YD

COMMUNICATION INDUSTRY STANDARD

OF THE PEOPLE'S REPUBLIC OF CHINA

ICS 33.060.20

M 36

YD/T 1484-2011

Measurement method for radiated RF power and receiver performance of mobile stations

移动台空间射频辐射功率和接收机性能测量方法

Issued on: May 18, 2011 **Implemented on: June 01, 2012**

Issued by: Ministry of Industry and Information Technology of People's Republic of China

Table of contents

Foreword

This standard was drafted in accordance with GB/T 1.1-2009 "Directives for standardization- Part 1: Structure and drafting of standards" and GB/T 1.2-2002 "Directives for standardization – Part 2: Methodology for the content of normative technical elements in standards".

The following standards are relevant to the technical content of this standard, AND it also takes into account of the harmonization with the following standards during the development of this standard:

YD/T 1214-2002 900/1800MH: TDMA digital cellular mobile telecommunication network technical requirement for general packet radio service (GPRS) equipment: Mobile stations;

YDC 023-2003 Test specification of mobile station (MS) for 800MHz CDMA 1X digital cellular mobile telecommunication network – Part 1: Minimum standard, function, and performance

This standard is a revised version of YD/T 1484-2006, and the main technical differences with the original standard are as follows:

1. ADD the GPRS/EDGE related test requirements;

2. ADD the CDMA 1xRTT related test requirements;

3. ADD the cdma2000 related test requirements;

4. ADD the test requirements for notebook configuration;

5. ADD the hand model related test requirements;

6. UPDATE the standard limits.

This standard was proposed by AND shall be under the jurisdiction of the China Communications Standardization Association.

The drafting organizations of this standard: Telecommunications Research Institute of Ministry of Industry and Information Technology, China Telecom Group Corporation, China Mobile Communications Corporation, ZTE Corporation, Huawei Technologies Co., Ltd.

The main drafters of this standard: Guo Lin, Xiao Li, Xie Yuming, Zhang Xinghai, Yu Zhong, Li Wenwen, Liu Qifei, Wang Na, Zhou Beiqi, Yang Meng, An Xudong.

This standard was first published in June 2006, AND this is the first revision.

Measurement method for radiated RF power and receiver performance of mobile stations

1 Scope

This standard specifies the measurement method for radiated RF power and receiver performance of mobile stations, including the frequency range and limits.

This standard is applicable to the portable and on-board mobile stations. It is also applicable to mobile stations powered by AC power sources and used in fixed locations, AND the data devices connected to portable computers via interfaces such as USB interface, Express interface and PCMCIA interface, etc.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this Standard.

3GPP2 C.S0011-B:2002 Recommended minimum performance standards for cdma2000 spread spectrum mobile stations

3GPP2 C.S0033-0:2004 Recommended minimum performance standards for cdma2000 high rate packet

IEEE 1528 Recommended practice for determining the peak spatial-average specific absorption rate (SAR) in the human head from wireless communication devices - Measurement techniques

3GPP TS 51.010 Mobile station (MS) conformance specification for GAN enhancements

3GPP TS 05.05 Digital cellular telecommunications system (Phase 2+); Radio transmission and reception

3 Terms, definitions and abbreviations

3.1 Terms and definitions

The following terms and definitions apply to this document.

FER: Frame error rate

MS: Mobile station

MCS: Modulation coding scheme

PER: Packet error ratio

RF: Radio frequency

RMS: Root mean square

4 Test conditions

To measure the three-dimensional radio frequency radiated power and receiver performance of the mobile station, this standard specifies the spherical equivalent isotropic radiated power of the mobile station, which is shortly referred as total isotropic radiated power (TIRP) AND the spherical equivalent isotropic radiation sensitivity, which is shortly referred as total isotropic radiated sensitivity (TIRS). Since the measurement results of the mobile station in the free space state may be different from the measurement results in the various test states such as the left and right ears of the head model and the hand model, this standard requires conducting respectively the test under all the test states as specified by the corresponding chapters on various communication systems. For mobile stations that support multiple typical operating states, it is only required to conduct test under the main machine mode.

As for the performance test methods for the radio frequency radiation power and receiver of new systems which appear with the development of technology, FOLLOW the corresponding product family test methods. In the absence of relevant product family criteria, it shall make reference to the general test methods in clause 5.2 and 6.1 of this standard.

4.1 Coordinate system

Figure 1 is a typical spherical coordinate system, Phi (φ) axis is the Z axis, Theta angle is defined as the angle between the measured point and the +Z axis, AND the Phi angle is defined as the angle between the projection of the measuring point on the XY plane and the +X axis.

• monitor

○ The angle setting of notebook or ultra-portable mobile PC (notebook shape)

■ The angle from the horizontal base to the front end of the monitor LCD is 110° ± 5°

■ The position as located by manufacturer close to 110°

○ The tablet needs to be parallel to the X-Y plane

• The transmission state of the wireless signal

In addition to the wireless modules used, TURN off other embedded modules, such as wireless LAN modules, Bluetooth modules, etc.

• Receive diversity - closed

• Power management settings

Computer screen protection - none

Turn off the monitor - never

Turn off the hardware - never

System sleeps - never

System standby - never

• Monitor (LCD) backlight intensity - Medium intensity (50% or equivalent to 50% intensity)

○ The ambient light sensor - closed

• The keyboard backlight - turn off

○ The ambient light sensor - closed

• Battery-powered (standard battery only)

• Dynamic control or energy saving of CPU and bus clock frequencies - if possible, turn off related settings

• The EUT of the retractable antenna is only tested under the configuration recommended by the antenna manufacturer

a.2 Test arrangement

placed towards the direction phi = 270° and theta = 90°, ADJUST the tablet height so that the crosshair horizontal beam intersects at point B.

Along the X axis of EUT, ADJUST its position to make the vertical laser beams intersect at points A, B, C and J. If necessary, PLACE an object at the J point behind the EUT to facilitate the observation of the position of the vertical laser beam.

ROTATE the turntable to the position phi = 90°; along the Y axis of the EUT, ADJUST the tablet to make the vertical laser beam pass through the points G, H, I and K. If necessary, PLACE an object at the point K behind the EUT to facilitate the observation of the position of the vertical laser beam. MAKE the turntable return back to the position phi = 0°, and RE-CHECK the alignment. If necessary, it may repeat this operation.

For the combined axis large circle cut darkroom, FIX the EUT body onto the Phi axis clamp; MAKE the center of the Phi rotation axis at the intersect between the AJ line and the GK line.

ROTATE the EUT around the Phi axis until the tablet Y direction is vertically downwards. ADJUST the base along the Phi axis until the point B is aligned with Theta axis, AND the Theta axis may be calibrated by a vertical line or laser positioner. Rotate the EUT around the Phi axis until the plate X direction is vertical up. USE the plumb line or laser positioner to verify that the point H is aligned with theta axis. If necessary, it may repeat this operation.

b. Data module externally inserted in notebook mode

As the data module shall be used in conjunction with the notebook, it adopts the standard reference notebook method to directly insert the data module into the standard reference notebook. CONSIDER this combination as EUT.

b.1 Standard reference notebook configuration requirements

The standard reference notebook shall be configured same as the item a.1 except that the operating system shall be in idle state. Standard reference notebook related configuration requirements are as follows:

Monitor - 14.1 inch wide-screen monitor

The USB main drive slot - Located in the Y-axis direction AND close to the end of the screen

The exhaust design - Minimize the impact on the USB slot temperature changes

Data module control software – KEEP the USB card control software running and working properly

Notebook thickness - The notebook body thickness after opening its screen is 21 ~ 32mm analyzing the measurement data for each measurement point on the spherical plane, in order to obtain the three-dimensional radiation characteristics of the EUT. In the theta axis and Phi axis of spherical coordinates, respectively, TAKE a measuring point at the interval of 15°, to fully describe the EUT far field radiation mode and the total isotropic radiated power. Since not test is required at θ = 0° and θ = 180°, each polarization requires measuring 264 points, AND all the measuring results are integrated in accordance with the equation D-1 of Appendix D into the total isotropic radiated power (TIRP).

4.3.2 Receiver performance measurement

The EUT reception performance is determined by measuring the minimum forward link power of the EUT at a certain bit error rate (BER) or frame error rate (FER). This standard specifies that the test is performed at the worst-case configuration of the EUT reception sensitivity, AND the measuring data of each measuring point on the spherical plane is analyzed to evaluate the effective receiver sensitivity, to obtain the EUT three-dimensional receiver characteristics. In the θ axis and Φ axis on the spherical coordinates, TAKE a measuring point at the interval of 30°, to fully describe the total reception sensitivity of the EUT. Since no test is required at θ = 0° and θ = 180°, each polarization requires measuring 60 points, AND all the measuring results are integrated in accordance with the equation D-4 into the total isotropic radiated sensitivity (TIRS).

Since some EUT requires special control methods to measure the BER, in which case this equipment may require external cables and manual commands to enter the setup state, BUT these can only be used to set the EUT. In the test process, all cable connections must be removed AND the EUT is operating in a separate battery-powered mode.

5 RF radiated power measurement method

5.1 Power measurement equipment

The recommended power measurement equipment is the spectrum analyzer, because it can directly control the relevant parameters to meet the measurement requirements of the different communication signal power. If the power probe has the appropriate response time and isolation, it may also use the power meter to conduct the test as specified in this chapter.

5.2 General conditions for power measurement

For all power measurements, this clause lists the general requirements. Assuming the using a spectrum analyzer as the power measurement device, unless otherwise specified, the spectrum analyzer uses RMS detection.

The signal strength received by the spectrum analyzer is at least 40 dB higher than the noise floor. ADJUST the reference level and attenuation value of the spectrum analyzer so that the received signal is at least 5 dB lower than the

Always up (mobile terminal)	≥ 18	NA	NA	TBD
Always up (data terminal)	≥ 18	NA	NA	TBD
Note: the requirement at free space is the minimum value requirement, AND the requirements at other conditions are average value requirements.				

5.9 TIRP simple test method

Some EUTs have a variety of systems, so it is very complicated if all TIRP tests are carried out in accordance with the above chapters. When the EUT's two or more systems use the same frequency or the frequency which is very close, if the antenna radiation pattern changes can be considered zero (such as GSM900 and GPRS900 and EGPRS900), it may use the following simple method to verify the EUT's TIRP performance.

If using the following test methods, it is preferable to select the speech system for the three-dimensional TIRP test. AND the data system may use simple method. In the following description, it is assumed that the speech system is the system A, AND the data system is the system B.

1) Firstly TEST the three-dimensional isotropic TIRP of the system A; and RECORD the position and polarization of the maximum EIRP of the EUT at the system A conditions;

2) After the TIRP test of the system A is completed, ADJUST the position of the EUT to the position of the three-dimensional maximum EIRP, and ADJUST the polarization of the test antenna to be consistent with the maximum EIRP polarization;

3) RE-TEST the TIRP of the system A of the EUT at this position; RECORD the result as a; under the conditions of not contacting the EUT, CHANGE the parameters of the base station simulator; SWITCH the EUT from the system A to the system B; at the system B, RE-TEST the EIRP at this position and this polarization, which is recorded as b; if it is not possible to switch without contacting the EUT, it is necessary to consider the resulting uncertainty in the total uncertainty;

4) USE the difference between the test result a and b as the difference between the TIRP of the system A and the TIRP of the system B; CALCULATE the TIRP of the system B.

6 Receiver performance measurement

6.1 General conditions for receiver performance measurement

The total isotropic radiated sensitivity (TIRS) shall be fully tested on the three channels (high, medium and low) of the frequency bands as described in Chapter 5. The remaining intermediate channels need to be subjected to the reception sensitivity test. Since some EUT supports a large number of intermediate channels, the intermediate channel between them can be ignored values of all the test points shall be integrated in accordance with the formula D.3 into the total isotropic radiated sensitivity (TIRS).

In the three channels (high, medium, low) of the frequency bands as supported by the EUT, PERFORM complete TIRS test. As for the intermediate channel, under the conditions of satisfying the maximum interval requirements, MEASURE the relative reception sensitivity, as shown in Figure 17.

The relative reception sensitivity measurement procedure for the intermediate channel is as follows:

1) FIND the measurement point of the best reception sensitivity, ADJUST the position and polarization of the EUT, to make it same as the measurement point; MAKE measurement at the channel which is most close to this measurement point AND satisfies with the conditions that the interval between the two adjacent continuous channels is not more than 500kHz;

2) INCREASE the base station simulator output power to the best reception sensitivity +5 dB;

3) MEASURE the FER of the intermediate channel, AND the FER shall not exceed 2%;

4) REPORT the measurement results of the intermediate channel.

6.2.2 Limits - CDMA reception sensitivity

The complete receiver sensitivity measurement shall include all the channel tests performed under all possible applicable scenarios of EUT (such as free space, head model, etc.) AND the main mechanical mode supported by EUT (such as the flip opening state of the flip-EUT, the slide opening state of slide-EUT, and the antenna extension state of the antenna retractable EUT). In addition, it shall also make the relative sensitivity test of the intermediate channel, as shown in Table 18.

Table 18 -- CDMA reception sensitivity requirements

	CDMA TIRP (dBm)			
Power control	Free space	Head model only	Head and hand model	Hand model only
Always up (mobile terminal)	≤ -100	≤ -96	TBD	TBD
Always up (data terminal)	≤ -100	NA	NA	TBD
Note: the requirement at free space is the minimum value requirement, AND the requirements at other conditions are average value requirements.				

6.3 GSM receiver performance test

6.3.1 Test procedure

USE the base station simulator to measure the mobile station reception sensitivity. The receiver sensitivity measurement procedures are the same as

	GSM 1800 TIRS (dBm)							
Power level	Free space		Head model only		Head and hand model		Hand model only	
	AVG	MIN	AVG	MIN	AVG	MIN	AVG	MIN
0 (mobile terminal)	TBD	TBD	≤ -99.5	≤ -96.5	TBD	TBD	TBD	TBD
0 (data terminal)	≤ -103	≤ -100	NA	NA	NA	NA	TBD	TBD

6.4 GPRS receiver performance test (optional)

6.4.1 Test procedure

USE the base station simulator to measure the mobile station reception sensitivity; and RECORD the minimum forward link power when the EUT's block error rate (BLER) reaches 10% (± 0.1%) AND the confidence level is greater than 95%.

MAKE settings in accordance with the parameters of clause 5.5, except for the following parameters: the base station simulator configures the EUT as the GPRS data loopback mode, as shown in 3GPP TS05.05 and 3GPP TS 51.010.

The EUT establishes connection with the base station simulator at the specified test channel. MAKE the EUT emit at the maximum power; START the block error rate (BLER) measurement, the measured number of block shall make the confidence level of the bit error rate be more than 95%, BUT the maximum value is 200 blocks. When the forward link power is close to the EUT sensitivity level, the power drop step shall not be greater than 0.5 dB. REDUCE the output power of the base station simulator until the BLER rises to 10% (± 0.1%). The sensitivity test values for all test points shall be integrated into total isotropic radiated sensitivity (TIRS) in accordance with the Equation D.3.

In the three channels (high, medium, low) of the frequency bands as supported by the EUT, PERFORM complete TIRS test. As for the intermediate channel, under the conditions of satisfying the maximum interval requirements, MEASURE the relative sensitivity.

The relative sensitivity measurement procedure is as follows:

1) FIND the measurement point of the best reception sensitivity, ADJUST the position and polarization of the EUT, to make it same as the measurement point; MAKE measurement at the channel which is most close to this measurement point AND satisfies with the conditions that the interval between the two adjacent continuous channels is not more than 500kHz;

2) INCREASE the base station simulator output power to the minimum reception sensitivity +5 dB;

3) MEASURE the BLER, AND the BLER shall not exceed 10%;

frame error rate reaches 2% (± 0.1%) AND the confidence level is greater than 95%.

SET the parameters in accordance with clause 5.7, with the following exceptions:

- Forward link power: -75dBm;

- Power control: loopback mode.

Other parameter settings are as shown in clause 3.5.1 and 6.5.2 of 3GPP2 C.S0011-B.

ESTABLISH connection at the specified test channel. MAKE the mobile station emit at the maximum power; START the frame error rate (FER) measurement, the measured number of frame shall make the confidence level of the frame error rate be more than 95%, BUT the maximum value is 500 frames. When the forward link power is close to the CDMA 1xRTT sensitivity level, the power drop step shall not be greater than 0.5 dB. When each test point is subjected to sensitivity measurement, SET the power control of the base station simulator at “Always Up”. REDUCE the output power of the base station simulator until the FER rises to 2%. The sensitivity test values for all test points shall be integrated into total isotropic radiated sensitivity (TIRS) in accordance with the Equation D.3.

In the three channels (high, medium, low) of the frequency bands as supported by the EUT, PERFORM complete TIRS test. As for the intermediate channel, under the conditions of satisfying the maximum interval requirements, MEASURE the relative sensitivity.

The relative sensitivity measurement procedure is as follows:

1) FIND the measurement point of the best reception sensitivity, ADJUST the position and polarization of the EUT, positioner, and measuring antenna, to make it same as the measurement point; MAKE measurement at the channel which is most close to this measurement point AND satisfies with the conditions that the interval between the two adjacent continuous channels is not more than 500kHz;

2) INCREASE the base station simulator output power to the best reception sensitivity +5 dB;

3) MEASURE the FER of the intermediate channel, AND the FER shall not exceed 2%;

4) REPORT the measurement results of the intermediate channel.

6.6.2 Limits - CDMA 1xRTT reception sensitivity

The complete receiver sensitivity measurement shall include all the channel tests performed under all possible applicable scenarios of EUT (such as free

The relative reception sensitivity measurement procedure is as follows:

1) FIND the measurement point of the best reception sensitivity, ADJUST the position and polarization of the EUT, positioner, and measuring antenna, to make it same as the measurement point; MAKE measurement at the channel which is most close to this measurement point AND satisfies with the conditions that the interval between the two adjacent continuous channels is not more than 500kHz;

2) INCREASE the base station simulator output power to the best reception sensitivity +5 dB;

3) MEASURE the PER of the intermediate channel, AND the PER shall not exceed 2%;

4) REPORT the measurement results of the intermediate channel.

6.7.2 Limits - cdma2000 EV-DO reception sensitivity

The complete receiver sensitivity measurement shall include all the channel tests performed under all possible applicable scenarios of EUT (such as free space, head model, etc.) AND the main mechanical mode supported by EUT (such as the flip opening state of the flip-EUT, the slide opening state of slide-EUT, and the antenna extension state of the antenna retractable EUT). In addition, it shall also make the relative sensitivity test of the intermediate channel, as shown in Table 23.

Table 23 -- cdma2000 EV-DO reception sensitivity requirements

	Cdma2000 EV-DO TIRS (dBm)			
Power control	Free space	Head model only	Head and hand model	Hand model only
Always up (mobile terminal)	≤ -100	NA	NA	TBD
Always up (data terminal)	≤ -100	NA	NA	TBD
Note: the requirement at free space is the minimum value requirement, AND the requirements at other conditions are average value requirements.				

Appendix A

(Normative)

Ripple test

This appendix specifies the method for performing site dead zone performance verification. This method is used to measure the performance changes caused by the reflection of the darkroom, AND to describe the characteristics of the entire test system, including the positioner and the support structure.

This test procedure uses high-symmetry dipole and loop antennas to make measurement in different locations and orientations in the dead zone. The deviation between the measured antenna pattern and the ideal mode (ripple) is included in the overall uncertainty of the entire measurement system after analysis, AND it requires that the total expansion uncertainty is less than 2dB.

A.1 Minimum measurement distance

This clause gives the minimum measurement distance R as required for far field test, as shown in Table A.1. The measurement distance is the distance between the EUT rotation center and the center of the measurement antenna phase.

Table A.1 -- Minimum measurement distance R

Frequency	Minimum measurement distance R (m)
CDMA (824 ~ 894 MHz)	1.09
GSM900 (880 ~ 960 MHz)	1.02
GSM1800 (1710 ~ 1880 MHz)	1.13
Cdma2000 1x EV-DO (1920 ~ 2170 MHz)	1.30

A.2 Test equipment

1) Darkroom and spherical positioning system. The darkroom must comply with the minimum measurement distance R requirements between the EUT and the measurement antenna, AND the test field has no electromagnetic interference.

2) As for the coaxial dipole detection antenna containing the frequency band in Table C-1, its symmetry is less than ± 0.1dB in plane mode.

3) As for the standard loop probe antenna containing the frequency band in Table C-1, its symmetry is less than ± 0.1dB in plane mode.

4) Low dielectric constant support system for detecting antenna positioning.

5) Measurement antenna.

6) Network analyzer or signal source/receiver.

1) The measurement antenna is fixed at θ = 90° position and at the same level as the center of the dead zone. The distance between the measurement antenna and the probe antenna is the same as the actual measurement, AND it is greater than the requirement in Table C-1. The measurement antenna has the same polarization with the probe antenna.

2) USE the low dielectric constant insulation support to fix the probe antenna onto the Phi axis positioner. The Theta polarization test uses the dipole probe antenna, AND the Phi polarization uses the loop probe antenna.

3) USE the coaxial cable to connect the signal source and the probe antenna; in accordance with the test frequency, SET the output frequency of the signal source; in accordance with the measurement range of the receiver, SET the output amplitude of the signal source. CONNECT the measurement antenna and the receiver; in the ripple test process, the signal strength as received by the receiver shall be at least 40dB higher than the noise floor. All the cables must be reasonably arranged and connected, in order to minimize the impact onto the measurement results.

4) The probe antenna rotates around the Phi axis for 1 cycle; AND a measurement value is recorded every 2°.

5) RECORD the test results, AND the recorded parameters include:

a) The distance between the measurement antenna and the probe antenna;

b) The cable loss and other associated loss in the test arrangement;

c) The signal power of the probe antenna input port;

d) The noise floor of the receiver when there is no signal injection.

6) At 6 positions and 2 polarizations, respectively REPEAT the step 1 ~ step 5.

7) For notebook type equipment, it shall also increase the Phi axis ripple text for additional 4 positions, the (R, Z) is respectively (0, D/2), (D/2, -150 mm), (D/2, 0), and (D/2, D/2), wherein D = 500mm.

A.4.2 Theta axis ripple test

The dead zone of theta axis ripple test is a ball having a diameter of 300mm. The probe antenna is parallel to the Theta axis, totally 7 positions are measured, AND each measurement point deviates 150mm from the Cartesian axis. At each test point, the measurement antenna is fixed at Φ = 0 position, the Theta axis is rotated from -165° to 165°, OR the measurement antenna is respectively located at Φ = 0 and Φ = 180°, respectively, AND the Theta axis is rotated from 1° to 165°, MAKE test twice. USE (X, Y, Z) to indicate the position of each test point, as shown in Figure A.2.

a) The distance between the measurement antenna and the probe antenna;

b) The cable loss and other associated loss;

c) The signal power of the probe antenna input port;

d) The noise level of the receiver.

6) At 7 positions and 2 polarizations, respectively REPEAT the step 1 ~ step 5.

7) For notebook type equipment, it shall also increase the Phi axis ripple text for additional 3 positions, the (X, Y, Z) is respectively (±D/2, 0, 0), (0, ±D/2, 0), and (0, 0, +D/2), wherein D = 500mm.

A.4.3 Adjustment of test points

When use the actual positioner to perform the above tests, the support which is used to fix the EUT or SAM model may block the progress of certain test points. In order to conduct tests under such situations, it may slightly modify the above test methods. This clause gives the details of the portion to be modified; if possible, it shall minimize the modification of the test methods.

1) During the free space ripple test, it may remove part of the support which rotates around the Phi axis. The tester shall demonstrate that the effect of the removed part of the support on the ripple test is negligible as relative to the remaining support.

2) As for the support material having a dielectric constant less than 1.2, the maximum distance from the dead zone may be 250mm, that is, 400mm from the test center.

3) As for the adapter for connecting the fixed SAM model, if the thickness is not greater than 13mm, AND the dielectric constant is less than 4.5, it may be considered as part of the SAM model, AND it may be removed together with the SAM model during the ripple test.

4) For Phi axis ripple testing, the mechanical device may block the rotation of the probe antenna around the Phi axis. It may move the Phi axis positioning structure outside the dead zone, AND the movement distance is the minimum distance satisfying the (X, -) position test.

5) In order to avoid the effect of the near field effect on the ripple test, the minimum distance from any support material having a dielectric constant greater than 1.2 to any point of the physical surface of the probe antenna is more than 75mm. When making the Theta axis test on the model which has SAM model, the loop antenna and dipole may intersect with the SAM model support, which is the most influential. In order not to reduce the number of test points, the (0, 0, -) point test is substituted by the following methods, in the order of preference.

Appendix B

(Normative)

Uncertainty analysis of test system

B.1 TIRP test system uncertainty analysis

For TIRP testing, the overall measurement system uncertainty is mainly analyzed from the following aspects, as shown in Table B.1. AND it requires the total expansion uncertainty of the test system is less than 1.5dB.

Table B.1 -- TIRP test system uncertainty factor

Uncertainty factor
Reception end mismatch: (for example: mismatch between reception equipment and measurement antenna)
Transmission end mismatch: (for example: mismatch between signal source and calibration reference antenna)
Signal source: absolute output level and stability
Cable factor: the impact of the measurement antenna cable and calibration reference antenna cable onto test
Insertion loss: Measurement antenna cable and calibration reference antenna cable
Insertion loss: Measurement antenna end attenuator and calibration reference antenna end attenuator (if any)
Measurement distance: The deviation between the calibration reference antenna phase center and the rotation center
Effect of ripple in the dead zone onto the measurement results
Antenna: Gain of the measurement antenna and calibration reference antenna
Measurement distance: - Deviation of EUT phase center from the rotation axis center - Impact of EUT onto the measurement antenna blocking - VSWR - Darkroom standing wave - EUT's phase curvature
Environmental temperature effects during test
Positioning uncertainty of EUT on head model
Random uncertainty

B.2 TIRS test system uncertainty analysis

When performing TIRS test, the overall measurement system uncertainty is mainly analyzed from the following aspects, as shown in Table B.2, AND it requires the total expansion uncertainty of the test system to be less than 2.25dB.