FCC PART 15 SUBPART C
ISED RSS-247 ISSUE 2

CERTIFICATION TEST REPORT

For

WIFI+BLE Module

MODEL NUMBER: GRJW05-J8

FCC ID: 2ADAP-GRJW05J8
IC: 12478A-GRJW05J8

REPORT NUMBER: 4790401446.2

ISSUE DATE: 16 June 2022

Prepared for

GREE Electric Appliances,Inc.of Zhuhai
West Jinji Rd, Qianshan, Zhuhai, Guangdong, China 519070

Prepared by

UL Verification Services (Guangzhou) Co., Ltd, Song Shan Lake Branch
Room 101, Building 10, Innovation Technology Park,
Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China
Tel: +86 769 33817100
Fax: +86 769 33244054
Website: www.ul.com

Revision History

Rev.	Issue Date	Revisions	Revised By
--	16/06/2022	Initial Issue	--

Summary of Test Results			
Clause	Test Items	FCC/IC Rules	Test Results
1	6 dB Bandwidth and 99% Bandwidth	FCC Part 15.247 (a) (2) RSS-247 Clause 5.2 (a) RSS-Gen Clause 6.7	Pass
2	Conducted Output Power	FCC Part 15.247 (b) (3) RSS-247 Clause 5.4 (d)	Pass
3	Power Spectral Density	FCC Part 15.247 (e) RSS-247 Clause 5.2 (b)	Pass
4	Conducted Bandedge and Spurious Emission	FCC Part 15.247 (d) RSS-247 Clause 5.5	Pass
5	Radiated Bandedge and Spurious Emission	FCC Part 15.247 (d) FCC Part 15.209 FCC Part 15.205 RSS-247 Clause 5.5 RSS-GEN Clause 8.9	Pass
6	Conducted Emission Test For AC Power Port	FCC Part 15.207 RSS-GEN Clause 8.8	Pass
7	Antenna Requirement	FCC Part 15.203 RSS-GEN Clause 6.8	Pass
Remark: 1) The measurement result for the sample received is <Pass> according to < CFR 47 FCC PART 15 SUBPART C, when <Accuracy Method> decision rule is applied.			

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name:	GREE Electric Appliances,Inc.of Zhuhai
Address:	West Jinji Rd, Qianshan, Zhuhai, Guangdong, China 519070

Manufacturer Information

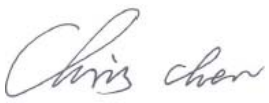
Company Name:	Same As the Applicant
Address:	Same As the Applicant

EUT Description

EUT Name:	WIFI+BLE Module
Brand Name:	N/A
Model:	GRJW05-J8
Sample Status:	Normal
Model:	22060602003-4
Sample Received Date:	07 June 2022
Date of Tested:	07 June 2022 ~ 16 June 2022

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC Part 15 Subpart C	**PASS**
ISED RSS-247 Issue 2	**PASS**
ISED RSS-GEN Issue 5	**PASS**

Prepared By:



Chris Chen
Engineer Project Associate

Checked By:

Shawn Wen
Laboratory Leader

Approved By:

Stephen Guo
Laboratory Manager

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with 558074 D01 15.247 Meas Guidance v05r02, 414788 D01 Radiated Test Site v01r01, FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, ISED RSS-247 Issue 2 and ISED RSS-GEN Issue 5.

3. FACILITIES AND ACCREDITATION

Accreditation Certificate	**A2LA (Certificate No.: 4338.01)** Shenzhen STS Test Services Co., Ltd. has been assessed and proved to be in compliance with A2LA**.** **CNAS (Registration No.: L7649)** Shenzhen STS Test Services Co., Ltd. has been assessed and proved to be in compliance with CNAS. **IC(Company No.: 12108A)** Shenzhen STS Test Services Co., Ltd. has been registered and fully described in a report filed with Industry Canada. The Company Number is 12108A.

Note: All tests measurement facilities use to collect the measurement data are located at A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, 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

The reported uncertainty of measurement **y** ± **U**, where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**, providing a level of confidence of approximately **95** %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.87dB
2	Unwanted Emissions, conducted	±2.895dB
3	All emissions, radiated 9K-30MHz	±3.80dB
4	All emissions, radiated 30M-1GHz	±4.09dB
5	All emissions, radiated 1G-6GHz	±4.92dB
6	All emissions, radiated>6G	±5.49dB
7	Conducted Emission (9KHz-30MHz)	±2.73dB

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT Name	WIFI+BLE Module	
EUT Description	WIFI+BLE Module	
Model	GRJW05-J8	
PMN	WIFI+BLE Module	
HVIN	GRJW05-J8	
FVIN	N/A	
Serial number	N/A	
Product Description (Bluetooth)	Operation Frequency	2402 MHz ~ 2480 MHz
	Modulation Type	GFSK
	Data Rate	1Mbps
Power Parameter	Input: DC 3.3V	
Bluetooth Version	5.0	
Bluetooth Configuration	LE	
Hardware Version	N/A	
Software Version	N/A	

5.2. MAXIMUM OUTPUT POWER

Frequency Range (MHz)	Number of Transmit Chains (NTX)	Bluetooth Mode	Frequency (MHz)	Channel Number	Max average Conducted Power (dBm)
2400-2483.5	1	BLE	2402-2480	0-39[40]	-5.16

5.3. CHANNEL LIST

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	11	2424	22	2446	33	2468
01	2404	12	2426	23	2448	34	2470
02	2406	13	2428	24	2450	35	2472
03	2408	14	2430	25	2452	36	2474
04	2410	15	2432	26	2454	37	2476
05	2412	16	2434	27	2456	38	2478
06	2414	17	2436	28	2458	39	2480
07	2416	18	2438	29	2460		
08	2418	19	2440	30	2462		
09	2420	20	2442	31	2464		
10	2422	21	2444	32	2466		

5.4. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel	Frequency
GFSK	CH 00, CH 19, CH 39	2402MHz, 2440MHz, 2480MHz

5.5. THE WORSE CASE POWER SETTING PARAMETER

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band				
Modulation Type	Transmit Antenna Number	Test Channel		
		CH 00	CH 19	CH 39
GFSK	1	6	6	6

5.6. DESCRIPTION OF AVAILABLE ANTENNAS

Ant.	Frequency (MHz)	Antenna Type	Antenna Gain (dBi)
1	2402-2480	PCB antenna	1 (Provided by applicant)

Test Mode	Transmit and Receive Mode	Description
GFSK	☒1TX, 1RX	Chain 1 can be used as transmitting/receiving antenna.

5.7. WORST-CASE CONFIGURATIONS

Bluetooth Mode	Modulation Technology	Modulation Type	Data Rate (Mbps)
BLE	DTS	GFSK	1Mbit/s

5.8. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	P/N
1	Notebook Adapter	LENOVO	ADLX45DLC3A	N/A
2	Notebook	LENOVO	Think Pad E470	N/A

I/O CABLES

Cable No	Port	Connector Type	Cable Type	Cable Length(cm)	Remarks
1	USB Cable	N/A	N/A	150cm	N/A

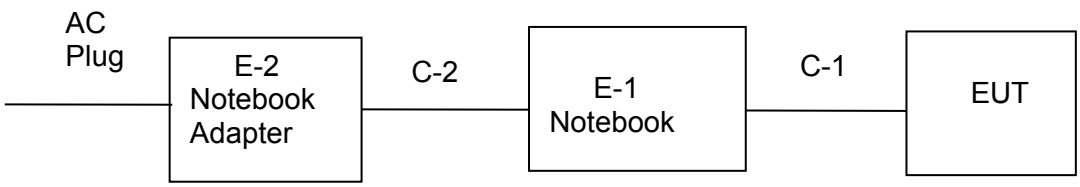
ACCESSORY

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

TEST SETUP

The EUT can work in engineering mode with software EspRFTestTool_v2.8_Manual through a Laptop.

SETUP DIAGRAM FOR TESTS



6. MEASURING INSTRUMENT AND SOFTWARE USED

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2021.09.30	2022.09.29
Signal Analyzer	R&S	FSV 40-N	101823	2021.09.30	2022.09.29
Active loop Antenna	ZHINAN	ZN30900C	16035	2021.04.11	2023.04.10
Bilog Antenna	TESEQ	CBL6111D	34678	2020.10.12	2022.10.11
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2021.10.11	2023.10.10
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2020.10.12	2022.10.11
Pre-Amplifier (0.1M-3GHz)	EM	EM330	060665	2021.10.08	2022.10.07
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2021.09.30	2022.09.29
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK2018101801	2021.09.28	2022.09.27
Temperature & Humidity	HH660	Mieo	N/A	2021.10.09	2022.10.08
Turn table	EM	SC100_1	60531	N/A	N/A
Antenna mast	EM	SC100	N/A	N/A	N/A
Band Reject Filter (2.4G-2.5GHz)	COM-MW	ZBSF-2400-2500	N/A	2021.09.30	2022.09.29
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

Conduction Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2021.09.30	2022.09.29
LISN	R&S	ENV216	101242	2021.09.30	2022.09.29
LISN	EMCO	3810/2NM	23625	2021.09.30	2022.09.29
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Power Sensor	Keysight	U2021XA	MY55520005	2021.09.30	2022.09.29
			MY55520006	2021.09.30	2022.09.29
			MY56120038	2021.09.30	2022.09.29
			MY56280002	2021.09.30	2022.09.29
Signal Analyzer	Agilent	N9020A	MY51110105	2022.03.01	2023.02.28
Temperature & Humidity	HH660	Mieo	N/A	2021.10.09	2022.10.08
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

7. MEASUREMENT METHODS

No.	Test Item	KDB Name	Section
1	6 dB Bandwidth and 99% Bandwidth	558074 D01 15.247 Meas Guidance v05r02	8.2
2	Peak Output Power	558074 D01 15.247 Meas Guidance v05r02	8.1.3
3	Power Spectral Density	558074 D01 15.247 Meas Guidance v05r02	8.4
4	Out-of-band emissions in non-restricted bands	558074 D01 15.247 Meas Guidance v05r02	8.5
5	Out-of-band emissions in restricted bands	558074 D01 15.247 Meas Guidance v05r02	8.6
6	Band-edge	558074 D01 15.247 Meas Guidance v05r02	8.7
7	Conducted Emission Test For AC Power Port	ANSI C63.10-2013	6.2

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

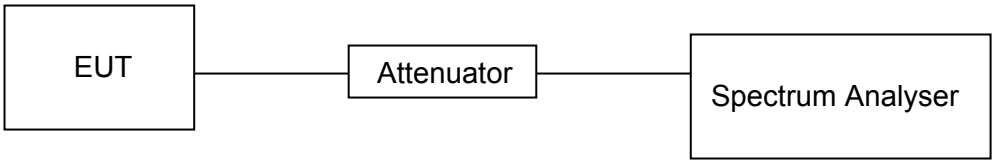
LIMITS

None; for reporting purposes only

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method

TEST SETUP



TEST ENVIRONMENT

Temperature	25.5°C	Relative Humidity	37%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

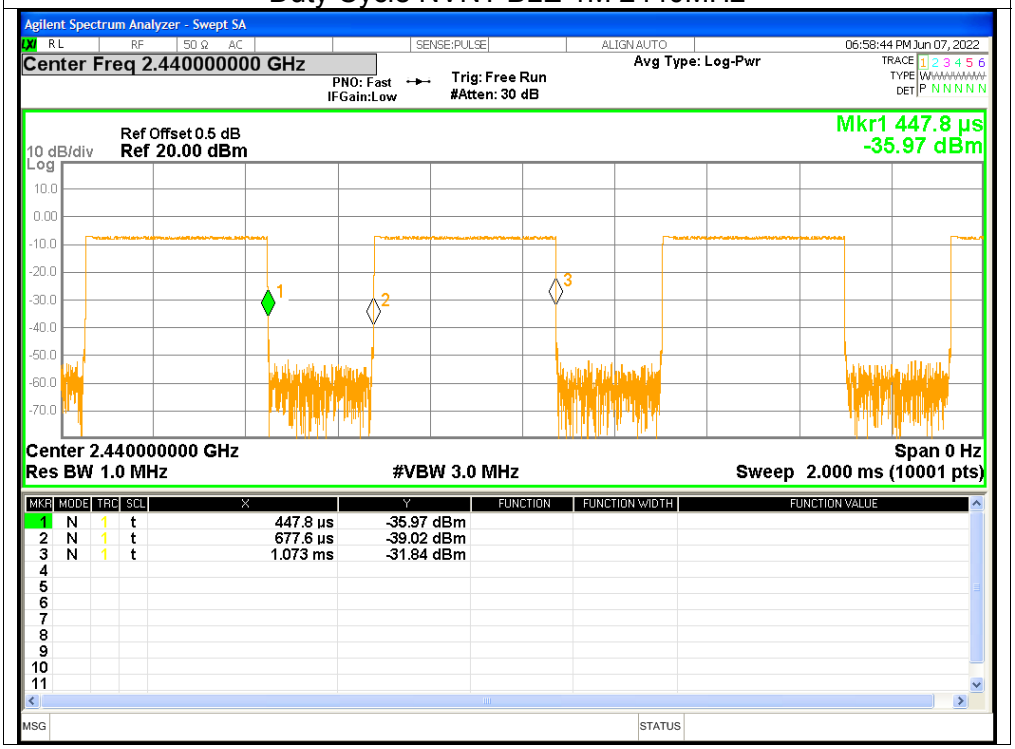
RESULTS

Condition	Mode	Frequency (MHz)	Duty Cycle (%)	Correction Factor (dB)	1/T (kHz)
NVNT	BLE 1M	2402	69.88	-1.46	2.53
NVNT	BLE 1M	2440	69.88	-1.46	2.53
NVNT	BLE 1M	2480	69.88	-1.46	2.53

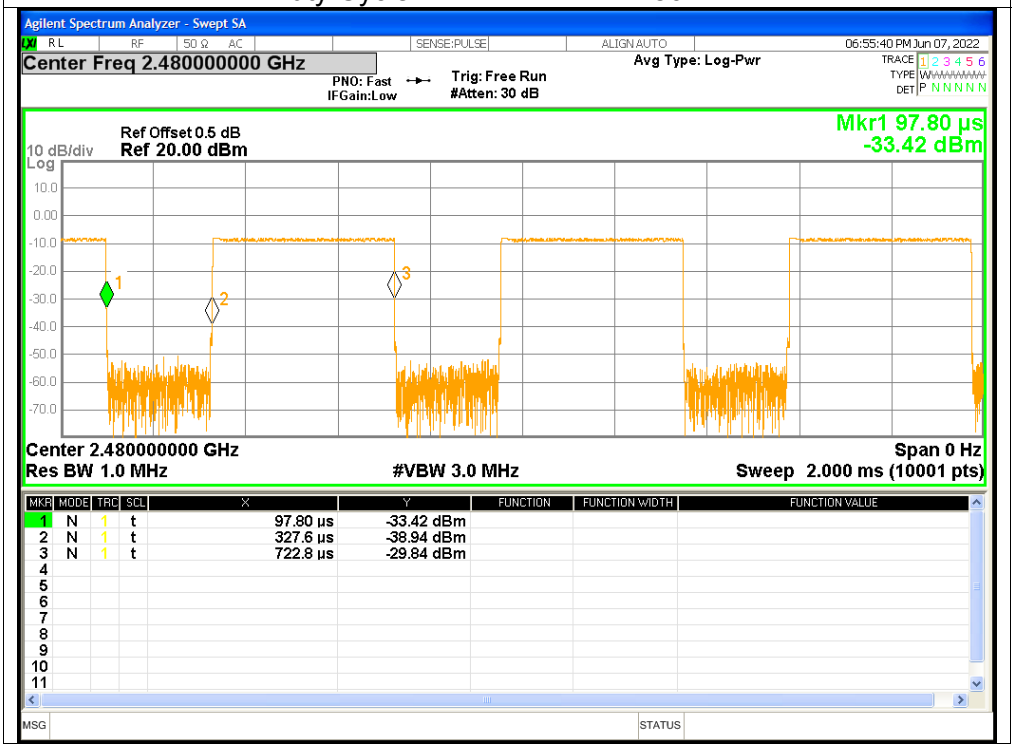
Test Graphs

Duty Cycle NVNT BLE 1M 2402MHz

Duty Cycle NVNT BLE 1M 2440MHz



Duty Cycle NVNT BLE 1M 2480MHz



8.2. 6 dB BANDWIDTH & 99% BANDWIDTH

LIMITS

FCC Part15 (15.247) Subpart C RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(a)(2) RSS-247 5.2 (a)	6dB Bandwidth	>= 500KHz	2400-2483.5
RSS-Gen Clause 6.7	99% Bandwidth	For reporting purposes only.	2400-2483.5

TEST PROCEDURE

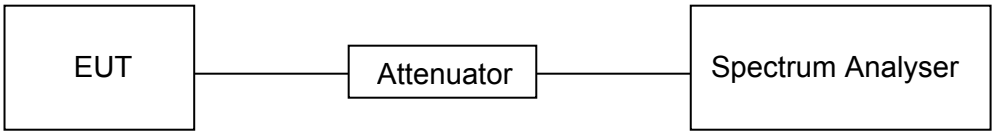
Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	For 6 dB Bandwidth :100K For 99% Bandwidth :1% to 5% of the occupied bandwidth
VBW	For 6dB Bandwidth : ≥3 × RBW For 99% Bandwidth : approximately 3×RBW
Trace	Max hold
Sweep	Auto couple

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB and 99% relative to the maximum level measured in the fundamental emission.

.

TEST SETUP



TEST ENVIRONMENT

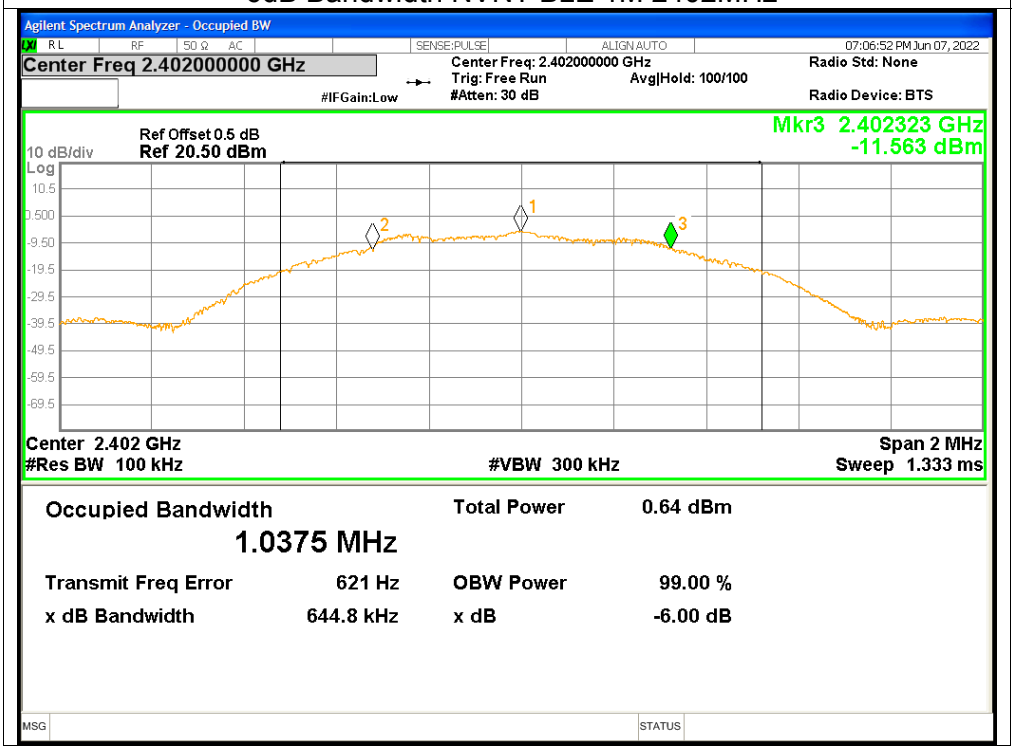
Temperature	25.5°C	Relative Humidity	37%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

RESULTS

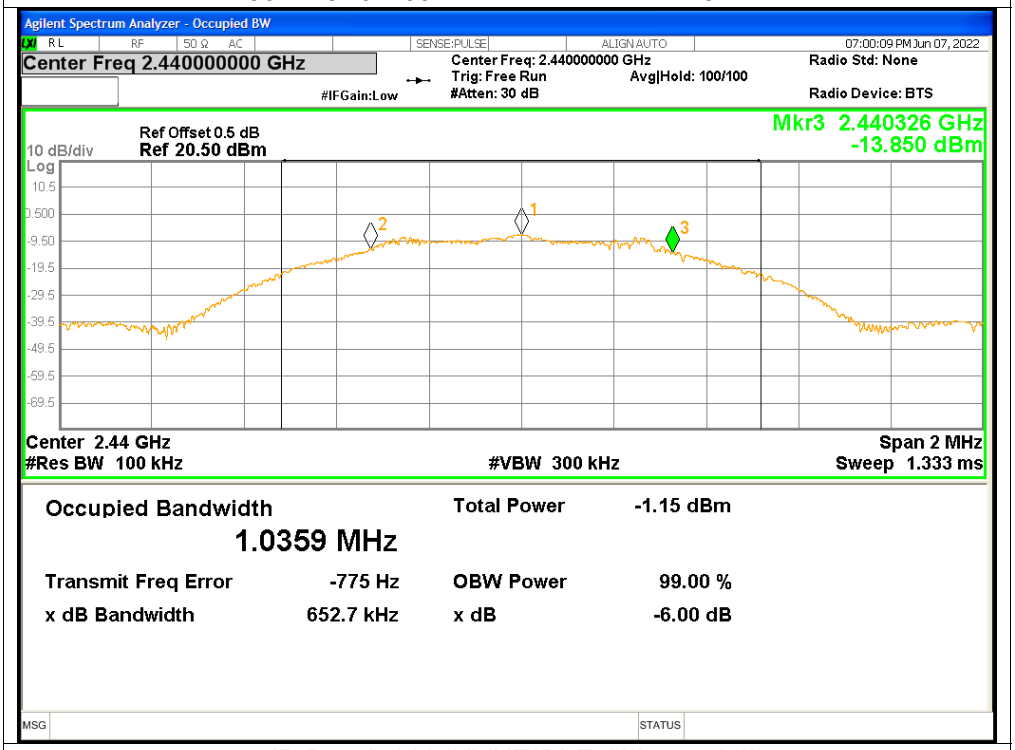
Condition	Mode	Frequency (MHz)	-6 dB Bandwidth (KHz)	-6 dB Bandwidth (MHz)	99% bandwidth (KHz)	Limit (MHz)	Verdict
NVNT	BLE 1M	2402	645.000	0.645	1030.300	>=0.5	Pass
NVNT	BLE 1M	2440	653.000	0.653	1026.800	>=0.5	Pass
NVNT	BLE 1M	2480	639.000	0.639	1029.100	>=0.5	Pass

Test Graphs

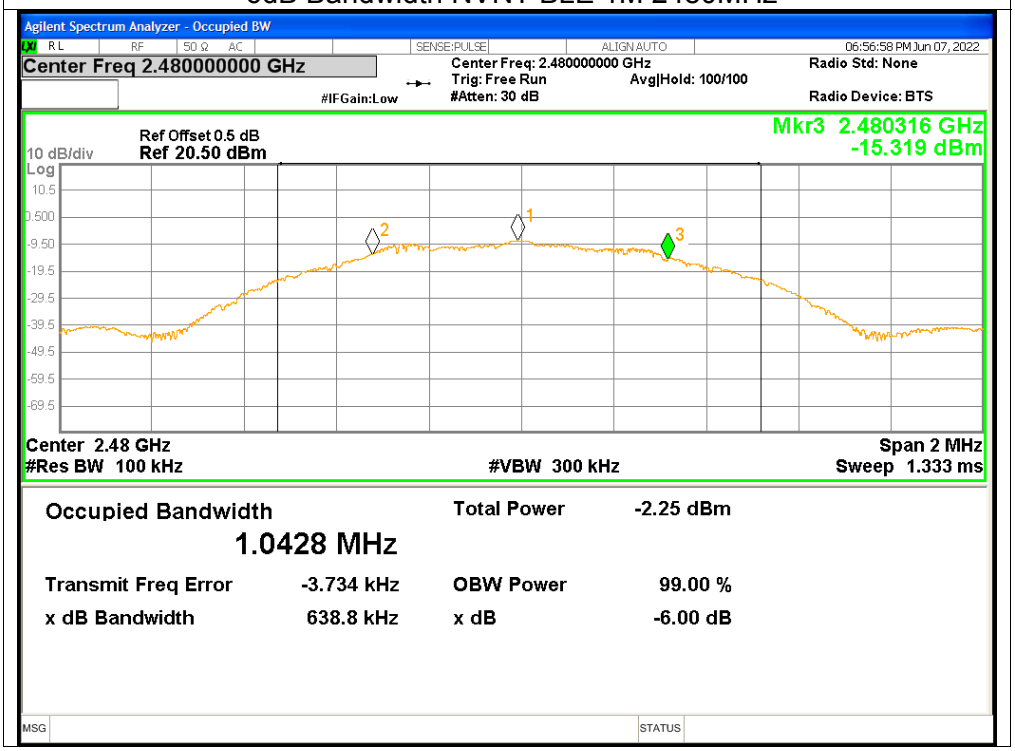
-6dB Bandwidth NVNT BLE 1M 2402MHz



-6dB Bandwidth NVNT BLE 1M 2440MHz

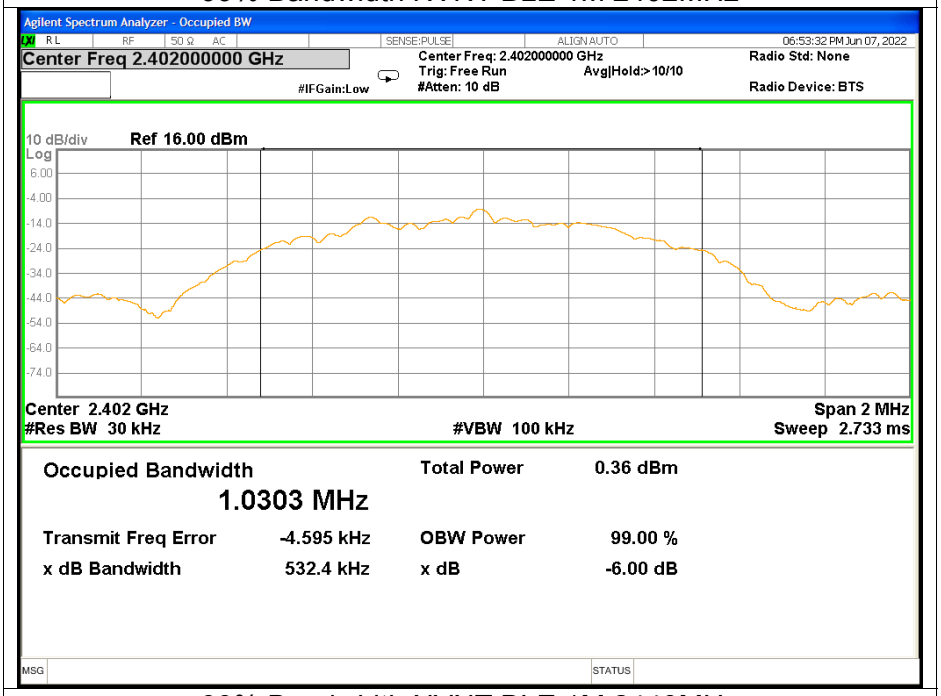


-6dB Bandwidth NVNT BLE 1M 2480MHz

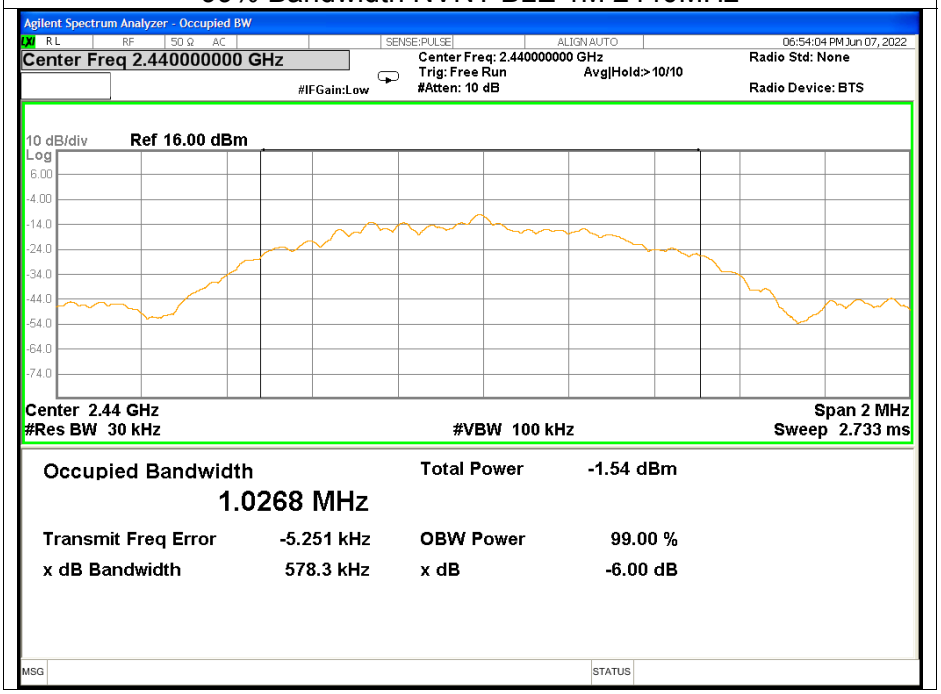


Test Graphs

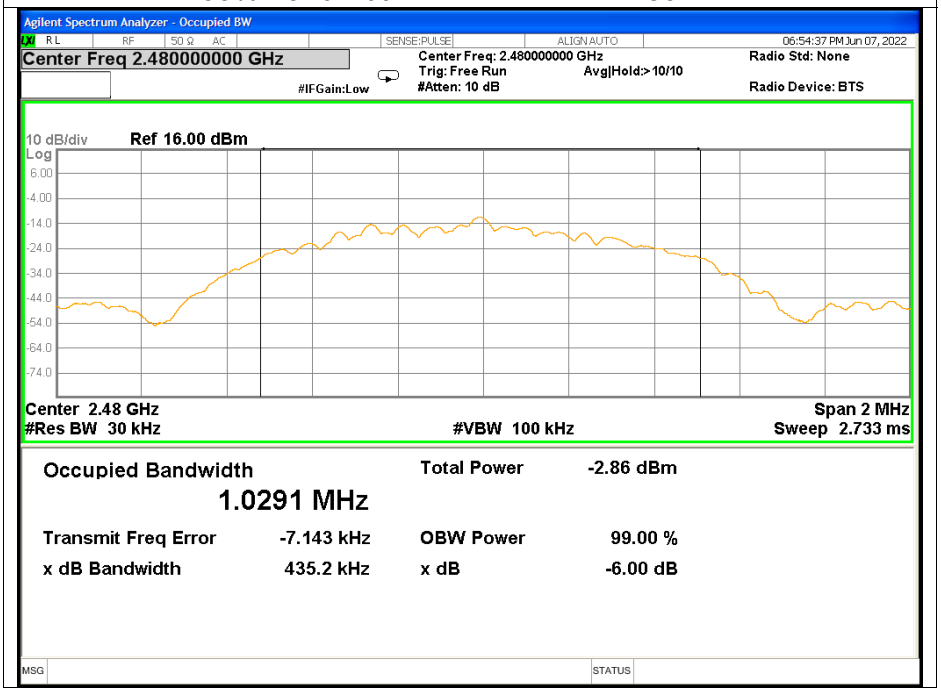
99% Bandwidth NVNT BLE 1M 2402MHz



99% Bandwidth NVNT BLE 1M 2440MHz



99% Bandwidth NVNT BLE 1M 2480MHz



8.3. CONDUCTED OUTPUT POWER

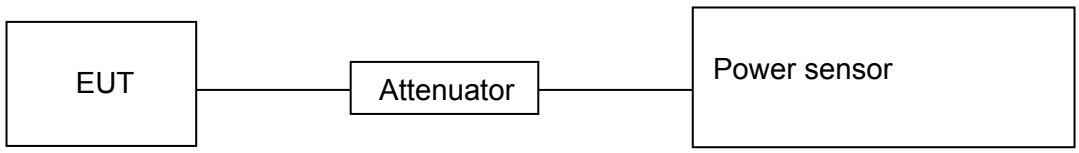
LIMITS

FCC Part15 (15.247) , Subpart C IC RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(b)(3) RSS-247 5.4 (d)	Conducted Output Power	1 watt or 30dBm	2400-2483.5
RSS-247	EIRP	4W	2400-2483.5

TEST PROCEDURE

Place the EUT on the table and set it in the transmitting mode.
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.
Measure peak power each channel.

TEST SETUP



TEST ENVIRONMENT

Temperature	25.5°C	Relative Humidity	37%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

RESULTS

Condition	Mode	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE 1M	2402	-5.16	<=30	Pass
NVNT	BLE 1M	2440	-6.93	<=30	Pass
NVNT	BLE 1M	2480	-7.76	<=30	Pass

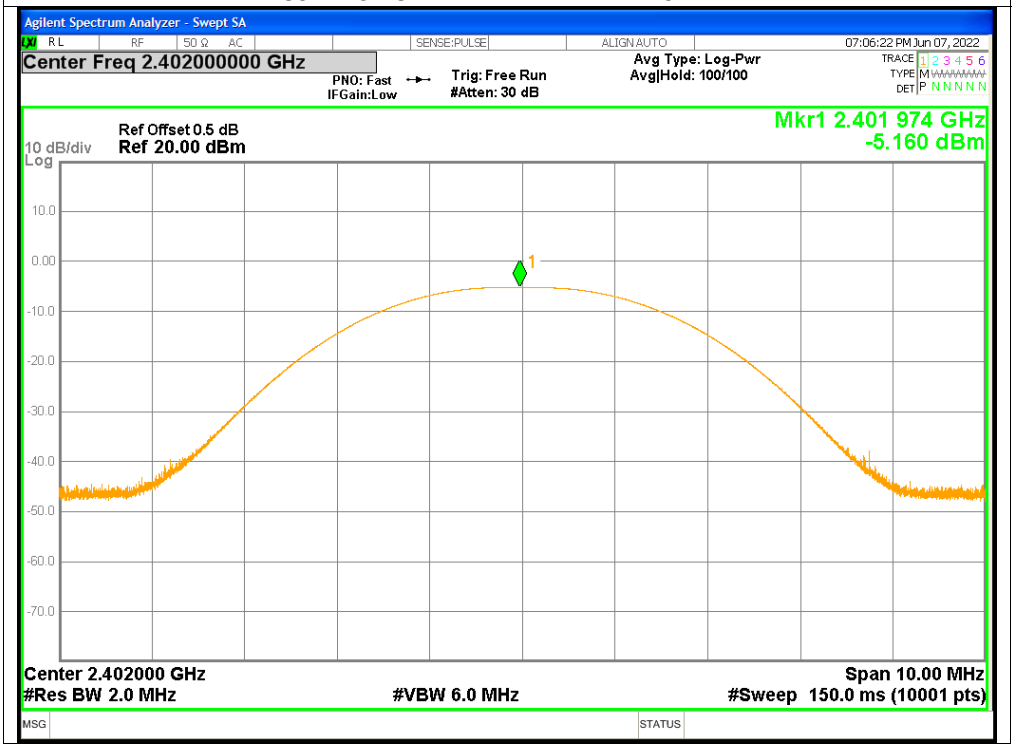
EIRP

Test Channel	Frequency	Peak Conducted Output Power	Antenna Gain	EIRP Power	LIMIT
	(MHz)	(dBm)	(dBi)	(dBm)	dBm
CH0	2402	-5.16	1.00	-4.16	36.02
CH19	2440	-6.93	1.00	-5.93	36.02
CH39	2480	-7.76	1.00	-6.76	36.02

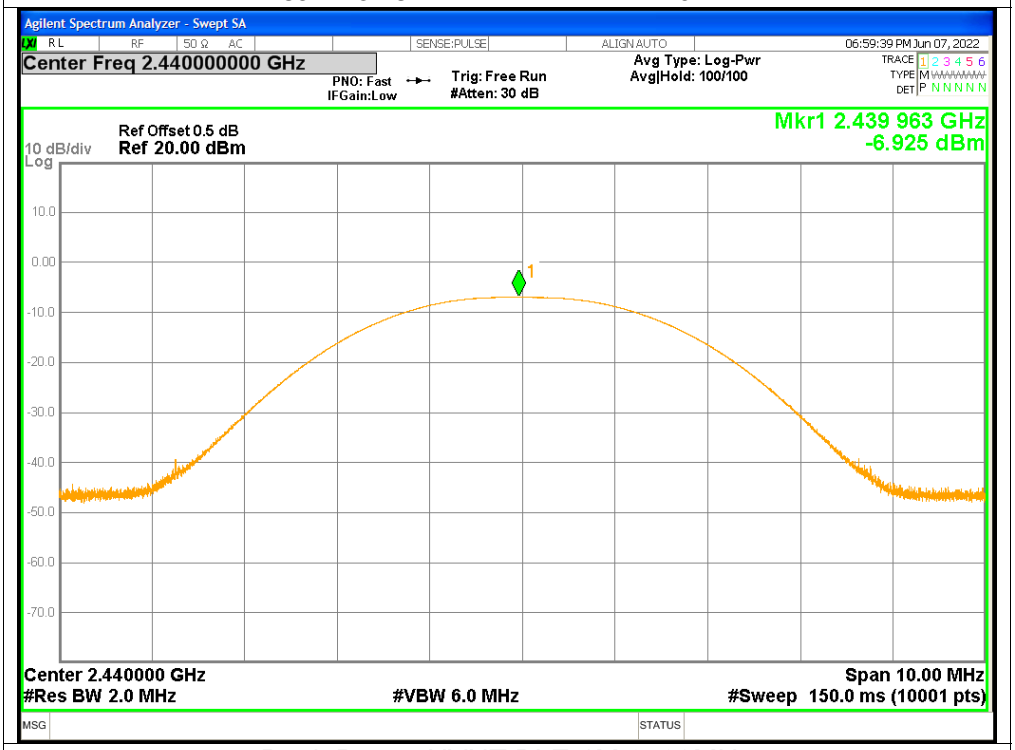
Note: The power sensor has no duty cycle display. The measured AVG power is Burst power. The software has considered the factor of the duty cycle correction factor, so it is unnecessary to add it again.

Test Graphs

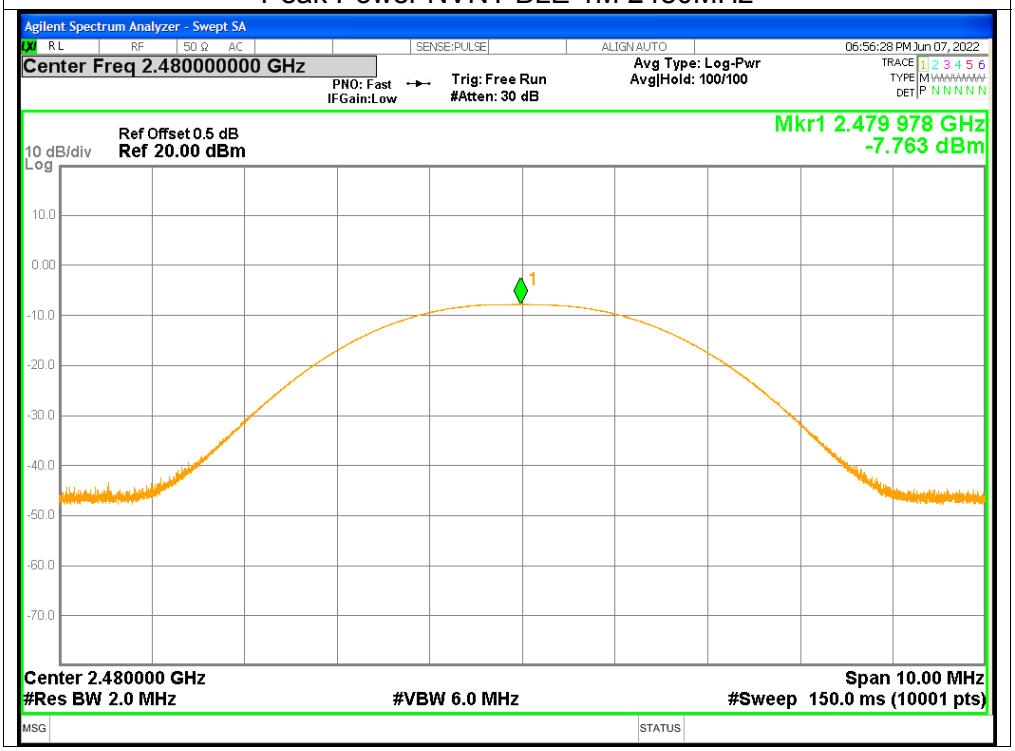
Peak Power NVNT BLE 1M 2402MHz



Peak Power NVNT BLE 1M 2440MHz



Peak Power NVNT BLE 1M 2480MHz



8.4. POWER SPECTRAL DENSITY

LIMITS

FCC Part15 (15.247) , Subpart C IC RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
FCC §15.247 (e) RSS-247 5.2 (b)	Power Spectral Density	8 dBm in any 3 kHz band	2400-2483.5

TEST PROCEDURE

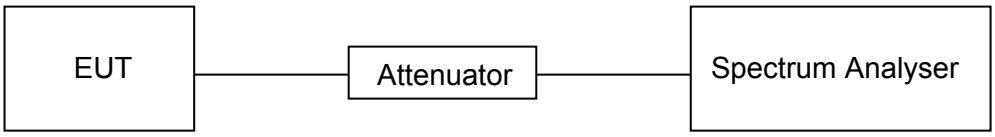
Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	3 kHz ≤ RBW ≤ 100 kHz
VBW	≥3 × RBW
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

Allow trace to fully stabilize and use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

TEST SETUP



TEST ENVIRONMENT

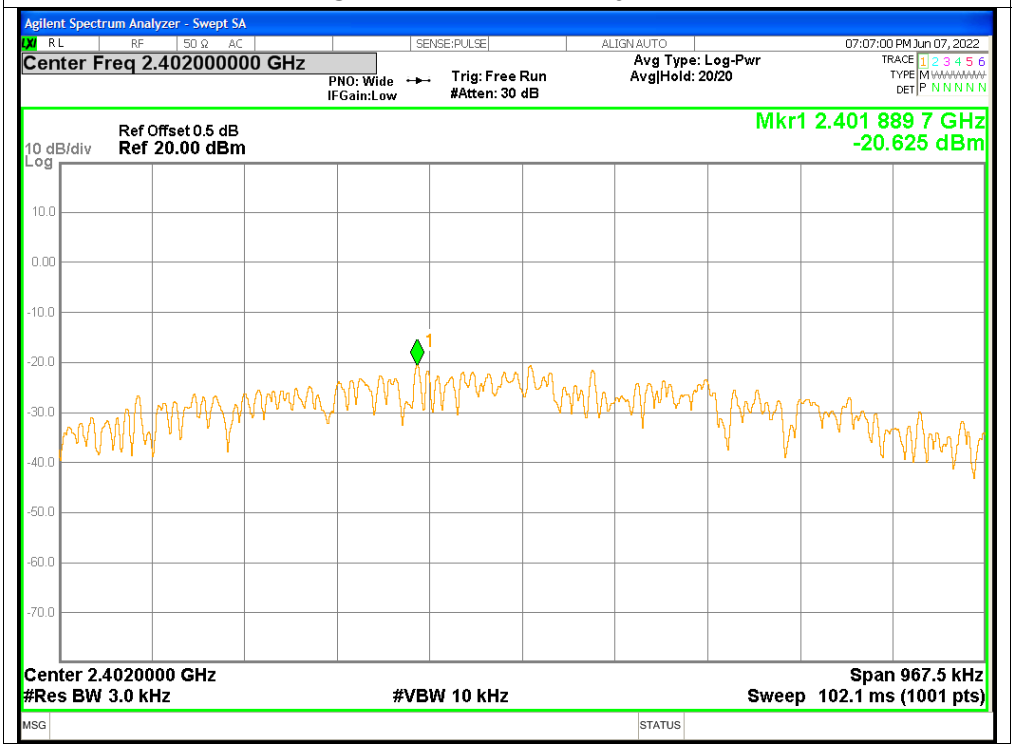
Temperature	25.5°C	Relative Humidity	37%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

RESULTS

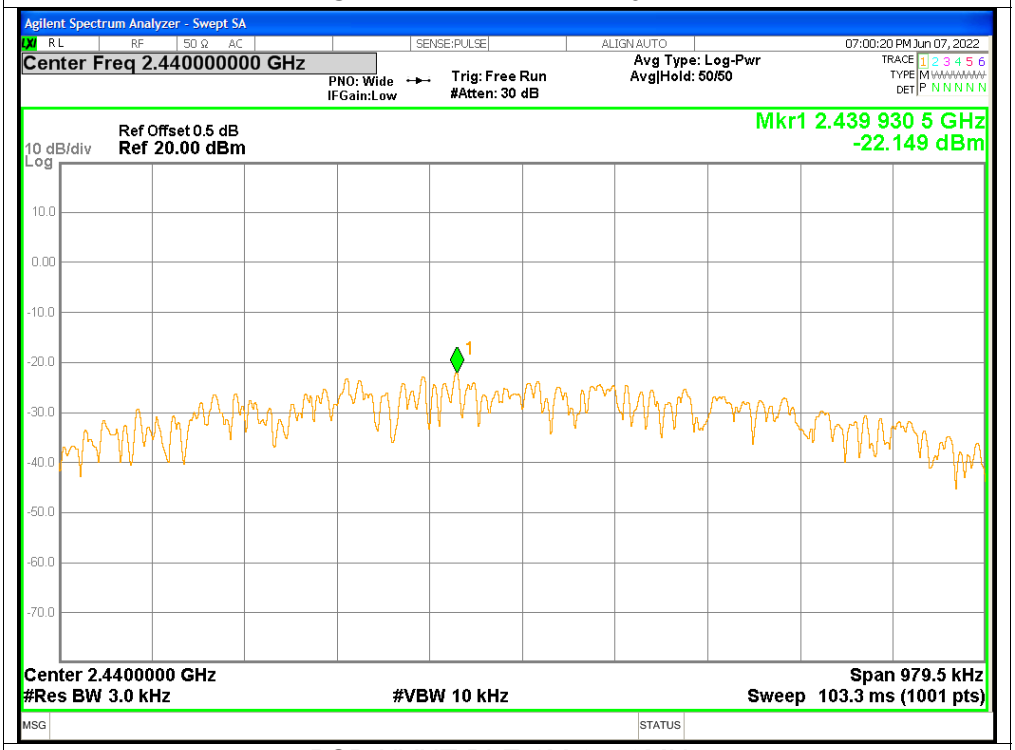
Condition	Mode	Frequency (MHz)	Conducted PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
NVNT	BLE 1M	2402	-20.63	<=8	Pass
NVNT	BLE 1M	2440	-22.15	<=8	Pass
NVNT	BLE 1M	2480	-24.06	<=8	Pass

Test Graphs

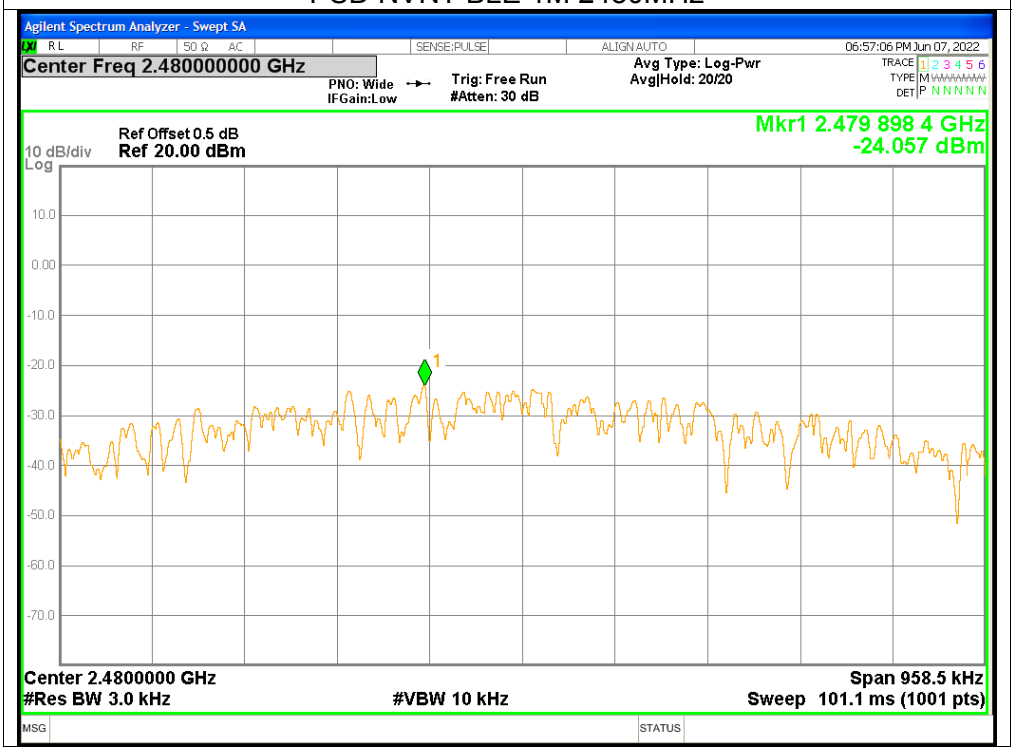
PSD NVNT BLE 1M 2402MHz



PSD NVNT BLE 1M 2440MHz



PSD NVNT BLE 1M 2480MHz



8.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

LIMITS

FCC Part15 (15.247) , Subpart C IC RSS-247 ISSUE 2		
Section	Test Item	Limit
FCC §15.247 (d) RSS-247 5.5	Conducted Bandedge and Spurious Emissions	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

TEST PROCEDURE

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

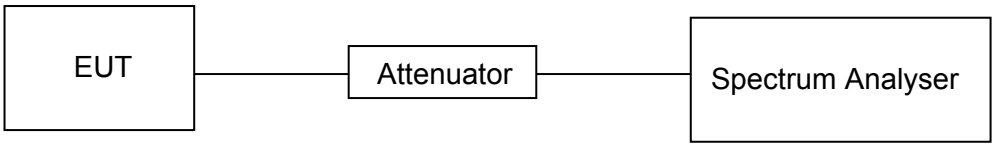
Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	100K
VBW	≥3 × RBW
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

Use the peak marker function to determine the maximum PSD level.

Span	Set the center frequency and span to encompass frequency range to be measured
Detector	Peak
RBW	100K
VBW	≥3 × RBW
measurement points	≥span/RBW
Trace	Max hold
Sweep time	Auto couple.

Use the peak marker function to determine the maximum amplitude level**.**

TEST SETUP



TEST ENVIRONMENT

Temperature	25.5°C	Relative Humidity	37%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

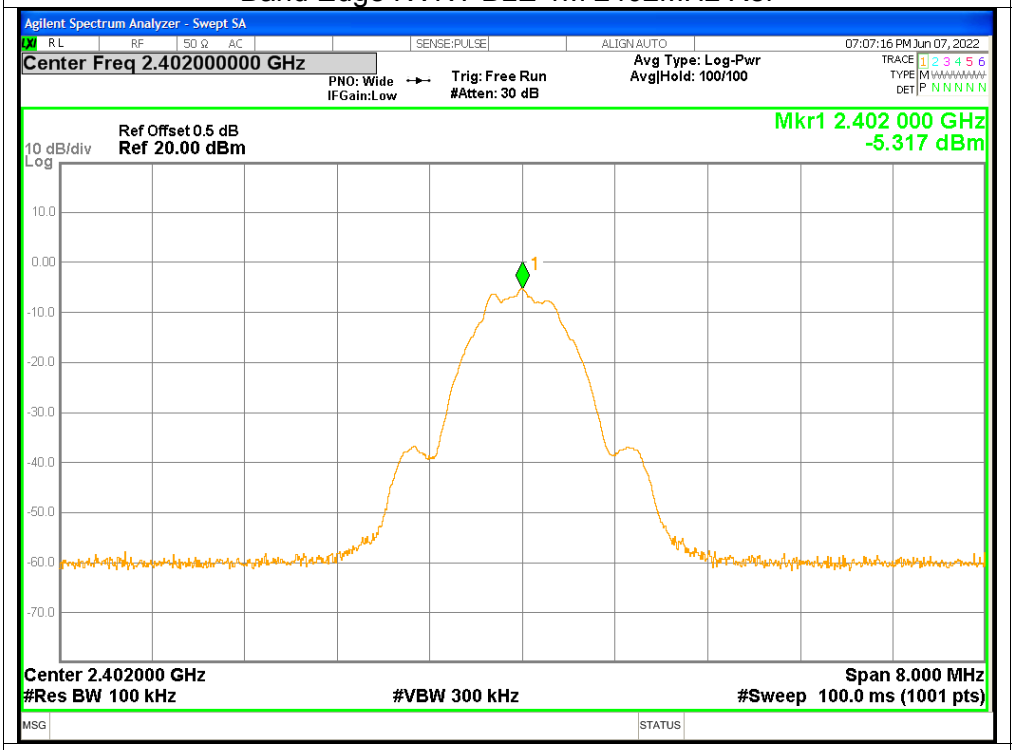
RESULTS

Band Edge

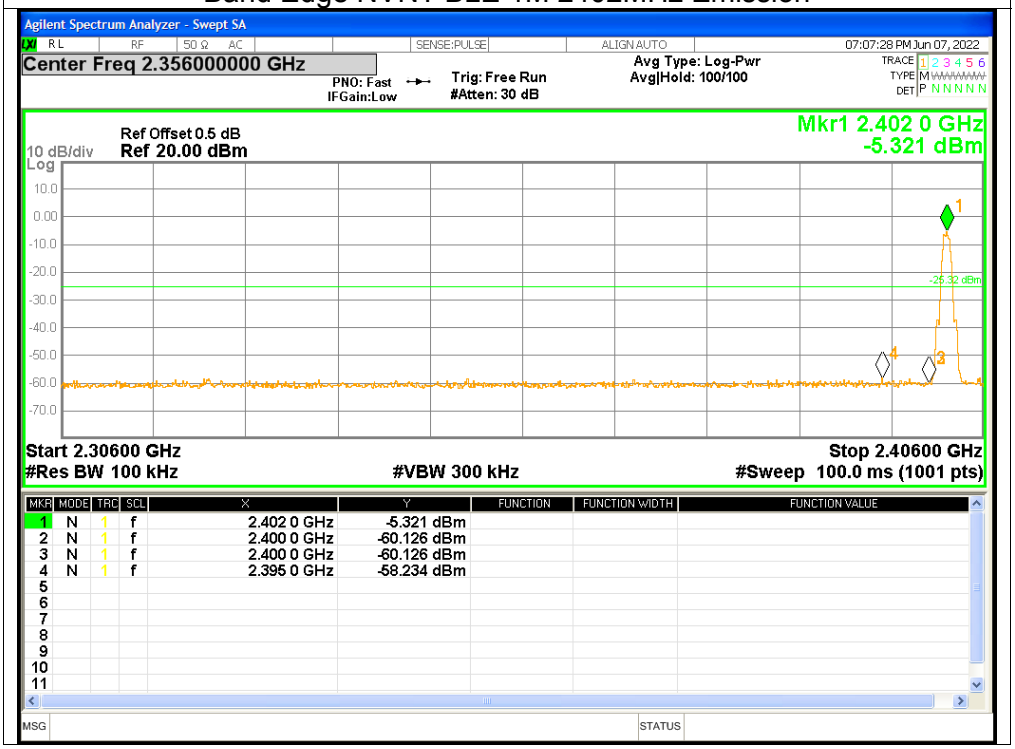
Condition	Mode	Frequency (MHz)	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	-52.91	<=-20	Pass
NVNT	BLE 1M	2480	-49.49	<=-20	Pass

Test Graphs

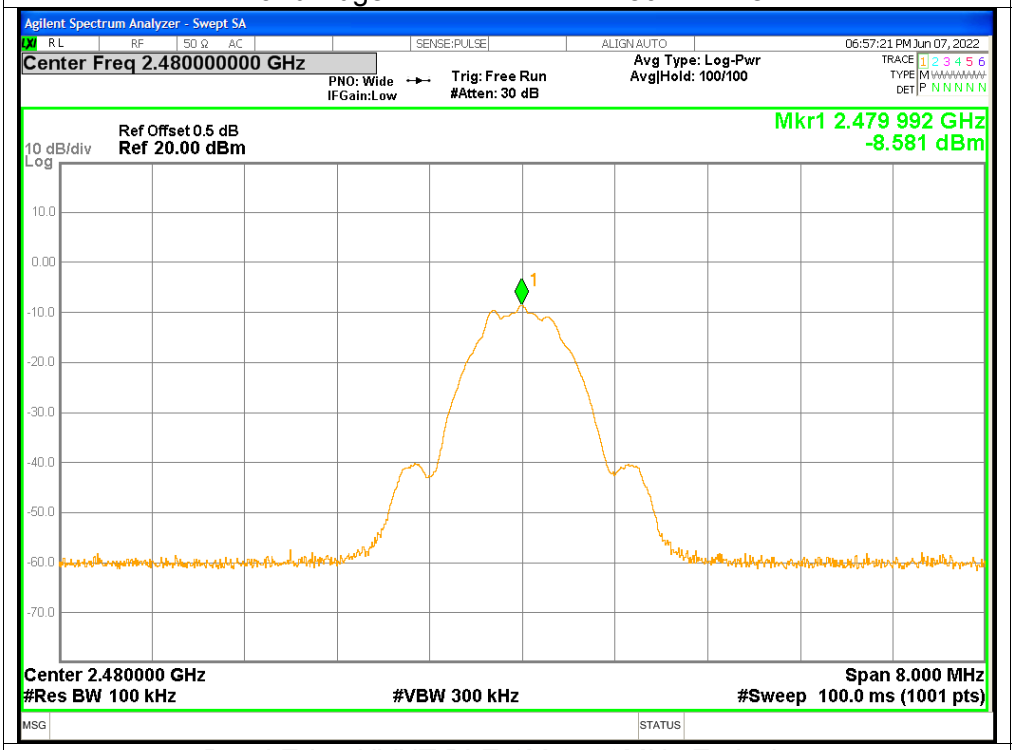
Band Edge NVNT BLE 1M 2402MHz Ref



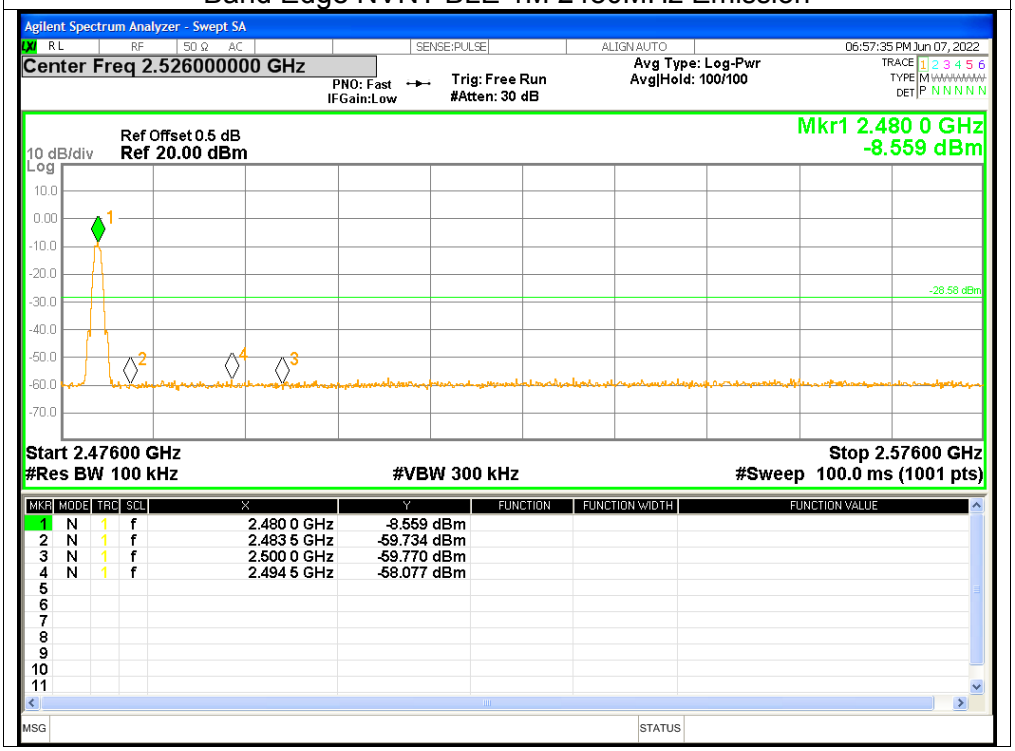
Band Edge NVNT BLE 1M 2402MHz Emission



Band Edge NVNT BLE 1M 2480MHz Ref



Band Edge NVNT BLE 1M 2480MHz Emission

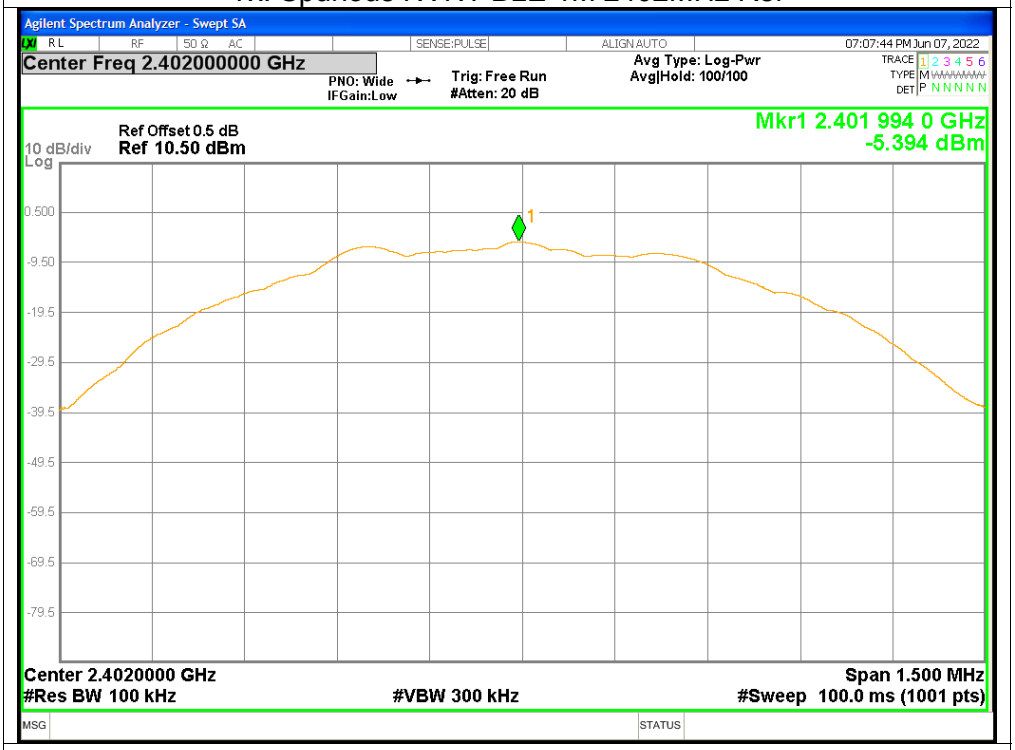


Conducted RF Spurious Emission

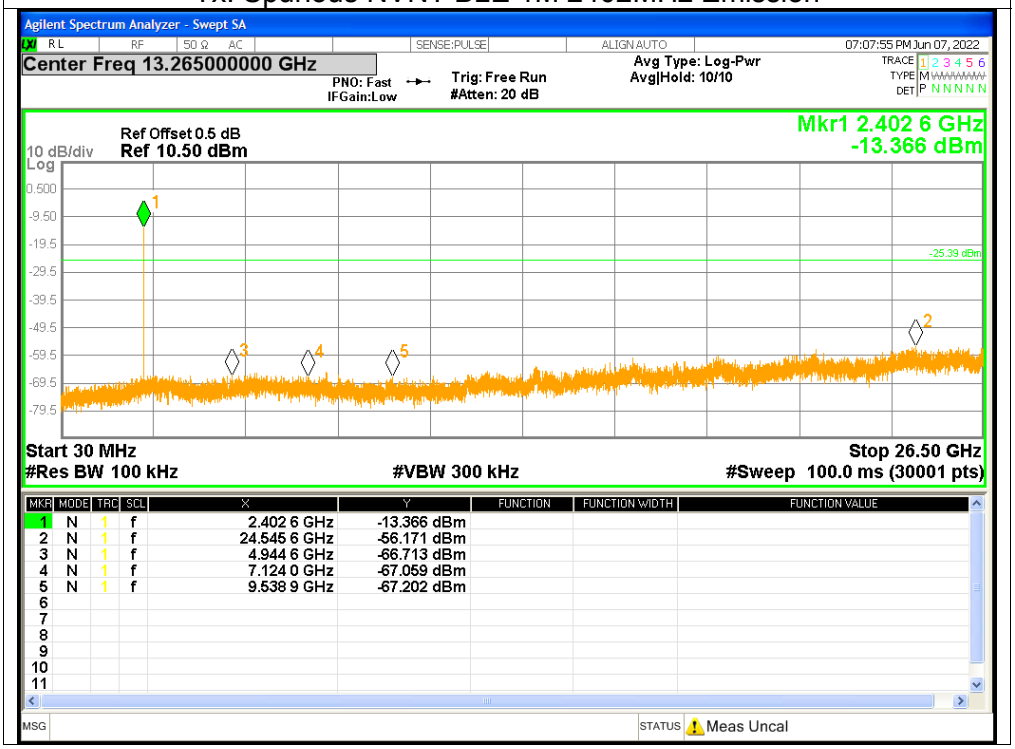
Condition	Mode	Frequency (MHz)	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	-50.78	<=-20	Pass
NVNT	BLE 1M	2440	-49.22	<=-20	Pass
NVNT	BLE 1M	2480	-47.76	<=-20	Pass

Test Graphs

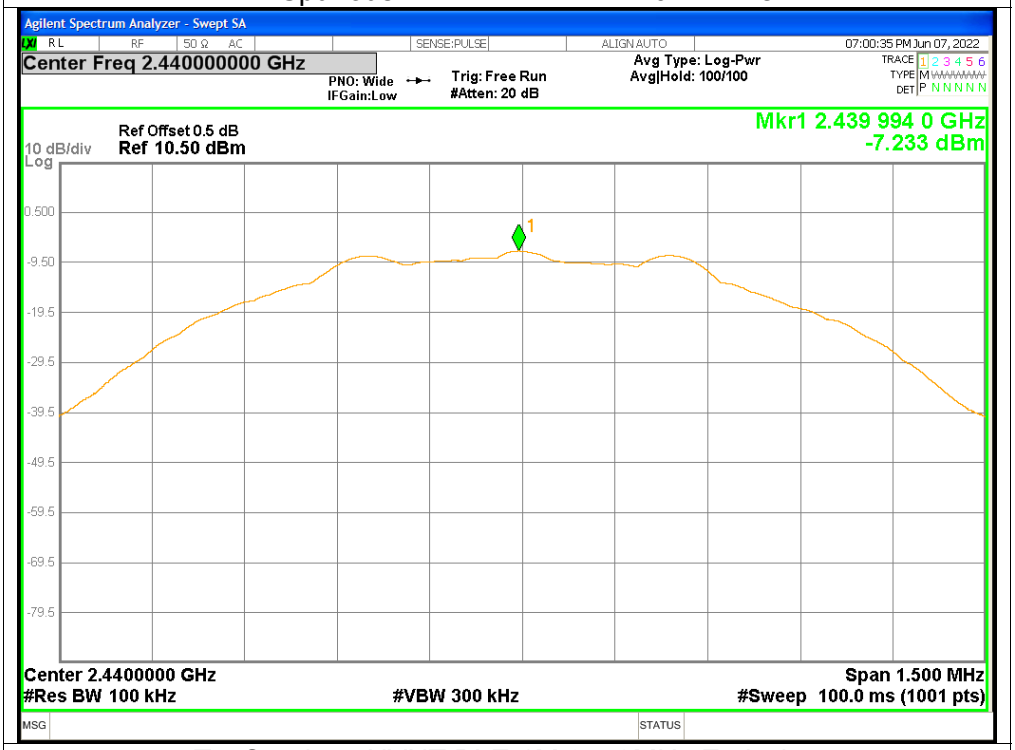
Tx. Spurious NVNT BLE 1M 2402MHz Ref



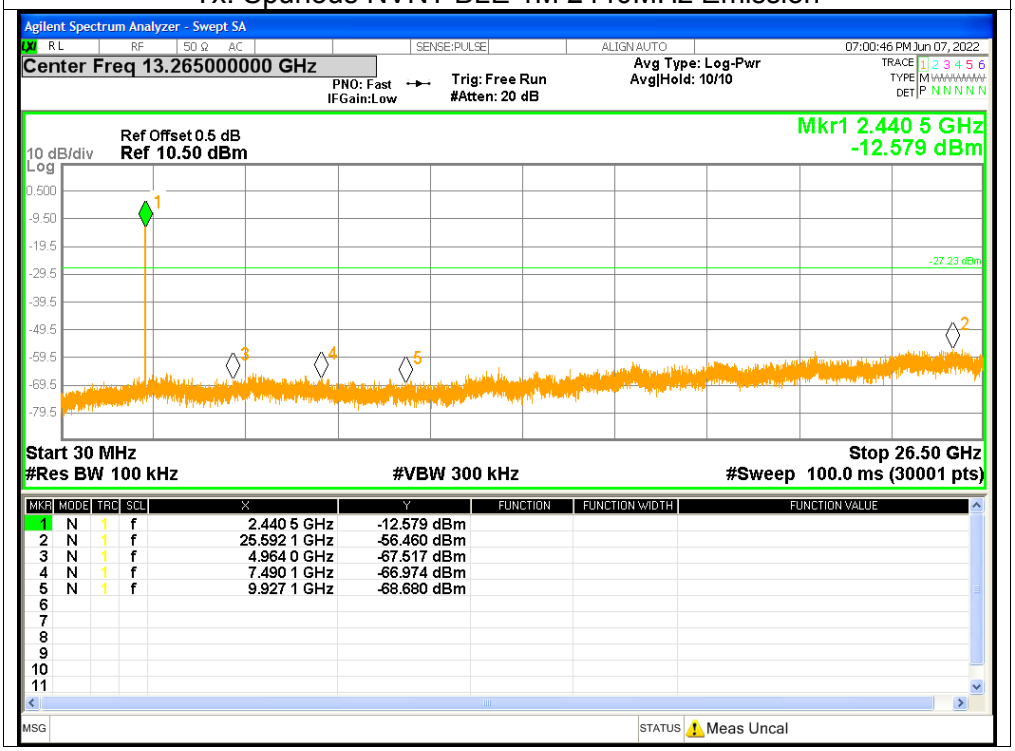
Tx. Spurious NVNT BLE 1M 2402MHz Emission



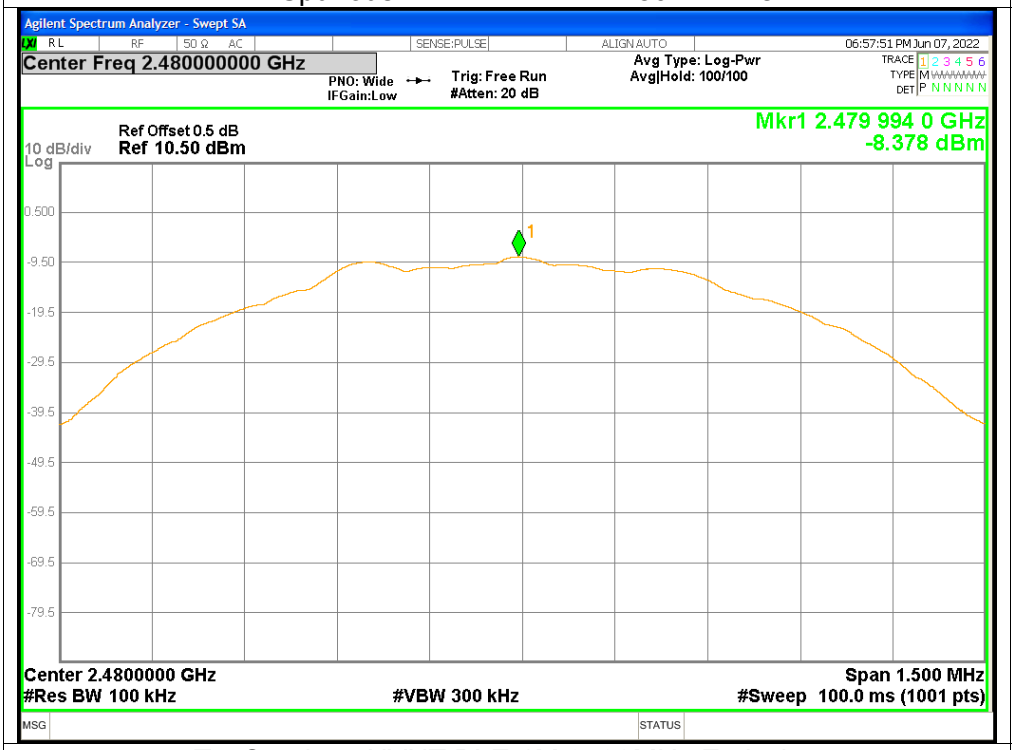
Tx. Spurious NVNT BLE 1M 2440MHz Ref



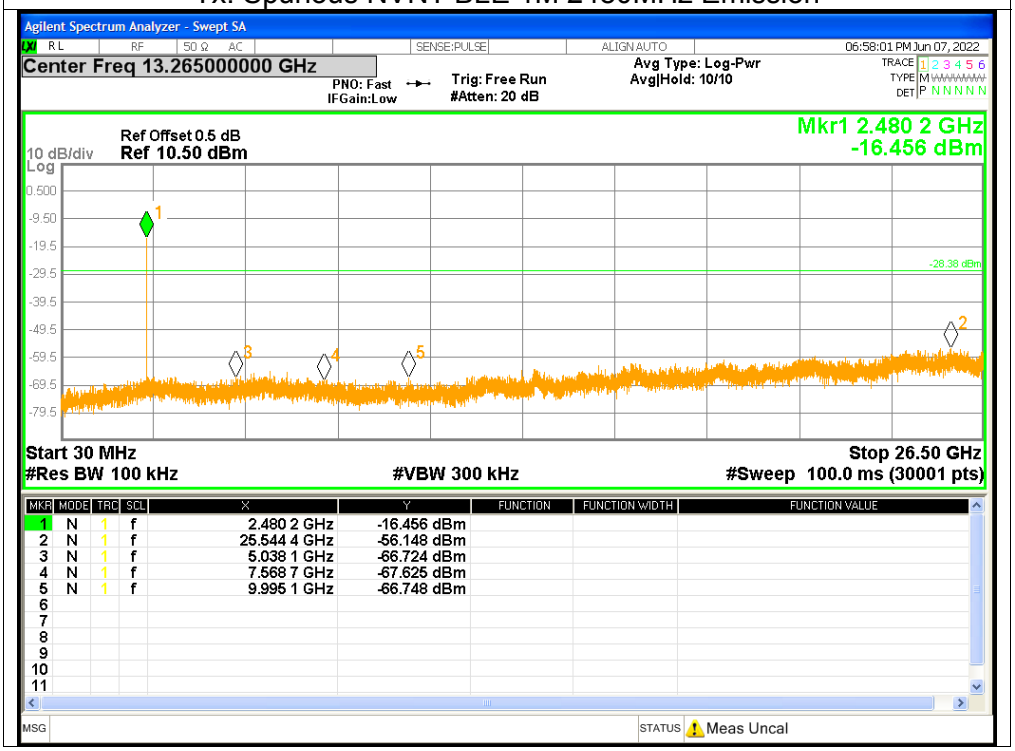
Tx. Spurious NVNT BLE 1M 2440MHz Emission



Tx. Spurious NVNT BLE 1M 2480MHz Ref



Tx. Spurious NVNT BLE 1M 2480MHz Emission



9. RADIATED TEST RESULTS

LIMITS

Please refer to FCC §15.205 and §15.209

Please refer to RSS-GEN Clause 8.9 (Transmitter)

Radiation Disturbance Test Limit for FCC (Class B)(9KHz-1GHz)

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3

Note: 1) At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

(2) At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). This paragraph (f) shall not apply to Access BPL devices operating below 30 MHz.

Radiation Disturbance Test Limit for RSS-Gen (9KHz-1GHz)

Frequencies (MHz)	Magnetic field strength (H-Field) (μA/m)	Measurement Distance (meters)
0.009~0.490	6.37/F(KHz)	300
0.490~1.705	63.7/F(KHz)	30
1.705~30.0	0.08	30

Frequencies (MHz)	Field strength (μV/m at 3 m)
30~88	100
88~216	150
216~960	200
Above 960	500

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

Radiation Disturbance Test Limit for FCC (Above 1G)

Frequency (MHz)	dB(uV/m) (at 3 meters)	
	Peak	Average
Above 1000	74	54

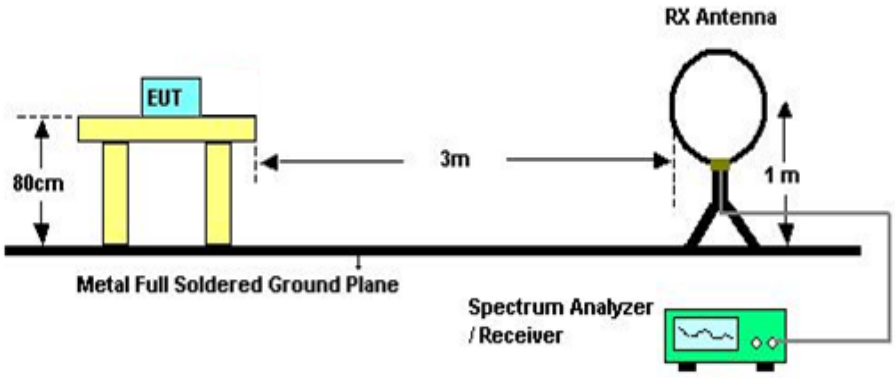
Restricted bands of operation

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

Note: [1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2]Above 38.6c

TEST SETUP AND PROCEDURE

Below 30MHz



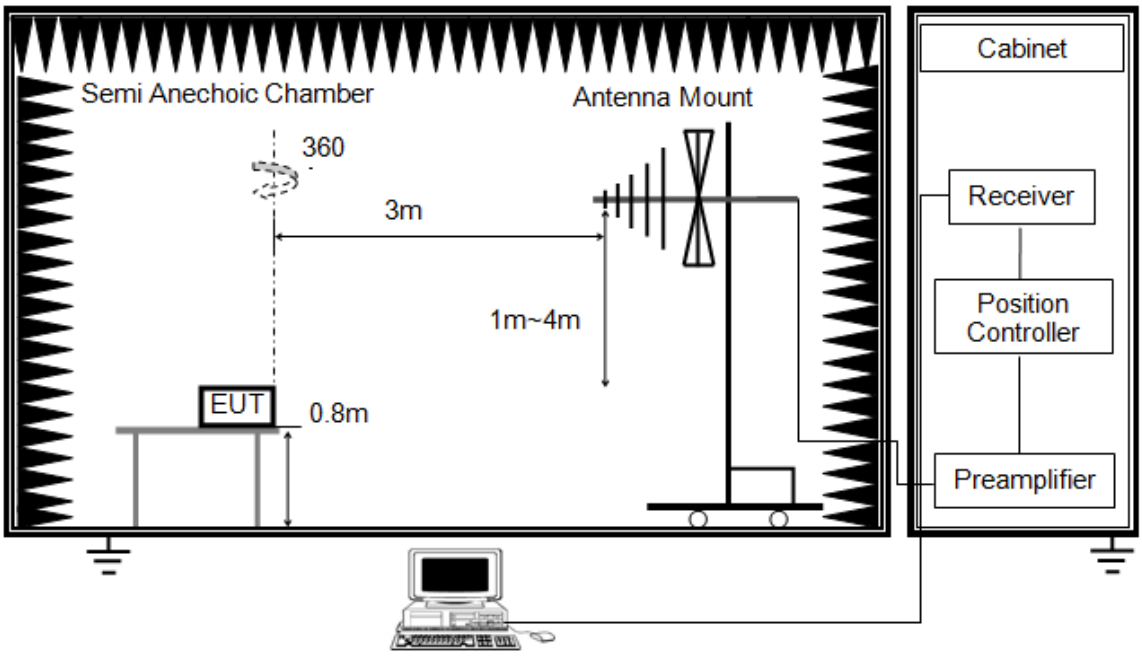
The setting of the spectrum analyser

RBW	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)
VBW	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)
Sweep	Auto
Detector	Peak/QP/ Average
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013
2. The EUT was arranged to its worst case and then turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. The EUT was placed on a turntable with 0.8 meter above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
6. For the actual test configuration, please refer to the related item in this test report (Photographs of the Test Configuration)

Note: Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

Below 1G



The setting of the spectrum analyser

RBW	120K
VBW	300K
Sweep	Auto
Detector	Peak/QP
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013.

2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

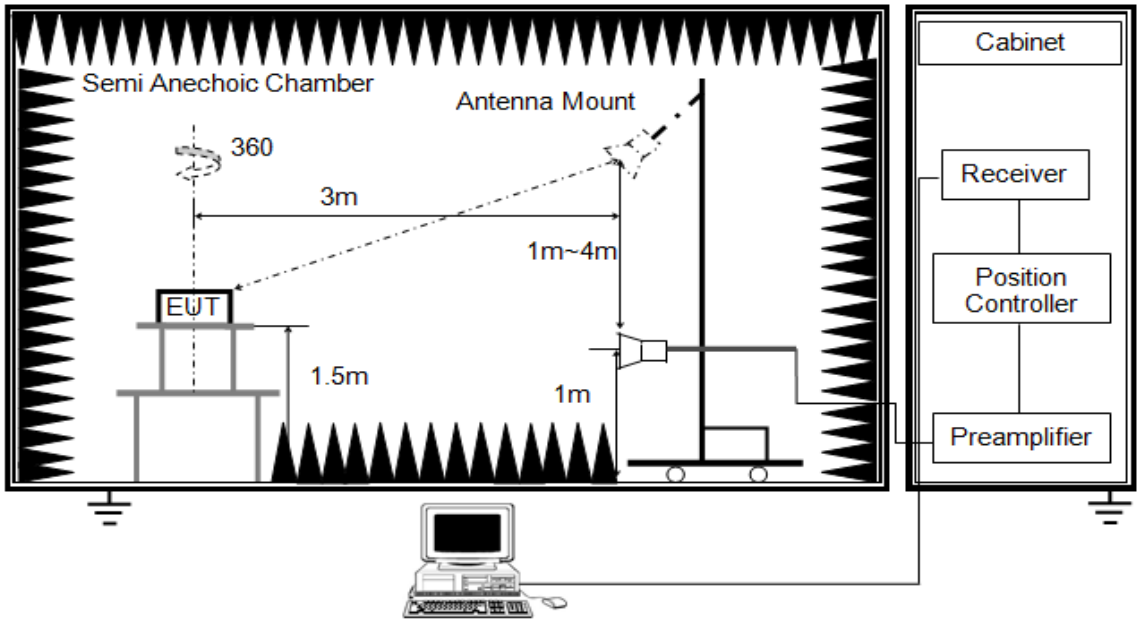
3. The EUT was placed on a turntable with 0.8 meter above ground.

4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

5. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

6. For the actual test configuration, please refer to the related Item in this test report (Photographs of the Test Configuration)

ABOVE 1G



The setting of the spectrum analyser

RBW	1M
VBW	PEAK: 3M AVG: see note 6
Sweep	Auto
Detector	Peak
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013.

2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

3. The EUT was placed on a turntable with 1.5m above ground.

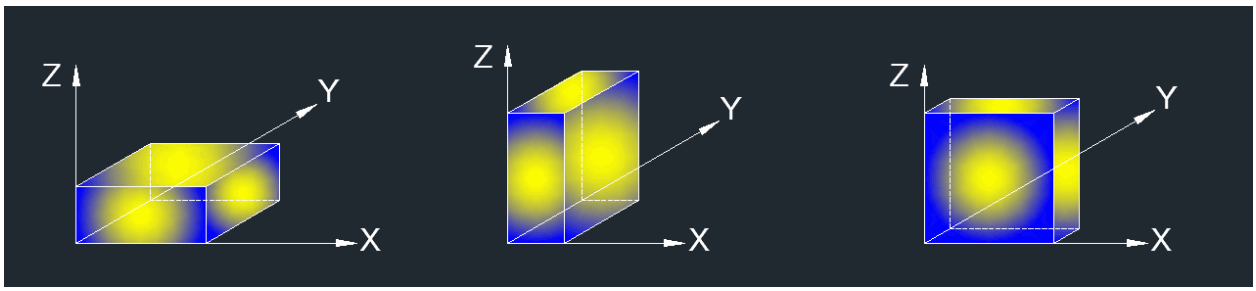
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

5. For measurement above 1GHz, the emission measurement will be measured by the peak detector. This peak level, once corrected, must comply with the limit specified in Section 15.209.

6. For peak measurements, the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz with peak detector; For average measurements, the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3KHz with peak detector.

7. For the actual test configuration, please refer to the related item in this test report (Photographs of the Test Configuration)

X axis, Y axis, Z axis positions:



TEST ENVIRONMENT

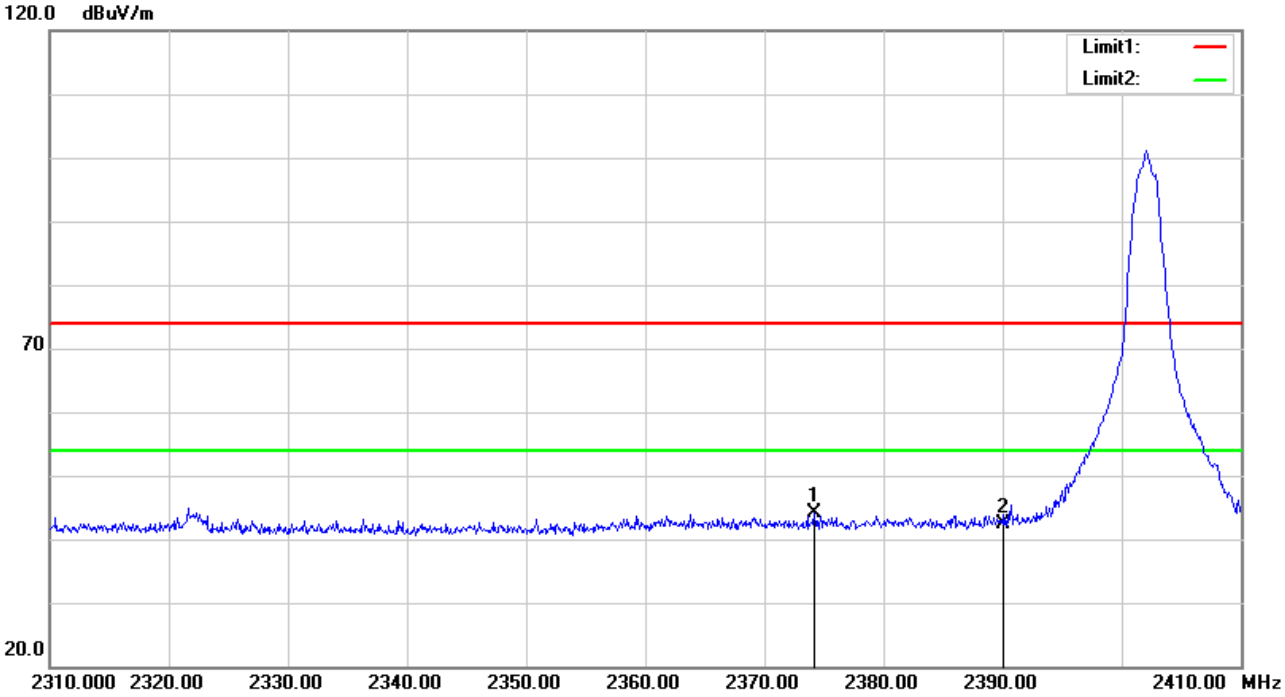
Temperature	23.1C	Relative Humidity	60%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

Note: Pre-test X-axis, Y-axis, and Z-axis positions, find the worst case in X-axis and record it in this report.

9.1. RESTRICTED BANDEDGE

GFSK

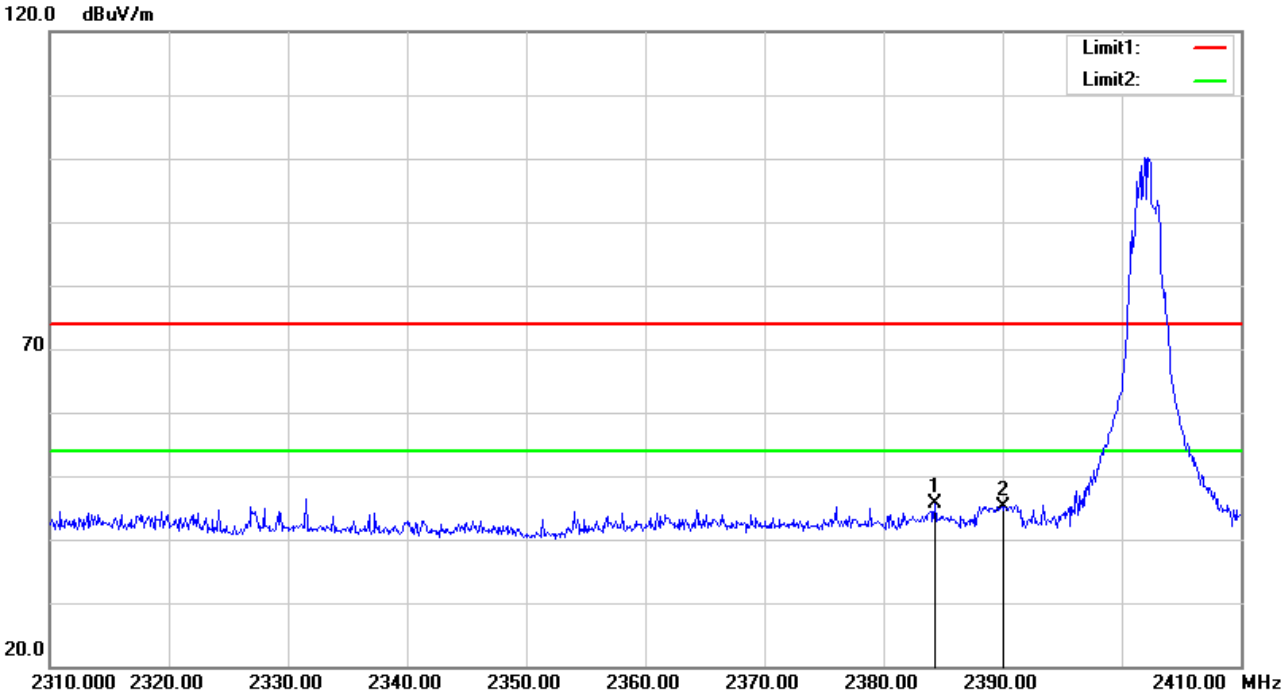
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2374.200	39.99	4.10	44.09	74.00	-29.91	peak
2	2390.000	38.04	4.34	42.38	74.00	-31.62	peak

Note: Measurement = Reading Level + Correct Factor.

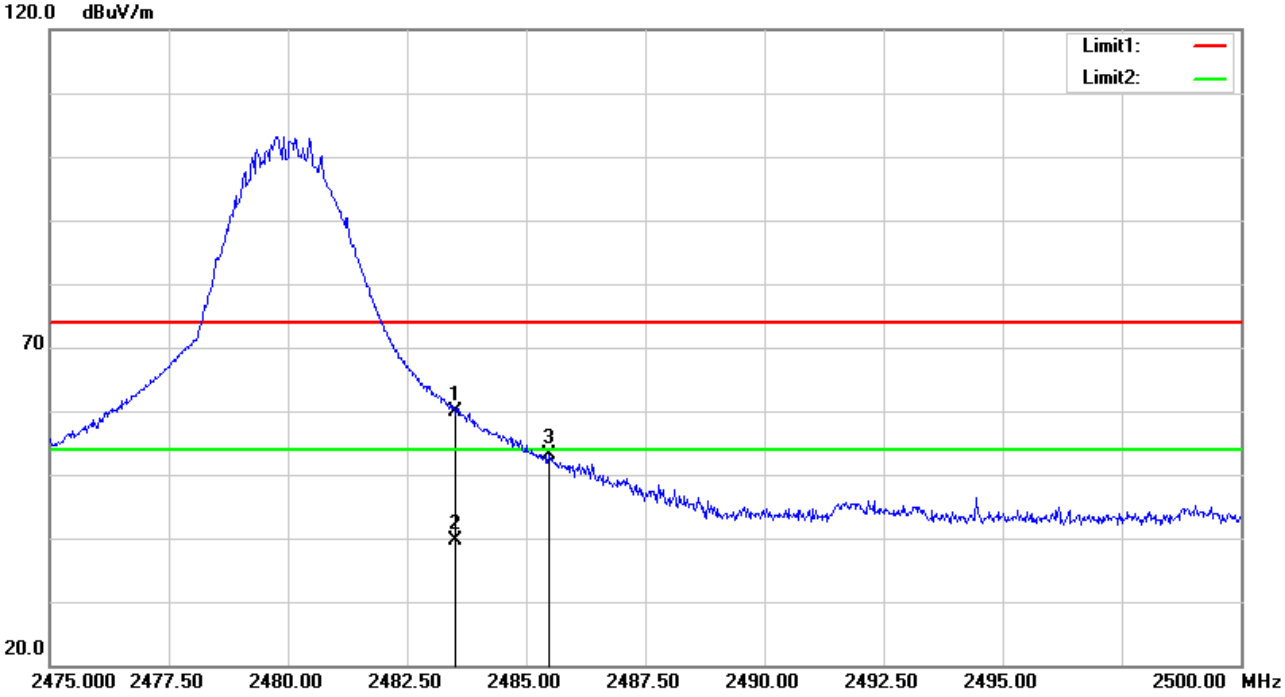
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2384.300	41.27	4.26	45.53	74.00	-28.47	peak
2	2390.000	40.77	4.34	45.11	74.00	-28.89	peak

Note: Measurement = Reading Level + Correct Factor.

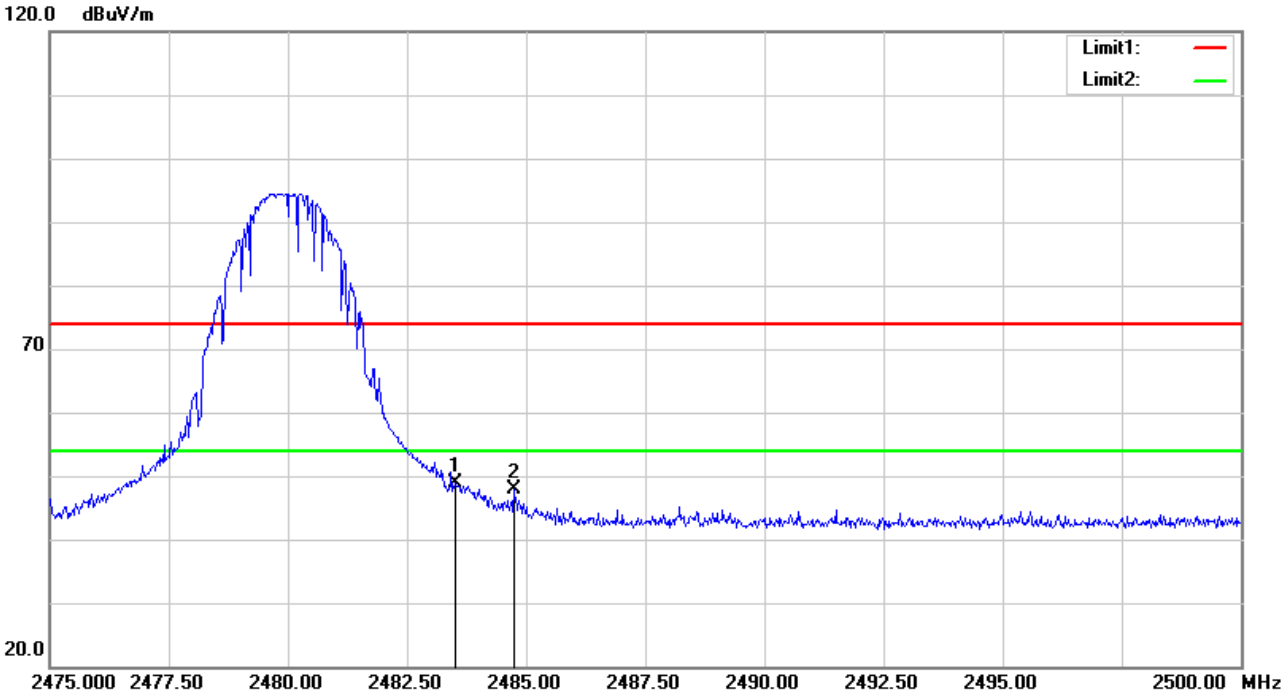
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	55.31	4.60	59.91	74.00	-14.09	peak
2	2483.500	35.05	4.60	39.65	54.00	-14.35	AVG
3	2485.475	48.43	4.61	53.04	74.00	-20.96	peak

Note: Measurement = Reading Level + Correct Factor.

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



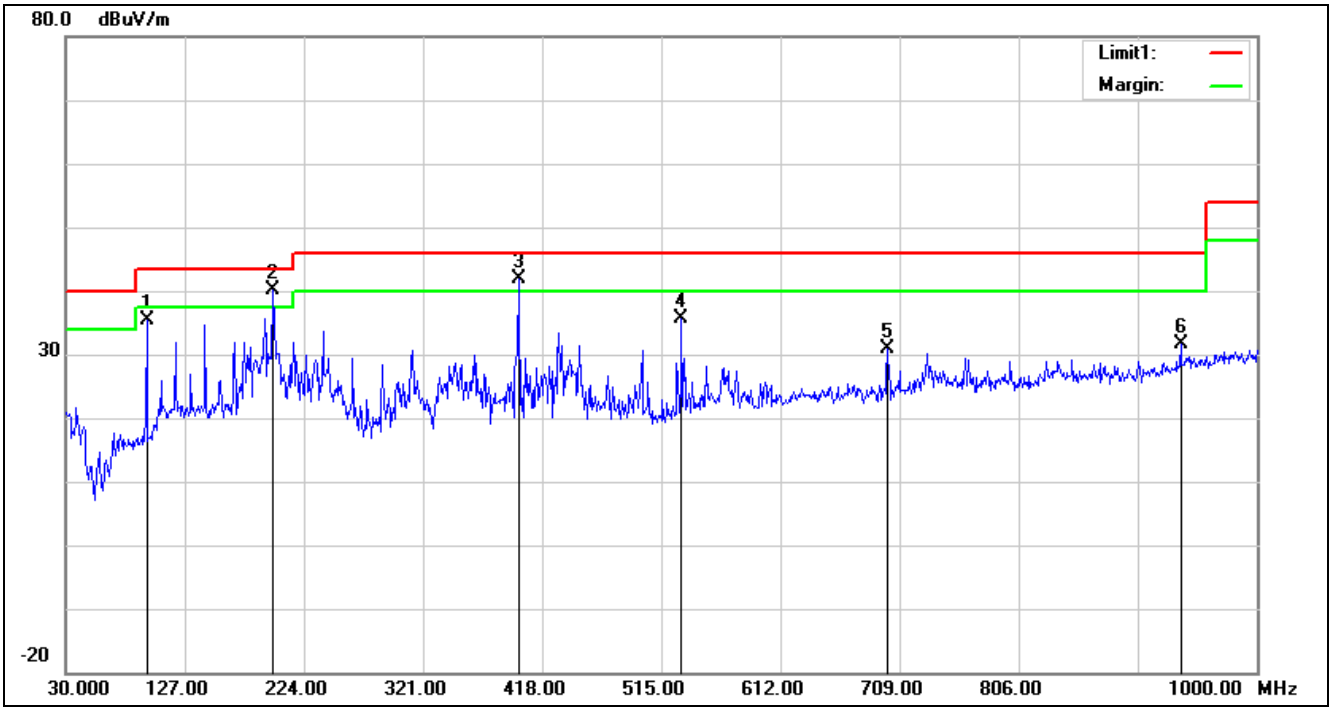
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	44.22	4.60	48.82	74.00	-25.18	peak
2	2484.750	43.25	4.61	47.86	74.00	-26.14	peak

Note: Measurement = Reading Level + Correct Factor.

9.2. SPURIOUS EMISSIONS 30MHz-1GHz

Note: All the channels had been tested, but only the worst data recorded in the report.

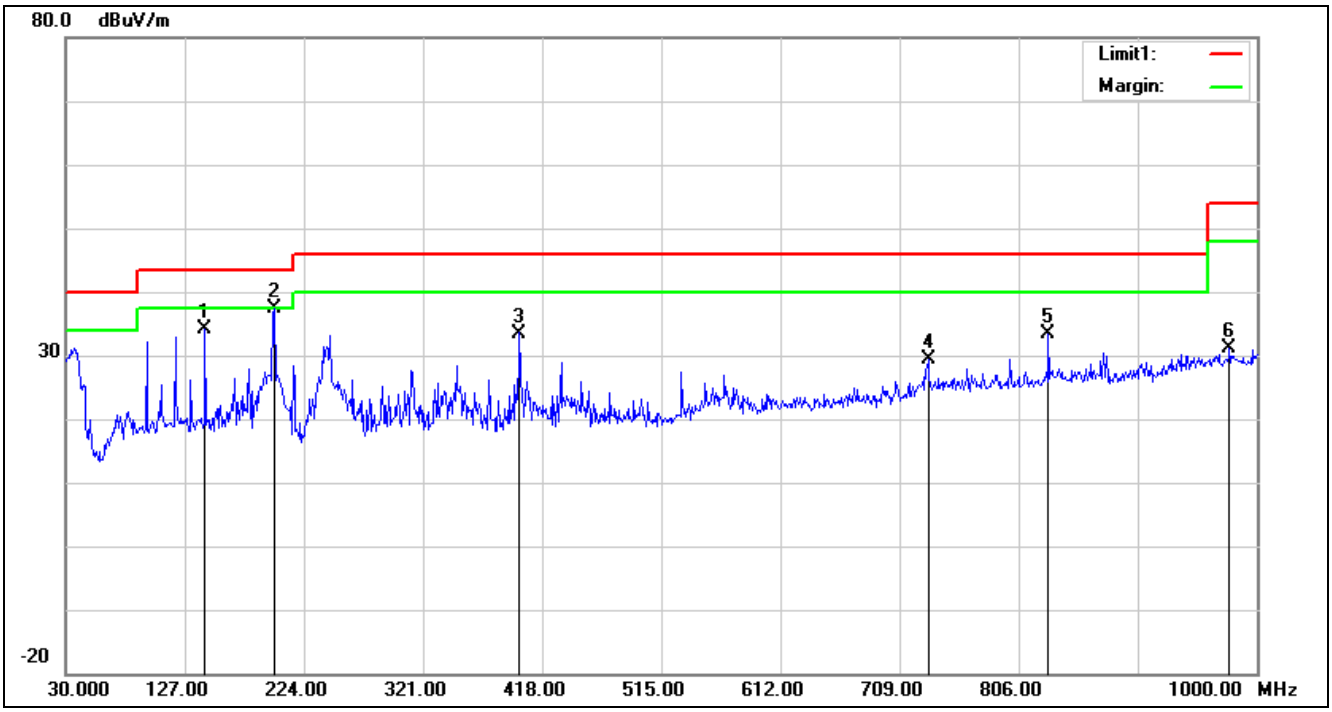
HARMONICS AND SPURIOUS EMISSIONS (HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	95.9600	56.17	-20.67	35.50	43.50	-8.00	peak
2	198.7800	61.33	-21.12	40.21	43.50	-3.29	peak
3	398.6000	53.17	-11.20	41.97	46.00	-4.03	peak
4	531.4900	43.08	-7.37	35.71	46.00	-10.29	peak
5	699.3000	35.17	-4.18	30.99	46.00	-15.01	peak
6	937.9200	30.48	1.20	31.68	46.00	-14.32	peak

Note: Measurement = Reading Level + Correct Factor.

HARMONICS AND SPURIOUS EMISSIONS (VERTICAL)

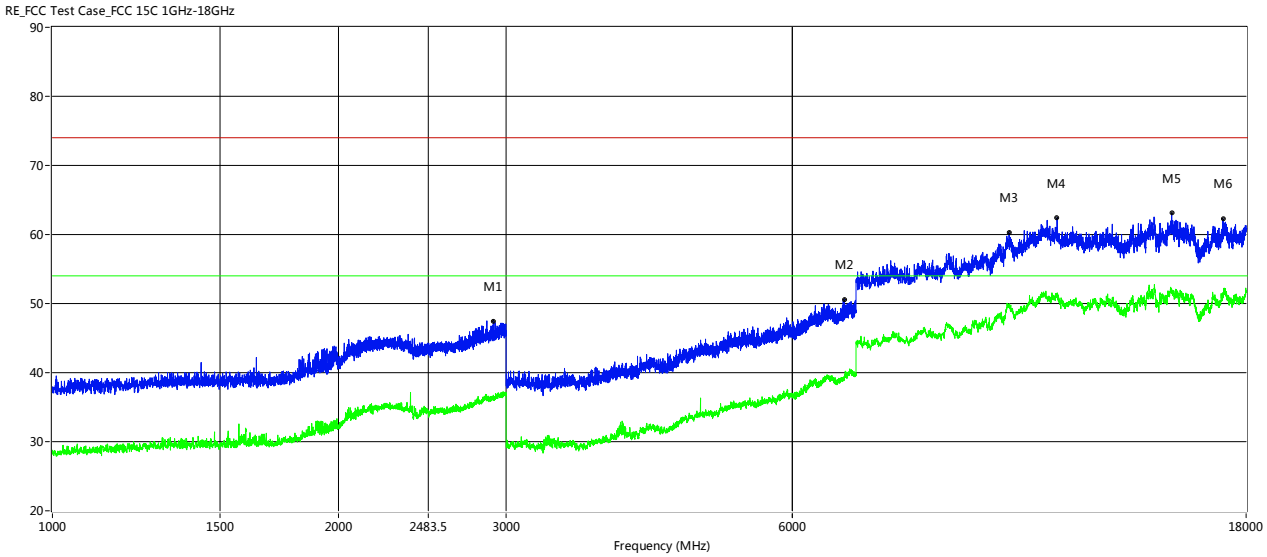


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	143.4900	52.31	-18.23	34.08	43.50	-9.42	peak
2	199.7500	58.44	-21.11	37.33	43.50	-6.17	peak
3	399.5700	44.66	-11.16	33.50	46.00	-12.50	peak
4	732.2800	31.78	-2.39	29.39	46.00	-16.61	peak
5	830.2500	34.20	-0.74	33.46	46.00	-12.54	peak
6	977.6900	28.64	2.52	31.16	54.00	-22.84	peak

Note: Measurement = Reading Level + Correct Factor.

9.3. SPURIOUS EMISSIONS Above 1 GHz

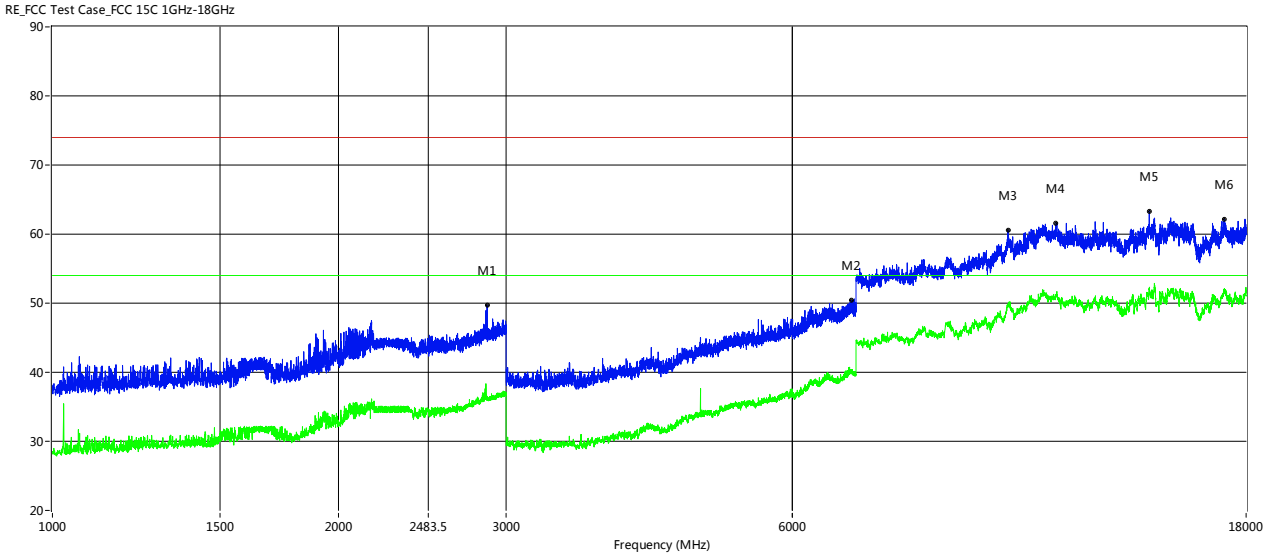
Low Channel
Horizontal



Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
2909.500	47.50	36.32	5.66	74.0	54.0	-17.68	Horizontal	Pass
6808.000	50.55	39.34	0.01	74.0	54.0	-14.66	Horizontal	Pass
10140.500	60.31	49.84	7.15	74.0	54.0	-4.16	Horizontal	Pass
11391.750	62.44	51.22	9.73	74.0	54.0	-2.78	Horizontal	Pass
15032.750	63.15	51.66	10.37	74.0	54.0	-2.34	Horizontal	Pass
17034.750	62.26	51.11	10.01	74.0	54.0	-2.89	Horizontal	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

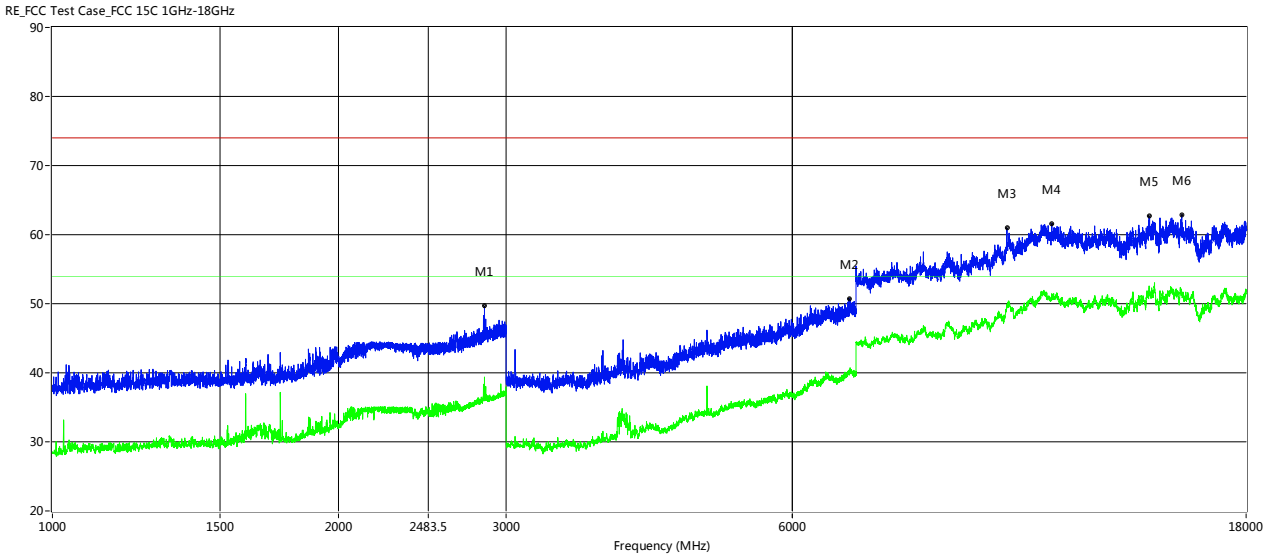
Vertical



Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
2865.000	49.73	36.44	5.61	74.0	54.0	-17.56	Vertical	Pass
6923.000	50.37	40.32	0.48	74.0	54.0	-13.68	Vertical	Pass
10124.000	60.58	49.76	7.16	74.0	54.0	-4.24	Vertical	Pass
11364.250	61.62	51.19	9.67	74.0	54.0	-2.81	Vertical	Pass
14240.750	63.31	51.99	11.28	74.0	54.0	-2.01	Vertical	Pass
17084.250	62.15	51.66	10.37	74.0	54.0	-2.34	Vertical	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

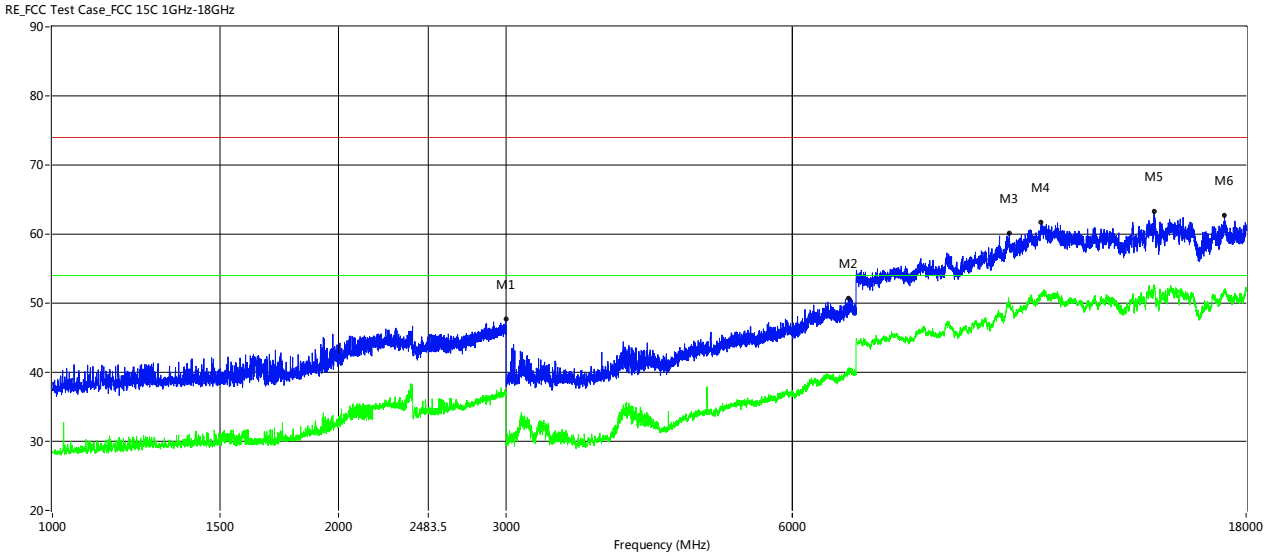
Mid Channel
Horizontal



Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
2848.000	49.66	39.39	5.60	74.0	54.0	-14.61	Horizontal	Pass
6883.000	50.74	40.12	0.38	74.0	54.0	-13.88	Horizontal	Pass
10088.250	60.94	49.94	6.94	74.0	54.0	-4.06	Horizontal	Pass
11246.000	61.64	51.46	9.57	74.0	54.0	-2.54	Horizontal	Pass
14235.250	62.67	52.55	11.33	74.0	54.0	-1.45	Horizontal	Pass
15404.000	62.89	51.59	10.95	74.0	54.0	-2.41	Horizontal	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

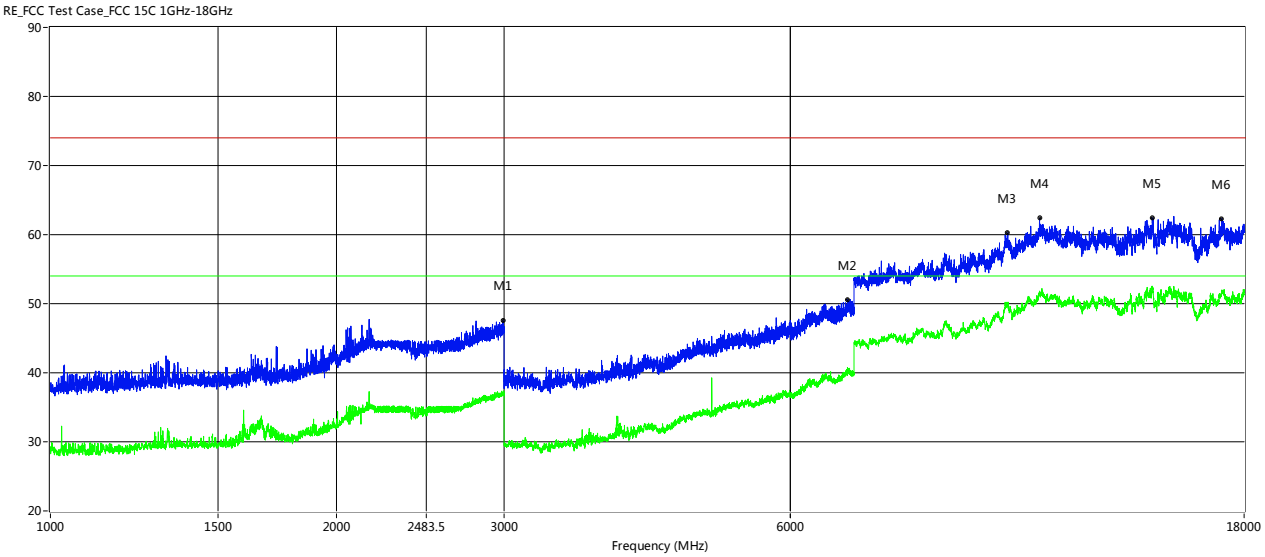
Vertical



Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
2998.000	47.68	37.16	6.10	74.0	54.0	-16.84	Vertical	Pass
6874.000	50.74	40.26	0.33	74.0	54.0	-13.74	Vertical	Pass
10146.000	60.19	50.24	7.15	74.0	54.0	-3.76	Vertical	Pass
10960.000	61.66	51.31	9.91	74.0	54.0	-2.69	Vertical	Pass
14403.000	63.23	52.38	11.39	74.0	54.0	-1.62	Vertical	Pass
17087.000	62.76	51.59	10.39	74.0	54.0	-2.41	Vertical	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

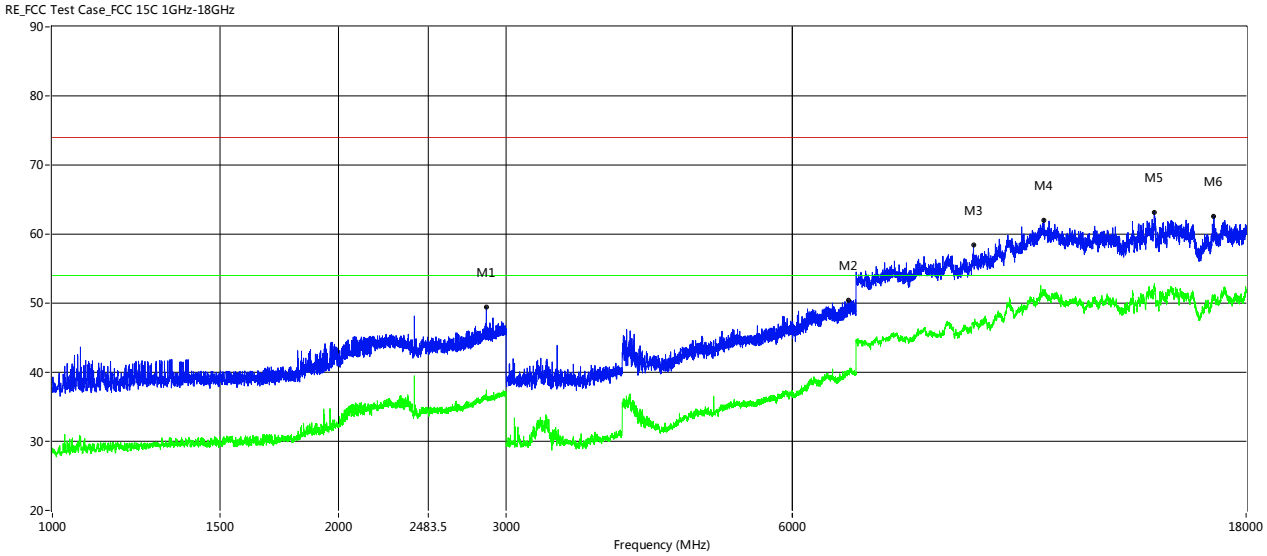
High Channel
Horizontal



Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
2993.000	47.56	36.90	6.08	74.0	54.0	-17.10	Horizontal	Pass
6893.000	50.61	40.30	0.43	74.0	54.0	-13.70	Horizontal	Pass
10157.000	60.29	49.81	7.14	74.0	54.0	-4.19	Horizontal	Pass
10971.000	62.37	51.52	10.00	74.0	54.0	-2.48	Horizontal	Pass
14414.000	62.46	52.22	11.26	74.0	54.0	-1.78	Horizontal	Pass
17056.750	62.33	51.82	10.17	74.0	54.0	-2.18	Horizontal	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

Vertical



Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
2860.000	49.44	37.44	5.61	74.0	54.0	-16.56	Vertical	Pass
6866.000	50.41	39.75	0.29	74.0	54.0	-14.25	Vertical	Pass
9304.500	58.47	46.70	5.38	74.0	54.0	-7.30	Vertical	Pass
11031.500	62.01	51.85	10.05	74.0	54.0	-2.15	Vertical	Pass
14414.000	63.20	52.29	11.26	74.0	54.0	-1.71	Vertical	Pass
16649.750	62.62	50.60	9.93	74.0	54.0	-3.40	Vertical	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

9.4. SPURIOUS EMISSIONS BELOW 30M

Freq.	Reading	Limit	Margin	State	Test Result
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F	
--	--	--	--	--	PASS
--	--	--	--	--	PASS

Note:
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =40 log (specific distance/test distance)(dB);
Limit line = specific limits (dBuv) + distance extrapolation factor.

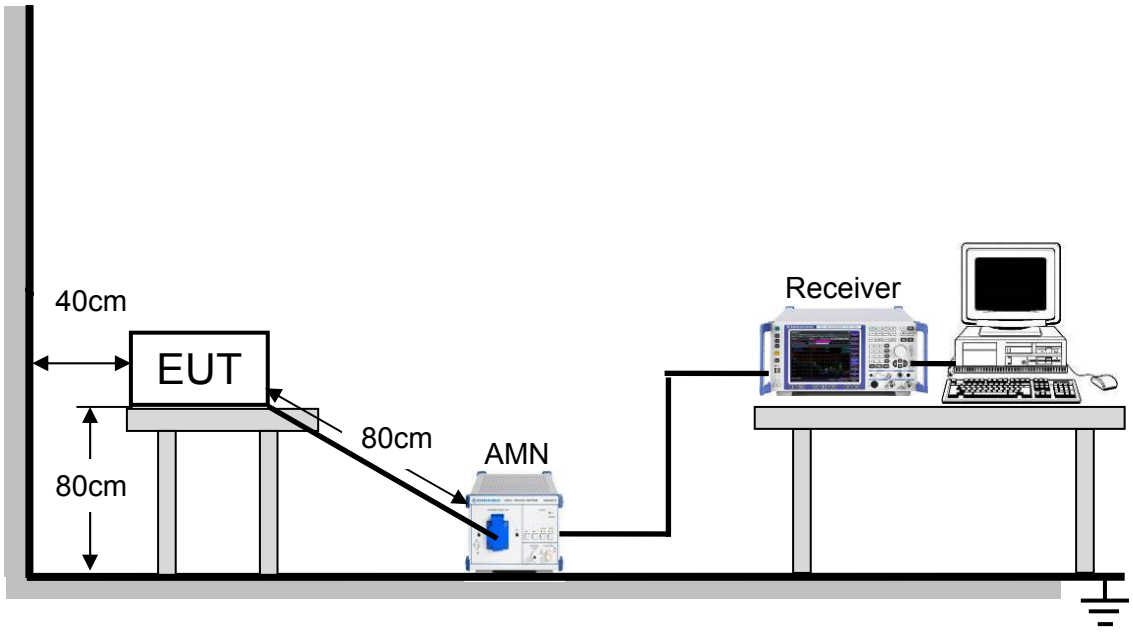
10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

Please refer to FCC §15.207 (a) and RSS-Gen Clause 8.8

FREQUENCY (MHz)	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

TEST SETUP AND PROCEDURE



The EUT is put on a table of non-conducting material that is 80cm high. The vertical conducting wall of shielding is located 40cm to the rear of the EUT. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.). A EMI Measurement Receiver (R&S Test Receiver ESR3) is used to test the emissions from both sides of AC line. According to the requirements in Section 7 and 13 of ANSI C63.10-2013.Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode. The bandwidth of EMI test receiver is set at 9kHz.

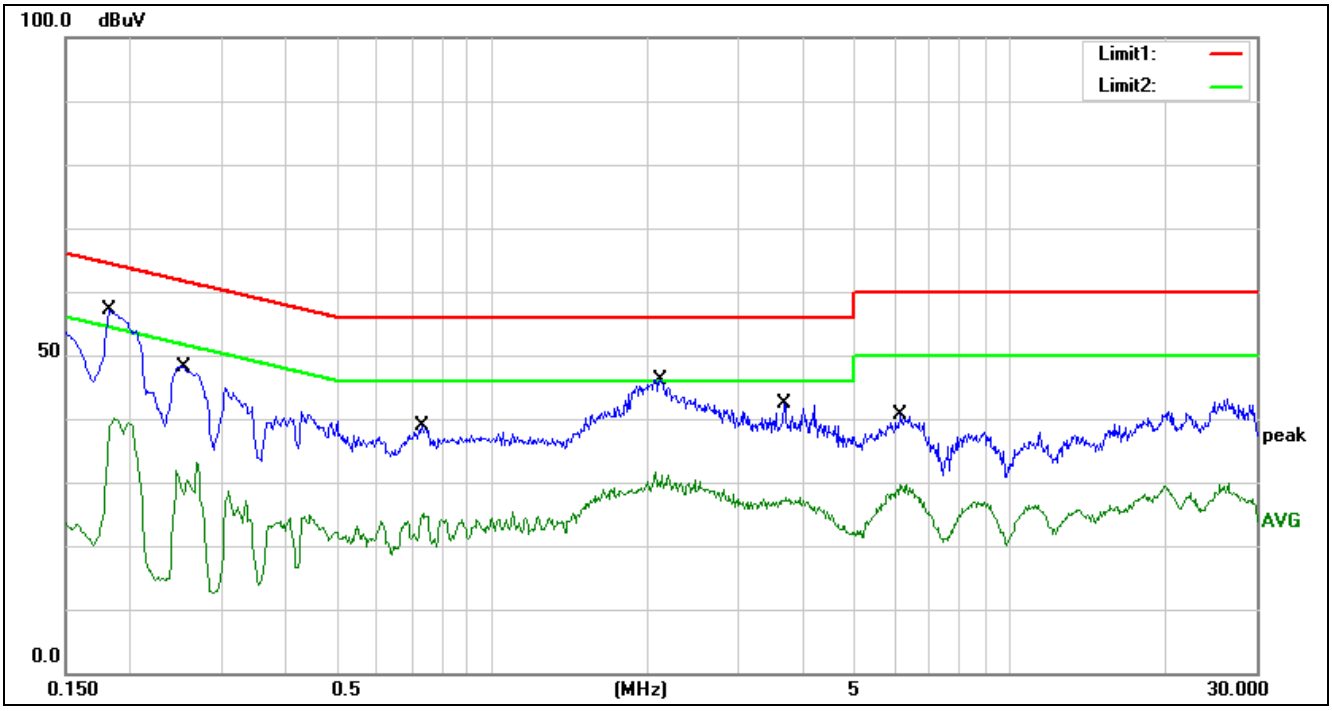
The arrangement of the equipment is installed to meet the standards and operating in a manner, which tends to maximize its emission characteristics in a normal application.

TEST ENVIRONMENT

Temperature	25.4°C	Relative Humidity	51%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

TEST RESULTS

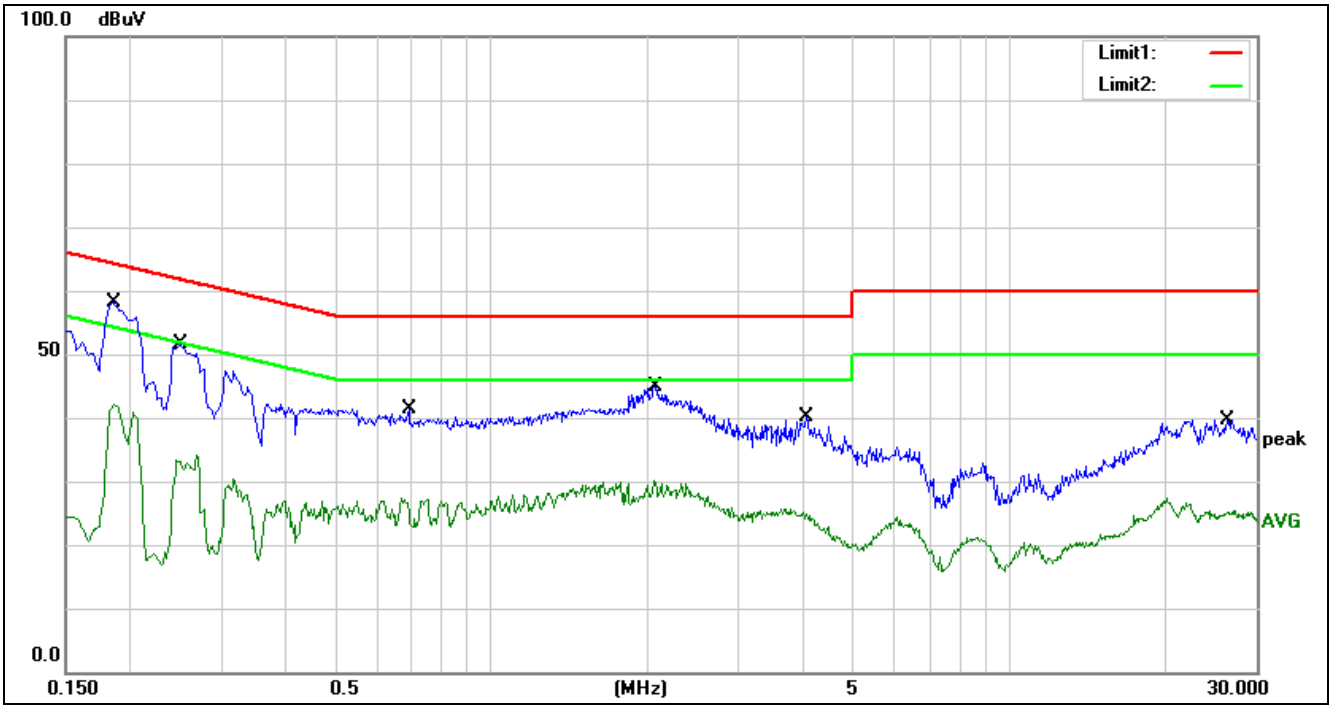
NEUTRAL N RESULTS



No.	Frequency (MHz)	Reading (dBuV)	Correct dB	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1820	36.66	20.36	57.02	64.39	-7.37	QP
2	0.1820	19.68	20.36	40.04	54.39	-14.35	AVG
3	0.2540	27.57	20.61	48.18	61.63	-13.45	QP
4	0.2540	12.43	20.61	33.04	51.63	-18.59	AVG
5	0.7340	18.62	20.36	38.98	56.00	-17.02	QP
6	0.7340	4.71	20.36	25.07	46.00	-20.93	AVG
7	2.1140	25.79	20.39	46.18	56.00	-9.82	QP
8	2.1140	11.27	20.39	31.66	46.00	-14.34	AVG
9	3.6700	21.80	20.49	42.29	56.00	-13.71	QP
10	3.6700	7.06	20.49	27.55	46.00	-18.45	AVG
11	6.1620	19.98	20.56	40.54	60.00	-19.46	QP
12	6.1620	9.01	20.56	29.57	50.00	-20.43	AVG

Note: 1. Result = Reading +Correct Factor.
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz).
4. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.

LINE L RESULTS



No.	Frequency (MHz)	Reading (dBuV)	Correct dB	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1860	37.87	20.31	58.18	64.21	-6.03	QP
2	0.1860	21.84	20.31	42.15	54.21	-12.06	AVG
3	0.2500	31.06	20.53	51.59	61.76	-10.17	QP
4	0.2500	13.66	20.53	34.19	51.76	-17.57	AVG
5	0.6900	20.94	20.36	41.30	56.00	-14.70	QP
6	0.6900	6.98	20.36	27.34	46.00	-18.66	AVG
7	2.0660	24.62	20.30	44.92	56.00	-11.08	QP
8	2.0660	9.77	20.30	30.07	46.00	-15.93	AVG
9	4.0620	19.79	20.40	40.19	56.00	-15.81	QP
10	4.0620	5.23	20.40	25.63	46.00	-20.37	AVG
11	26.3700	17.04	22.69	39.73	60.00	-20.27	QP
12	26.3700	4.57	22.69	27.26	50.00	-22.74	AVG

Note: 1. Result = Reading +Correct Factor.
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz).
4. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.

11. ANTENNA REQUIREMENTS

APPLICABLE REQUIREMENTS

Please refer to FCC §15.203
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Please refer to FCC §15.247(b)(4)
The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

ANTENNA CONNECTOR

EUT has an integral antenna without antenna connector.

ANTENNA GAIN

The antenna gain of EUT is less than 6 dBi.

Test photos

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

END OF REPORT