

International Telecommunication Union

ITU-R
Radiocommunication Sector of ITU

Report ITU-R SM.2179
(09/2010)

**Short-range radiocommunication
devices measurements**

SM Series
Spectrum management



International
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Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

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Note: This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.

Electronic Publication
Geneva, 2010

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REPORT ITU-R SM.2179

Short-range radiocommunication devices measurements

(2010)

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1 Introduction

Short-range device (SRD) applications and their associated frequency bands are described in Report ITU-R SM.2153 (former Recommendation ITU-R SM.1538).

Some SRD applications also could benefit from true worldwide harmonization.

Monitoring methods for SRD are described in Report ITU-R SM.2154.

This Report is meant to complete the set of Recommendations and Reports by documenting the measurement methods available for SRDs.

2 The reasons for SRD measurements

Technical SRD measurements performed in test laboratories and performing type approval procedures in addition to and/or supporting spectrum monitoring tasks can be performed for the following reasons:

– Type approval

Type approval is a condition granted to a product when a minimum set of regulatory, technical and/or safety requirements are met. The process of approval is performed on a specific item of a specific manufacturer using one or a set of standards and/or one or more national regulatory frameworks. Type approval is usually performed by governmental institutions and lost much of its popularity due to conformity/compliance testing against technical standards. Usually a product specific labelling and coding method is used to indicate that a product is approved.

– Conformance/Compliance testing

Conformance/Compliance testing are two words for the same process comparable with type approval but with some specific differences. Testing is performed against technical standards that can be relevant in more than a single country. Testing against such a standard may grant a product “approved” in more than a single country. Conformance/Compliance testing is frequently performed by independent institutes operating under a regime agreed by regulators and standardisation institutes. These institutes are called notified bodies. Usually a generic label is used for compliant products.

NOTE 1 – In Europe under the R&TTE Directive there is no requirement to use a notified body to demonstrate compliance.

The main reason for these tests is putting products on the market.

– Enforcement purposes

Enforcement performs measurements for other reasons than putting a product on the market. The most important reason for enforcement measurements is to determine if the product is constructed according the standards for type approval or conformance/compliance. This is usually done when the product is already on the market. The standard for the particular product should guarantee conformance with the regulation if its procedures and limits are followed. It is therefore logical that enforcement uses the same measurement methods as described in the standards. On the other hand enforcement functions often as a feedback between the regulatory body and the standardisation institute to guarantee that the standards fulfil the regulatory requirements. Alternative measurements could be recommended by the enforcement body.

Another enforcement reason is tracing the origin of a device and the manufacturer/distributor responsible for putting it on the market. This is usually done as part of a normal enforcement measurement procedure and involves checking the markings on the device but also typical technical properties. These properties may be determined by specific measurement procedures such as the behaviour of a device under a specific stimulus. Also the real life behaviour of a device may be a sign of its nature but this is more a monitoring task.

– Assistance in the spectrum monitoring task of measuring spectrum occupancy

Spectrum monitoring of short range devices differs to some extent from monitoring of other spectrum users, because of their low power and specific geographical distribution to be effective, some specific guidelines need to be observed such as described in Report ITU-R SM.2154.

To characterise the spectrum occupancy in terms of the number of devices and their location in a RF band where SRDs operate it is necessary to translate the specific time behaviour of a device in actual occupancy. For example a device that sends a 1ms pulse every second can be considered active for 100% of time (activity factor) but producing an actual occupancy figure of less than 0.1% (duty cycle). Checking the relevant standards and using the described measurement methods can be used to obtain insight in the working of a device and analyse the occupancy figures properly. This avoids the use of complicated and expensive time domain measurements in the SRD bands.

3 Selection of a measurement method

The selection of a measurement method is described from the point of view of a regulatory body.

The measurement methods contained in technical standards are usually used by industry to place products on the market. This means that the testing methods are sometimes detailed in both setup and procedures, the reason is to have a legal base. For enforcement purposes it is not needed to follow these detailed measurement instructions in all cases. An e.r.p. measurement for example can be performed at a standard test site with standard measurement equipment as long as the value of this parameter can be determined with the same or better uncertainty as with the method in the standard.

Testing is a often a time consuming and expensive process therefore many enforcement agencies use a method called “pre compliance testing”, the used methods are basically the same as described in the standard but with a higher measurement uncertainty and shorter measurement time. This pre compliance test is used to make a selection of devices to be “full compliance tested” (tested in more detail) by the enforcement agency or a in a dedicated test facility. The reason for this two stage process is to work in a more cost effective way and to enhance the probability of finding non compliant devices. Pre compliance testing may be also performed in the field without a test range as described in the standard.

Standards can be divided into product specific and non specific standards. The reason for this distinction is that certain products use alternative and sometimes complicated methods to fulfil a regulatory requirement that cannot be made mandatory for all devices under the same regulatory regime. It is commonly accepted that if a product specific standard exist the specific product needs to fulfil the requirements in the product specific standard.

A special case of non specific standards are the standards that are used to test for EMC and EMF compliance. These standards do not deal directly with spectrum use but relate to safety limits for health and EMC. The choice for a particular standard and test method has to be based on the type of regulation for which the testing takes place. (i.e., spectrum regulation, EMC regulation and EMF regulation.)

Annex 1

Standards containing measurement methods within CEPT

1 Regulation of short range devices in CEPT countries

In the CEPT countries regulation of Short range devices is documented in ERC Recommendation 70-03. The recommendation contains a list of frequency bands with regulatory parameters for SRDs and a table listing the implementation status of these bands in the CEPT countries. If a country implements a frequency band it can be assumed that national regulation according the technical parameters stated in the ERC Recommendation 70-03 is in force in that particular country.

For a group of CEPT countries (EU/EEA¹ member states) it is mandatory to implement the EC decisions listed in Appendix 2 of ERC Recommendation 70-03. The technical annexes of these EC Decisions states the frequency bands and the relevant essential regulatory parameters for SRDs. The parameters in the EC Decisions listed may be subject to a derogation for an individual EU country and are detailed in Appendix 3 of ERC Recommendation 70-03.

2 Measurement procedures for short range devices in CEPT countries

This section contains the ETSI harmonized standards as used in CEPT countries for SRDs. The list can be divided into standards for non specific use, also called generic standards, and application specific standards. Non specific standards are indicated in the notes column. Documents can be found and downloaded free of charge at the web site: portal.etsi.org and located using the search engine at that web site.

Standard	Name	Notes
EN 300-220	Technical characteristics and test methods for radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW	To be used for non specific SRDs
EN 300-328	Data transmission equipment operating in the 2.4 GHz ISM band and using wide band modulation techniques	
EN 300 330	Technical characteristics and test methods for radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz	To be used for non specific SRDs
EN 300 422	Wireless microphones in the 25 MHz to 3 GHz frequency range	
EN 300 440	Radio equipment to be used in the 1 GHz to 40 GHz frequency range	To be used for non specific SRDs
EN 300 674	Road Transport and Traffic Telematics (RTTT); Technical characteristics and test methods for Dedicated Short Range Communication (DSRC) transmission equipment (500 kbit/s/250 kbit/s) operating in the 5.8 GHz Industrial, Scientific and Medical (ISM) band	
EN 300 718	Avalanche Beacons; Transmitter-receiver systems	

¹ EU: European Union; EEA: European Economic Area.

Standard	Name	Notes
EN 300 761	Automatic Vehicle Identification (AVI) for railways operating in the 2.45 GHz frequency range	
EN 301 091	Road Transport and Traffic Telematics (RTTT)	
EN 301 357	Consumer radio microphones and in-ear monitoring systems operating in the CEPT harmonized band 863 MHz to 865 MHz	
EN 301 391	Data communications using short range devices; Access protocol, occupation rules and corresponding technical characteristics for the transmission of data	
EN 301 839	Radio equipment in the frequency range 402 MHz to 405 MHz for Ultra Low Power Active Medical Implants and Accessories	
EN 301 840	Digital radio microphones operating in the CEPT Harmonized band 1 785 MHz to 1 800 MHz	
EN 301 893	5 GHz high performance RLAN	
EN 302 195	Radio equipment in the frequency range 9 kHz to 315 kHz for Ultra Low Power Active Medical Implants (ULP-AMI) and accessories	
EN 302 054	Radiosondes to be used in the 400.15 MHz to 406 MHz frequency range with power levels ranging up to 200 mW	
EN 302 065	Short Range Devices (SRDs) using Ultra Wide Band technology (UWB) for communications purposes	
EN 302 066	Ground- and Wall- Probing Radar applications	
EN 302 195	Radio equipment in the frequency range 9 kHz to 315 kHz for Ultra Low Power Active Medical Implants (ULP-AMI) and accessories	
EN 302 208	Radio Frequency Identification Equipment operating in the band 865 MHz to 868 MHz with power levels up to 2 W	
EN 302 264	Road Transport and Traffic Telematics (RTTT)	
EN 302 291	Close Range Inductive Data Communication equipment operating at 13.56 MHz	
EN 302 288	Road Transport and Traffic Telematics (RTTT)	
EN 302 372	Equipment for Detection and Movement	
EN 302 435	Technical characteristics for SRD equipment using Ultra Wide Band technology (UWB)	
EN 302 500	Location Tracking equipment operating in the frequency range from 6 GHz to 8.5 GHz	
EN 302 510	Radio equipment in the frequency range 30 MHz to 37.5 MHz for Ultra Low Power Active Medical Membrane Implants and Accessories	
EN 302 536	Radio equipment in the frequency range 315 kHz to 600 kHz	
EN 302 537	Ultra Low Power Medical Data Service Systems operating in the frequency range 401 MHz to 402 MHz and 405 MHz to 406 MHz	
EN 302 567	60 GHz Multiple-Gigabit WAS/RLAN Systems	
EN 302 608	Radio equipment for Eurobalise railway systems	

Standard	Name	Notes
EN 302 609	Radio equipment for Euroloop railway systems	
EN 302 645	Global navigation satellite systems (GNSS) repeaters	
EN 301 489	Electromagnetic compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRDs) operating on frequencies between 9 kHz and 40 GHz	
EN 300 683	EMC standard for Short Range Devices (SRDs) operating on frequencies between 9 kHz and 25 GHz	
ETSI TR 101 870	Exposure to non-ionising electromagnetic fields; Guidelines for working conditions	Applicable to but not specifically meant for SRDs

Annex 2

USA (FCC) SRD regulation containing accepted measurement methods

1 Regulation of short range devices in the United States of America

In the United States of America, short range device (SRD) regulations are based on the establishment of basic technical standards for these devices which facilitate spectrum sharing among license-exempt devices, including short-range devices, using designated bands. The technical requirements placed on these devices ensure adequate protection of radiocommunication services operating in the same or adjacent frequency bands. Because of the nature of these devices, the regulation of SRDs is primarily a national matter and does not require any modifications to the Radio Regulations or the need for international regulations. The regulations in the United States of America are contained in Part 15 of the FCC Rules and Regulations (Title 47, Code of Federal Regulations, Part 15), which covers a broad range of intentional, unintentional and incidental radiation devices, including SRDs. Report ITU-R SM.2153 – Technical and operating parameters and spectrum use for short range radiocommunication devices, Appendix 2 to Annex 2 describes the regulation of SRDs and other devices under FCC Part 15 Rules in more detail.

2 Measurement procedures for SRDs in the United States of America

General measurement procedures applicable to short-range devices are described in Section 15.31 – Measurement standards, in Part 15 of FCC Rules. These procedures have evolved and expanded as these devices have increased in sophistication and popularity. Recent work in the United States of America by the Accredited Standards Committee on Electromagnetic Compatibility, C63[®] Committee, has collected, updated and summarized a number of measurement procedures that were contained in FCC Rules, Orders and in some technical notes on the FCC “Knowledge Data Base” website (KDB) into a new consolidated document, ANSI C63.10-2009, which covers general wireless devices. Nevertheless, there are a number of additional references that are necessary for clarification and also special measurement procedures for certain categories of equipment.

The measurement procedures described and/or accepted by the FCC for SRDs include the following:

Radio Frequency Devices/Intentional Radiators – Part 15

Standard	Name	Remarks
Title 47 CFR 15.31	FCC Rules Subpart A – General Section 15.31 – Measurement Standards (General Guidance)	http://edocket.access.gpo.gov/cfr_2009/octqtr/47cfr15.31.htm
ANSI C63.4-2003 or ANSI C63.4-2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	Available from IEEE at: http://standards.ieee.org/prod-serv/index.html or http://webstore.ansi.org/
ANSI C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices	Available from IEEE at: http://standards.ieee.org/prod-serv/index.html or http://webstore.ansi.org/
ANSI C63.17-2006	Methods of Measurement of the Electromagnetic and Operational Compatibility of Unlicensed Personal Communications Services (UPCS) Devices	Available from IEEE at: http://standards.ieee.org/prod-serv/index.html or http://webstore.ansi.org/
FCC Public Notice DA 02-2850	FCC Clarifies Equipment Certification Procedures for “Learned Mode” or “Trainable” Transmitters	http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-02-2850A1.pdf
FCC Public Notice DA 04-3946	OET Clarifies Equipment Authorization Policy for Measurement of Broadband Emissions. Use of “pulse desensitization correction factor” (PDCF)	http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-04-3946A1.pdf
KDB Publication No. 200443	Millimeter Wave Test Procedures	https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?switch=P&id=20677

Frequency Hopping and Digitally Modulated Devices under FCC Part 15.247

Standard	Name	Remarks
FCC Public Notice DA 00-705	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems	http://www.fcc.gov/Bureaus/Engineering_Technology/Public_Notices/2000/da000705.doc
KDB Publication No. 558074	Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)	https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=21124&switch=P

Additional Guidance on Modular Transmitters under FCC Part 15.212

Standard	Name	Remarks
Title 47 CFR 15.212	FCC Rules Subpart C – Intentional Radiators Section 15.212 – Modular Transmitters	http://edocket.access.gpo.gov/cfr_2009/octqtr/47cfr15.212.htm
KDB Publication No. 996369	Guidance for Equipment Authorization of transmitter module devices	http://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=44637&switch=P

Unlicensed National Information Infrastructure (UNII) – Part 15 Sub-Part E

Standard	Name	Remarks
FCC Order ET Docket No. 03-122 (FCC 06-96)	Compliance Measurement Procedures for Unlicensed-National Information Infrastructure Devices Operating in the 5.25-5.35 GHz and 5.47-5.725 GHz Bands Incorporating Dynamic Frequency Selection	http://hraunfoss.fcc.gov/edocs_public/attachm atch/FCC-06-96A1.pdf
FCC Public Notice DA 02-2138	Measurement Procedure Updated for Peak Transmit Power in the Unlicensed National Information Infrastructure (U-NII) Bands	http://hraunfoss.fcc.gov/edocs_public/attachm atch/DA-02-2138A1.pdf

Ultra Wideband (UWB) – Part 15 Sub-Part F

Standard	Name	Remarks
FCC Order, ET Docket No. 98-153 (FCC 02-48)	Ultra Wideband Transmission Systems	http://hraunfoss.fcc.gov/edocs_public/attachm atch/FCC-02-48A1.pdf
KDB Publication No. 393764	Frequently Asked Questions (FAQ) Regarding Ultra-wideband Compliance Measurements	https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSS earchResultPage.cfm?id=20253&switch=P

Measurement evaluation of Specific Absorption Rate (SAR) for Short Range Device Approval

Standard	Name	Remarks
KDB Publication No. 447498	Clarification and Guidance Pertaining To RF Exposure Requirements For Mobile And Portable Device Equipment Authorizations, including USB “Dongle” transmitters	http://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSS earchResultPage.cfm?id=20676&switch=P
KDB Publication No. 616217	Specific Absorption Rate (SAR) Evaluation Considerations for Laptop Computers with Transmitter Modules	https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSS earchResultPage.cfm?id=33240&switch=P
KDB Publication No. 248227	Specific Absorption Rate (SAR) Measurement Procedures for 802.11 a/b/g Transmitters	https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSS earchResultPage.cfm?id=28238&switch=P
KDB Publication No. 615223	802.16e/WiMax Specific Absorption Rate (SAR) Measurement Guidance	https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSS earchResultPage.cfm?switch=P&id=41734

References

FCC Part 15 – http://www.access.gpo.gov/nara/cfr/waisidx_09/47cfr15_09.html.

ANSI documents – <http://shop.ieee.org/ieeestore/> or <http://www.ansi.org/>.

(NOTE 1 – The ANSI documents can be purchased at the above links).

FCC Office of Engineering and Technology.

Laboratory Knowledge Database (KDB) – <http://www.fcc.gov/labhelp>.

FCC Orders and Dockets http://hraunfoss.fcc.gov/edocs_public/edocsLink.do?mode=basic&type=n.

Annex 3

Canadian standards containing measurement methods

This Annex contains the standards used in Canada for SRDs.

Standard	Name	Notes
RSS-Gen	General Requirements and Information for the Certification of Radiocommunication Equipment	ANSI C63.4-2009 IEEE C63.4-2009 IEEE C63.10-2009
RSS-102	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) (Issue 4, March 2010)	Industry Canada accepted KDBs (FCC) Procedures for SAR Measurements Health Canada Safety Code 6 FCC Bulletin OET 65, Supplement C IEEE Std. 1528a-2005 IEC 62209-1:2005 IEC 62209-2:2010 IEEE Std. C95.3-2002
RSS-125	Land Mobile and Fixed Radio Transmitters and Receivers, 1.705 to 50 MHz, Primarily Amplitude Modulated (Issue 2, Revision 1, 25 March 2000)	RSP-100 TRC-49 CP-01 CS-03 RSS-102
RSS-136	Land and Mobile Station Radiotelephone Transmitters and Receivers Operating in the 26.960 – 27.410 MHz General Radio Service Band (Issue 5, October 2002)	Radio Standards Procedure 100
RSS-137	Location and Monitoring Service in the Band 902-928 MHz	RSS-Gen RSS-210 Annex 7 & 8
RSS-181	Coast and Ship Station Single Sideband Radiotelephone Transmitters and Receivers Operating in the 1.605-28.000 kHz Band (Issue 1, 1 April 1971)	Radio Standards Procedure 100 Radio Standards Specification 111
RSS-210	Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment (Issue 7 June 2007)	
RSS-220	Devices Using Ultra – Wideband (UWB)Technology (Issue 1, March 2009)	RSS-Gen
RSS-243	Medical Devices Operating in the 401-406 MHz Frequency Band (Issue 3, February 2010)	ETSI EN 301 839-1 ETSI EN 302 537-1 ITU-R RS.1346
RSS-310	Low-power Licence-exempt Radiocommunication Devices (All frequency Bands) Category II Equipment (Issue 2 June 2007)	
ICES-001	Industrial, Scientific and Medical (ISM) Radio Frequency Generators (Issue 4, June 2006)	CAN/CSA-CEI /IEC CISPR 11-04 IEC Publication No. 50(161) (1990)
ICES-002	Spark Ignition Systems of Vehicles and Other Devices Equipped with Internal Combustion Engines (Issue 5, August 2009)	Canadian Standards Association Standard CAN/CSA-C108.4-06, <i>Limits and Methods of Measurement</i>

Standard	Name	Notes
ICES-003	Digital Apparatus (Issue 4, February 2004)	Canadian Standards Association Standard CAN/CSA-CEI/IEC CISPR 22:02, "Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment"
ICES-004	Alternating Current High Voltage Power Systems (Issue 3, December 2001)	CSA Standard C108.1.1-1977 entitled <i>Electromagnetic Interference Measuring Instrument – C.I.S.P.R. Type</i> , published February, 1977 in the English language
ICES-005	Radio Frequency Lighting Devices (RFLDs) (Issue 3, May 2009)	Canadian Standards Association Standard C108.1.1-1977, <i>Electromagnetic Interference Measuring Instrument – C.I.S.P.R. Type</i> Canadian Standards Association Standard C108.1.5-M85-CAN3, <i>Line Impedance Stabilization Network (LISN)</i>
ICES-006	AC Wire Carrier Current Devices (Unintentional Radiators) (Issue 2, June 2009)	CSA Standard C108.1.5 M-85, <i>Line Impedance Stabilization Network (LISN)</i> CSA Standard C108.1.1-1977, <i>Electromagnetic Interference Measuring Instrument-C.I.S.P.R. Type</i> Industry Canada Radio Standards Specification 210 (RSS-210), <i>Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands)</i> Industry Canada Radio Standards Specification Gen (RSS-Gen), <i>General Requirements and Information for the Certification of Radiocommunication Equipment</i> ANSI C63.4.-2003, <i>American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz</i>

Annex 4

Standards containing measurement methods used within IEC/ISO

This Annex contains the IEC/ISO standards for SRDs.

Standard	Name	Notes
ISO/IEC 18046-1	Information technology – Radio frequency identification device performance test methods – Part 1: Test methods for system performance	
ISO/IEC 18046-2	Information technology – Radio frequency identification device performance test methods – Part 2: Test methods for interrogator performance	
ISO/IEC 18046-3	Information technology – Radio frequency identification device performance test methods – Part 3: Test methods for tag performance	

Standard	Name	Notes
ISO/IEC TR 18047-2	Information technology – Radio frequency identification device conformance test methods – Part 2: Test methods for air interface communications below 135 kHz	
ISO/IEC TR 18047-3	Information technology – Radio frequency identification device conformance test methods – Part 3: Test methods for air interface communications at 13.56 MHz	
ISO/IEC TR 18047-4	Information technology – Radio frequency identification device conformance test methods – Part 4: Test methods for air interface communications at 2.45 GHz	
ISO/IEC TR 18047-6	Information technology – Radio frequency identification device conformance test methods – Part 6: Test methods for air interface communications at 860 MHz to 960 MHz	
ISO/IEC TR 18047-7	Information technology – Radio frequency identification device conformance test methods – Part 7: Test methods for active air interface communications at 433 MHz	
ISO 18000-2	Air interface for < 135 kHz – Type A (FDX), Type B (HDX) – Optional anti-collision, Tags & System provides interoperability	Published
ISO 18000-3	Air interface at 13,56 MHz – Mode 1 based on ISO 15693, 2 speeds 26 & 52 kB – Mode 2 high speed interface, 424 kB, 8 return channels	Published
ISO 18000-4	Air Interface at 2,45 GHz – Mode 1 passive tag – Mode 2 battery assisted & long range, High speed 384 kB or R/O at 76 kB	Published
ISO 18000-6	Air Interface at 860-960 MHz – Type A, pulse interval encoding & adaptive Aloha anti-collision algorithm – Type B, Manchester encoding & adaptive binary-tree anti-collision algorithm – Type C, pulse interval Encoding, EPC Global Gen2	Published
ISO 18000-6 A1	Amendment 1 – Mode C	Published as AMD1 2006
ISO 18000-7	Air interface at 433 MHz – only applicable for active tags because of max 10 mW emission level	Published
ISO 18000-7 R1	Revision 1	Published
ISO 24730-1	Real Time Locating Systems (RTLS) – Part 1: Application Program Interface (API)	Published
ISO 24730-2	Real Time Locating Systems (RTLS) – Part 2: 2,4 GHz – Direct sequence Spread spectrum (DSSS)	Published
ISO 11785	Radio Frequency Identification of Animals Technical concept ace	
ISO 14223	Radio Frequency Identification of Animals Advanced Transponders Part 1: Air Interface	Published
ISO 15693	Identification cards – Contactless integrated circuit(s) cards; Vicinity Integrated Circuit(s) Card; Part 2: Radio frequency power and signal interface	Published
ISO 14443	Identification cards Contactless integrated circuit cards Proximity cards Part 1: Physical characteristics	Published