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PERFORMANCE SPECIFICATION FOR ANGLE MODULATED RADIO EQUIPMENT FOR USE AS REPEATER, BASE AND MOBILE STATIONS IN 800 MHz TRUNKED RADIO

電訊管理局

TELECOMMUNICATIONS AUTHORITY
HONG KONG

FOREWORD

1. This specification is prescribed under section 32D of the Telecommunications Ordinance (Cap 106) ("the Ordinance") to set out the technical and evaluation requirements for angle modulated radio equipment used in 800 MHz trunked systems in land mobile service. The frequencies earmarked in Hong Kong are from 850 MHz to 863 MHz for mobile station receive and from 805 MHz to 818 MHz for mobile station transmit. Radiocommunications apparatus falling into the scope of this specification shall meet the stipulated requirements.

2. Under the Ordinance, the possession or use of any radiocommunications apparatus or any apparatus emitting radio frequency energy must be covered by an appropriate licence issued by the Telecommunications Authority (TA) with the exception of those specifically exempted from licensing under the Ordinance, such as those covered by the Telecommunications (Telecommunications Apparatus)(Exemption from Licensing) Order.

3. At present, the Office of the Telecommunications Authority (OFTA) operates a Hong Kong Telecommunications Equipment Evaluation and Certification (HKTEC) Scheme. Details of the HKTEC Scheme can be found in the information note OFTA I 421. Under the Scheme, suppliers or manufacturers of the radiocommunications apparatus shall apply to OFTA for certification of their apparatus against this specification. The application procedures for certification of radiocommunications apparatus can be found in the information note OFTA I 401.

4. The TA reserves the right to give separate certification to models he considers to be technical variants and the performance of which may differ between models.

5. The TA may amend any part of this specification as and when he deems necessary.

6. In case of doubt about the interpretation of this specification, the methods of carrying out the test and the validity of statements made by the equipment manufacturers or suppliers about the equipment, the decision of the TA shall be final.

7. The HKTA specifications and information notes are issued by the TA. The documents can be obtained through one of the following methods :-

   - downloading direct through the OFTA's Internet Home Page. The Home Page address is http://www.ofta.gov.hk;

- making a request for hard copies to :-

  Radio Laboratory,
  Standards Section,
  Office of the Telecommunications Authority,
  29/F Wu Chung House,
  213 Queen's Road East,
  Wanchai,
  Hong Kong.

  Fax: +852 2343 5824
  Email: radiolab@ofta.gov.hk

8. Enquiries about this specification may be directed to :-

   Radio Laboratory, Standards Section,
   Office of the Telecommunications Authority,
   29/F Wu Chung House,
   213 Queen's Road East, Wanchai, Hong Kong.

   Fax : +852 2343 5824
   Email: radiolab@ofta.gov.hk

AMENDMENT HISTORY

Item	Issue No.	Paragraph	Descriptions
1.	Issue 3 February 2003	Foreword	Add information of HKTEC Scheme and other editorial changes.
2.	Issue 4 January 2007	Clause 1	Expand the list of information requiring declarations by the manufacturers.
3.	Issue 4 January 2007	Clause 2	Revise paragraphs on test conditions, including provisions for more battery types.
4.	Issue 4 January 2007	Clause 3	Revise paragraph on general arrangements for measurements involving the use of radiated field and draw reference to relevant CISPR and ETSI specifications.
5.	Issue 4 January 2007	Clause 4	Revise paragraphs on test methods, drawing reference to HKTA 1046, which is based on ETSI specifications. Revise the limit of frequency error, based on ITU-R recommendations.
6.	Issue 4 January 2007	Clause 5	Revise paragraphs on test methods, drawing reference to ETSI specifications.
7.	Issue 4 January 2007	Clause 6	Add a new clause for repeater tests.
8.	Issue 4 January 2007	Clause 7	Revise accuracy of measurements, previously under clause 6, based on ETSI requirements.
9.	Issue 4 January 2007	Clause 8	Add a new clause to enlist reference specifications.

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1. GENERAL

1.1 Scope of Specification

This specification covers the minimum performance requirements for radio equipment for use as repeater, base and mobile stations in 800 MHz trunked systems.

1.2 Operating Frequency Ranges and Channel Spacing Requirement

For equipment covered by this specification, unless otherwise approved by the Authority, the operating frequency ranges shall be 850-863 MHz for mobile receive and 805-818 MHz for mobile transmit.

Equipment shall have a channels spacing of 25 kHz.

1.3 Transmitter RF Power

Whenever the RF power of a radio transmitter is referred to it shall be expressed as the carrier power which is the average power supplied by a transmitter during one radio frequency cycle taken under the condition of no modulation.

For equipment with antenna output terminals, the carrier power shall be that supplied from the transmitter output to a matched transmission line connected to the antenna terminals.

For equipment with integral antenna, the carrier power shall mean the effective radiated power in the direction of maximum field strength, i.e. the product of the power supplied to the antenna and its gain relative to a half-wave dipole in the direction of maximum field strength.

The rated carrier power shall be that declared by the manufacturer.

Unless otherwise approved by the Authority, the maximum rated carrier power shall be limited to :

(i) 100 W for repeater equipment,
(ii) 25 W for base and mobile equipment,
(iii) 3 W for portable equipment

1.4 Integral Antenna

In this specification, the term of integral antenna is defined as an antenna connected to the transmitter or receiver without the use of an external feeder.

1.5 Labelling

The equipment shall be provided with a clear indication of the type number and description under which it is submitted for type testing. Each type number shall be unique and in the event that the Authority finds two manufacturers have used a similar type number, the latecomer manufacturer will be asked to use another type number.

Technical variants of the same model shall be separately labelled.

1.6 Controls

Those controls, which if maladjusted might increase the interfering potentialities of the equipment, shall not be easily accessible.

1.7 Declarations by the Manufacturer

When submitting equipment for type-approval testing, the manufacturer shall supply a service manual complete with drawings of constructional details, circuit diagrams and printed circuits board layouts. In addition, the following information should be supplied if not recorded in the manual supplied:

(1) nominal frequency
(2) crystal frequency and carrier generation formula
(3) crystal type
(4) rated carrier power
(5) continuous or intermittent power rating
(6) maximum permissible frequency deviation
(7) rated audio output power of receiver
(8) value of resistive load into which audio output power is delivered
(9) nominal supply voltage
(10) type of battery
(11) battery end point voltage when applicable
(12) different operating modes when available (e.g. high and low power modes) and if operation is continuous or is subject to a maximum test duty cycle (e.g. 1 minute on, 4 minutes off)
(13) polarization and the reference face of the radiation

2. TEST CONDITIONS : ATMOSPHERIC CONDITIONS AND POWER SUPPLIES

2.1 General

Type-approval test shall be made under normal test conditions and also, where stated, under extreme test conditions.

2.2 Normal test conditions

2.2.1 Atmospheric test conditions

The atmospheric conditions of the test site shall be maintained at any convenient combination of temperature, relative humidity and air pressure within the following ranges :

(1) Temperature : 15°C to 35°C
(2) Relative humidity : 10% to 80%

When it is impracticable to carry out the tests under these conditions, a note to this effect, stating the ambient temperature and relative humidity during the tests, shall be added to test report.

2.2.2 Test power source

2.2.2.1 General

The power supply for the equipment under test may be replaced by a test power source, capable of producing normal and extreme test source voltages as specified below and in 2.3.2 and 2.3.3.

The supply voltage shall be measured at the input terminals of the equipment.

2.2.2.2 Mains test source voltage

For equipment powered by AC mains, 220V ± 6% at a frequency of 50 Hz ± 1 Hz shall be designated as the normal test voltage.

2.2.2.3 DC test source voltage

For equipment supplied from self-contained primary cells or batteries or any other DC sources, the normal test source voltage shall be the nominal supply voltage declared by the manufacturer.

2.3 Extreme test conditions

2.3.1 Extreme temperatures

For tests of extreme temperatures, measurements shall be made in accordance with procedures specified in clause 2.4 at an upper value of +55°C and at lower value of -10°C.

2.3.2 Extreme mains test source voltage

The extreme mains test source voltage shall be ±10% of 220V at a frequency of 50 Hz ± 1 Hz.

2.3.3 Extreme DC test source voltage

The extreme DC test source voltage shall be as follows:

(1) Regulated lead-acid battery power sources

When the equipment is intended for operation from regulated lead-acid power source, the extreme test source voltages shall be +30% and -10% of the nominal voltage of the battery.

(2) Other power sources

When the equipment is intended for operation from power sources using primary batteries, the lower extreme test source voltage shall be as follows:

(a) For Leclanche or Lithium type of battery, it shall be 15% below the nominal voltage.
(b) For Mercury or Nickel-Cadmium type of battery, it shall be 10% below the nominal voltage.
(c) For other types of battery, it shall be the end point voltage declared by the equipment manufacturer.

No upper extreme test voltage shall apply for radio equipment designed for battery-only use.

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

2.4 Procedures for tests at extreme temperatures

2.4.1 General

Before making measurements, the equipment, which is switched off, shall be placed in a temperature controlled chamber for a period of one hour for temperature stabilization. The humidity content in the test chamber shall be controlled so that excessive condensation does not occur.

2.4.2 Equipment designed for continuous operation

For tests at the upper temperature, after temperature stabilization in accordance with clause 2.4.1, the equipment shall be switched on in the transmit condition for half an hour, after which the appropriate tests shall be carried out. For tests at the lower temperature, after temperature stabilization in accordance with clause 2.4.1, the equipment shall be switched on in the receive or transmit condition for one minute, after which the appropriate tests shall be carried out. (Note: In any test, if the equipment contains temperature stabilization circuits designed to operate continuously, the equipment shall be switched on for 15 minutes before measurements are made).

2.4.3 Equipment designed for intermittent operation only

The procedure shall be as described in clause 2.4.2, except that at the upper temperature, the half hour transmit condition shall be replaced by one minute in the transmit condition followed by four minutes in the receive condition before measurements are made.

3. ELECTRICAL TEST CONDITIONS

3.1 Normal test modulation

Normal test modulation shall be a sinusoidal signal of frequency 1 kHz and the level adjusted to produce 60% of the maximum permissible frequency deviation. The test signal shall be substantially free from amplitude modulation.

3.2 Transmitter loading conditions

The transmitter antenna output shall be terminated with a non-reactive, non-radiating load with nominal impedance of 50 ohms. In case the nominal impedance is of value other than 50 ohms, the manufacturer shall provide suitable matching devices for type-approval purpose.

3.3 Receiver input signal

Test signals applied to the receiver input terminals shall be connected in such a way that the source impedance seen from the receiver input terminals equals to

the nominal input impedance of the receiver, and the load impedance seen by each generator also equals to the nominal input impedance of the receiver.

The levels of the test signals shall be expressed in terms of the potential difference at the input terminals of the receiver. The effects of any intermodulation products and noise produced in the signal generators shall be negligible.

3.4 Receiver rated audio output power

The rated audio output power shall be the maximum power, declared by the manufacturer, for which all the requirements of this specification are met. With normal test modulation applied, the audio output power shall be measured in a resistive load simulating of load with which the receiver normally operates.

3.5 Receiver mute or squelch facility

If the receiver is equipped with a mute or squelch circuit, this shall be made inoperative for the duration of type-approval test except otherwise stated in this specification.

3.6 SINAD ratio

SINAD ratio is defined as the ratio expressed in decibels of “signal plus noise plus distortion” to “noise plus distortion” where the former refers to the audio power recovered from a modulated RF carrier and the latter is the residual audio power after the audio signal is removed.

3.7 General requirements for tests involving the use of radiated fields

All radiated measurement should be carried out at a test site as specified in CISPR 16-1, "Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus" issued by the International Electrotechnical Commission. Test sites including fully Anechoic Chamber, Anechoic Chamber with ground plate and Open Area Test Site (OATS) shall be considered acceptable if the horizontal and vertical site attenuation measurements are within + 4dB of the theoretical site attenuation for an ideal free field test site. The performance of the test site shall be verified before conducting any radiated measurement at the test site.

If the radiated measurement is carried out at a fully Anechoic Chamber or Anechoic Chamber with ground plate, the separation distance between the centre of the vertical projection of the equipment under test (EUT) (i.e. the test sample) in the horizontal plane and the centre of the test antenna shall be at least 3 m and adequate to allow for radiated measurement in the far field of the EUT.

Unless otherwise specified, all radiated measurements should follow the general arrangements as specified in the relevant clause of ETSI EN 300 086-1 and ETSI EN 300 296-1 issued by the European Telecommunications Standards Institute.

4. TRANSMITTER TESTS

4.1 Carrier power

4.1.1 Definition

The carrier power is the average power during one radio frequency cycle in the absence of modulation. The rated carrier power is the carrier power of the equipment as declared by the manufacturer.

For equipment with antenna output terminals, the carrier power is that available at the output terminals when they are connected to the nominal load condition specified by the manufacturer.

For equipment with integral antenna, the carrier power is the effective radiated power in the direction of maximum field strength.

4.1.2 Test method

The carrier power shall be obtained in accordance with the test methods as stipulated in the relevant clause of HKTA 1046. Alternatively, measurement in accordance with ETSI EN 300 086-1 and ETSI EN 300 296-1 will also be acceptable.

The measurement shall be made under normal test conditions (clause 2.2) and repeated under extreme test conditions (clause 2.3).

4.1.3 Limits

The carrier power shall be within ± 1.5 dB of the rated carrier power under normal test conditions, and within ± 2 dB of the rated carrier power under extreme test conditions. These limits apply to transmitters with or without integral antenna.

4.2 Frequency error

4.2.1 Definition

The frequency error of the transmitter is the difference between the unmodulated carrier frequency and the nominal frequency.

4.2.2 Test method

The frequency error shall be obtained in accordance with the test methods as stipulated in the relevant clause of HKTA 1046. Alternatively, measurement in accordance with ETSI EN 300 086-1 and ETSI EN 300 296-1 will also be acceptable.

The measurement shall be made under normal test conditions (clause 2.2) and repeated under extreme test conditions (clause 2.3).

4.2.3 Limits

The frequency error, under both normal and extreme test conditions, or at any intermediate condition, shall not exceed ± 2.5 p.p.m.

4.3 Frequency deviation

4.3.1 Definition

The frequency deviation is the difference between the instantaneous frequency of the modulated radio frequency signal and the carrier frequency in the absence of modulation. The peak deviation is the largest value of the frequency deviation during an audio frequency cycle. For type-approval purposes, only the maximum value of the peak frequency deviation available in the transmitter will be measured.

The maximum permissible frequency deviation is the maximum value of frequency deviation under any conditions of modulation.

4.3.2 Test method

The modulation frequency shall be varied between 300 Hz, or any other lowest frequency as declared by the manufacturer, and 3 kHz. The maximum permissible frequency deviation shall then be obtained in accordance with the test methods as stipulated in the relevant clause of HKTA 1046. Alternatively, measurement in accordance with ETSI EN 300 086-1 and ETSI EN 300 296-1 will also be acceptable.

4.3.3 Limits

At any modulation frequency, the maximum frequency deviation shall not exceed ± 5.0 kHz.

4.4 Spurious emissions

4.4.1 Definition

Spurious emissions are emissions at frequencies other than those of the carrier and sidebands associated with normal modulation resulting from signals generated within the equipment.

For equipment with antenna output terminals, the level of spurious emissions shall be measured as :

1. the power level delivered from the transmitter output into a specified load (e.g. transmission line or antenna), which is also known as conducted spurious emissions, and

2. the effective radiated power when radiated by the cabinet and structure of the equipment, which is also known as cabinet radiation.

For equipment incorporating integral antenna, the level of spurious emissions shall be measured as their effective radiated power when radiated by integral antenna and cabinet of the equipment.

4.4.2 Test method

For measuring the conducted spurious emission of equipment with antenna output terminals, the measuring receiver shall be tuned over the frequency range from 100 kHz to 3200 MHz. For measuring effective radiated power of equipment with integral antenna, the measurement shall be repeated at all spurious response frequencies found during the search over the limited frequency range from 30 MHz to 3200 MHz. The spurious emissions shall then be obtained in accordance with the test methods as stipulated in the relevant clause of HKTA 1046. Alternatively, measurement in accordance with ETSI EN 300 086-1 and ETSI EN 300 296-1 will also be acceptable.

4.4.3 Limits

Any conducted and radiated spurious emission in the frequency range 100 kHz / 30 MHz - 3200 MHz shall be attenuated below the rate carrier power in accordance with the following formula:

$$\text{Spurious attenuation in dB} = 43 + 10 \log_{10} (\text{rated carrier power in Watts})$$

5. RECEIVER TESTS

5.1 Usable sensitivity

5.1.1 Definition

For equipment with antenna terminals, the maximum usable sensitivity (conducted) of a receiver is the minimum level of signal (e.m.f.) at the receiver input, at its nominal frequency from a standard signal source which, when modulated by normal test modulation (clause 3.1), will produce:

- an audio frequency output power of at least 50% of the rated power output (clause 3.4); and
- a SINAD ratio of 20dB, measured at the receiver output through a telephone psophometric weighting network as described in ITU-T Recommendation O.41 (10/1994).

For equipment with integral antenna, the average usable sensitivity (field strength) of the receiver is the average field strength at the location of the receiver, at nominal frequency of the receiver and with normal test modulation which produces a signal at the receiver output as mentioned above.

5.1.2 Test method

The maximum/average usable sensitivity of a receiver shall be obtained in accordance with the test methods as stipulated in the relevant clause of ETSI EN 300 086-1 and ETSI EN 300 296-1.

The measurement shall be made under normal test conditions (clause 2.2) and repeated under extreme test conditions (clause 2.3).

5.1.3 Limits

For equipment with antenna terminals, the maximum usable sensitivity shall not exceed 6 dBμV (e.m.f.) under normal test conditions, and 12 dBμV (e.m.f.) under extreme test conditions.

For equipment with integral antenna, the average usable field strength sensitivity shall not exceed 26 dBμV/m under normal test conditions and 32 dBμV/m under extreme conditions.

5.2 Adjacent channel selectivity

5.2.1 Definition

The adjacent channel selectivity is a measurement of the equipment capability to receive the wanted modulated signal at the assigned carrier frequency in the presence of the unwanted modulated signal which differs by one channel spacing.

5.2.2 Test method

The upper and lower adjacent channel selectivity shall be obtained in accordance with the test methods as stipulated in relevant clause of ETSI EN 300 086-1 and ETSI EN 300 296-1.

5.2.3 Limits

The adjacent channel selectivity shall be expressed as the lower value of the ratios, in decibels, for the upper and lower adjacent channels of the level of the unwanted signal to the level of the wanted signal.

The adjacent channel selectivity shall not be less than 60 dB for base and mobile equipment, or 50 dB for portable equipment.

5.3 Intermodulation response rejection

5.3.1 Definition

The intermodulation response rejection is a measure of the capability of a receiver to inhibit the generation of in-band signals caused by the presence of two or more signals at unwanted frequencies. The intermodulation response rejection ratio is the ratio in dB of the levels of the unwanted and wanted signals when a specific degraded SINAD ratio is obtained.

5.3.2 Test method

The intermodulation response rejection shall be measured in accordance with the test methods as stipulated in the relevant clause of ETSI EN 300 086-1 and ETSI EN 300 296-1.

5.3.3 Limits

The intermodulation response rejection ratio shall not be less than 60 dB for base and mobile equipment, or 50 dB for portable equipment.

5.4 Spurious response rejection

5.4.1 Definition

The spurious response rejection is a measure of the capability of the receiver to discriminate between a wanted modulated signal at the nominal frequency and an unwanted signal at any other frequency. The spurious response rejection ratio is the ratio in dB of the levels of the unwanted and wanted signals when a specific degraded SINAD ratio is obtained.

5.4.2 Test method

The spurious response rejection shall be obtained in accordance with the test methods as stipulated in the relevant clause of ETSI EN 300 086-1 and ETSI EN 300 296-1.

5.4.3 Limits

At any frequency, separated from the nominal frequency of the receiver by more than one channel spacing, the spurious response rejection ratio shall not be less than 60 dB for base and mobile equipment, or 50 dB for portable equipment.

5.5 Receiver spurious emissions

5.5.1 Definition

Spurious emissions from receivers are any emissions present at the antenna terminals of the equipment or radiated from the cabinet and structure of the receiver (which is also known as receiver cabinet radiation).

5.5.2 Test method

For measuring the conducted spurious emission of equipment with antenna terminals, the measuring receiver shall be tuned over the frequency range from 100 kHz to 3200 MHz. For measuring effective radiated power of equipment with integral antenna, the measurement shall be repeated at all spurious response frequencies found during the search over the limited frequency range from 30 MHz to 3200 MHz. The receiver spurious emissions shall then be obtained in accordance with the test methods as stipulated in the relevant clause of ETSI EN 300 086-1 and ETSI EN 300 296-1.

5.5.3 Limits

The power of any spurious emission measured as :

(i) output power level at the antenna terminals shall not exceed - 77 dBW, and

(ii) effective radiated power in free space shall not exceed the following levels:-

Frequency (MHz)	Power (-dBW)	Frequency (MHz)	Power (-dBW)
25 - 70	77	174 - 260	63
70 - 130	72	260 - 470	63 - 53*
130 - 174	72 - 63*	Above 470	53

Note *: interpolate linearly on log frequency scale.

6. REPEATER TESTS

6.1 Carrier power

Same as clause 4.1 for the test method and performance limit.

6.2 Spurious emission

Same as clause 4.4 for the test method and performance limit.

6.3 Intermodulation attenuation

6.3.1 Definition

The intermodulation attenuation of a repeater is the capability of the repeater to avoid the generation of signals in the non-linear elements caused by the presence of the carrier and an interfering signal entering the repeater via the antenna.

6.3.2 Test method

The intermodulation attenuation shall be obtained in accordance with the test methods as stipulated in the relevant clause of ETSI EN 300 086-1.

6.3.3 Limits

The intermodulation attenuation ratio shall not be less than 40 dB for any intermodulation component.

7. ACCURACY OF MEASUREMENT

The absolute allowable 95% confidence level measurement uncertainties for the measurements included in this document shall not exceed the values stated below:

RF frequency	1×10^{-6}
Radiated RF power	6 dB
Conducted RF power variations using a test fixture	0.75 dB
Maximum frequency deviation	5 %
Adjacent channel power	5 dB
Conducted emission of transmitter	4 dB
Conducted emission of transmitter (cabinet radiation)	6 dB
Audio output power	0.5 dB
Sensitivity at 20dB SINAD	3 dB
Conducted emission of receiver	4 dB
Conducted emission of receiver (cabinet radiation)	6 dB
Two-signal measurement (using a test fixture)	4 dB
Two-signal measurements using radiated fields	6 dB
Three-signal measurement (using a test fixture)	3 dB
Radiated emission of transmitter	6 dB
Radiated emission of receiver	6 dB

8. REFERENCE

HKTA 1046 “Method of Measurement for Radio Transmitter for use in the Land Mobile Service”

CISPR 16-1 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 1 Radio disturbance and immunity measuring apparatus”

ETSI EN 300 086-1 “Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment with an internal or external RF connector intended primarily for analogue speech; Part 1 Technical characteristics and methods of measurement”

ETSI EN 300 296-1 “Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment using integral antennas intended primarily for analogue speech; Part 1 Technical characteristics and methods of measurement”

ITU-R Recommendation M.478 “Technical characteristics of equipment and principles governing the allocation of frequency channels between 25 and 3000 MHz for the FM land mobile service”

ITU-R Recommendation SM.1045 “Frequency tolerance of transmitters”

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