

FCC

RF Test Report

Product Name: Smart Phone

Model Number: HUAWEI GRA-UL00,HUAWEI GRA-UL10

Report No: SYBH(Z-RF)011022015-2001

FCC ID: QISGRA-ULX0

Reliability Laboratory of Huawei Technologies Co., Ltd.

Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District,
Shenzhen, 518129, P.R.C

Tel: +86 755 28780808 Fax: +86 755 89652518

Notice

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2. The laboratory has Passed the accreditation by The American Association for Laboratory Accreditation (A2LA). The accreditation number is 2174.01.
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4. The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 6369A-2.
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Applicant: Huawei Technologies Co., Ltd.
Address: Administration Building, Headquarters of Huawei Technologies Co., Ltd.,
Bantian, Longgang District, Shenzhen, 518129, P.R.C

Date of Receipt Sample: 2015-03-16
Start Date of Test: 2015-03-17
End Date of Test: 2015-03-27

Test Result: Pass

**Approved by Senior
Engineer:**

2015-03-31

Liu Chunlin

Date

Name

Signature

Prepared by:

2015-03-31

Wu Tingsi

Date

Name

Signature



Modification Record

No.	Last Report No.	Modification Description
1		First report.

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1 General Information

1.1 Applied Standard

Applied Rules: 47 CFR FCC Part 02: 2013
47 CFR FCC Part 22: 2013
47 CFR FCC Part 24: 2013
47 CFR FCC Part 27: 2013

Test Method: FCC KDB 971168 D01 Power Meas License Digital Systems v02r02

1.2 Test Location

Test Location 1: Reliability Laboratory of Huawei Technologies Co., Ltd.
Address: Administration Building, Headquarters of Huawei Technologies Co., Ltd.,
Bantian, Longgang District, Shenzhen, 518129, P.R.C

1.3 Test Environment Condition

Ambient Temperature: 19.5 to 25 °C
Ambient Relative Humidity: 40 to 55 %
Atmospheric Pressure: Not applicable

2 Test Summary

2.1 Cellular Band (824-849 MHz paired with 869-894 MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§2.1046, §22.913	ERP ≤ 7 W.	Appendix A	Pass
Peak-Average Ratio	---	---	Appendix B	N/T
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §22.917	≤ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block.	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §22.917	≤ -13 dBm/100 kHz, from 9 kHz to 10 th harmonics but outside authorized operating frequency ranges.	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §22.917	≤ -13 dBm/100 kHz.	Appendix G	Pass
Frequency Stability	§2.1055, §22.355	≤ ±2.5ppm.	Appendix H	Pass
NOTE 1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".				

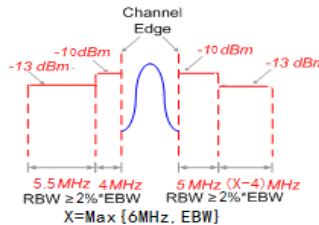
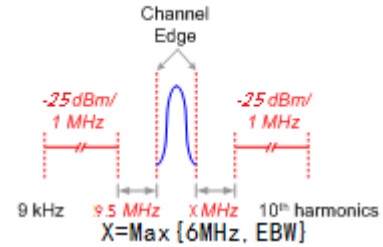
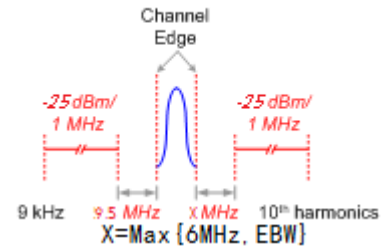
2.2 PCS Band (1850-1915 MHz paired with 1930-1995 MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§2.1046, §24.232	EIRP $\leq$ 2 W	Appendix A	Pass
Peak-Average Ratio	§2.1046, §24.232	Limit $\leq$ 13 dB	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §24.238	$\leq$ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block.	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §24.238	$\leq$ -13 dBm/1 MHz, from 9 kHz to 10 th harmonics but outside authorized operating frequency ranges.	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §24.238	$\leq$ -13 dBm/1 MHz.	Appendix G	Pass
Frequency Stability	§2.1055, §24.235	within authorized frequency block.	Appendix H	Pass
NOTE 1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".				

2.3 AWS Band (1710-1755 MHz paired with 2110-2155 MHz)

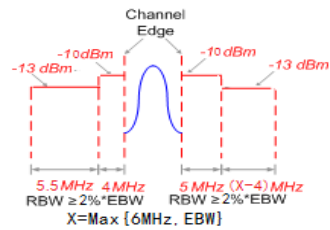
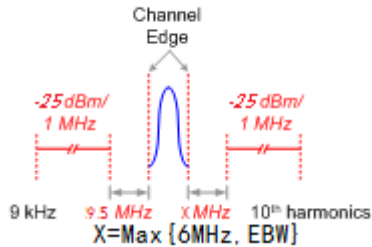
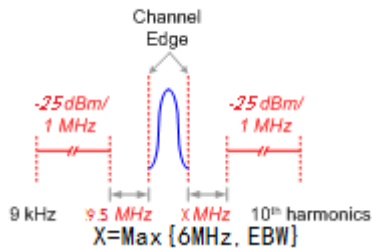
Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(d)	$EIRP \leq 1\text{ W}$	Appendix A	Pass
Peak-Average Ratio	§2.1046, §27.50(d)	Limit $\leq$ 13 dB	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §27.53(h)	$\leq -13\text{ dBm}/1\%*EBW$, in 1 MHz bands immediately outside and adjacent to the frequency block.	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(h)	$\leq -13\text{ dBm}/1\text{ MHz}$, from 9 kHz to 10^{th} harmonics but outside authorized operating frequency ranges.	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(h)	$\leq -13\text{ dBm}/1\text{ MHz}$.	Appendix G	Pass
Frequency Stability	§2.1055, §27.54	Within authorized bands of operation/frequency block.	Appendix H	Pass
NOTE 1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".				

2.4 BRS&EBS Band (2500-2570 MHz paired with 2620-2690 MHz)

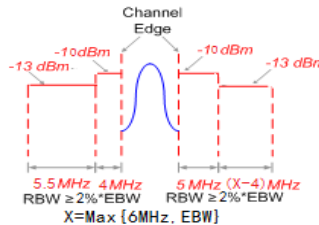
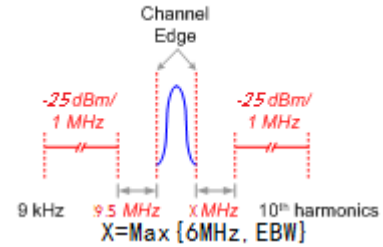
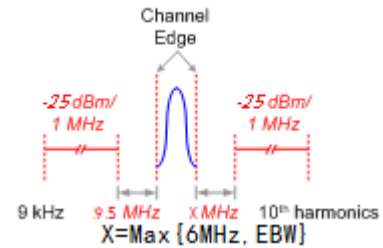
Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(h)	EIRP ≤ 2W	Appendix A	Pass
Peak-Average Ratio	---	---	Appendix B	N/T
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §27.53(m)	 Channel Edge -10 dBm -13 dBm 5.5 MHz 4 MHz 5 MHz (X-4) MHz RBW ≥ 2%*EBW RBW ≥ 2%*EBW X=Max {6MHz, EBW}	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(m)	 Channel Edge -25 dBm/1 MHz -25 dBm/1 MHz 9 kHz 9.5 MHz X MHz 10th harmonics X=Max {6MHz, EBW}	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(m)	 Channel Edge -25 dBm/1 MHz -25 dBm/1 MHz 9 kHz 9.5 MHz X MHz 10th harmonics X=Max {6MHz, EBW}	Appendix G	Pass
Frequency Stability	§2.1055, §27.54	Within authorized bands of operation/frequency block.	Appendix H	Pass

NOTE 1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".

2.5 BRS&EBS Band (2570-2620 MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(h)	$EIRP \leq 2W$	Appendix A	Pass
Peak-Average Ratio	---	---	Appendix B	N/T
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §27.53(m)		Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(m)		Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(m)		Appendix G	Pass
Frequency Stability	§2.1055, §27.54	Within authorized bands of operation/frequency block.	Appendix H	Pass
NOTE 1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".				

2.6 BRS&EBS Band (2496-2690 MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(h)	EIRP ≤ 2W	Appendix A	Pass
Peak-Average Ratio	---	---	Appendix B	N/T
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §27.53(m)	 Channel Edge -10 dBm -13 dBm 5.5 MHz 4 MHz RBW ≥ 2%*EBW RBW ≥ 2%*EBW X=Max {6MHz, EBW}	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(m)	 Channel Edge -25 dBm/1 MHz -25 dBm/1 MHz 9 kHz 9.5 MHz X MHz 10th harmonics X=Max {6MHz, EBW}	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(m)	 Channel Edge -25 dBm/1 MHz -25 dBm/1 MHz 9 kHz 9.5 MHz X MHz 10th harmonics X=Max {6MHz, EBW}	Appendix G	Pass
Frequency Stability	§2.1055, §27.54	Within authorized bands of operation/frequency block.	Appendix H	Pass

NOTE 1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".

3 Description of the Equipment under Test (EUT)

3.1 General Description

HUAWEI GRA-UL00, HUAWEI GRA-UL10 is subscriber equipment in the LTE/UMTS/GSM system. The LTE frequency band is Band I,Band III,Band IV, Band VII, Band XXXVIII,Band XXXIX,Band XL and Band XLI. But only Band IV, Band VII, Band XXXVIII and Band XLI test data included in this report. The HSUPA/HSDPA/UMTS frequency band is Band I, Band II, Band IV, Band V and Band VIII, But only Band II, Band IV and Band V test data can be used in this report. The GSM/GPRS/EDGE frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900, but only GSM850 and DCS1900 bands test data included in this report. The Mobile Phone implements such functions as RF signal receiving/transmitting, LTE/UMTS/GSM protocol processing, voice, video, MMS service, GPS, AGPS and WIFI etc. Externally it provides earphone port (to provide voice service) and USIM card interface. It also provides Bluetooth module to synchronize data between a PC and the phone, or to use the built-in modem of the phone to access the Internet with a PC, or to exchange data with other Bluetooth devices.

3.2 EUT Identity

NOTE: Unless otherwise noted in the report, the functional boards installed in the units shall be selected from the below list, but not means all the functional boards listed below shall be installed in one unit.

3.2.1 Board

Board		
Description	Hardware Version	Software Version
Main Board	HL2TGRACEM	GRA-UL00V100R001C900B022

3.2.2 Sub-Assembly

Name	Manufacture	Description
Adapter	Huawei Technologies Co., Ltd.	Model: HW-050100B2W Input voltage: 100V~240V AC and 50/60 Hz, 0.2A Output voltage: +5V $\overline{\text{---}}$ 1A Rated Power: 5W
Adapter	Huawei Technologies Co., Ltd.	Model: HW-050100U2W Input voltage: 100V~240V AC and 50/60 Hz, 0.2A Output voltage: +5V $\overline{\text{---}}$ 1A Rated Power: 5W

Adapter	Huawei Technologies Co., Ltd.	Model: HW-050100A2W Input voltage: 100V~240V AC and 50/60 Hz, 0.2A Output voltage: +5V $\overline{\text{---}}$ 1A Rated Power: 5W
Adapter	Huawei Technologies Co., Ltd.	Model: HW-050100E2W Input voltage: 100V~240V AC and 50/60 Hz, 0.2A Output voltage: +5V $\overline{\text{---}}$ 1A Rated Power: 5W
Adapter	Huawei Technologies Co., Ltd.	Model: HW-050100U01 Input voltage: 100V~240V AC and 50/60 Hz, 0.2A Output voltage: +5V $\overline{\text{---}}$ 1A Rated Power: 5W
Adapter	Huawei Technologies Co., Ltd.	Model: HW-050100E01 Input voltage: 100V~240V AC and 50/60 Hz, 0.2A Output voltage: +5V $\overline{\text{---}}$ 1A Rated Power: 5W
Adapter	Huawei Technologies Co., Ltd.	Model: HW-050100U01 Input voltage: 100V~240V AC and 50/60 Hz, 0.2A Output voltage: +5V $\overline{\text{---}}$ 1A Rated Power: 5W
Adapter	Huawei Technologies Co., Ltd.	Model: HW-050100A01 Input voltage: 100V~240V AC and 50/60 Hz, 0.2A Output voltage: +5V $\overline{\text{---}}$ 1A Rated Power: 5W

3.2.3 Battery

Name	Manufacture	Description
Rechargeable Li-ion	Huawei Technologies Co., Ltd.	Battery Model: Rated capacity: 2600mAh Nominal Voltage:  +3.8V Charging Voltage:  +4.35V

3.3 Technical Specification

Characteristics	Description		
Radio System Type	☒ GSM ☒ UMTS ☒ LTE		
Supported Frequency Range	GSM850/ WCDMA850	Transmission (TX):	824 to 849 MHz
		Receiving (RX):	869 to 894 MHz
	GSM1900/ WCDMA1900	Transmission (TX):	1850 to 1910 MHz
		Receiving (RX):	1930 to 1990 MHz
	WCDMA1700	Transmission (TX):	1710 to 1755 MHz
		Receiving (RX):	2110 to 2155 MHz
	LTE BAND4	Transmission (TX):	1710 to 1755 MHz
		Receiving (RX):	2110 to 2155 MHz
	LTE BAND7	Transmission (TX):	2500 to 2570 MHz
		Receiving (RX):	2620 to 2690 MHz
	LTE BAND38	Transmission (TX):	2570 to 2620 MHz
		Receiving (RX):	2570 to 2620 MHz
	LTE BAND41	Transmission (TX):	2496 to 2690 MHz
		Receiving (RX):	2496 to 2690 MHz
TX and RX Antenna Ports	TX & RX port:	2	
Target TX Output Power	GSM850	32.5dBm	
	GSM1900	29.5dBm	
	UMTS850	23dBm	
	UMTS1700	22.5dBm	
	UMTS1900	22.5dBm	
	LTE BAND4	23dBm	
	LTE BAND7	22.5dBm	
	LTE BAND38	23dBm	
	LTE BAND41	23dBm	
Supported Channel Bandwidth	GSM System:	☒ 200 kHz	
	UMTS system:	☒ 5 MHz	
	LTE band 4	☒ 1.4 MHz, ☒ 3 MHz, ☒ 5 MHz, ☒ 10 MHz, ☒ 15 MHz, ☒ 20 MHz	
	LTE band 7	☒ 5 MHz, ☒ 10 MHz, ☒ 15 MHz, ☒ 20 MHz	
	LTE band 38	☒ 5 MHz, ☒ 10 MHz, ☒ 15 MHz, ☒ 20 MHz	
	LTE band 41	☒ 5 MHz, ☒ 10 MHz, ☒ 15 MHz, ☒ 20 MHz	
Designation of Emissions (Note: the necessary bandwidth of	GSM850	Direct Mode	245KGXW, 247KG7W
		Cross Mode	245KGXW, 252KG7W

Characteristics	Description		
which is the worst value from the measured occupied bandwidths for each type of channel bandwidth configuration.)	GSM1900	Direct Mode	244KGXW, 253KG7W
		Cross Mode	246KGXW, 250KG7W
	UMTS850:	Direct Mode	4M16F9W
	UMTS1700:	Direct Mode	4M16F9W
	UMTS1900:	Direct Mode	4M16F9W
	LTE BAND4	Direct Mode	1M09G7D (1.4 MHz QPSK modulation), 1M09W7D (1.4 MHz 16QAM modulation) 2M07G7D (3 MHz QPSK modulation), 2M71W7D (3 MHz 16QAM modulation) 4M50G7D (5 MHz QPSK modulation), 4M50W7D (5 MHz 16QAM modulation) 9M00G7D (10 MHz QPSK modulation), 9M02 W7D (10 MHz 16QAM modulation) 13M5G7D (15 MHz QPSK modulation), 13M5W7D (15 MHz 16QAM modulation) 18M0G7D (20 MHz QPSK modulation), 18M0W7D (20 MHz 16QAM modulation)
	LTE BAND7	Direct Mode	4M50G7D (5 MHz QPSK modulation), 4M50W7D (5 MHz 16QAM modulation) 9M02G7D (10 MHz QPSK modulation), 9M01W7D (10 MHz 16QAM modulation) 13M5G7D (15 MHz QPSK modulation), 13M5W7D (15 MHz 16QAM modulation) 18M0G7D (20 MHz QPSK modulation), 18M0W7D (20 MHz 16QAM modulation)
	LTE BAND38	Direct Mode	4M51G7D (5 MHz QPSK modulation), 4M49W7D (5 MHz 16QAM modulation) 9M01G7D (10 MHz QPSK modulation), 9M00W7D (10 MHz 16QAM modulation) 13M5G7D (15 MHz QPSK modulation), 13M5W7D (15 MHz 16QAM modulation) 18M0G7D (20 MHz QPSK modulation), 18M0W7D (20 MHz 16QAM modulation)
	LTE BAND41	Direct Mode	4M49G7D (5 MHz QPSK modulation), 4M50W7D (5 MHz 16QAM modulation) 9M00G7D (10 MHz QPSK modulation), 9M01W7D (10 MHz 16QAM modulation) 13M5G7D (15 MHz QPSK modulation), 13M5W7D (15 MHz 16QAM modulation) 18M0G7D (20 MHz QPSK modulation), 18M0W7D (20 MHz 16QAM modulation)

4 General Test Conditions / Configurations

4.1 Test Modes

NOTE: The test mode(s) are selected according to relevant radio technology specifications.

Test Mode	Test Modes Description
GSM/TM1	GSM system, GSM/GPRS, GMSK modulation
GSM/TM2	GSM system, EDGE, 8PSK modulation
UMTS/TM1	WCDMA system, QPSK modulation
UMTS/TM2	HSDPA system, QPSK modulation
UMTS/TM3	HSUPA system, QPSK modulation
LTE/TM1	LTE system, QPSK modulation
LTE/TM2	LTE system, 16QAM modulation

4.2 Test Environment

Environment Parameter	Selected Values During Tests	
Relative Humidity	Ambient	
Temperature	TN	Ambient
Voltage	VL	3.5V
	VN	3.8V
	VH	4.35V

NOTE: VL= lower extreme test voltage
VN= nominal voltage
VH= upper extreme test voltage
TN= normal temperature

4.3 Test Frequency

Test Mode	TX / RX	RF Channel		
		Low (L)	Middle (M)	High (H)
GSM850	TX	Channel 128	Channel 190	Channel 251
		824.2MHz	836.6MHz	848.8MHz
	RX	Channel 128	Channel 190	Channel 251
		869.2MHz	881.6MHz	893.8MHz
WCDMA850	TX	Channel 4132	Channel 4182	Channel 4233
		826.4MHz	836.4MHz	846.6MHz
	RX	Channel 4357	Channel 4407	Channel 4458
		871.4MHz	881.4MHz	891.6MHz
Test Mode	TX / RX	RF Channel		
		Low (L)	Middle (M)	High (H)
GSM1900	TX	Channel 512	Channel 661	Channel 810
		1850.2MHz	1880.0MHz	1909.8MHz
	RX	Channel 512	Channel 661	Channel 810
		1930.2 MHz	1960.0 MHz	1989.8 MHz
WCDMA1900	TX	Channel 9262	Channel9400	Channel9538
		1852.4MHz	1880.0MHz	1907.6MHz
	RX	Channel 9662	Channel 9800	Channel 9938
		1932.4 MHz	1960.0 MHz	1987.6 MHz

Test Mode	TX / RX	RF Channel		
		Low (L)	Middle (M)	High (H)
WCDMA1700	TX	Channel1312	Channel1413	Channel1513

		1712.4MHz	1732.6MHz	1752.6MHz
	RX	Channel 1537	Channel 1638	Channel 1738
		2112.4 MHz	2132.6 MHz	2152.6 MHz

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 4	TX (1.4M)	Channel 19957	Channel 20175	Channel 20393
		1710.7 MHz	1732.5 MHz	1754.3 MHz
	TX (3M)	Channel 19965	Channel 20175	Channel 20385
		1711.5 MHz	1732.5 MHz	1753.5 MHz
	TX (5M)	Channel 19975	Channel 20175	Channel 20375
		1712.5 MHz	1732.5 MHz	1752.5 MHz
	TX (10M)	Channel 20000	Channel 20175	Channel 20350
		1715 MHz	1732.5 MHz	1750 MHz
	TX (15M)	Channel 20025	Channel 20175	Channel 20325
		1717.5 MHz	1732.5 MHz	1747.5 MHz
	TX (20M)	Channel 20050	Channel 20175	Channel 20300
		1720 MHz	1732.5 MHz	1745 MHz
	RX (1.4M)	Channel 1957	Channel 2175	Channel 2393
		2110.7 MHz	2132.5MHz	2154.3 MHz
	RX (3M)	Channel 1965	Channel 2175	Channel 2385
		2111.5 MHz	2132.5MHz	2153.5 MHz
	RX (5M)	Channel 1975	Channel 2175	Channel 2375
		2112.5 MHz	2132.5MHz	2152.5 MHz
	RX (10M)	Channel 2000	Channel 2175	Channel 2350

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
		2115 MHz	2132.5MHz	2150 MHz
		Channel 2025	Channel 2175	Channel 2325
	RX (15M)	2117.5 MHz	2132.5MHz	2147.5 MHz
		Channel 2050	Channel 2175	Channel 2300
	RX (20M)	2120 MHz	2132.5MHz	2145 MHz

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 7	TX (5M)	Channel 20775	Channel 21100	Channel 21425
		2502.5 MHz	2535 MHz	2567.5 MHz
	TX (10M)	Channel 20800	Channel 21100	Channel 21400
		2505 MHz	2535 MHz	2565 MHz
	TX (15M)	Channel 20825	Channel 21100	Channel 21375
		2507.5 MHz	2535 MHz	2562.5 MHz
	TX (20M)	Channel 20850	Channel 21100	Channel 21350
		2510 MHz	2535 MHz	2560 MHz
	RX (5M)	Channel 2775	Channel 3100	Channel 3425
		2622.5 MHz	2655 MHz	2687.5 MHz
	RX (10M)	Channel 2800	Channel 3100	Channel 3400
		2625 MHz	2655 MHz	2685 MHz
	RX (15M)	Channel 2825	Channel 3100	Channel 3375
		2627.5 MHz	2655 MHz	2682.5 MHz
	RX (20M)	Channel 2850	Channel 3100	Channel 3350
		2630 MHz	2655 MHz	2680 MHz

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 38	TX(5M)	Channel 37775	Channel 38000	Channel 38225
		2572.5 MHz	2595 MHz	2617.5 MHz
	TX(10M)	Channel 37800	Channel 38000	Channel 38200
		2575 MHz	2595 MHz	2615 MHz
	TX(15M)	Channel 37825	Channel 38000	Channel 38175
		2577.5 MHz	2595 MHz	2612.5 MHz
	TX(20M)	Channel 37850	Channel 38000	Channel 38150
		2580 MHz	2595 MHz	2610 MHz
	RX(5M)	Channel 37775	Channel 38000	Channel 38225
		2572.5 MHz	2595 MHz	2617.5 MHz
	RX(10M)	Channel 37800	Channel 38000	Channel 38200
		2575 MHz	2595 MHz	2615 MHz
	RX(15M)	Channel 37825	Channel 38000	Channel 38175
		2577.5 MHz	2595 MHz	2612.5 MHz
	RX(20M)	Channel 37850	Channel 38000	Channel 38150
		2580 MHz	2595 MHz	2610 MHz

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 41	TX(5M)	Channel 40265	Channel 40740	Channel 41215
		2557.5 MHz	2605 MHz	2652.5 MHz
	TX(10M)	Channel 40290	Channel 40740	Channel 41190

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
		2560 MHz	2605 MHz	2650 MHz
	TX(15M)	Channel 40315	Channel 40740	Channel 41165
		2562.5 MHz	2605 MHz	2647.5 MHz
	TX(20M)	Channel 40340	Channel 40740	Channel 41140
		2565 MHz	2605 MHz	2545 MHz
	RX(5M)	Channel 40265	Channel 40740	Channel 41215
		2557.5 MHz	2605 MHz	2652.5 MHz
	RX(10M)	Channel 40290	Channel 40740	Channel 41190
		2560 MHz	2605 MHz	2650 MHz
	RX(15M)	Channel 40315	Channel 40740	Channel 41165
		2562.5 MHz	2605 MHz	2647.5 MHz
	RX(20M)	Channel 40340	Channel 40740	Channel 41140
		2565 MHz	2605 MHz	2545 MHz

4.4 DESCRIPTION OF TESTS

4.4.1 Radiated Power and Radiated Spurious Emissions

Radiated spurious emissions are investigated indoors in a semi-anechoic chamber to determine the frequencies producing the worst case emissions. Final measurements for radiated power and radiated spurious emissions are performed on the 3 meter OATS per the guidelines of ANSI/TIA-603-C-2004. The equipment under test was transmitting while connected to its integral antenna and is placed on a wooden turntable 80cm above the ground plane and 3 meters from the receive antenna. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer. Emissions are also investigated with the receive antenna horizontally and vertically polarized.

A portable or small unlicensed wireless device shall be placed on a non-metallic test fixture or other non-metallic support during testing. The supporting fixture shall permit orientation of the EUT in each of three orthogonal (x, y, z) axis positions such that emissions from the EUT are maximized. Measure the EUT maximum RF power and record the result.

A half-wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT. The power of the emission is calculated using the following formula:

$$P_d \text{ [dBm]} = P_g \text{ [dBm]} - \text{cable loss [dB]} + \text{antenna gain [dBd/dBi]}$$

Where, P_d is the dipole equivalent power, P_g is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to $P_g \text{ [dBm]} - \text{cable loss [dB]}$.

The calculated P_d levels are then compared to the absolute spurious emission limit of -13dBm which is equivalent to the required minimum attenuation of $43 + 10\log_{10}(\text{Power [Watts]})$.

Note: Reference test setup 3

4.4.2 Occupied Bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual. The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

Note: Reference test setup 1.

4.4.3 Spurious and Harmonic Emissions at Antenna Terminal

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log(P)$ dB. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

Note: Reference test setup 1.

4.4.4 Peak-Average Ratio

A peak to average ratio measurement is performed at the conducted port of the EUT. For WCDMA signals, the spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level. For GSM signals, an average and a peak trace are used on a spectrum analyzer to determine the largest deviation between the average and the peak power of the EUT in a bandwidth greater than the emission bandwidth. The traces are generated with the spectrum analyzer set to zero span mode.

Note: Reference test setup 1.

4.4.5 Frequency Stability / Temperature Variation

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-C-2004. The frequency stability of the transmitter is measured by:

- a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.
- b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

Specification – The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within $\pm 0.00025\%$ (± 2.5 ppm) of the center frequency.

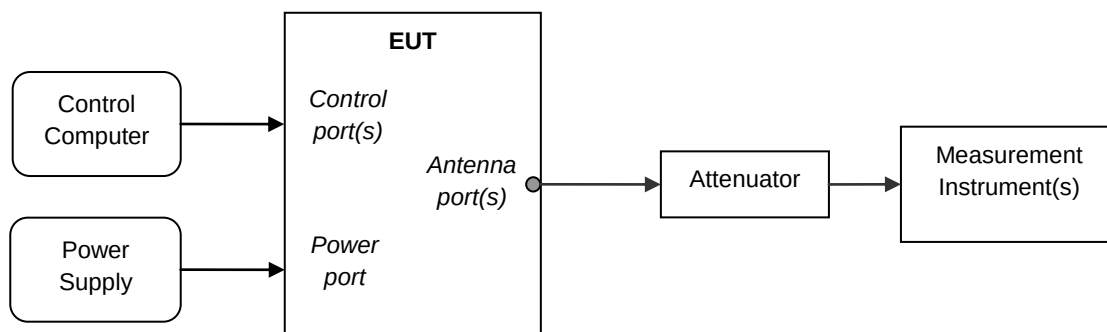
Time Period and Procedure:

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

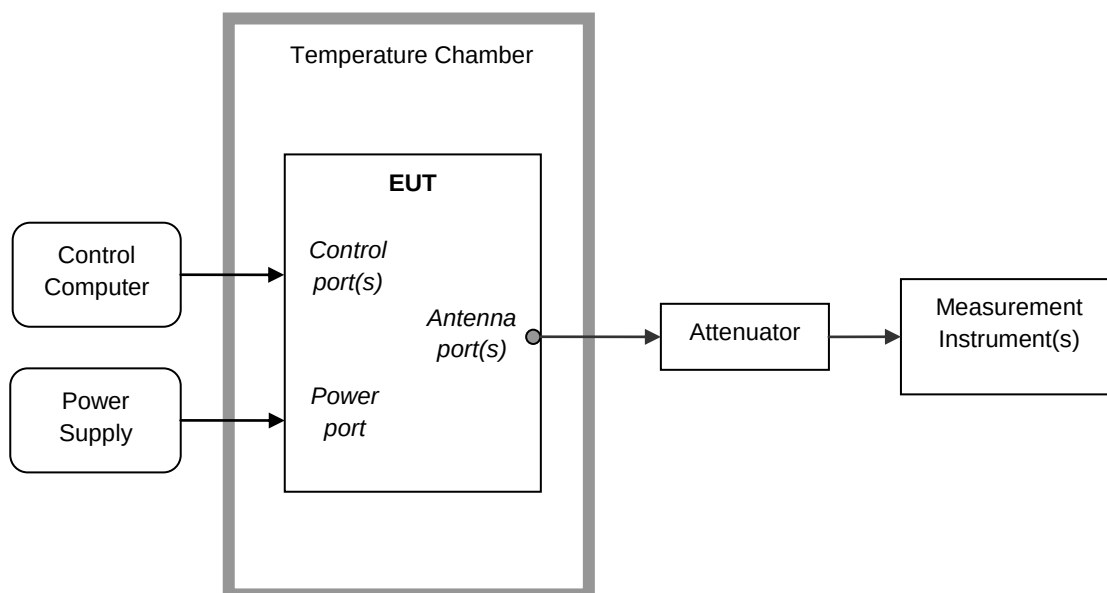
Note: Reference test setup 2.

4.5 Test Setups

4.5.1 Test Setup 1



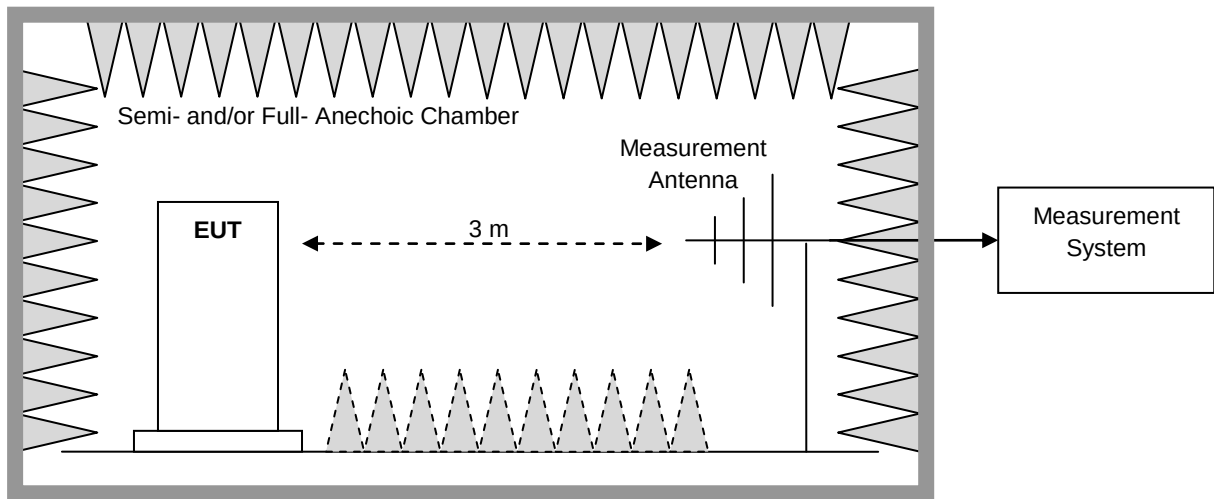
4.5.2 Test Setup 2



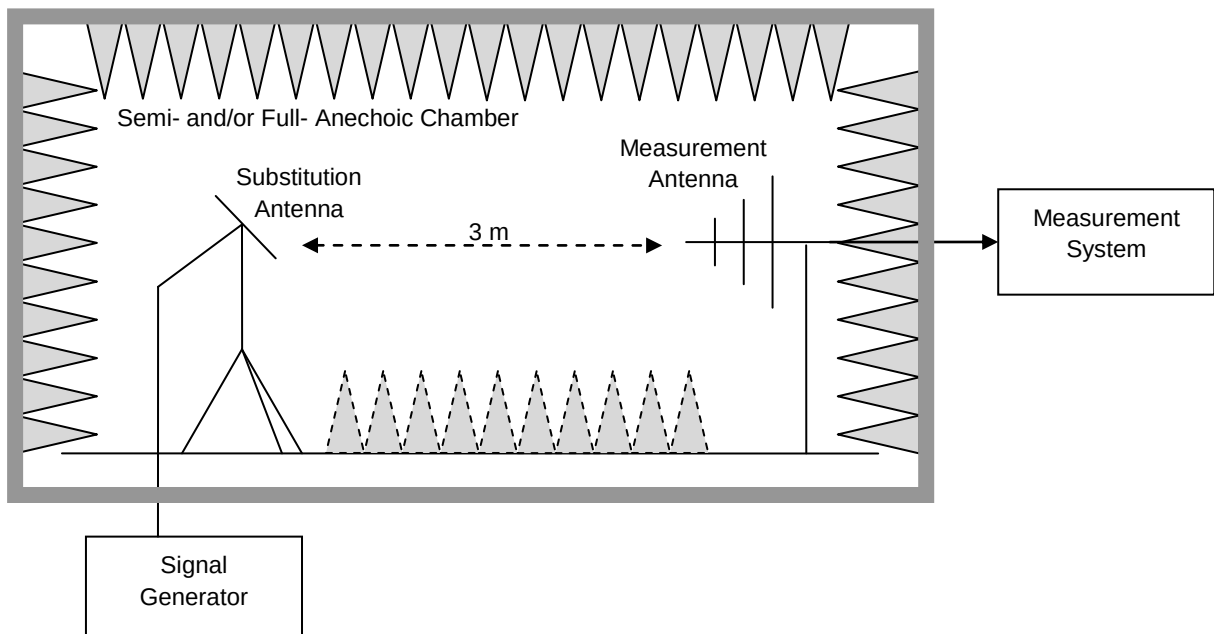
4.5.3 Test Setup 3

NOTE: Effective radiated power (ERP) refers to the radiation power output of the EUT, assuming all emissions are radiated from half-wave dipole antennas.

4.5.3.1 Step 1: Pre-test



4.5.3.2 Step 2: Substitution method to verify the maximum ERP



4.6 Test Conditions

Test Case		Test Conditions	
Transmit Output Power Data	Average Power, Total	Test Env.	Ambient Climate & Rated Voltage
		Test Setup	Test Seup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
		Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2
	Average Power, Spectral Density (if required)	Test Env.	Ambient Climate & Rated Voltage
		Test Setup	Test Seup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
		Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2
Peak-to-Average Ratio (if required)		Test Env.	Ambient Climate & Rated Voltage
		Test Setup	Test Seup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
		Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2
Modulation Characteristics		Test Env.	Ambient Climate & Rated Voltage
		Test Setup	Test Seup 1
		RF Channels (TX)	M (L= low channel, M= middle channel, H= high channel)
		Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2
Bandwidth	Occupied Bandwidth	Test Env.	Ambient Climate & Rated Voltage
		Test Setup	Test Seup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
		Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2
	Emission Bandwidth (if required)	Test Env.	Ambient Climate & Rated Voltage
		Test Setup	Test Seup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
		Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2
Band Edges Compliance		Test Env.	Ambient Climate & Rated Voltage
		Test Setup	Test Seup 1
		RF Channels (TX)	L, H (L= low channel, M= middle channel, H= high channel)
		Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2
Spurious Emission at Antenna Terminals		Test Env.	Ambient Climate & Rated Voltage
		Test Setup	Test Seup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)

Test Case	Test Conditions	
	Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2
Field Strength of Spurious Radiation	Test Env.	Ambient Climate & Rated Voltage
	Test Setup	Test Seup 3
	Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1/TM2/TM3,LTE/TM1,LTE/TM2 NOTE: If applicable, the EUT conf. that has maximum power density (based on the equivalent power level) is selected.
	RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
Frequency Stability	Test Env.	(1) -30 °C to +50 °C with step 10 °C at Rated Voltage; (2) VL, VN and VH of Rated Voltage at Ambient Climate.
	Test Setup	Test Seup 2
	RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
	Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2

**5 Main Test Instruments**

Equipment Name	Manufacturer	Model	Serial Number	Cal Date	Cal- Due
Power supply	KEITHLEY	2303	A120714713	2014-08-07	2016-08-06
Wireless Communication Test set	Agilent	N4010A	MY49081592	2014-11-04	2015-11-03
Universal Radio Communication Tester	R&S	CMU200	123299	2014-11-04	2015-11-03
Spectrum Analyzer	Agilent	N9020A	MY52090652	2014-07-11	2015-07-10
Universal Radio Communication Tester	R & S	CMW500	126854	2015-02-13	2016-02-12
Spectrum Analyzer	Agilent	E4440A	MY48250119	2014-07-11	2015-07-10
Signal Analyzer	R&S	FSQ31	200021	2014-11-04	2015-11-03
Spectrum Analyzer	Agilent	N9030A	MY49431698	2014-11-04	2015-11-03
Temperature Chamber	WEISS	WKL64	56246002940010	2015-02-13	2016-02-12
Temperature Chamber	ESPEC	MW3030	06114003	2014-05-09	2015-05-08
Signal generator	Agilent	E8257D	MY51500314	2014-05-09	2015-05-08
Vector Signal Generator	R&S	SMU200A	104162	2014-11-04	2015-11-03
Test receiver	R&S	ESU26	100150	2014-05-09	2015-05-08
Spectrum analyzer	R&S	FSU3	200474	2014-11-04	2015-11-03
Spectrum analyzer	R&S	FSU43	100144	2014-11-04	2015-11-03
Double-Ridged Waveguide Horn Antenna (1G~18GHz)	R&S	HF907	100391	2013-12-21	2015-12-20
Trilog Broadband Antenna (30M~3GHz)	SCHWARZ BECK	VULB 9163	9163-521	2013-12-21	2015-12-20
LOOP Antennas(9kHz-30MHz)	R&S	HFH2-Z2	100263	2013-05-11	2015-05-10
Pyramidal Horn Antenna(18GHz-26-5GHz)	ETS-LIND GREN	3160-09	5140299	2015-01-05	2017-01-04
Artificial Mains Network	R&S	ENV4200	100134	2014-11-04	2015-11-03
Artificial Mains Network	R&S	ENV216	100382	2014-11-04	2015-11-03
Power Detecting & Sampling Unit	R&S	OSP-B157	19709DD	2014-09-08	2015-09-07
Signal Generator	Agilent	E4438C	MY47271904	2014-10-28	2015-10-27

6 Measurement Uncertainty

For a 95% confidence level ($k = 2$), the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 as following:

Test Item		Extended Uncertainty
Transmit Output Power Data	Power [dBm]	U = 0.39 dB
Bandwidth	Magnitude [%]	U = 0.2%
Band Edge Compliance	Disturbance Power [dBm]	U = 2.0 dB
Spurious Emissions, Conducted	Disturbance Power [dBm]	U = 2.0 dB
Field Strength of Spurious Radiation	ERP [dBm]	For 3 m Chamber: U = 4.6 dB (30 MHz to 1GHz) U = 3.0 dB (above 1 GHz) For 10 m Chamber: U = 4.6 dB (30 MHz to 1GHz) U = 3.0 dB (above 1 GHz)
Frequency Stability	Frequency Accuracy [ppm]	U = 0.21 ppm

END