

**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
Radio Frequency Identification Equipment operating in the  
band 865 MHz to 868 MHz with power levels up to 2 W;  
Part 1: Technical requirements and  
methods of measurement**

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# Contents

Intellectual Property Rights .....	7
Foreword.....	7
1 Scope .....	8
2 References .....	8
2.1 Normative references .....	9
2.2 Informative references.....	9
3 Definitions, symbols and abbreviations .....	9
3.1 Definitions.....	9
3.2 Symbols.....	10
3.3 Abbreviations .....	10
4 Technical requirement specifications .....	11
4.1 General requirements .....	11
4.2 Presentation of equipment for testing purposes.....	11
4.2.1 Choice of model for testing .....	12
4.2.2 Operational frequency ranges .....	12
4.2.2.1 Choice of frequencies.....	12
4.2.2.2 Channel range .....	12
4.2.2.3 Testing of operational frequencies .....	12
4.2.3 Number of samples for testing.....	13
4.2.4 Test mode.....	13
4.2.5 Testing of equipment with alternative power levels .....	13
4.2.6 Testing of equipment that does not have an external 50 $\Omega$ RF connector (integral antenna equipment).....	14
4.2.6.1 Equipment with an internal permanent or temporary antenna connector.....	14
4.2.6.2 Equipment with a temporary antenna connector.....	14
4.3 Mechanical and electrical design.....	14
4.3.1 General.....	14
4.3.2 Controls .....	14
4.3.3 Transmitter shut-off facility .....	14
4.3.4 CE Marking .....	14
4.4 Declarations by the provider .....	14
4.5 Auxiliary test equipment .....	15
5 Test conditions, power sources and ambient temperatures .....	15
5.1 Normal and extreme test conditions .....	15
5.2 Test power sources .....	15
5.2.1 External test power source.....	15
5.2.2 Internal test power source .....	15
5.3 Normal test conditions.....	16
5.3.1 Normal temperature and humidity .....	16
5.3.2 Normal test power source .....	16
5.3.2.1 Mains voltage.....	16
5.3.2.2 Regulated lead-acid battery power sources .....	16
5.3.2.3 Other power sources.....	16
5.4 Extreme test conditions .....	16
5.4.1 Extreme temperatures .....	16
5.4.1.1 Procedure for tests at extreme temperatures.....	16
5.4.1.1.1 Procedure for equipment designed for continuous operation .....	17
5.4.1.1.2 Procedure for equipment designed for intermittent operation .....	17
5.4.1.2 Extreme temperature ranges.....	17
5.4.2 Extreme test source voltages.....	17
5.4.2.1 Mains voltage.....	17
5.4.2.2 Regulated lead-acid battery power sources and gel-cell battery power sources.....	18
5.4.2.3 Power sources using other types of batteries.....	18

5.4.2.4	Other power sources.....	18
6	General conditions.....	18
6.1	Normal test signals and test modulation.....	18
6.1.1	Normal test signals for data.....	18
6.2	Artificial antenna.....	18
6.3	Test fixture.....	19
6.4	Test sites and general arrangements for radiated measurements.....	19
6.5	Modes of operation of the transmitter.....	19
6.6	Measuring receiver.....	19
7	Measurement uncertainty.....	20
8	Methods of measurement and limits for transmitter parameters.....	20
8.1	Frequency error for mains operated equipment.....	20
8.1.1	Definition.....	20
8.1.2	Method of measurement of frequency error.....	21
8.1.3	Limits.....	21
8.2	Frequency stability under low voltage conditions.....	21
8.2.1	Definition.....	21
8.2.2	Method of measurement.....	21
8.2.3	Limits.....	21
8.3	Radiated power (e.r.p.).....	22
8.3.1	Definition.....	22
8.3.2	Method of measurement.....	22
8.3.2.1	Radiated measurement.....	22
8.3.2.2	Conducted measurement.....	23
8.3.3	Limits.....	23
8.4	Transmitter spectrum mask.....	24
8.4.1	Definition.....	24
8.4.2	Method of measurement.....	24
8.4.3	Limits.....	25
8.5	Unwanted emissions in the spurious domain.....	25
8.5.1	Definition.....	25
8.5.2	Method of measurement.....	25
8.5.2.1	Method of measuring the power level in a specified load, clause 8.5.2, a) i).....	26
8.5.2.2	Method of measuring the effective radiated power, clause 8.5.2, a) ii).....	26
8.5.2.3	Method of measuring effective radiated power, clause 8.5.2, b).....	27
8.5.3	Limits.....	27
8.6	Transmission times.....	27
8.6.1	Definition.....	27
8.6.2	Method of measurement.....	28
8.6.3	Limits.....	28
9	Receiver parameters.....	29
9.1	Co-channel rejection.....	29
9.1.1	Definition.....	29
9.1.2	Method of measurement.....	29
9.1.2.1	Method of measuring radiated signals.....	29
9.1.2.2	Method of measuring using power splitter.....	30
9.1.3	Limits.....	30
9.2	Adjacent channel selectivity.....	30
9.2.1	Definition.....	30
9.2.2	Method of measurement.....	30
9.2.2.1	Method of measuring radiated signals.....	31
9.2.2.2	Method of measuring using power splitter.....	31
9.2.3	Limits.....	32
9.3	Blocking or desensitization.....	32
9.3.1	Definition.....	32
9.3.2	Method of measurement.....	32
9.3.2.1	Method of measuring radiated signals.....	32
9.3.2.2	Method of measuring using power splitter.....	33
9.3.3	Limits.....	33

9.4	Spurious emissions .....	33
9.4.1	Definition .....	33
9.4.2	Method of measurement .....	34
9.4.2.1	Method of measuring the power level in a specified load, clause 9.4.2, a) i).....	34
9.4.2.2	Method of measuring the effective radiated power, clause 9.4.2, a) ii).....	34
9.4.2.3	Method of measuring the effective radiated power, clause 9.4.2, b).....	35
9.4.3	Limits.....	35
10	Limits and methods of measurement for tag emissions .....	35
10.1	Definition .....	35
10.2	Method of measurement .....	35
10.3	Limits .....	36
<b>Annex A (normative): Radiated measurement.....</b>		<b>38</b>
A.1	Test sites and general arrangements for measurements involving the use of radiated fields .....	38
A.1.1	Anechoic chamber .....	38
A.1.2	Anechoic chamber with a conductive ground plane .....	39
A.1.3	Open Area Test Site (OATS) .....	40
A.1.4	Test antenna.....	41
A.1.5	Substitution antenna .....	42
A.1.6	Measuring antenna .....	42
A.1.7	Stripline arrangement .....	42
A.1.7.1	General.....	42
A.1.7.2	Description.....	42
A.1.7.3	Calibration .....	42
A.1.7.4	Mode of use .....	42
A.2	Guidance on the use of radiation test sites .....	43
A.2.1	Verification of the test site .....	43
A.2.2	Preparation of the EUT.....	43
A.2.3	Power supplies to the EUT .....	43
A.2.4	Range length.....	43
A.2.5	Site preparation .....	44
A.3	Coupling of signals.....	45
A.3.1	General .....	45
A.3.2	Data signals .....	45
A.4	Standard test position .....	45
A.5	Test fixture .....	46
A.5.1	Description .....	46
A.5.2	Calibration.....	46
A.5.3	Mode of use.....	47
<b>Annex B (normative): Listen Before Talk .....</b>		<b>48</b>
B.1	General performance criteria.....	48
B.1.1	Void.....	48
B.1.2	Receiver functional specification .....	48
B.1.2.1	Listen mode .....	48
B.1.2.2	Talk mode .....	48
B.1.3	Scan mode .....	48
B.2	Receiver threshold in listen mode .....	49
B.2.1	Definition .....	49
B.2.2	Method of measurement.....	49
B.2.3	Limits .....	50
B.3	Blocking or desensitization in listen mode.....	50
B.3.1	Definition .....	50
B.3.2	Method of measurement.....	51
B.3.2.1	Method of measuring radiated signals .....	51
B.3.2.2	Conducted method of measurement.....	52

B.3.3	Limits .....	53
<b>Annex C (informative):</b>	<b>Bibliography .....</b>	<b>54</b>
History .....		55

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## Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Vote phase of the ETSI standards Two-step Approval Procedure.

Every EN prepared by ETSI is a voluntary standard. The present document contains technical characteristics and test methods for the equipment to which it relates. This text should be considered as guidance only and does not make the present document mandatory.

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 98/34/EC (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

Annex A provides normative specifications concerning radiated measurements.

Annex B provides normative specifications on tests to be carried out on interrogators that include the optional feature called "Listen Before Talk".

The present document is part 1 of a multi-part deliverable covering Radio Frequency Identification Equipment operating in the band 865 MHz to 868 MHz with power levels up to 2 W, as identified below:

**Part 1: "Technical requirements and methods of measurement";**

Part 2: "Harmonized EN covering essential requirements of Article 3.2 of the R&TTE Directive".

The present document includes improvements to the previous version of the standard that take advantage of technical developments within the RFID industry. In particular this includes the ability for multiple interrogators to transmit simultaneously on the same channel. This provides significant improvements in spectrum efficiency and system performance. As a consequence "listen before talk" is no longer a requirement.

<b>Proposed national transposition dates</b>	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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# 1 Scope

The present document covers the minimum characteristics considered necessary in order to make the best use of the available frequencies. It does not necessarily include all the characteristics that may be required by a user, nor does it necessarily represent the optimum performance achievable.

Radio frequency identification products covered within the present document are considered by definition short-range devices. Power limits up to a maximum e.r.p. of 2 W are specified for this equipment in the frequency range 865 MHz to 868 MHz.

The present document applies to RFID interrogators and tags operating together as a system. The interrogators transmit in four specified channels of 200 kHz each using a modulated carrier. The tags respond with a modulated signal preferably in the adjacent low power channels. Interrogators may be used with either integral or external antennas.

ElectroMagnetic Compatibility (EMC) requirements are covered by EN 301 489-1 [4] and EN 301 489-3 [5].

The types of equipment covered by the present document are as follows:

- fixed interrogators;
- portable interrogators;
- batteryless tags;
- battery assisted tags;
- battery powered tags.

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# 2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
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  - for informative references.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.



## 2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

- [1] ETSI TR 100 028 (V.1.4.1) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [2] ETSI TR 102 273 (V.1.2.1) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".
- [3] ANSI C63.5-2006: "American National Standard for Calibration of Antennas Used for Radiated Emission Measurements in Electromagnetic Interference".

## 2.2 Informative references

- [4] ETSI EN 301 489-1 (V.1.7.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements".
- [5] ETSI EN 301 489-3 (V.1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz".
- [6] TCAM (21)36: "Passive RFID tags at the stage of placing on the market and the R&TTE Directive".
- [7] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).

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## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**adaptive frequency agility:** technique that allows an interrogator to change its frequency of operation automatically from one channel to another

**assigned frequency band:** frequency band within which the emission by a device is authorized

**battery assisted tag:** transponder that includes a battery to enhance its receive performance and power its internal circuitry

**batteryless tag:** transponder that derives all of the power necessary for its operation from the field generated by an interrogator

**battery powered tag:** transponder that uses the power from its battery to perform all of its operational functions

**conducted measurements:** measurements which are made using a direct 50  $\Omega$  connection to the equipment under test

**dedicated antenna:** removable antenna supplied and type tested with the radio equipment, designed as an indispensable part of the equipment

**dense interrogator mode:** RFID operating mode in which multiple interrogators can transmit simultaneously in the same channel while tags respond in the adjacent channels

**effective radiated power:** product of the power supplied to the antenna and its gain relative to a half wave dipole in the direction of maximum gain

**external antenna:** antenna that may be connected to an interrogator via its external connector

**full tests:** all tests specified in the present document

**global scroll:** mode in which an interrogator is able to read the same tag continuously for test purposes only

**integral antenna:** permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment

**interrogator:** equipment that will activate an adjacent tag and read its data. It may also enter or modify the information in a tag

**limited tests:** limited tests (see clauses 4.2.1 to 4.2.2.3 of the present document) are as follows:

- transmitter frequency error and frequency stability under low voltage conditions for mains operated equipment, see clause 8.1 of the present document;
- transmitter frequency stability under low voltage conditions, see clause 8.2 of the present document;
- transmitter effective radiated power, see clause 8.3 of the present document.

**Listen Before Talk (LBT):** action taken by an interrogator to detect an unoccupied channel prior to transmitting (also known as "listen before transmit")

**provider:** means the manufacturer, or his authorized representative or the person responsible for placing on the market

**radiated measurements:** measurements which involve the absolute measurement of a radiated field

**scan mode:** specific test mode of an interrogator that detects a signal on a pre-selected channel and transmits automatically on another channel

NOTE: See clause B.1.3.

**tag:** transponder that holds data and responds to an interrogation signal

**talk mode:** transmission of intentional radiation by an interrogator

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

dB	decibel
d	distance
f	frequency measured under normal test conditions
fc	centre frequency of carrier transmitted by interrogator
fe	the maximum frequency drift as measured in clause 8.1.2 b)
$\Omega$	Ohms
$\lambda$	wavelength

## 3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ANSI	American National Standards Institute
BER	Bit Error Ratio
CEPT	European Conference of Postal and Telecommunications administrations
e.r.p.	effective radiated power
EMC	ElectroMagnetic Compatibility
emf	electromotive force
ERC	European Radio communication Committee
EUT	Equipment Under Test

FT	Full Tests
LBT	Listen Before Talk
LT	Limited Tests
OATS	Open Area Test Site
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
RFID	Radio Frequency IDentification
SRD	Short Range Device
VSWR	Voltage Standing Wave Ratio

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## 4 Technical requirement specifications

### 4.1 General requirements

Interrogators shall transmit on any of the high power channels specified in clause 4.2.2.1 at power levels up to the limit specified in clause 8.3.3.

An interrogator may transmit a continuous signal on any of the high power channels for a period not exceeding the limit defined in clause 8.6.3. At the end of the transmission the interrogator shall not transmit again on the same channel for the period defined in clause 8.6.3. Alternatively the interrogator may switch immediately to any one of the other high power channels send a further continuous transmission in accordance with the requirements of clause 8.6.3. There is no limit to the number of times that this process may be repeated.

In a preferred method of operation tags, that are activated by an interrogator transmitting in a high power channel, respond in the adjacent low power channels. This technique is called the dense interrogator mode. It has the benefit of separating the frequencies of transmission of the interrogators and tags, allowing multiple interrogators to share the same channel thereby improving system performance. It also minimises the generation of inter-modulation products, which may disrupt the behaviour of tags.

The interrogator shall be so designed as to ensure that its length of transmission is no greater than is necessary to perform the intended operation. Interrogators shall support trigger techniques that indicate the presence or arrival of objects that may be tagged. Irrespective of the application, an interrogator shall stop transmitting after it has ceased to read any further tags, as specified in clause 8.6.3.

Interrogators may also operate in a presence sensing mode in which they periodically transmit to determine whether tags have entered their interrogation zones. When operating in this mode, interrogators shall restrict the length of each transmission to less than 1 second and the period between successive transmissions shall be no less than 100 ms. Once an interrogator has determined the presence of tags, it will commence its reading routine.

### 4.2 Presentation of equipment for testing purposes

Equipment submitted for testing shall fulfil the requirements of the present document on all frequencies over which it is intended to operate.

Providers shall select frequencies of operation in accordance with the channel plan defined in clause 4.2.2.1 and in accordance with the power levels defined in clause 8.3.3.

If equipment is designed to operate with different carrier powers, measurement of each transmitter parameter shall be performed at the highest power level at which the transmitter is intended to operate.

To simplify and harmonize the testing procedures between the different testing laboratories, measurements shall be performed according to the present document on samples of equipment as defined in clauses 4.2.1 to 4.5. These clauses are intended to give confidence that the requirements set out in the present document have been met without the necessity of performing measurements at all frequencies.

## 4.2.1 Choice of model for testing

The provider shall supply one or more samples of the equipment, as appropriate, for testing.

If an equipment has several optional features considered not to affect the RF parameters then tests need only be performed on the equipment configured with that combination of features considered to be the most complex, as proposed by the provider and agreed by the test laboratory.

In the case of hand portable equipment without a 50  $\Omega$  external antenna connector, see clause 4.2.6.

## 4.2.2 Operational frequency ranges

### 4.2.2.1 Choice of frequencies

Interrogators shall operate within the band 865 MHz to 868 MHz on any of the four specified high power channels as illustrated in figure 1. The band width of each high power channel shall be 200 kHz and the centre frequency of the lowest channel shall be 865,7 MHz. The remaining three high power channels shall be spaced at equal intervals of 600 kHz. Tags should preferably respond in the dense interrogator mode within the low power channels. A diagram of the channel plan for the band is shown in figure 1.

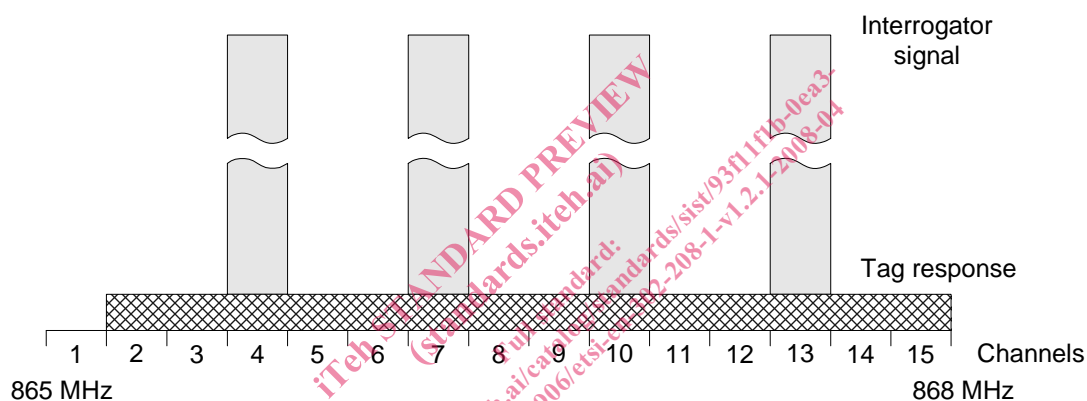


Figure 1: Diagram of channel plan

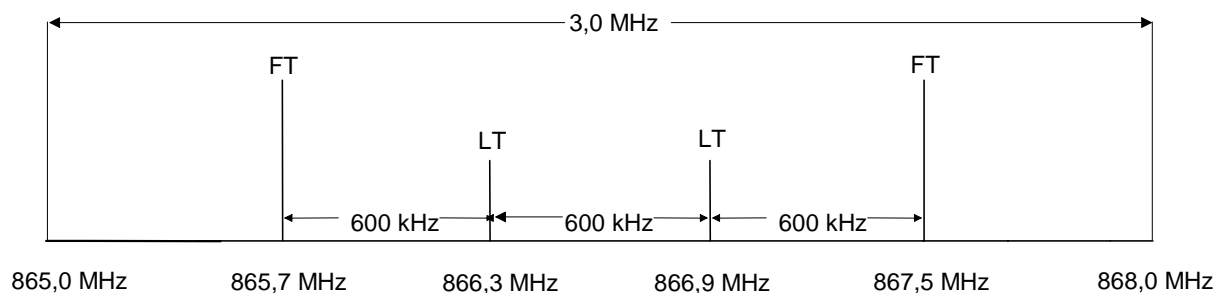
### 4.2.2.2 Channel range

When submitting equipment for testing, the provider shall state the frequencies of the channels on which the interrogator will operate. The provider shall also confirm that the interrogator shall operate on each of the declared channels without any change to the circuit or trimming of discrete components.

Trimming is an act by which the value (in this case relating to frequency) of a component is changed within the circuit. This act may include the physical alteration, substitution (by components of similar size and type) or activation/de-activation (via the setting of soldered bridges) of components.

### 4.2.2.3 Testing of operational frequencies

Figure 2 shows the centre frequencies of the four high power channels permitted for use by interrogators at levels up to 2 W e.r.p. within the band designated for RFID. Full (FT) and Limited (LT) Tests, as defined in clause 3.1, shall be carried out in the applicable channels at the frequencies shown in figure 2.



Legend: LT: Limited tests, see clause 3.1.  
 FT: Full tests, see clause 3.1.

**Figure 2: Tests on a single sample for equipment within the band 865,0 MHz to 868,0 MHz**

### 4.2.3 Number of samples for testing

Interrogators shall be submitted for test such that they may be configured to operate on each of the four high power channels as specified in figure 2. It is only necessary for one sample of equipment to be tested.

The provider shall supply a quantity of at least 3 pre-programmed tags with each interrogator that is submitted for test.

### 4.2.4 Test mode

The interrogator shall include a suitable test mode to permit testing of the parameters defined in clauses 8 and 9. The test mode shall be readily controlled by means, for example, of an external PC or terminal unit.

The test mode shall include the features listed below:

- 1) It shall be possible to set the interrogator to transmit a continuously un-modulated carrier on any one of the declared channels of operation.
- 2) While the interrogator is transmitting on a preset channel, it shall be possible to read and log the identity of any valid tags that are present in the interrogation field.
- 3) It shall be possible to cause the interrogator to transmit normal test signals continuously as defined in clause 6.1.1 at its maximum data rate as declared by the provider.
- 4) It shall be possible to configure a tag in a test mode such that, in the presence of an interrogation field, it transmits a continuous modulated response. Alternatively this requirement may be satisfied by a suitably configured test tag with an output that is representative of the production version.

### 4.2.5 Testing of equipment with alternative power levels

If a family of equipment has alternative output power levels provided by the use of separate power modules or add-on stages, then each module or add-on stage shall be tested in combination with the equipment. The necessary number of samples and additional tests can be proposed by the provider and shall be agreed by the test laboratory based on the requirements of clause 4.2.