery
 - 8.10.1.1 Minimum requirements
 - 8.10.1.2 Temporary network
 - 8.10.1.3 Associated networks
 - 8.10.2 Transmitting network discovery beacons
 - 8.10.3 Connectionless network
 - 8.10.3.1 Connectionless NDB message
 - 8.10.3.2 NDB device response for NDBs
 - 8.10.3.3 NSM encryption
 - 8.10.3.4 Data exchange
 - 8.10.3.5 Commanding
 - 8.10.4 Associated network connection (ANC)
 - 8.10.4.1 Associated network NDB message
 - 8.10.4.2 ISO/IEC/IEEE 8802#15-4 association request and association response
 - 8.10.4.3 Link encryption requests
- 8.11 Link encryption methods

9 MODE 4: Configurable data rate active RFID system

- 9.1 General
- 9.2 Cryptographic suite indicators
- 9.3 Physical layer
 - 9.3.1 Operating frequency
 - 9.3.2 Emission spectrum density mask
 - 9.3.3 Modulation and spectrum spread
 - 9.3.3.1 O-QPSK
 - 9.3.3.2 Pulse shaping using O-QPSK modulator
 - 9.3.3.3 DBPSK
 - 9.3.3.4 Pulse shaping using DBPSK modulation
 - 9.3.3.5 Information rate
 - 9.3.4 TX/RX switch time
 - 9.3.5 EVM
- 9.4 Data link layer
 - 9.4.1 General
 - 9.4.2 Preamble
 - 9.4.3 Synchronous code
 - 9.4.4 Data length
 - 9.4.5 Frame option
 - 9.4.6 Message data
 - 9.4.6.1 Interrogator to tag
 - 9.4.6.2 Tag to interrogator
 - 9.4.6.2.1 Overview
 - 9.4.6.2.2 Short frame from tags to interrogators
 - 9.4.6.2.3 Long frame from tags to interrogators
 - 9.4.6.3 Execution state
 - 9.4.6.4 TID format
 - 9.4.7 CRC
 - 9.5 Tag memory structure
 - 9.5.1 Overview
 - 9.5.2 Data organization of security section
 - 9.5.3 Data organization of user section
 - 9.5.3.1 File system structure
 - 9.5.3.2 EF data structure
 - 9.5.3.3 File selection method

9.5.3.4	File system operation command
9.5.3.5	File system operation process
9.5.3.6	File system access control
9.5.4	File definitions of user section
9.6	Tag state transition
9.6.1	Overview
9.6.2	Figure of tag state transition
9.6.3	Sense state
9.6.4	Ready state
9.6.5	Operation state
9.6.5.1	Arbitration state
9.6.5.2	Collection state
9.6.5.3	Session state
9.6.5.4	Secure session state
9.6.6	Sleep state
9.6.7	Killing state
9.7	Interrogator commands and tag responses
9.7.1	Command types
9.7.2	Command codes list
9.7.3	Ready and sleep commands
9.7.3.1	Ready
9.7.3.2	Sleep all tags
9.7.3.3	Sleep all tags except specific type
9.7.3.4	Sleep all tags except specific one
9.7.3.5	Direct session
9.7.3.5.1	Command format
9.7.3.5.2	Response format
9.7.4	Access commands
9.7.4.1	Access frame initiation
9.7.4.2	Access time-slot initiation
9.7.4.2.1	Command format
9.7.4.2.2	Response format
9.7.4.3	Access failure ACK
9.7.4.3.1	Command format
9.7.4.3.2	Response format
9.7.4.4	Access success ACK
9.7.4.4.1	Command format
9.7.4.4.2	Response format
9.7.4.5	Re-access
9.7.4.5.1	Command format
9.7.4.5.2	Response format
9.7.5	Collection commands
9.7.5.1	Collection period initiation
9.7.5.1.1	Command format
9.7.5.1.2	Response format
9.7.5.2	Collection failure ACK
9.7.5.2.1	Command format
9.7.5.2.2	Response format
9.7.5.3	Collection success ACK
9.7.6	File access commands
9.7.6.1	Select file
9.7.6.1.1	Command format
9.7.6.1.2	Response format
9.7.6.2	File password verification
9.7.6.2.1	Command format
9.7.6.2.2	Response format
9.7.6.3	Invalid file
9.7.6.3.1	Command format
9.7.6.3.2	Response format
9.7.6.4	Valid file
9.7.6.4.1	Command format
9.7.6.4.2	Response format
9.7.6.5	List file
9.7.6.5.1	Command format

- 9.7.6.5.2 Response format
- 9.7.6.6 Read transparent file
 - 9.7.6.6.1 Command format
 - 9.7.6.6.2 Response format
- 9.7.6.7 Update transparent file
 - 9.7.6.7.1 Command format
 - 9.7.6.7.2 Response format
- 9.7.6.8 Read record file
 - 9.7.6.8.1 Command format
 - 9.7.6.8.2 Response format
- 9.7.6.9 Update record file
 - 9.7.6.9.1 Command format
 - 9.7.6.9.2 Response format
- 9.7.6.10 Query record
 - 9.7.6.10.1 Command format
 - 9.7.6.10.2 Query condition
 - 9.7.6.10.3 Response format
- 9.7.7 Monitor commands
 - 9.7.7.1 Monitor period configuration
 - 9.7.7.1.1 Command format
 - 9.7.7.1.2 Response format
 - 9.7.7.2 Monitor period initiation
 - 9.7.7.2.1 Command format
 - 9.7.7.2.2 Response format
- 9.7.8 Security protocol commands
 - 9.7.8.1 Authenticate command
 - 9.7.8.1.1 Command format
 - 9.7.8.1.2 Response format
 - 9.7.8.2 Secure communication command
 - 9.7.8.2.1 Command format
 - 9.7.8.2.2 Response format
 - 9.7.8.3 AuthComm command
 - 9.7.8.3.1 Command format
 - 9.7.8.3.2 Response format
 - 9.7.8.4 KeyUpdate command
 - 9.7.8.4.1 Command format
 - 9.7.8.4.2 Response format
- 9.7.9 Other commands
 - 9.7.9.1 Killing command
 - 9.7.9.1.1 Command format
 - 9.7.9.1.2 Response format
 - 9.7.9.2 Random number request
 - 9.7.9.2.1 Command format
 - 9.7.9.2.2 Response format
 - 9.7.9.3 Update system password command
 - 9.7.9.3.1 Command format
 - 9.7.9.3.2 Response format
- 9.7.9.4 Data broadcast
 - 9.7.9.4.1 Command format
- 9.8 Protocol operation mode
 - 9.8.1 Overview
 - 9.8.2 Operation process
 - 9.8.2.1 Ready stage
 - 9.8.2.2 Access stage
 - 9.8.2.3 Collection stage
 - 9.8.2.4 Session stage
 - 9.8.2.5 Monitor stage
 - 9.8.3 Operation mode
 - 9.8.3.1 Inventory mode
 - 9.8.3.2 Monitor mode
 - 9.8.3.3 Information release mode
 - 9.8.3.4 Wake-up mode
- 9.9 Anti-collision method
 - 9.9.1 Overview

- 9.9.2 Anti-collision process
- 9.9.3 Binary tree algorithm
- 9.10 Parameters for air interface
 - 9.10.1 Parameters of physical and data link layer
 - 9.10.1.1 The link parameters table from interrogator to tag
 - 9.10.1.2 The link parameter table from tag to interrogator
 - 9.10.2 Protocol parameters

10 Table of characteristic differences between the modes specified in this document

Annex A (informative) Mode 1: Memory map

- A.1 Tag memory map
- A.2 Unique identifier
 - A.2.1 Default unique identifier
 - A.2.1.1 'E0' (byte 0)
 - A.2.1.2 IC Mfg code according to ISO/IEC 7816#6 (byte 1)
 - A.2.1.3 Chip manufacturer assigned (bytes 2 to 7)
 - A.2.2 Unique identifier according to ANSI 256
 - A.2.2.1 Check sum (bits 0, 1)
 - A.2.2.2 Fab code (bits 2 to 5)
 - A.2.2.3 Manufacturer code (bits 6 to 13)
 - A.2.2.4 Chip manufacturer assigned (bits 14 to 63)
- A.3 Manufacturer ID and tag hardware
- A.4 Tag memory layout
 - A.4.1 Embedded application code "01" — Reserved
 - A.4.2 Embedded application code "02" — Customer specific memory allocation
 - A.4.3 Embedded application code "03" — File allocation table (Long Directory)
 - A.4.4 Embedded application code "04" — Check tag
 - A.4.5 Embedded application code "05" — RFID reader configuration tag
 - A.4.6 Embedded application codes "06" through "09"
 - A.4.7 Embedded application code "0A" — ISO/IEC 15962 compliant data format
 - A.4.8 Embedded application codes "0B" — ANSI MH10.8.4 compliant data format
 - A.4.9 Embedded application codes "0C" through "0E"
 - A.4.10 Embedded application codes "0F" — EAN.UCC GTAG compliant data format
 - A.4.11 Embedded application codes "10" through "FF"
- A.5 Application (USER) memory

Annex B (informative) Mode 1: CRC

- B.1 Interrogator to tag and tag to interrogator CRC-16
- B.2 CRC calculation examples

Annex C (normative) Mode 2: Memory map

- C.1 Tag memory map
- C.2 Tag serial number — UserTagID
- C.3 Tag manufacturer's identifiers — MfrTagID
 - C.3.1 Allocation and registration of tag manufacturer's identifier

Annex D (informative) Mode 2: CRC

- D.1 Cyclic redundancy check (CRC)
- D.2 CRC calculation example

Annex E (normative) Mode 4: Tag state transition tables

- E.1 Sense state transition table
- E.2 Ready state transition table
- E.3 Arbitration state transition table
- E.4 Collection state transition table
- E.5 Session state transition table
- E.6 Secure session state transition table
- E.7 Killing state transition table
- E.8 Sleep state transition table

Annex F (informative) Mode 4: Inventory process example

Annex G (informative) Mode 4: Wake-up mechanism

- G.1 Overview**
- G.2 External 125 kHz signal wake-up method**
- G.3 External 2 kHz quasi-static magnetic wake-up method**
 - G.3.1 Modulation**
 - G.3.2 Encoding**
 - G.3.3 Magnetic field signal specification**
 - G.3.3.1 Interrogator magnetic field signal strength**
 - G.3.3.2 Threshold of tag magnetic field signal strength**
 - G.3.3.3 Symbol periodical jitter of magnetic field signal**
 - G.3.4 Wake-up signal**
- G.4 Internal period self wake-up**

Annex H (informative) Mode 4: Typical parameters of anti-collision algorithm

Page count: 200