



FCC

RF Test Report

Product Name: LTE CPE

Model Number: B311-521

Report No.: SYBH(Z-RF)20191011017001-2001

FCC ID: QISB311-521

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MODIFICATION RECORD

No.	Report No	Modification Description
1	SYBH(Z-RF)2019101 1017001-2001	First release.

DECLARATION

Type	Description
Multiple Models Applications	☒ The present report applies to single model. ☐ The present report applies to several models. The practical measurements are performed with the model. The present report only presents the worst test case of all modes, see relevant test results for detailed.

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2 General Information

2.1 Test standard/s

Applied Rules :	47 CFR FCC Part 02 47 CFR FCC Part 22 47 CFR FCC Part 24 47 CFR FCC Part 27
Test Method :	FCC KDB 971168 D01 Power Meas License Digital Systems v03r01 ANSI C63.26

2.2 Test Environment

Temperature :	TN	15 to 30	°C during room temperature tests
Ambient Relative Humidity:	25 to 75 %		
Atmospheric Pressure:	Not applicable		
Power supply :	VL	10.8	V
	VN	12	V DC by Battery
	VH	13.2	V

NOTE: 1) VN= nominal voltage, VL= low extreme test voltage, VH= High extreme test voltage;

TN= normal temperature, TL= low extreme test temperature, TH= High extreme test temperature.

2.3 Test Laboratories

Test Location 1 :	RELIABILITY LABORATORY OF HUAWEI TECHNOLOGIES CO., LTD.
Address of Test Location 1 :	No.2, New City Avenue, Songshan Lake Sci. & Tech. Industry Park, Dongguan, 523808, P.R.C

2.4 Applicant and Manufacturer

Company Name :	HUAWEI TECHNOLOGIES CO., LTD
Address :	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C

2.5 Application details

Date of Receipt Sample:	2019-10-31
Start of test:	2019-11-01
End of test:	2019-11-26

3 Test Summary

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

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)	Testing location
Effective (Isotropic) Radiated Power Output Data	§2.1046, §22.913	FCC: ERP $\leq$ 7 W.	Appendix A	Pass	Test Location 1
Peak-Average Ratio	---	Limit $\leq$ 13 dB	Appendix B	Pass	Test Location 1
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass	Test Location 1
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass	Test Location 1
Band Edges Compliance	§2.1051, §22.917	FCC: $\leq$ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block. Note 1): EBW is -26 dBc EBW.	Appendix E	Pass	Test Location 1
Spurious Emission at Antenna Terminals	§2.1051, §22.917	FCC: $\leq$ -13 dBm/RefBW, from max(lowest internal frequency, 9 kHz) to min(10 * highest fundamental frequency, 40 GHz), after 1 MHz bands immediately outside and adjacent to the frequency block. (RefBW: $\geq$ 100 kHz for frequency below 1 GHz, and =1 MHz above 1 GHz)	Appendix F	Pass	Test Location 1
Field Strength of Spurious Radiation	§2.1053, §22.917	FCC: $\leq$ -13 dBm/RefBW, from max(lowest internal frequency, 9 kHz) to min(10 * highest fundamental frequency, 40 GHz), after 1 MHz bands immediately outside and adjacent to the frequency block. (RefBW: $\geq$ 100 kHz for frequency below 1 GHz, and =1 MHz above 1 GHz)	Appendix G	Pass	Test Location 1
Frequency Stability	§2.1055, §22.355	$\leq \pm 2.5$ ppm	Appendix H	Pass	Test Location 1
NOTE: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".					

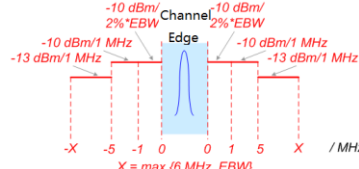
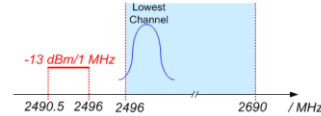
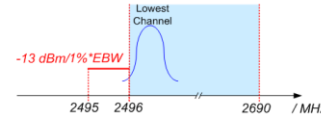
3.2 PCS Band (1850-1910 MHz paired with 1930-1990 MHz)

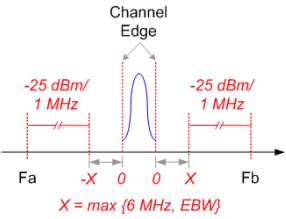
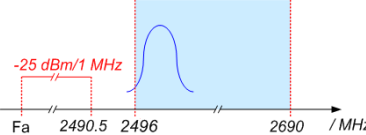
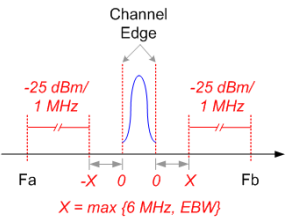
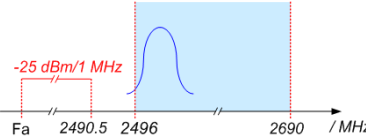
Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)	Testing location
Effective (Isotropic) Radiated Power Output Data	§2.1046, §24.232	EIRP $\leq$ 2 W	Appendix A	Pass	Test Location 1
Peak-Average Ratio	§2.1046, §24.232	Limit $\leq$ 13 dB	Appendix B	Pass	Test Location 1
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass	Test Location 1
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass	Test Location 1
Band Edges Compliance	§2.1051, §24.238	FCC: $\leq$ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block. Note 1): EBW is -26 dBc EBW.	Appendix E	Pass	Test Location 1
Spurious Emission at Antenna Terminals	§2.1051, §24.238	FCC: $\leq$ -13 dBm/1 MHz, from max(lowest internal frequency, 9 kHz) to min(10 * highest fundamental frequency, 40 GHz) but outside authorized operating frequency blocks..	Appendix F	Pass	Test Location 1
Field Strength of Spurious Radiation	§2.1053, §24.238	FCC: $\leq$ -13 dBm/1 MHz, from max(lowest internal frequency, 9 kHz) to min(10 * highest fundamental frequency, 40 GHz) but outside authorized operating frequency blocks.	Appendix G	Pass	Test Location 1
Frequency Stability	§2.1055, §24.235	FCC: Within authorized bands of operation/frequency block.	Appendix H	Pass	Test Location 1
NOTE: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".					

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

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)	Testing location
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(d)	$EIRP \leq 1\text{ W}$	Appendix A	Pass	Test Location 1
Peak-Average Ratio	§2.1046, §27.50(d)	Limit $\leq 13\text{ dB}$	Appendix B	Pass	Test Location 1
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass	Test Location 1
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass	Test Location 1
Band Edges Compliance	§2.1051, §27.53(h)	FCC: $\leq -13\text{ dBm}/1\% \cdot \text{EBW}$, in 1 MHz bands immediately outside and adjacent to the frequency block. Note 1): EBW is -26 dBc EBW.	Appendix E	Pass	Test Location 1
Spurious Emission at Antenna Terminals	§2.1051, §27.53(h)	FCC: $\leq -13\text{ dBm}/1\text{ MHz}$, from max(lowest internal frequency, 9 kHz) to min(10 * highest fundamental frequency, 40 GHz) but outside authorized operating frequency ranges.	Appendix F	Pass	Test Location 1
Field Strength of Spurious Radiation	§2.1053, §27.53(h)	FCC: $\leq -13\text{ dBm}/1\text{ MHz}$, from max(lowest internal frequency, 9 kHz) to min(10 * highest fundamental frequency, 40 GHz) but outside authorized operating frequency ranges.	Appendix G	Pass	Test Location 1
Frequency Stability	§2.1055, §27.54	Within authorized bands of operation/frequency block.	Appendix H	Pass	Test Location 1
NOTE: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".					

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

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)	Testing location
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(h)	$EIRP \leq 2W$	Appendix A	Pass	Test Location 1
Peak-Average Ratio	§27.50(a)	Limit≤13 dB	Appendix B	Pass	Test Location 1
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass	Test Location 1
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass	Test Location 1
Band Edges Compliance	§2.1051, §27.53(m4)	FCC:  AND  AND, if 2495-2496MHz is immediately outside and adjacent to the frequency block  Note 1): EBW is -26 dBc EBW.	Appendix E	Pass	Test Location 1
Spurious Emission at Antenna Terminals	§2.1051, §27.53(m)	FCC:	Appendix F	Pass	Test Location 1

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)	Testing location
		 Channel Edge -25 dBm/1 MHz -25 dBm/1 MHz Fa -X 0 0 X Fb $X = \max \{6 \text{ MHz}, \text{EBW}\}$ AND  -25 dBm/1 MHz Fa 2490.5 2496 2690 /MHz Fa = max(lowest internal frequency, 9 kHz) Fb = min(10 * highest fundamental frequency, 40 GHz) Note 1): EBW is -26 dBc EBW. Note 2): MeasFrom: max(lowest internal frequency, 9 kHz). Note 3): MeasTo: min(10 * highest fundamental frequency, 40 GHz).			
Field Strength of Spurious Radiation	§2.1053, §27.53(m)	FCC:  Channel Edge -25 dBm/1 MHz -25 dBm/1 MHz Fa -X 0 0 X Fb $X = \max \{6 \text{ MHz}, \text{EBW}\}$ AND  -25 dBm/1 MHz Fa 2490.5 2496 2690 /MHz Fa = max(lowest internal frequency, 9 kHz) Fb = min(10 * highest fundamental frequency, 40 GHz) Note 1): EBW is -26 dBc EBW. Note 2): MeasFrom: max(lowest internal frequency, 9 kHz). Note 3): MeasTo: min(10 * highest fundamental frequency, 40 GHz).	Appendix G	Pass	Test Location 1
Frequency Stability	§2.1055, §27.54	Within authorized bands of operation/frequency block.	Appendix H	Pass	Test Location 1
NOTE: For the verdict, the “N/A” denotes “not applicable”, the “N/T” denotes “not tested”.					

3.5 Band 66 (1710-1780 MHz paired with 2110-2175 MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)	Testing location
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(d)	$EIRP \leq 1\text{ W}$	Appendix A	Pass	Test Location 1
Peak-Average Ratio	§2.1046, §27.50(d)	Limit $\leq$ 13 dB	Appendix B	Pass	Test Location 1
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass	Test Location 1
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass	Test Location 1
Band Edges Compliance	§2.1051, §27.53(h)	FCC: $\leq -13\text{ dBm}/1\%*EBW$, in 1 MHz bands immediately outside and adjacent to the frequency block. Note 1): EBW is -26 dBc EBW.	Appendix E	Pass	Test Location 1
Spurious Emission at Antenna Terminals	§2.1051, §27.53(h)	FCC: $\leq -13\text{ dBm}/1\text{ MHz}$, from max(lowest internal frequency, 9 kHz) to min(10 * highest fundamental frequency, 40 GHz) but outside authorized operating frequency ranges.	Appendix F	Pass	Test Location 1
Field Strength of Spurious Radiation	§2.1053, §27.53(h)	FCC: $\leq -13\text{ dBm}/1\text{ MHz}$, from max(lowest internal frequency, 9 kHz) to min(10 * highest fundamental frequency, 40 GHz) but outside authorized operating frequency ranges.	Appendix G	Pass	Test Location 1
Frequency Stability	§2.1055, §27.54	Within authorized bands of operation/frequency block.	Appendix H	Pass	Test Location 1
NOTE: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".					

4 Description of the Equipment under Test (EUT)

4.1 General Description

The HUAWEI LTE CPE B311-521 is a Long Term Evolution (LTE) wireless gateway for multiple users in household or small office environments. It enables users to access the Internet, supports 3GPP Release 9 with UE downlink/uplink category 4. Working band: LTE: B2/B4/B5/B7/B66, UMTS: B2/B4/B5, Wi-Fi: 2.4 GHz 802.11b/g/n 2x2 MIMO up to 300Mbps. Maximum Users: 32

Note1: Only UMTS Band II/IV/V, LTE Band 2/4/5/7/66 test data included in this report.

4.2 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.

4.2.1 Board

Board		
Description	Software Version	Hardware Version
Main Board	10.0.2.1(H190SP8C00)	WL4B311SW

4.2.2 Sub-Assembly

Sub-Assembly			
Sub-Assembly Name	Model	Manufacturer	Description
Adapter	HW-120100E01	Huawei Technologies Co., Ltd.	Input voltage: 100-240V ~50/60Hz 0.5A Output voltage: 12V  1A
Adapter	HW-120100B01	Huawei Technologies Co., Ltd.	Input voltage: 100-240V ~50/60Hz 0.5A Output voltage: 12V  1A
Adapter	HW-120100U01	Huawei Technologies Co., Ltd.	Input voltage: 100-240V ~50/60Hz 0.5A Output voltage: 12V  1A

4.3 Technical Specification

NOTE: For the detailed technical descriptions, see the applicant/manufacture's specifications or user manual.

4.3.1 General

Characteristics	Description	
Radio System Type	☒ UMTS ☒ LTE	
Supported Frequency Range	WCDMA850	Transmission (TX): 824 to 849 MHz
		Receiving (RX): 869 to 894 MHz
	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 BAND2	Transmission (TX): 1850 to 1910 MHz
		Receiving (RX): 1930 to 1990 MHz
	LTE BAND4	Transmission (TX): 1710 to 1755 MHz
		Receiving (RX): 2110 to 2155 MHz
	LTE BAND5	Transmission (TX): 824 to 849 MHz
		Receiving (RX): 869 to 894 MHz
Antenna	Description	Isotropic Antenna
	Type	☒ Integral (permanent fixed antenna, which may be built-in, designed as an indispensable part of EUT) ☐ Dedicated (removable antenna supplied with EUT, designed as an indispensable part of EUT)
	TX and RX Antenna Ports(one band)	TX & RX port: 1 TX-only port: 0 RX-only port: 1
	Smart Antenna(for uplink)	☐ MIMO ☒ Non MIMO
	Gain	WCDMA 850: 1.8 dBi (per antenna port, max) WCDMA 1700: 0.3 dBi (per antenna port, max) WCDMA 1900: 1.1 dBi (per antenna port, max)

Characteristics	Description	
		LTE Band 2: 1.1 dBi (per antenna port, max) LTE Band 4: 0.3 dBi (per antenna port, max) LTE Band 5: 1.8dBi (per antenna port, max) LTE Band 7: 1.6 dBi (per antenna port, max) LTE Band 66: 0.3 dBi (per antenna port, max)
	Remark	When the EUT is put into service, the practical maximum antenna gain should NOT exceed the value as described above.
Target TX Output Power	UMTS850 23.0dBm UMTS1900: 22.5dBm UMTS1700 22.5dBm LTE Band 2: 22.5dBm LTE Band 4: 22.5dBm LTE Band 5: 22.5dBm LTE Band 7: 22.5dBm LTE Band 66: 22.5dBm	
Supported Channel Bandwidth	UMTS system:	☒ 5 MHz
	LTE band 2	☒ 1.4MHz, ☒ 3MHz, ☒ 5MHz, ☒ 10MHz , ☒ 15MHz , ☒ 20MHz
	LTE band 4	☒ 1.4MHz, ☒ 3MHz, ☒ 5MHz, ☒ 10MHz , ☒ 15MHz , ☒ 20MHz
	LTE band 5	☒ 1.4MHz, ☒ 3MHz, ☒ 5MHz, ☒ 10MHz
	LTE band 7	☒ 5MHz, ☒ 10MHz , ☒ 15MHz , ☒ 20MHz
	LTE band 66	☒ 1.4MHz, ☒ 3MHz, ☒ 5MHz, ☒ 10MHz , ☒ 15MHz , ☒ 20MHz
Type of Modulation for uplink	WCDMA	☒ QPSK ☐ 16QAM(only for HSPA+) ☐ 64QAM
	LTE	☒ QPSK ☒ 16QAM ☐ 64QAM
Designation of Emissions (Note: the necessary bandwidth of which is the worst value from the measured occupied bandwidths for each type of channel bandwidth configuration.)	UMTS850:	4M17F9W
	UMTS1900:	4M16F9W
	UMTS1700:	4M16F9W
	LTE BAND2:	1M09G7D (1.4 MHz QPSK modulation), 1M10W7D (1.4 MHz 16QAM modulation) 2M71G7D (3 MHz QPSK modulation), 2M71W7D (3 MHz 16QAM modulation) 4M51G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 9M02G7D (10 MHz QPSK modulation), 9M04W7D (10 MHz 16QAM modulation)

Characteristics	Description	
		13M6G7D (15 MHz QPSK modulation), 13M5W7D (15 MHz 16QAM modulation) 18M1G7D (20 MHz QPSK modulation), 18M1W7D (20 MHz 16QAM modulation)
	LTE BAND4:	1M10G7D (1.4 MHz QPSK modulation), 1M10W7D (1.4 MHz 16QAM modulation) 2M70G7D (3 MHz QPSK modulation), 2M71W7D (3 MHz 16QAM modulation) 4M51G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 9M03G7D (10 MHz QPSK modulation), 9M02W7D (10 MHz 16QAM modulation) 13M5G7D (15 MHz QPSK modulation), 13M5W7D (15 MHz 16QAM modulation) 18M1G7D (20 MHz QPSK modulation), 18M1W7D (20 MHz 16QAM modulation)
	LTE BAND5:	1M10G7D (1.4 MHz QPSK modulation), 1M10W7D (1.4 MHz 16QAM modulation) 2M71G7D (3 MHz QPSK modulation), 2M71W7D (3 MHz 16QAM modulation) 4M51G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 9M03G7D (10 MHz QPSK modulation), 9M05W7D (10 MHz 16QAM modulation)
	LTE BAND7:	4M51G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 9M01G7D (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 BAND66:	1M10G7D (1.4 MHz QPSK modulation), 1M10W7D (1.4 MHz 16QAM modulation) 2M70G7D (3 MHz QPSK modulation), 2M71W7D (3 MHz 16QAM modulation) 4M52G7D (5 MHz QPSK modulation), 4M52W7D (5 MHz 16QAM modulation) 9M04G7D (10 MHz QPSK modulation), 9M04W7D (10 MHz 16QAM modulation) 13M5G7D (15 MHz QPSK modulation), 13M5W7D (15 MHz 16QAM modulation)

Characteristics	Description	
		18M0G7D (20 MHz QPSK modulation), 18M0W7D (20 MHz 16QAM modulation)

5 General Test Conditions / Configurations

5.1 Test Modes

NOTE1: The test mode(s) are selected according to relevant radio technology specifications.

NOTE2: The modulation for WCDMA, HSUPA, HSDPA, DC-HSDPA is the same, which is QPSK, and the WCDMA is the worst, so we test the WCDMA only

Test Mode	Test Modes Description
UMTS/TM1	WCDMA system, QPSK modulation
LTE/TM1	LTE system, QPSK modulation
LTE/TM2	LTE system, 16QAM modulation

5.2 Test Frequency

Test Mode	TX / RX	RF Channel		
		Low (L)	Middle (M)	High (H)
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)
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 2	TX(1.4M)	Channel 18607	Channel 18900	Channel 19193
		1850.7 MHz	1880 MHz	1909.3 MHz

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
	TX(3M)	Channel 18615	Channel 18900	Channel 19185
		1851.5 MHz	1880 MHz	1908.5 MHz
	TX(5M)	Channel 18625	Channel 18900	Channel 19175
		1852.5 MHz	1880 MHz	1907.5 MHz
	TX(10M)	Channel 18650	Channel 18900	Channel 19150
		1855 MHz	1880 MHz	1905 MHz
	TX(15M)	Channel 18675	Channel 18900	Channel 19125
		1857.5 MHz	1880 MHz	1902.5 MHz
	TX(20M)	Channel 18700	Channel 18900	Channel 19100
		1860 MHz	1880 MHz	1900 MHz
	RX(1.4M)	Channel 607	Channel 900	Channel 1193
		1930.7 MHz	1960 MHz	1989.3 MHz
	RX(3M)	Channel 615	Channel 900	Channel 1185
		1931.5 MHz	1960 MHz	1988.5 MHz
	RX(5M)	Channel 625	Channel 900	Channel 1175
		1932.5 MHz	1960 MHz	1987.5 MHz
	RX(10M)	Channel 650	Channel 900	Channel 1150
		1935 MHz	1960 MHz	1985 MHz
	RX(15M)	Channel 675	Channel 900	Channel 1125
		1937.5 MHz	1960 MHz	1982.5 MHz
	RX(20M)	Channel 700	Channel 900	Channel 1100
		1940 MHz	1960 MHz	1980 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 1975	Channel 2175	Channel 2375
		2112.5 MHz	2132.5MHz	2152.5 MHz
	RX(3M)	Channel 2000	Channel 2175	Channel 2350
		2115 MHz	2132.5MHz	2150 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
		2115 MHz	2132.5MHz	2150 MHz
	RX(15M)	Channel 2025	Channel 2175	Channel 2325
		2117.5 MHz	2132.5MHz	2147.5 MHz
	RX(20M)	Channel 2050	Channel 2175	Channel 2300
		2120 MHz	2132.5MHz	2145 MHz

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 5	TX(1.4M)	Channel 20407	Channel 20525	Channel 20643
		824.7 MHz	836.5 MHz	848.3 MHz
	TX(3M)	Channel 20415	Channel 20525	Channel 20635
		825.5 MHz	836.5 MHz	847.5 MHz
	TX(5M)	Channel 20425	Channel 20525	Channel 20625
		826.5 MHz	836.5 MHz	846.5 MHz
	TX(10M)	Channel 20450	Channel 20525	Channel 20600
		829 MHz	836.5 MHz	844 MHz
	RX(1.4M)	Channel 2407	Channel 2525	Channel 2643
		869.7 MHz	881.5 MHz	893.3 MHz
	RX (3M)	Channel 2415	Channel 2525	Channel 2635
		870.5 MHz	881.5 MHz	892.5 MHz
	RX(5M)	Channel 2425	Channel 2525	Channel 2625
		871.5 MHz	881.5 MHz	891.5 MHz
	RX (10M)	Channel 2450	Channel 2525	Channel 2600
		874 MHz	881.5 MHz	889 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

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
		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 66	TX(1.4M)	Channel 131979	Channel 132322	Channel 132665
		1710.7 MHz	1745 MHz	1779.3 MHz
	TX(3M)	Channel 131987	Channel 132322	Channel 132657
		1711.5 MHz	1745 MHz	1778.5 MHz
	TX(5M)	Channel 131997	Channel 132322	Channel 132647
		1712.5 MHz	1745 MHz	1777.5 MHz
	TX(10M)	Channel 132022	Channel 132322	Channel 132622
		1715 MHz	1745 MHz	1775MHz

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
	TX(15M)	Channel 132047	Channel 132322	Channel 132597
		1717.5 MHz	1745 MHz	1772.5 MHz
	TX(20M)	Channel 132072	Channel 132322	Channel 132572
		1720 MHz	1745 MHz	1770 MHz
	RX(1.4M)	Channel 66443	Channel 66786	Channel 67129
		2110.7 MHz	2145 MHz	2179.3 MHz
	RX(3M)	Channel 66451	Channel 66786	Channel 67121
		2111.5 MHz	2145 MHz	2178.3 MHz
	RX(5M)	Channel 66461	Channel 66786	Channel 67111
		2112.5 MHz	2145 MHz	2177.5 MHz
	RX(10M)	Channel 66486	Channel 66786	Channel 67086
		2115 MHz	2145 MHz	2175 MHz
	RX(15M)	Channel 66511	Channel 66786	Channel 67061
		2117.5 MHz	2145 MHz	2172.5 MHz
	RX(20M)	Channel 66536	Channel 66786	Channel 67036
		2120 MHz	2145 MHz	2170 MHz

5.3 DESCRIPTION OF TESTS

5.3.1 Radiated Power and Radiated Spurious Emissions

Radiated spurious emissions are investigated indoors in a full-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-E-2016. The equipment under test was transmitting while connected to its integral antenna and is placed on a wooden turntable 150cm 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 3GHz, 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 $43 + 10\log_{10}(\text{Power [Watts]})$.

Test Procedures Used

KDB 971168 D01 v03-Section 5

ANSI/TIA-603-E-2016-Section 2.2.17 / ANSI/TIA-603-E-2016-Section 2.2.12

Note: Reference test setup 3

5.3.2 Peak-Average Ratio

A peak to average ratio measurement is performed at the conducted port of the EUT. 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.

Test Procedures Used

KDB 971168 D01 v03-Section 5.7.2

Test Settings

- 1、 The signal analyzer's CCDF measurement profile enabled
- 2、 Frequency= carrier center frequency
- 3、 Measurement BW > EBW of signal
- 4、 for continuous transmissions, set to 1ms
- 5、 Record the maximum PAPR level associated with a probability of 0.1%.

Note: Reference test setup 1

5.3.3 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.

Test Procedures Used

KDB 971168 D01 v03-Section 4.3

Test Settings

- 1、 SET RBW=1-5% of OBW
- 2、 SET VBW $\geq 3 \times$ RBW
- 3、 Detector: Peak
- 4、 Trace mode= max hold.
- 5、 Sweep= auto couple
- 6、 Steps 1-5 were repeated after it is stable

Note: Reference test setup 1.

5.3.4 Band Edge Compliance

The test complies with the requirements in clause 2 of the present report according to test procedures in KDB 971168 D01 v03-Section 6 with corresponding test settings.

Note: Reference test setup 1.

5.3.5 Spurious and Harmonic Emissions at Antenna Terminal

The test complies with the requirements in clause 2 of the present report according to test procedures in KDB 971168 D01 v03-Section 6 with corresponding test settings.

Note: Reference test setup 1.

5.3.6 Frequency Stability / Temperature Variation

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-E-2016. 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.

Test Procedures Used

ANSI/TIA-603-E-2016

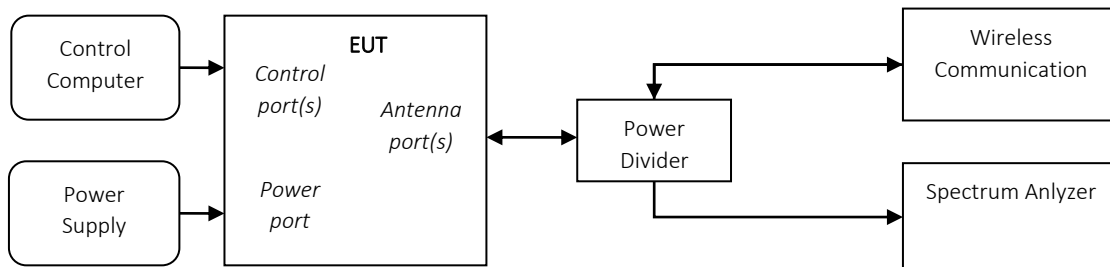
Note: Reference test setup 2.

5.4 Test Setups

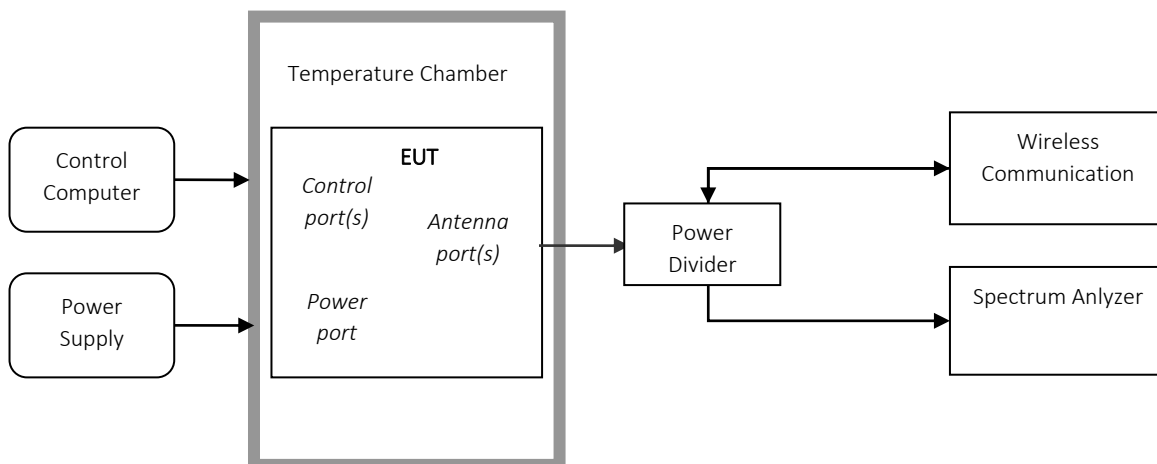
5.4.1 General Test Setup Configurations

Configuration	Description
Test Antenna Port	Until declared, all Transmitter tests are performed at TRX port of the EUT
Multiple RF Source	Other RF sources or functions of the EUT are disabled during testing for RF source.
Sensors and Antenna	Sensors and Antenna optimization function should be disabled during testing by software method to get the stable maximum power and avoid the influence of uncertain conditions

5.4.2 Test Setup 1



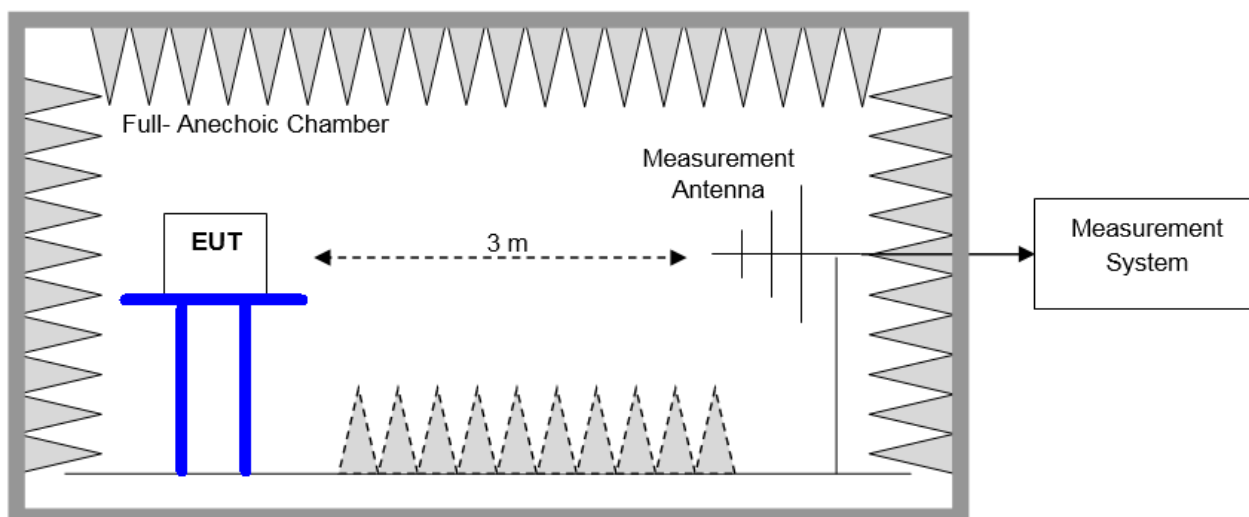
5.4.3 Test Setup 2



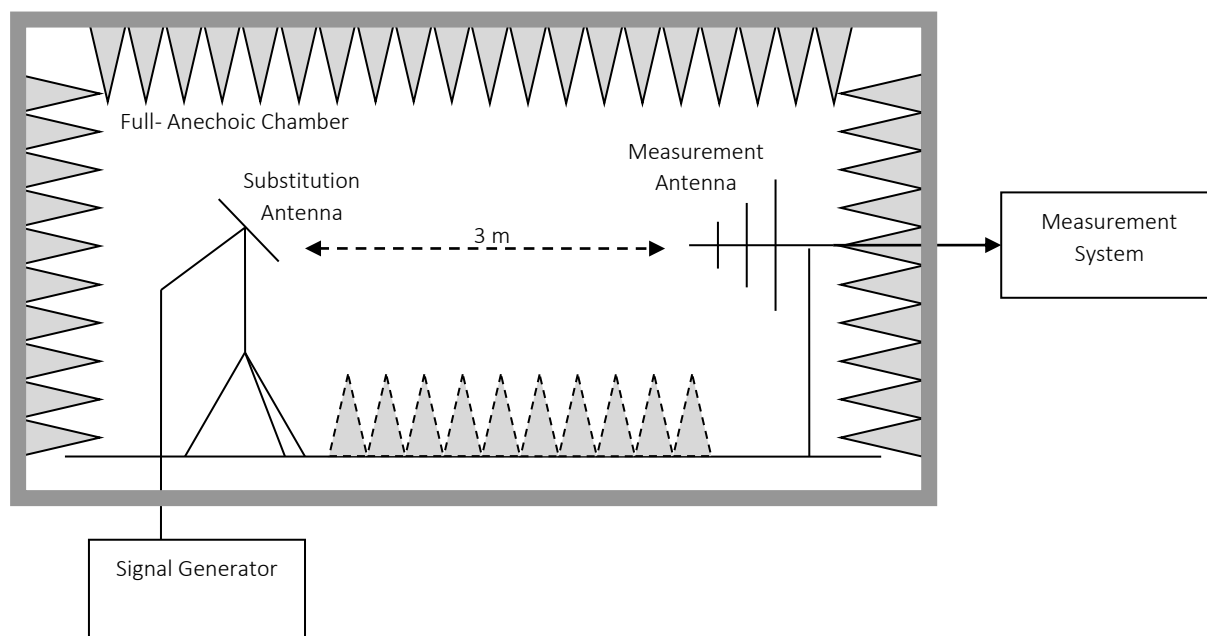
5.4.4 Test Setup 3

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

5.4.4.1 Step 1: Pre-test



5.4.4.2 Step 2: Substitution method to verify the maximum ERP/EIRP



5.5 Test Conditions

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

Test Case	Test Conditions	
	Test Mode	UMTS/TM1,LTE/TM1,LTE/TM2
Field Strength of Spurious Radiation	Test Env.	Ambient Climate & Rated Voltage
	Test Setup	Test Setup 3
	Test Mode	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 Setup 2
	RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
	Test Mode	UMTS/TM1,LTE/TM1,LTE/TM2

6 Main Test Instruments

6.1 Current Test Project/Report

Main Test Equipments(GSM/WCDMA/LTE test system)					
Equipment Name	Manufacturer	Model	Serial Number	Cal Date	Cal-Due
Universal Radio Communication Tester	R&S	CMW500	164698	2019/07/05	2020/07/05
Spectrum Analyzer	Agilent	N9030A	MY51380032	2019/03/01	2020/03/01
Signal generator	Agilent	E8257D	MY51500314	2019/07/05	2020/07/05

Main Test Equipments(RSE test system)					
Equipment Name	Manufacturer	Model	Serial Number	Cal Date	Cal-Due
Universal Radio Communication Tester	R&S	CMU200	117057	2019/03/01	2020/03/01
Universal Radio Communication Tester	R&S	MT8821C	6261760791	2019/03/01	2020/03/01
Spectrum analyzer	R&S	FSW8	104470	2019/01/15	2020/01/14
Spectrum analyzer	R&S	FSW43	104070	2019/01/15	2020/01/14
Trilog Broadband Antenna (30M~3GHz)	SCHWARZ BECK	VULB 9163	01157	2019/03/11	2021/03/10
Double-Ridged Waveguide Horn Antenna (1G~18GHz)	SCHWARZ BECK	BBHA 9120D	01931	2019/03/22	2021/03/21
Pyramidal Horn Antenna(18GHz-40GHz)	SCHWARZ BECK	BBHA 9170	00863	2019/03/30	2021/03/29
Software Information					
Test Item	Software Name		Manufacturer		Version
RSE	TS+		Tonscend		Ver2.1

Main Test Equipments(RE test system)					
Equipment Name	Manufacturer	Model	Serial Number	Cal Date	Cal-Due
Test receiver	R&S	ESU26	100387	2019/01/15	2020/01/14
LOOP Antennas(9kHz-30MHz)	R&S	HFH2-Z2	100263	2019/03/15	2021/03/15
Trilog Broadband Antenna (30M~3GHz)	SCHWARZ BECK	VULB 9163	9163-356	2018/4/9	2020/04/08
Double-Ridged Waveguide Horn Antenna (1G~18GHz)	R&S	HF906	100684	2018/5/27	2020/05/26
Pyramidal Horn Antenna(18GHz-26.5GHz)	ETS-Lindgren	3160-09	5140299	2018/07/20	2020/07/19

Pyramidal Horn Antenna(26.5GHz-40GHz)	ETS-Lindgren	3160-10	00205695	2018/04/20	2020/04/19
Software Information					
Test Item	Software Name		Manufacturer		Version
RE	EMC32		R&S		V9.25.0

7 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 Conducted	Power [dBm]	U = 0.64 dB
RF Power Density, Conducted	Power [dBm]	U = 0.64 dB
Bandwidth	Magnitude [kHz]	200kHz: U=9.06kHz 1.4MHz: U=9.48kHz 3MHz: U=10.86kHz 5MHz: U=13.84kHz 10MHz: U=22.32kHz 15MHz: U=31.9kHz 20MHz: U=41.78kHz
Band Edge Compliance	Disturbance Power [dBm]	U = 0.9 dB
Spurious Emissions, Conducted	Disturbance Power [dBm]	20MHz~3.6GHz: U=0.88dB 3.6GHz~8.4GHz: U=1.08dB 8.4GHz~13.6GHz: U=1.24dB 13.6GHz~22GHz: U=1.34dB 22GHz~26.5GHz: U=1.36dB
Field Strength of Spurious Radiation	ERP/EIRP [dBm]	For 3 m Chamber: U = 3.868 dB (9 kHz to 150 kHz) U = 3.782 dB (150 kHz to 30 MHz) U = 5.94 dB (30 MHz to 3GHz) U = 5.54 dB (3GHz to 18GHz) U = 4.94 dB (18GHz to 26.5GHz)
Frequency Stability	Frequency Accuracy [Hz]	800MHz: U=24.08Hz 900MHz: U=24.54Hz 1900MHz: U=34.7Hz 2100MHz: U=36.96Hz 2300MHz: U=39.24Hz 2500MHz: U=41.58Hz 2600MHz: U=42.74Hz

8 Appendixes

Appendix No.	Description
SYBH(Z-RF)20191011017001-2001-A	Appendix_for_WCDMA
SYBH(Z-RF)20191011017001-2001-B	Appendix_for_LTE_Band_2
SYBH(Z-RF)20191011017001-2001-C	Appendix_for_LTE_Band_4
SYBH(Z-RF)20191011017001-2001-D	Appendix_for_LTE_Band_5
SYBH(Z-RF)20191011017001-2001-E	Appendix_for_LTE_Band_7
SYBH(Z-RF)20191011017001-2001-F	Appendix_for_LTE_Band_66

Appendix	Description
Appendix A	Effective (Isotropic) Radiated Power Output Data
Appendix B	Peak-Average Ratio
Appendix C	Modulation Characteristics
Appendix D	Bandwidth
Appendix E	Band Edges Compliance
Appendix F	Spurious Emission at Antenna Terminals
Appendix G	Field Strength of Spurious Radiation
Appendix H	Frequency Stability

END