FCC IC Test Report

Report No.:	FCC_IC_RF_SL21060701-CAAR-002A1_BLE
FCC ID:	TCZ-10105567G1
ISED:	1175F-10105567G1
Test Model:	**002277**
Received Date:	02/24/2022
Test Date:	03/04/2022
Issued Date:	03/14/2022
Applicant:	Supra DirectKey Module Carrier Fire & Security Americas corporation
Address:	4001 Fairview Industrial Dr. SE, Salem, OR 97302
Manufacturer:	Supra DirectKey Module Carrier Fire & Security Americas corporation
Address:	4001 Fairview Industrial Dr. SE, Salem, OR 97302
Issued By:	Bureau Veritas Consumer Products Services, Inc.
Lab Address:	775 Montague Expressway, Milpitas, CA 95035
Test Location (1):	775 Montague Expressway, Milpitas, CA 95035
FCC/ IC Test Site Number:	US1109/US0160

TESTING CERT # 2742-01

Table of Contents

RELEASE CONTROL RECORD

Issue No.	Description	Date Issued
FCC_IC_RF_SL21060701-CAAR-002A1_BLE	Orignal Release	03/14/2022

1 CERTIFICATE OF CONFORMITY

Product:	The Supra® DirectKey™ Module
Brand:	Supra®
Test Model:	**002277**
Sample Status:	Engineering sample
Applicant:	Supra DirectKey Module Carrier Fire & Security Americas corporation
Test Date:	03/04/2022
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) RSS-247 Issue 2, February 2017 ANSI C63.10: 2013 RSS-Gen Issue 5, March 2019 558074 D01 15.247 Meas Guidance v05r02

The above equipment has been tested by **Bureau Veritas Consumer Products Services, Inc., Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : _____ **, Date:** 03/15/2022

James Ma / Test Engineer

Approved by _____ **; Date:** 03/15/2022

Suresh Kondapalli / Reviewing Engineer

2 SUMMARY OF TEST RESULTS

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC / IC Clause	Test Item	Result	Remarks
15.207 RSS Gen 8.8	AC Power Conducted Emission	NA	EUT is battery powered.
15.247(a)(2) RSS 247 5.2.1	6dB bandwidth & 99% bandwidth	PASS	Meet the requirement of limit.
15.247(b) RSS 247 5.4.4	Maximum Output power	PASS	Meet the requirement of limit.
15.247(e) RSS 247 5.2.2	Power Spectral Density	PASS	Meet the requirement of limit.
15.247(d) RSS 247 5.4.4	Conducted Band Edges and Spurious Emissions	PASS	Meet the requirement of limit.
15.205 &15.209 & 15.247(d) RSS 247 5.5C	Radiated Emissions and Band Edge Measurement	PASS	Meet the requirement of limit.
15.203 &15.247(b)	Antenna Requirement	PASS	The EUT has an internal antenna which is not user accessible

2.1 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed onthe EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	3.51dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.73dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	4.64dB
	6GHz ~ 18GHz	4.82dB
	18GHz ~ 40GHz	4.91dB

2.2 MODIFICATION RECORD

There were no modifications required for compliance.

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Product	The Supra® DirectKey™ Module
Brand	Supra®
Test Model	**002277**
Identification No. of EUT	85000465 (Radiated), 85000477 (Conducted)
Status of EUT	Engineering sample
Software Used	For Testing Purposes Customer Provided Custom Testing Software, Supra DirectKey Uses propriety for operation.
Testing Instruction	Supra Onity Doc. Standard Work for BT Testing Rev R1.4 04-02-2022
Power Supply Rating	1.8 – 3.6 Vdc
Modulation Type	GFSK
Modulation Technology	DTS
Transfer Rate	Up to 1Mbps by Customer
Operating Frequency	2.402 ~ 2.480GHz
Number of Channel	40
Output Power	**3dBm**
Antenna Gain	1.5 dBi
Antenna Type	Chip Antenna (Johanson 2450AT18D0100E)
Antenna Connector	Permanently attached

3.2 DESCRIPTION OF TEST MODES

40 channels are provided to this EUT:

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

Radiated Emission Test (Above 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	0,19,39	GFSK	1

Radiated Emission Test (Below 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	0,19,39	GFSK	1

Power Line Conducted Emission Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	19	GFSK	1

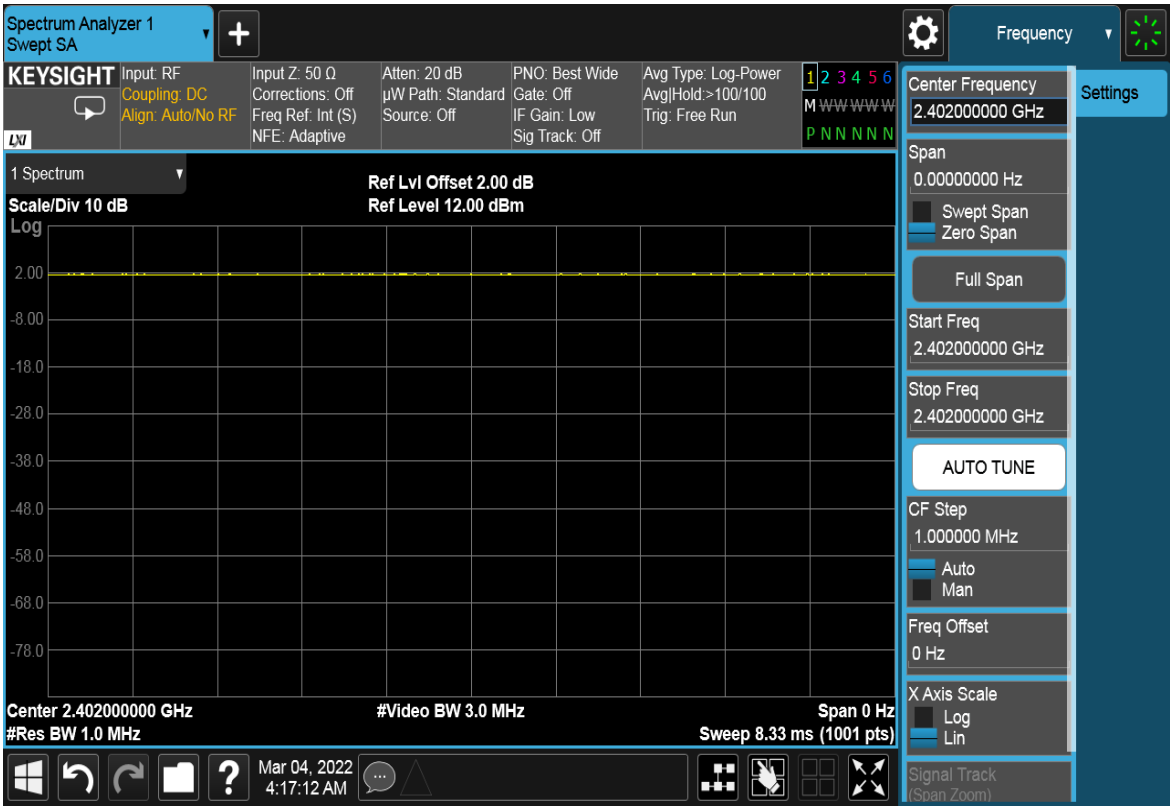
Antenna Port Conducted Measurement:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	19	GFSK	1

3.3 DUTY CYCLE OF TEST SIGNAL



Duty cycle of test signal is 100% (CH 0)

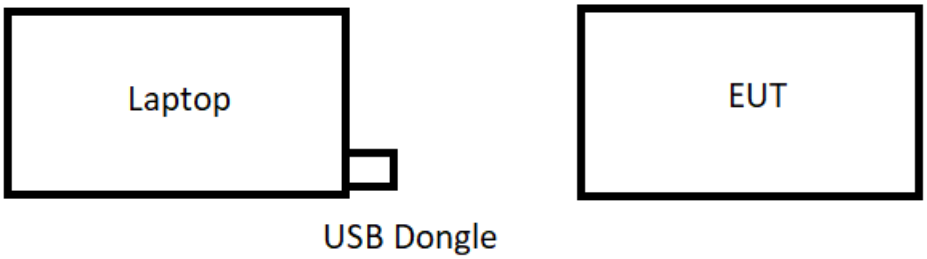
3.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	Dell	Latitude D630	84V6QF1	-	Provided by Customer

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Blue Giga USB dongle	1	0.02	N	0	Connect from EUT to Laptop

Note: The core(s) is(are) originally attached to the cable(s).



3.5 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with therequirements of the following standards:

47 CFR FCC Part 15, Subpart C (Section 15.247)
RSS 247 Issue2, February 2017
ANSI C63.10: 2013
RSS Gen Issue5, March 2019
558074 D01 15.247 Meas Guidance v05r02

All test items have been performed and recorded as per the above standards

4 TEST TYPES AND RESULTS

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.1.2 Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

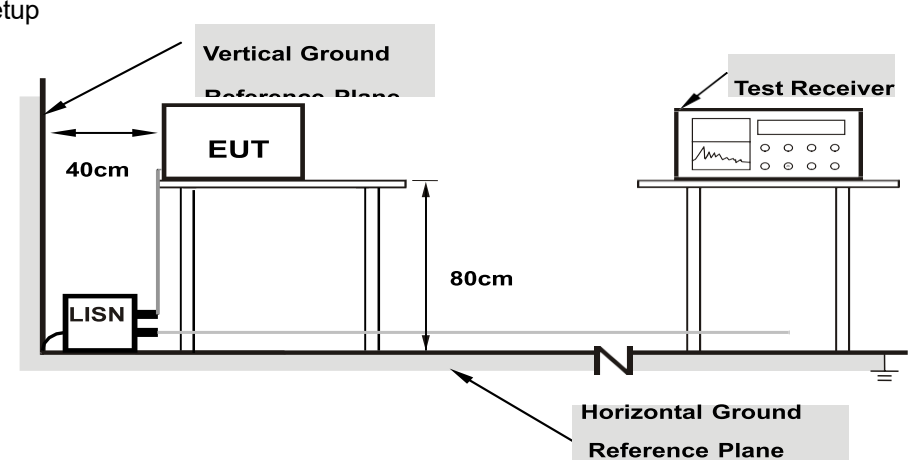
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection(QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.1.3 Deviation from Test Standard

No deviation.

4.1.4 Test Setup



Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

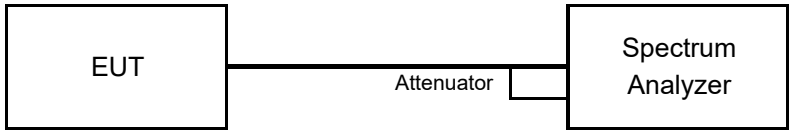
Test Results: N/A (Work with battery).

4.2 6DB BANDWIDTH MEASUREMENT & 99% BANDWIDTH MEASUREMENT

4.2.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

4.2.2 Test Setup



4.2.3 Test Procedure

The following procedure shall be used for measuring 99% power bandwidth:

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

a. Set resolution bandwidth (RBW) = 30kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

4.2.4 Deviation from Test Standard

No deviation.

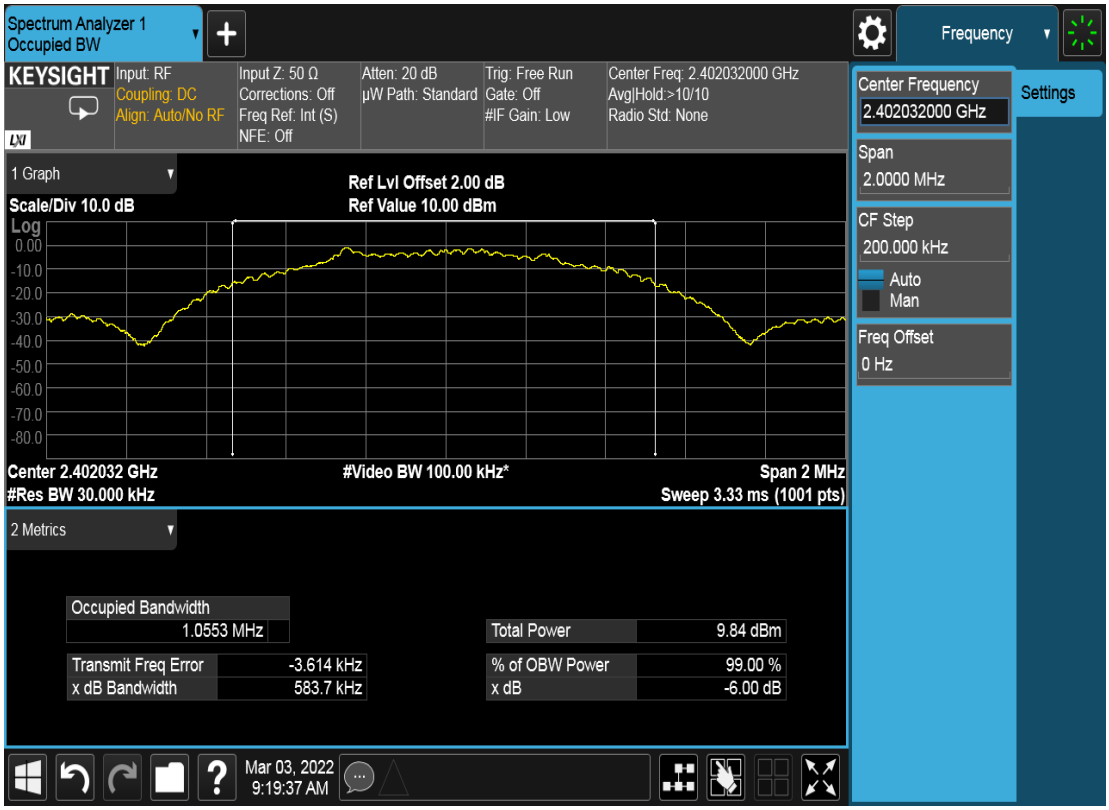
4.2.5 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest,middle and highest channel frequencies individually.

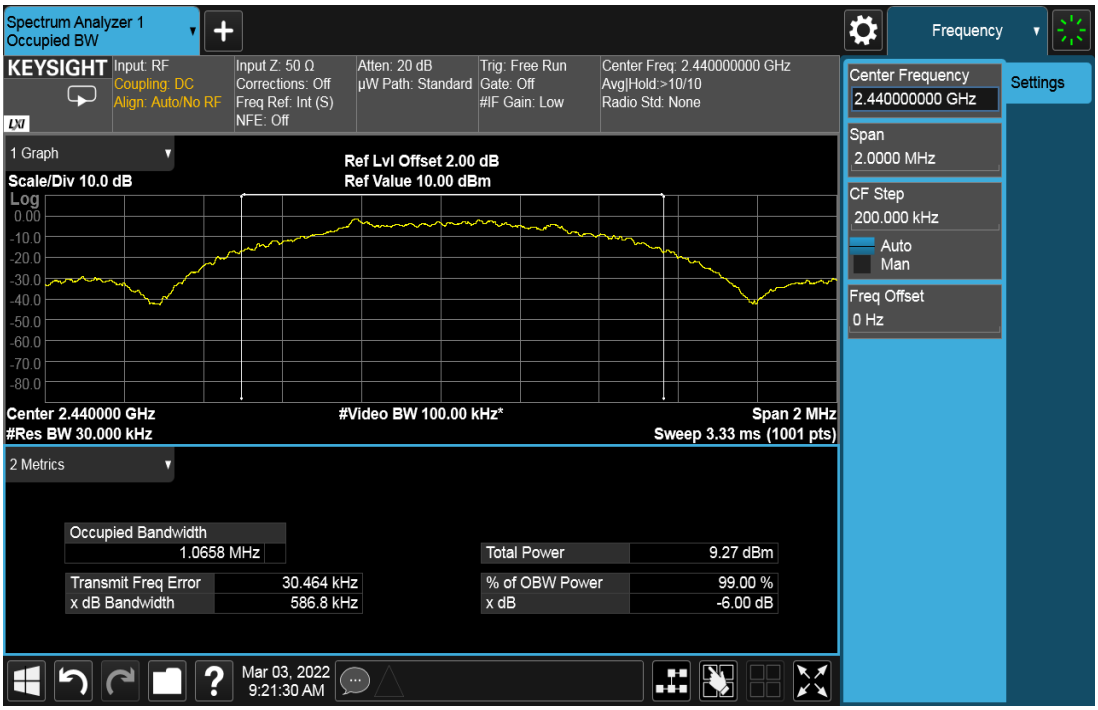
4.2.6 Test Result

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.584	1.055	0.5	PASS
19	2440	0.587	1.066	0.5	PASS
39	2480	0.589	1.065	0.5	PASS

Test Plots:



CH 0: 2402 MHz



CH 19: 2440 MHz

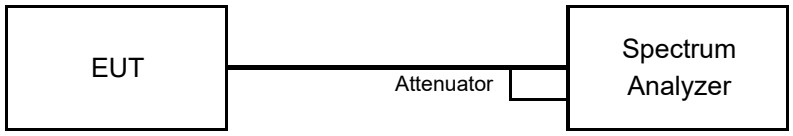
CH 39: 2480 MHz

4.3 CONDUCTED OUTPUT POWER MEASUREMENT

4.3.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.6.2 to get information of above instrument.

4.3.4 Test Procedures

a. Set the RBW ≥ DTS bandwidth.
b. Set VBW ≥ 3 × RBW.
c. Set span ≥ 3 x RBW
d. Sweep time = auto couple.
e. Detector = peak.
f. Trace mode = max hold.
g. Allow trace to fully stabilize.
h. Use peak marker function to determine the peak amplitude level.

4.3.5 Deviation from Test Standard

No deviation.

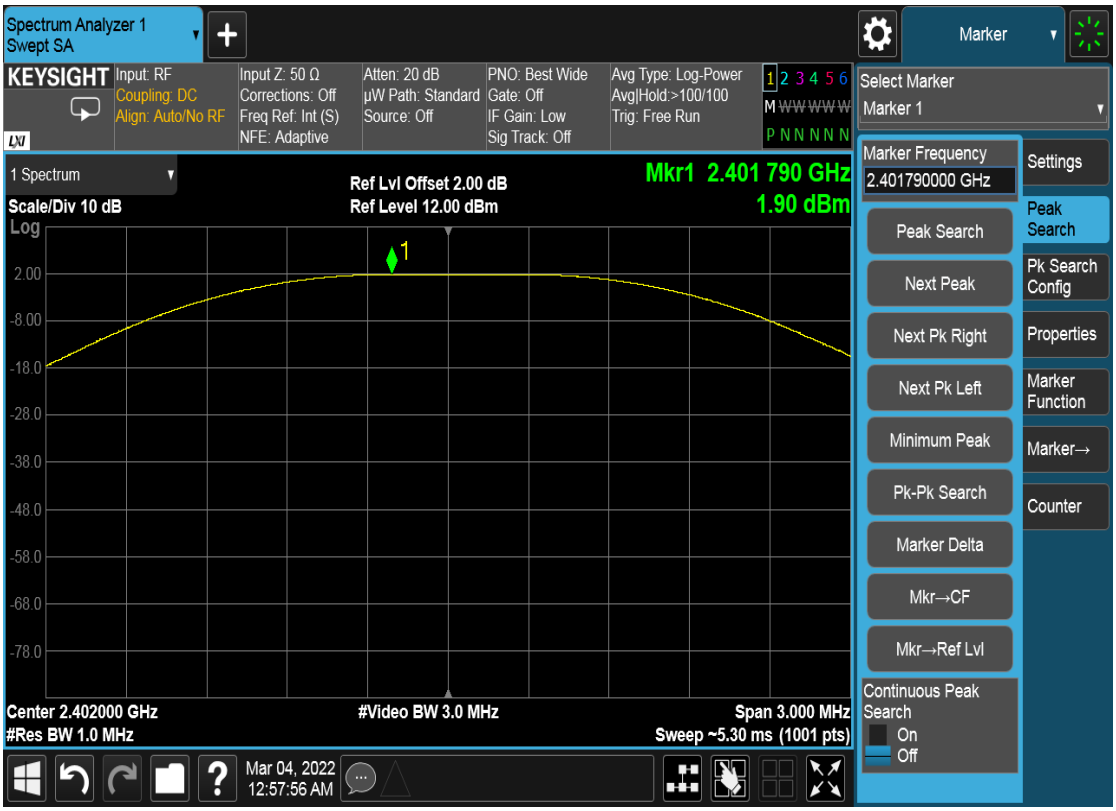
4.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

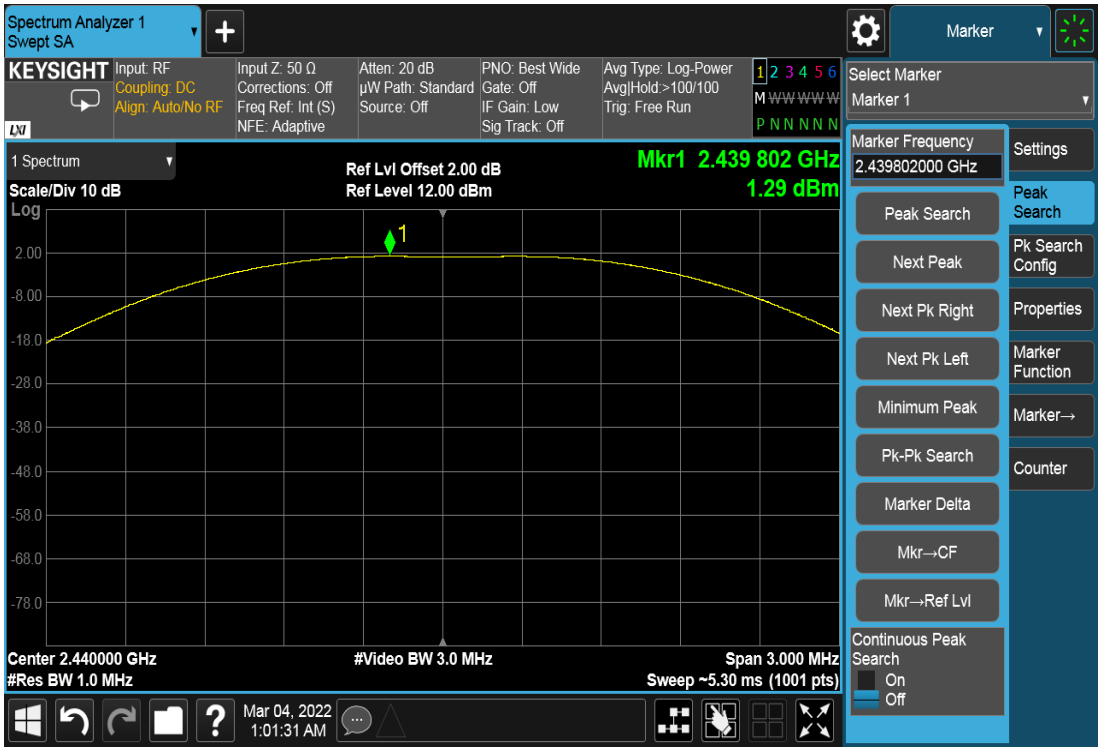
4.3.7 Test Results

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Pass/Fail
0	2402	1.90	30	Pass
19	2440	1.29	30	Pass
39	2480	0.51	30	Pass

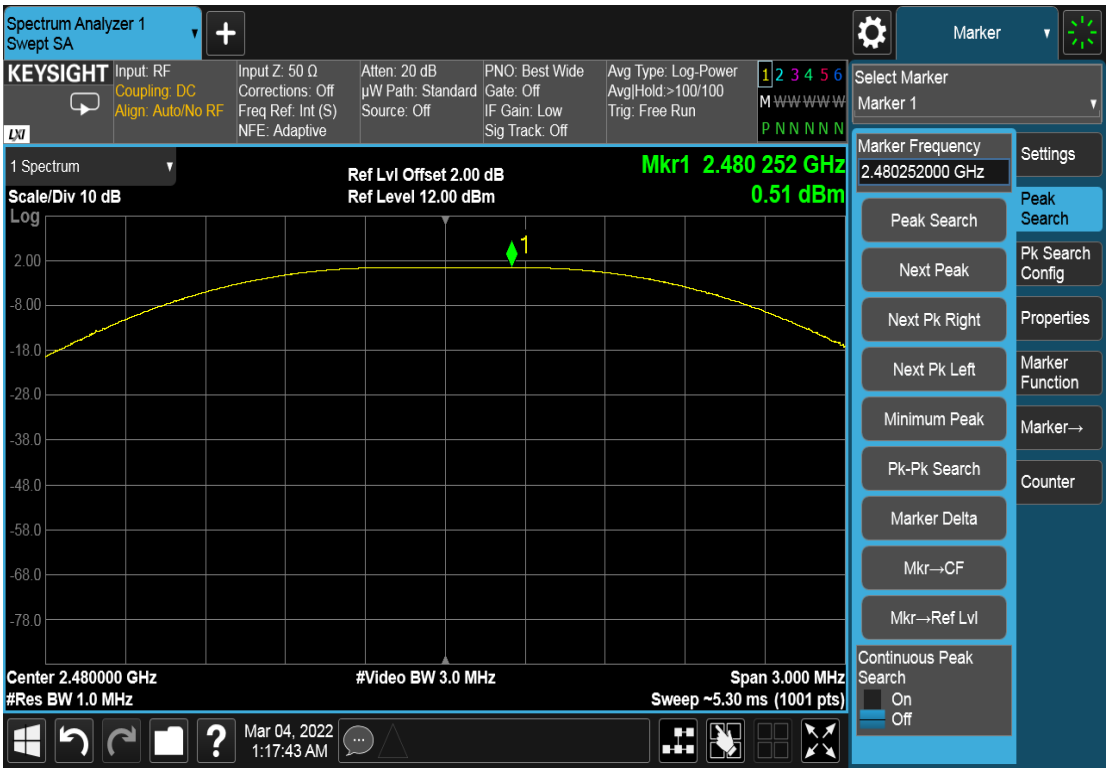
Test Plots:



CH 0


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto/No RF
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 20 dB
µW Path: Standard
Source: Off
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Log
Ref Lvl Offset 2.00 dB
Ref Level 12.00 dBm
Mkr1 2.439 802 GHz
1.29 dBm
Center 2.440000 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 3.000 MHz
Sweep ~5.30 ms (1001 pts)
Mar 04, 2022
1:01:31 AM
Marker
Select Marker
Marker 1
Marker Frequency
2.439802000 GHz
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Settings
Peak Search
Pk Search Config
Properties
Marker Function
Marker→
Counter

CH 19


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto/No RF
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 20 dB
µW Path: Standard
Source: Off
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Log
Ref Lvl Offset 2.00 dB
Ref Level 12.00 dBm
Mkr1 2.480 252 GHz
0.51 dBm
Center 2.480000 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 3.000 MHz
Sweep ~5.30 ms (1001 pts)
Mar 04, 2022
1:17:43 AM
Marker
Select Marker
Marker 1
Marker Frequency
2.480252000 GHz
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Settings
Peak Search
Pk Search Config
Properties
Marker Function
Marker→
Counter

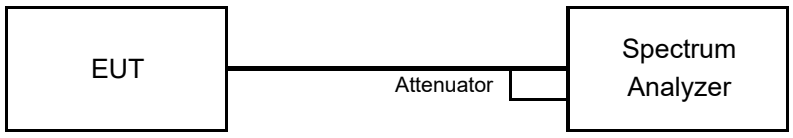
CH 39

4.4 POWER SPECTRAL DENSITY MEASUREMENT

4.4.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.6.2 to get information of above instrument.

4.4.4 Test Procedure

a. Set analyzer center frequency to DTS channel center frequency.
b. Set the span to 1.5 times the DTS bandwidth.
c. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d. Set the VBW ≥ 3 × RBW.
e. Detector = peak.
f. Sweep time = auto couple.
g. Trace mode = max hold.
h. Allow trace to fully stabilize.
i. Use the peak marker function to determine the maximum amplitude level within the RBW.

4.4.5 Deviation from Test Standard

No deviation.

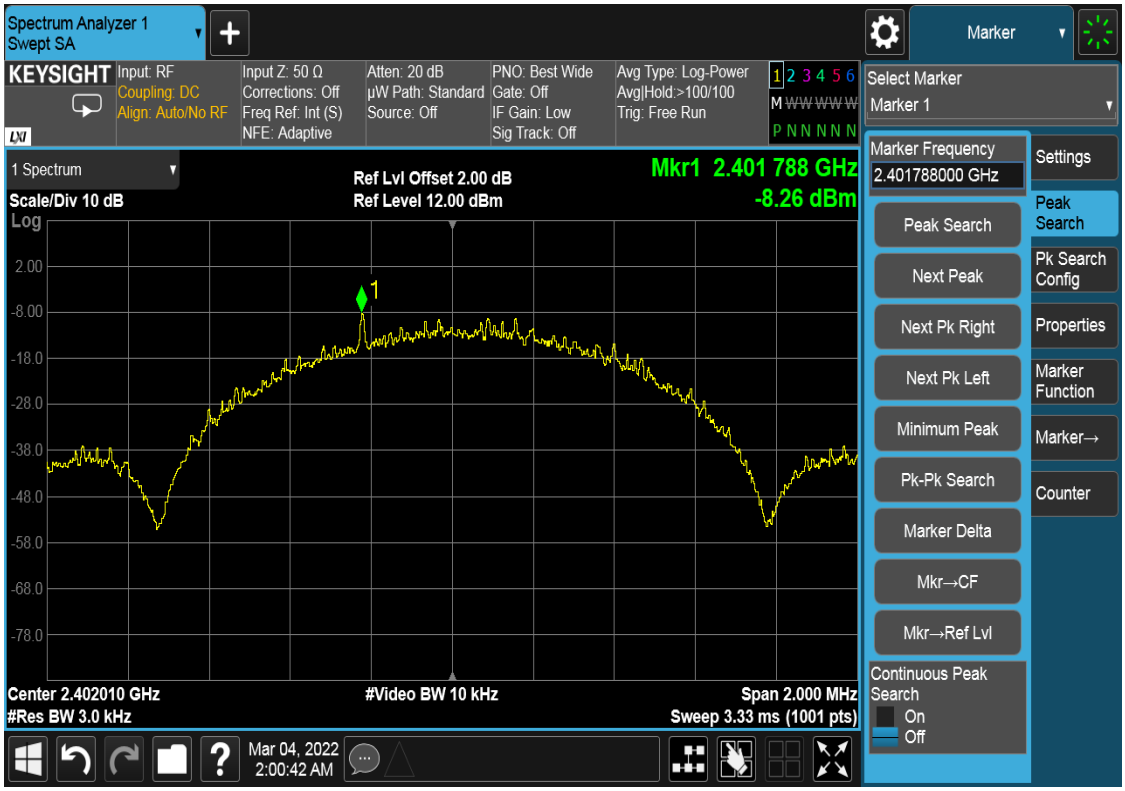
4.4.6 EUT Operating Condition

Same as Item 4.3.6

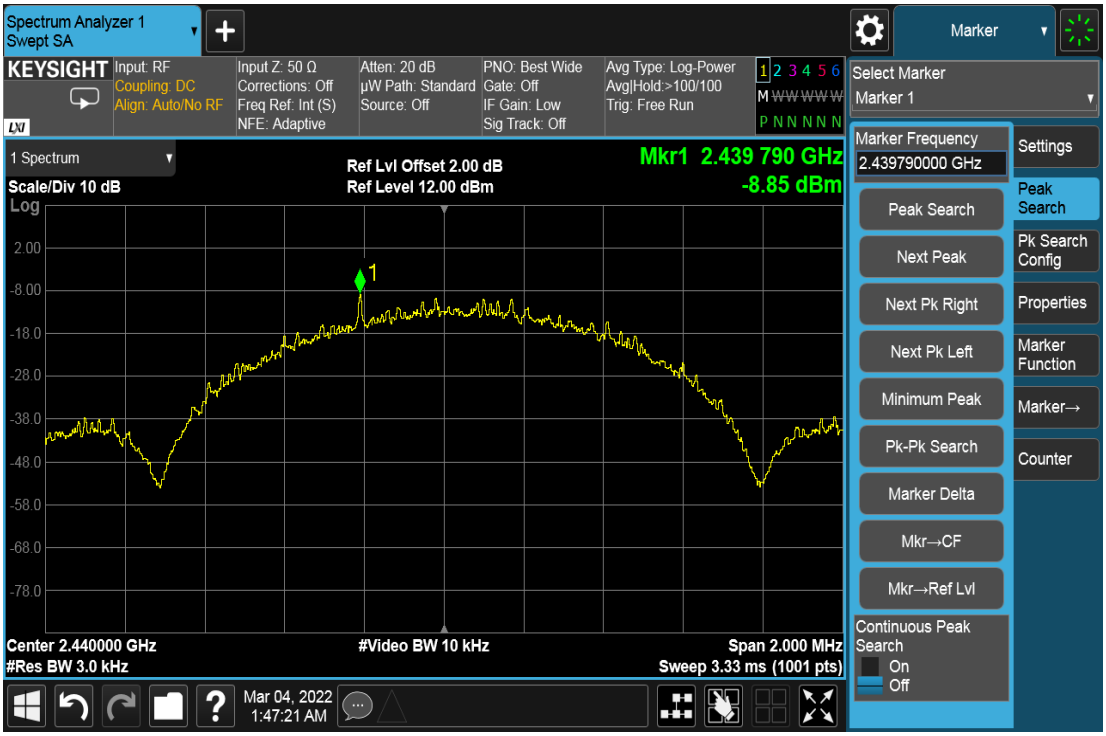
4.4.7 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass/Fail
0	2402	-8.26	8	Pass
19	2440	-8.85	8	Pass
39	2480	-9.69	8	Pass

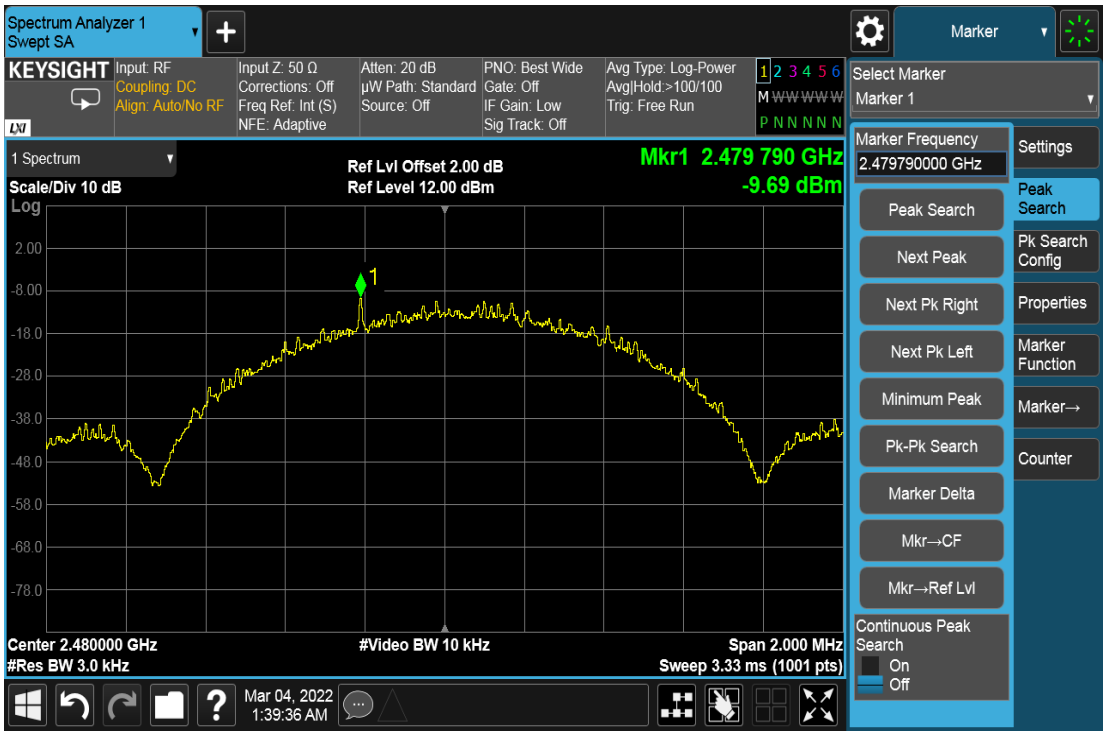
Test Plots:



CH 0


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto/No RF
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 20 dB
µW Path: Standard
Source: Off
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Log
Ref Lvl Offset 2.00 dB
Ref Level 12.00 dBm
Mkr1 2.439 790 GHz
-8.85 dBm
Center 2.440000 GHz
#Res BW 3.0 kHz
#Video BW 10 kHz
Span 2.000 MHz
Sweep 3.33 ms (1001 pts)
Mar 04, 2022
1:47:21 AM
Marker
Select Marker
Marker 1
Marker Frequency
2.439790000 GHz
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Settings
Peak Search
Pk Search Config
Properties
Marker Function
Marker→
Counter

CH 19


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto/No RF
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 20 dB
µW Path: Standard
Source: Off
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Log
Ref Lvl Offset 2.00 dB
Ref Level 12.00 dBm
Mkr1 2.479 790 GHz
-9.69 dBm
Center 2.480000 GHz
#Res BW 3.0 kHz
#Video BW 10 kHz
Span 2.000 MHz
Sweep 3.33 ms (1001 pts)
Mar 04, 2022
1:39:36 AM
Marker
Select Marker
Marker 1
Marker Frequency
2.479790000 GHz
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Settings
Peak Search
Pk Search Config
Properties
Marker Function
Marker→
Counter

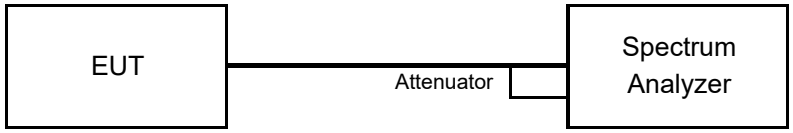
CH 39

4.5 CONDUCTED OUT OF BAND EMISSION MEASUREMENT

4.5.1 Limits of Conducted Out of Band Emission Measurement

Below 20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.6.2 to get information of above instrument.

4.5.4 Test Procedure

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOBE

1. Set RBW = 100 kHz.
2. Set VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

4.5.5 Deviation from Test Standard

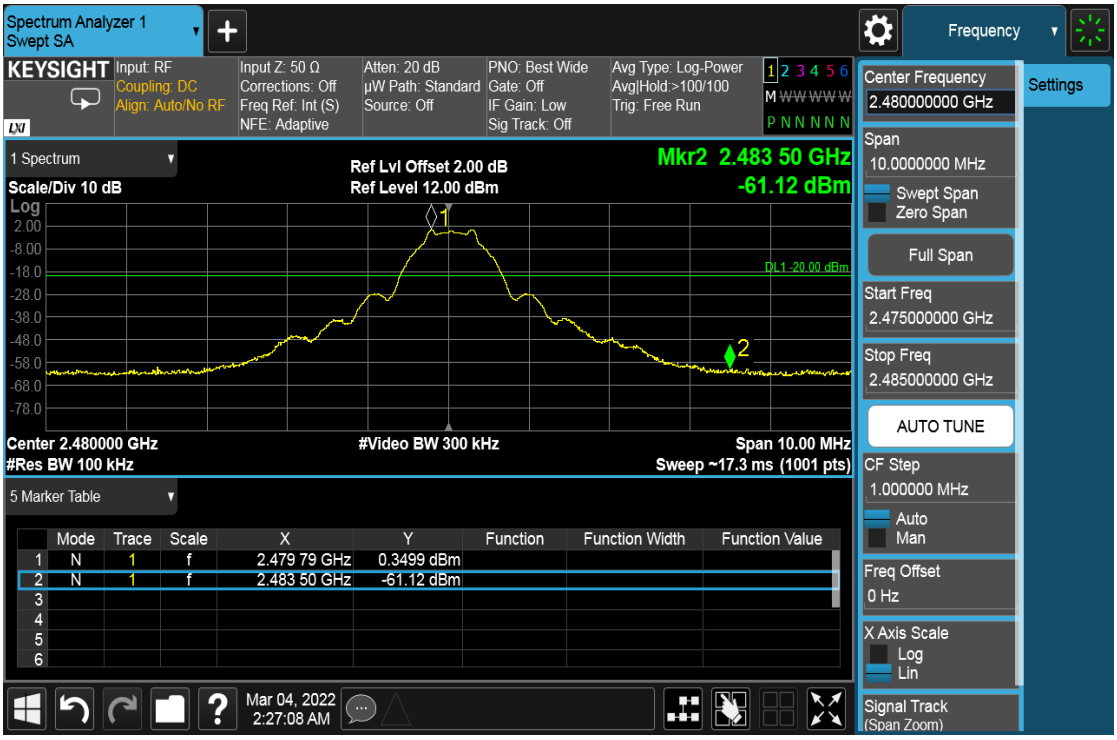
No deviation.

4.5.6 EUT Operating Condition

Same as Item 4.3.6

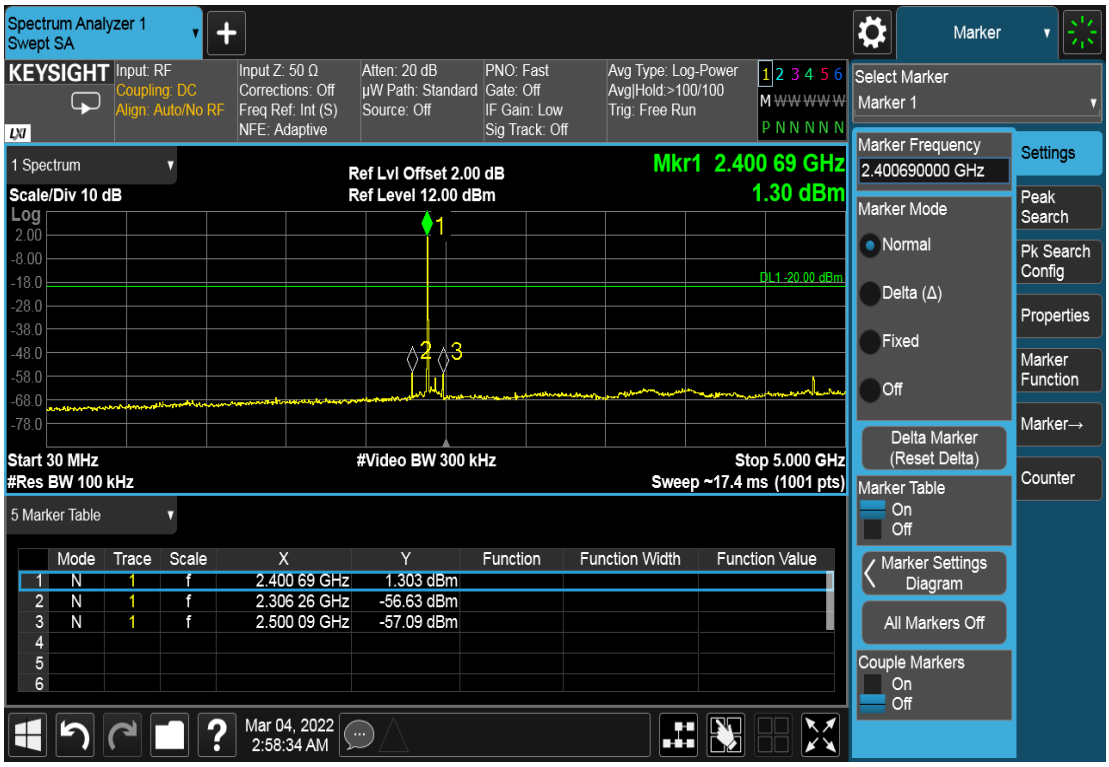
4.5.7 Test Results of Conducted Band Edges Plots

CH 0



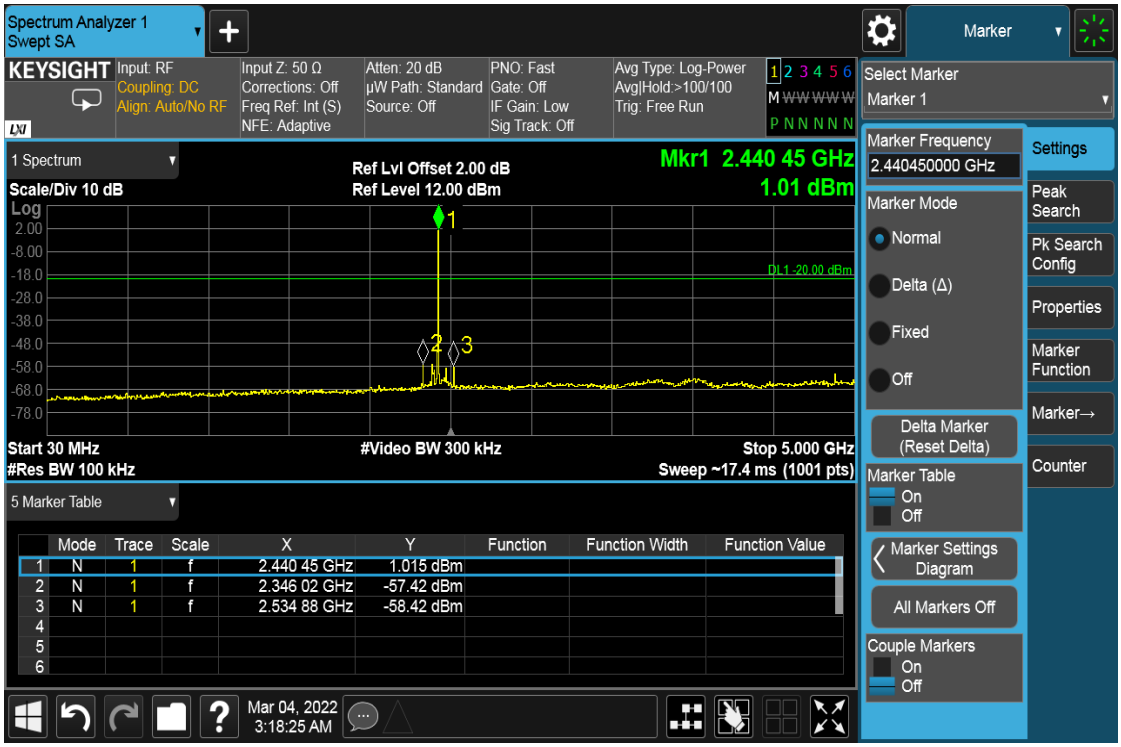
CH 39

4.5.8 Test Results of Conducted Spurious Emission Plots

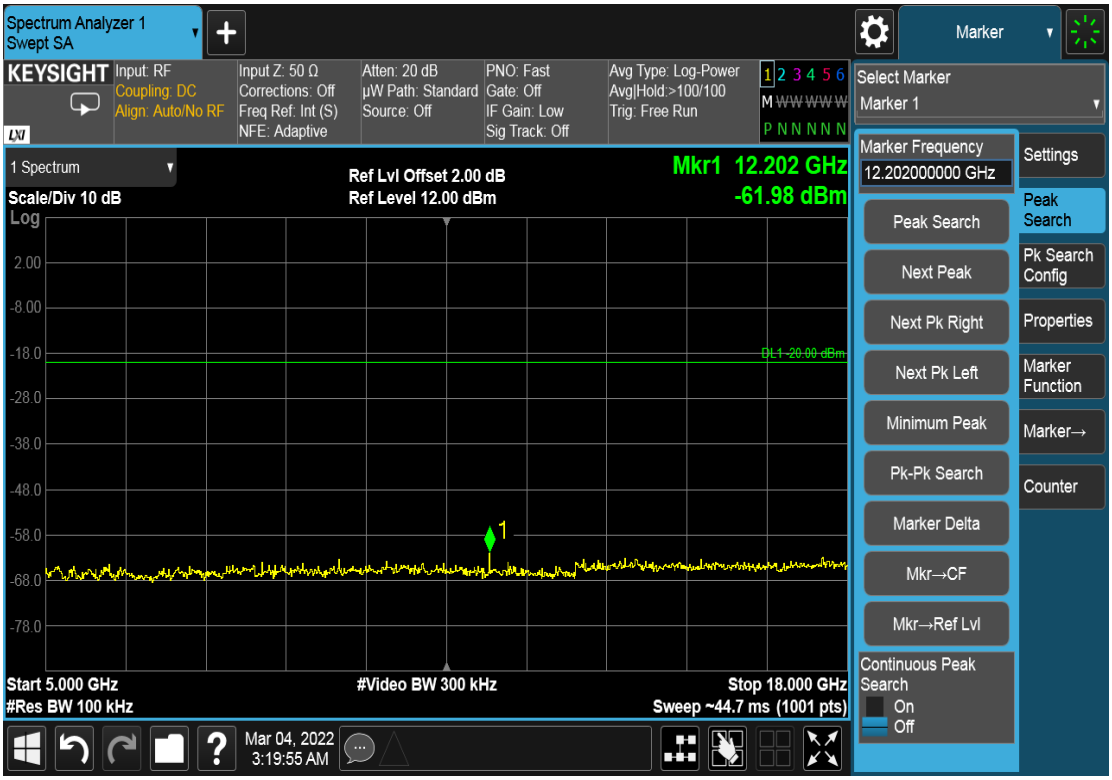


CH 0 – Plot 1

CH 0 – Plot 2
All emissions 18 to 25 GHz were more 20 dB below the limit line.

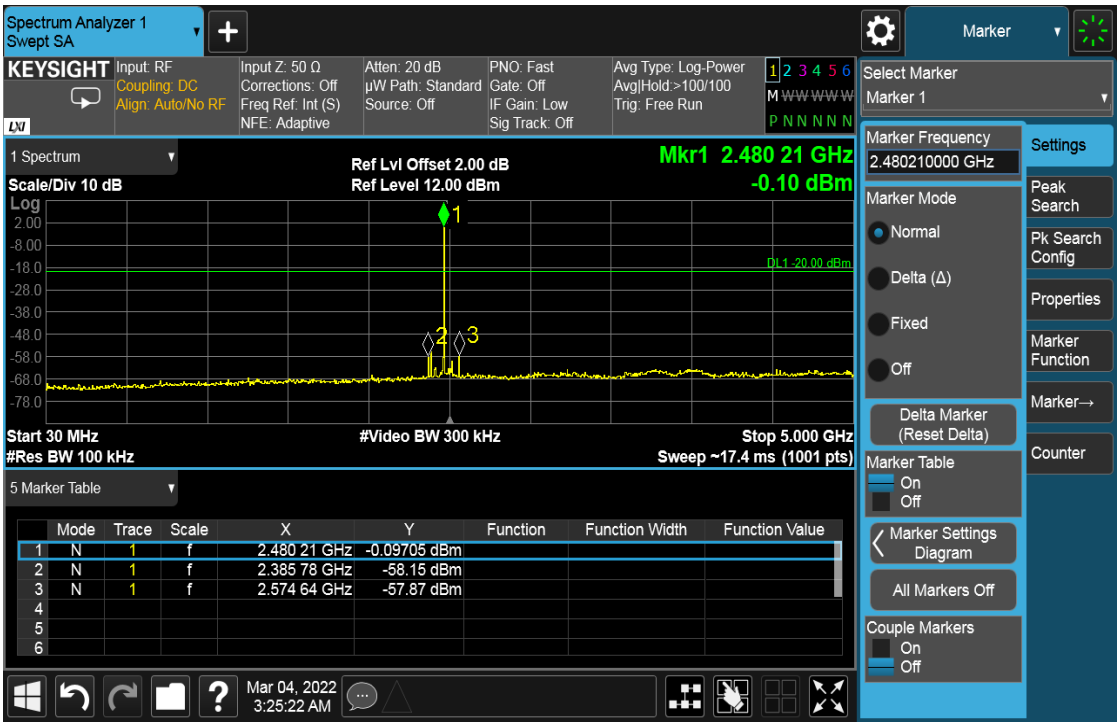


CH 19 – Plot 1

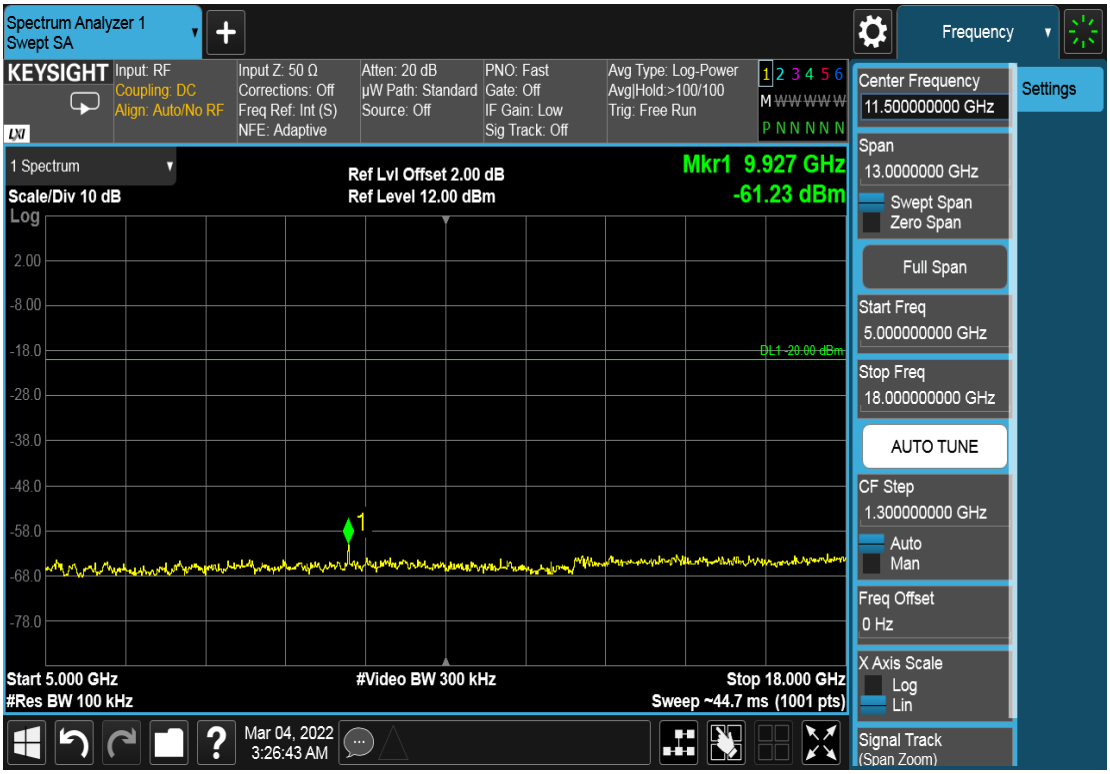


CH 19 – Plot 2

All emissions 18 to 25 GHz were more 20 dB below the limit line.



CH 39 – Plot 1



CH 39 – Plot 2
All emissions 18 to 25 GHz were more 20 dB below the limit line.

4.6 RADIATED EMISSION AND BAND EDGE MEASUREMENT

4.6.1 Limits of Radiated Emission and Band edge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

Frequencies (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
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

4.6.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Test Receiver Keysight	N9038A	MY55330108	09/22/2021	09/22/2022
Spectrum Analyzer Keysight	N9030B	MY57140100	07/22/2021	07/22/2022
Hybrid Antenna Sunol	JB6	A111717	09/04/2020	09/04/2022
Horn Antenna ETS-Lindgren	3117	218553	04/21/2021	04/21/2023
Preamplifier RF-Lambda	RAMP00M50GA	18040300055	05/07/2021	05/07/2022

4.6.3 Test Procedures

For Radiated emission below 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

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

c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

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

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

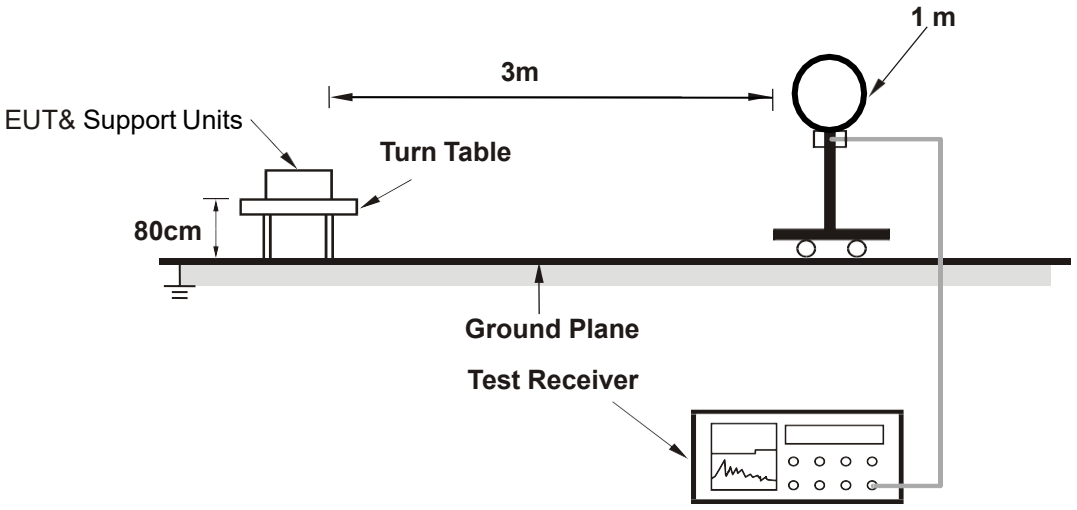
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.6.4 Deviation from Test Standard

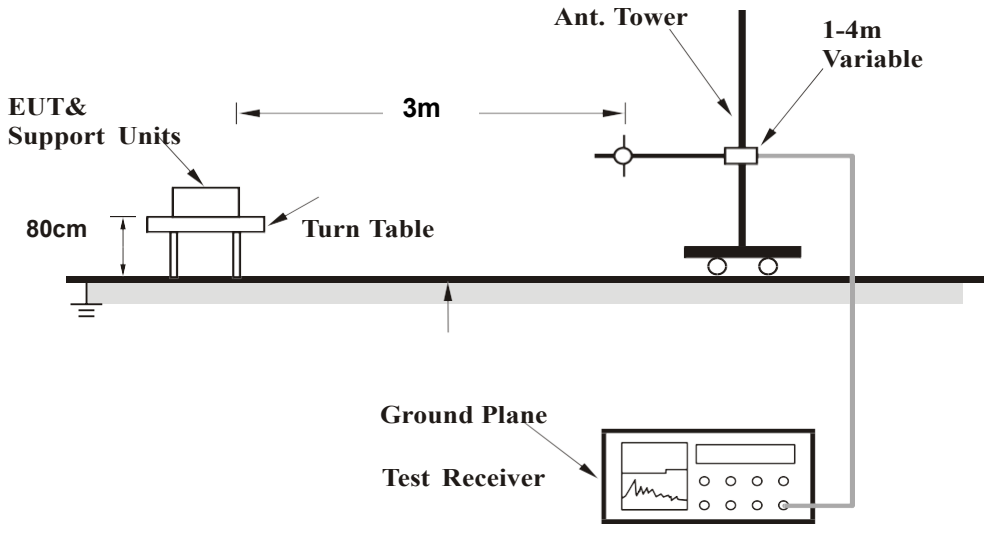
No deviation.

4.6.5 Test Setup

For Radiated emission below 30MHz



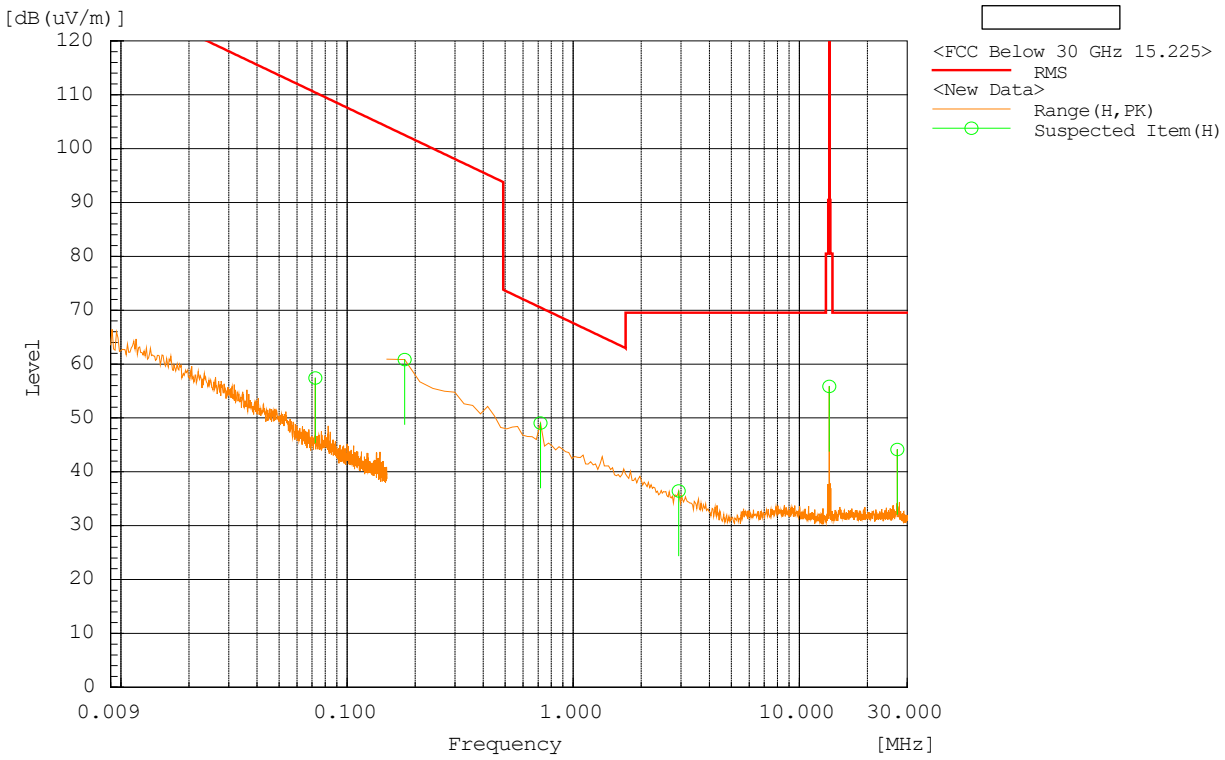
For Radiated emission 30MHz to 1GHz



4.6.6 Test Setup

BELOW 30MHZ, 0-DEGREES, EUT IN CONTINUOUS TX MODE:

FREQUENCY RANGE 9 KHz – 30 MHz	**DETECTOR FUNCTION**	Quasi Peak



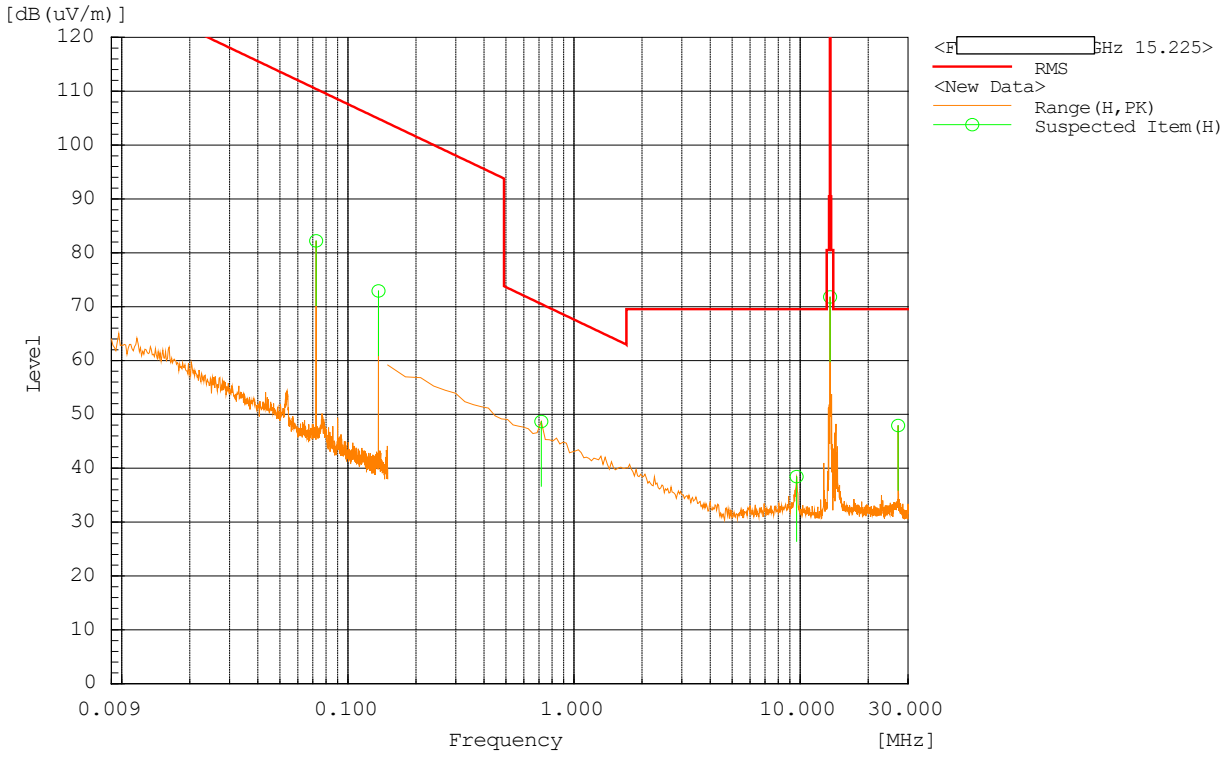
ANTENNA POLARITY & test distance: 0-Degrees at 3 m										
No	Frequency [MHz]	Pol	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Pass/Fail
1	0.072	H	-10.2	67.6	57.4	110.4	-53.0	100	360	Pass
2	0.18	H	0.7	60.1	60.8	102.5	-41.7	100	18.9	Pass
3	0.717	H	0.2	48.8	49.0	70.5	-21.5	100	9.7	Pass
4	2.926	H	-2.1	38.5	36.4	69.5	-33.1	100	12.2	Pass
5	13.553	H	21	34.9	55.9	90.5	-34.6	100	165.2	Pass
6	27.134	H	9.1	35.0	44.1	69.5	-25.4	100	53.8	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

BELOW 30MHZ, 90-DEGREES, EUT IN CONTINUOUS TX MODE:

FREQUENCY RANGE	DETECTOR FUNCTION	
9 KHz – 30 MHz		Quasi Peak

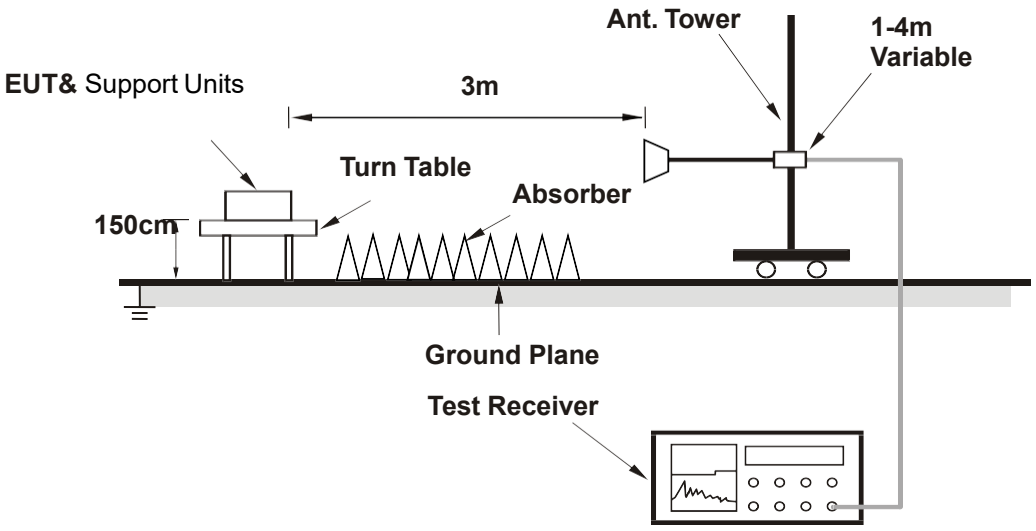


ANTENNA POLARITY & test distance: 90-Degrees at 3 m										
No	Frequency [MHz]	Pol	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Pass/Fail
1	0.072	V	14.6	67.6	82.2	110.4	-28.2	100	359.4	Pass
2	0.136	V	10.9	62.0	72.9	104.9	-32.0	100	359.4	Pass
3	0.717	V	-0.1	48.8	48.7	70.5	-21.8	100	335.4	Pass
4	13.553	V	36.9	34.9	71.8	90.5	-18.7	100	83.2	Pass
5	9.642	V	2.8	35.7	38.5	69.5	-31.0	100	197.3	Pass
6	27.134	V	12.9	35.0	47.9	69.5	-21.6	100	70.1	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.6.7 EUT Operating Conditions

a. Connected the EUT with the Notebook Computer which is placed on remote site.
b. Controlling software has been activated to set the EUT on specific status.

4.6.8 Test Results

BELOW 1GHz WORST-CASE DATA:

BT-LE (GFSK)

CHANNEL	TX Channel 19	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	30MHz – 1GHz		

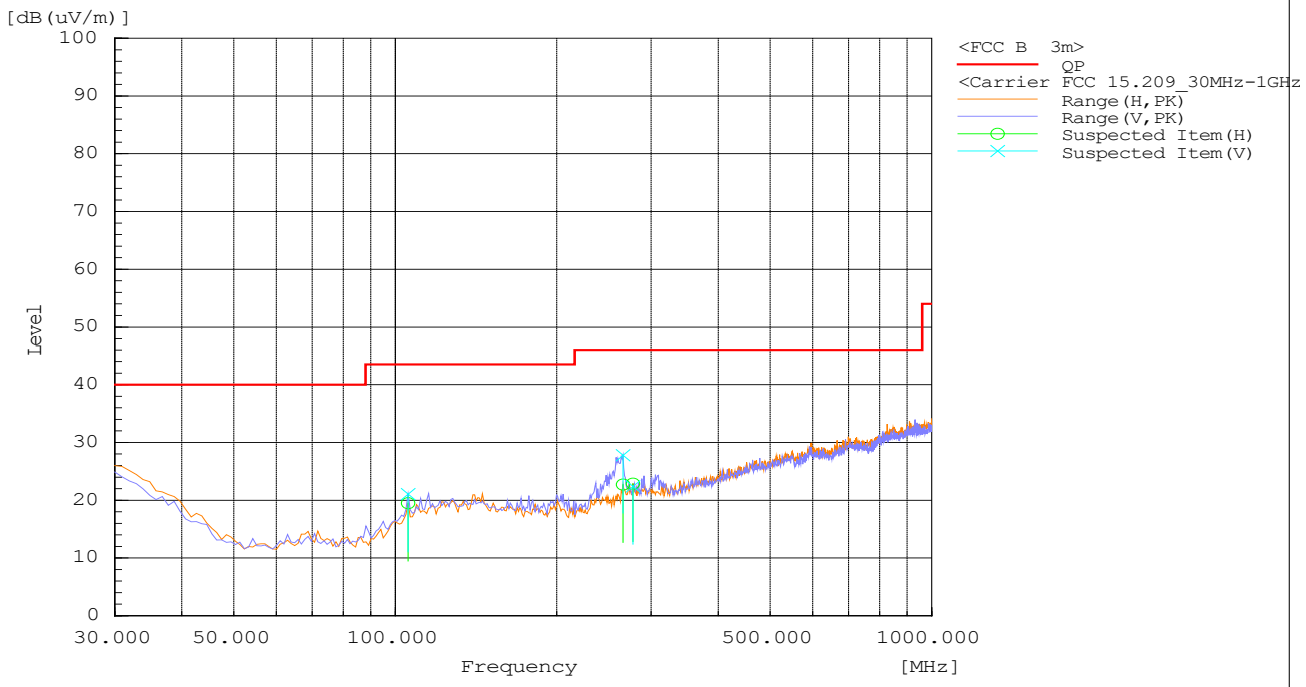
Final Data List

Frequency MHz	Polarization	Reading dB(uV)	Factor dB(1/m)	Level PK dB(uV/m)	Limit QP dB(uV/m)	Margin QP dB	Height cm	Angle Deg
105.66	V	3.3	17.8	21.1	43.5	22.4	200	5.9
105.66	H	2.1	17.4	19.5	43.5	24	200	121.3
277.35	H	2.7	20.2	22.9	46	23.1	300	127.8
277.35	V	2.2	20.2	22.4	46	23.6	300	256.7
265.71	V	8	19.8	27.8	46	18.2	100	232.3
265.71	H	2.9	19.8	22.7	46	23.3	200	159.8

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

Note: Lower FCC B limit was used for evaluation of all signals



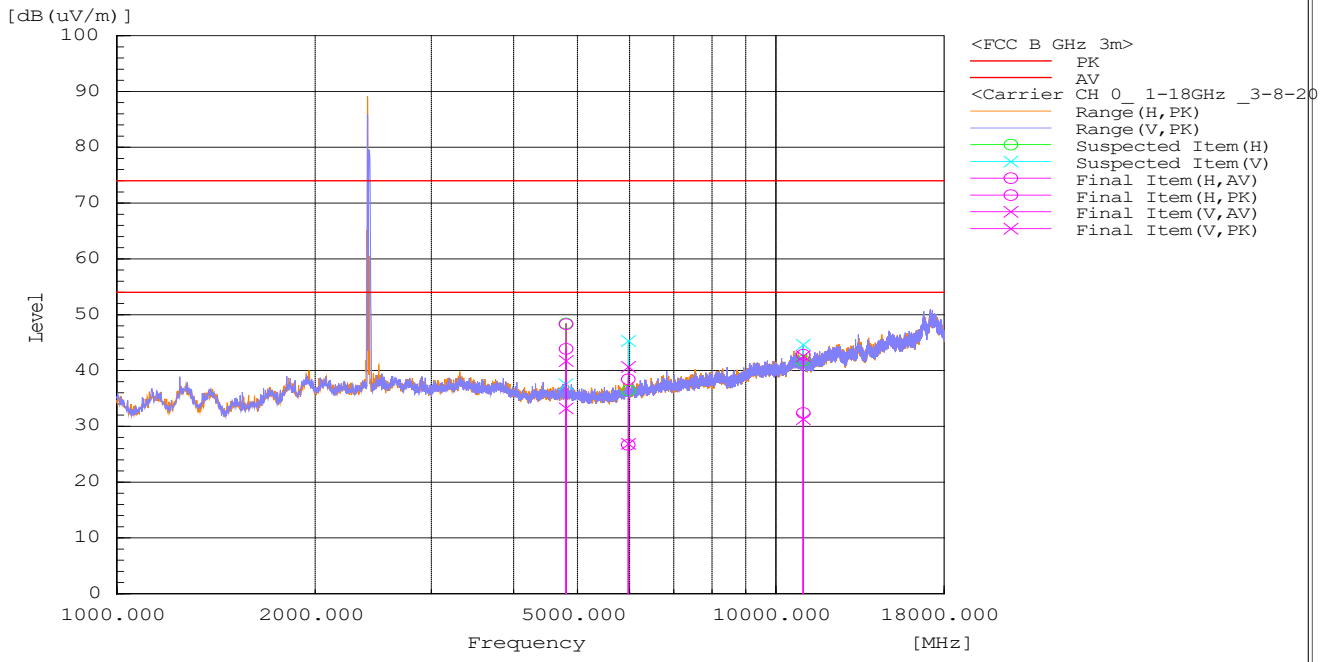
ABOVE 1GHz TEST DATA:

BT-LE (GFSK)

CHANNEL	TX Channel 0	**DETECTOR FUNCTION**	Peak Average
FREQUENCY RANGE	1GHz ~ 18GHz		

Final Data List

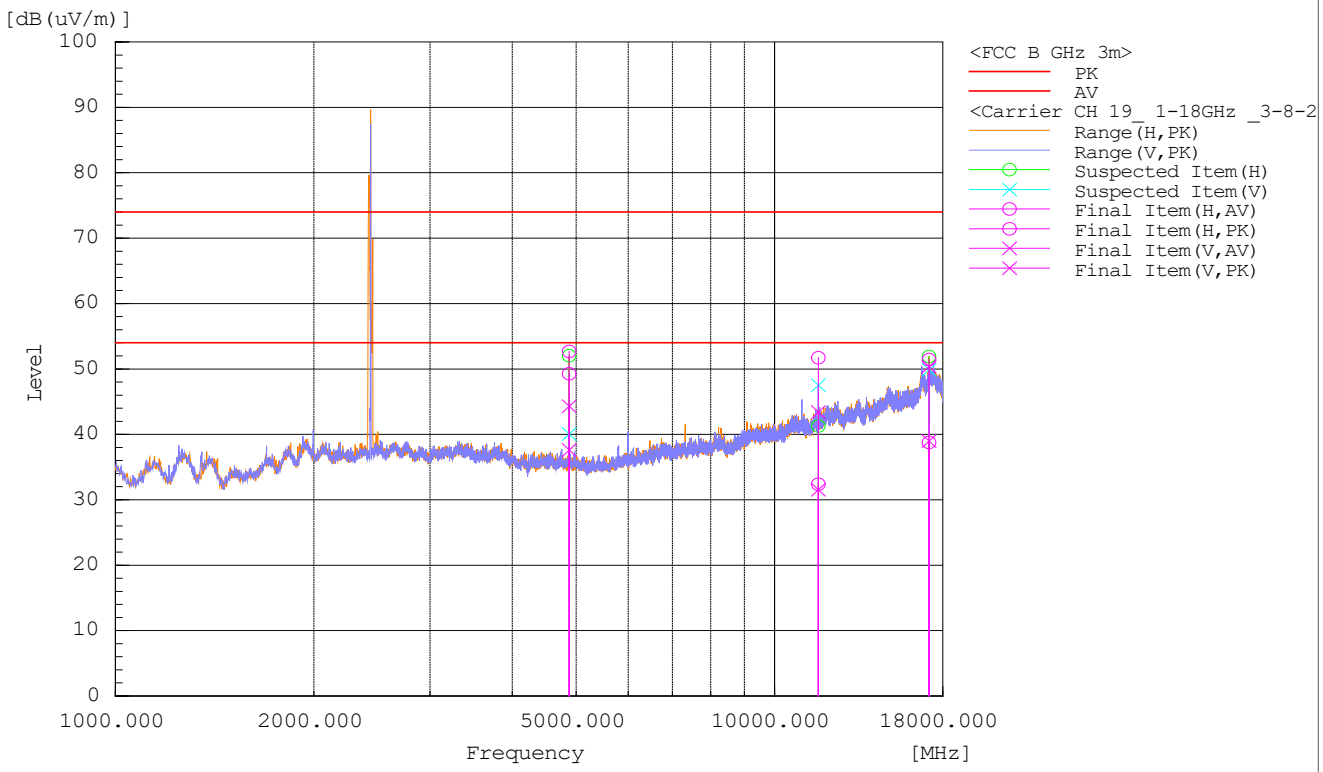
Frequency MHz	Polarization	Reading AV dB(uV)	Reading PK dB(uV)	Factor dB(1/m)	Level AV dB(uV/m)	Level PK dB(uV/m)	Limit AV dB(uV/m)	Limit PK dB(uV/m)	Margin AV dB	Margin PK dB
4804.413	V	44.8	53.3	-11.6	33.2	41.7	54	74	20.8	32.3
4803.805	H	55.5	59.9	-11.6	43.9	48.3	54	74	10.1	25.7
5974.549	V	36.3	50.1	-9.4	26.9	40.7	54	74	27.1	33.3
5972.457	H	36.1	47.8	-9.4	26.7	38.4	54	74	27.3	35.6
11000.441	V	31.4	42.7	-0.1	31.3	42.6	54	74	22.7	31.4
10999.155	H	32.5	42.9	-0.1	32.4	42.8	54	74	21.6	31.2



CHANNEL	TX Channel 19	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	1GHz ~ 18GHz		

Final Data List

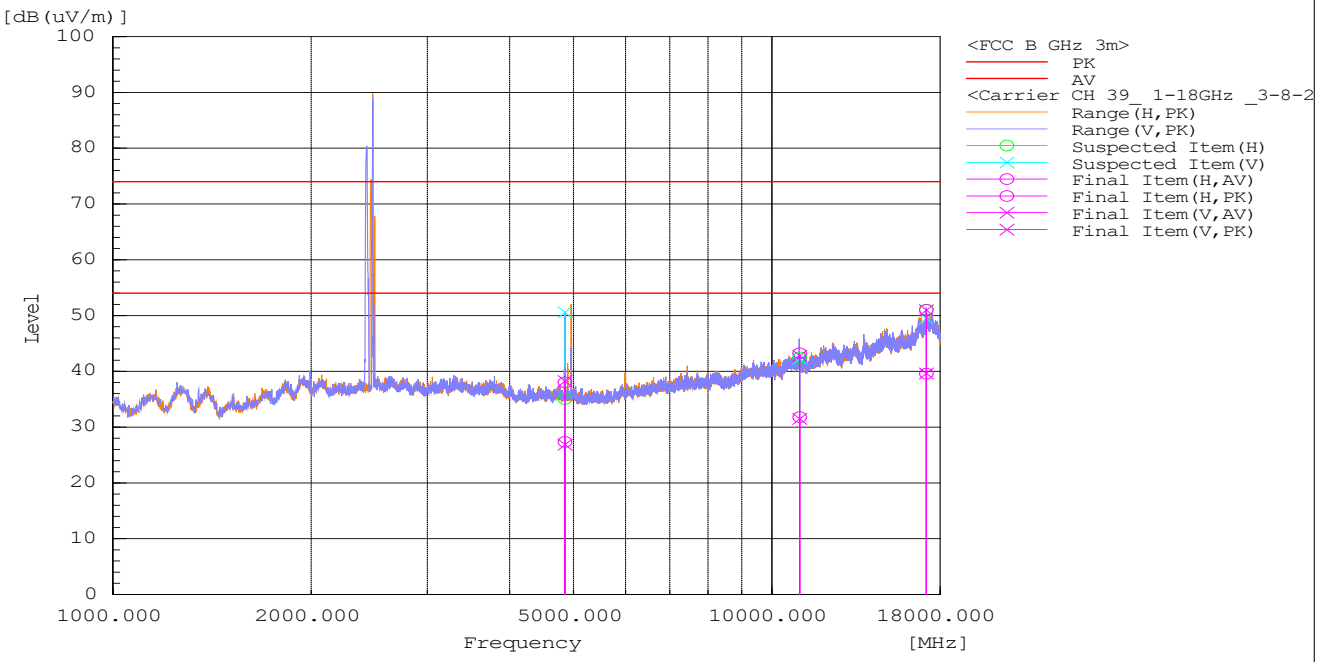
Frequency MHz	Polarization	Reading AV dB(uV)	Reading PK dB(uV)	Factor dB(1/m)	Level AV dB(uV/m)	Level PK dB(uV/m)	Limit AV dB(uV/m)	Limit PK dB(uV/m)	Margin AV dB	Margin PK dB
4880.41	V	49.1	55.8	-11.5	37.6	44.3	54	74	16.4	29.7
4879.792	H	60.8	64.2	-11.5	49.3	52.7	54	74	4.7	21.3
11650.509	V	31	42.9	0.5	31.5	43.4	54	74	22.5	30.6
11650.571	H	31.9	51.2	0.5	32.4	51.7	54	74	21.6	22.3
17154.966	V	30.7	42.1	8.3	39	50.4	54	74	15	23.6
17155.352	H	30.5	43.1	8.3	38.8	51.4	54	74	15.2	22.6



CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	1GHz ~ 18GHz		

Final Data List

Frequency MHz	Polarization	Reading AV dB(uV)	Reading PK dB(uV)	Factor dB(1/m)	Level AV dB(uV/m)	Level PK dB(uV/m)	Limit AV dB(uV/m)	Limit PK dB(uV/m)	Margin AV dB	Margin PK dB
4853.527	V	38.5	49.9	-11.6	26.9	38.3	54	74	27.1	35.7
4853.952	H	39	49.6	-11.6	27.4	38	54	74	26.6	36
11018.183	V	31.5	42.8	0	31.5	42.8	54	74	22.5	31.2
11018.217	H	31.8	43.2	0	31.8	43.2	54	74	22.2	30.8
17153.11	V	31.3	42.7	8.3	39.6	51	54	74	14.4	23
17153.032	H	31.3	42.7	8.3	39.6	51	54	74	14.4	23



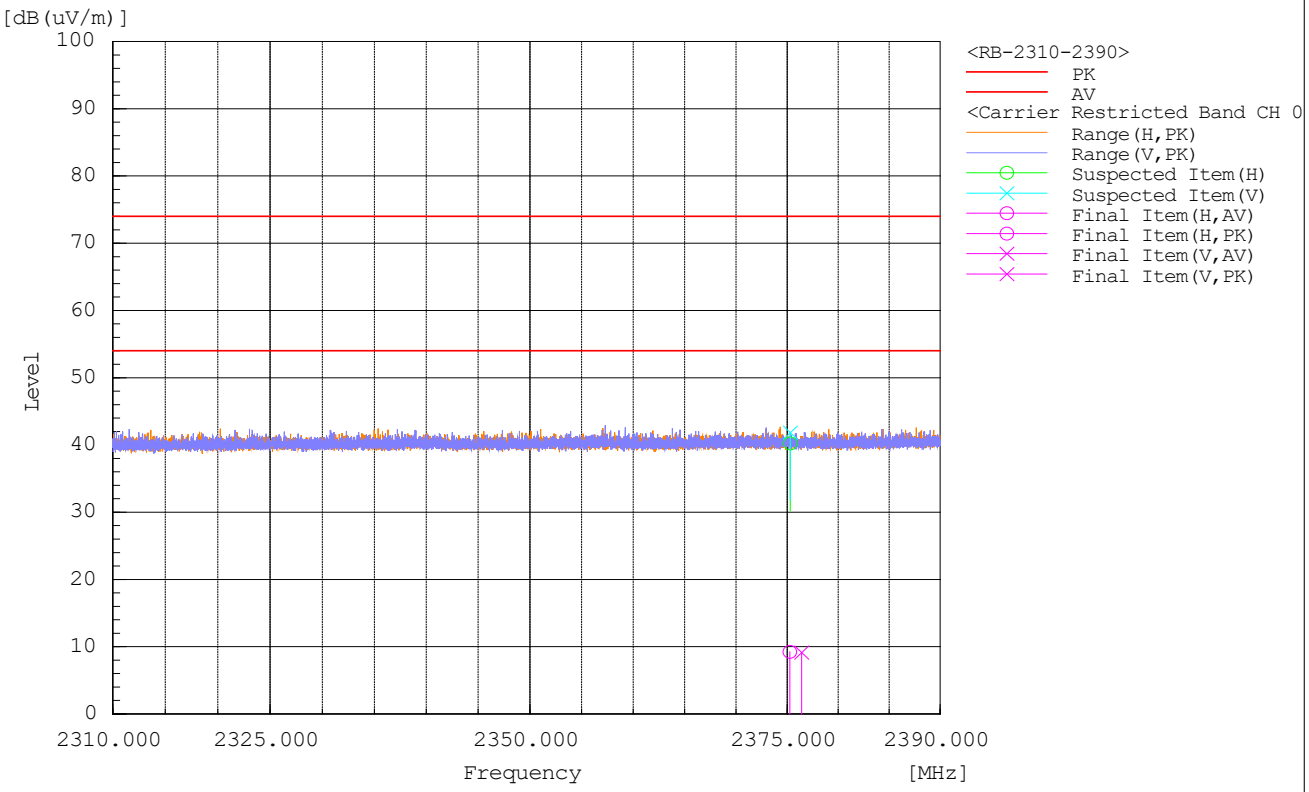
REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

RESTRICTED BAND (LOW CHANNEL)

Final Data List

Frequency MHz	Polarization	Reading AV dB(uV)	Reading PK dB(uV)	Factor dB(1/m)	Level AV dB(uV/m)	Level PK dB(uV/m)	Limit AV dB(uV/m)	Limit PK dB(uV/m)	Margin AV dB	Margin PK dB
2376.41	V	43.1	54	-44.9	-1.8	9.1	54	74	55.8	64.9
2375.269	H	43	54.1	-44.9	-1.9	9.2	54	74	55.9	64.8



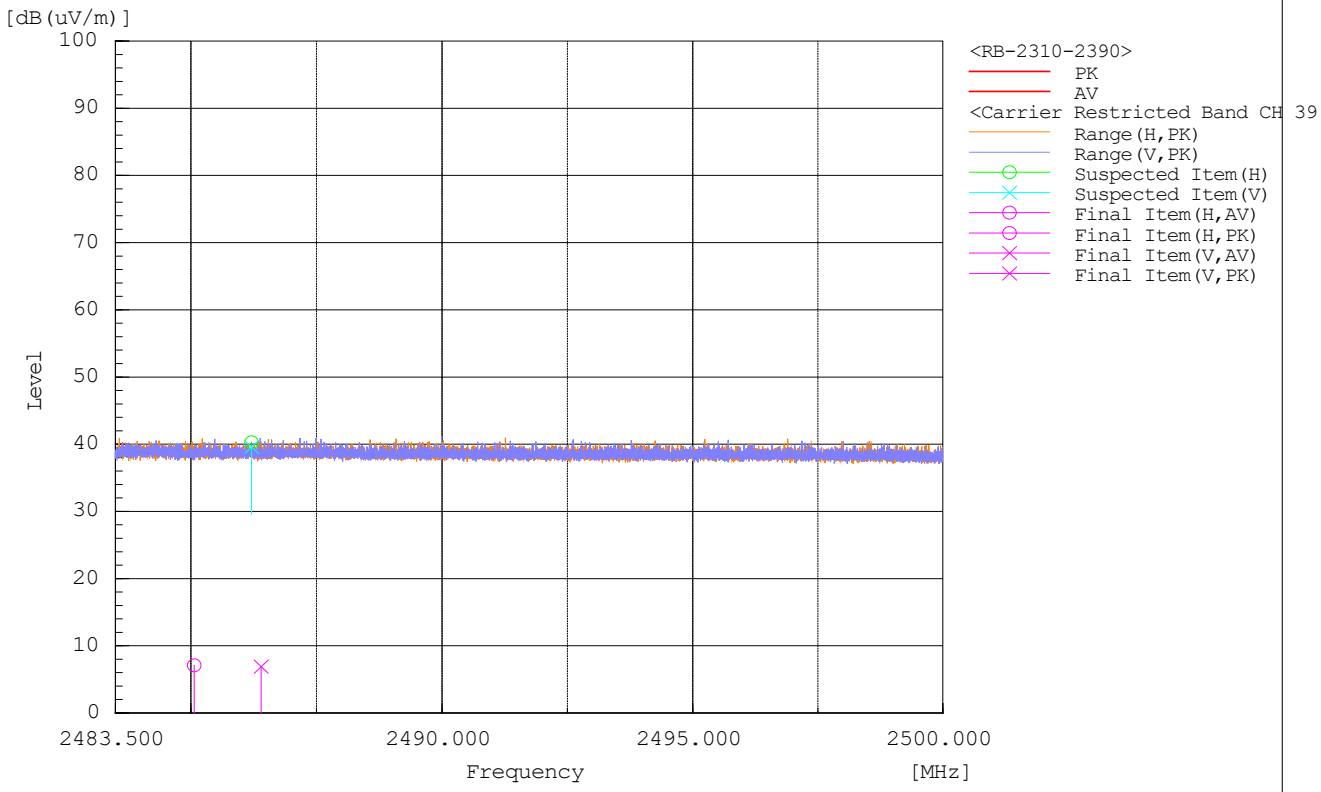
REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

RESTRICTED BAND (HIGH CHANNEL)

Final Data List

Frequency MHz	Polarization	Reading AV dB(uV)	Reading PK dB(uV)	Factor dB(1/m)	Level AV dB(uV/m)	Level PK dB(uV/m)	Limit AV dB(uV/m)	Limit PK dB(uV/m)	Margin AV dB	Margin PK dB
2486.397	V	40	51.8	-44.9	-4.9	6.9	54	74	49.1	67.1
2485.065	H	40.1	52	-44.9	-4.8	7.1	54	74	49.2	66.9



REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

4.7 ANTENNA REQUIREMENTS

Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of permanent attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

Antenna Gain

The antenna peak gain of the EUT is less than 6dBi. Therefore, it is not necessary to reduce maximum output power limit.

5 APPENDIX – INFORMATION ON THE TESTING LABORATORIES

Bureau Veritas is a global leader in testing, inspection and certification (TIC) services. We help businesses improve safety, sustainability and productivity; and our clients include the majority of leading brands in retail, manufacturing and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

If you have any comments, please feel free to contact us at the following:

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Sunnyvale OTA/Bluetooth Lab
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Tel: +1 669 600 5293

Littleton EMC/RF/Safety/Environmental Lab
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Tel: +1 978 486 8880

Email: sales.eaw@us.bureauveritas.com
Web Site: www.cpsusa-bureauveritas.com

The address and road map of all our labs can be found in our web site also.

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