



**International
Standard**

ISO/IEC 18000-63

**Information technology — Radio
frequency identification for item
management —**

**Part 63:
Parameters for air interface
communications at 860 MHz to 930
MHz Type C**

*Technologies de l'information — Identification par
radiofréquence (RFID) pour la gestion d'objets —*

*Partie 63: Paramètres de communications d'une interface radio
entre 860 MHz et 930 MHz, Type C*

**Fourth edition
2026-10**

Sample Document

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ISO copyright office
CP 401 • CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document 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 or www.iec.ch/members_experts/refdocs).

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For an explanation of 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 www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

This fourth edition cancels and replaces the third edition (ISO/IEC 18000-63:2021), which has been technically revised.

The main changes are as follows:

- tag selection process has been improved;
- a method to ensure tags are sufficiently energized before selection and communication has been added;
- a method for tag data reading has been provided;
- QueryX and QueryY has been added to make the selection process more topics useful and robust;
- ReadVar and Read-User-Memory-bit (RUM) automate the access to item attributes and the Tag Identifier (TID);
- ResponseBuffer has been made optional.

A list of all parts in the ISO/IEC 18000 series can be found on the ISO and IEC websites.

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 and www.iec.ch/national-committees.

Introduction

A radio frequency identification (RFID) system comprises:

- Interrogators, also known as radio identification (RAIN) Readers, and
- RAIN Tags, also known as RAIN Labels or RAIN Transponders.

This document is also referred as RAIN Air Interface. For more information on RAIN, see [Annex S](#).

A RAIN Interrogator transmits information to a RAIN Tag by modulating an RF signal in the 860 MHz to 930 MHz frequency range. The Tag receives both information and operating energy from this RF signal. Tags are passive, which means that they receive all of their operating energy from the Interrogator's RF signal.

A RAIN Interrogator receives information from a RAIN Tag by transmitting a continuous wave (CW) RF signal to the Tag; the Tag responds by modulating the reflection coefficient of its antenna, thereby backscattering an information signal to the Interrogator. The system is Interrogator-talks-first (ITF), which means that a Tag modulates its antenna reflection coefficient with an information signal only after being directed to do so by an Interrogator.

Interrogators and Tags are not required to talk simultaneously; rather, communications are half-duplex, i.e. Interrogators talk and Tags listen, or vice versa.

The backscatter RFID system described in this document supports the following system capabilities:

- identification and communication with multiple tags in the field;
- selection of a subgroup of tags for identification or with which to communicate;
- reading from and writing to or rewriting data many times to individual tags;
- user-controlled permanently lockable memory;
- data integrity protection;
- Interrogator-to-Tag communications link with error detection;
- Tag-to-Interrogator communications link with error detection;
- support for both passive back-scatter tags with or without batteries.

Information technology — Radio frequency identification for item management —

Part 63:

Parameters for air interface communications at 860 MHz to 930 MHz Type C

1 Scope

This document establishes the air interface for radio frequency identification (RFID) devices operating in the 860 MHz to 930 MHz industrial, scientific and medical (ISM) band used in item management applications.

This document specifies a common technical specification for RFID devices that can be used to develop standards for applications using this radio identification (RAIN) air interface. This document is intended to improve compatibility and encourage inter-operability of products for the growing RFID market in the international marketplace.

This document establishes the forward and return link parameters for technical attributes including, but not limited to, operating frequency, operating channel accuracy, occupied channel bandwidth, maximum effective isotropic radiated power (EIRP), spurious emissions, modulation, duty cycle, data coding, bit rate, bit rate accuracy, bit transmission order, and, where appropriate, operating channels, frequency hop rate, hop sequence, spreading sequence, and chip rate. This document further specifies the communications protocol used in the air interface.

This document describes the physical and logical requirements for a passive backscatter, Interrogator-talks-first (ITF), radio frequency identification system operating in the 860 MHz to 930 MHz frequency range.

This document specifies:

- physical interactions (the signalling layer of the communication link) between Interrogators and Tags;
- logical operating procedures and commands between Interrogators and Tags;
- the collision arbitration scheme used to identify a specific tag in a multiple-tag environment;
- optional security commands that allow the use of crypto suites of ISO/IEC 29167-1:2014 [\[1\]](#).

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/IEC 15961-1, *Information technology — Data protocol for radio frequency identification (RFID) for item management — Part 1: Application interface*

ISO/IEC 15961-2, *Information technology — Data protocol for radio frequency identification (RFID) for item management — Part 2: Registration of RFID data constructs*

ISO/IEC 15961-3, *Information technology — Data protocol for radio frequency identification (RFID) for item management — Part 3: RFID data constructs*

ISO/IEC 15962, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: data encoding rules and logical memory functions*

ISO/IEC 15963-1, *Information technology — Radio frequency identification for item management — Part 1: Unique identification for RF tags numbering systems*

ISO/IEC 18047-63, *Information technology — Radio frequency identification device conformance test methods — Part 63: Test methods for air interface communications at 860 MHz to 960 MHz*

ISO/IEC 19762:2025, *Information technology — Automatic identification and data capture (AIDC) techniques — Vocabulary*

ISO/IEC 29143, *Information technology — Automatic identification and data capture techniques — Air interface specification for Mobile RFID interrogators*

GS1 EPC Tag Data Standard (TDS), available at: <https://www.gs1.org/standards/epc-rfid/tds>

ISO/IEC 18000-61, *Information technology — Radio frequency identification for item management — Part 61: Parameters for air interface communications at 860 MHz to 960 MHz Type A*

ISO/IEC 18000-62, *Information technology — Radio frequency identification for item management — Part 62: Parameters for air interface communications at 860 MHz to 960 MHz Type B*

ISO/IEC 18000-64, *Information technology — Radio frequency identification for item management — Part 64: Parameters for air interface communications at 860 MHz to 960 MHz Type D*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762:2025 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

air interface

complete communication link between an Interrogator and a Tag including the physical layer, collision-arbitration algorithm, command and response structure and data-coding methodology

3.2

authenticated communication

communication in which message integrity is protected

3.3

backscatter link frequency

frequency at which a Tag modulates the backscattered signal

3.4

battery assisted mode

working mode of battery assisted tags with non-empty battery

3.5

cover coding

method by which an Interrogator obscures information that it is transmitting to a Tag

Note 1 to entry: To cover-code data or a password, an Interrogator first requests a random number from the Tag. The Interrogator then performs a bitwise exclusive OR (XOR) of the data or password with this random number, and transmits the cover-coded string to the Tag. The Tag uncovers the data or password by performing a bitwise XOR of the received cover-coded string with the original random number.

3.6

Extended Tag identifier

XTID

memory construct that defines a Tag's capabilities and which can include a Tag serial number

Note 1 to entry: More information on XTID is provided in Reference [\[2\]](#).

3.7

extended temperature range

temperature range that is from $-40\text{ }^{\circ}\text{C}$ to $+65\text{ }^{\circ}\text{C}$

3.8

file type

8-bit string that specifies a file's designated type

3.9

file superuser

access password or key with a 0011_2 **secured**-state file privilege value

3.10

full-duplex communication

communication channel that carries data in both directions at once

Note 1 to entry: See *half-duplex communications* ([3.12](#)) for another option for bidirectional communication.

3.11

GS1 application

application whose usage denotes an acceptance of GS1 EPCglobal® standards and policies

Note 1 to entry: Reference [\[3\]](#) contains more details on GS1 application.

Note 2 to entry: See *ISO application* ([3.17](#)) for an alternative application option.

3.12

half-duplex communication

communication channel that carries data in one direction at a time rather than in both directions at once

Note 1 to entry: See *full-duplex communications* ([3.10](#)) for another option for bidirectional communication.

3.13

handle

16-bit tag identifier

3.14

hibernate

state of energy saving when the device is not required to be used

3.15

interrogator authentication

means for a Tag to determine, via cryptographic means, that an Interrogator's identity is as claimed

3.16

inventory round

period initiated by a Query command or a QueryX command and terminated by either a subsequent Query command, a subsequent QueryX command, a Select command or a Challenge command

3.17

ISO application

application whose usage denotes an acceptance of ISO standards and policies

Note 1 to entry: See *GS1 application* ([3.11](#)) for an alternative application option.

3.18

keyID

numerical designator for a single key

3.19

MAC

message authentication code

code, computed over bits in a message, that an Interrogator or a Tag can use to verify the integrity of the message

3.20

mutual authentication

means for a Tag and an Interrogator to each determine, via cryptographic means, that the others' identity is as claimed

3.21

nominal temperature range

temperature range that is from $-25\text{ }^{\circ}\text{C}$ to $+40\text{ }^{\circ}\text{C}$

Note 1 to entry: An *extended temperature range* (3.7) also exists.

3.22

non-removable Tag

Tag that a consumer cannot physically detach from an item without special equipment or without compromising the item's intended functionality

Note 1 to entry: In addition to a non-removable tag, a *removable Tag* (3.25) also exists.

3.23

password

secret value sent by an Interrogator to a Tag to enable restricted Tag operations

Note 1 to entry: Passwords are not keys.

Note 2 to entry: The only passwords defined by the protocol defined in this document are the kill and access passwords.

3.24

Q

parameter that an Interrogator uses to regulate the probability of Tag response

Note 1 to entry: An Interrogator instructs Tags in an inventory round to load a Q -bit random (or pseudo-random) number into their slot counter; the Interrogator can also command Tags to decrement their slot counter. Tags reply when the value in their slot counter, i.e. their *slot* (3.30), is zero. Q is an integer in the range (0 to 15); the corresponding Tag-response probabilities range from $2^0 = 1$ to $2^{-15} = 0,000031$.

3.25

removable Tag

Tag that a consumer can physically detach from an item without special equipment and without compromising the item's intended functionality

Note 1 to entry: In addition to a removable Tag, a *non-removable Tag* (3.22) also exists.

3.26

secure communication

communication in which message confidentiality is protected

3.27

security

degree of protection against threats identified in a *security policy*

Note 1 to entry: A system is secure if it is protected to the degree specified in the security policy.

3.28

session key

temporary key generated by one or both of Tag and Interrogator and typically used for both authenticated and secure communications

3.29

Simple Sensor functionality

functionality whereby a sensor provides a valid simple sensor data address and transmits simple sensor data subsequent to the UII as part of the reply to the *ACK* command

3.30

slot

point in an *inventory round* ([3.16](#)) at which a Tag can respond

Note 1 to entry: Slot is the value output by a Tag's slot counter; Tags reply when their slot (i.e. the value in their slot counter) is zero.

Note 2 to entry: See *Q* ([3.24](#)) for the for the maximum number of slots.

3.31

snapshot sensor

sensor that makes a measurement during power-up or on demand from an Interrogator

3.32

Tag authentication

means for an Interrogator to determine, via cryptographic means, that a Tag's identity is as claimed

3.33

traceable

not restricting the identifying information that a Tag exposes or the Tag's operating range, or both

Note 1 to entry: To view the definition of the opposite term, refer to *untraceable* ([3.36](#)).

3.34

untraceable privilege

privilege given to the access password or to a key that grants an Interrogator using the access password or key the right to access *untraceably hidden memory* ([3.35](#)) or to issue an *untraceable* ([3.36](#)) command, or both

3.35

untraceably hidden memory

memory that an untraceable Tag hides from Interrogators with a deasserted *untraceable privilege* ([3.34](#))

3.36

untraceable

restricting the identifying information that a Tag exposes or the Tag's operating range, or both

Note 1 to entry: To view the definition of the opposite term, refer to *traceable* ([3.33](#)).

4 Symbols, abbreviated terms and notations

4.1 Symbols

A	numodulated field strength
A_{adj}	adjusted unmodulated field strength
B	modulated field strength
B_{adj}	adjusted modulated field strength
C	computed-response indicator
F	file-services indicator (whether a Tag supports the <i>FileOpen</i> command)
f_{BLF}	backscatter link frequency
FrT	frequency tolerance
FS	full function sensor indicator
H	hazmat indicator
INACT_T	inactivity threshold
K	killable indicator
M	number of subcarrier cycles per symbol
M_{adjd}	RF field adjust downwards
M_{adju}	RF field adjust upwards
M_{adjh}	RF envelope ripple adjusted (overshoot)
M_{adjl}	RF envelope ripple adjusted (undershoot)
M_{h}	RF signal envelope ripple (overshoot)
M_{l}	RF signal envelope ripple (undershoot)
M_{s}	RF signal level when OFF
n_{DR}	divide ratio
NR	non-removable Tag indicator
Q	slot-count parameter that is an integer in the range of 0 to 15
$\text{R} \Rightarrow \text{T}$	interrogator-to-tag (reader-to-tag)
RTcal	interrogator-to-tag (reader-to-tag) calibration symbol
S	security-services indicator
SA	sensor alarm indicator
SLI	SL indicator
SN	snapshot sensor indicator

SS	simple sensor indicator
T	numbering system identifier
T=>R	tag-to-Interrogator (tag-to-reader)
T_1	time from Interrogator transmission to Tag response for an <i>immediate</i> Tag reply
T_2	time from tag response to Interrogator transmission
T_3	time an Interrogator waits, after T_1 , before it issues another command
T_4	minimum time between Interrogator commands
T_5	time from Interrogator transmission to Tag response for a <i>delayed</i> Tag reply
T_6	time from Interrogator transmission to first Tag response for an <i>in-process</i> Tag reply
T_7	time between Tag responses for an <i>in-process</i> Tag reply
T_8	time from end of <i>QueryX</i> or <i>QueryY</i> command to beginning of a subsequent <i>QueryY</i>
T_{cp}	time before command, power-up
$t_{f,10-90\%}$	RF signal envelope fall time
T_{fp}	fall time, power-down
t_{lag}	RF adjust lag time
t_{lead}	RF adjust lead time
TN	tag-notification indicator
T_{pri}	backscatter link pulse-repetition interval
T_r or $T_{r,10-90\%}$	RF signal envelope rise time
T_{REPLY}	time between Interrogator command and Tag backscattered
T_{rp}	rise time, power-up
T_{sp}	settling time, power-up
T_{RTcal}	time duration of RTcal
T_{TRcal}	time duration of TRcal
TRcal	tag-to-Interrogator (tag-to-reader) calibration symbol
U	untraceability indicator
RUM	read user memory indicator
X	XTID indicator (whether a Tag implements an XTID)
XEB	XPC_W2 indicator
x_{fp}	floating-point value
XI	XPC_W1 indicator

xxxx ₂	binary notation
xxxx _h	hexadecimal notation

4.2 Abbreviated terms

AC	activation code
AFI	application family identifier
AM	amplitude modulation
ASIC	application specific integrated circuit
BAM	battery assisted mode
BAP	battery assisted passive
BAT	battery assisted tag
BLF	backscatter link frequency
CSI	cryptographic suite identifier
CW	continuous wave
dBch	decibels referenced to the integrated power in the reference channel
DBLF	digital backscatter link frequency
DBR	dead battery response
DR	divide ratio
FDM	frequency-division multiplexing
LPR	low power receive
MAC	message authentication code
MDID	mask designer identifier
MSB	most significant bit
NA	not applicable
NoS	number of sensors
NRZ	Non-Return-to-Zero
OTP	one-time programmable
PC	protocol control
PIE	pulse interval encoding
pivot	decision threshold differentiating an R=>T data-0 symbol from a data-1 symbol
PM	passive mode
ppm	parts per million

PW	pulse width
pwd	password
R/W	read or write
RAIN	radio identification
RNG	random or pseudo-random number generator
RO	read only
RTC	real time clock
SDS	sensor directory system
SS	simple sensor
SSB-ASK	single-sideband amplitude-shift keying
SSD	simple sensor data
TEDS	transducer electronic data sheet
RUM	read user memory indicator
UTC	universal coordinated time
UWC	User word count
XOR	exclusive OR
XPC_W1	XPC word 1
XPC_W2	XPC word 2
XTID	extended tag identifier

4.3 Notations

This document uses the following notational conventions.

- States and flags are denoted in bold. Some command parameters are also flags; a command parameter used as a flag is denoted in bold.

EXAMPLE 1 **ready**.

- Command and Tag reply parameters are underlined. Some flags are also command parameters; a flag used as a command parameter is underlined.

EXAMPLE 2 Pointer.

- Command parameters are given in upper case and Tag reply parameters are given in lower case.

EXAMPLE 3 Pointer and handle.

- Commands are denoted in italics.

NOTE As variables are also denoted in italics, where there can be confusion between commands and variables, an explicit statement is added.

EXAMPLE 4 *Query*.

- For logical negation, labels are preceded by "~".