HKTA 1046
ISSUE 03
SEPTEMBER 2008

METHOD OF MEASUREMENT FOR RADIO TRANSMITTER FOR USE IN THE LAND MOBILE SERVICE

OFTA
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").

2. Radio equipment for use in Hong Kong shall meet certain minimum technical performances. The performances may be given in specifications prescribed by the Telecommunications Authority (TA) or embedded in the Exemption Orders made under the Telecommunications Ordinance (Cap. 106). The transmitter parameters of radio equipment are generally considered as essential electrical characteristics for the purpose of preventing or reducing radio interference to telecommunications installations or services.

3. This specification is intended to describe the methods, including the conditions and procedures, that are used by the TA to determine the compliance of the radio transmitter with the essential technical performances.

4. At present, the Office of the Telecommunications Authority (OFTA) operates a **H**ong **K**ong **T**elecommunications Equipment **E**valuation and **C**ertification (HKTEC) Scheme. Details of the HKTEC Scheme can be found in the information note OFTA I 421. Under the HKTEC Scheme, the TA will also accept test conducted by recognized testing agencies to demonstrate the compliance of radio equipment. The methods given in this specification may be used by the recognised testing agencies for the assessment of the performance of the radio equipment. Where a test method specified in this specification cannot be followed, an alternate method may be used.

5. This specification has taken into consideration of the relevant standards of the European Telecommunications Standards Institute (ETSI). The provisions in this specification may be superseded in whole or in part by specific specifications for specific applications.

6. 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: certification@ofta.gov.hk

7. 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: certification@ofta.gov.hk

AMENDMENT TABLE

Item	Issue No.	Paragraph	Descriptions
1.	Issue 02	Foreword	Editorial changes are incorporated to align with other HKTA specifications.
2.	Issue 03	3.1	The test condition on air pressure is removed.

CONTENTS

1 Scope

This specification stipulates the reference methods to measure the essential technical performances, from the perspective of control of interference, of the radio transmitter intended primarily for land mobile service. The technical performances for radio transmitter are given in the relevant standards or specifications issued by the Telecommunications Authority. Compliance with these technical performances should be determined in accordance with the method of measurement contained in this specification as far as possible.

The types of radio transmitter covered by this specification are as follows: -

(a) a transmitter fitted with a 50-ohm RF connector (for antenna connection); and

(b) a transmitter fitted with an integral antenna.

2 Definitions and abbreviations

2.1 Definitions

For the purpose of the document, the following terms and definitions apply:

conducted measurements: measurements which are made using a direct connection to the equipment under test

confidence level: probability of the accumulated error of a measurement being within the stated range of uncertainty of measurement

coverage factor (expansion factor) : numerical factor used as a multiplier of the combined standard uncertainty in order to obtain an expanded uncertainty

far field: field (wave or potential) which has a constant ratio between the electric and magnetic field intensities

integral antenna: an antenna designed to be connected to the equipment without the use of a 50 ohm external connector and considered to be part of the equipment. An integral antenna may be fitted internally or externally to the equipment.

intermittent operation: the maximum time that the equipment intended to transmit plus the necessary standby period before repeating a transmit period

measurement uncertainty: an estimate characterizing the range of values within which the true value of a measured lies

nominal frequency: one of the channel frequencies on which the equipment is designed to operate

test conditions: defined in terms of temperature, humidity and supply voltage stated in the relevant deliverable

normal test modulation: a sinusoidal test signal with a frequency of 1 kHz resulting a frequency deviation equal to 60 % of the maximum permissible frequency deviation (see Section 4.4.1.1). The test signal shall be substantially free from amplitude modulation.

quiet zone (or test volume): a volume within the test site in which a specified performance has either been proven by test, or is guaranteed by the designer/manufacturer. The specified performance is usually the reflectivity of the absorbing panels or a directly related parameter (e.g. signal uniformity in amplitude and phase). The measured normalized site attenuation (NSA) results taken within the volume shall be within $\pm$4 dB of the theoretical NSA for an ideal site.

radiated measurements: measurements which involve the use of a radiated field.

test load: a 50-ohm substantially non-reactive, non-radiating power attenuator which is capable of safely dissipating the power from the transmitter

transmitter: a device or circuit that generates high-frequency electric energy, controlled or modulated, which can be radiated by an antenna.

2.2 Abbreviations

AC	Alternating Current
EUT	Equipment Under Test
IF	Intermediate Frequency
NSA	Normalized Site Attenuation
RF	Radio Frequency
TUT	Transmitter Under Test

3. Test conditions and general arrangement

All tests shall be made under the following test conditions.

3.1 Atmospheric conditions

The temperature and relative humidity conditions for tests shall be any convenient combination of the following ranges:

- temperature: + 15°C to + 35°C;
- 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 the test report.

3.2 Test power source

3.2.1 Test power source

During the measurements, the power source of the transmitter shall be replaced by a test power source capable of producing test voltage as specified in Section 3.2.2. 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 transmitter 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.

For battery operated equipment, the battery shall be removed and the test power source shall be applied as close to the battery terminals as practicable.

During tests, the power source voltages shall be maintained within a tolerance of < ± 3 % relative to the voltage at the beginning of each test.

3.2.2 Test voltage

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

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

3.3 Transmitter automatic shut-off facility

If the transmitter is fitted with an automatic transmit shut-off facility it shall be made inoperative for the duration of the measurements, unless it has to remain operative to protect the equipment. If the shut off facility is left operative the status of the equipment shall be indicated in the test report.

3.4 Arrangement for test signals at the input of the transmitter

The transmitter audio frequency modulation signal shall be applied to the microphone input terminals with the internal microphone disconnected, unless otherwise stated.

3.5 Interpretation of the measurement results

The interpretation of the measurement results for the measurements described in this document shall be as follows:

(a) the measured value related to the corresponding limit shall be used to decide whether a radio transmitter meets the requirements of the relevant standard or specification;

(b) the values of the actual measurement uncertainty value shall be, for each measurement, equal to or lower than the figures given in Section 6 (maximum allowable measurement uncertainties);

(c) the actual measurement uncertainty of the laboratory carrying out the measurements, for each particular measurement, shall be included in the corresponding test report (if any).

For each test, the 95% confidence level measurement uncertainty of the measured result should be evaluated and stated in the test report together with the corresponding coverage factor.

4. Methods of conducted measurements for transmitter parameters

For transmitters fitted with a 50-ohm RF connector, the methods of conducted measurements specified in this Section apply.

For measurement of spurious emission radiated by the cabinet and structure of the transmitter, the method in Section 5.3 applies.

When performing transmitter measurements on equipment designed for intermittent operation, the maximum transmit time specified by the manufacturer shall not be exceeded.

4.1 Frequency error

4.1.1 Definition

The frequency error of the transmitter is the difference between the measured carrier frequency in the absence of modulation and the nominal frequency of the transmitter.

4.1.2 Method of measurement

The carrier frequency shall be measured in the absence of modulation with the transmitter connected to a frequency meter (via a 50-ohm power attenuator [test load] if necessary) as shown in Figure 1.

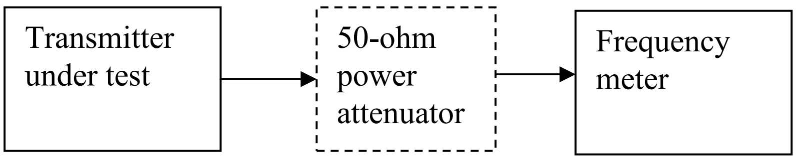


Figure 1 Measurement arrangement for conducted frequency error test

4.2 Carrier power (conducted)

4.2.1 Definitions

The carrier power (conducted) of the transmitter is the mean power delivered to the test load during a radio frequency cycle, in the absence of modulation.

4.2.2 Method of measurement

The carrier power shall be measured in the absence of modulation by a RF power meter (via a 50-ohm power attenuator if necessary) as shown in Figure 2.

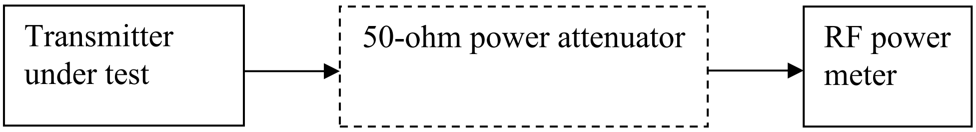


Figure 2 Measurement arrangement for conducted carrier power test

4.3 Spurious emissions

4.3.1 Definition

Spurious emissions are emissions at frequency other than those of the carrier and sidebands associated with normal test modulation. The level of conducted spurious emissions shall be measured as their power level in a specified load.

4.3.2 Method of measurement

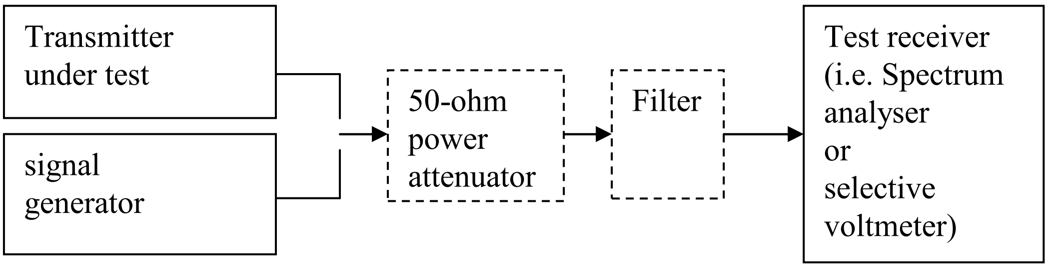


Figure 3 Measurement arrangement for conducted spurious emissions test

(a) The transmitter shall be connected to a test receiver (i.e. spectrum analyser or selective voltmeter) (via a 50-ohm power attenuator and/or an appropriate filter to avoid overloading of the test receiver) as shown in Figure 3. The bandwidth of the test receiver shall beset to a suitable value to correctly perform the measurement. The equipment used shall have sufficient dynamic range and sensitivity to achieve the required measurement accuracy at the specified limit.

For the measurement of spurious emissions below the second harmonic of the carrier frequency the filter used shall be a high "Q" (notch) filter centred on the transmitter carrier frequency and attenuating this signal by at least 30 dB.

For the measurement of spurious emissions at and above the second harmonic of the carrier frequency the filter used shall be a high pass filter with a stop band rejection exceeding 40 dB. The cut-off frequency of the high pass filter shall be approximately 1.5 times the transmitter carrier frequency.

Precautions may be required to ensure that the 50-ohm power attenuator does not generate or that the high pass filter does not attenuate the harmonics of the carrier.

(b) The transmitter shall be unmodulated and operating at the maximum limit of its specified power range. Any spurious emission shall be detected by the test receiver up to to 1 GHz or four times the working frequency whichever is the greater, except for the channel on which the transmitter is intended to operate and its adjacent channels.

(c) The frequency of the test receiver shall be adjusted over the specified frequency range. The frequency and level of every spurious emission found shall be noted.

The resolution bandwidth of the test receiver shall be the smallest bandwidth available which is greater than the spectral width of the spurious component being measured. This shall be considered to be achieved when the next highest bandwidth causes less than 1 dB increase in amplitude. The conditions used in the measurement shall be recorded in the test report.

(d) If the test receiver has not been calibrated in terms of power level at the transmitter output, the level of any detected components shall be determined by replacing the transmitter by the signal generator and adjusting it to reproduce the frequency and level of every spurious emission recorded in step (c).

(e) The absolute power level of each of the emissions noted shall be measured and recorded.

(f) The measurement shall be repeated with the transmitter in stand-by condition if this option is available.

4.4 Frequency deviation

(This requirement applies only to the angle modulated transmitter intended primarily for analogue speech)

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. The frequency deviation shall be measured by means of the deviation meter.

4.4.1 Maximum permissible frequency deviation

4.4.1.1 Definition

The maximum permissible frequency deviation is the maximum value of frequency deviation stated for the relevant channel separation as given in Table 1 below.

Table 1 Maximum permissible frequency deviation

Channel separation (kHz)	Maximum permissible frequency deviation (kHz)
12.5	+/- 2.5
25	+/- 5.0

4.4.1.2 Method of measurement

As shown in Figure 4, the frequency deviation shall be measured at the output of the transmitter (via a 50-ohm power attenuator if necessary) by means of a deviation meter capable of measuring the maximum deviation, including that due to any harmonics and intermodulation products which may be generated in the transmitter.

With the modulating signal generator tuned to 1 kHz, the modulating signal level shall be adjusted to obtain a frequency deviation of 60% of the maximum permissible frequency deviation. Keeping the modulating signal level unchanged, the peak deviation shall be measured with the modulation frequency varied from 300 Hz to 3 kHz for both positive and negative frequency deviations including that due to any harmonics and intermodulation products which may be produced in the transmitter.

The measurement shall then be repeated by increasing the modulating signal by 20 dB above the level to produce normal test modulation and the modulation frequency varied from 300 Hz to 3 kHz.

4.4.2 Response of the transmitter to modulation frequencies above 3kHz

4.4.2.1 Definition

The frequency deviation characteristics of the transmitter at modulation frequencies above 3 kHz are the peak deviation expressed as a function of modulation frequencies above 3 kHz.

4.4.2.2 Method of measurement

As shown in Figure 4, the transmitter shall be connected to the deviation meter (via a 50 ohm power attenuator if necessary).

The transmitter shall be modulated by normal test modulation. Keeping the modulating signal level unchanged, the modulation frequency shall be varied from 3 kHz to a frequency equal to the channel separation for which the equipment is intended.

At each test frequency, the resulting frequency deviation shall be measured.

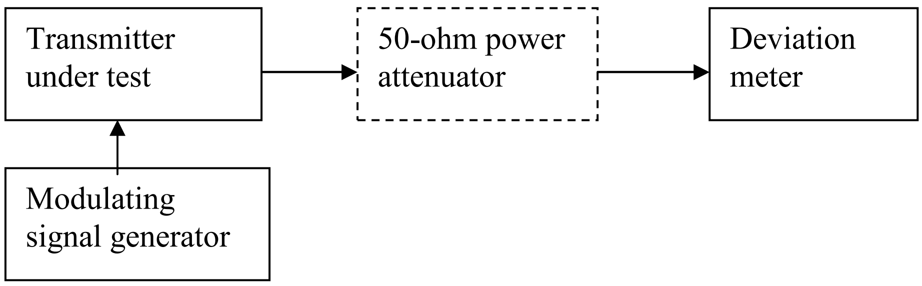


Figure 4 Measurement arrangement for conducted frequency deviation test

4.5 Adjacent channel power
(This requirement applies only to the angle modulated transmitter intended primarily for analogue speech)

4.5.1 Definition

The adjacent channel power is that part of the total output power of a transmitter under defined conditions of modulation, which falls within a specified passband centred on the nominal frequency of either of the adjacent channels. This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter.

It is specified either as the ratio expressed in decibels of the carrier power to the adjacent channel power or as an absolute value.

4.5.2 Methods of measurement

The adjacent channel power may be measured with a power-measuring receiver, which conforms to the requirements given in Annex A.

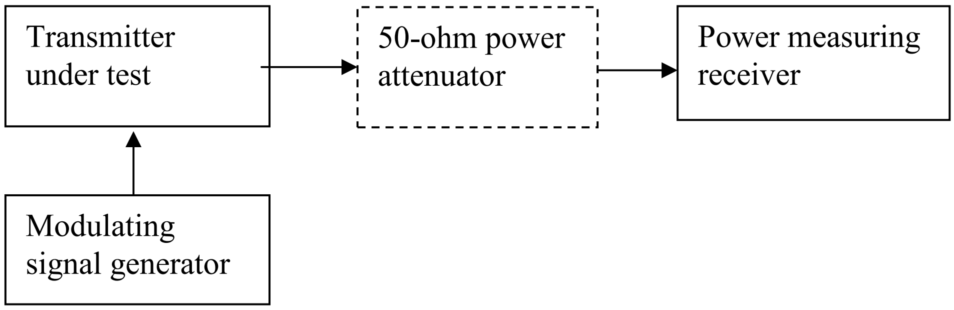


Figure 5 Measurement arrangement for adjacent channel power test

(a) Under the measurement arrangement as shown in Figure 5, the transmitter shall be operated at the carrier power determined in Section 4.2.

The output of the transmitter shall be connected to the input of the power measuring receiver (via a 50-ohm power attenuator if necessary).

(b) With the transmitter unmodulated, the tuning of the power measuring receiver shall be adjusted so that a maximum response is obtained. This is the 0 dB reference point. The variable attenuator setting of the power measuring receiver and the reading of the rms value indicator shall be recorded. If an unmodulated carrier cannot be obtained then the measurement shall be made with the transmitter modulated with normal test modulation in which case this fact shall be recorded in test reports.

(c) The frequency of the power measuring receiver shall be adjusted above the carrier so that its -6 dB response nearest to the transmitter carrier frequency is located at a displacement from the nominal carrier frequency as given in Table 2.

Table 2 Frequency displacement

Channel separation (kHz)	Specified necessary bandwidth (kHz)	Displacement from the -6dB point (kHz)
12.5	8.5	8.25
25	16	17

(d) The transmitter shall be modulated by a test signal of 1250 Hz at a level which is 20 dB higher than that required to produce 60 % of the maximum permissible frequency deviation.

(e) The variable attenuator of the power measuring receiver shall be adjusted to obtain the same reading as in step (b) or a known relation to it.

(f) The ratio of the adjacent channel power to the carrier power is the difference between the attenuator settings in steps (b) and (e), corrected for any differences in the reading of the rms value indicator. Alternatively, the absolute value of the adjacent channel power may be calculated from the above ratio and the carrier power.

(g) Step (c) to (f) shall be repeated with the power measuring receiver tuned to the other side of the carrier.

5. Methods of radiated measurements for transmitter parameters

For transmitters fitted with integral antennas, the methods of radiated measurement specified in this Section apply.

When performing transmitter tests on equipment designed for intermittent operation, the maximum transmit time specified by the manufacturer shall not be exceeded.

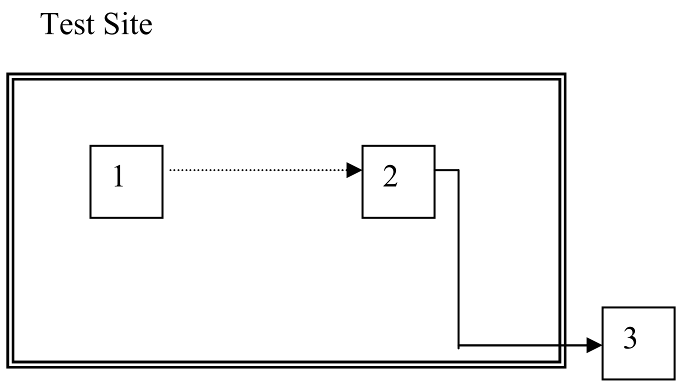
The test site and general arrangements for radiated measurements refer to Annex B. Unless otherwise specified, the transmitter under test (TUT) shall be mounted on the turntable, whose surface is at a convenient height within the quiet zone of the test site. The phase centre of the test antenna and the mid-point of the TUT shall be along the central line of the test site.

5.1 Frequency error

5.1.1 Definition

The frequency error of a transmitter is the difference between the measured carrier frequency in the absence of modulation and the nominal frequency of the transmitter.

5.1.2 Method of measurement



(1) the transmitter under test (TUT);
(2) Test antenna;
(3) Frequency Meter

Figure 6 Test Site set-up for the Frequency Error test

The TUT shall be mounted in an orientation which matches that of its normal usage as stated by the manufacturer. The orientation and mounting configuration shall be recorded.

The test antenna shall be oriented for the stated polarization of the TUT. For cases in which the test antenna is a tuned half wavelength dipole, this shall be tuned to the appropriate frequency. The output of the test antenna shall be connected to the frequency counter (via a 10 dB attenuator if necessary).

The TUT shall be switched on without modulation, allowed adequate time to stabilize and the resolution of the frequency counter adjusted to read to the nearest Hz.

5.2 Effective radiated power

5.2.1 Definition

The effective radiated power is the power radiated in the direction of the maximum field strength under specified conditions of measurement, in the absence of modulation.

5.2.2 Method of measurement

(a) The test site which fulfils the requirements for the specified frequency range of this measurement shall be used. Using the measurement arrangement of Figure 7, the test antenna shall be oriented initially for vertical polarisation unless otherwise stated.

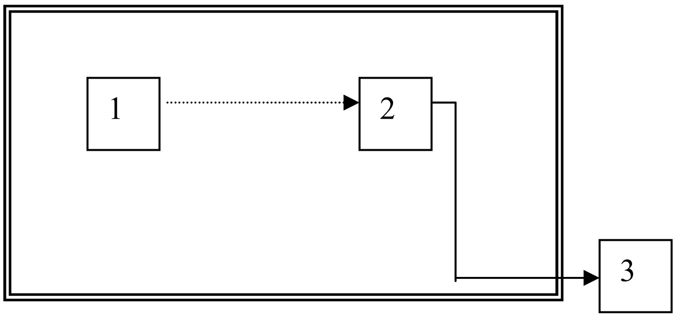
The transmitter under test shall be switched on without modulation.

(b) The spectrum analyser or selective voltmeter (test receiver) shall be tuned to the transmitter carrier frequency.

(c) The transmitter shall be rotated through 360° around a vertical axis in order to obtain the maximum signal detected by the test receiver.

(d) The maximum power reading detected shall be recorded.

Test Site



(1) Transmitter under test (TUT);
(2) Test antenna;
(3) Spectrum analyser or selective voltmeter (test receiver).

Figure 7 Test Site set-up for the Effective Radiated Power measurement on the TUT

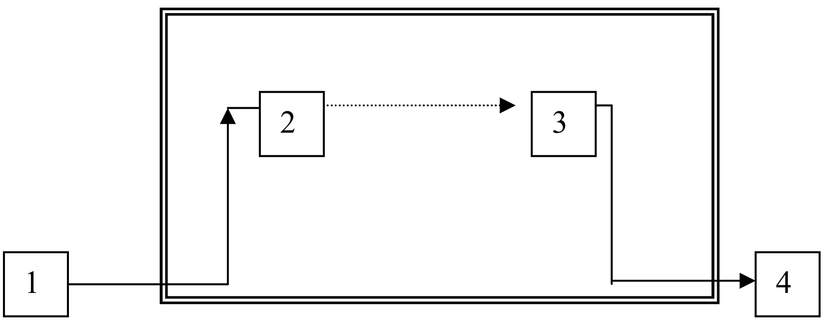
(e) Using the measurement arrangement of Figure 8, the substitution antenna shall replace the TUT in the same position and in vertical polarisation. The frequency of the signal generator shall be adjusted to the transmitter carrier frequency.

(f) The input signal to the substitution antenna shall be adjusted in level until an equal or a known related level to that detected from the transmitter is obtained in the test receiver.

(g) The effective radiated power is equal to the power supplied by the signal generator, increased by the known relationship if necessary and after corrections due to the gain of the substitution antenna and the cable loss between the signal generator and the substitution antenna.

(h) Steps (b) to (g) above shall be repeated with the test antenna and the substitution antenna oriented in horizontal polarisation.

Test Site



(1) Signal generator;
(2) Substitution antenna;
(3) Test antenna;
(4) Spectrum analyser or selective voltmeter (test receiver).

Figure 8 Substitution antenna replacing the TUT

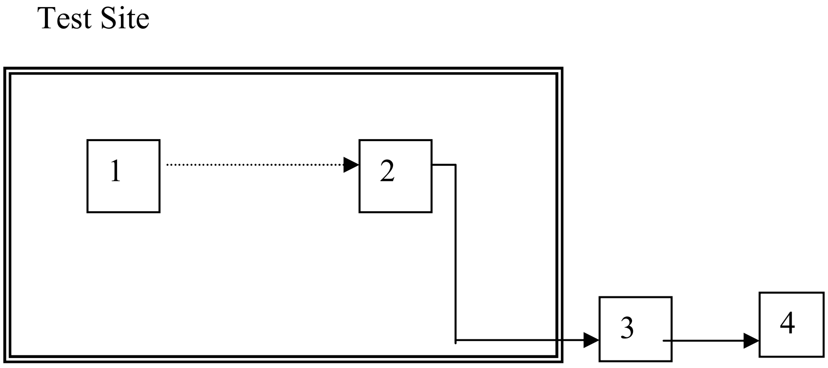
5.3 Radiated spurious emissions

5.3.1 Definition

Spurious emissions are emissions at frequencies other than those of the carrier and sidebands associated with normal modulation, radiated by the antenna and by the cabinet of the transmitter.

They are specified as the radiated power of any discrete signal.

5.3.2 Method of measurement



(1) Transmitter under test (TUT);
(2) Test antenna;
(3) High 'Q' (notch) or high pass filter;
(4) Spectrum analyser or selective voltmeter (test receiver).

Figure 9 Test Site set-up for Spurious Emissions testing

(a) The test site, which fulfils the requirements of the specified frequency range of this measurement, shall be used.

Using the measurement arrangement of Figure 9, the test antenna shall be oriented initially for vertical polarisation and connected to a spectrum analyser or a selective voltmeter (test receiver), through a suitable filter to avoid overloading. The bandwidth of the test receiver shall be set to a suitable value to correctly perform the measurement.

For the measurement of spurious emissions below the second harmonic of the carrier frequency the filter used shall be a high 'Q' (notch) filter centred on the transmitter carrier frequency and attenuating this signal by at least 30 dB.

For the measurement of spurious emissions at and above the second harmonic of the carrier frequency the filter used shall be a high pass filter with a stop band rejection exceeding 40 dB. The cut-off frequency of the high pass filter shall be approximately 1.5 times the transmitter carrier frequency.

The transmitter under test shall be switched on without modulation.

(b) The radiation of any spurious emission shall be detected by the test antenna and test receiver up to to 1 GHz or four times the working frequency whichever is the greater, except for the channel on which the transmitter is intended to operate and its adjacent channels. The frequency of each spurious emission detected shall be recorded.

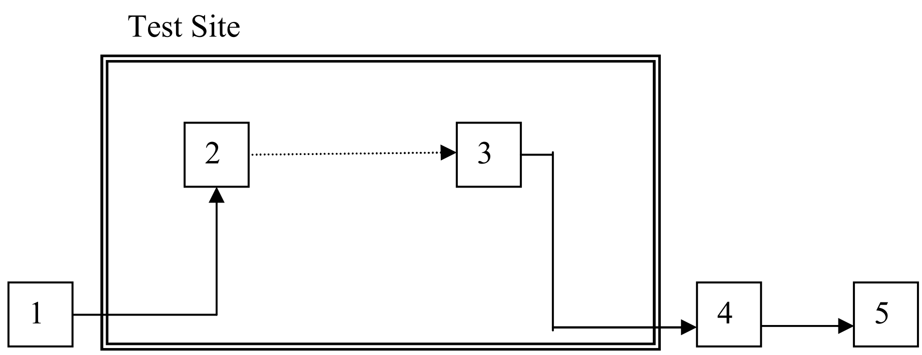
(c) At each frequency at which an emission has been detected, the test receiver shall be tuned.

(d) The transmitter shall be rotated through 360° about a vertical axis, until a maximum signal is received.

(e) The reading of the maximum signal shown in the test receiver shall be recorded.

The resolution bandwidth of the test receiver shall be the smallest bandwidth available which is greater than the spectral width of the spurious component being measured. This shall be considered to be achieved when the next highest bandwidth causes less than 1 dB increase in amplitude. The conditions used in the measurement shall be recorded in the test report.

(f) Using the measurement arrangement of Figure 10, the substitution antenna shall replace the TUT in the same position and in vertical polarisation. The substitution antenna shall be connected to the signal generator.



(1) Signal generator;
(2) Substitution antenna;
(3) Test antenna;
(4) High 'Q' (notch) or high pass filter;
(5) Spectrum analyser or selective voltmeter (test receiver).

Figure 10 Substitution antenna replacing TUT for Spurious Emission testing

(g) At each frequency at which an emission has been detected, the signal generator, substitution antenna and test receiver shall be correspondingly tuned.

(h) The level of the signal generator giving the same signal level on the test receiver as in item (e) above shall be recorded. This value, after corrections due to the gain of the substitution antenna and the cable loss between the signal generator and the substitution antenna, is the radiated spurious emission at this frequency.

(i) Steps (c) to (h) above shall be repeated with the test antenna oriented in horizontal polarisation.

(j) Steps (c) to (i) above shall be repeated with the transmitter in stand-by condition if this option is available.

5.4 Frequency deviation
(This requirement applies only to the angle modulated transmitter intended primarily for analogue speech)

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. Only the maximum value of the peak frequency deviation available in the transmitter will be measured. The frequency deviation shall be measured by means of the deviation meter.

5.4.1 Maximum permissible frequency deviation

5.4.1.1 Definition

The maximum permissible frequency deviation is the maximum value of frequency deviation stated for the relevant channel separation as specified in Table 1.

5.4.1.2 Method of measurement

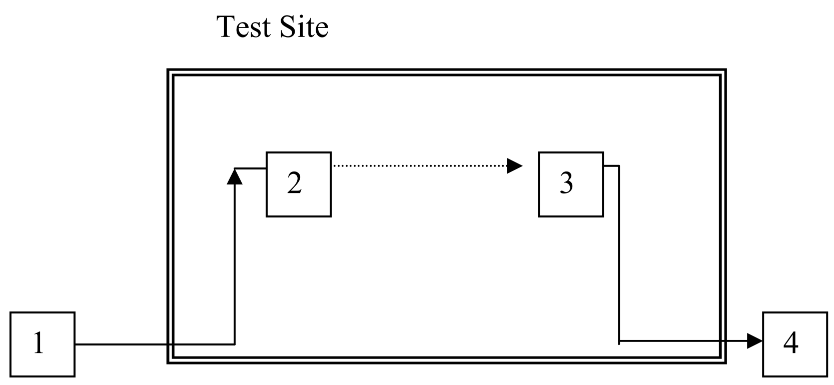
The transmitter under test shall be placed inside a test site as shown in Figure 11.

The transmitter shall be connected with an integral antenna and the modulated signal shall be received by the test antenna connected to a deviation meter capable of measuring the maximum permissible frequency deviation, including that due to any harmonics and intermodulation products, which may be produced in the transmitter. The deviation meter bandwidth must be able to accommodate the highest modulating frequency and to achieve the required dynamic range.

With the modulating signal generator tuned to 1 kHz, the modulating signal level shall be adjusted to obtain a frequency deviation of 60% of the maximum permissible frequency deviation. The peak deviation shall be measured with the modulation frequency varied from 300 Hz to 3 kHz for both positive and negative frequency deviations including that due to any harmonics and intermodulation products which may be produced in the transmitter.

The measurement shall then be repeated by increasing the modulating signal by 20 dB above the level to produce normal test modulation and the modulation frequency varied from 300 Hz to 3 kHz.

The value of the frequency deviation on the deviation meter shall be recorded in the test report.



(1) Modulating signal generator
(2) the transmitter under test with an integral antenna;
(3) Test antenna;
(4) Deviation Meter

Figure 11 Test Site set-up for the Frequency Deviation test

5.4.2 Response of the transmitter to analogue signals above the audio bandwidth (above 3 kHz)

5.4.2.1 Definition

The frequency deviation characteristics of the transmitter at modulation frequencies above 3 kHz is the peak deviation expressed as a function of modulation frequencies above 3 kHz.

5.4.2.2 Method of measurement

The transmitter under test shall be placed inside a test site as shown in Figure 11. The transmitter shall be connected with an integral antenna and the modulated signal shall be received by the test antenna connected to the deviation meter.

The transmitter shall be modulated by normal test modulation. Keeping the modulating signal level unchanged, the modulation frequency shall be varied from 3 kHz equal to a frequency equal to the channel separation for which the equipment is intended.

At each test frequency, the resulting frequency deviation shall be measured.

5.5 Adjacent channel power

(This requirement applies only to the angle modulated transmitter intended primarily for analogue speech)

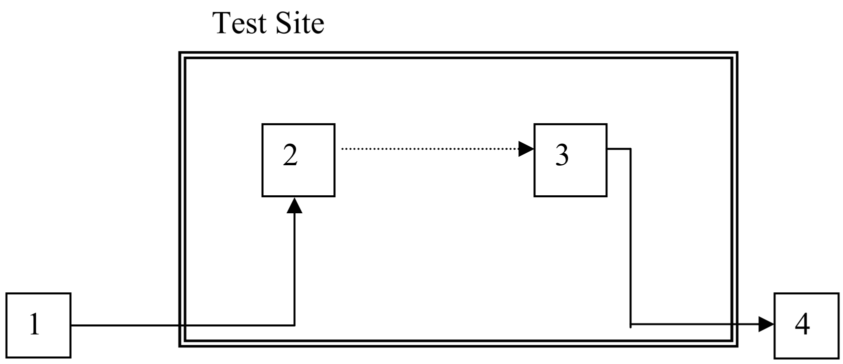
5.5.1 Definition

The adjacent channel power is that part of the total power output of a transmitter under defined conditions of modulation, which falls within a specified passband centred on the nominal frequency of either of the adjacent channels. This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter.

It is specified either as the ratio expressed in decibels of the effective radiated power to the adjacent channel power or as an absolute value.

5.5.2 Method of measurement

The adjacent channel power may be measured with a power measuring receiver, which conforms to the requirements given in Annex A.



(1) Modulating signal generator;
(2) Transmitter under test (TUT);
(3) Test antenna;
(4) Power measuring receiver

Figure 12 Test Site set-up for Adjacent Channel Power test

(a) A test site, which fulfils the requirements of the specified frequency range of this measurement, shall be used. Using the measurement arrangement of Figure 12, the transmitter under test shall be placed inside the test site and connected with a modulating signal generator. The test antenna shall be oriented initially for vertical polarisation and connected to a power measuring receiver calibrated to measure rms power level. The level at the input of the power measuring receiver shall be within its allowed limit. The transmitter shall be operated at the effective radiated power determined in Section 5.2.

(b) With the transmitter unmodulated, the tuning of the power measuring receiver shall be adjusted so that a maximum response is obtained. This is the 0 dB response point. The power measuring receiver attenuator setting and the reading of the meter shall be noted.

(c) The tuning of the power measuring receiver shall be adjusted away from the carrier so that its -6 dB response nearest to the transmitter carrier frequency is located at a displacement from the nominal frequency of the carrier as given in the Table 2.

(d) The transmitter shall be modulated with a 1250 Hz tone at a level which is 20 dB higher than that required to produce 60 % of the maximum permissible frequency deviation.

(e) The variable attenuator of the power measuring receiver shall be adjusted to obtain the same meter reading as in step (b) or a known relation to it. This value shall be noted.

(f) The ratio of the adjacent channel power to the effective radiated power is the difference between the attenuator settings in step (b) and (e), corrected for any differences in the reading of the meter. Alternatively the absolute value of the adjacent channel power may be calculated from the above ratio and the effective radiated power.

(g) For each adjacent channel, the adjacent channel power shall be recorded. Steps (c) to (f) shall be repeated with the power measuring receiver tuned to the other side of the carrier.

6. Measurement uncertainty

The maximum allowable measurement uncertainties based on a level of confidence of 95% for all tests are stated below:

Valid up to 1 GHz for the RF parameters unless otherwise stated.

RF frequency	1×10^{-6}
Carrier power (Conducted)	4 dB
Radiated RF power	6 dB
Frequency deviation	5 %
Adjacent channel power	5 dB
Conducted emission of transmitter, valid to 4 GHz	4 dB
Radiated emission of transmitter, valid to 4 GHz	6 dB

For each test, the 95% confidence level measurement uncertainty of the measured result should be evaluated and stated in the test report together with the corresponding coverage factor.

7. Reference

[1] HKTA 1002 "Performance Specification for Angle Modulated Radio Transmitters and Receivers for use as Base, Mobile and Portable Equipment for Land Mobile Radio Service"

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

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

[4] "Guide to the Expression of Uncertainty in Measurement" published by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML

Annex A (normative): Specifications for adjacent channel power measurement arrangements

{The following general arrangements are extracted from Annex B – Specifications for adjacent channel power measurement arrangements of ETSI EN 300 086-1}

A.1 Power measuring receiver specification

The power measuring receiver consists of a mixer, an IF filter, and oscillator, an amplifier, a variable attenuator and an rms value indicator. Instead of the variable attenuator with the rms value indicator it is also possible to use an rms voltmeter calibrated in dB as the rms value indicator. The technical characteristics of the power-measuring receiver are given in Sections A.1.1 to A.1.4.

A.1.1 IF filter

The IF filter shall be within the limits of the following selectivity characteristic.

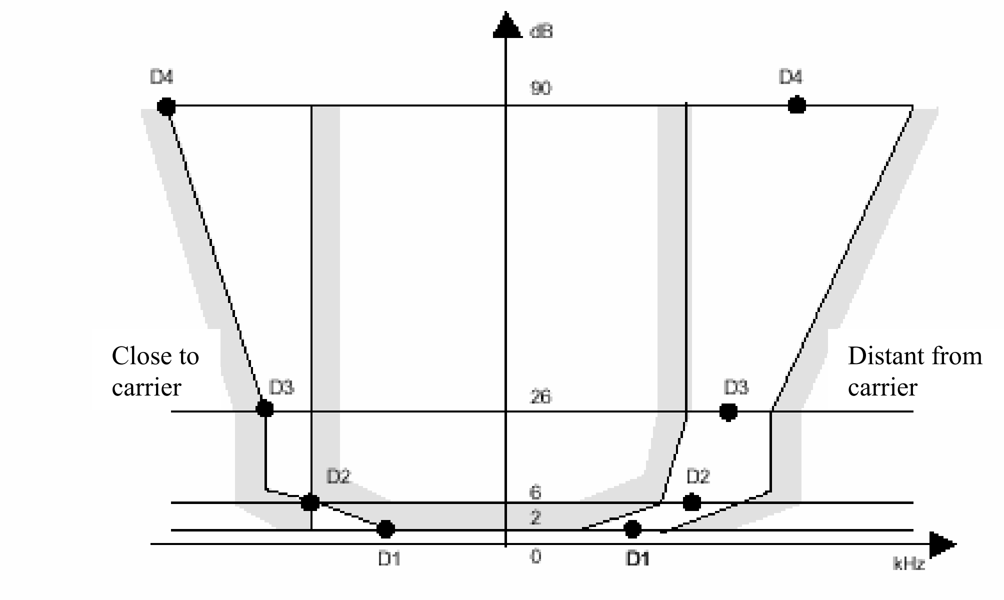


Figure A.1 Limits of the selectivity characteristic

Depending on the channel separation, the selectivity characteristic shall keep the following separations from the nominal centre frequency of the adjacent channel:

Table A.1 Selectivity characteristic

Channel separation	Frequency separation of filter curve from nominal centre frequency of adjacent channel (kHz)			
(kHz)	D1	D2	D3	D4
12.5	3	4.25	5.5	9.5
25	5	8.0	9.25	13.25

Depending on the channel separation, the attenuation points shall not exceed the tolerances given in Table A.2 and Table A.3.

Table A.2 Attenuation points close to carrier

Channel separation (kHz)	Tolerance range (kHz)			
	D1	D2	D3	D4
12.5	+1.35	±0.1	-1.35	-5.35
25	+3.1	±0.1	-1.35	-5.35

Table A.3 Attenuation points distant from the carrier

Channel separation (kHz)	Tolerance range (kHz)			
	D1	D2	D3	D4
12.5	±2.0	±2.0	±2.0	+2.0 -6.0
25	±3.5	±3.5	±3.5	+3.5 -7.5

The minimum attenuation of the filter outside of 90dB attenuation points shall be equal to or greater than 90dB.

Table A.4 Frequency displacement

Channel separation (kHz)	Specified necessary Bandwidth (kHz)	Displacement from the -6 dB point (kHz)
12.5	8.5	8.25
25	16	17

The tuning of the power-measuring receiver shall be adjusted away from the carrier so that the -6 dB response nearest to the transmitter carrier frequency is located at a displacement from the nominal carrier frequency as given in Table A.4.

A.1.2 Variable attenuator

The variable attenuator shall have a minimum range of 80 dB and a resolution of 1 dB.

A.1.3 Rms value indicator

The instrument shall accurately indicate non-sinusoidal signals in a ratio of up to 10:1 between peak value and rms value.

A.1.4 Oscillator and amplifier

The oscillator and the amplifier shall be designed in such a way that the measurement of the adjacent channel power of a low-noise unmodulated transmitter, whose self-noise has a negligible influence on the measurement result, yields a measurement result, yields a measured value of ≤ -90dB for channel separations of 25kHz and of ≤ -80dB for a channel separation of 12.5kHz, referred to the carrier of the oscillator.

Annex B(normative): Radiated measurements

{The following general arrangements are extracted from Annex A – Radiation measurement of ETSI EN 300 086-1}

B.1 Test site and general arrangements for measurements involving the use of radiated fields

To ensure reproducibility and traceability of radiated measurements, free field test site shall be used for conducting the tests. Both absolute and relative measurements can be performed in a test site. Where absolute measurements are to be carried out, the chamber shall be verified.

B.1.1 Test Sites

B.1.1.1 Anechoic Chamber

An Anechoic Chamber is an enclosure, usually shielded, whose internal walls, floor and ceiling are covered with radio absorbing material, normally of the pyramidal urethane foam type. The chamber usually contains an antenna support at one end and a turntable at the other.

The chamber shielding and radio absorbing material work together to provide a controlled environment for testing purposes. This type of test chamber attempts to simulate free space conditions.

B.1.1.2 Anechoic Chamber with a conductive ground plane

An anechoic chamber with a conductive ground plane is an enclosure, usually shielded, whose internal walls and ceiling are covered with radio absorbing material, normally of the pyramidal urethane foam type. The floor, which is metallic, is not covered and forms the ground plane. The chamber usually contains an antenna mast at one end and a turntable at the other. This type of test chamber attempts to simulate an ideal open test site whose primary characteristics is a perfectly conducting ground plane of infinite extent.

B.1.1.3 Open Area Test Site

An open area test site comprises a turntable at one end and an antenna mast of variable length at the other end above a ground plane which, in the ideal case, is perfectly conducting and of infinite extent. In practice, whilst good conductivity can be achieved, the ground plane size has to be limited.

B.1.2 Test antenna

A test antenna is always used in radiated test methods. In emission tests the test antenna is used to detect the field from the EUT in one stage of the measurement and from the substitution antenna in the other stage.

The test antenna should be mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization.

In the frequency band 30 MHz to 1000 MHz, dipole antennas (constructed in accordance with ANSI C63.5) are generally recommended. For frequencies of 80 MHz and above, the dipoles should have their arm lengths set for resonance at the frequency of test. Below 80 MHz, shortened arm lengths are recommended. For spurious emission testing, however, a combination of bicones and log periodic dipole array antennas (commonly termed 'log periodics') could be used to cover the entire 30 MHz to 1 000 MHz band. Above 1 000 MHz, waveguide horns are recommended although, again, log periodics could be used.

B.1.3 Substitution antenna

The substitution antenna is used to replace the EUT for tests in which a transmitting parameter is being measured. For measurements in the frequency band 30 MHz to 1000 MHz, the substitution antenna should be a dipole antenna (constructed in accordance with ANSI C63.5). For frequencies of 80 MHz and above, the dipoles should have their arm lengths set for resonance at the frequency of test. Below 80 MHz, shortened arm lengths are recommended. For measurements above 1000 MHz, a waveguide horn is recommended. The centre of this antenna should coincide with either the phase centre or volume centre.

B.2 Guidance on the use of radiation test sites

This Section details procedures, test equipment arrangements and verification that shall be carried out before any of the radiated tests are undertaken.

B.2.1 Verification of the test site

No test shall be carried out on a test site, which does not possess a valid verification.

B.2.2 Preparation of the EUT

The manufacturer shall supply information about the EUT covering the operating frequency, polarization, supply voltage(s) and the reference face. Additional information, specific to the type of EUT shall include, where relevant, carrier power, channel separation, whether different operating modes are 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).

Where necessary, a mounting bracket of minimal size shall be available for mounting the EUT on the turntable. This bracket shall be made from low conductivity, low relative dielectric constant (i.e. less than 1.5) material(s) such as expanded polystyrene, balsawood, etc.

B.2.3 Power supplies to the EUT

All tests shall be performed using power supplies wherever possible, including tests on EUT designed for battery-only use. In all cases, power leads shall be connected to the EUT's supply terminals (and monitored with a digital voltmeter) but the battery shall remain present, electrically isolated from the rest of the equipment, possibly by putting tape over its contacts.

The presence of these power cables can, however, affect the measured performance of the EUT. For this reason, they shall be made to be "transparent" as far as the testing is concerned. This can be achieved by routing them away from the EUT and down to either the screen, ground plane or facility wall (as appropriate) by the shortest possible paths. Precautions shall be taken to minimize pick-up on these leads (e.g. the leads could be twisted together, loaded with ferrite beads at 0.15 m spacing or otherwise loaded).

B.2.4 Range length

The range length for the test site shall be adequate to allow for testing in the far field of the EUT i.e. it shall be equal to or exceed:

$$\frac{2(d_1 + d_2)^2}{\lambda}$$

where:

d_1 is the largest dimension of the EUT/dipole after substitution (m);
d_2 is the largest dimension of the test antenna (m);
λ is the test frequency wavelength (m).

It shall be noted that in the substitution part of this measurement, where both test and substitution antennas are half wavelength dipoles, this minimum range length for far-field testing would be:

$$2\lambda$$

It shall be noted in test reports when either of these conditions is not met so that the additional measurement uncertainty can be incorporated into the results.

B.2.5 Site preparation

The cables for both ends of the anechoic chamber should be routed horizontally away from the testing area and then allowed to drop vertically and out through either the ground plane or screen (as appropriate) to the test equipment. Precautions should be taken to minimize pick up on these leads (e.g. dressing with ferrite beads, or other loading). The cables, their routing and dressing should be identical to the verification set-up.

Calibration data for all items of test equipment shall be available and valid. For test and substitution antennas, the data shall include gain relative to an isotropic radiator (or antenna factor) for the frequency of test.

The calibration data on all cables and attenuators shall include insertion loss throughout the entire frequency range of the tests. All insertion loss figures shall be recorded for the specific test.

Where correction factors/tables are required, these shall be immediately available.

- End -