RADIO TEST REPORT

For

Shenzhen KVD Communication Equipment Limited

LTE GSM/WCDMA Smartphone

Test Model: S60 Lite

Prepared for	:	Shenzhen KVD Communication Equipment Limited
Address	:	Lenovo R&D Center 2F-B, South First Road, High-tech Park, Nanshan District, Shenzhen, Guangdong, China
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample	:	Dec 21, 2017
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	Dec 21, 2017~Jan 03, 2018
Date of Report	:	Jan 03, 2018

CE

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RADIO TEST REPORT
ETSI EN 300 328 V2.1.1 (2016-11)
Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

Report Reference No.	:	**LCS171221034AEC**
Date of Issue	:	Jan 03, 2018
Testing Laboratory Name.....	:	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure.....	:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name.....	:	**Shenzhen KVD Communication Equipment Limited**
Address	:	Lenovo R&D Center 2F-B, South First Road, High-tech Park, Nanshan District, Shenzhen, Guangdong, China
Test Specification		
Standard	:	ETSI EN 300 328 V2.1.1 (2016-11)
Test Report Form No.	:	LCSEMC-1.0
TRF Originator.....	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF	:	Dated 2017-06

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Test Item Description.	:	**LTE GSM/WCDMA Smartphone**
Trade Mark.....	:	DOOGEE
Test Model	:	S60 Lite
Ratings	:	DC 3.8V by Li-ion Battery(5580mAh) Recharged by DC 5V/7V/3A,9V/2.7A,12V/2A Adapter
Result	:	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Calvin Weng	Dick Su	Gavin Liang
Calvin Weng/ Administrators	Dick Su/ Technique principal	Gavin Liang/ Manager

RADIO -- TEST REPORT

Test Report No. : LCS171221034AEC	Jan 03, 2018 Date of issue

Test Model.....	:	S60 Lite
EUT.....	:	LTE GSM/WCDMA Smartphone
Applicant.....	**:**	**Shenzhen KVD Communication Equipment Limited**
Address.....	:	Lenovo R&D Center 2F-B, South First Road, High-tech Park, Nanshan District, Shenzhen, Guangdong, China
Telephone.....	:	
Fax.....	:	
Manufacturer.....	**:**	**Shenzhen KVD Communication Equipment Limited**
Address.....	:	A,3rd floor, Building A2, Silicon valley Digital Industrial Park,22nd of Dafu industrial area,Aobei Community,Guanlan town,Longhua District,shenzhen 518000, China
Telephone.....	:	
Fax.....	:	
Factory.....	**:**	**Shenzhen KVD Communication Equipment Limited**
Address.....	:	A,3rd floor, Building A2, Silicon valley Digital Industrial Park,22nd of Dafu industrial area,Aobei Community,Guanlan town,Longhua District,shenzhen 518000, China
Telephone.....	:	
Fax.....	:	

Test Result	Positive

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Revision	Issue Date	Revisions	Revised By
000	Jan 03, 2018	Initial Issue	Gavin Liang

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1. GENERAL INFORMATION

1.1. Product Description for Equipment Under Test (EUT)

EUT	:	LTE GSM/WCDMA Smartphone
Test Model	:	S60 Lite
Power Supply	:	DC 3.8V by Li-ion Battery(5580mAh) Recharged by DC 5V/7V/3A,9V/2.7A,12V/2A Adapter
Hardware Version	:	T777_MAIN_PCB_V1.1
Software Version	:	DOOGEE-S60 Lite-Android7.0-20171227
2G	:	
Support Band	:	☒GSM 900 (EU-Band) ☒DCS 1800 (EU-Band) ☒GSM 850 (U.S.-Band) ☒PCS 1900 (U.S.-Band)
Release Version	:	R99
GPRS Class	:	Class 12
EGPRS Class	:	Class 12
Uplink	:	GSM 900: 880MHz ~ 915MHz DCS 1800: 1710MHz ~ 1785MHz
Downlink	:	GSM 900: 925MHz ~ 960MHz DCS 1800: 1805MHz ~ 1880MHz
Type Of Modulation	:	GMSK for GSM/GPRS; GMSK/8PSK for EGPRS
Antenna Description	:	PIFA Antenna, 0dBi(Max.)
Power Class	:	GSM 900: Class 4, DCS 1800: Class 1
3G	:	
Support Band	:	☐WCDMA Band II (U.S.-Band) ☐WCDMA Band V (U.S.-Band) ☒WCDMA Band I (EU-Band) ☒WCDMA Band VIII (EU-Band)
Release Version	:	R99
Uplink	:	WCDMA Band I: 1920MHz ~ 1980MHz WCDMA Band VIII: 880MHz~915MHz
Downlink	:	WCDMA Band I: 2110MHz ~ 2170MHz WCDMA Band VIII: 925MHz~960MHz
Type Of Modulation	:	WCDMA: QPSK; HSDPA/HSUPA: QPSK
Antenna Description	:	PIFA Antenna, 0dBi(Max.)
Power Class	:	Class 3

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LTE	:	
Support Band	:	☒E-UTRA Band 1(EU-Band) ☒E-UTRA Band 3(EU-Band) ☒E-UTRA Band 7(EU-Band) ☒E-UTRA Band 8(EU-Band) ☒E-UTRA Band 20(EU-Band)
LTE Release Version	:	R9
Uplink	:	E-UTRA Band 1: 1920MHz ~ 1980MHz E-UTRA Band 3: 1710MHz~1785MHz E-UTRA Band 7: 2500MHz ~ 2570MHz E-UTRA Band 8: 880MHz ~ 915MHz E-UTRA Band 20: 832MHz ~ 862MHz
Downlink	:	E-UTRA Band 1: 2110MHz ~ 2170MHz E-UTRA Band 3: 1805MHz~1880MHz E-UTRA Band 7: 2620MHz ~ 2690MHz E-UTRA Band 8: 925MHz ~ 960MHz E-UTRA Band 20: 791MHz ~ 821MHz
Type Of Modulation	:	QPSK/16-QAM
Antenna Description	:	PIFA Antenna; 0dBi(Max.) for Band 1,3,7,8,20
Power Class	:	Class 3
Bluetooth	:	
Frequency Range	:	2.402-2.480GHz
Channel Number	:	79 channels for Bluetooth V4.0 (DSS) 40 channels for Bluetooth V4.0 (DTS)
Channel Spacing	:	1MHz for Bluetooth V4.0 (DSS) 2MHz for Bluetooth V4.0 (DTS)
Modulation Type	:	GFSK, π/4-DQPSK, 8-DPSK for Bluetooth V4.0 (DSS) GFSK for Bluetooth V4.0 (DTS)
Bluetooth Version	:	V4.0
Antenna Description	:	PIFA Antenna, -1dBi(Max.)
WIFI(2.4G Band)	:	
Frequency Range	:	2412-2472MHz
Channel Spacing	:	5MHz
Channel Number	:	13 Channel for 20MHz bandwidth(2412~2472MHz) 9 channels for 40MHz bandwidth(2422~2462MHz)
Modulation Type	:	802.11b: DSSS; 802.11g/n: OFDM
Antenna Description	:	PIFA Antenna, -1dBi(Max.)

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GPS Receiver	:	
Receive Frequency	:	1575.42MHz
Channel Number	:	1
Antenna Description	:	PIFA Antenna
FM Receiver	:	
Frequency Range	:	87.5MHz ~ 108MHz
Modulation Type	:	FM
Antenna Description	:	External Antenna(earphone)

Product Information

a) The type of modulation used by the equipment:

☒FHSS

☐other forms of modulation

b) In case of FHSS modulation:

•In case of non-Adaptive Frequency Hopping equipment:

The number of Hopping Frequencies:

•In case of Adaptive Frequency Hopping Equipment:

The maximum number of Hopping Frequencies: 79

The minimum number of Hopping Frequencies: 79

The Dwell Time: .....ms maximum

c) Adaptive / non-adaptive equipment:

☐non-adaptive Equipment

☒adaptive Equipment without the possibility to switch to a non-adaptive mode

☐adaptive Equipment which can also operate in a non-adaptive mode

d) In case of adaptive equipment:

The Channel Occupancy Time implemented by the equipment:

☐The equipment has implemented an LBT based DAA mechanism

- In case of equipment using modulation different from FHSS:

☐The equipment is Frame Based equipment

☐The equipment is Load Based equipment

☐The equipment can switch dynamically between Frame Based and Load Based equipment

The CCA time implemented by the equipment: ..... μs

The value q as referred to in clause 4.3.2.5.2.2.2 .....

☒The equipment has implemented an non-LBT based DAA mechanism

☐The equipment can operate in more than one adaptive mode

e) In case of non-adaptive Equipment:

The maximum RF Output Power (e.i.r.p.): .....dBm

The maximum (corresponding) Duty Cycle: ..... %

Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared):

f) The worst case operational mode for each of the following tests:

- RF Output Power

GFSK, π/4-DQPSK, 8-DPSK

- Power Spectral Density

.....

- Duty cycle, Tx-Sequence, Tx-gap

.....

- Dwell time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment)

GFSK, π/4-DQPSK, 8-DPSK

- Hopping Frequency Separation (only for FHSS equipment)

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GFSK, π/4-DQPSK, 8-DPSK

- Medium Utilisation

.....

- Adaptivity & Receiver Blocking

.....

- Occupied Channel Bandwidth

GFSK, π/4-DQPSK, 8-DPSK

- Transmitter unwanted emissions in the OOB domain

GFSK, π/4-DQPSK, 8-DPSK

- Transmitter unwanted emissions in the spurious domain

GFSK, π/4-DQPSK, 8-DPSK

- Receiver spurious emissions

GFSK, π/4-DQPSK, 8-DPSK

g) The different transmit operating modes (tick all that apply):

☒Operating mode 1: Single Antenna Equipment

☒Equipment with only 1 antenna

☐Equipment with 2 diversity antennas but only 1 antenna active at any moment in time

☐Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used. (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems)

☐Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming

☐Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode)

☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1

☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2

NOTE: Add more lines if more channel bandwidths are supported.

☐Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming

☐Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode)

☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1

☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2

NOTE: Add more lines if more channel bandwidths are supported.

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h) In case of Smart Antenna Systems:

- The number of Receive chains: .....
- The number of Transmit chains: .....

☐symmetrical power distribution

☐asymmetrical power distribution

In case of beam forming, the maximum beam forming gain: .....

NOTE: Beam forming gain does not include the basic gain of a single antenna.

i) Operating Frequency Range(s) of the equipment:

- Operating Frequency Range 1: 2402 MHz to 2480 MHz
- Operating Frequency Range 2: ..... MHz to ..... MHz

NOTE: Add more lines if more Frequency Ranges are supported.

j) Occupied Channel Bandwidth(s):

- Occupied Channel Bandwidth: 0.81MHz
- Occupied Channel Bandwidth 2: 1.08MHz

NOTE: Add more lines if more channel bandwidths are supported.

k) Type of Equipment (stand-alone, combined, plug-in radio device, etc.):

☒Stand-alone

☐Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment)

☐Plug-in radio device (Equipment intended for a variety of host systems)

Other .....

l) The extreme operating conditions that apply to the equipment:

Operating temperature range:-10° C to 40° C

Details provided are for the: ■stand-alone equipment

☐combined (or host) equipment

☐test jig

m) The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels:

- Antenna Type

☒PIFA Antenna

Antenna Gain: -1dBi

If applicable, additional beamforming gain (excluding basic antenna gain): ..... dB

☐Temporary RF connector provided

☐No temporary RF connector provided

☐Dedicated Antennas (equipment with antenna connector)

☐Single power level with corresponding antenna(s)

☐Multiple power settings and corresponding antenna(s)

Number of different Power Levels: 1

Power Level 1: ……. dBm

Power Level 2: ..... dBm

Power Level 3: ..... dBm

NOTE 1: Add more lines in case the equipment has more power levels.

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NOTE 2: These power levels are conducted power levels (at antenna connector).

n) The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:
Details provided are for the: ☒stand-alone equipment
☐combined (or host) equipment
☐test jig
Supply Voltage ☐AC mains State AC voltage ……. V
☒ DC State DC voltage : 3.8V

In case of DC, indicate the type of power source
☐Internal Power Supply
☐External Power Supply or AC/DC adapter
☒Battery: 3.8V
☐Other: .....

o) Describe the test modes available which can facilitate testing:
The EUT can transmit in engineering mode.

p) The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.):
Bluetooth®

1.2. Objective

This Type approval report is prepared on behalf of **Shenzhen KVD Communication Equipment Limited** in accordance with ETSI EN 300 328 V2.1.1 (2016-11), Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU.

The objective is to determine compliance with ETSI EN 300 328 V2.1.1 (2016-11).

1.3. Related Submittal(s)/Grant(s)

No Related Submittals.

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1.4. Test Methodology

All measurements contained in this report were conducted with ETSI EN 300 328 V2.1.1 (2016-11).

1.5. Description of Test Facility

FCC Registration Number. is 254912.
Industry Canada Registration Number. is 9642A-1.
ESMD Registration Number. is ARCB0108.
UL Registration Number. is 100571-492.
TUV SUD Registration Number. is SCN1081.
TUV RH Registration Number. is UA 50296516-001

1.6. Support Equipment List

Manufacturer	Description	Model	Serial Number	Certificate
--	--	--	--	--

1.7. External I/O

I/O Port Description	Quantity	Cable
USB Port	1	1 m, unshielded
Earphone	1	N/A

1.8. List Of Measuring Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1	X-series USB Peak and Average Power Sensor Aglient	Agilent	U2021XA	MY54080022	2017-10-27	2018-10-26
2	4 CH. Simultaneous Sampling 14 Bits 2MS/s	Agilent	U2531A	MY54080016	2017-10-27	2018-10-26
3	Test Software	Ascentest	AT890-SW	20160630	N/A	N/A
4	RF Control Unit	Ascentest	AT890-RFB	N/A	2017-06-17	2018-06-16
5	ESA-E SERIES SPECTRUM ANALYZER	Agilent	E4407B	MY41440754	2017-11-18	2018-11-17
6	MXA Signal Analyzer	Agilent	N9020A	MY49100040	2017-06-17	2018-06-16
7	SPECTRUM ANALYZER	R&S	FSP	100503	2017-06-17	2018-06-16
8	MXG Vector Signal Generator	Agilent	N5182A	MY47071151	2017-11-18	2018-11-17
9	ESG VECTOR SIGNAL GENERATOR	Agilent	E4438C	MY42081396	2017-11-18	2018-11-17
10	PSG Analog Signal Generator	Agilent	E8257D	MY4520521	2017-11-18	2018-11-17
11	Universal Radio Communication Tester	R&S	CMU 200	105788	2017-06-17	2018-06-16
12	WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW 500	103818	2017-06-17	2018-06-16
13	RF Control Unit	Tonscend	JS0806-1	N/A	2017-06-17	2018-06-16
14	DC Power Supply	Agilent	E3642A	N/A	2017-11-18	2018-11-17
15	LTE Test Software	Tonscend	JS1120-1	N/A	N/A	N/A
16	Temperature & Humidity Chamber	GUANGZHOU GOGNWEN	GDS-100	70932	2017-10-11	2018-10-10
17	DC Source	CHROMA	62012P-80-60	34782951	2017-10-11	2018-10-10
18	RF Filter	Micro-Tronics	BRC50718	S/N-017	2017-06-17	2018-06-16
19	RF Filter	Micro-Tronics	BRC50719	S/N-011	2017-06-17	2018-06-16
20	RF Filter	Micro-Tronics	BRC50720	S/N-011	2017-06-17	2018-06-16
21	RF Filter	Micro-Tronics	BRC50721	S/N-013	2017-06-17	2018-06-16
22	RF Filter	Micro-Tronics	BRM50702	S/N-195	2017-06-17	2018-06-16
23	Splitter/Combiner	Micro-Tronics	PS2-15	CB11-20	2017-06-17	2018-06-16
24	Splitter/Combiner	Micro-Tronics	CB11-20	N/A	2017-06-17	2018-06-16
25	Attenuator	Micro-Tronics	PAS-8-10	S/N23466	2017-06-17	2018-06-16
26	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2017-06-17	2018-06-16
27	Positioning Controller	MF	MF-7082	/	2017-06-17	2018-06-16
28	EMI Test Software	AUDIX	E3	N/A	2017-06-17	2018-06-16
29	EMI Test Receiver	R&S	ESR 7	101181	2017-06-17	2018-06-16
30	AMPLIFIER	QuieTek	QTK-A2525G	CHM10809065	2017-11-18	2018-11-17
31	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2017-06-23	2018-06-22
32	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2017-05-02	2018-05-01
33	Horn Antenna	EMCO	3115	6741	2017-06-23	2018-06-22
34	RF Cable-R03m	Jye Bao	RG142	CB021	2017-06-17	2018-06-16
35	RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	2017-06-17	2018-06-16
36	TEST RECEIVER	R&S	ESCI	101142	2017-06-17	2018-06-16
37	RF Cable-CON	UTIFLEX	3102-26886-4	CB049	2017-06-17	2018-06-16

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38	10dB Attenuator	SCHWARZBECK	MTS-IMP136	261115-001-0032	2017-06-17	2018-06-16
39	Artificial Mains	R&S	ENV216	101288	2017-06-17	2018-06-16
40	Power Analyzer Test System	Voltech	PM6000	20000670053	2017-06-17	2018-06-16
41	ESD Simulator	SCHLODER	SESD 230	604035	2017-06-17	2018-06-16
42	RF POWER AMPLIFIER	OPHIR	5225R	1052	2017-03-22	2018-03-21
43	RF POWER AMPLIFIER	OPHIR	5273F	1019	2017-03-24	2018-03-23
44	Stacked Broadband Log Periodic Antenna	SCHWARZBECK	STLP 9128	9128ES-145	2017-04-28	2018-04-27
45	Stacked Mikrowellen Log.-Per Antenna	SCHWARZBECK	STLP 9149	9149-482	2017-04-28	2018-04-27
46	Electric field probe	Narda S.TS./PMM	EP601	611WX70332	2017-02-05	2018-02-04
47	Power Meter	Agilent	E4419B	MY45104493	2017-06-17	2018-06-16
48	Power Sensor	Agilent	E9301H	MY41495234	2017-06-17	2018-06-16
49	Power Sensor	Agilent	E4412A	MY41500229	2017-06-17	2018-06-16
50	Immunity Simulative Generator	EM TEST	UCS500-M4	0101-34	2017-11-18	2018-11-17
51	Simulator	FRANKONIA	CIT-10	A126A1195	2017-06-17	2018-06-16
52	CDN	FRANKONIA	CDN-M2	5100100100	2017-06-17	2018-06-16
53	CDN	FRANKONIA	CDN-M3	0900-11	2017-06-17	2018-06-16
54	Attenuator	FRANKONIA	ATT6	0010222A	2017-06-17	2018-06-16
55	Infuse tongs	EM TEST	EM-Clamp	0513A031201	2017-06-17	2018-06-16
56	Voltage dips and up generator	3CTEST	VDG-1105G	EC0171014	2017-06-17	2018-06-16
Note: All equipment is calibrated through GUANGZHOU LISAI CALIBRATION AND TEST CO.,LTD.						

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1.9. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Occupied Channel Bandwidth	5 %
RF output power, conducted	1,5 dB
Power Spectral Density, conducted	3 dB
Unwanted Emissions, conducted	3 dB
All emissions, radiated	6 dB
Temperature	1 °C
Humidity	5 %
DC and low frequency voltages	3 %
Time	5 %
Duty Cycle	5 %

1.10. Test Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	21
Humidity (%RH)	25-75	50
Barometric pressure (mbar)	860-1060	950-1000

1.11. Description Of Test Modes

LCS has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Transmit by DH1
Mode 2: Transmit by 2DH1
Mode 3: Transmit by 3DH1
Mode 4: Receive by DH1
Mode 5: Receive by 2DH1
Mode 4: Receive by 3DH1

Note:

(1) For portable device, radiated spurious emission was verified over X, Y, Z Axis, and shown the worst case on this report.

(2) Regards to the frequency band operation for systems using FHSS modulation: normal operation (hopping) was selected to test for conducted, and the lowest, highest frequency channel for radiation spurious test.

(3) The extreme test condition for voltage and temperature were declared by the manufacturer.

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2. SYSTEM TEST CONFIGURATION

2.1. Justification

The system was configured for testing in engineering mode.

2.2. EUT Exercise Software

N/A.

2.3. Special Accessories

N/A.

2.4. Block Diagram/Schematics

Please refer to the related document.

2.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

2.6. Configuration of Test Setup

Please refer to the test setup photo.

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3. SUMMARY OF TEST RESULT

☒ No deviations from the test standards

☐ Deviations from the test standards as below description:

Technical requirements for Frequency Hopping equipment:

Performed Test Item	Normative References	Test Performed	Deviation
RF Output Power & Receiver Category	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Duty cycle, Tx-Sequence, Tx-gap	ETSI EN 300 328 V2.1.1 (2016-11)	N/A	N/A
Accumulated Transmit Time, Frequency Occupation and Hopping Sequence	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Hopping Frequency Separation	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Medium Utilisation (MU) factor	ETSI EN 300 328 V2.1.1 (2016-11)	N/A	N/A
Adaptivity (Adaptive Frequency Hopping)	ETSI EN 300 328 V2.1.1 (2016-11)	N/A	N/A
Occupied Channel Bandwidth	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Transmitter unwanted emissions in the out-of-band domain	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Transmitter unwanted emissions in the spurious domain	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Receiver Spurious Emissions	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Receiver Blocking	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No

Note:
The EUT can operate in an adaptive mode, and can't operate in a non-adaptive mode which is stated by the supplier.

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4. RF OUTPUT POWER

4.1. Limit

For non-adaptive frequency hopping systems

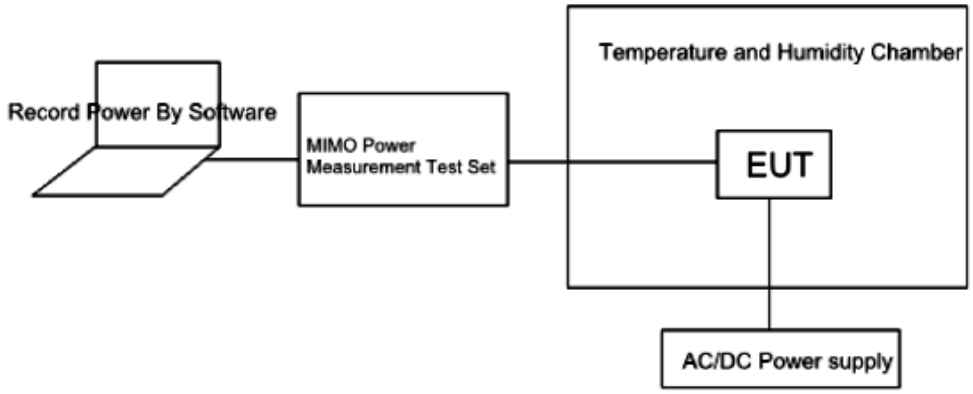
The maximum RF output power for non-adaptive Frequency Hopping equipment shall be declared by the supplier. The maximum RF output power for this equipment shall be equal to or less than the value declared by the supplier. This declared value shall be equal to or less than 20 dBm.

For adaptive frequency hopping systems

The maximum RF output power for adaptive Frequency Hopping equipment shall be equal to or less than 20 dBm.

4.2. Test Setup

For Conducted Measurement



4.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.2

Step 1:

• The fast power sensor use the following setting: Sample speed 1 MS/s.

Step 2:

• Connect the power sensor to the transmit port, sample the transmit signal and store the raw data. Use these stored samples in all following steps.

Step 3:

• Find the start and stop times of each burst in the stored measurement samples.

Step 4:

• Between the start and stop times of each individual burst calculate the RMS power over the burst. Save these P_{burst} values, as well as the start and stop times for each burst.

Step 5:

• The highest of all P_{burst} values (value "A" in dBm) will be used for maximum e.i.r.p. calculations.

Step 6:

• Add the (stated) antenna assembly gain "G" in dBi of the individual antenna.

• If applicable, add the additional beamforming gain "Y" in dB.

The RF Output Power (P) shall be calculated using the formula below:
P = A + G + Y

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4.4. Test Result

Pass

***Note: 20 bursts had been captured for power measurement.

Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	RF Output Power
Test Mode	:	Mode 1: Transmit by DH1

Test Conditions		Frequency (MHz)	RF Output Power EIRP (dBm)	Limit (dBm)
Tnom (25℃)	Vnom (DC 3.8V)	2402	1.37	20
		2441	1.65	
		2480	**1.91**	
Tmax (40℃)	Vnom (DC 3.8V)	2402	1.24	20
		2441	1.64	
		2480	1.90	
Tmin (-10℃)	Vnom (DC 3.8V)	2402	1.40	20
		2441	1.79	
		2480	1.70	

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Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	RF Output Power
Test Mode	:	Mode 2: Transmit by 2DH1

Test Conditions		Frequency (MHz)	RF Output Power EIRP (dBm)	Limit (dBm)
Tnom (25℃)	Vnom (DC 3.8V)	2402	0.75	20
		2441	0.96	
		2480	1.40	
Tmax (40℃)	Vnom (DC 3.8V)	2402	0.61	20
		2441	0.96	
		2480	1.30	
Tmin (-10℃)	Vnom (DC 3.8V)	2402	0.88	20
		2441	1.09	
		2480	1.05	

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Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	RF Output Power
Test Mode	:	Mode 3: Transmit by 3DH1

Test Conditions		Frequency (MHz)	RF Output Power EIRP (dBm)	Limit (dBm)
Tnom (25℃)	Vnom (DC 3.8V)	2402	0.85	20
		2441	0.98	
		2480	1.25	
Tmax (40℃)	Vnom (DC 3.8V)	2402	0.62	20
		2441	1.13	
		2480	1.40	
Tmin (-10℃)	Vnom (DC 3.8V)	2402	0.81	20
		2441	1.28	
		2480	1.11	

4.5. Receiver Category

Receiver Category 1: Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p. shall be considered as receiver category 1 equipment.

Receiver Category 2:Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of 10 dBm e.i.r.p. shall be considered as receiver category 2 equipment.

Receiver Category 3: Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p. shall be considered as receiver category 3 equipment.

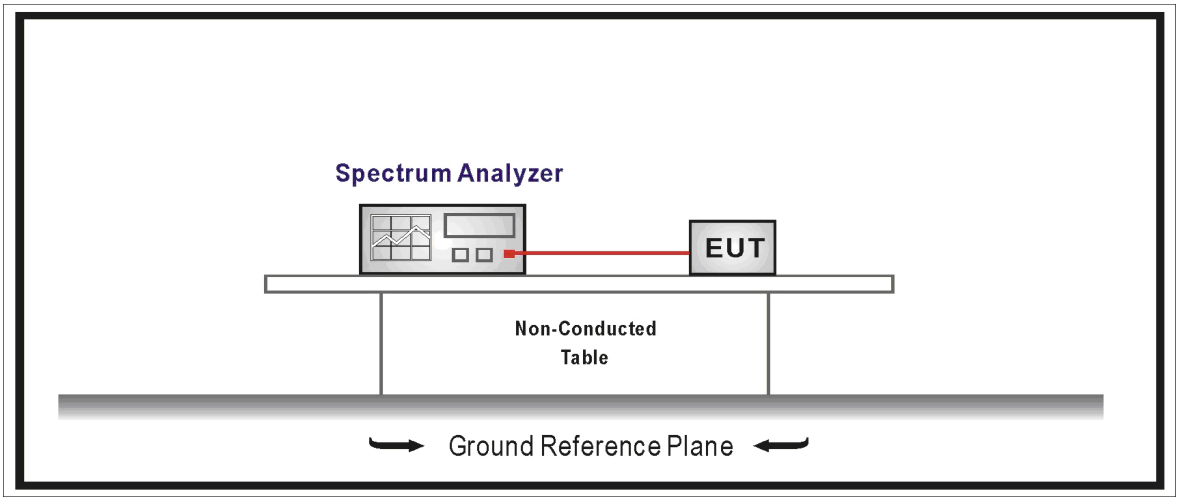
As this is an adaptivity device with a maximum power of 1.91dBm, **it belongs to recevier category 2**.

5. DUTY CYCLE, TX-SEQUENCE, TX-GAP

5.1. Limit

For non-adaptive FHSS equipment, the Duty Cycle shall be equal to or less than the maximum value declared by the supplier. In addition, the maximum Tx-sequence time shall be 5 ms while the minimum Tx-gap time shall be 5 ms.

5.2. Test Setup



5.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.2

5.4. Test Result

These requirements apply to non-adaptive frequency hopping equipment or to adaptive frequency hopping equipment operating in a non-adaptive mode.
These requirements do not apply for equipment with a maximum declared RF Output power of less than 10dBm E.I.R.P. or for equipment when operating in a mode where the RF Output power is less than 10dBm E.I.R.P.
No applicable.

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6. ACCUMULATED TRANSMIT TIME, FREQUENCY OCCUPATION AND HOPPING SEQUENCE

6.1. Limit

For non-adaptive frequency hopping systems

The Accumulated Transmit Time on any hopping frequency shall not be greater than 15 ms within any observation period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.

Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.

The hopping sequence(s) shall contain at least N hopping frequencies where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

For adaptive frequency hopping systems

Adaptive Frequency Hopping systems shall be capable of operating over a minimum of 70 % of the band.

The Accumulated Transmit Time on any hopping frequency shall not be greater than 400 ms within any observation period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

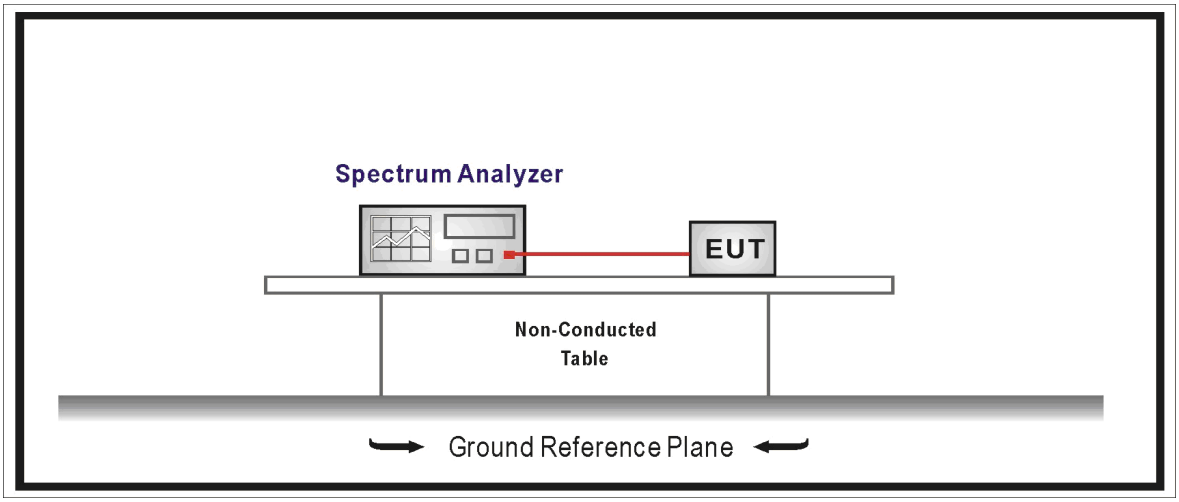
Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.

Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.

The hopping sequence(s) shall contain at least N hopping frequencies at all times, where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

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6.2. Test Setup



6.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.4

Step 1:

• The output of the transmitter shall be connected to a spectrum analyzer or equivalent.
• The analyzer shall be set as follows:
- Centre Frequency: Equal to the hopping frequency being investigated
- Frequency Span: 0 Hz
- RBW: ~ 50 % of the Occupied Channel Bandwidth(we set RBW=510KHz)
- VBW: ≥ RBW(we set RBW=1500KHz)
- Detector Mode: RMS
- Sweep time: Equal to the applicable observation period (we set 400ms ×79=31600ms)
- Number of sweep points: 30 000
- Trace mode: Clear / Write
- Trigger: Free Run

Step 2:

• Save the trace data to a file for further analysis by a computing device using an appropriate software application or program.

Step 3:

• Indentify the data points related to the frequency being investigated by applying a threshold.
The data points resulting from transmissions on the hopping frequency being investigated are assumed to have much higher levels compared to data points resulting from transmissions on adjacent hopping frequencies. If a clear determination between these transmissions is not possible, the RBW in step 1 shall be further reduced. In addition, a channel filter may be used.
• Count the number of data points identified as resulting from transmissions on the frequency being investigated and multiply this number by the time difference between two consecutive data points.

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Step 4:

• The result in step 3 is the Accumulated Transmit Time which shall comply with the limit provided in clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2 and which shall be recorded in the test report.

Step 5:

• Make the following changes on the analyzer and repeat steps 2 and 3.

Sweep time: 4 × Dwell Time × Actual number of hopping frequencies in use

The hopping frequencies occupied by the equipment without having transmissions during the dwell time (blacklisted frequencies) should be taken into account in the actual number of hopping frequencies in use. If this number cannot be determined (number of blacklisted frequencies unknown) it shall be assumed that the equipment uses the maximum possible number of hopping frequencies.

• The result shall be compared to the limit for the Frequency Occupation defined in clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2. The result of this comparison shall be recorded in the test report.

Step 6:

• Make the following changes on the analyzer:

- Start Frequency: 2 400 MHz
- Stop Frequency: 2 483,5 MHz
- RBW: ~ 50 % of the Occupied Channel Bandwidth (single hop) (we set RBW=510KHz)
- VBW: ≥ RBW (we set RBW=1500KHz)
- Detector Mode: RMS
- Sweep time: 1s
- Trace Mode: Max Hold
- Trigger: Free Run

• Wait for the trace to stabilize. Identify the number of hopping frequencies used by the hopping sequence.

• The result shall be compared to the limit (value N) defined in clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2. This value shall be recorded in the test report. For equipment with blacklisted frequencies, it might not be possible to verify the number of hopping frequencies in use. However they shall comply with the requirement for Accumulated Transmit Time and Frequency Occupation assuming the minimum number of hopping frequencies (N) defined in clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2 is used.

Step 7:

• For adaptive equipment, using the lowest and highest -20 dB points from the total spectrum envelope obtained in step 6, it shall be verified whether the equipment uses 70 % of the band specified in clause 1. The result shall be recorded in the test report.

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6.4. Test Result

Product	:	LTE GSM/WCDMA Smartphone
Test Result	:	Pass

Accumulated Transmit Time

Packet	One Pulse time (ms)	Accumulated Dwell Time (ms)	Measure Time (ms)	Limit	Conclusion
DH1	0.40	122.13	31600	<400ms	PASS
DH3	1.61	242.16			
DH5	2.83	318.15			
Remark: Only record the worst data.					

Mini Frequency Occupation Time

Mode	Mini frequency occupation Time(ms)	Measure Time (ms)	Conclusion
DH1	0.34	120.12	PASS
DH3	3.23	511.96	PASS
DH5	11.54	899.94	PASS
Remark: Only record the worst data.			

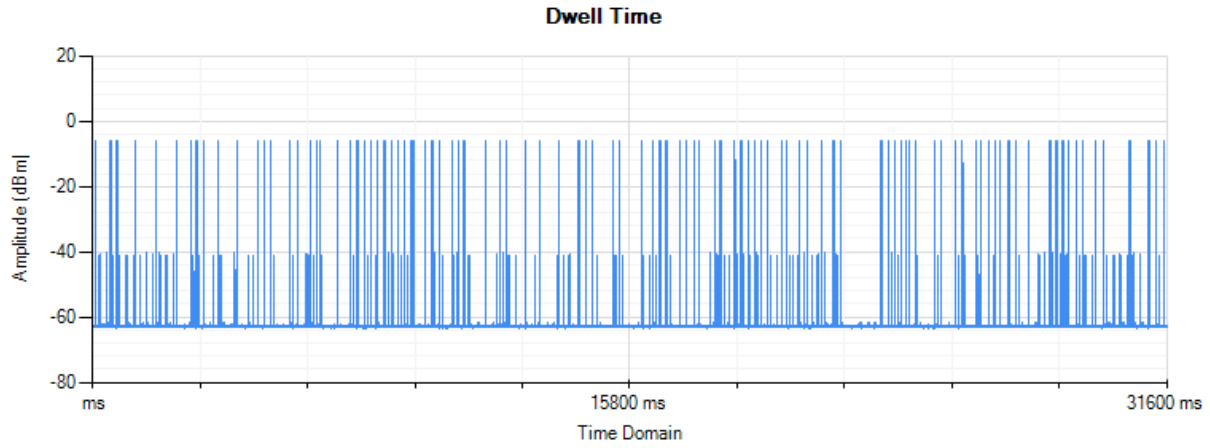
Hopping channel & Hopping sequence

Mode	Number of hopping channel	Limit	Conclusion
GFSK	79	>15	PASS
Mode	Hopping Sequence(%)	Limit	Conclusion
GFSK	96.35%	>70%	PASS

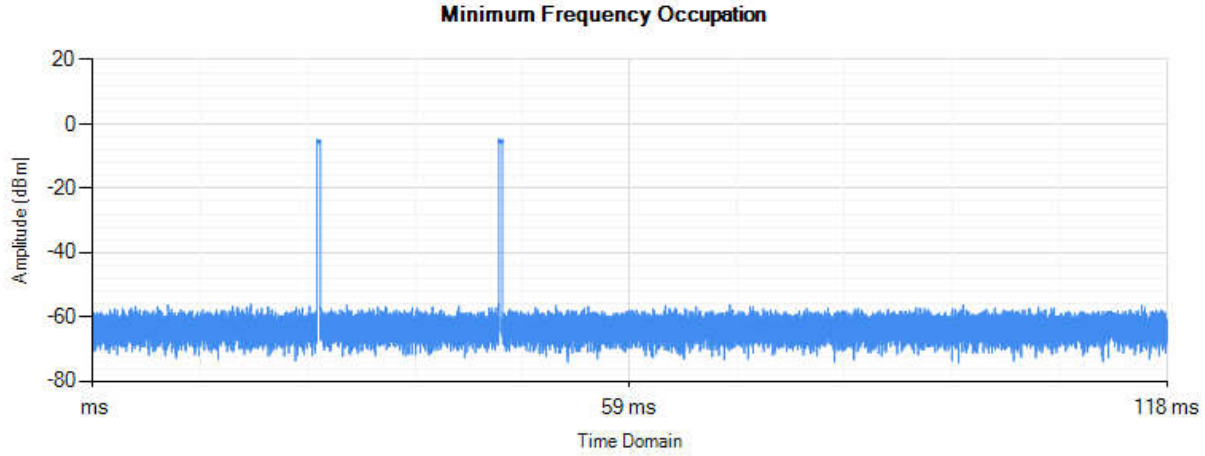
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*****Note: Only report the worst test plot**

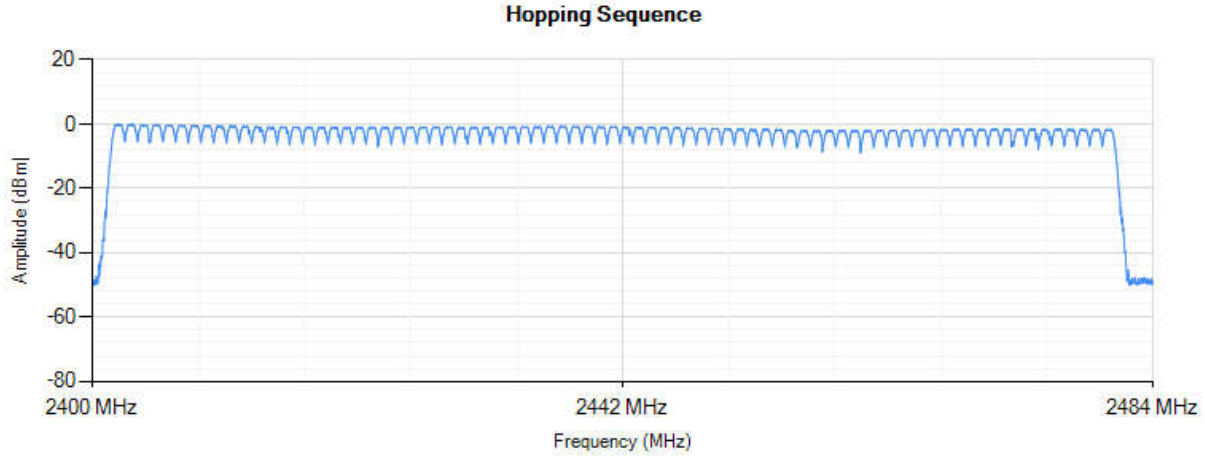
Test Plot For Accumulated Dwell Time(DH5)



Test Plot For Mini Frequency Occupation Time(DH1)



Test Plot For Hopping channel & Hopping sequence(DH1)



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7. HOPPING FREQUENCY SEPARATION

7.1. Limit

For non-adaptive equipment

For non-adaptive Frequency Hopping equipment, the Hopping Frequency Separation shall be equal or greater than the Occupied Channel Bandwidth, with a minimum separation of 100 kHz.

For equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for non-adaptive Frequency Hopping equipment operating in a mode where the RF Output power is less than 10 dBm e.i.r.p. only the minimum Hopping Frequency Separation of 100 kHz applies.

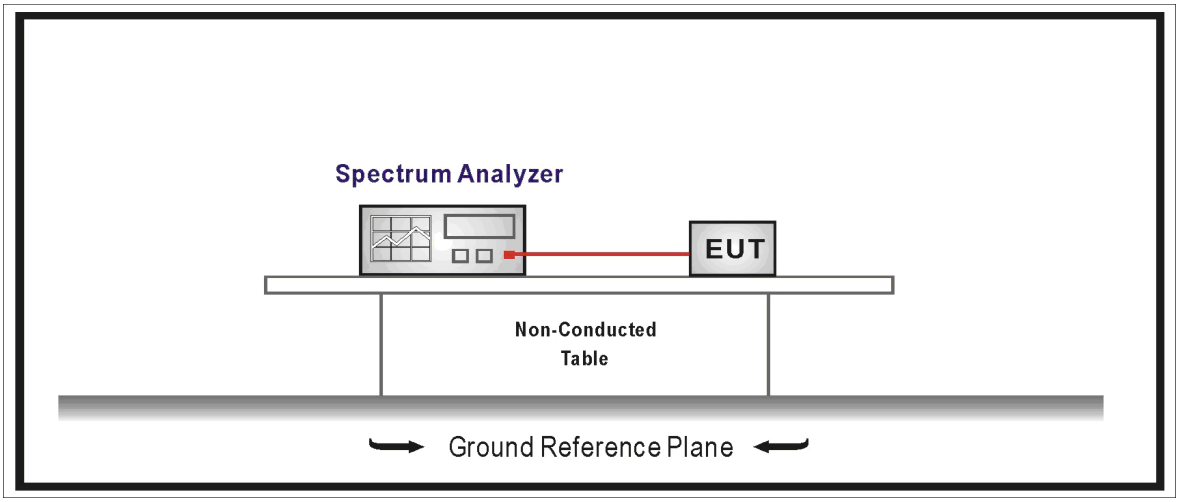
For adaptive equipment

For adaptive Frequency Hopping equipment, the minimum Hopping Frequency Separation shall be 100 kHz.

Adaptive Frequency Hopping equipment, which for one or more hopping frequencies, has switched to a non-adaptive mode because interference was detected on all these hopping positions with a level above the threshold level defined in clause 4.3.1.7.2.2 or clause 4.3.1.7.3.2, is allowed to continue to operate with a minimum Hopping Frequency Separation of 100 kHz on these hopping frequencies as long as the interference is present on these frequencies. The equipment shall continue to operate in an adaptive mode on other hopping frequencies.

Adaptive Frequency Hopping equipment which decided to operate in a non-adaptive mode on one or more hopping frequencies without the presence of interference, shall comply with the limit in clause 4.3.1.5.3.1 for these hopping frequencies as well as with all other requirements applicable to non-adaptive frequency hopping equipment.

7.2. Test Setup



7.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.5

The analyzer was setting as follow:
- Centre Frequency: Centre of the two adjacent hopping frequencies
- Frequency Span: Sufficient to see the complete power envelope of both hopping frequencies
- RBW: 1 % of the span (we set RBW=30KHz)
- VBW: 3 × RBW (we set VBW=91KHz)
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep time: 1s

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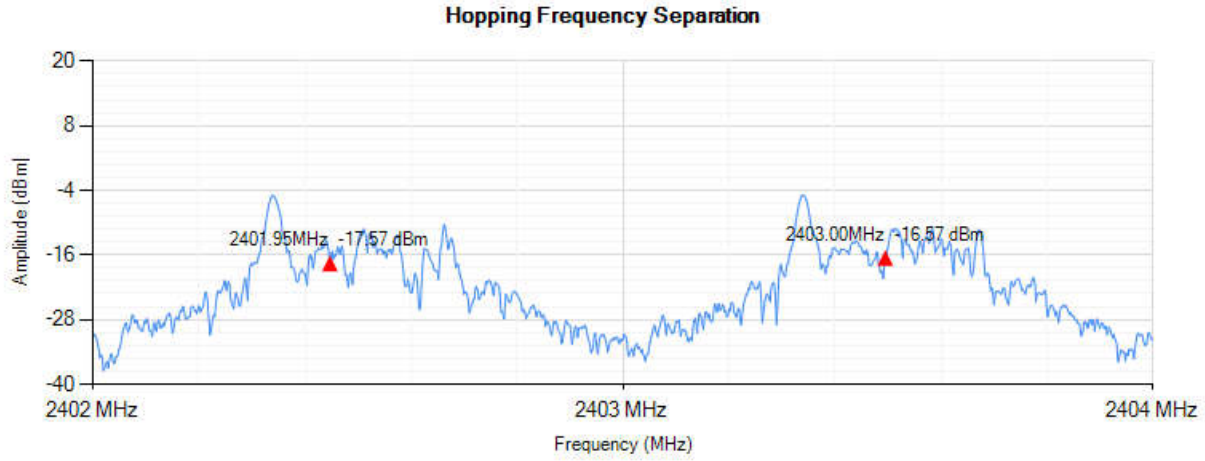
7.4. Test Result

Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Hopping Frequency Separation
Test Result	:	Pass

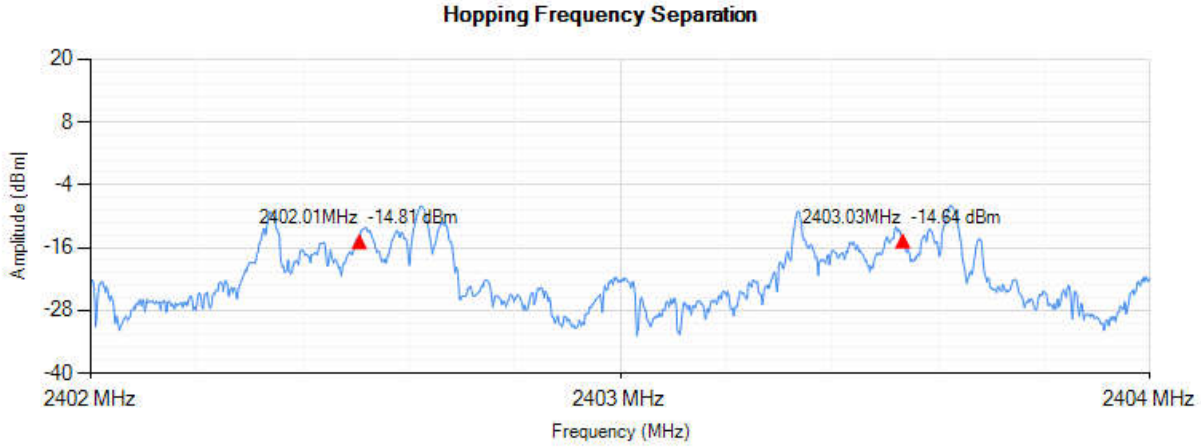
Mode	Result (MHz)	Limit (MHz)	Conclusion
DH1	1.05	>=0.1	PASS
2DH1	1.02	>=0.1	
3DH1	1.00	>=0.1	

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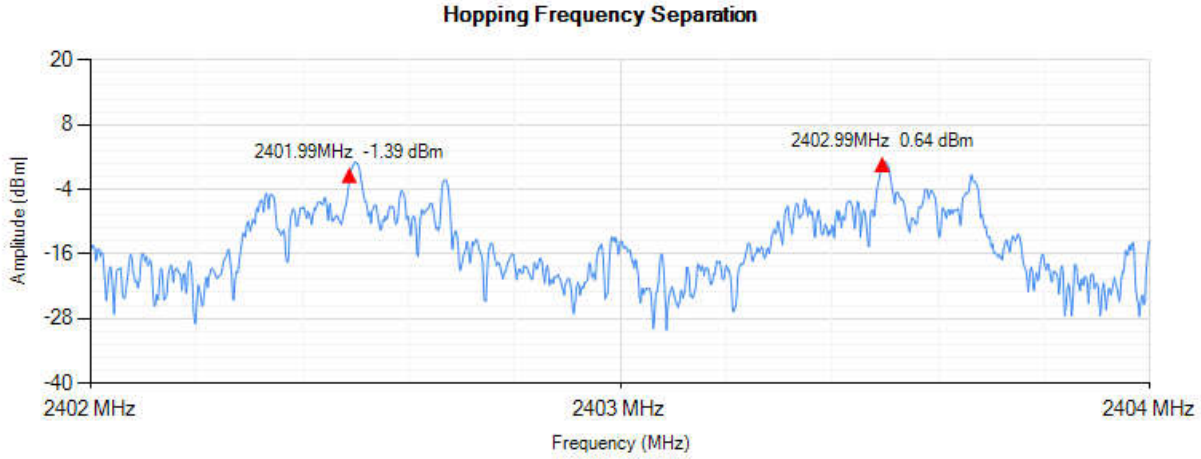
Test Plot For DH1



Test Plot For 2DH1



Test Plot For 3DH1



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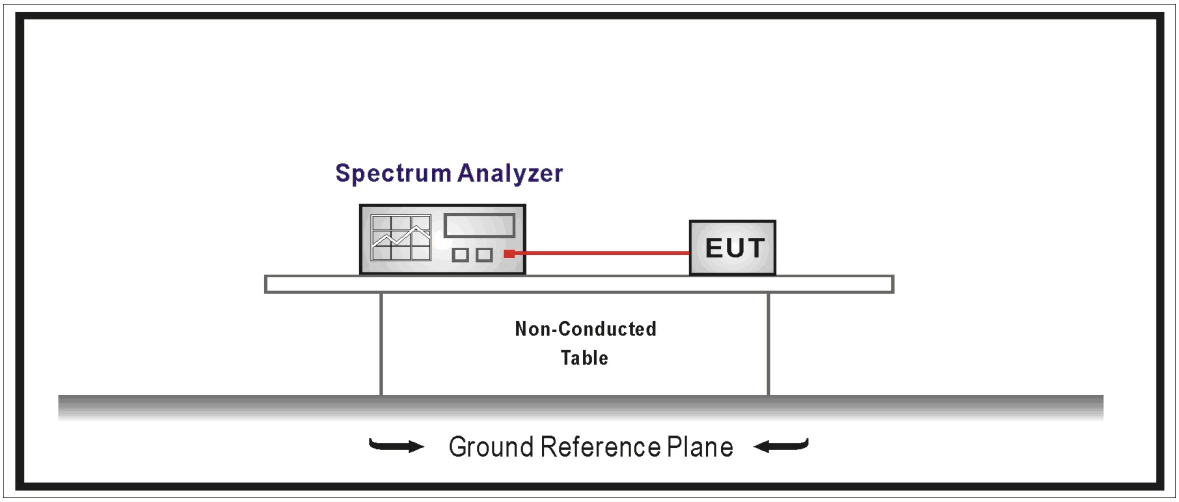
8. MEDIUM UTILISATION (MU) FACTOR

8.1. Limit

For non-adaptive equipment

The maximum Medium Utilization factor for non-adaptive Frequency Hopping equipment shall be 10 %.

8.2. Test Setup



8.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.2

8.4. Test Result

This requirement does not apply to adaptive equipment unless operating in a non-adaptive mode.
In addition, this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10dBm E.I.R.P. or for equipment when operating in a mode where the RF Output power is less than 10dBm E.I.R.P.
No applicable.

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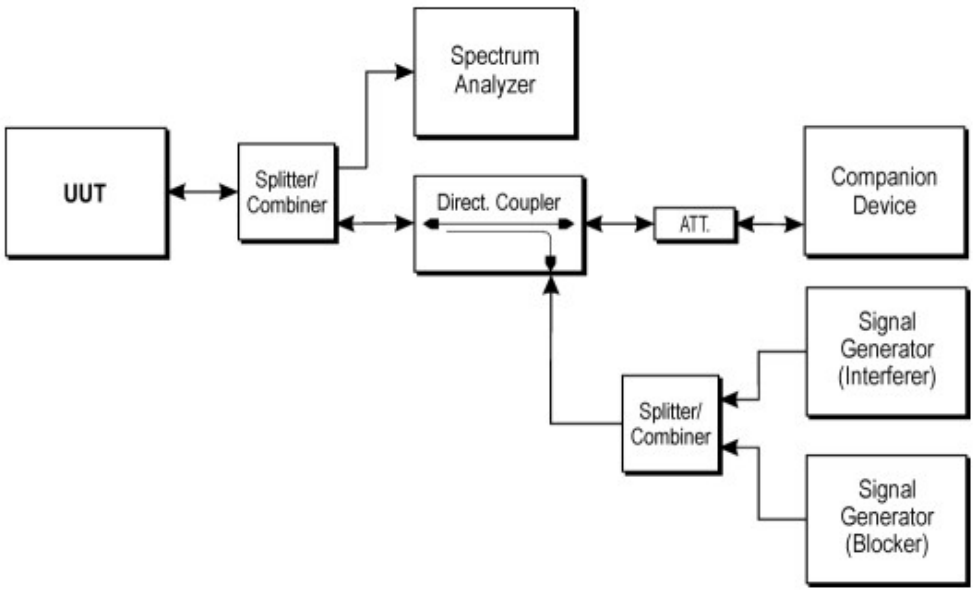
9. ADAPTIVITY (ADAPTIVE FREQUENCY HOPPING)

9.1. Limit

Adaptivity Limit
☐ LBT based Detect and Avoid --- The CCA observation time shall be not less than 0,2 % of the Channel Occupancy Time with a minimum of 18 μs.; --- COT ≤ 60 ms; --- Idle Period = 5% of COT with a minimum of 100 μs; --- Detection threshold level = -70 dBm/MHz + (20 dBm - Pout e.i.r.p)/1 MHz (Pout in dBm)
☒ Non-LBT based Detect and Avoid --- The frequency shall remain unavailable for a minimum time equal to 1 second or 5 times the actual number of hopping frequencies in the current (adapted) channel map used by the equipment, multiplied with the Channel Occupancy Time whichever is the longest. --- COT ≤ 40 ms; --- For equipment using a dwell time > 40 ms that want to have other transmissions during the same hop (dwell time) an Idle Period (no transmissions) of minimum 5 % of the Channel Occupancy Period with a minimum of 100 μs shall be implemented. --- Detection threshold level = -70 dBm/MHz + (20 dBm - Pout e.i.r.p.)/1 MHz (Pout in dBm)
☐ Short Control Signalling Transmissions: --- Short Control Signalling Transmissions shall have a maximum TxOn / (TxOn + TxOff) ratio of 10 % within any observation period of 50 ms or within an observation period equal to the dwell time, whichever is the shorter.

9.2. Test Setup

Conducted measurements



9.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.7

9.4. Test Result

This requirement does not apply to non-adaptive equipment or adaptive equipment operating in a non-adaptive mode providing the equipment complies with the requirements and/or restrictions applicable to non-adaptive equipment.
In addition, this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10dBm E.I.R.P. or for equipment when operating in a mode where the RF Output power is less than 10dBm E.I.R.P.
No applicable.

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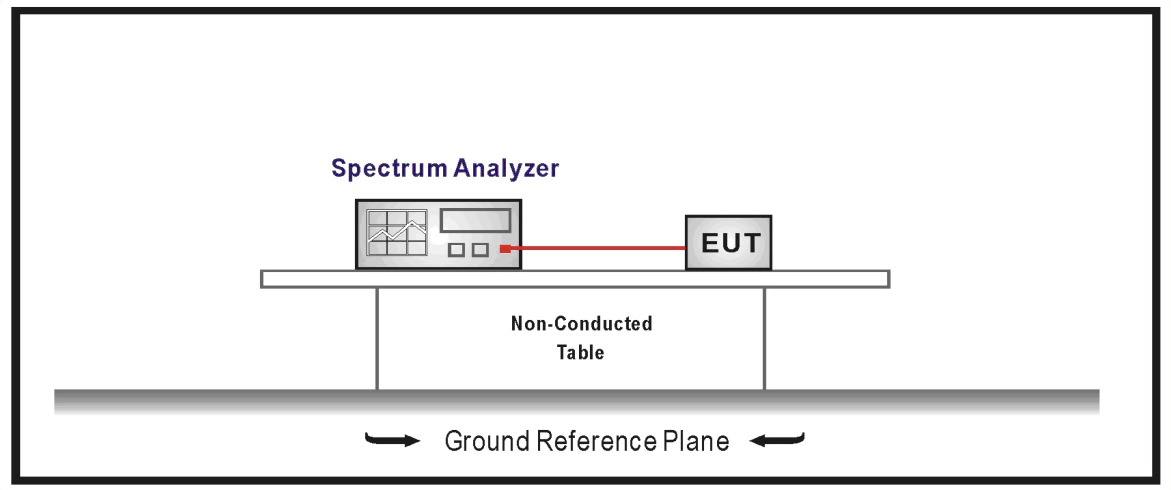
10. OCCUPIED CHANNEL BANDWIDTH

10.1. Limit

The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band 2.4GHz to 2.4835GHz.

For non-adaptive Frequency Hopping equipment with E.I.R.P greater than 10dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the value declared by the supplier. This declared value shall not be greater than 5 MHz.

10.2. Test Setup



10.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.8

Step 1:

Connect the UUT to the spectrum analyser and use the following settings:

- Centre Frequency: The centre frequency of the channel under test
- Resolution BW: ~ 1 % of the span without going below 1 % (We set RBW=20KHz)
- Video BW: 3 × RBW (We set VBW=62KHz)
- Frequency Span: 2 × Occupied Channel Bandwidth (We set Span=2MHz)
- Detector Mode: RMS
- Trace Mode: Max Hold

Step 2:

Wait until the trace is completed. Find the peak value of the trace and place the analyser marker on this peak.

Step 3:

Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT. This value shall be recorded.

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10.4. Test Result

Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Occupied Channel Bandwidth
Test Mode	:	Mode 1: Transmit by DH1

Channel No.	Frequency (MHz)	99% Bandwidth (MHz)	Limit
00	2402	0.81	Within the band 2400.0MHz~2483.5MHz
79	2480	0.81	

Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Occupied Channel Bandwidth
Test Mode	:	Mode 2: Transmit by 2DH1

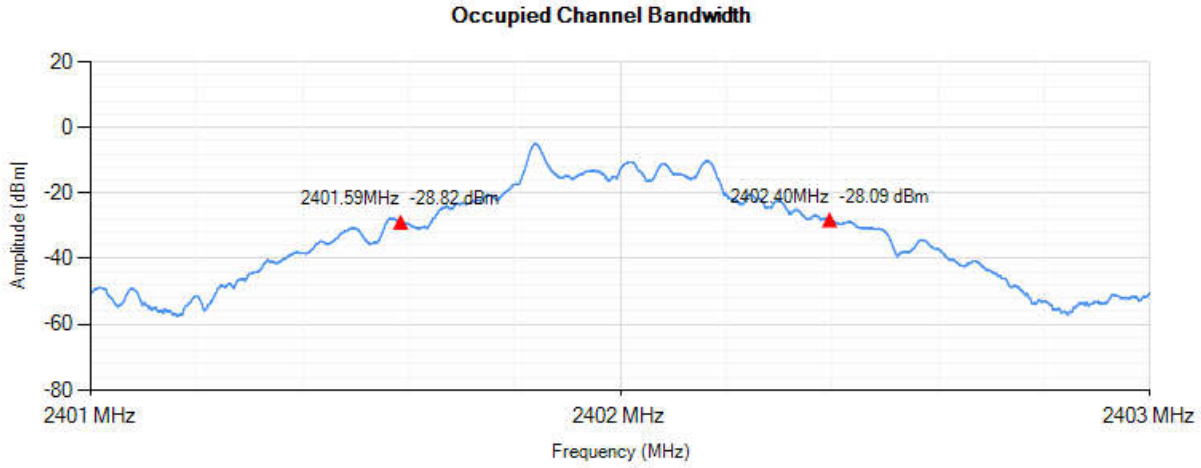
Channel No.	Frequency (MHz)	99% Bandwidth (MHz)	Limit
00	2402	1.04	Within the band 2400.0MHz~2483.5MHz
79	2480	1.04	

Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Occupied Channel Bandwidth
Test Mode	:	Mode 3: Transmit by 3DH1

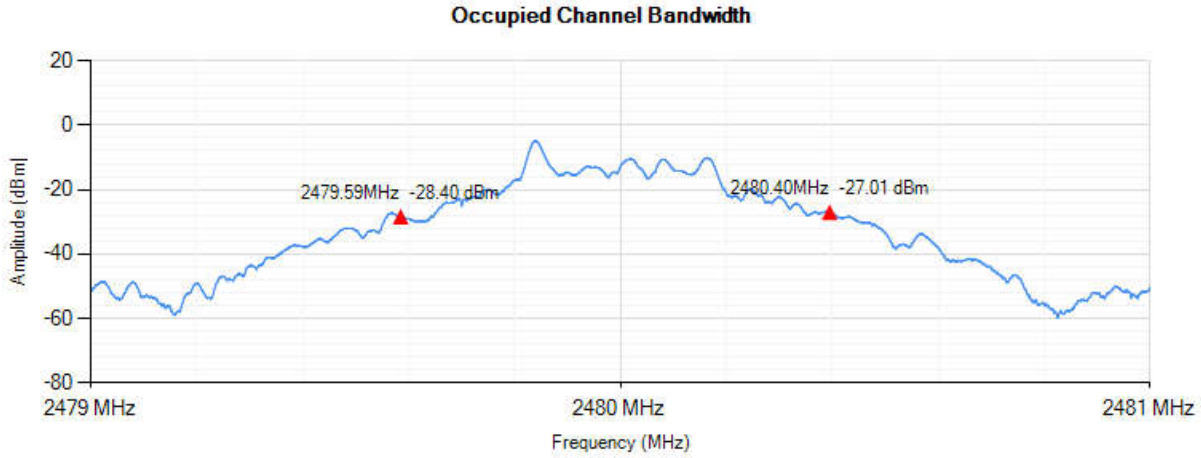
Channel No.	Frequency (MHz)	99% Bandwidth (MHz)	Limit
00	2402	1.08	Within the band 2400.0MHz~2483.5MHz
79	2480	1.08	

Test Result	:	Pass

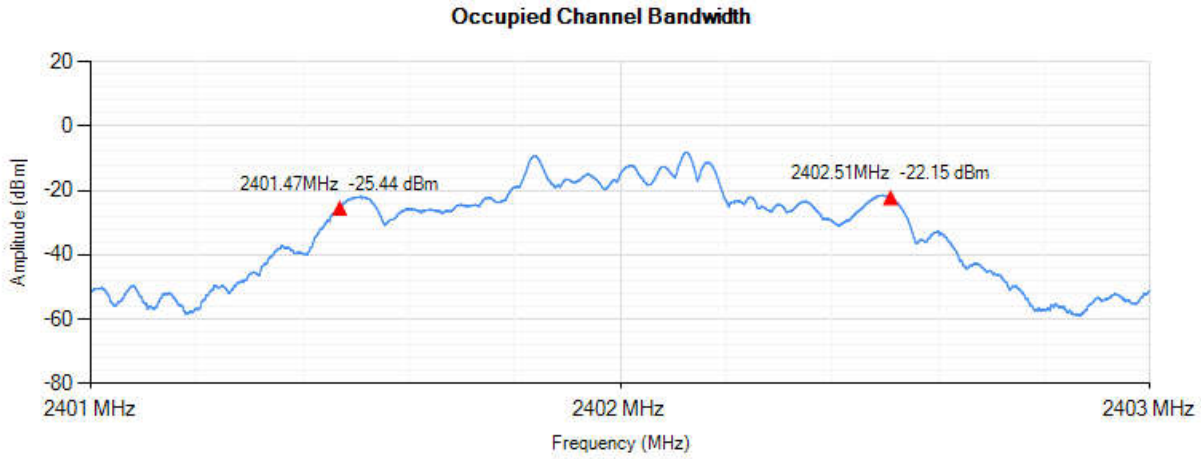
DH1-Low channel



DH1-High channel

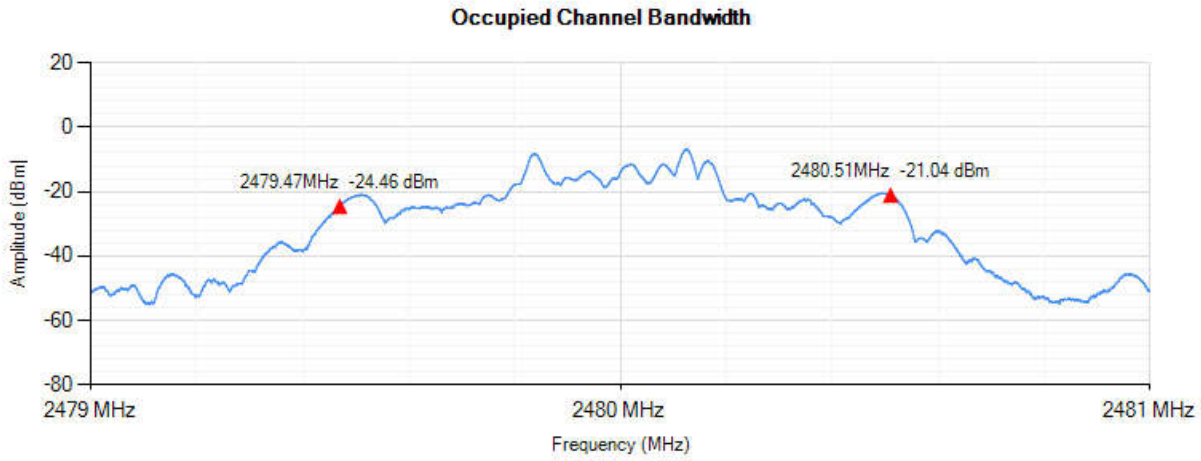


2DH1-Low channel

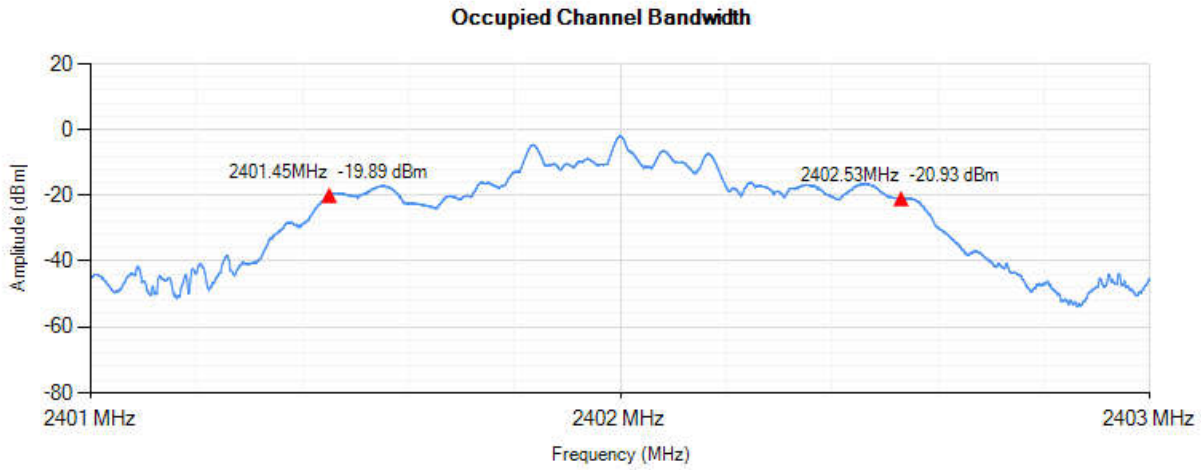


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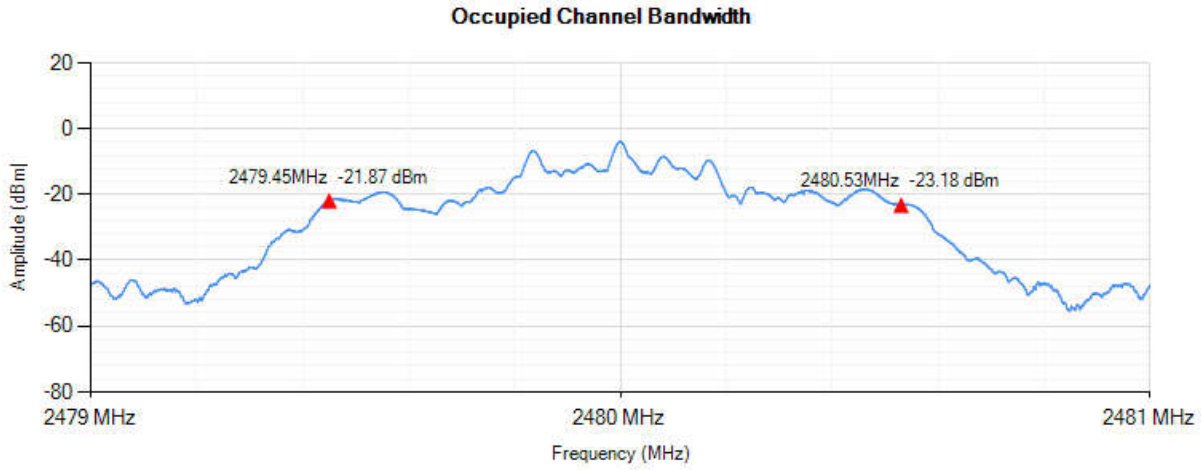
2DH1-High channel



3DH1-Low channel



3DH1-High channel



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11. TRANSMITTER UNWANTED EMISSIONS IN THE OUT-OF-BAND DOMAIN

11.1. Limit

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 1.

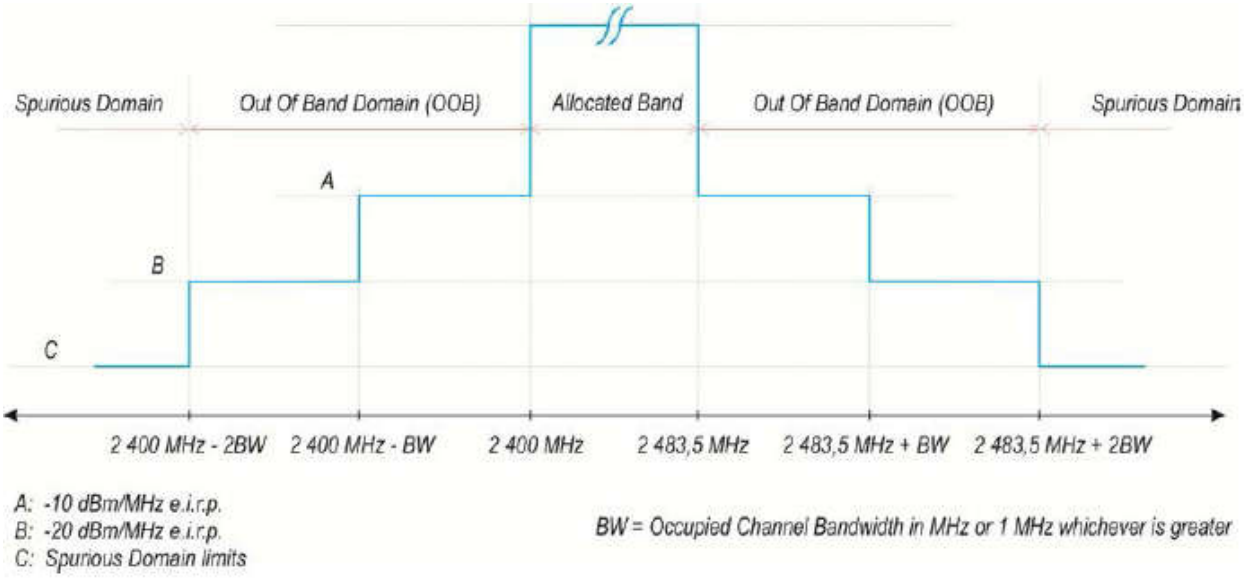
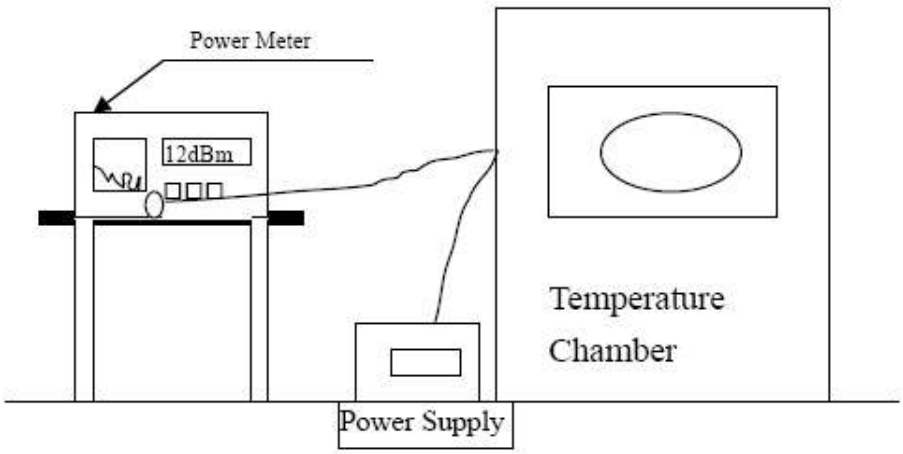


Figure 1: Transmit mask

11.2. Test Setup

For Conducted Measurement



11.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.9

Step 1:

• Connect the UUT to the spectrum analyser and use the following settings:
- Centre Frequency: 2 484 MHz
- Span: 0 Hz
- Resolution BW: 1 MHz
- Filter mode: Channel filter
- Video BW: 3 MHz
- Detector Mode: RMS
- Trace Mode: Clear / Write
- Sweep Mode: Continuous
- Sweep Points: Sweep Time [s] / (1 μs) or 5 000 whichever is greater
- Trigger Mode: Video trigger

NOTE 1: In case video triggering is not possible, an external trigger source may be used.

- Sweep Time: > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

Step 2: (segment 2 483,5 MHz to 2 483,5 MHz + BW)

• Adjust the trigger level to select the transmissions with the highest power level.

• For frequency hopping equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected.

• Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS power shall be measured using the Time Domain Power function.

• Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask.

• Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 3: (segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW)

• Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz.

Step 4: (segment 2 400 MHz - BW to 2 400 MHz)

• Change the centre frequency of the analyser to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz.

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Step 5: (segment 2 400 MHz - 2BW to 2 400 MHz - BW)

• Change the centre frequency of the analyser to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz.

Step 6:

• In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain "G" in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figures 1 or 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered.

• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements need to be repeated for each of the active transmit chains. The declared antenna assembly gain "G" in dBi for a single antenna shall be added to these results. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. Comparison with the applicable limits shall be done using any of the options given below:

- Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added. The additional beamforming gain "Y" in dB shall be added as well and the resulting values compared with the limits provided by the mask given in figures 1 or 3.
- Option 2: the limits provided by the mask given in figures 1 or 3 shall be reduced by 10 x log10(Ach) and the additional beamforming gain "Y" in dB. The results for each of the transmit chains shall be individually compared with these reduced limits.

NOTE 2: Ach refers to the number of active transmit chains.

It shall be recorded whether the equipment complies with the mask provided in figures 1 or 3.

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11.5. Test Result

Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Transmitter unwanted emissions in the out-of-band domain
Test Mode	:	Mode 1: Transmit by DH1

Frequency (MHz)	Test Conditions (℃)	Max measured Values (dBm/MHz)	Limit (dBm/MHz)
2400–2BW~ 2400-BW	25	-66.09	-20
2400–BW~2400	25	-63.49	-10
2483.5~ 2483.5+BW	25	-63.92	-10
2483.5+BW~ 2483.5+2BW	25	-67.50	-20

Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Transmitter unwanted emissions in the out-of-band domain
Test Mode	:	Mode 2: Transmit by 2DH1

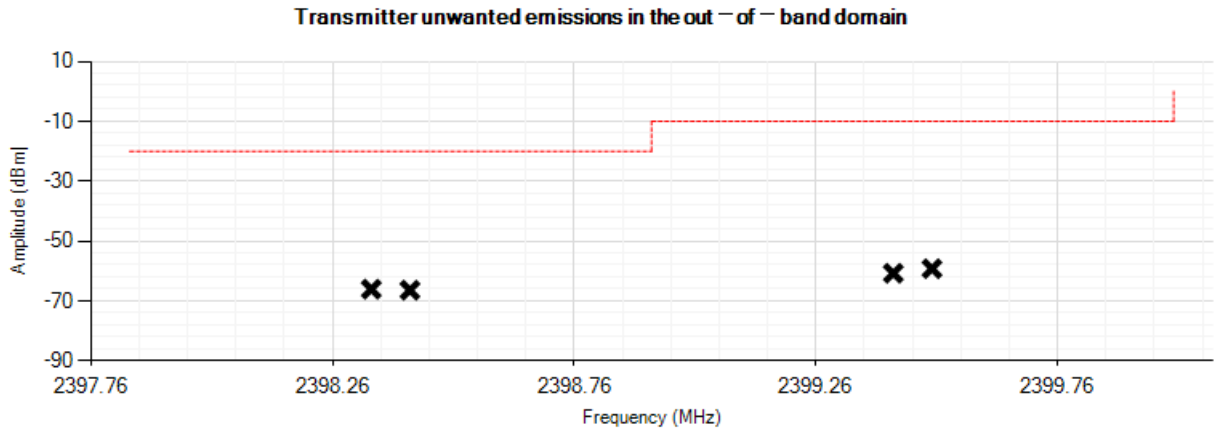
Frequency (MHz)	Test Conditions (℃)	Max measured Values (dBm/MHz)	Limit (dBm/MHz)
2400–2BW~ 2400-BW	25	-62.49	-20
2400–BW~2400	25	-55.65	-10
2483.5~ 2483.5+BW	25	-62.46	-10
2483.5+BW~ 2483.5+2BW	25	-63.19	-20

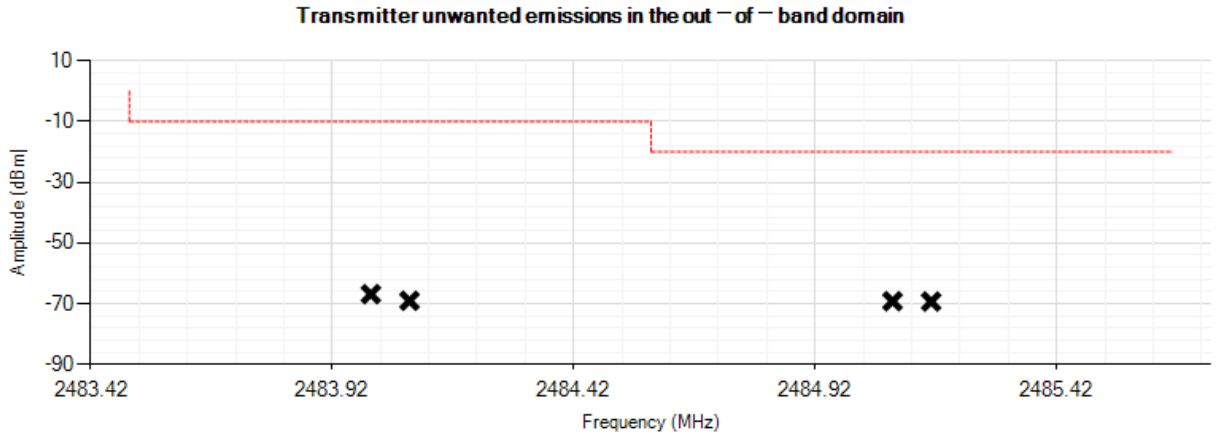
Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Transmitter unwanted emissions in the out-of-band domain
Test Mode	:	Mode 3: Transmit by 3DH1

Frequency (MHz)	Test Conditions (℃)	Max measured Values (dBm/MHz)	Limit (dBm/MHz)
2400–2BW~ 2400-BW	25	-67.28	-20
2400–BW~2400	25	-61.00	-10
2483.5~ 2483.5+BW	25	-69.09	-10
2483.5+BW~ 2483.5+2BW	25	-69.65	-20

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Note: All modulations of EUT have been tested and only record the worst data(Mode 3) in the report.





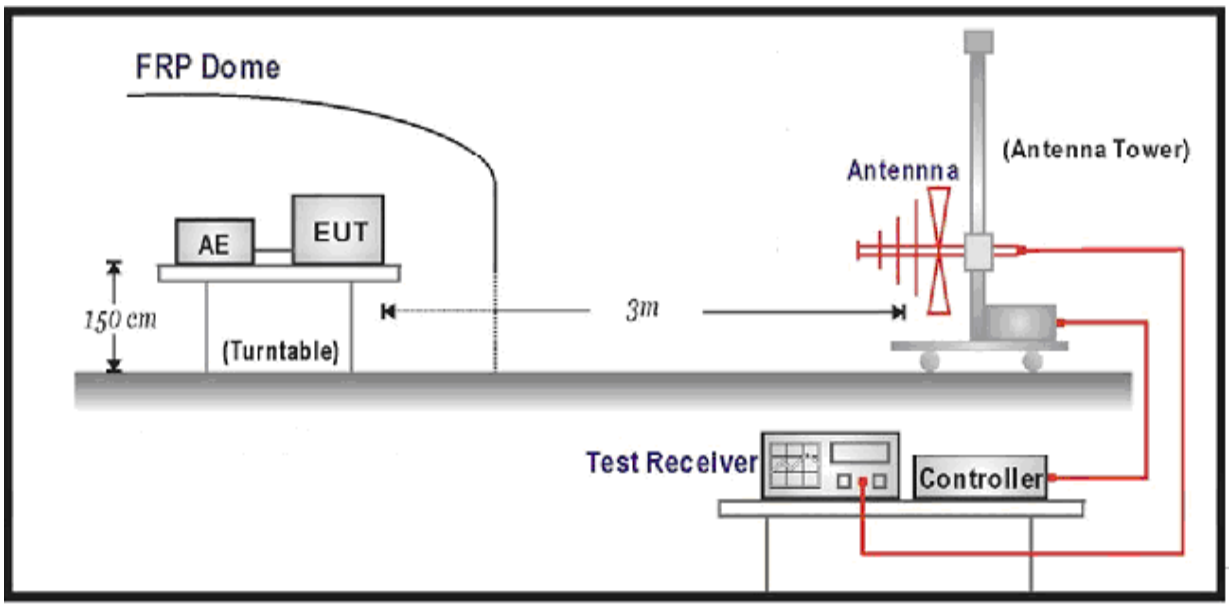
12. TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

12.1. Limit

Transmitter Limits for Spurious Emissions		
Frequency Range	Maximum power E.R.P. (≤ 1GHz) E.I.R.P. (> 1GHz)	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

12.2. Test Setup

For Radiated Measurement



12.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.10

Step 1:

The sensitivity of the spectrum analyser should be such that the noise floor is at least 12 dB below the limits given in tables 1 or 4.

Step 2:

The emissions over the range 30 MHz to 1 000 MHz shall be identified.

Spectrum analyser settings:

• Resolution bandwidth: 100 kHz

• Video bandwidth: 300 kHz

• Detector mode: Peak

• Trace Mode: Max Hold

• Sweep Points: ≥ 19400

NOTE 1: For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.

• Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT. For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on the same hopping frequency in different hopping sequences. Allow the trace to stabilize. Any emissions identified during the sweeps above and that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.3.10.2.1.3 and compared to the limits given in tables 1 or 4.

Step 3:

The emissions over the range 1 GHz to 12,75 GHz shall be identified.

Spectrum analyser settings:

• Resolution bandwidth: 1 MHz

• Video bandwidth: 3 MHz

• Detector mode: Peak

• Trace Mode: Max Hold

• Sweep Points: ≥ 23500

NOTE 2: For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.

• Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 1 MHz frequency step, the measurement time is greater than two transmissions of the UUT.

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12.4. Test Result

Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Transmitter spurious emissions(Radiated Measurement)
Test Mode	:	Mode 1: Transmit by DH1

Frequency (MHz)	Polarization (H/V)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector
Channel 0 (2402MHz)					
195.48	H	-68.00	-54.00	-14.00	PK
206.28	V	-68.36	-54.00	-14.36	PK
818.89	H	-68.22	-54.00	-14.22	PK
999.66	V	-50.19	-36.00	-14.19	PK
4803.99	H	-44.91	-30.00	-14.91	PK
4803.97	V	-43.90	-30.00	-13.90	PK
7206.00	H	-42.66	-30.00	-12.66	PK
7206.01	V	-43.37	-30.00	-13.37	PK
Channel 78 (2480MHz)					
202.70	H	-66.93	-54.00	-12.93	PK
243.40	V	-48.96	-36.00	-12.96	PK
825.31	H	-66.47	-54.00	-12.47	PK
837.51	V	-68.55	-54.00	-14.55	PK
4959.99	H	-44.13	-30.00	-14.13	PK
4960.01	V	-42.14	-30.00	-12.14	PK
7440.01	H	-41.66	-30.00	-11.66	PK
7440.00	V	-41.25	-30.00	-11.25	PK

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Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Transmitter spurious emissions(Conducted Measurement)
Test Mode	:	Mode 1: Transmit by DH1

Frequency(MHz)	Measure Level(dBm)	Limit(dBm)	Margin(dB)	Detector
Channel 0 (2402MHz)				
249.97	-48.65	-36.00	-12.65	PK
857.13	-64.42	-54.00	-10.42	PK
4804.03	-43.57	-30.00	-13.57	PK
7205.98	-44.51	-30.00	-14.51	PK
Channel 78 (2480MHz)				
241.80	-50.49	-36.00	-14.49	PK
963.32	-50.66	-36.00	-14.66	PK
4960.00	-44.35	-30.00	-14.35	PK
7439.98	-40.73	-30.00	-10.73	PK

Note: All modulations of EUT have been tested and only record the worst data in the report.

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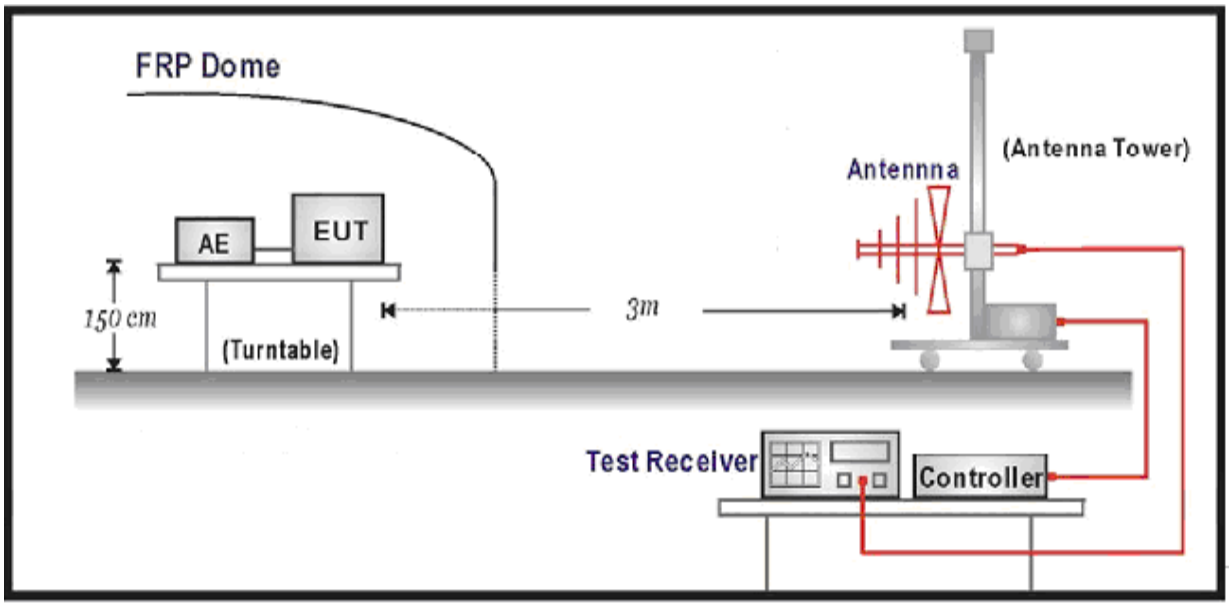
13. RECEIVER SPURIOUS EMISSIONS

13.1. Limit

Spurious emissions limits for receivers		
Frequency Range	Maximum power E.R.P. (≤ 1GHz) E.I.R.P. (> 1GHz)	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12.75 GHz	-47 dBm	1 MHz

13.2. Test Setup

For Radiated Measurement



13.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.11

Step 1:

The sensitivity of the spectrum analyser should be such that the noise floor is at least 12 dB below the limits given in tables 2 or 5.

Step 2:

The emissions over the range 30 MHz to 1 000 MHz shall be identified.

Spectrum analyser settings:

• Resolution bandwidth: 100 kHz
• Video bandwidth: 300 kHz
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ≥ 19400
• Sweep time: Auto

Allow the trace to stabilize. Any emissions identified during the sweeps above and that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.3.11.2.1.3 and compared to the limits given in tables 2 or 5.

Step 3:

The emissions over the range 1 GHz to 12,75 GHz shall be identified.

Spectrum analyser settings:

• Resolution bandwidth: 1 MHz
• Video bandwidth: 3 MHz
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ≥ 23500
• Sweep time: Auto

Allow the trace to stabilize. Any emissions identified during the sweeps above that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.3.11.2.1.3 and compared to the limits given in tables 2 or 5. Frequency Hopping equipment may generate a block (or several blocks) of spurious emissions anywhere within the spurious domain. If this is the case, only the highest peak of each block of emissions shall be measured using the procedure in clause 5.3.11.2.1.3.

Step 4:

• In case of conducted measurements on smart antenna systems (equipment with multiple receive chains), the steps 2 and 3 need to be repeated for each of the active receive chains (Ach).The limits used to identify emissions during this pre-scan need to be reduced with 10 × log10 (Ach) (number of active receive chains).

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13.4. Test Result

Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Receiver spurious emissions(Radiated Measurement)
Test Mode	:	Mode 4: Receive by DH1

Frequency (MHz)	Polarization (H/V)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector
Channel 0 (2402MHz)					
174.15	H	-71.73	-57.00	-14.73	PK
201.13	V	-71.06	-57.00	-14.06	PK
977.13	H	-69.07	-57.00	-12.07	PK
910.23	V	-71.59	-57.00	-14.59	PK
1371.18	H	-57.52	-47.00	-10.52	PK
1600.69	V	-60.18	-47.00	-13.18	PK
2389.05	H	-61.72	-47.00	-14.72	PK
2711.75	V	-57.72	-47.00	-10.72	PK
Channel 78 (2480MHz)					
195.31	H	-67.73	-57.00	-10.73	PK
211.20	V	-70.36	-57.00	-13.36	PK
857.89	H	-69.16	-57.00	-12.16	PK
986.03	V	-69.80	-57.00	-12.80	PK
1723.40	H	-61.24	-47.00	-14.24	PK
1638.59	V	-57.72	-47.00	-10.72	PK
2463.49	H	-61.09	-47.00	-14.09	PK
2413.73	V	-58.58	-47.00	-11.58	PK

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Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Receiver spurious emissions(Conducted Measurement)
Test Mode	:	Mode 4: Receive by DH1

Frequency(MHz)	Measure Level(dBm)	Limit(dBm)	Margin(dB)	Detector
Channel 0 (2402MHz)				
284.18	-68.00	-57.00	-11.00	PK
923.04	-69.78	-57.00	-12.78	PK
1386.29	-58.48	-47.00	-11.48	PK
2578.18	-58.00	-47.00	-11.00	PK
Channel 78 (2480MHz)				
199.53	-68.58	-57.00	-11.58	PK
909.08	-69.78	-57.00	-12.78	PK
1435.70	-57.03	-47.00	-10.03	PK
2562.48	-60.23	-47.00	-13.23	PK

Note: All modulations of EUT have been tested and only record the worst data in the report.

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14. RECEIVER BLOCKING

14.1. Limit

Adaptive Frequency Hopping equipment shall comply with the requirements defined in clause 4.3.1.12.4

Table 6: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-53	CW
P_{min} + 6 dB	2 300 2 330 2 360	-47	CW
P_{min} + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW
NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Table 7: Receiver Blocking parameters receiver category 2 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

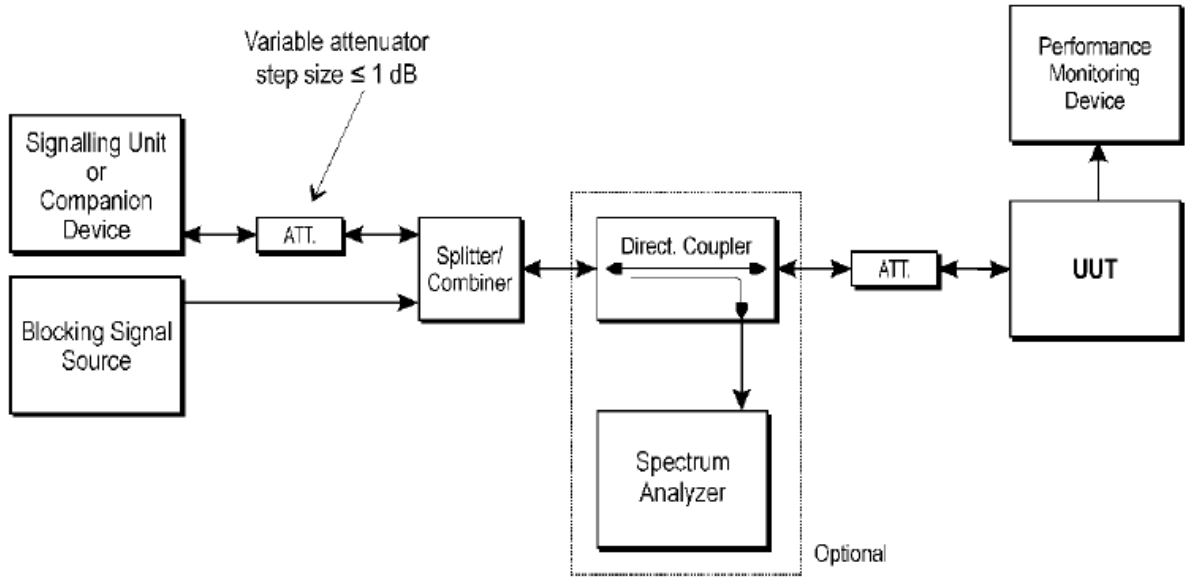
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Table 8: Receiver Blocking parameters receiver category 3 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 12 dB	2 380 2 503,5	-57	CW
P_{min} + 12 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

14.2. Test Setup

Conducted measurements



14.3. Test Procedure

Step 1:

• For non-frequency hopping equipment, the UUT shall be set to the lowest operating channel.

Step 2:

• The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding to the receiver category and type of equipment.

Step 3:

• With the blocking signal generator switched off, a communication link is established between the UUT and the associated companion device using the test setup shown in figure 6. The attenuation of the variable attenuator shall be increased in 1 dB steps to a value at which the minimum performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still met. The resulting level for the wanted signal at the input of the UUT is Pmin.

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• This signal level (Pmin) is increased by the value provided in the table corresponding to the receiver category and type of equipment.

Step 4:

• The blocking signal at the UUT is set to the level provided in the table corresponding to the receiver category and type of equipment. It shall be verified and recorded in the test report that the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is met.

Step 5:

• Repeat step 4 for each remaining combination of frequency and level for the blocking signal as provided in the table corresponding to the receiver category and type of equipment.

Step 6:

• For non-frequency hopping equipment, repeat step 2 to step 5 with the UUT operating at the highest operating channel.

14.4. Test Result

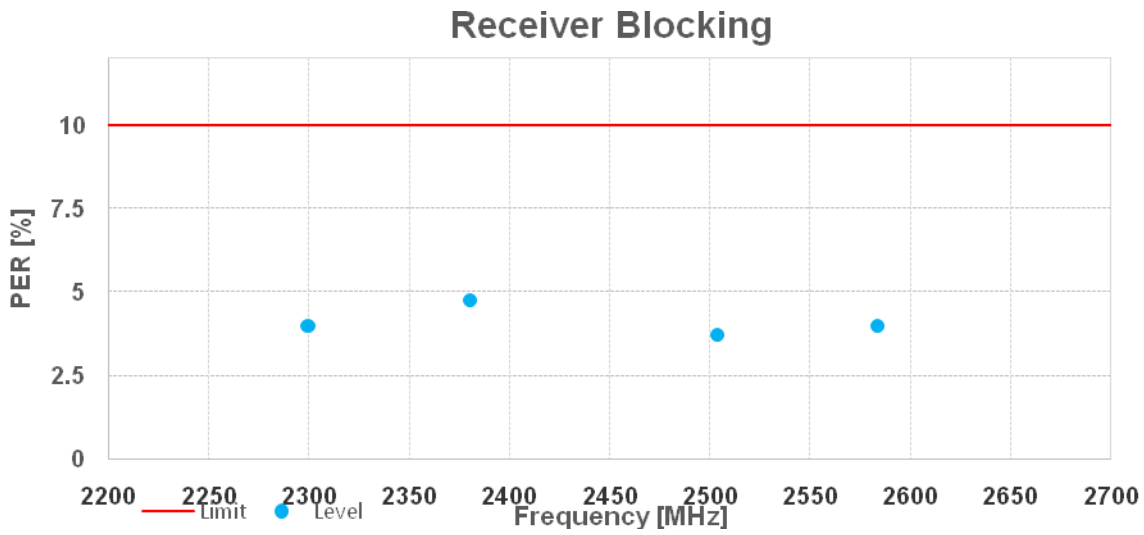
Product	:	LTE GSM/WCDMA Smartphone
Test Item	:	Receiver spurious emissions(conducted)
Test Mode	:	Receiving
Test Environment	:	25℃ 43.5%RH

Wanted signal mean power from companion device (dBm)	Test mode	Test channel (MHz)	Blocking signal frequency (MHz)	Pmin	Blocking signal power (dBm)		Type of blocking signal	PER(%)		Test Result
					Test Value	Limit		Test Value	Limit	
Pmin + 6 dB	DH1	2402	2380	-88	-32	≥-57	CW	3.98	10	Pass
			2503.5	-88	-30	≥-57	CW	4.76	10	Pass
			2300	-88	-23	≥-47	CW	3.73	10	Pass
			2583.5	-88	-23	≥-47	CW	4.00	10	Pass
		2480	2380	-89	-18	≥-57	CW	3.19	10	Pass
			2503.5	-89	-26	≥-57	CW	4.27	10	Pass
			2300	-89	-19	≥-47	CW	4.33	10	Pass
			2583.5	-89	-19	≥-47	CW	4.06	10	Pass
	2DH1	2402	2380	-87	-27	≥-57	CW	4.27	10	Pass
			2503.5	-87	-31	≥-57	CW	4.49	10	Pass
			2300	-87	-19	≥-47	CW	3.04	10	Pass
			2583.5	-87	-24	≥-47	CW	3.17	10	Pass
		2480	2380	-88	-20	≥-57	CW	3.01	10	Pass
			2503.5	-88	-27	≥-57	CW	4.47	10	Pass
			2300	-88	-24	≥-47	CW	4.48	10	Pass
			2583.5	-88	-16	≥-47	CW	3.02	10	Pass
	3DH1	2402	2380	-88	-27	≥-57	CW	4.63	10	Pass
			2503.5	-88	-30	≥-57	CW	3.54	10	Pass
			2300	-88	-20	≥-47	CW	4.99	10	Pass
			2583.5	-88	-22	≥-47	CW	3.13	10	Pass

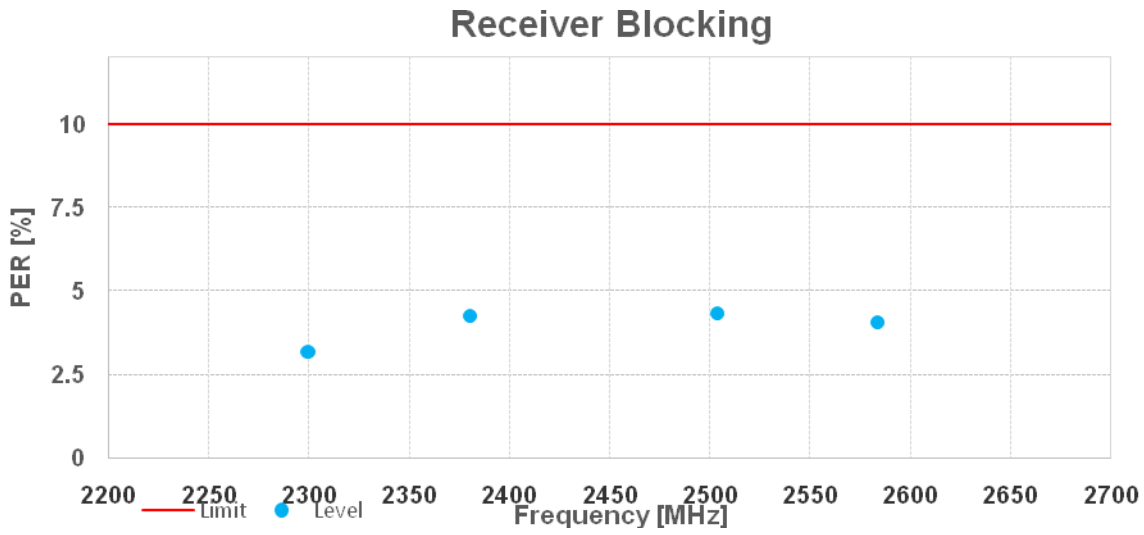
		2480	2380	-87	-24	⩾-57	CW	3.62	10	Pass
			2503.5	-87	-27	⩾-57	CW	3.81	10	Pass
			2300	-87	-19	⩾-47	CW	3.34	10	Pass
			2583.5	-87	-22	⩾-47	CW	4.77	10	Pass

TEST PLOT

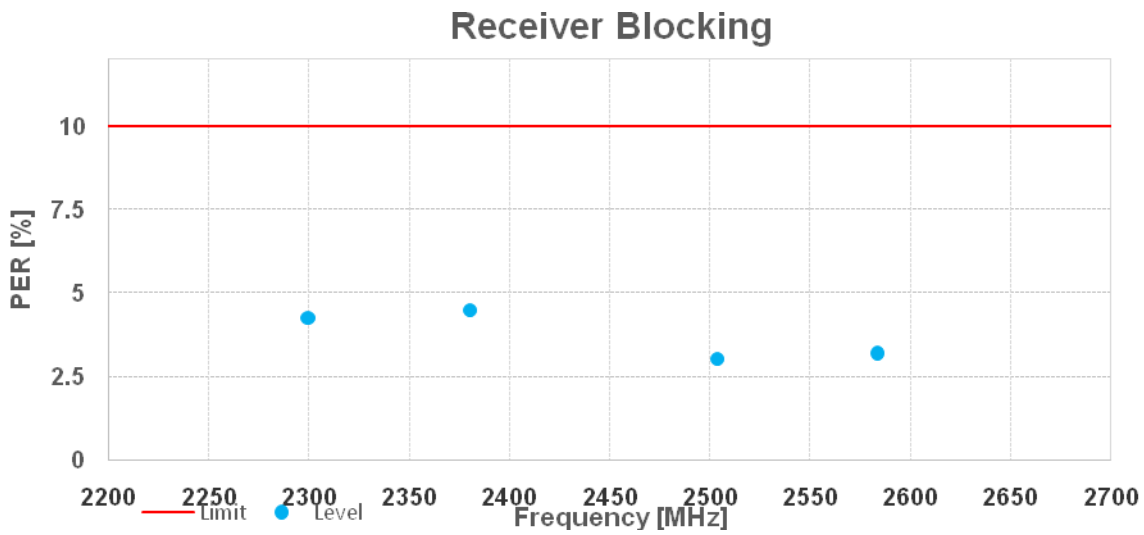
Receiver Blocking_DH1_2402



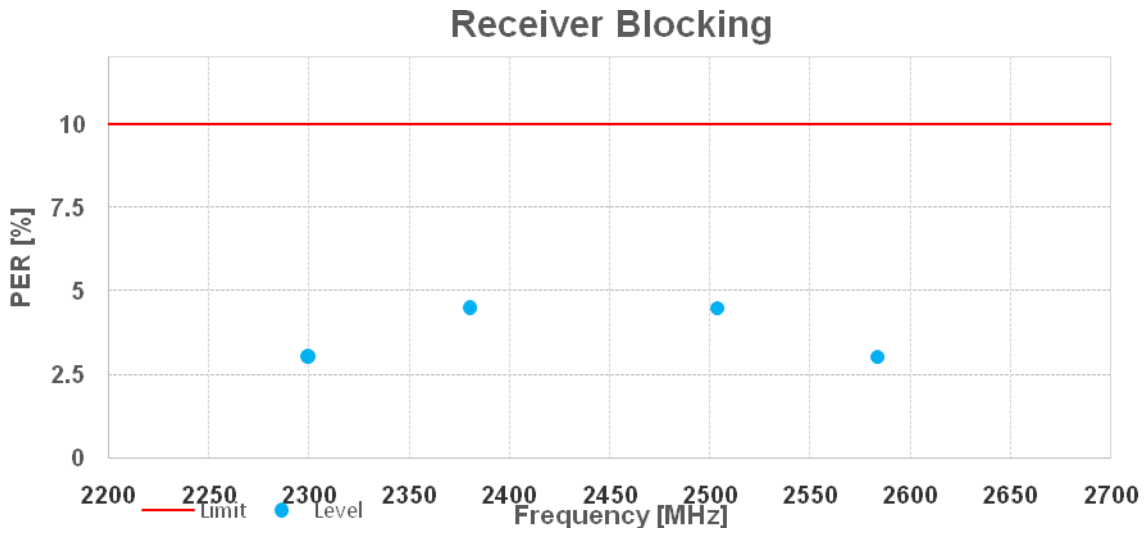
Receiver Blocking_DH1_2480



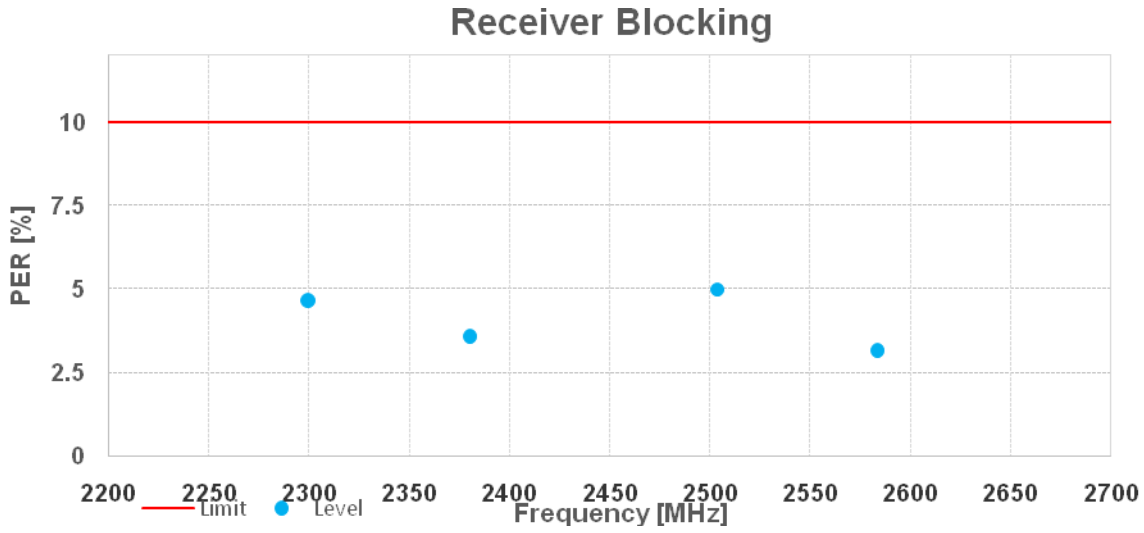
Receiver Blocking_2DH1_2402



Receiver Blocking_2DH1_2480

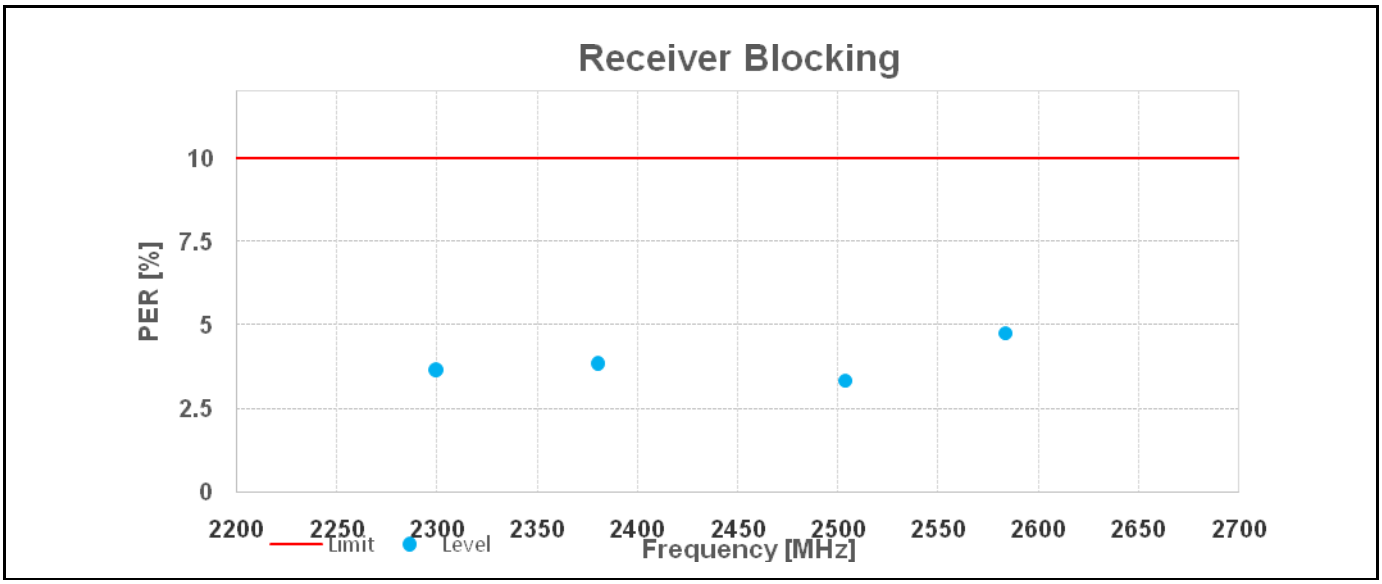


Receiver Blocking_3DH1_2402

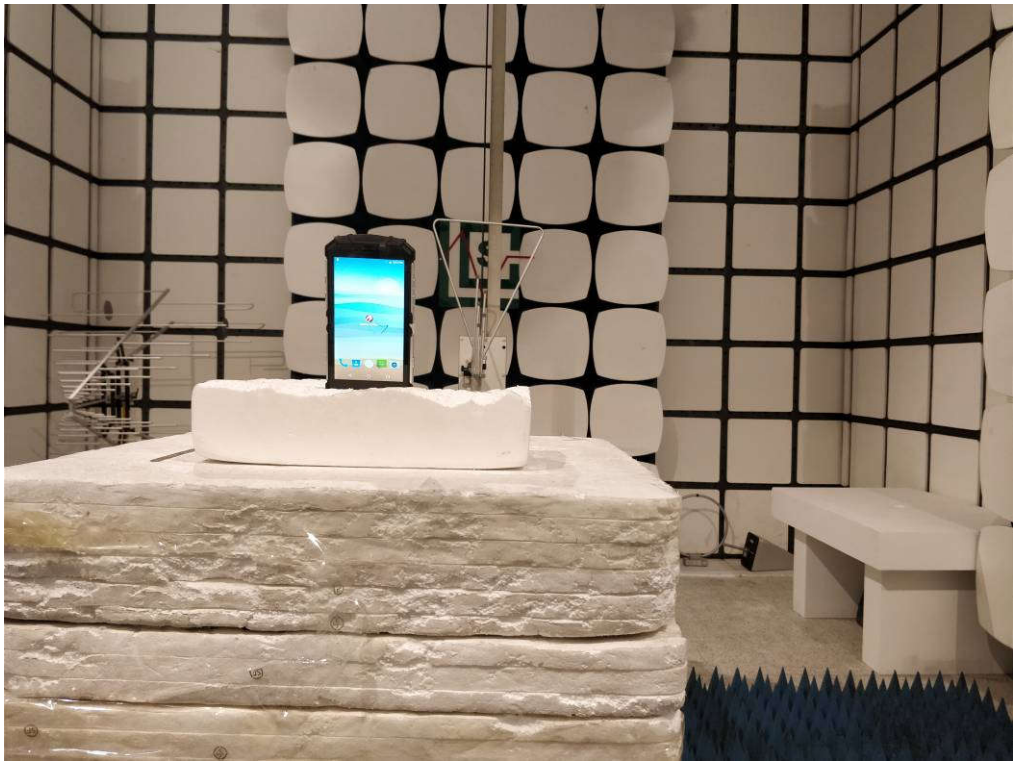


Receiver Blocking_3DH1_2480

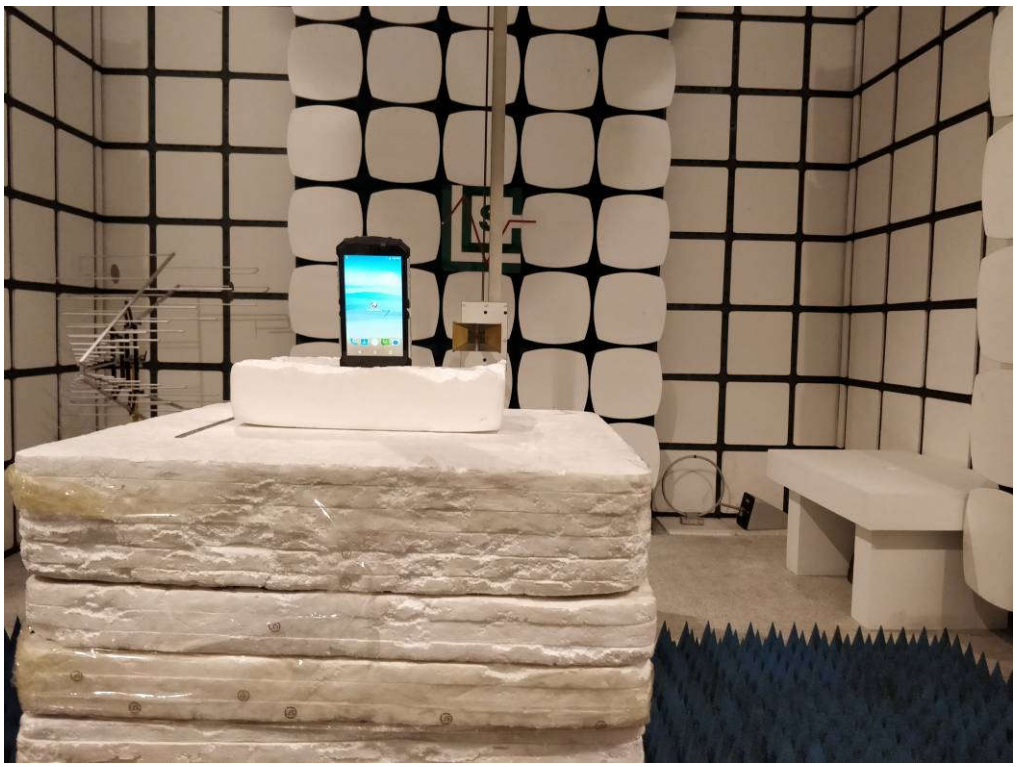
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Receiver Blocking
PER [%]
10
7.5
5
2.5
0
2200
2250
2300
2350
2400
2450
2500
2550
2600
2650
2700
Limit
Level
Frequency [MHz]

15. PHOTOGRAPHS OF TEST SETUP



Spurious Emission below 1GHz



Spurious Emission above 1GHz

----------THE END OF REPORT----------

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