EN 300 328 V2.2.2

TEST REPORT

For

WIFI+BT Module

MODEL NUMBER: WCT2GM2511

REPORT NUMBER: 4790119556.2-6

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Prepared for

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Prepared by

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Revision History

Rev.	Issue Date	Revisions	Revised By
V0	10/11/2021	Initial Issue	

Summary of Test Results			
Clause	Test Item	Limit/ Requirements	Results
TRANSMITTER PARAMETERS			
4.3.2.2	RF Output Power	20 dBm	Pass
4.3.2.3	Power Spectral Density	10 dBm/MHz	Pass
4.3.2.4	Duty cycle, Tx-Sequence, Tx-Gap	The Duty Cycle ≤ the maximum value declared by the manufacturer. Tx-Sequence ≤ 10 ms Tx-gap ≤ 3.5 ms	N/A (Note 2)
4.3.2.5	Medium Utilization (MU) factor	Less than 10 %	N/A (Note 2)
4.3.2.6	Adaptivity	Refer to ETSI EN 300 328 V2.2.2 Clause 4.3.2.6.2.2 & 4.3.2.6.2.3 & 4.3.2.6.2.4	N/A (Note 1)
4.3.2.7	Occupied Channel Bandwidth	Within the band given in table 1	Pass
4.3.2.8	Transmitter unwanted emission in the OOB domain	Refer to ETSI EN 300 328 V2.2.2 Figure 3	Pass
4.3.2.9	Transmitter unwanted emissions in the spurious domain	Refer to ETSI EN 300 328 V2.2.2 Table 12	Pass
RECEIVER PARAMETERS			
4.3.2.10	Receiver Spurious Emissions	Refer to ETSI EN 300 328 V2.2.2 Table 13	Pass
4.3.2.11	Receiver Blocking	Refer to ETSI EN 300 328 V2.2.2 Clause 4.3.2.11.4	Pass
4.3.2.12	Geo-location capability	Refer to ETSI EN 300 328 V2.2.2 Clause 4.3.2.12.3	Not Support

Note:
1. N/A means not applicable.
2. These requirements do not apply for equipment with a declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.
3. This requirement does not apply to adaptive non-FHSS equipment unless operating in a non-adaptive mode.
4. This test report is only published to and used by the applicant, and it is not for evidence purpose in China.
5. The measurement result for the sample received is <Pass> according to < EN 300 328 V2.2.2 > when <Accuracy Method> decision rule is applied.

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1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name:	Hui Zhou Gaoshengda Technology Co.,LTD
Address:	No.2,Jin-da Road,Huinan High-tech Industrial Park,Hui-ao Avenue,Huizhou City,Guangdong,China

Manufacturer Information

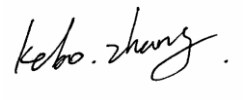
Company Name:	Hui Zhou Gaoshengda Technology Co.,LTD
Address:	No.2,Jin-da Road,Huinan High-tech Industrial Park,Hui-ao Avenue,Huizhou City,Guangdong,China

EUT Information

EUT Name:	WIFI+BT Module
Model:	WCT2GM2511
Brand:	GSD
Sample Received Date:	September 23, 2021
Sample Status:	Normal
Sample ID:	4167750
Date of Tested:	September 23 ~ 30, 2021

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
ETSI EN 300 328 V2.2.2 (2019-07)	**PASS**

Prepared By:



Kebo Zhang
Project Engineer

Checked By:

Shawn Wen
Laboratory Leader

Approved By:

Stephen Guo
Laboratory Manager

2. TEST METHODOLOGY

All tests were performed in accordance with the procedures documented in ETSI EN 300 328 V2.2.2 (2019-07).

3. FACILITIES AND ACCREDITATION

Accreditation Certificate	**A2LA (Certificate No.: 4102.01)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with A2LA. **FCC (FCC Designation No.: CN1187)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. Has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules **ISED (Company No.: 21320)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been registered and fully described in a report filed with Industry Canada. The Company Number is 21320. **VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793. Facility Name: Chamber D, the VCCI registration No. is G-20019 and R-20004 Shielding Room B, the VCCI registration No. is C-20012 and T-20011

Note: All tests measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

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

Test Case	Description	Limit	Uncertainties
5.3.2.2.1.1	RF Output Power	±1.5 dB	1.15
5.3.2.2.1.2	Duty Cycle	±5 %	0.03
	Tx Sequence	±5 %	0.03
	Tx Gap	±5 %	0.03
5.3.2.2.1.3	Medium Utilisation	±5 %	0.10
5.3.3.2.1	Power Spectral Density	±3 dB	1.21
5.3.4.2.1	Accumulated Dwell Time	±5 %	0.05
	Minimum Frequency Occupation Time	±5 %	0.15
5.3.5.2.1	Hopping Frequency Separation	-	0.24
5.3.8.2.1	Occupied Channel Bandwidth	±5 %	1.71
5.3.9..2.1	Out-of-band emissions	±3 dB	1.39
5.3.10.2.1	Transmitter unwanted emissions in the spurious domain		
	30 MHz to 1 GHz	±3 dB	0.64
	1 GHz to 12.75GHz	±3 dB	1.68
5.3.11.2.1	Receiver Spurious emission		
	30 MHz to 1 GHz	±3 dB	0.64
	1 GHz to 12.75GHz	±3 dB	1.68

Test Item	Uncertainty
Uncertainty for Radiation Emission test	4.62 dB (30 MHz-1 GHz)
	3.50 dB (1 GHz-18 GHz)
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k=2.	

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT Name	WIFI+BT Module	
Model	WCT2GM2511	
Technology	*Bluetooth* - Low Energy	
Transmit Frequency Range	2402 MHz ~ 2480 MHz	
Modulation	GFSK	
Data Rate	GFSK	1 Mbps
	GFSK	2Mbps
Ratings	DC 5 V	

5.2. RECEIVER CATEGORY

EUT belong to	Receiver category	Relevant receiver clauses
☐	1	Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p.
☒	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.
☐	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.

5.3. CHANNEL LIST

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	11	2424	22	2446	33	2468
1	2404	12	2426	23	2448	34	2470
2	2406	13	2428	24	2450	35	2472
3	2408	14	2430	25	2452	36	2474
4	2410	15	2432	26	2454	37	2476
5	2412	16	2434	27	2456	38	2478
6	2414	17	2436	28	2458	39	2480
7	2416	18	2438	29	2460	/	/
8	2418	19	2440	30	2462	/	/
9	2420	20	2442	31	2464	/	/
10	2422	21	2444	32	2466	/	/

5.4. MAXIMUM AVERAGE EIRP

Test Mode	Frequency (MHz)	Channel Number	Max AVG EIRP (dBm)
GFSK(1Mbps)	2402 ~ 2480	0-39[40]	9.28
GFSK(2Mbps)	2402 ~ 2480	0-39[40]	9.57

5.5. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel	Frequency
GFSK(1Mbps)	CH 0(Low Channel), CH 19(MID Channel), CH 39(High Channel)	2402 MHz, 2440 MHz, 2480 MHz
GFSK(2Mbps)	CH 0(Low Channel), CH 19(MID Channel), CH 39(High Channel)	2402 MHz, 2440 MHz, 2480 MHz

5.6. THE WORSE CASE POWER SETTING PARAMETER

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band				
Test Software Version		WCN_Combo_Tool		
Modulation Type	Test Software setting value	Test Software setting value		
		CH 0	CH 19	CH 39
GFSK(1Mbps)	1	Defult	Defult	Defult
GFSK(2Mbps)	1	Defult	Defult	Defult

5.7. DESCRIPTION OF AVAILABLE ANTENNAS

Antenna	Frequency (MHz)	Antenna Type	MAX Antenna Gain (dBi)
1	2402-2480	PCB	2

Test Mode	Transmit and Receive Mode	Description
GFSK(1Mbps)	☒1TX, 1RX	Antenna 1 can be used as transmitting/receiving antenna.
GFSK(2Mbps)	☒1TX, 1RX	Antenna 1 can be used as transmitting/receiving antenna.
Note: 1.BT&WLAN 2.4G, BT & WLAN 5G, WLAN 2.4G & WLAN 5G can't transmit simultaneously. (declared by client)		

Note: The value of the antenna gain was declared by customer.

5.8. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	Remarks
1	Laptop	Lenovo	XIAOXIN 5000	/
2	UART	/	/	/

I/O CABLES

Cable No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
1	USB	N/A	N/A	1	N/A

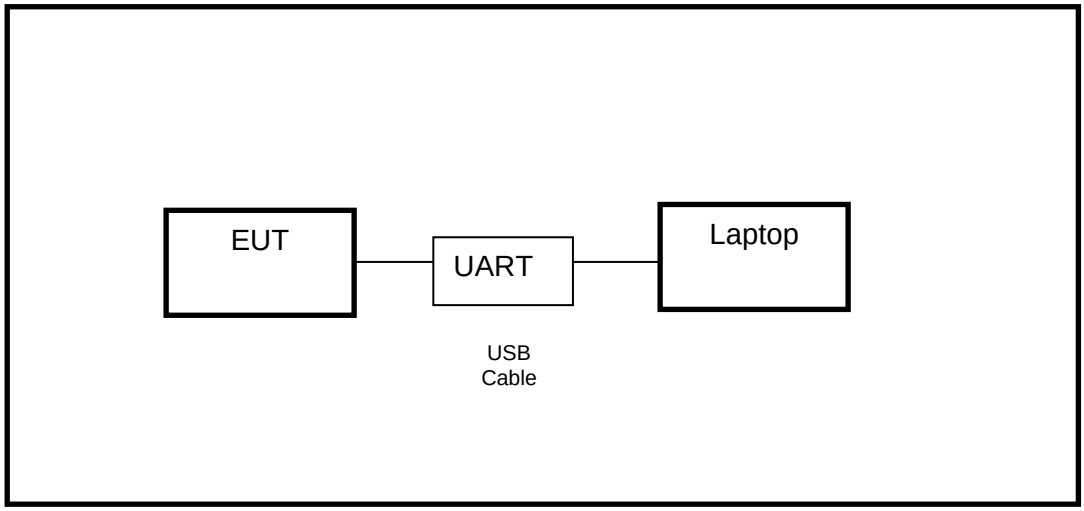
ACCESSORIES

Item	Accessory	Brand Name	Model Name	Description
1	/	/	/	/

TEST SETUP

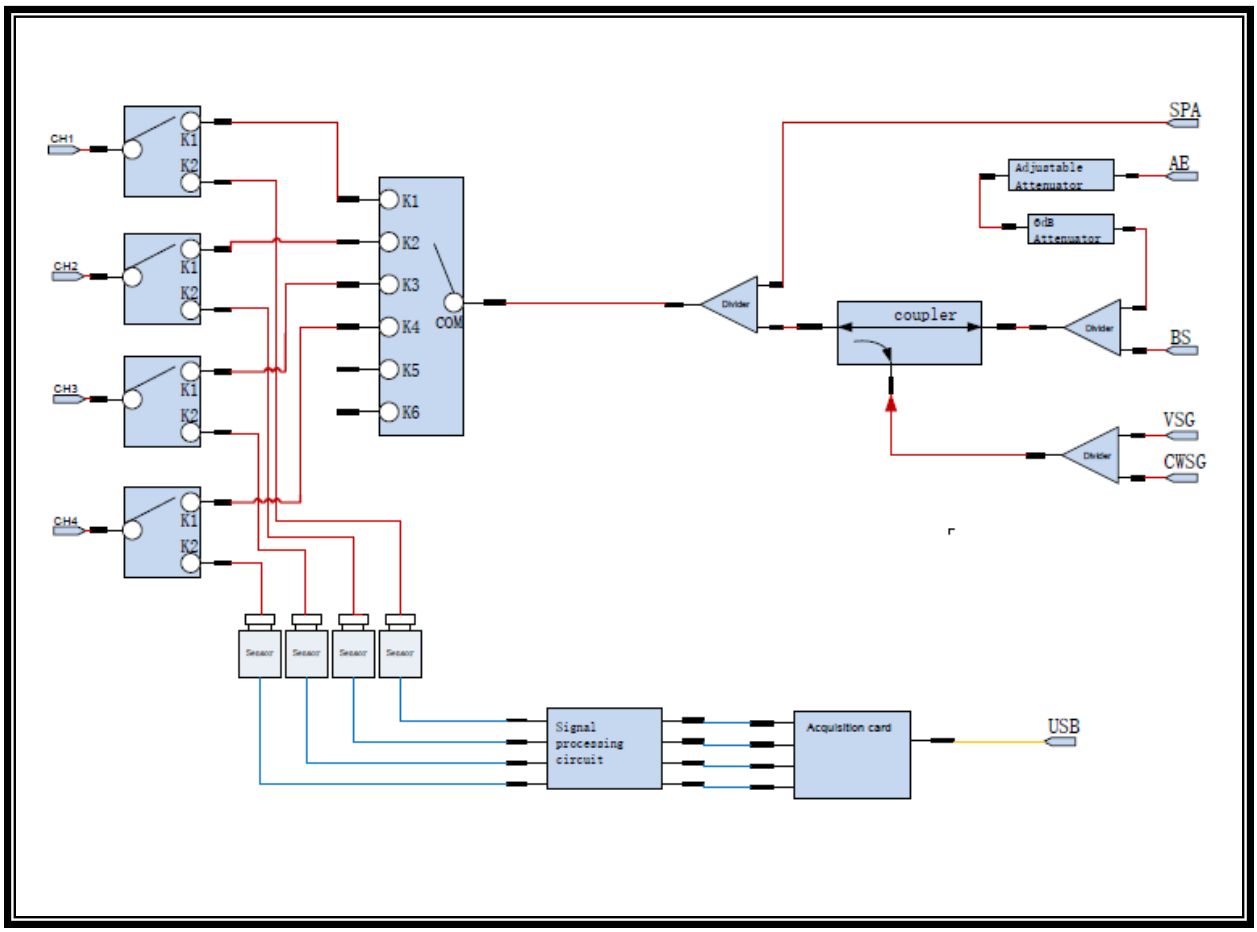
The EUT can work in engineering mode with a software through a Laptop.

SETUP DIAGRAM FOR TESTS



5.9. TEST SYSTEM CONFIGURATION

Tonsend SRD Test System



5.10. DESCRIPTION OF THE EQUIPMENT UNDER TESTED

(INFORMATION AS REQUIRED BY EN 300 328 V2.2.2, CLAUSE 5.4.1)

a)	**Modulation Type**		
	☐ FHSS		
	☒ non-FHSS		
b)	FHSS Equipment Description		
	The Number of Hopping Frequencies	The Maximum	/
		The Minimum	/
	The (average) dwell time	/	
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)	**Adaptive Equipment Description**		
	The maximum Channel Occupancy Time implemented by the equipment	/	
	☒ The equipment has implemented an LBT mechanism		
	☐ The equipment has implemented a DAA mechanism		
	☐ The equipment can operate in more than one adaptive mode		
e)	**The different transmit operating modes**		
	☒ Operating mode 1 (single antenna)	☒ Equipment with only one antenna	
		☐ Equipment with two diversity antennas but only one antenna active at any moment in time	
		☐ Smart Antenna Systems with two or more antennas, but operating in a (legacy) mode where only one antenna is used (e.g. IEEE 802.11™ 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™ legacy mode)	
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1	
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2	
	☐ Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming	☐ Single spatial stream/Standard throughput (e.g. IEEE 802.11™ legacy mode)	
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1	
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2	
f)	**In case of Smart Antenna Systems**		
	The number of Receive chains		1
	The number of Transmit chains		1
	In case of beam forming, the maximum (additional) beam forming gain:		/
g)	**Operating Frequency Range(s) of the equipment**		
	Operating Frequency Range	2402 MHz to 2480 MHz	
h)	**Nominal Channel Bandwidth(s)**		
	Occupied Channel Bandwidth	2.0812 MHz	

<table>
<tr><td>i)</td><td colspan="8">Type of Equipment</td></tr>
<tr><td></td><td colspan="8">☒Stand-Alone</td></tr>
<tr><td></td><td colspan="8">☐ Plug-in radio Equipment</td></tr>
<tr><td></td><td colspan="8">☐ Combined Equipment</td></tr>
<tr><td>j)</td><td colspan="8">The extreme operating conditions that apply to the equipment</td></tr>
<tr><td></td><td colspan="2">Operating temperature range</td><td colspan="6">0 °C to 70 °C</td></tr>
<tr><td>k)</td><td colspan="8">The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels</td></tr>
<tr><td></td><td>Antenna Type</td><td colspan="2">☐ Integral Antenna</td><td>Antenna Gain</td><td colspan="4"></td></tr>
<tr><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5">☒ Dedicated Antennas (equipment with antenna connector)</td><td rowspan="3">☒Single power level with corresponding antenna(s)</td><td rowspan="3">Gain</td><td>ANT1</td><td>2 dBi</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="2">☐Multiple power settings and corresponding antenna(s)</td><td>Power Level 1</td><td></td></tr>
<tr><td>Power Level 2</td><td></td></tr>
<tr><td>Power Level 3</td><td></td></tr>
<tr><td>l)</td><td colspan="8">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:</td></tr>
<tr><td></td><td rowspan="3">Details provided are for the</td><td colspan="7">☒ Testing of stand-alone equipment</td></tr>
<tr><td></td><td colspan="7">☐ Combined equipment</td></tr>
<tr><td></td><td colspan="7">☐ Test jig</td></tr>
<tr><td></td><td>Supply Voltage</td><td colspan="2">☐ AC mains</td><td colspan="2">State AC voltage</td><td colspan="2"></td></tr>
<tr><td></td><td></td><td>☒ DC</td><td>State DC voltage</td><td colspan="3">☐ Internal Power Supply</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="3">☐ External Power Supply or AC/DC adapter</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="3">☐ Battery</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="3">☒Other</td><td>DC 5 V</td></tr>
<tr><td>m)</td><td colspan="8">The equipment type</td></tr>
<tr><td></td><td colspan="8">☒ Bluetooth®</td></tr>
<tr><td></td><td colspan="8">☐ IEEE 802.11™ [i.3]</td></tr>
<tr><td></td><td colspan="8">☐ Proprietary</td></tr>
<tr><td rowspan="2">n)</td><td colspan="2" rowspan="2">Geo-location capability supported by the equipment</td><td colspan="6">☐ Yes
☐ The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user.</td></tr>
<tr><td colspan="6">☒ No</td></tr>
</table>

6. MEASURING INSTRUMENT AND SOFTWARE USED

Tonsend RF Test System					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due. Date
Wideband Radio Communication Tester	R&S	CMW500	155523	Nov.20,2020	Nov.19,2021
PXA Signal Analyzer	Keysight	N9030A	MY55410512	Nov.20,2020	Nov.19,2021
MXG Vector Signal Generator	Keysight	N5182B	MY56200284	Nov.20,2020	Nov.19,2021
MXG Vector Signal Generator	Keysight	N5172B	MY56200301	Nov.20,2020	Nov.19,2021

Software			
Description	Manufacturer	Name	Version
Tonsend SRD Test System	Tonsend	JS1120-3 RF Test System	2.6.77.0518

RSE Test System					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due. Date
Spectrum Analyzer	R&S	FSV40	101117	Nov.20,2020	Nov.19,2021
Trilog broadband antenna	Schwarzbeck	VULB9163	01061	Feb.28,2020	Feb.28,2023
Horn Antenna	ETS-Lindgren	3117	00213191	Feb.28,2020	Feb.28,2023
Preamplifier	TDK	PA-02-001-3000	TRS-305-00067	Nov.12,2020	Nov.11,2021
Preamplifier	TDK	PA-02-0118	TRS-305-00067	Nov.20,2020	Nov.19,2021
High Gain Horn Antenna	Schwarzbeck	BBHA-9170	697	July 20, 2021	July 19, 2024
Preamplifier	TDK	PA-02-2	TRS-307-00002	Nov.12,2020	Nov.11,2021
Preamplifier	TDK	PA-02-3	TRS-308-00002	Nov.12,2020	Nov.11,2021
Band Reject Filter	Wainwright	WRCJV8-2350-2400-2483.5-2533.5-40SS	4	Nov.12,2020	Nov.11,2021
Highpass Filter	Wainwright	WHKX10-2700-3000-1800-40SS	24	Nov.12,2020	Nov.11,2021

Software			
Description	Manufacturer	Name	Version
For TDK RSE Test System	TDK	TDK Emission lab	V10.81

7. TEST PROCEDURES AND RESULTS

7.1. NORMAL AND EXTREME CONDITIONS

LIMITS

None; for reporting purposes only.

RESULTS

	Normal Test Conditions	Extreme Test Conditions
Relative Humidity	45 % ~ 70 %	N/A
Atmospheric Pressure	100 kPa ~ 102 kPa	N/A
Temperature	NT (Normal Temperature): 22 °C ~ 28 °C	LT(Low Temperature): 0°C
		HT(High Temperature): 70°C
Supply Voltage	NV (Normal Voltage): DC 5 V	N/A
		N/A

7.2. OCCUPIED CHANNEL BANDWIDTH

LIMITS

OCCUPIED CHANNEL BANDWIDTH		
Condition		Limit
All types of equipment		Each hopping frequency shall be within the 2400 to 2483.5 MHz band
Additional requirement	For non-adaptive non-FHSS equipment with e.i.r.p. greater than 10 dBm	Each hopping frequency shall be equal to or less than 20 MHz

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.7

Measurement	
☒Conducted measurement	☐Radiated measurement

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

Center Frequency	The center frequency of the channel under test
Frequency Span	2 × Nominal Channel Bandwidth
Detector	RMS
RBW	~ 1 % of the span without going below 1 %
VBW	3 × RBW
Trace	Max hold
Sweep Time	1s

TEST ENVIRONMENT

Temperature	26.9 °C	Relative Humidity	56.3 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 5 V

RESULTS

Please refer to appendix C.

7.3. RF OUTPUT POWER

LIMIT

RF OUTPUT POWER	
Condition	Limit
☐ Non-adaptive non-FHSS Equipment	For non-adaptive non-FHSS equipment, where the manufacturer has declared an RF output power of less than 20 dBm e.i.r.p., the RF output power shall be equal to or less than that declared value.
☒ Adaptive non-FHSS Equipment	non-FHSS equipment shall be equal to or less than 20 dBm.

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.2

The power sensor was used for power measurement, and it use a fast power sensor with a minimum sensitivity of -40 dBm and capable of minimum 1 MS/s.

The test software was used to control the power detector and the sampling unit.

For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured.

Measurement	
☒Conducted measurement	☐Radiated measurement

CALCULATIONS

Add the (stated) antenna assembly gain G in dBi of the individual antenna.
• In case of smart antenna systems operating in mode with beamforming (see clause 5.3.2.2.4), add the additional beamforming gain Y in dB.
• If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used.
• The RF Output Power (Pout) shall be calculated using the formula below:

$$P_{out} = A + G + Y$$

TEST ENVIRONMENT

Temperature	26.9 °C	Relative Humidity	56.3 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 5 V

RESULTS

Please refer to appendix A.

7.4. POWER SPECTRAL DENSITY

LIMIT

Power Spectral Density	
Condition	Limit
All types of non-FHSS equipment	10 dBm/MHz

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.3

R&S EMC32 software is used to control the spectrum analyzer to use the following settings:

Start Frequency	2400 MHz
Stop Frequency	2483.5 MHz
Detector	RMS
Sweep Point	> 8 350; for spectrum analysers not supporting this number of sweep points, the frequency band may be segmented
RBW	10 kHz
VBW	30 kHz
Trace Mode	Max Hold
Sweep Time	For non-continuous transmissions: 2 × Channel Occupancy Time × number of sweep points For non-adaptive equipment use the maximum TX-sequence time in the formula above instead of the Channel Occupancy Time For continuous transmissions: 10 s; the sweep time may be increased further until a value where the sweep time has no further impact anymore on the RMS value of the signal

The test software acquires the trace data and calculate the Spectral Density in 1MHz.

TEST ENVIRONMENT

Temperature	26.9 °C	Relative Humidity	56.3 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 5 V

RESULTS

Please refer to appendix B.

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

LIMITS

Transmitter Unwanted Emissions in The Out-Of-Band Domain	
Condition	Limit
Under Normal Test Condition	The transmitter unwanted emissions in the out-of-band domain shall not exceed the values provided by the mask in figure 3.

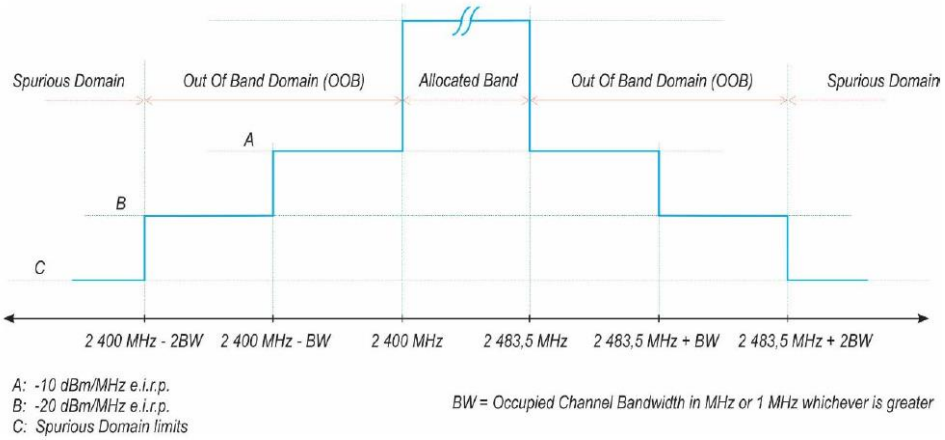


Figure 3: Transmit mask

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.8

Measurement	
☒Conducted measurement	☐Radiated measurement

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

Span	Zero Span
Filter Mode	Channel Filter
Trace Mode	Max Hold
Trigger Mode	Video
Detector	RMS
Sweep Points	Sweep time [µs] / (1 µs) with a maximum of 30 000
RBW / VBW	1MHz / 3MHz
Measurement Mode	Time Domain Power
Sweep Time	> 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

TEST ENVIRONMENT

Temperature	26.9 °C	Relative Humidity	56.3 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 5 V

RESULTS

Please refer to appendix D.

7.6. TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

LIMITS

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 12.
In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and as e.i.r.p. for emissions above 1 GHz.

Table 12: Transmitter limits for spurious emissions

Frequency range	Maximum power	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 694 MHz	-54 dBm	100 kHz
694 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

TEST PROCEDURE

Refer to Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.9

Measurement	
☒Conducted measurement	☒Radiated measurement

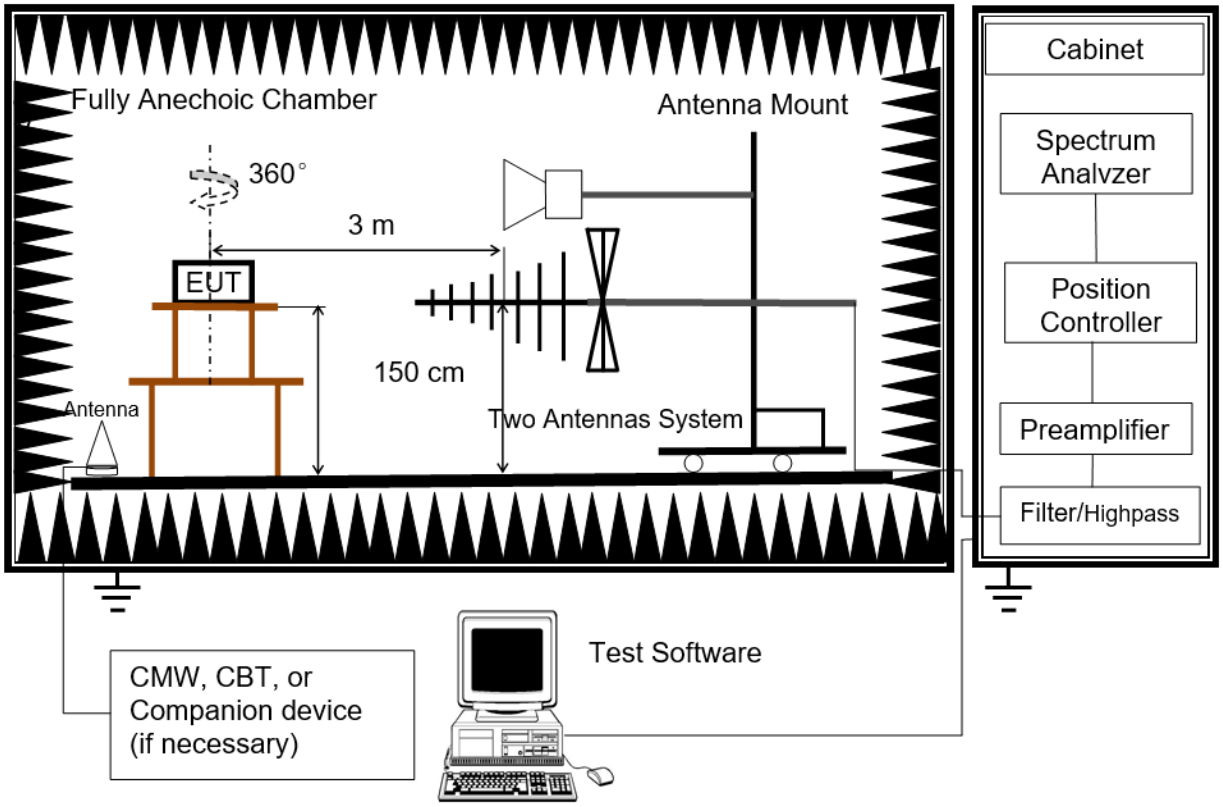
Spectrum analyser settings for pre-scan:

RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Detector Mode	Peak
Filter type	3 dB (Gaussian)
Trace Mode	Max hold
Sweep Points	⩾ 19 400 (< 1 GHz); ⩾ 23 500 (> 1 GHz); for spectrum analysers not supporting this high number of sweep points, the frequency band may 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, on any channel. For FHSS equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies. The above sweep time setting may result in long measuring times in case of FHSS equipment. To avoid such long measuring times, an FFT analyser may be used.

Spectrum analyser settings for the emissions identified during the pre-scan:

Measurement Mode	Time Domain Power
Centre Frequency	Frequency of the emission identified during the pre-scan
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Frequency Span	Zero Span
Sweep Mode	Single Sweep
Detector Mode	RMS
Trace Mode	Max hold
Trigger Mode	Video (burst signals) or Manual (continuous signals)
Sweep Points	Sweep time [µs] / (1 µs) with a maximum of 30 000
Sweep Time	> 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

TEST SETUP



TEST ENVIRONMENT

For Conducted measurement:

Temperature	26.9 °C	Relative Humidity	56.3 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 5 V

For Radiated measurement

Temperature	24.5 °C	Relative Humidity	66 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 5 V

RESULTS

Please refer to appendix E.

7.7. RECEIVER SPURIOUS EMISSIONS

LIMITS

The spurious emissions of the receiver shall not exceed the values given in table 13.
In case of non-FHSS equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or for emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Table 13: Spurious emission limits for receivers

Frequency range	Maximum power	Bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

TEST PROCEDURE

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.10

Measurement	
☒Conducted measurement	☒Radiated measurement

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.10

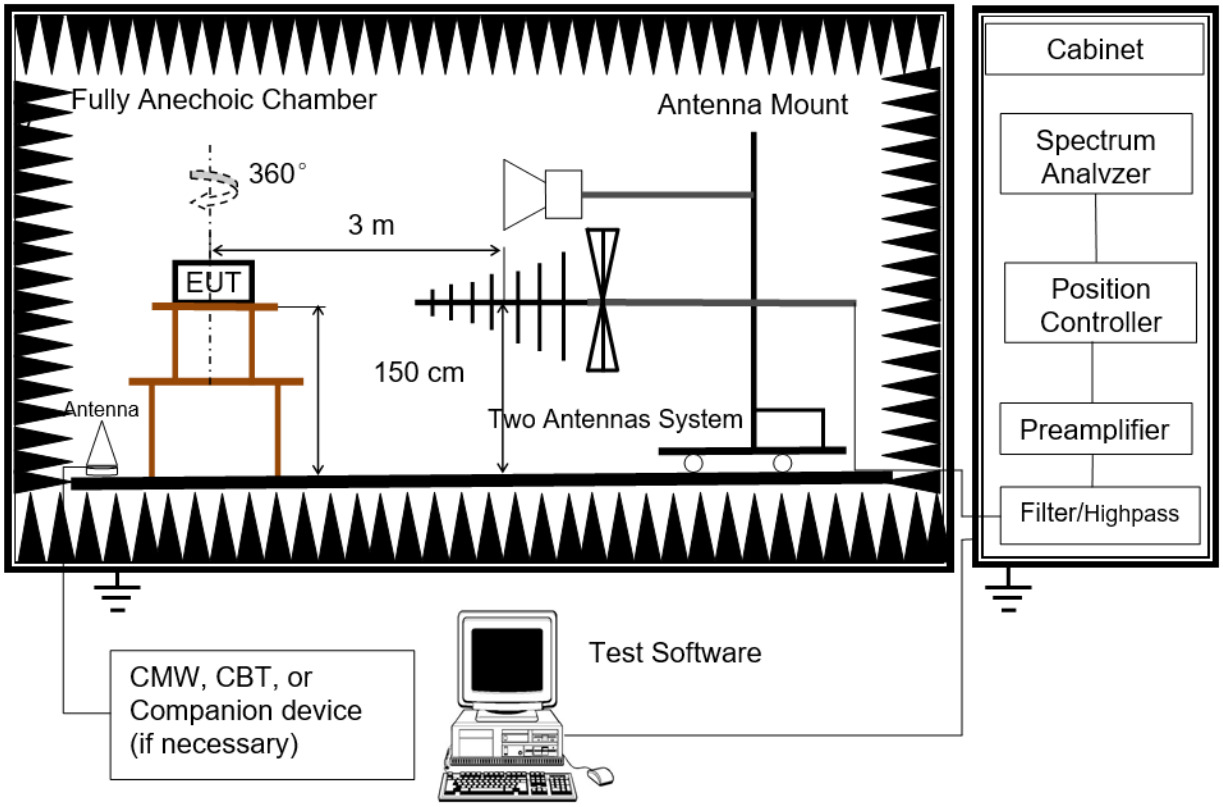
Spectrum analyser settings for pre-scan:

RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Detector Mode	Peak
Filter type	3 dB (Gaussian)
Trace Mode	Max hold
Sweep Points	⩾ 19 400 (< 1 GHz); ⩾ 23 500 (> 1 GHz); for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented.
Sweep Time	Auto

Spectrum analyser settings for the emissions identified during the pre-scan:

Measurement Mode	Time Domain Power
Centre Frequency	Frequency of the emission identified during the pre-scan
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Frequency Span	Zero Span
Sweep Mode	Single Sweep
Detector Mode	RMS
Trace Mode	Max hold
Trigger Mode	Video (burst signals) or Manual (continuous signals)
Sweep Points	⩾ 30 000
Sweep Time	30 ms

TEST SETUP



TEST ENVIRONMENT

For Conducted measurement:

Temperature	26.9 °C	Relative Humidity	56.3 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 5 V

For Radiated measurement

Temperature	24.5 °C	Relative Humidity	66 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 5 V

RESULTS

Please refer to appendix F.

7.8. RECEIVER BLOCKING

LIMITS

Performance Criteria

For equipment that supports a PER or FER test to be performed, the minimum performance criterion shall be a PER or FER less than or equal to 10 %.
For equipment that does not support a PER or a FER test to be performed, the minimum performance criterion shall be no loss of the wireless transmission function needed for the intended use of the equipment.

While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 14, table 15 or table 16.

☐ Receiver Category 1

Table 14: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 4)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
(-133 dBm + 10 × $\log_{10}$(OCBW)) or -68 dBm whichever is less (see note 2)	2 380 2 504	-34	CW
(-139 dBm + 10 × $\log_{10}$(OCBW)) or -74 dBm whichever is less (see note 3)	2 300 2 330 2 360 2 524 2 584 2 674		
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 20 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 4: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

☒ Receiver Category 2

Table 15: Receiver Blocking parameters receiver Category 2 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

☐ Receiver Category 3

Table 16: Receiver Blocking parameters receiver Category 3 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 30 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

TEST PROCEDURE

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.11

Measurement	
☒Conducted measurement	☐Radiated measurement

Step 1:
• For non-FHSS equipment, the UUT shall be set to the lowest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).
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.
• Unless the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the level of the wanted signal shall be set to the value provided in the table corresponding to the receiver category and type of equipment. The test procedure defined in clause 5.4.2, and more in particular clause 5.4.2.2.1.2, can be used to measure the (conducted) level of the wanted signal however no correction shall be made for antenna gain of the companion device (step 6 in clause 5.4.2.2.1.2 shall be ignored). This level may be measured directly at the output of the companion device and a correction is made for the coupling loss into the UUT. The actual level for the wanted signal shall be recorded in the test report.
• When the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, 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. This signal level (Pmin) is increased by the value provided in note 2 of the applicable 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.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 are met then proceed to step 6.
Step 5:
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been increased with a value equal to the Occupied Channel Bandwidth except:
- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been decreased with a value equal to the Occupied Channel Bandwidth except:

- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.

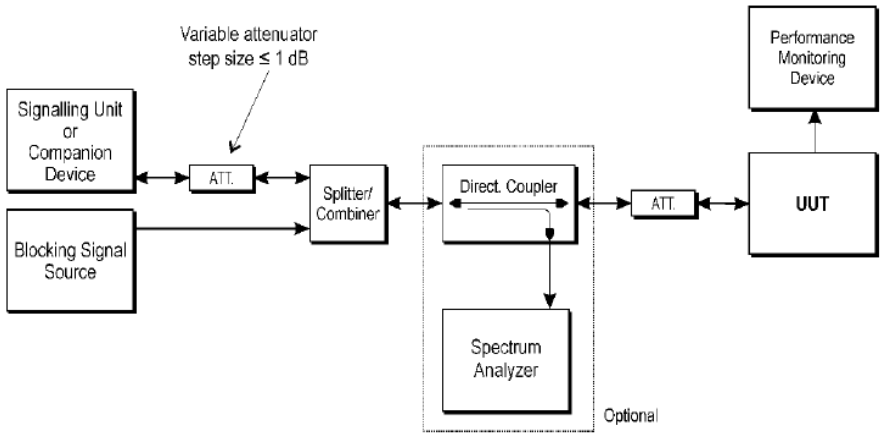
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, the UUT fails to comply with the Receiver Blocking requirement and step 6 and step 7 are no longer required.
• It shall be recorded in the test report whether the shift of blocking frequencies as described in the present step was used.

Step 6:
• Repeat step 4 and step 5 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 7:
• For non-FHSS equipment, repeat step 2 to step 6 with the UUT operating at the highest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).

Step 8:
• It shall be assessed and recorded in the test report whether the UUT complies with the Receiver Blocking requirement.

TEST SETUP



TEST ENVIRONMENT

Temperature	26.9 °C	Relative Humidity	56.3 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 5 V

RESULTS

Please refer to appendix G.

8. GEO-LOCATION CAPABILITY

REQUIREMENTS

Geo-location capability is a feature of the equipment to determine its geographical location with the purpose to configure itself according to the regulatory requirements applicable at the geographical location where it operates.
The geo-location capability may be present in the equipment or in an external device (temporary) associated with the equipment operating at the same geographical location during the initial power up of the equipment. The geographical
location may also be available in equipment already installed and operating at the same geographical location.

GEO-LOCATION CAPABILITY FUNCTION DESCRIBE FOR EUT

Not Support.

CONCLUSION

N/A

9. Appendix

9.1. Appendix A: RF Output Power

9.1.1. Test Result

Test Condition	Test Mode	Antenna	Channel	EIRP[dBm]	Limit[dBm]	Verdict
NTNV	BLE_1M	Ant1	2402	9.10	20	PASS
			2440	9.28	20	PASS
			2480	9.11	20	PASS
	BLE_2M	Ant1	2402	9.37	20	PASS
			2440	9.57	20	PASS
			2480	9.42	20	PASS

Test Condition	Test Mode	Antenna	Channel	EIRP[dBm]	Limit[dBm]	Verdict
LTNV	BLE_1M	Ant1	2402	8.82	20	PASS
			2440	8.97	20	PASS
			2480	8.81	20	PASS
	BLE_2M	Ant1	2402	9.01	20	PASS
			2440	9.13	20	PASS
			2480	9.05	20	PASS

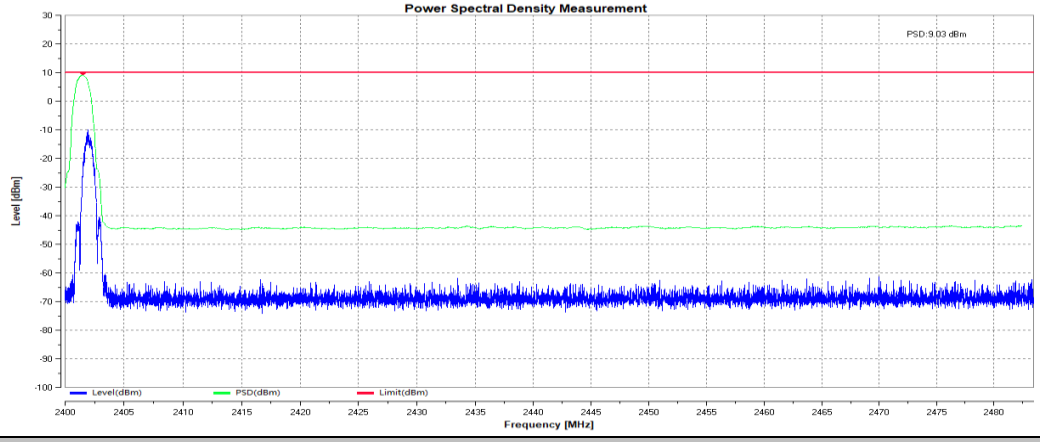
Test Condition	Test Mode	Antenna	Channel	EIRP[dBm]	Limit[dBm]	Verdict
HTNV	BLE_1M	Ant1	2402	8.79	20	PASS
			2440	8.93	20	PASS
			2480	8.77	20	PASS
	BLE_2M	Ant1	2402	9.03	20	PASS
			2440	9.22	20	PASS
			2480	9.11	20	PASS

9.2. Appendix B: Power Spectral Density

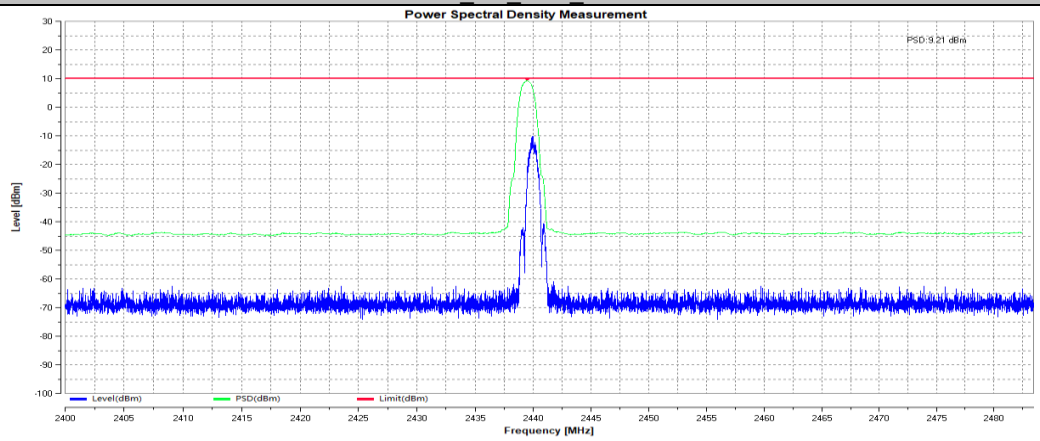
9.2.1. Test Result

Test Mode	Antenna	Channel	PSD[dBm/MHz]	Limit[dBm/MHz]	Verdict
BLE_1M	Ant1	2402	9.03	10	PASS
		2440	9.21	10	PASS
		2480	9.04	10	PASS
BLE_2M	Ant1	2402	8.15	10	PASS
		2440	8.36	10	PASS
		2480	8.20	10	PASS

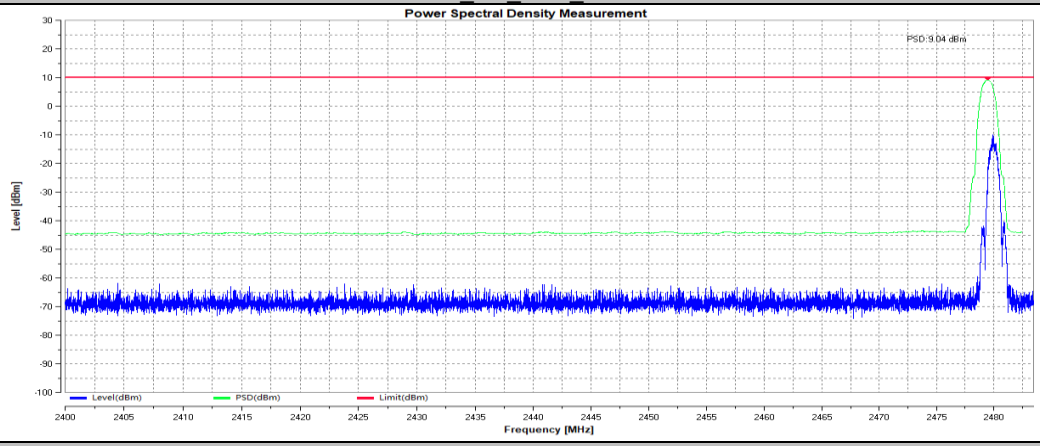
9.2.2. Test Graphs



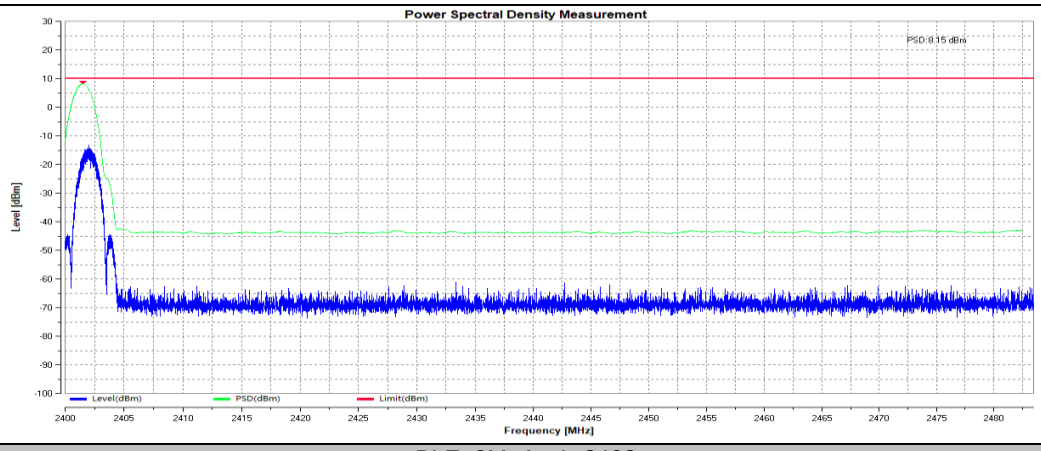
BLE_1M_Ant1_2402



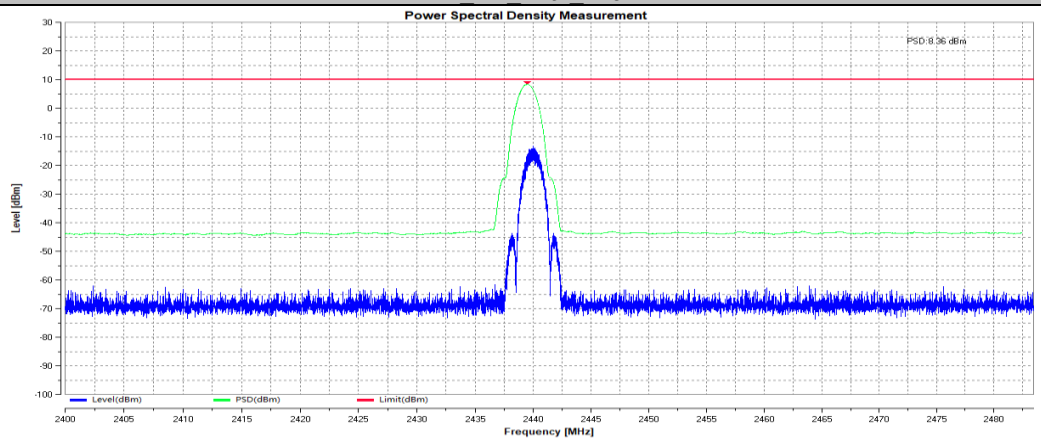
BLE_1M_Ant1_2440



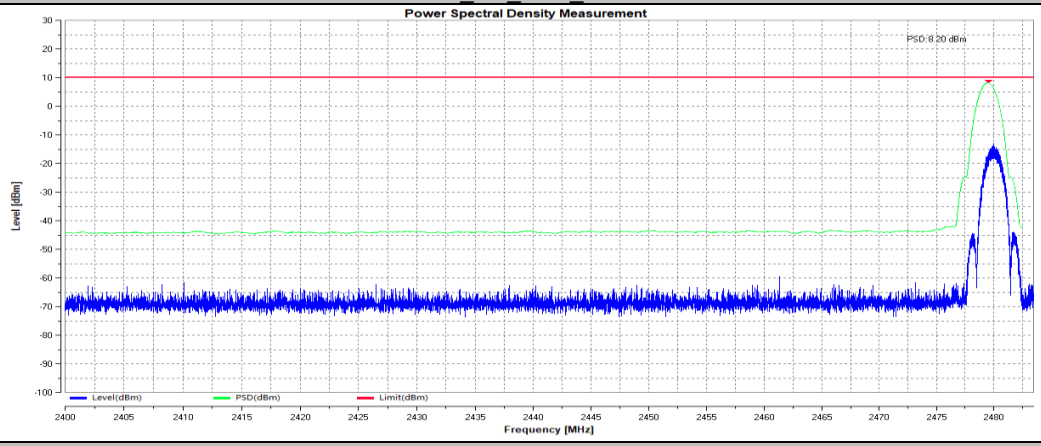
BLE_1M_Ant1_2480



BLE_2M_Ant1_2402



BLE_2M_Ant1_2440



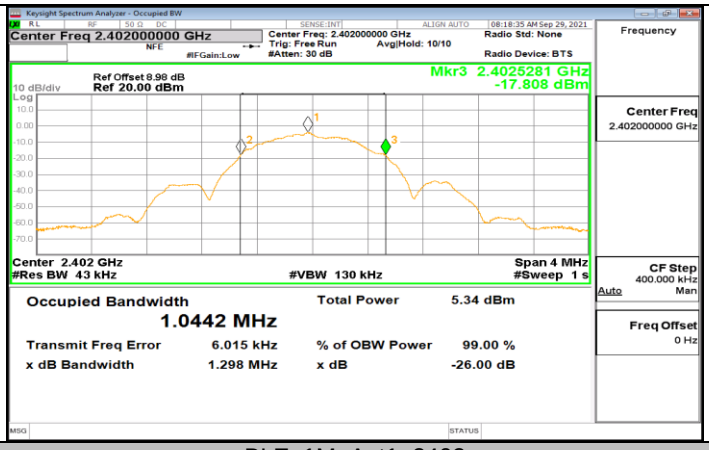
BLE_2M_Ant1_2480

9.3. Appendix C: Occupied Channel Bandwidth

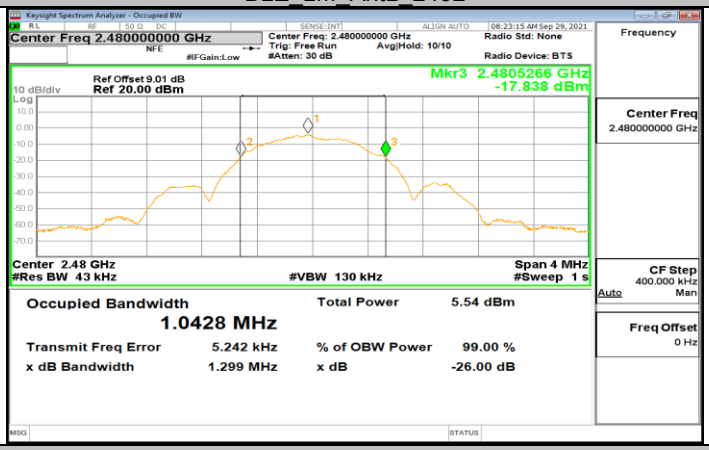
9.3.1. Test Result

Test Mode	Antenna	Channel	OCB[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.0442	2401.4839	2402.5281	2400 to 2483.5	PASS
		2480	1.0428	2479.4838	2480.5266	2400 to 2483.5	PASS
BLE_2M	Ant1	2402	2.0809	2400.9559	2403.0368	2400 to 2483.5	PASS
		2480	2.0812	2478.9545	2481.0357	2400 to 2483.5	PASS

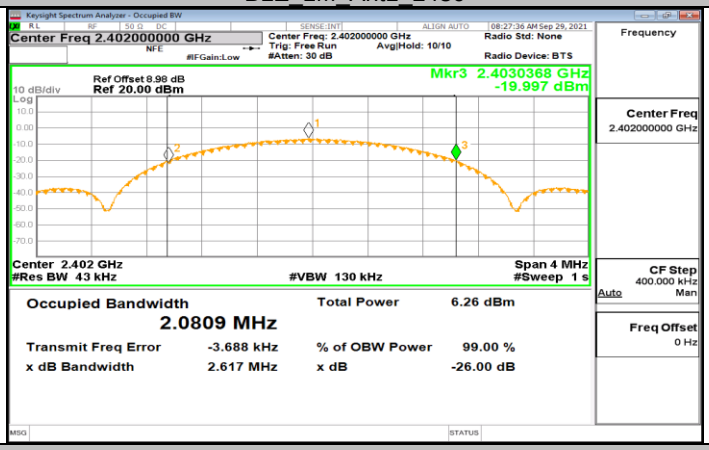
9.3.2. Test Graphs



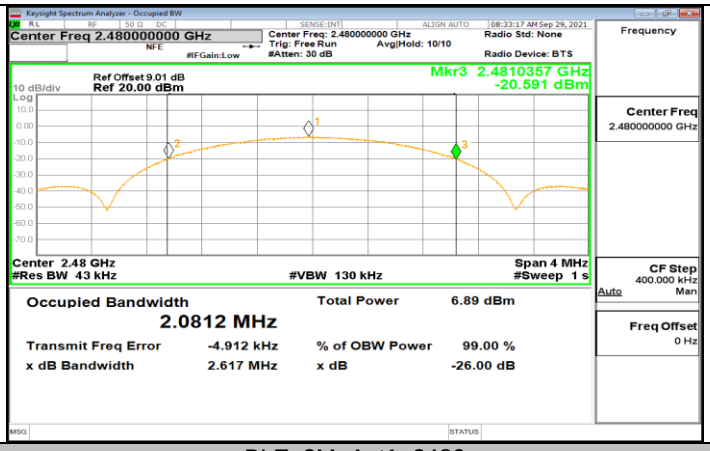
BLE_1M_Ant1_2402



BLE_1M_Ant1_2480



BLE_2M_Ant1_2402



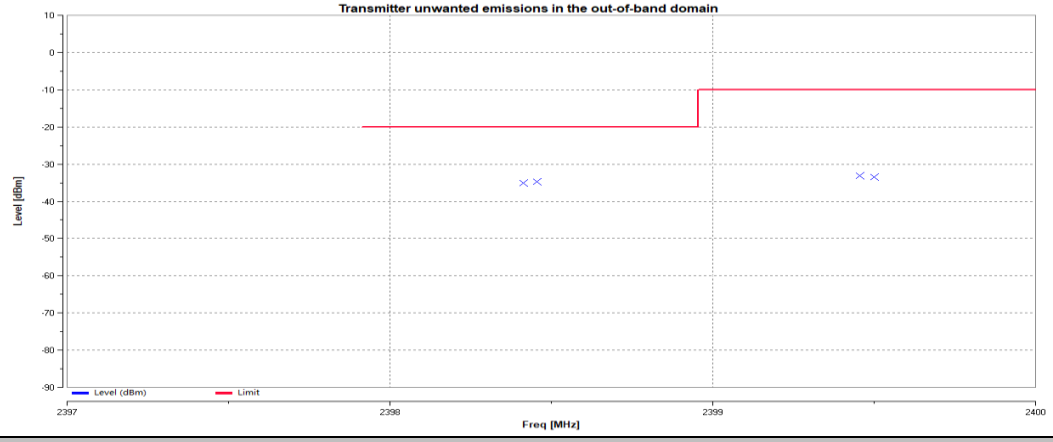
BLE_2M_Ant1_2480

9.4. Appendix D: Transmitter Unwanted Emissions In The Out-Of-BandDomain

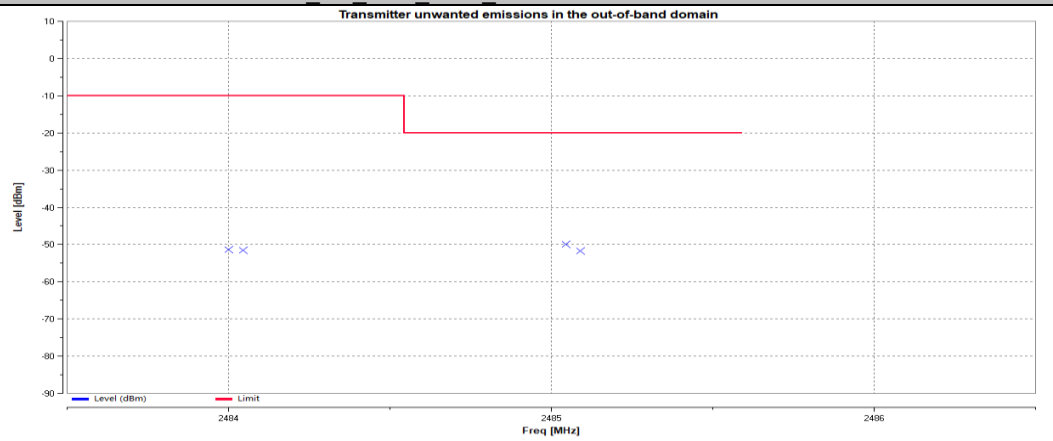
9.4.1. Test Result

Test Mode	Antenna	Channel	Freq. [MHz]	Level[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	2398.4116	-35.01	-20.00	PASS
			2398.4558	-34.68	-20.00	PASS
			2399.4558	-33.06	-10.00	PASS
			2399.5	-33.43	-10.00	PASS
			2484	-51.37	-10.00	PASS
			2484.0442	-51.51	-10.00	PASS
			2485.0442	-49.90	-20.00	PASS
			2485.0884	-51.68	-20.00	PASS
		2480	2398.4144	-52.09	-20.00	PASS
			2398.4572	-51.40	-20.00	PASS
			2399.4572	-51.72	-10.00	PASS
			2399.5	-51.49	-10.00	PASS
			2484	-40.32	-10.00	PASS
			2484.0428	-40.86	-10.00	PASS
			2485.0428	-41.63	-20.00	PASS
			2485.0856	-41.23	-20.00	PASS
BLE_2M	Ant1	2402	2396.3382	-37.22	-20.00	PASS
			2396.4191	-37.57	-20.00	PASS
			2397.4191	-35.83	-20.00	PASS
			2398.4191	-34.31	-10.00	PASS
			2398.5	-33.91	-10.00	PASS
			2399.5	-25.52	-10.00	PASS
			2484	-51.13	-10.00	PASS
			2485	-51.12	-10.00	PASS
			2485.0809	-51.10	-10.00	PASS
			2486.0809	-51.85	-20.00	PASS
			2487.0809	-51.68	-20.00	PASS
			2487.1618	-50.77	-20.00	PASS
		2480	2396.3376	-50.54	-20.00	PASS
			2396.4188	-51.57	-20.00	PASS
			2397.4188	-50.98	-20.00	PASS
			2398.4188	-51.37	-10.00	PASS
			2398.5	-51.85	-10.00	PASS
			2399.5	-51.38	-10.00	PASS
			2484	-41.42	-10.00	PASS
			2485	-41.96	-10.00	PASS
			2485.0812	-43.14	-10.00	PASS
			2486.0812	-41.38	-20.00	PASS
			2487.0812	-43.13	-20.00	PASS
			2487.1624	-42.25	-20.00	PASS

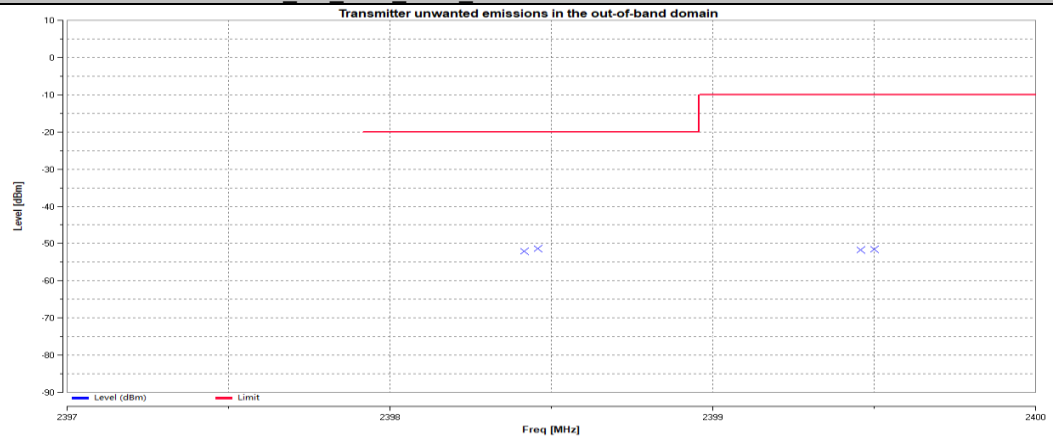
9.4.2. Test Graphs



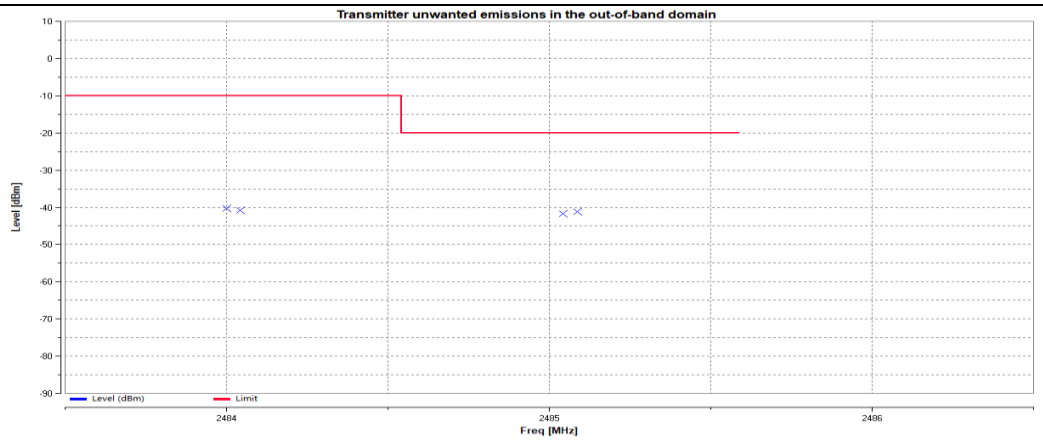
BLE_1M_Ant1_2402_2400MHz-2BW to 2400MHz



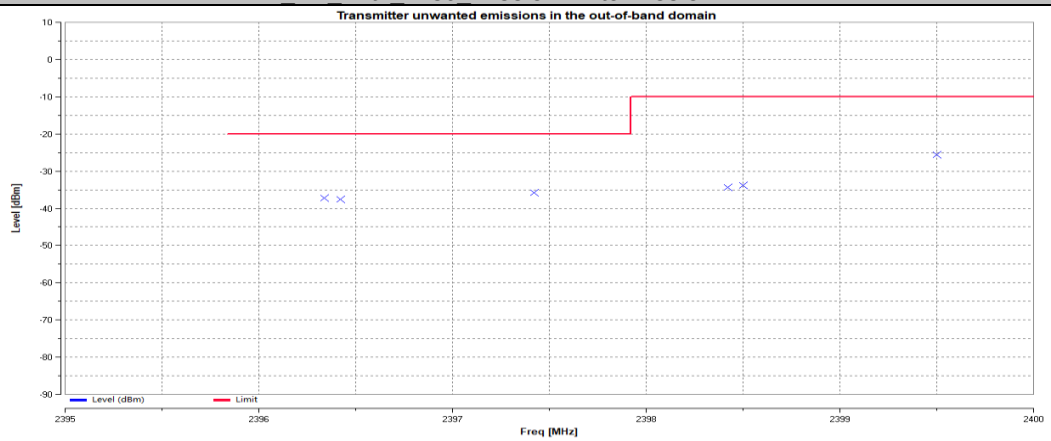
BLE_1M_Ant1_2402_2483.5MHz to 2483.5MHz+2BW



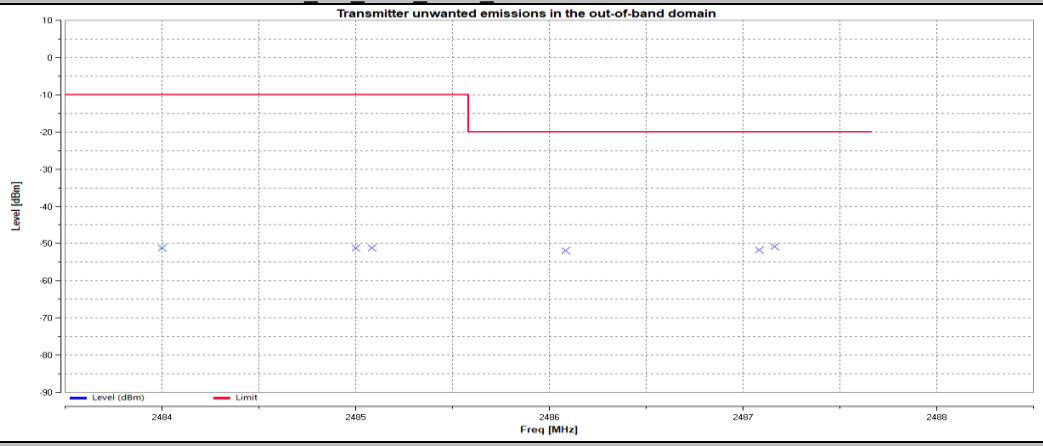
BLE_1M_Ant1_2480_2400MHz-2BW to 2400MHz



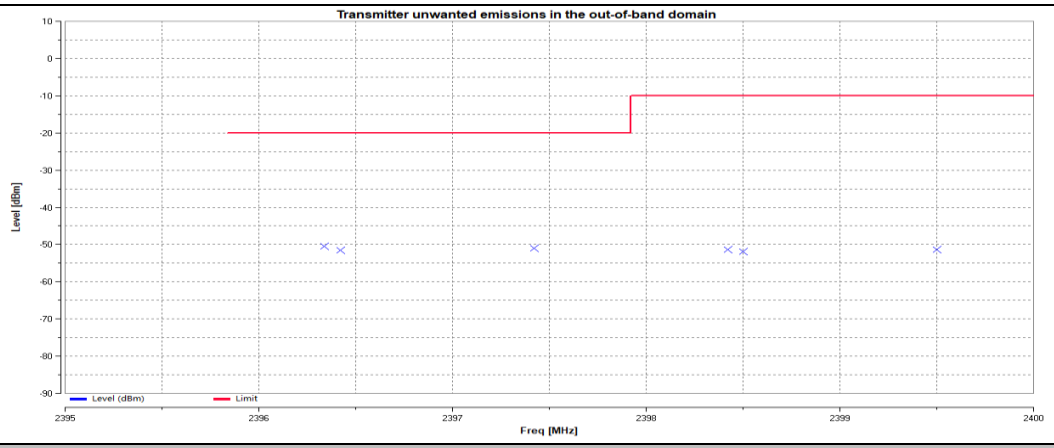
BLE_1M_Ant1_2480_2483.5MHz to 2483.5MHz+2BW



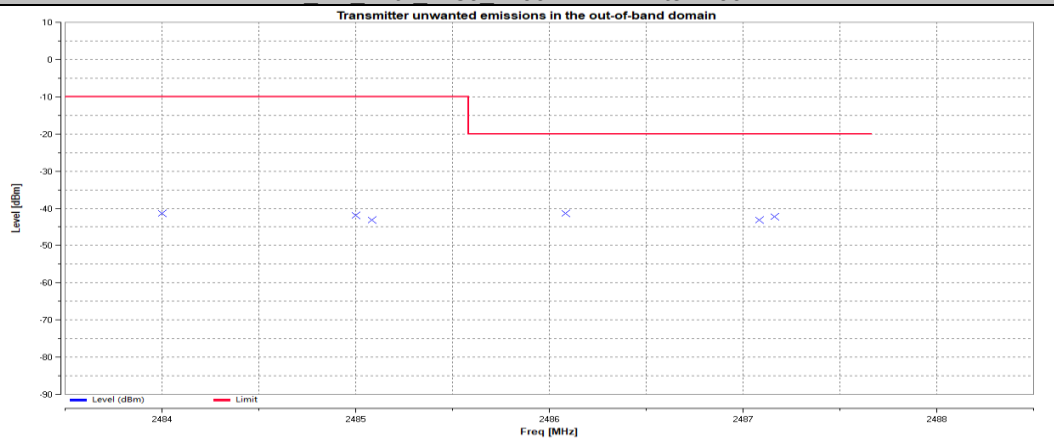
BLE_2M_Ant1_2402_2400MHz-2BW to 2400MHz



BLE_2M_Ant1_2402_2483.5MHz to 2483.5MHz+2BW



BLE_2M_Ant1_2480_2400MHz-2BW to 2400MHz



BLE_2M_Ant1_2480_2483.5MHz to 2483.5MHz+2BW

9.5. Appendix E: Transmitter unwanted emissions in the spurious domain

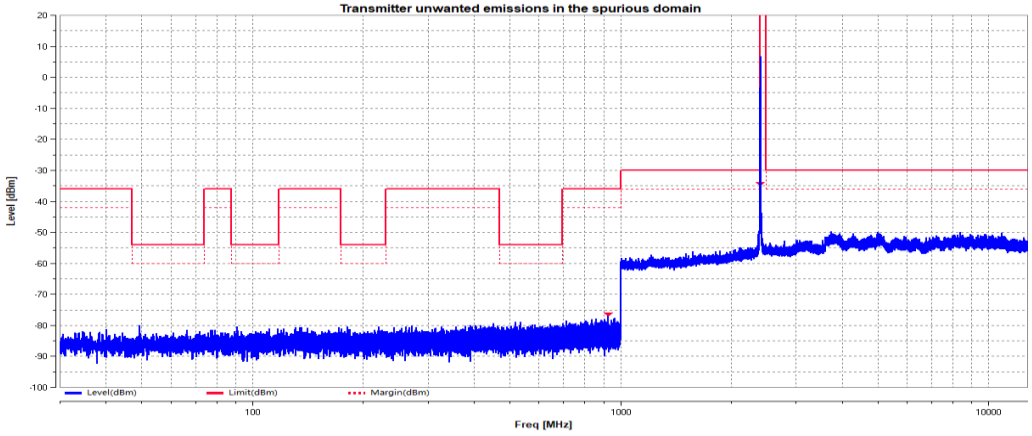
9.5.1. Test Result-Pre-scan

Test Mode	Antenna	Channel	Freq. [MHz]	Level[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	2397.9	-35.02	-30	See table below
		2480	844.21	-77.86	-36	PASS
			2486.82	-42.12	-30	PASS
BLE_2M	Ant1	2402	945.16	-77.58	-36	PASS
			2395.55	-38.72	-30	PASS
		2480	925.63	-77.35	-36	PASS
			2487.99	-43.47	-30	PASS

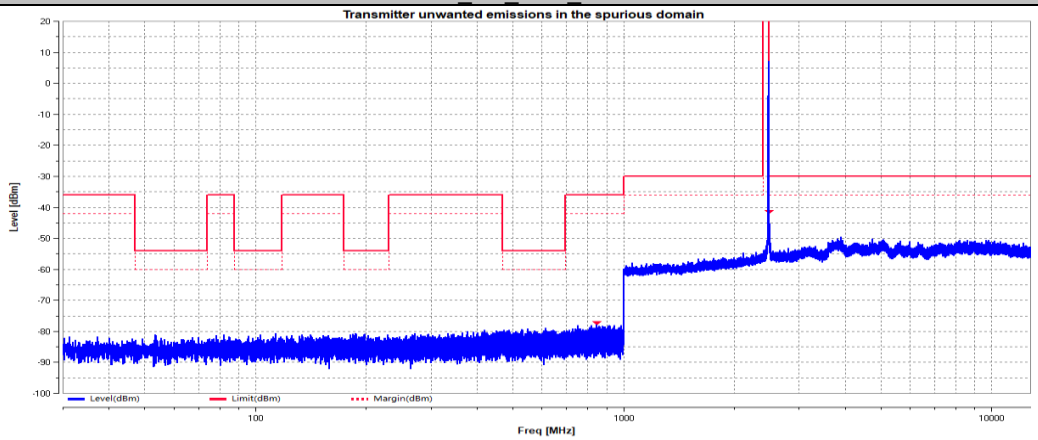
9.5.2. Test Result- Emissions identified during the pre-scan

Test Mode	Antenna	Channel	Freq. [MHz]	Level[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	2397.90	-76.52	-30	PASS

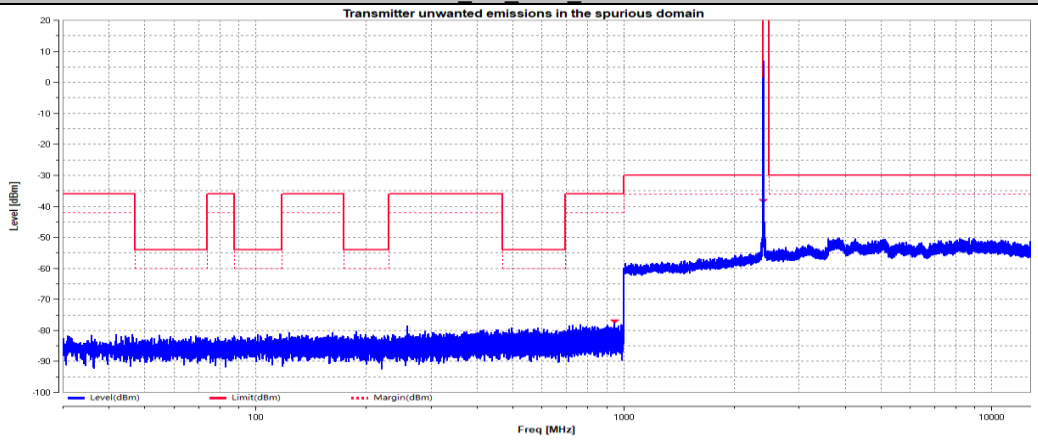
9.5.3. Test Graphs-Pre-scan



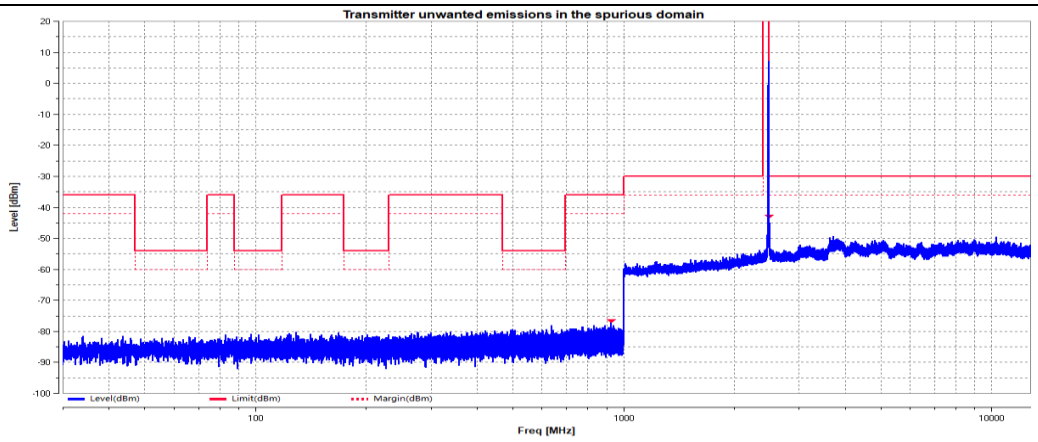
BLE_1M_Ant1_2402



BLE_1M_Ant1_2480

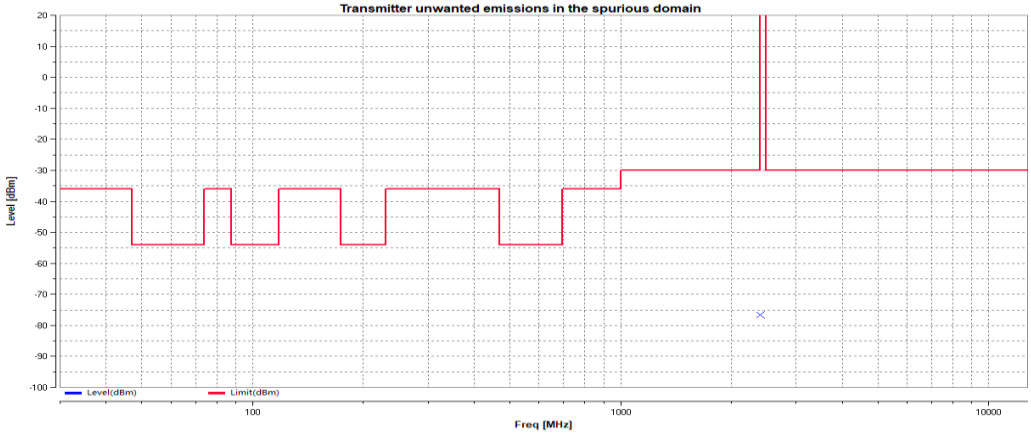


BLE_2M_Ant1_2402



BLE_2M_Ant1_2480

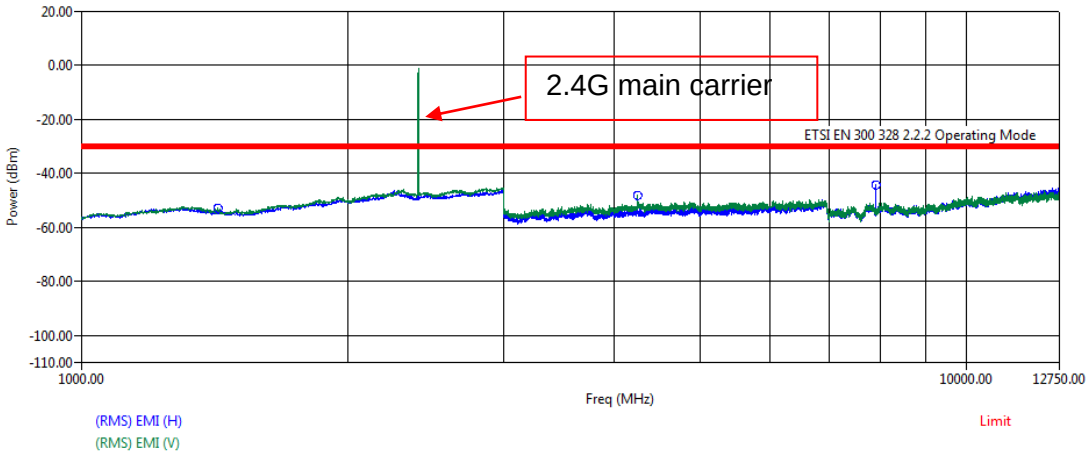
9.5.4. Test Graphs- Emissions identified during the pre-scan



BLE_1M_Ant1_2402

9.5.5. Radiated Test Result

Transmitter unwanted emissions in the spurious domain above 1 GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	LE 1M	Test Channel:	CH 0



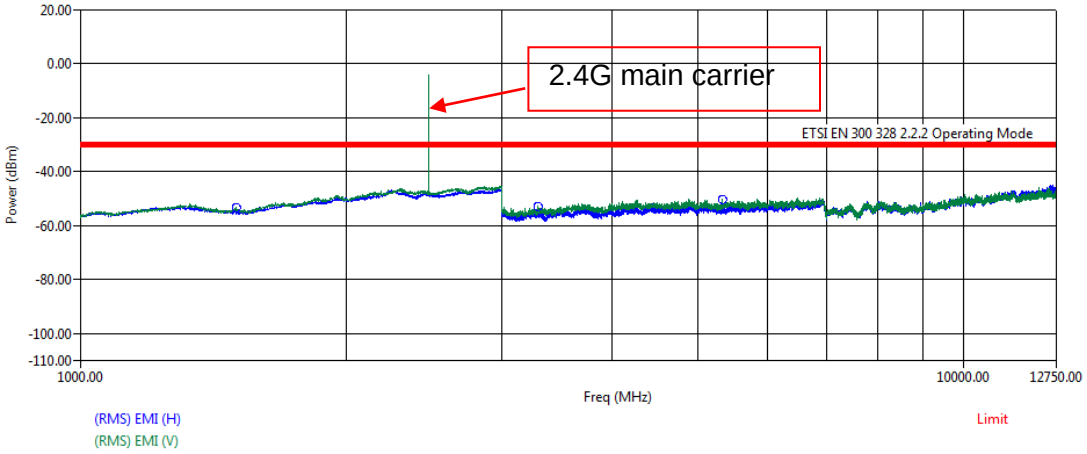
Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
1423.00	6.01	-66.35	0.00	5.49	0.00	-54.85	-30.00	-24.85
4255.50	40.47	-61.32	0.00	10.11	43.36	-54.11	-30.00	-24.11
7907.50	46.21	-62.16	0.00	13.61	41.84	-44.17	-30.00	-14.17

Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
1423.00	8.03	-66.23	0.00	5.49	0.00	-52.71	-30.00	-22.71
4255.50	44.53	-59.33	0.00	10.11	43.36	-48.05	-30.00	-18.05
7907.50	35.90	-61.98	0.00	13.61	41.84	-54.31	-30.00	-24.31

Note: EMI=Trace + Cable(Loss) + ERP Factor + Transducer
Margin=EMI – Limit

Note: 2.4G main carrier was recorded in the plot.

Transmitter unwanted emissions in the spurious domain above 1 GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	LE 1M	Test Channel:	CH 39



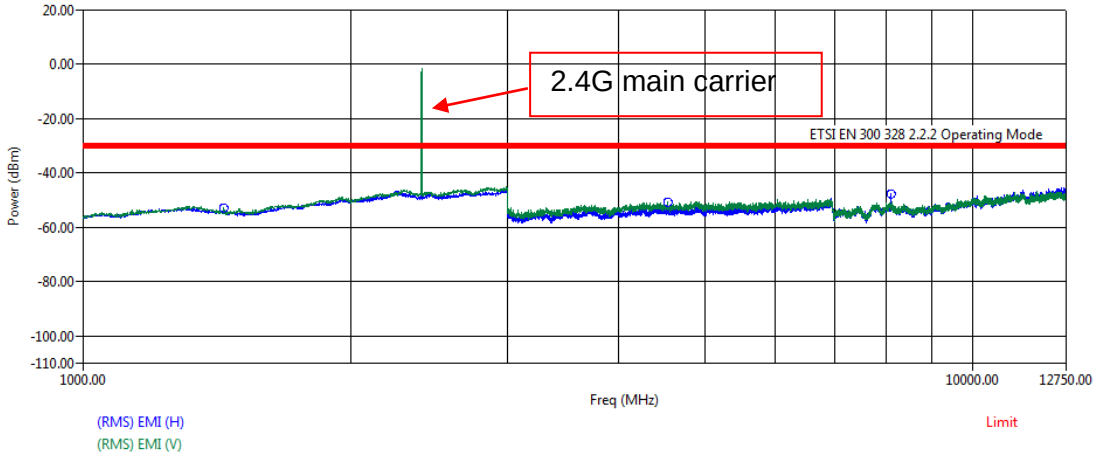
Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
1498.50	6.48	-67.24	0.00	5.58	0.00	-55.19	-30.00	-25.19
3298.00	41.32	-63.08	0.00	9.20	43.46	-56.03	-30.00	-26.03
5324.50	39.08	-61.06	0.00	10.66	43.10	-54.42	-30.00	-24.42

Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
1498.50	7.68	-66.30	0.00	5.58	0.00	-53.03	-30.00	-23.03
3298.00	43.64	-62.04	0.00	9.20	43.46	-52.67	-30.00	-22.67
5324.50	41.38	-59.32	0.00	10.66	43.10	-50.38	-30.00	-20.38

Note: EMI=Trace + Cable(Loss) + ERP Factor + Transducer
Margin=EMI – Limit

Note: 2.4G main carrier was recorded in the plot.

Transmitter unwanted emissions in the spurious domain above 1 GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	LE 2M	Test Channel:	CH 0



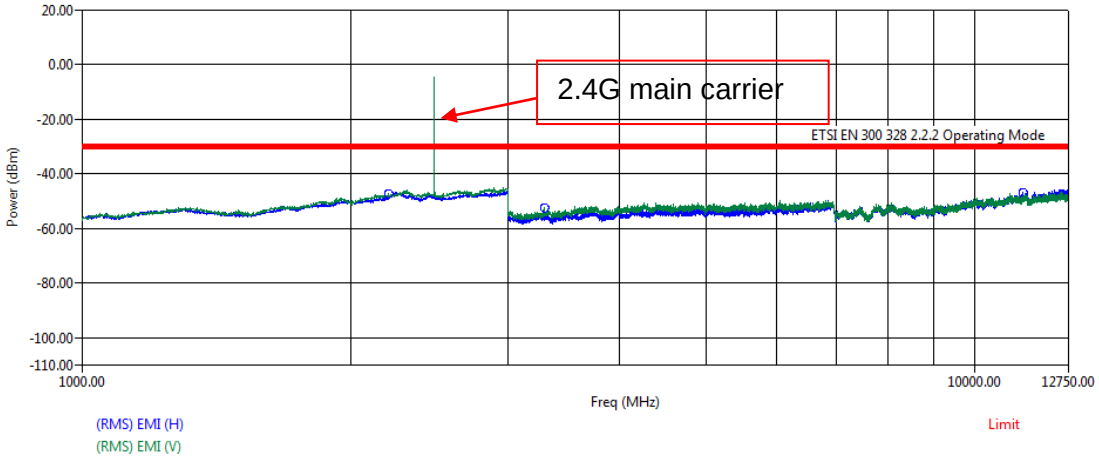
Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
1436.00	7.06	-66.52	0.00	5.50	0.00	-53.96	-30.00	-23.96
4541.00	39.27	-60.97	0.00	10.10	43.34	-54.94	-30.00	-24.94
8107.50	41.69	-61.33	0.00	13.77	41.82	-47.69	-30.00	-17.69

Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
1436.00	8.25	-66.50	0.00	5.50	0.00	-52.74	-30.00	-22.74
4541.00	42.05	-59.52	0.00	10.10	43.34	-50.71	-30.00	-20.71
8107.50	35.72	-60.86	0.00	13.77	41.82	-53.19	-30.00	-23.19

Note: EMI=Trace + Cable(Loss) + ERP Factor + Transducer
Margin=EMI – Limit

Note: 2.4G main carrier was recorded in the plot.

Transmitter unwanted emissions in the spurious domain above 1 GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	LE 2M	Test Channel:	CH 39



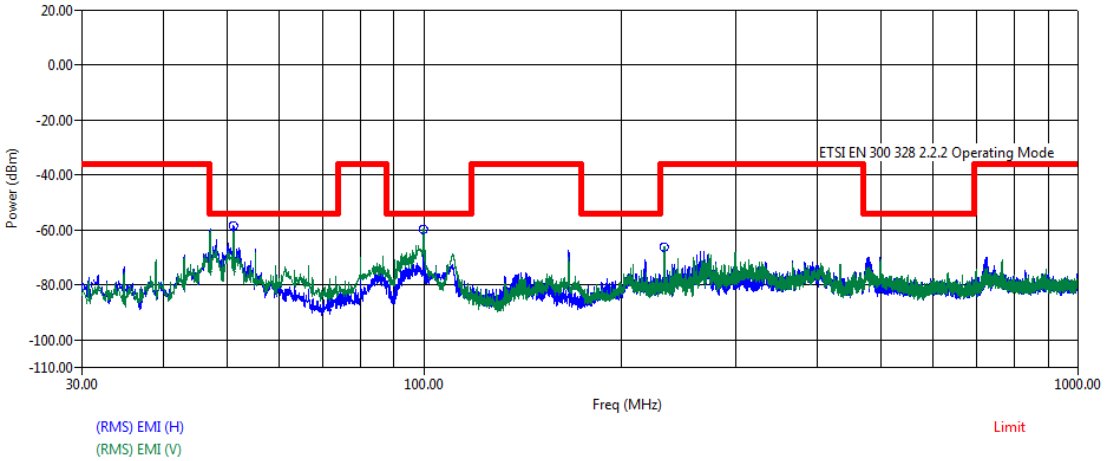
Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
2204.50	7.00	-62.72	0.00	6.84	0.00	-48.88	-30.00	-18.88
3294.00	41.13	-63.05	0.00	9.19	43.46	-56.20	-30.00	-26.20
11333.50	37.54	-58.63	0.00	16.75	42.20	-46.55	-30.00	-16.55

Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
2204.50	8.11	-62.11	0.00	6.84	0.00	-47.15	-30.00	-17.15
3294.00	43.87	-62.05	0.00	9.19	43.46	-52.46	-30.00	-22.46
11333.50	34.54	-59.07	0.00	16.75	42.20	-49.98	-30.00	-19.98

Note: EMI=Trace + Cable(Loss) + ERP Factor + Transducer
Margin=EMI – Limit

Note: 2.4G main carrier was recorded in the plot.

Transmitter unwanted emissions in the spurious domain below 1 GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	LE 1M	Test Channel:	CH 0

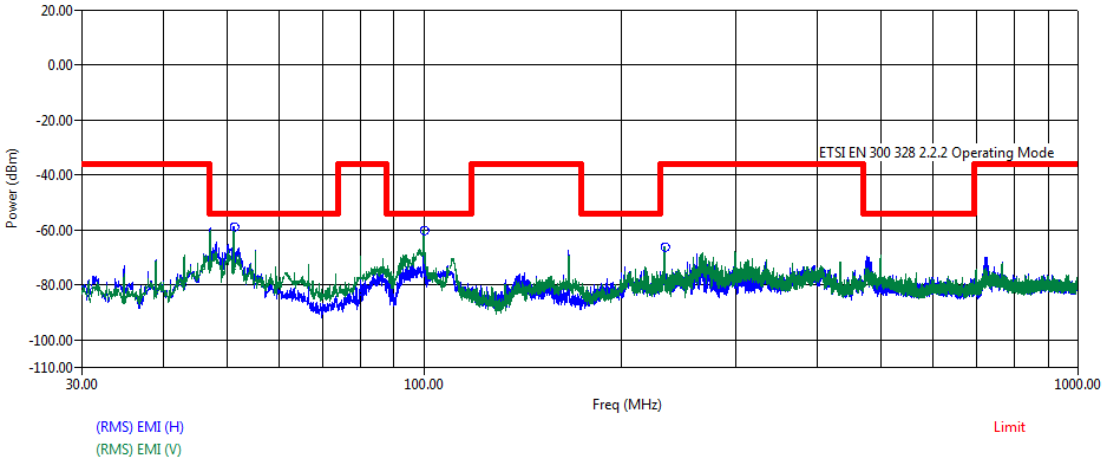


Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
51.15	66.41	-83.07	0.00	0.89	42.68	-58.45	-54.00	-4.45
99.65	61.57	-83.09	0.00	1.27	42.80	-63.05	-54.00	-9.05
232.60	60.19	-86.48	0.00	2.04	42.55	-66.79	-36.00	-30.79

Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
51.15	61.53	-80.48	0.00	0.89	42.68	-60.74	-54.00	-6.74
99.65	64.74	-82.80	0.00	1.27	42.80	-59.58	-54.00	-5.58
232.60	61.04	-86.49	0.00	2.04	42.55	-65.96	-36.00	-29.96

Note: EMI=Trace + Cable(Loss) + ERP Factor + Transducer
Margin=EMI – Limit

Transmitter unwanted emissions in the spurious domain below 1 GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	LE 1M	Test Channel:	CH 39



Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
51.20	66.27	-83.08	0.00	0.89	42.68	-58.60	-54.00	-4.60
99.90	60.81	-82.98	0.00	1.27	42.80	-63.71	-54.00	-9.71
233.25	59.37	-86.54	0.00	2.05	42.55	-67.67	-36.00	-31.67

Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
51.20	61.91	-80.48	0.00	0.89	42.68	-60.37	-54.00	-6.37
99.90	64.21	-82.69	0.00	1.27	42.80	-60.01	-54.00	-6.01
233.25	61.08	-86.55	0.00	2.05	42.55	-65.97	-36.00	-29.97

Note: EMI=Trace + Cable(Loss) + ERP Factor + Transducer
Margin=EMI – Limit

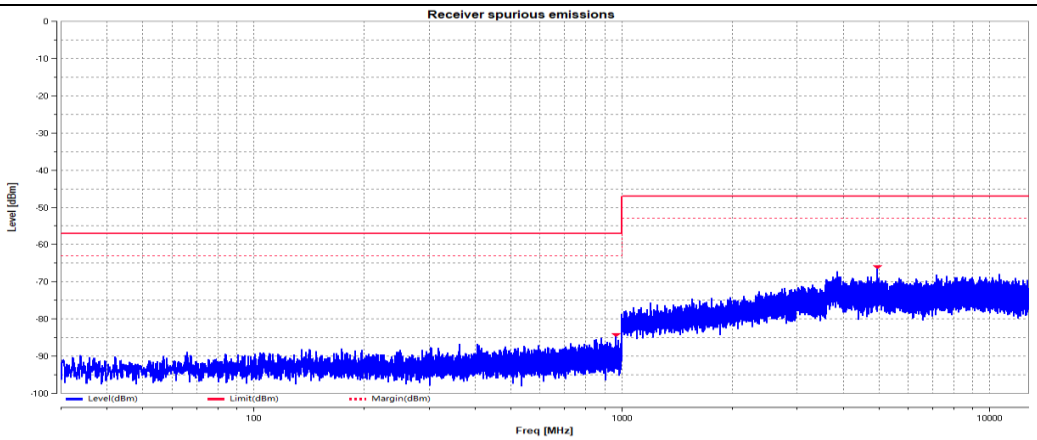
Note All the modes had been tested, but only the worst data was recorded in the report.

9.6. Appendix F: Receiver spurious emissions

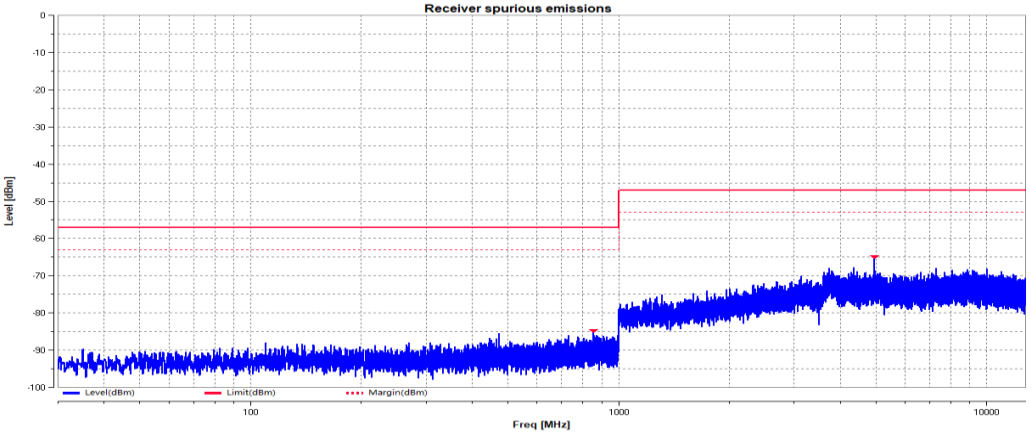
9.6.1. Test Result-Pre-scan

Test Mode	Antenna	Channel	Freq. [MHz]	Level[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	965.47	-84.76	-57.00	PASS
			4957.79	-66.59	-47.00	PASS
		2480	855.37	-85.34	-57.00	PASS
			4958.18	-65.42	-47.00	PASS
BLE_2M	Ant1	2402	870.02	-85.32	-57.00	PASS
			4958.18	-65.02	-47.00	PASS
		2480	854.6	-85.21	-57.00	PASS
			4958.58	-65.84	-47.00	PASS

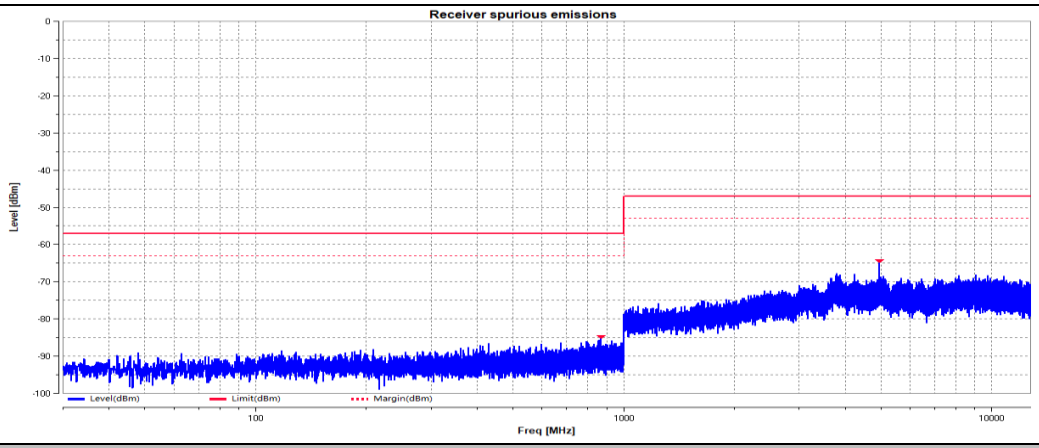
9.6.2. Test Graphs-Pre-scan



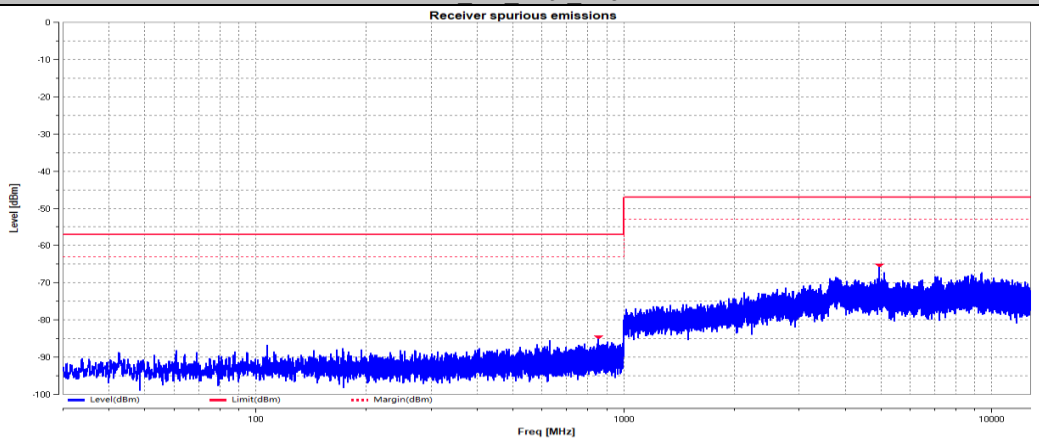
BLE_1M_Ant1_2402



BLE_1M_Ant1_2480



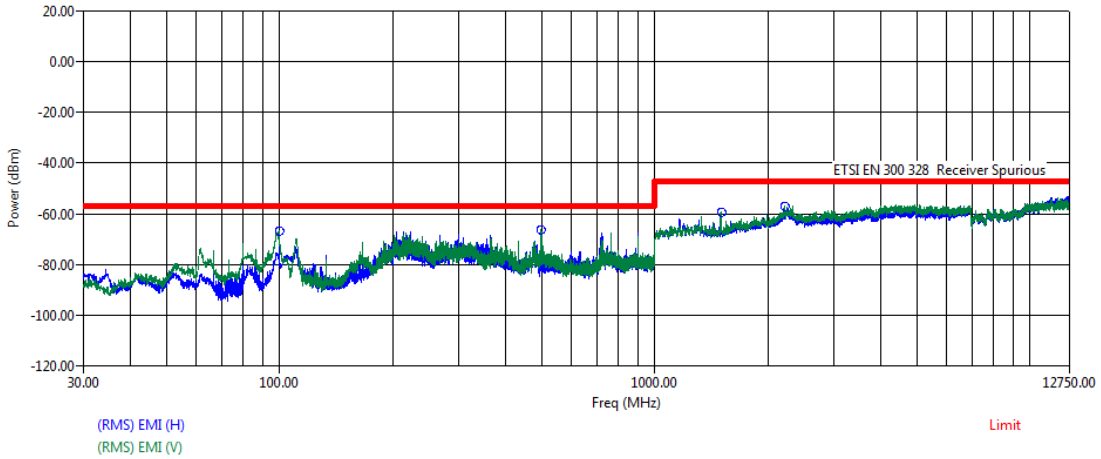
BLE_2M_Ant1_2402



BLE_2M_Ant1_2480

9.6.3. Radiated Test Result

Receiver spurious emissions			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	LE 1M	Test Channel:	CH 0

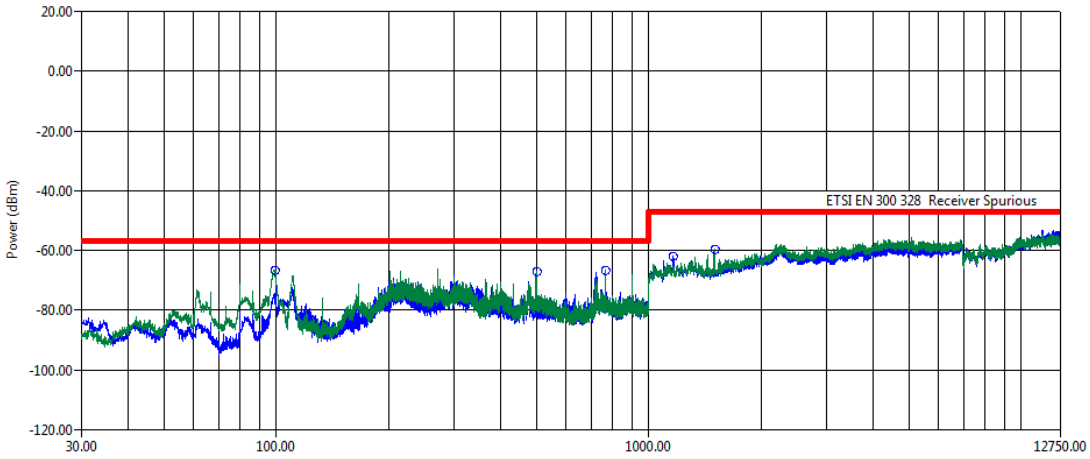


Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
99.70	52.61	-83.07	0.00	1.27	42.80	-71.99	-57.00	-14.99
498.30	49.01	-81.14	0.00	3.13	42.80	-71.80	-57.00	-14.80
1499.00	46.75	-67.25	0.00	5.10	48.77	-64.16	-47.00	-17.16
2225.50	42.95	-62.04	0.00	6.32	48.21	-60.97	-47.00	-13.97

Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
99.70	57.81	-82.78	0.00	1.27	42.80	-66.50	-57.00	-9.50
498.30	54.02	-80.50	0.00	3.13	42.80	-66.16	-57.00	-9.16
1499.00	50.86	-66.29	0.00	5.10	48.77	-59.10	-47.00	-12.10
2225.50	47.05	-62.10	0.00	6.32	48.21	-56.94	-47.00	-9.94

Note: EMI=Trace + Cable(Loss) + ERP Factor + Transducer
Margin=EMI - Limit

Receiver spurious emissions			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	LE 1M	Test Channel:	CH 39



Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
98.75	49.79	-83.49	0.00	1.27	42.78	-75.22	-57.00	-18.22
499.90	48.87	-81.07	0.00	3.17	42.80	-71.84	-57.00	-14.84
766.45	42.68	-78.11	0.00	3.73	42.53	-74.23	-57.00	-17.23
1165.00	49.04	-66.16	0.00	4.49	49.35	-61.98	-47.00	-14.98
1499.50	49.60	-67.25	0.00	5.10	48.76	-61.32	-47.00	-14.32
Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
98.75	58.28	-83.19	0.00	1.27	42.78	-66.42	-57.00	-9.42
499.90	53.19	-80.42	0.00	3.17	42.80	-66.86	-57.00	-9.86
766.45	50.49	-78.21	0.00	3.73	42.53	-66.52	-57.00	-9.52
1165.00	45.02	-66.03	0.00	4.49	49.35	-65.87	-47.00	-18.87
1499.50	50.40	-66.29	0.00	5.10	48.76	-59.55	-47.00	-12.55

Note: EMI=Trace + Cable(Loss) + ERP Factor + Transducer
Margin=EMI - Limit

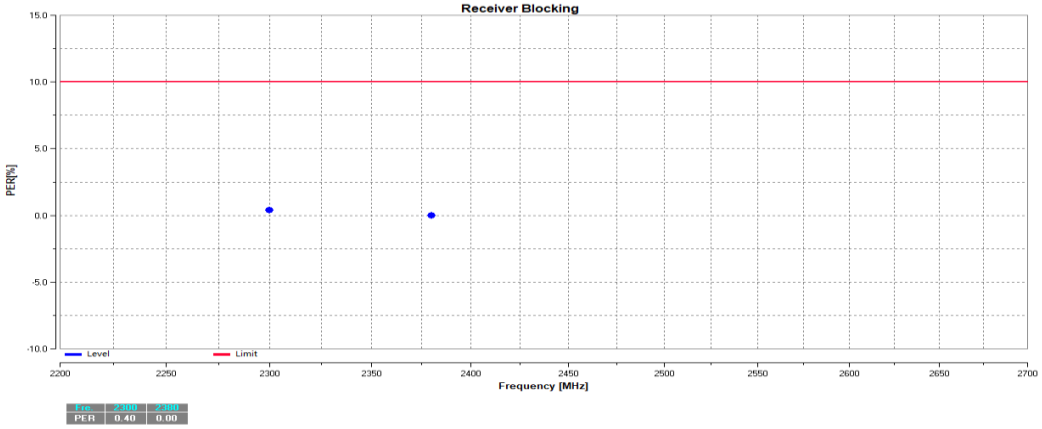
Note All the modes had been tested, but only the worst data was recorded in the report.

9.7. Appendix G: Receiver Blocking

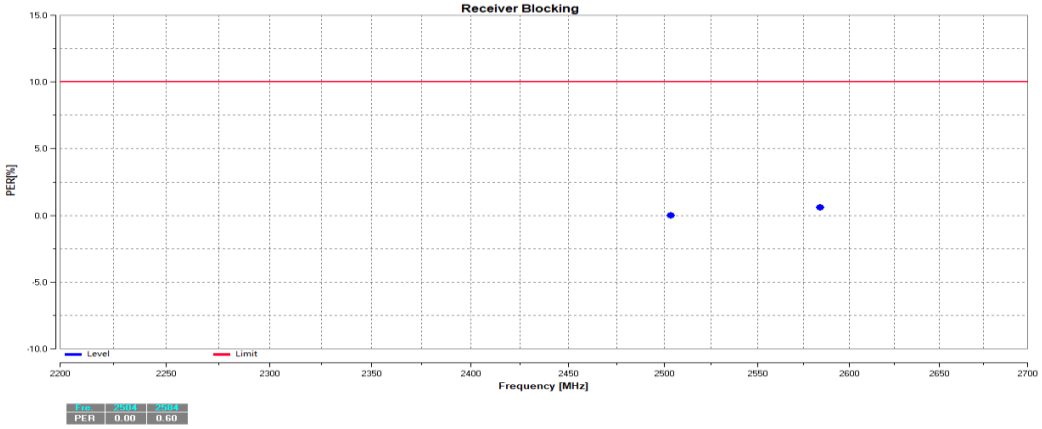
9.7.1. Test Result

Test Mode	Antenna	Channel	Wanted signal [dBm]	Freq. [MHz]	CW [dBm]	PER [%]	Limit [%]	Verdict
BLE_1M	Ant1	2402	-66.81	2300	-32	0.40	<=10	PASS
			-66.81	2380	-32	0.00	<= 10	PASS
		2480	-66.82	2504	-32	0.00	<=10	PASS
			-66.82	2584	-32	0.60	<= 10	PASS

9.7.2. Test Graphs

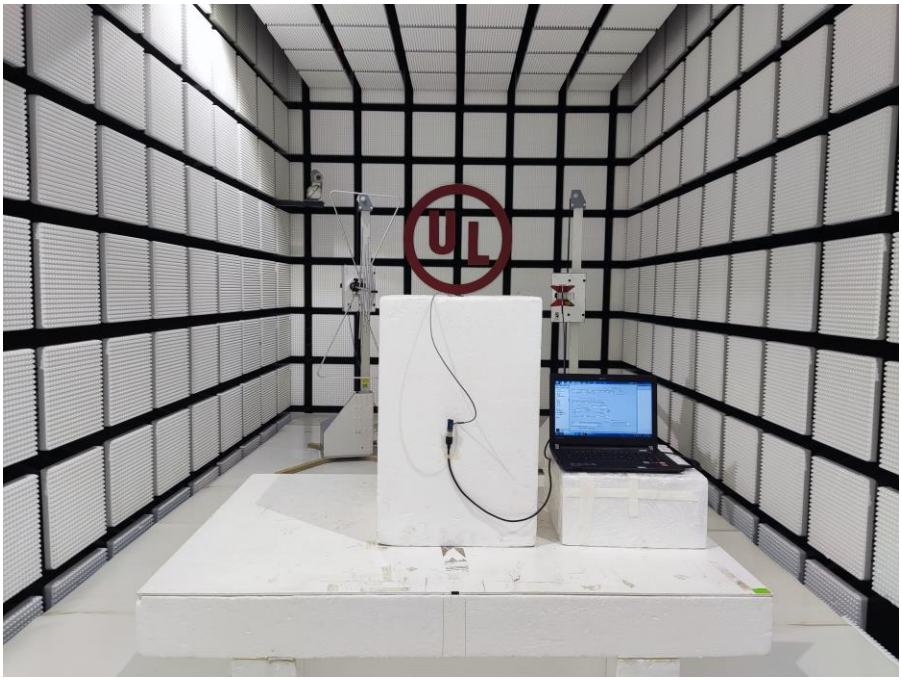


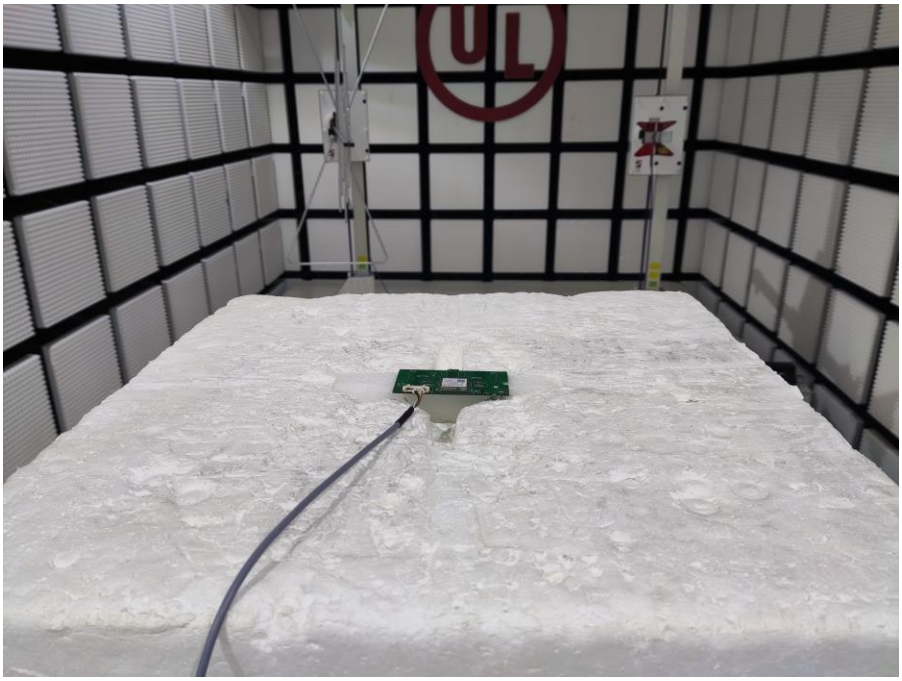
BLE_1M_Ant1_2402



BLE_1M_Ant1_2480

RADIATED SPURIOUS EMISSIONS TEST PHOTOS





END OF REPORT