MPT 1349

PERFORMANCE SPECIFICATION

Transmitters and receivers for use in the microwave bands allocated to low power applications

Revised and reprinted December 1999

Superseded specification BR 14

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FOREWORD

It is a requirement of the Wireless Telegraphy Act 1949 that no radio apparatus shall be installed or used in the United Kingdom except under the authority granted by the Secretary of State. It is a condition of this authority that the performance of the apparatus must meet certain minimum standards. These minimum standards of performance are given in specifications prepared by the Radiocommunications Agency in consultation with the relevant manufacturers.

Applicants who wish to submit equipment for type approval testing should apply to one of the accredited test houses. Guidance for applicants is given in the RA Information Sheet 'RA 207 : Type Approval - UK Type Approval Requirements for Land Mobile and Maritime Mobile Radiocommunications Equipment'. This is available on a single copy basis free from the RA Information & Library Service.

Equipment will be considered for approval purposes either:

a) by direct compliance with MPT 1349 or;

b) by compliance with any national standard or government regulation of any Member State of the European Community, or any Member State which is a contracting party to the EEA Agreement or;

c) by compliance with any relevant international standard or regulation recognised in a member State of the European Community, or a Member State which is a contracting party to the EEA Agreement;

d) and, where appropriate, by compliance with manufacturing rules and procedures of a Member State of the European Communities, or a Member State which is a contracting party to the EEA Agreement, relating to quality control operations during manufacture of the equipment where they form part of a standard or technical regulations in a) to c) as above;

provided that in case b) or c) the regulation is deemed to comply with MPT 1349.

The results of tests to such a standard will be taken into consideration if carried out by authorised and accredited test houses in accordance with ISO guides 25 and 58 or EN45001 and EN45002 or a national standard confirming these requirements.

This specification was notified to the EU under Directive 83/189/EEC.

For aspects relating to electromagnetic compatibility, the equipment covered by this specification must be in conformity with either the Statutory Instrument No. 2372 (1992) implementing the EMC Directive 89/336/EEC, or - until 31 December 1995 - the national regulations in force in the United Kingdom on 30 June 1992.

Notwithstanding the provisions of the EMC Directive, the following sub clauses shall be applied for spectrum management:

1) transmitter spurious emissions, subcaluse 4.3
2) receiver spurious radiations, subclause 5.1

The EMC tests carried out on the basis of article 10 in paragraph 5 of the EMC Directive 89/336/EEC by the notified bodies established in other Member States should not be repeated for licensing purposes in the United Kingdom.

Applicants who wish to demonstrate compliance with the EMC directive are advised to refer to the RA Information sheets 'RA 200: Electromagnetic Compatibility for Radio' and 'RA 277 : EMC - The EC Type Examination Route to compliance for Radiocommunication Transmission Apparatus'. These are available on a single copy basis free from the RA Information & Library Service.

It may be necessary for amendments to this specification to be issued. Amendment sheets will be available from the RA Information and Library Service.

For the latest information concerning Type Approval Status and Licensing conditions, refer to the RA Information Sheet 'RA 275: Status of Land Mobile Radio Specifications (MPT 1300 series)'. This publication also contains contact names and telephone numbers for Agency staff who are able to assist you with licensing and technical enquiries and is available on a single copy basis free from the RA Information & Library Service.

In order to permit the greatest freedom of design for this equipment, whilst protecting other radio services from interference, a balance is possible between the permitted range of frequencies on which the equipment may be used, and its frequency and modulation stability characteristics. An equipment with poor frequency stability and/or wide modulation bandwidth would only be permitted to operate within a narrow frequency range within the band. Conversely, equipment designed to have a better frequency stability and narrower modulation bandwidth would be permitted a wider range of operating frequencies. Manufacturers and suppliers should, however, endeavour to use the highest frequency stability and narrowest modulation bandwidth possible, in order that the band is available to as many users as possible. The methods of determining the permitted range of operating frequencies is to be found in subclause 4.2 of this specification. This range of frequencies will be specified on each type approval certificate issued.

This revision was required in order to allow for;

a) This document to be updated in line with the Agency's current Standard format and layout for the MPT 1300 series specifications.

b) the introduction of 1394 MHz ±5 MHz for Closed Circuit Video Links;

c) the maximum of 500 milliwatts in the 2.445 to 2.455 GHz band and removal of the restriction of "indoor only" for data links;

d) the withdrawal of the 2.445 to 2.475 GHz band and associated methods of measurement;

e) the adoption of European Technical Standards Institute (ETSI) standard ETS 300 328 for Wideband Data Transmission systems as the type approval standard for equipment employing spread spectrum modulation techniques in the 2400 to 2483.5 MHz band;

f) the withdrawal of the 31.80 to 33.40 GHz band;

g) the introduction of 13.4 to 14.0 GHz Licensed band.

The Radiocommunications Agency has a 'web site' which can be accessed on *http://www.radio.gov.uk*; it is planned that all of the MPT 1300 series of specifications will be available here using 'LIBRARY' and 'MPT Specifications' options.

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1 GENERAL

1.1 Scope of specification

This specification covers the minimum performance requirements for low power devices operating in the frequency bands 1.389 to 1.399 GHz, 2.445 to 2.455 GHz, 10.577 to 10.597 GHz, 10.675 to 10.699 GHz, 13.4 to 14.0 GHz, 24.150 to 24.250GHz and 24.250 to 24.350 GHz. It does not necessarily include all characteristics which may be required by a user, nor does it necessarily represent the maximum performance achievable.

Within the designated frequency bands the following applications shall be employed:

	Frequency Band	Application
-	1.389 to 1.399 GHz	Video applications including associated voice and control signals.
-	2.445 to 2.455 GHz	Field disturbance and doppler apparatus. Short range data links.
-	10.577 to 10. 597 GHz	Field disturbance and doppler apparatus.
-	10.675 to 10.699 GHz	Field disturbance and doppler apparatus for use within buildings. Short range data links within buildings.
-	13.4 to 14.0 GHz	Field disturbance and doppler apparatus used as anti-collision devices.
-	24.150 to 24.250 GHz	Field disturbance and doppler apparatus.
-	24.250 to 24.350 GHz	Field disturbance and doppler apparatus for mobile applications.

1.2 Operating frequencies

The operating frequencies shall be at the discretion of the applicant within the permitted range of operating frequencies defined in subclause 1.1.

1.3 Classes of emission

All classes of emission are permitted provided that the requirements of this specification are met (in particular subclause 1.1)

1.4 Phase-locked loop (PLL) systems

If, for determining the transmitter frequency, use is made of a synthesizer and/or a phase locked loop system, the transmitter shall be inhibited when synchronisation is absent.

1.5 Controls

Those controls (of the radio part) which, if adjusted, might increase the interfering potential of the equipment shall not be easily accessible to the user.

1.6 Applicant's responsibility

- Type approval is granted under the Telecommunications Act 1984 sec 84.
- The Approval Certificate holder (the applicant) is responsible for ensuring that the products produced are compliant with the issued type approval.

1.7 Labelling

The equipment shall be provided with a clear indication of the type number and description under which it is submitted for type testing. The equipment shall be permanently marked which shall be located on the outside of the equipment and be immediately visible. The location of the marking shall be recorded on the test report. The type number must allow recognition of the multiple unit type of assembly. In the case of an r.f module, which is to be incorporated into other equipment, the manufacturer shall provide a label to be permanently fixed to the exterior of the host equipment. Each type number shall be unique and in the event that the approval authority finds two manufacturers have used a similar type number one manufacturer will be asked to change the type number.

1.7.1 Additional marking requirement for licence exempt equipment

The equipment shall be permanently marked with an approved inspection mark which shall be located on the outside of the equipment and be immediately visible. The location of the inspection mark shall be recorded in the test report. The mark used to indicate compliance shall be one of the marks given below. The mark shall be decided by using the application information given in subclause 1.1. Where the equipment is capable of operating on more than one band, those bands shall be clearly shown on the compliance mark.

(1)
MPT 1349
W.T.LICENCE EXEMPT
FREQUENCY BAND 1.389 to 1.399 GHz

(2)
MPT 1349
W.T.LICENCE EXEMPT
FREQUENCY BAND 2.445 to 2.455 GHz

(3)
MPT 1349
W.T.LICENCE EXEMPT
FREQUENCY BAND 10.577 to 10.597 GHz

(4)
MPT 1349
W.T.LICENCE EXEMPT
FOR USE WITHIN BUILDINGS
FREQUENCY BAND 10.675 to 10.699 GHz

(5)
MPT 1349
W.T.LICENCE EXEMPT
FREQUENCY BAND 13.4 to 14.0 GHz

(6)
MPT 1349
W.T.LICENCE EXEMPT
FREQUENCY BAND 24.150 to 24.250 GHz

(7)
MPT 1349
W.T.LICENCE EXEMPT
FOR MOBILE USE ONLY
FREQUENCY BAND 24.250 to 24.350 GHz

Letters and figures height shall not be less than 2 mm.

2 TEST CONDITIONS, POWER SOURCES AND AMBIENT TEMPERATURES

2.1 Normal and extreme test conditions

Type testing shall be conducted under normal test conditions and also where stated, under extreme test conditions. The test conditions and procedures shall be as specified in subclauses 2.2 to 2.5.

2.2 Test power source

During type testing the power source of the equipment shall be replaced by a test power source capable of producing normal and extreme test voltages as specified in subclauses 2.3.2 and 2.4.2. The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the purpose of tests, the voltage of the power source shall be measured at the input terminals of the equipment.

If the equipment is provided with a permanently connected power cable, the test voltage shall be that measured at the point of connection of the power cable to the equipment.

In equipment with incorporated batteries, the batteries shall be removed and the test power source applied as close to the battery terminals as practicable. During tests the power source voltages shall be maintained within a tolerance of $\leq \pm 1\%$ relative to the voltage at the beginning of each test.

2.3 Normal test conditions

2.3.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges;

Temperature	+15°C to +35°C
Relative humidity	20% to 75%

NOTE: When it is impracticable to carry out the tests under these conditions a statement giving the actual temperature and relative humidity during the tests shall be added to the test report.

2.3.2 Normal test power source

2.3.2.1 Mains voltage

The normal test voltage for equipment to be connected to the AC mains shall be the nominal mains voltage. For the purpose of this specification the nominal voltage shall be the declared voltage or the declared voltages for which the equipment was designed.

The frequency of the test power source corresponding to the AC mains shall be between 49 and 51 Hz.

2.3.2.2 Regulated lead-acid battery power sources

When the equipment is intended for operation from the usual type of regulated lead-acid battery source used in vehicles the normal test source voltage shall be 1.1 times the nominal voltage of the battery (6 volts, 12 volts etc.).

2.3.2.3 Nickel-cadmium battery

When the equipment is intended for operation from the usual type of nickel-cadmium battery the normal test voltage shall be the nominal voltage of the battery (1.2 V per cell).

2.3.2.4 Other power sources

For operation from other power sources or types of battery, either primary or secondary, the normal test source voltage shall be that declared by the applicant.

2.4 Extreme test conditions

2.4.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in subclause 2.5 at an upper value of +55°C and at a lower value of -10°C.

2.4.2 Extreme test source voltages

2.4.2.1 Mains voltage

The extreme test source voltages for equipment to be connected to an AC mains source shall be the nominal mains voltage ±10%. The frequency of the test power source shall be between 49 and 51 Hz.

2.4.2.2 Regulated lead-acid battery power sources

When the equipment is intended for operation from the usual type of regulated lead-acid power source the extreme test voltages shall be 1.3 and 0.9 times the nominal voltage of the battery.

2.4.2.3 Nickel-cadmium battery

When the equipment is intended for operation from the usual type of nickel-cadmium battery the extreme test voltages shall be 1.25 and 0.85 times the nominal voltage of the battery.

2.4.2.4 Other power sources

The lower extreme test voltage for equipment with power sources using primary batteries shall be as follows:

For Leclanché type of battery - 0.85 times the nominal voltage.
For mercury type of battery - 0.9 times the nominal voltage.
For other types of primary battery - end point voltage declared by the equipment applicant.

For equipment using other power sources, or capable of being operated from a variety of power sources, the extreme test voltages shall be those agreed between the equipment applicant and the testing authority and shall be recorded in the test report.

2.5 Procedure for tests at extreme temperatures

2.5.1 Test procedure

Before measurements are made the equipment under test shall have reached thermal balance in the test chamber. The equipment shall be switched off during the temperature stabilising period. It should be noted that in the case of equipment containing temperature stabilisation circuits designed to operate continuously, the temperature stabilisation circuits shall be switched on for 15 minutes after thermal balance has been obtained after which the tests as appropriate shall commence. If the thermal balance is not checked by measurements, a temperature stabilising period of at least one hour shall be permitted. The sequence of measurements shall be chosen and the humidity level in the test chamber shall be controlled so that excessive condensation does not occur.

2.5.1.1 Procedure for equipment designed for continuous operation

If the applicant states that the equipment under test is designed for continuous operation the test procedure shall be as follows:

Before tests at the upper temperature the equipment under test shall be placed in the test chamber and left until thermal balance is attained. The equipment shall then be switched on in the transmit condition for a period of half an hour after which the tests as appropriate shall commence.

2.5.1.2 Procedure for equipment designed for intermittent operation

If the applicant states that the equipment under test is designed for intermittent operation the test procedure shall be as follows.

Before tests at the upper temperature the equipment shall be placed in the test chamber and left until thermal balance is attained. The equipment under test shall then be switched on for one minute in the transmit condition, followed by four minutes in the receive condition, after which the tests as appropriate shall commence. For tests at the lower temperatures the equipment shall be left in the test chamber until thermal balance is attained, then switched to the standby or receive condition for 2 minutes after which the tests as appropriate shall commence. It should be noted that in the case of equipment containing temperature stabilisation circuits designed to operate continuously, the temperature stabilisation circuits may be switched on for 15 minutes after thermal balance has been obtained after which the tests as appropriate shall commence.

3 ELECTRICAL TEST CONDITIONS

3.1 Normal test signal

The normal test signal shall be, where appropriate, a continuously modulated signal or trains of correctly coded signals. This signal shall be that which requires the greatest radio frequency occupied bandwidth, as agreed between the applicant and testing authority. Details of the test signal shall be included in the test report. The modulating source, where appropriate, which is associated with the transmitter, shall be capable of supplying the normal test signal.

3.1.1 Test signal for video applications

For video applications a CCIR 100% colour bar signal shall be used. The normal level shall be 1 Volt peak to peak, or any lower value agreed between the applicant and the testing authority. For sound subcarrier a 1259 Hz tone shall be used at a level of 100 millivolts rms, or any lower value, as agreed between the applicant and the testing authority.

3.2 Indication of receiver response

For type testing purposes the receiver equipment shall provide a visual indication that the appropriate radio frequency signal is being received.

3.3 Coupling device

Applicants shall supply a coupling device suitable to allow relative measurements to be made on the submitted sample. This coupling device shall provide a correctly matched 50 ohm radio frequency terminal at the working frequencies of the equipment.

The test house may alternatively provide its own coupling device.

The coupling device shall provide means of replacing the power source by an external power supply.

The performance characteristics of this coupling device under normal and extreme conditions shall satisfy the following requirements:

- the coupling loss shall not be excessive, i.e. not greater than 20 dB,
- the variation of coupling loss with frequency shall not cause errors exceeding 2 dB in measurements using the coupling device,
- the coupling device shall not include any non-linear elements.

3.4 Test site and general arrangements for measurements involving the use of radiated fields

3.4.1 Test site

The test site shall be on a level surface or ground. At one point on the site, a ground plane of at least 5 metres diameter shall be provided. In the middle of this ground plane, a non-conducting support, capable of rotation through 360° in the horizontal plane, shall be used to support the test sample at 1.5 metres above the ground plane. The test site shall be large enough to allow the erection of a measuring antenna at a distance of 3 metres.

Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site and ground reflections do not degrade the measurement results.

3.4.2 Test antenna

The test antenna shall be used to detect the radiation from the test sample. This antenna shall be mounted on a support such as to allow the antenna to be used in either horizontal or vertical polarisation and for the height of its centre above ground to be varied over the range 1 to 4 metres. Test antennas with pronounced directivity shall be used. The size of the test antenna along the measurement axis shall not exceed 20% of the measuring distance.

For radiation measurements the test antenna shall be connected to a test receiver capable of being tuned to any frequency under investigation and of measuring accurately levels of signals at its input.

3.5 Arrangement for test signals at the input of the transmitter

For the purpose of this specification the transmitter modulating signal, where appropriate, shall be provided by a suitable encoder if not generated within the transmitter.

4 TRANSMITTER

4.1 Effective radiated power

4.1.1 Definition

The effective radiated power is the maximum isotropically radiated power under specified conditions of measurement. The rated maximum isotropically radiated power shall be declared by the applicant.

4.1.2 Method of measurement under normal test conditions

On a test site fulfilling the requirements of subclause 3.4, the equipment under test shall be placed on the support so that maximum radiation is directed towards a test antenna. The test antenna shall be connected to a spectrum analyser. The transmitter shall be switched on, (without modulation if possible) and the spectrum analyser shall be tuned to the frequency of the signal being measured. The test antenna shall be

orientated for the same polarisation as the sample and shall be raised or lowered through the specified height range until a maximum signal level is detected on the spectrum analyser. The transmitter shall be rotated until the maximum signal is received. It should be noted that this maximum may be a lower value than the value obtainable at heights outside the specified limits.

For equipment operating in the bands up to and including 10.699 GHz the resolution bandwidth shall be set at 100 kHz.

For equipment operating in the bands above 10.699 GHz the resolution bandwidth shall be set at 300 kHz.

The signal level as measured by the spectrum analyser is converted into power incident at the test antenna from the calibration of the analyser and gain of the test antenna.

The path loss between the sample under test and the test antenna is calculated as follows:

$$Pathloss(dB) = 20 \log_{10} \frac{4\pi D}{\lambda}$$

where D is the distance between the equipment under test and the test antenna in metres, and λ is the wavelength of the transmission being measured in metres. From the incident power at the test antenna, the calculated path loss, and the losses associated with cables and connectors the maximum equivalent isotropically radiated power can be obtained.

A measurement should be made at other planes of polarisation to ensure that the value obtained above is the maximum. If larger values are obtained this fact should be recorded in the test report.

This measurement shall be repeated for any alternative antenna supplied by the applicant.

4.1.3 Method of measurement under extreme test conditions

The equipment under test shall be coupled to a spectrum analyser by means of a coupling device (subclause 3.3) where appropriate, and the effective radiated power shall be measured under extreme test conditions (subclauses 2.4.1 and 2.4.2 applied simultaneously) in accordance with subclause 2.5, maintaining the test equipment settings described in subclause 4.1.2.

4.1.4 Limits

The transmitter maximum equivalent isotropically radiated power under normal test conditions and under extreme test conditions shall not exceed the values given in table 1.

Table 1

Frequency band GHz	Maximum equivalent isotropically radiated power Watts
1.389 to 1.399	0.5
2.445 to 2.455	0.5[1]
10.577 to 10.597	1.0
10.675 to 10.699	1.0
13.400 to 14.000	0.5
24.150 to 24.250	2.0
24.250 to 24.350	2.0

4.2 Permitted range of operating frequencies

4.2.1 Definition

The permitted range of operating frequencies includes all frequencies on which the type approved equipment may operate within the appropriate band. This range of frequencies will be specified on each type approval certificate issued.

4.2.2 Method of measurement under normal test conditions

The equipment under test shall be arranged in the manner described in subclauses 4.1.2.

The transmitter shall be modulated, where appropriate, by the normal test signal (subclause 3.1) at the input level declared by the applicant.

In the case of analogue inputs, the test shall be repeated with the transmitter modulated by the test signals as defined in subclause 3.1 at a level 20 dB above the level of the normal test signal.

The spectrum analyser shall be adjusted so that the spectrum of the transmitter output, including that part which falls in the band allocated for use by the equipment under test is displayed.

The power level calibration of the spectrum analyser shall be related to the power level measured in subclause 4.1.2, by a known radio frequency attenuation factor. This factor will be used to calculate absolute levels of radio frequency power.

The points on the displayed spectrum furthest from the nominal frequency of the equipment under test, but within the frequency band allocated for use by the equipment under test, at which a power level of 1 microwatt is measured shall be recorded. For this measurement the resolution bandwidth of the spectrum analyser shall be adjusted to 10 kHz. That point below the nominal frequency shall be recorded as (f_l), that point above the nominal frequency shall be recorded as (f_h) and the frequency at which peak power is observed shall be recorded as (f_p).

4.2.3 Method of measurement under extreme test conditions

The measurement described in subclause 4.2.2 shall be repeated under extreme test conditions (subclauses 2.4.1 and 2.4.2 applied simultaneously) using the normal test signal, in order to measure frequency error (f_d).

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[1] Power levels greater than 100 mW are only permitted for tagging and identification applications

4.2.4 Limits

The permitted range of operating frequencies shall be determined as follows:

lower limit = lower limit of allocated band + $[(f_p)-(f_l)]$ + (f_d) GHz
upper limit = upper limit of allocated band - $[(f_h)-(f_p)]$ - (f_d) GHz

where
(f_p), (f_l) and (f_h) are determined as described in subclause 4.2.2.

and
(f_d), is determined as described in subclause 4.2.3.

4.3 Spurious emissions of the transmitter (radiated)

4.3.1 Definition

Spurious emissions are emissions at frequencies other than those of the carrier and sidebands associated with normal modulation. The level of spurious emissions shall be measured as the effective radiated power radiated by the cabinet, antenna and structure of the equipment.

4.3.2 Method of measurement

On a test site fulfilling the requirements of subclause 3.4 the equipment under test shall be placed at the specified height on the support. The transmitter shall be operated where possible without modulation at the carrier power determined in subclause 4.1.

Radiation of any spurious components shall be detected by the test antenna and spectrum analyser, over the frequency range 25 MHz to 10 GHz for equipment operating in the bands below 10 GHz and 25 MHz to twice the operating frequency for equipment operating in bands above 10 GHz.

At each frequency at which a component is detected the sample shall be rotated to obtain the maximum response and the effective radiated power of that component determined.

The measurement shall be repeated with the test antenna in the orthogonal polarisation plane.

The measurements shall be repeated with the transmitter modulated by the normal test signal where appropriate (subclause 3.1).

The measurements shall be repeated for any alternative antenna which can be supplied by the applicant.

4.3.3 Limits

The power of any spurious emission shall not exceed the value of 4 nanowatts in the frequency bands

41.0 to 68.0 MHz
87.5 to 118.0 MHz
162.0 to 230.0 MHz
470.0 to 862.0 MHz

and shall not exceed a value of 250 nanowatts on other frequencies below 1 GHz.
On frequencies above 1 GHz the power of any spurious emission shall not exceed a value of 1 microwatt.

5 RECEIVER

5.1 Spurious radiations

This test is to be performed where the receiver is not combined with the transmitter and operating simultaneously.

5.1.1 Definition

Spurious radiations from receivers are emissions at any frequency radiated by the equipment and its antenna.

5.1.2 Method of measurement

On a test site fulfilling the requirements of subclause 3.4, the equipment under test shall be placed at the specified height on the support. The receiver shall be operated from a power source via a radio frequency filter to avoid radiation from the power leads. Radiation of any spurious components shall be detected by the test antenna and receiver. At each frequency at which a component is detected, the equipment under test shall be rotated to obtain maximum response and the effective radiated power of that component determined.

The measurement shall be repeated with the test antenna in the orthogonal polarisation plane. The measurement shall extend over the range 25 MHz to 10 GHz for equipment operating in the bands below 10 GHz and 25 MHz to twice the operating frequency for equipment operating in bands above 10 GHz.

5.1.3 Limits

The power of any spurious emission shall not exceed 2 nanowatts in the range 25 MHz to 1 GHz and shall not exceed 20 nanowatts on frequencies above 1 GHz.

6 ACCURACY OF MEASUREMENTS

The tolerance for the measurements of the following parameters shall be as follows:

*	Radio frequency field strength	± 3 dB
*	Radio frequency carrier power	± 10%
*	Impedance of artificial loads combining units, cables, plugs, attenuators, etc.	± 5%
*	Input impedance of measuring receivers	± 10%
*	Attenuation of attenuators	± 0.5 dB
*	Temperature	± 1°C
*	Humidity	± 5%

7 INTERPRETATION OF THIS SPECIFICATION

In cases of doubt about the interpretation of this specification the methods of carrying out the tests and the validity of statements made by the applicant, the decision of the Radiocommunications Agency shall be final.