

FCC IC Test Report

Report No.: FCC_IC_RF_SL20061801-UTC-002_BLE_Rev5

FCC ID: R32-10106653P1

IC: 5058A-10106653P1

Test Model: 10106653P1

Received Date: 01/04/2021

Test Date: 01/14/2021 - 09/20/2022

Issued Date: 01/27/2021

Applicant: Onity, Inc.

Address: 4001 Fairview Industrial Dr. SE, Salem, OR 97302

Manufacturer: Onity, Inc.

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

FCC Registration / 540430

Designation Number:

ISED# / CAB identifier: 4842D



Government
of Canada

Gouvernement
du Canada

**Testing Cert #2742-
01**

US1109

4842D

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Release Control Record

Issue No.	Description	Engineer	Reviewer	Date Issued
FCC_IC_RF_SL20061801-UTC-002_BLE	Original Release	EC	DD	01/27/2021
FCC_IC_RF_SL20061801-UTC-002_BLE_Rev1	Errors Correction			04/28/2022
FCC_IC_RF_SL20061801-UTC-002_BLE_Rev2	Errors Correction	BQ	SK	08/22/2022
FCC_IC_RF_SL20061801-UTC-002_BLE_Rev3	Errors Correction	BQ	SK	08/30/2022
FCC_IC_RF_SL20061801-UTC-002_BLE_Rev4	Errors Correction	BQ	SK	09/20/2022
FCC_IC_RF_SL20061801-UTC-002_BLE_Rev5	Errors Correction	BQ	SK	

1 Certificate of Conformity

Product: Serene Lock
Brand: Onity
Test Model: 10106653P1
Sample Status: Engineering sample
Applicant: Onity, Inc.
Test Date: 01/14/2021 - 09/20/2022
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:** 01/27/2021
Ellen Chu / Test Engineer

Approved by :  _____, **Date:** 01/27/2021
Deon Dai / Engineer Review

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 on the EUT as specified in CISPR 16-4-2 and ETSI TR 100 028:

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	Serene Lock
Brand	Onity
Test Model	10106653P1
Identification No. of EUT	001755C2548E (Radiated), 001755C25471 (Conducted)
Status of EUT	Engineering sample
Power Supply Rating	6Vdc
Modulation Type	GFSK
Modulation Technology	DTS
Transfer Rate	Up to 2Mbps
Operating Frequency	2.402 ~ 2.480GHz
Number of Channel	40
Output Power	3 dBm
Antenna Gain	1.5 dBi
Antenna Type	Chip Antenna (Johanson 2450AT18D0100)
Antenna Connector	Permanently attached

Note:

1. The above EUT information is declared by the manufacturer. For more details, please refer to the manufacturer's specifications or user's manual.
2. The antenna gain is provided by the client. Lab has not performed any testing on the antenna, and assumes no responsibility or liability for the accuracy of this value.

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

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE \geq 1G	RE $<$ 1G	PLC	APCM	
-	√	√	-	√	-

Where RE \geq 1G: Radiated Emission above 1GHz & Bandedge Measurement
 RE $<$ 1G: Radiated Emission below 1GHz
 PLC: Power Line Conducted Emission
 APCM: Antenna Port Conducted Measurement

NOTE: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Y-plane**.
NOTE: “-” means no effect.

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

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.

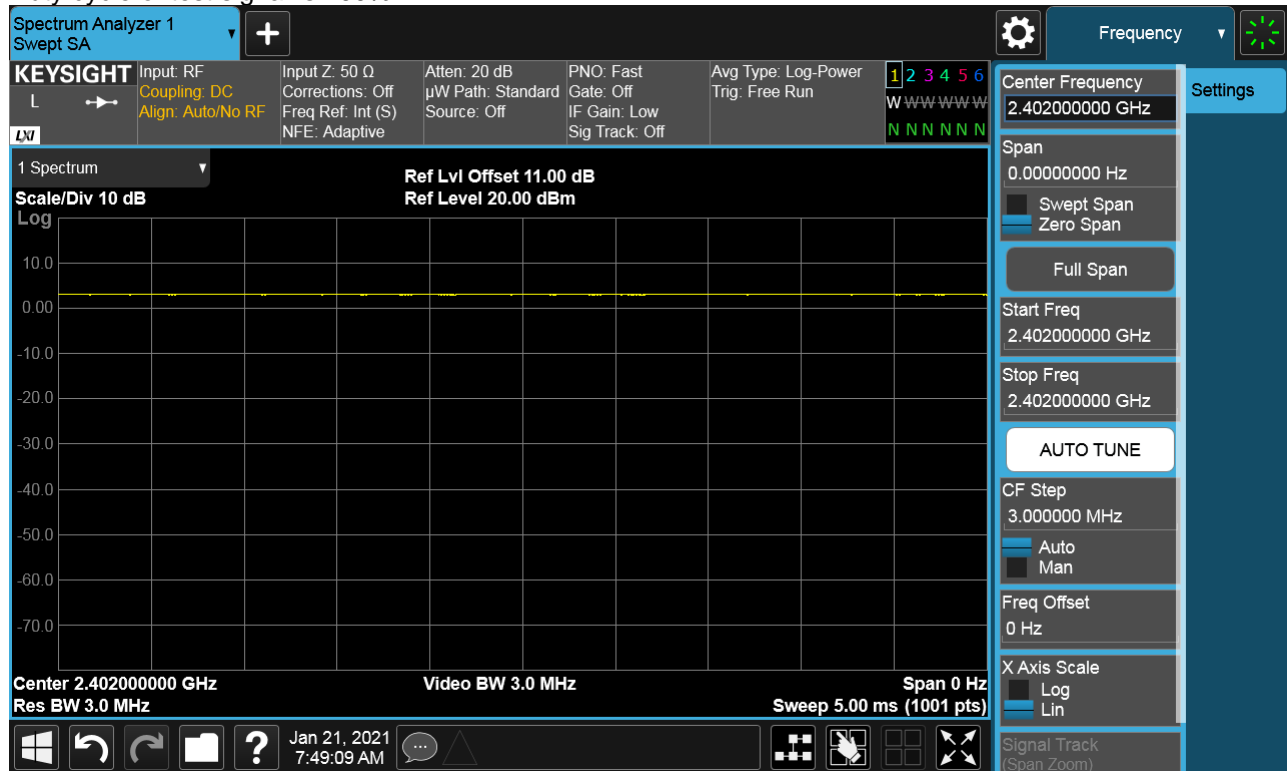
AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	19	GFSK	1

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE≥1G	25deg. C, 65%RH	6Vdc	Ellen Chu
RE<1G	25deg. C, 65%RH	6Vdc	Ellen Chu
PLC	25deg. C, 68%RH	6Vdc	Ellen Chu
APCM	21deg. C, 60%RH	6Vdc	Ellen Chu

3.3 Duty Cycle of Test Signal

Duty cycle of test signal is 100%.



3.4 Description of Support Units

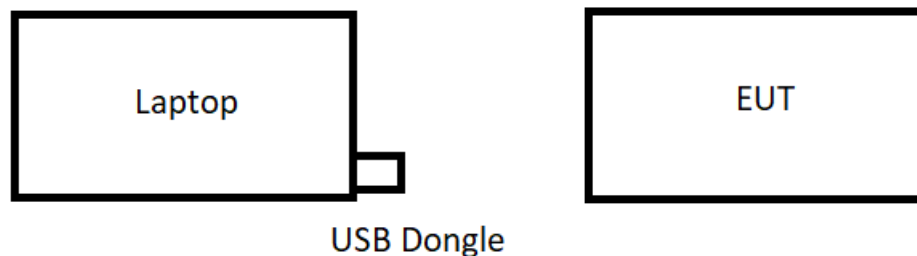
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

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).

3.4.1 Configuration of System under Test



3.5 EUT Operating Conditions

For Radiated Emissions and RF Conducted Measurements:

- a. BE Excel Program was used to set the EUT to transmit continuously at either Low (2402 MHz), Mid (2440 MHz) and High (2480 MHz) Channel at 3 dBm of power.

3.6 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements 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.

3.7 Conducted Emission Measurement

3.7.1 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.

3.7.2 Test Procedures

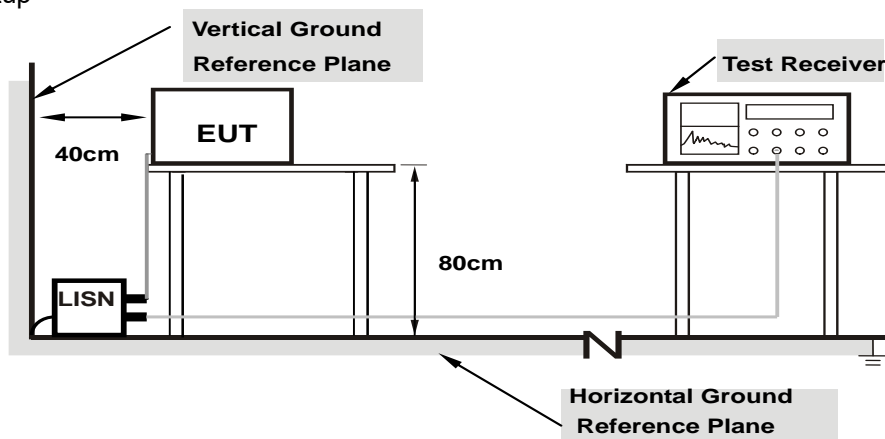
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

3.7.3 Deviation from Test Standard

No deviation.

3.7.4 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).

3.7.5 EUT Operating Conditions (SAME AS 3.5)

3.7.6 Test Results

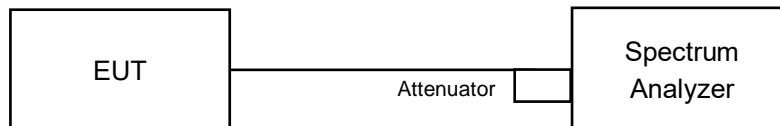
N/A (Work with battery).

3.8 6dB Bandwidth Measurement & 99% Bandwidth Measurement

3.8.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

3.8.2 Test Setup



3.8.3 Test Procedure

- Set resolution bandwidth (RBW) = 30KHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- 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

3.8.4 Deviation from Test Standard

No deviation.

3.8.5 EUT Operating Conditions

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

3.8.6 Test Result

1 Mbps

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.617	1.053	0.5	PASS
19	2440	0.632	1.056	0.5	PASS
39	2480	0.629	1.062	0.5	PASS

2 Mbps

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
39	2480	1.060	1.394	0.5	PASS

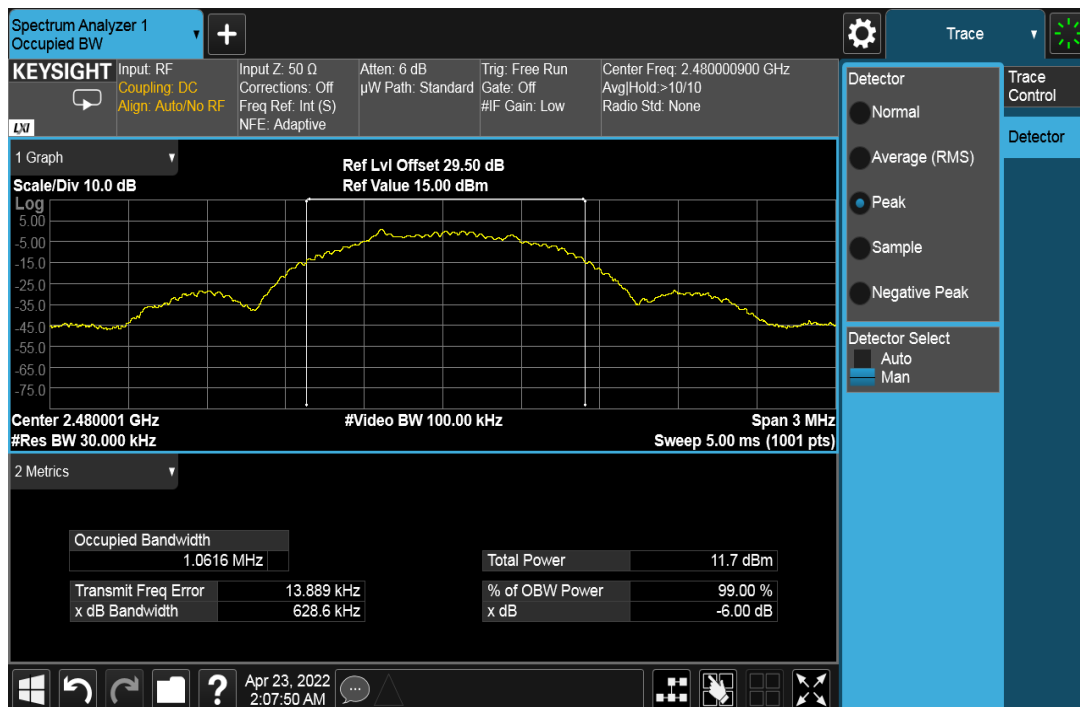
Test Plots:



1 Mbps CH 0: 2402 MHz



1 Mbps CH 19: 2440 MHz



1 Mbps CH 39: 2480 MHz



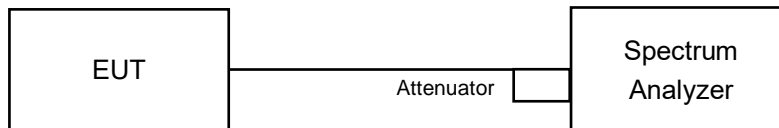
2 Mbps CH39: 2480 MHz

3.9 Conducted Output Power Measurement

3.9.1 Limits of Conducted Output Power Measurement

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

3.9.2 Test Setup



3.9.3 Test Instruments

Refer to section 3.12.2 to get information of above instrument.

3.9.4 Test Procedures

- a. Set the RBW \geq DTS bandwidth.
- b. Set VBW $\geq 3 \times$ RBW.
- c. Set span $\geq 3 \times$ 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.

3.9.5 Deviation from Test Standard

No deviation.

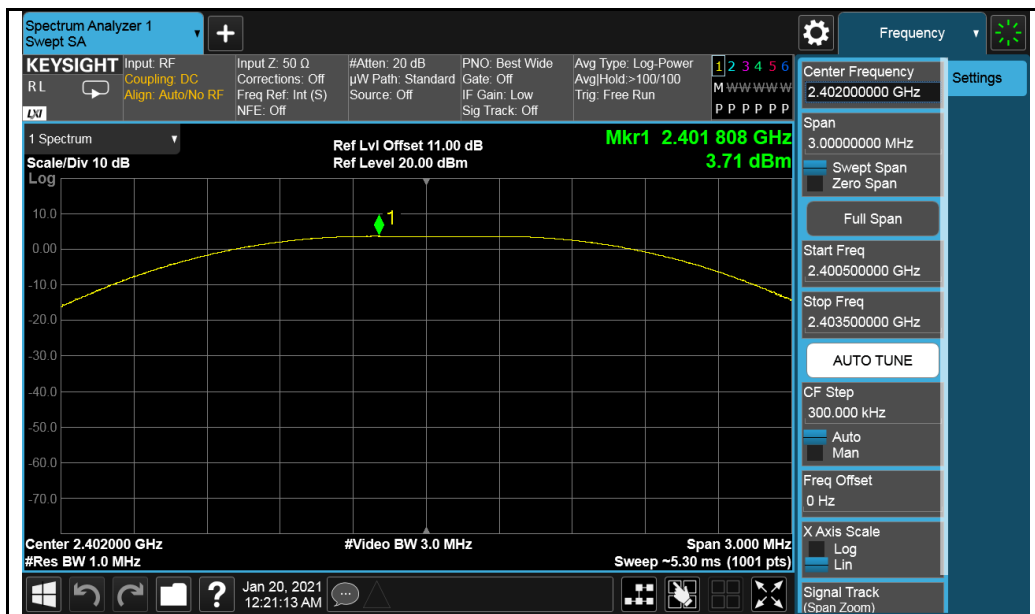
3.9.6 EUT Operating Conditions

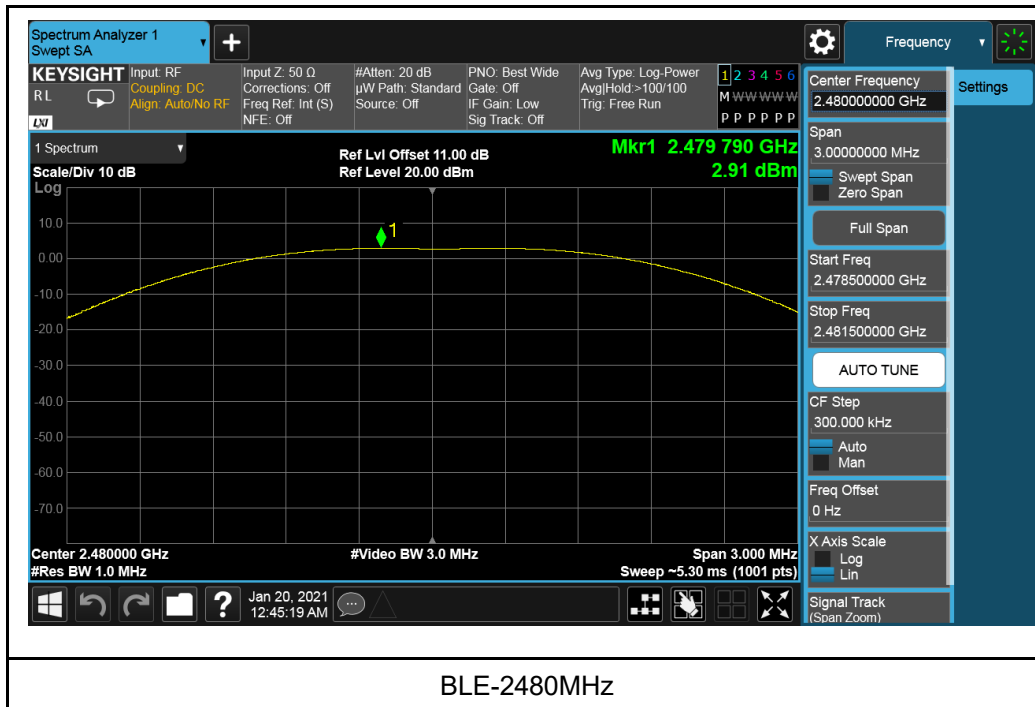
Same as Item 3.5

3.9.7 Test Results

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Pass/Fail
0	2402	3.71	30	Pass
19	2440	3.29	30	Pass
39	2480	2.91	30	Pass

Test Plots:





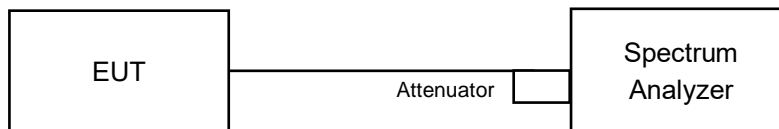
BLE-2480MHz

3.10 POWER SPECTRAL DENSITY MEASUREMENT

3.10.1 Limits of Power Spectral Density Measurement

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

3.10.2 Test Setup



3.10.3 Test Instruments

Refer to section 3.12.2 to get information of above instrument.

3.10.4 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: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d. Set the VBW $\geq 3 \times \text{RBW}$.
- 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.

3.10.5 Deviation from Test Standard

No deviation.

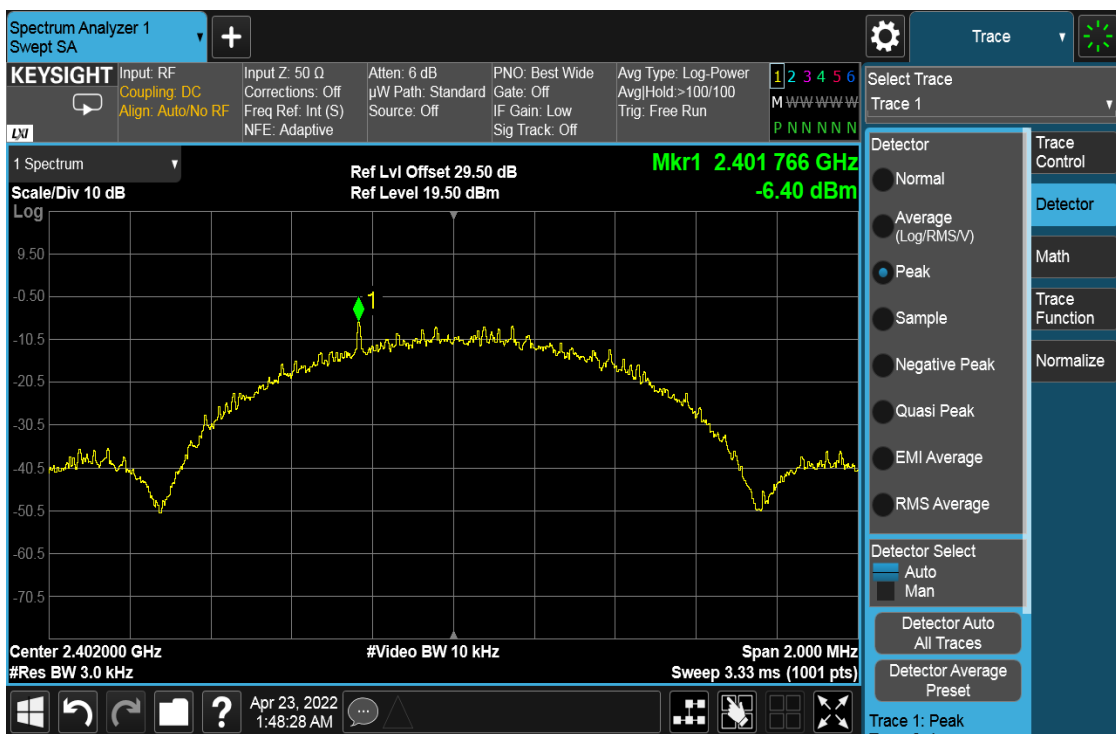
3.10.6 EUT Operating Condition

Same as Item 3.5

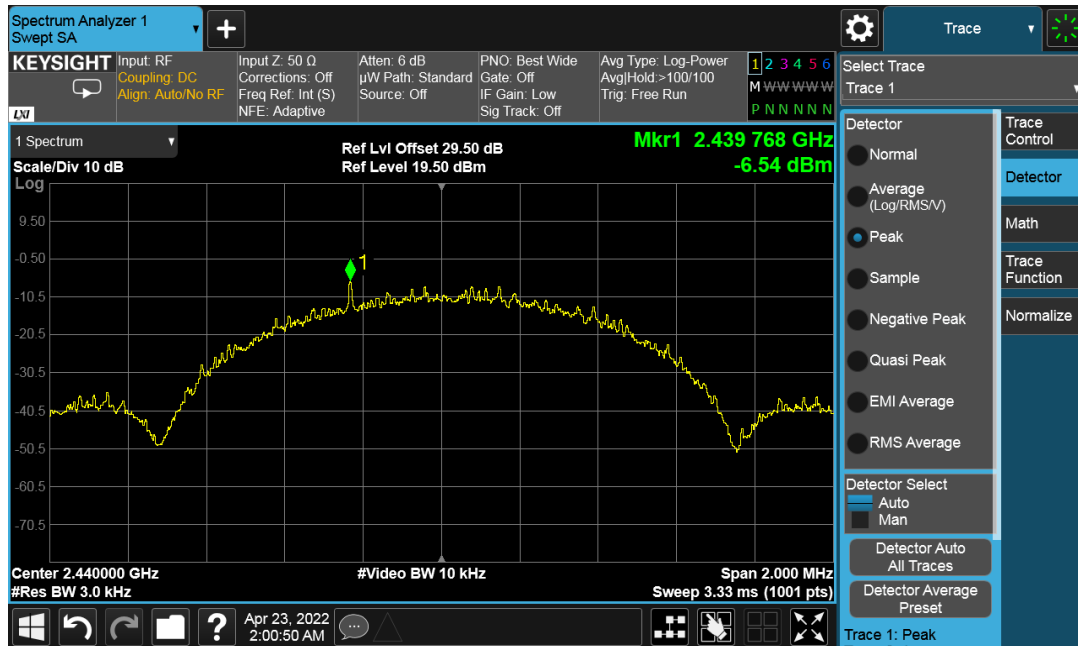
3.10.7 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass/Fail
0	2402	-6.40	8	Pass
19	2440	-6.54	8	Pass
39	2480	-6.92	8	Pass

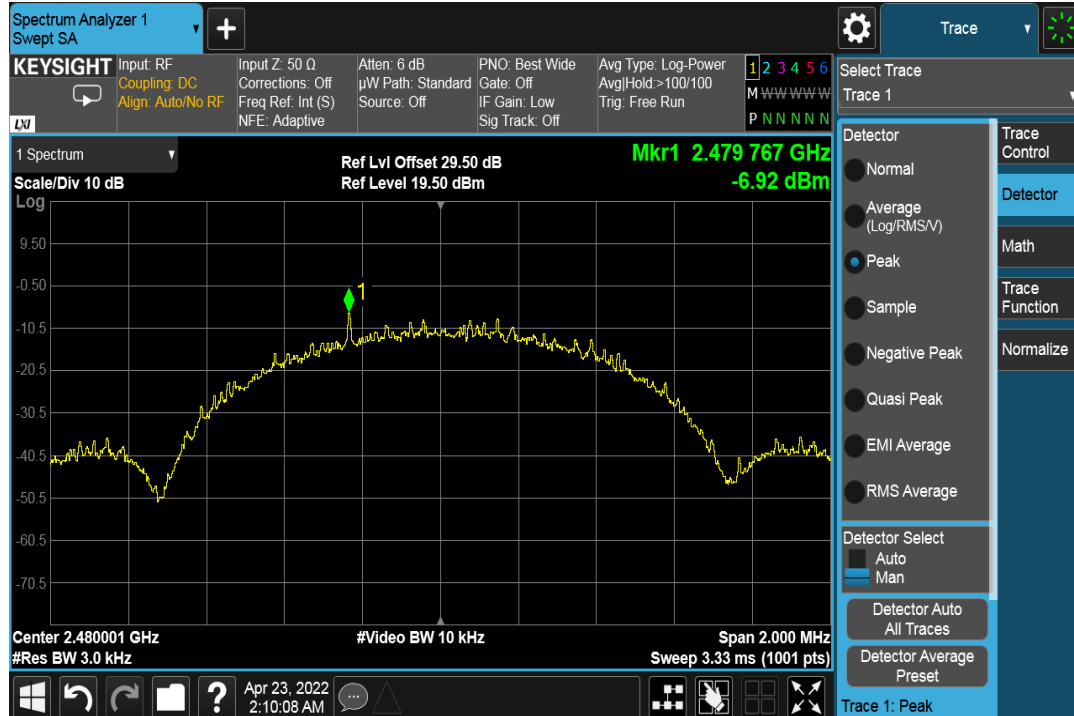
Test Plots:



CH 0



CH 19



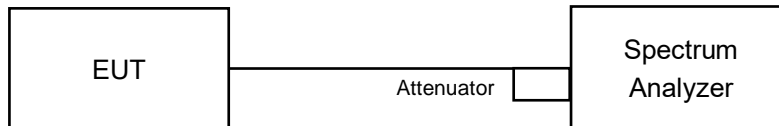
CH 39

3.11 Conducted Out of Band Emission Measurement

3.11.1 Limits of Conducted Out of Band Emission Measurement

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

3.11.2 Test Setup



3.11.3 Test Instruments

Refer to section 3.12.2 to get information of above instrument.

3.11.4 Test Procedure

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW \geq 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 OOB

1. Set RBW = 100 kHz.
2. Set VBW \geq 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.

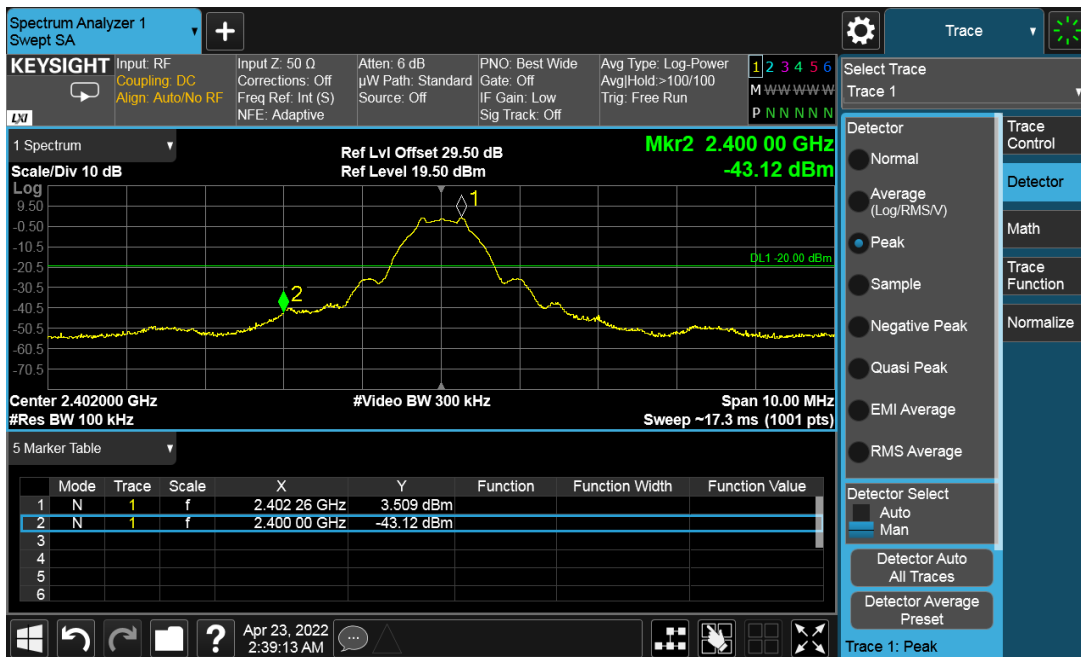
3.11.5 Deviation from Test Standard

No deviation.

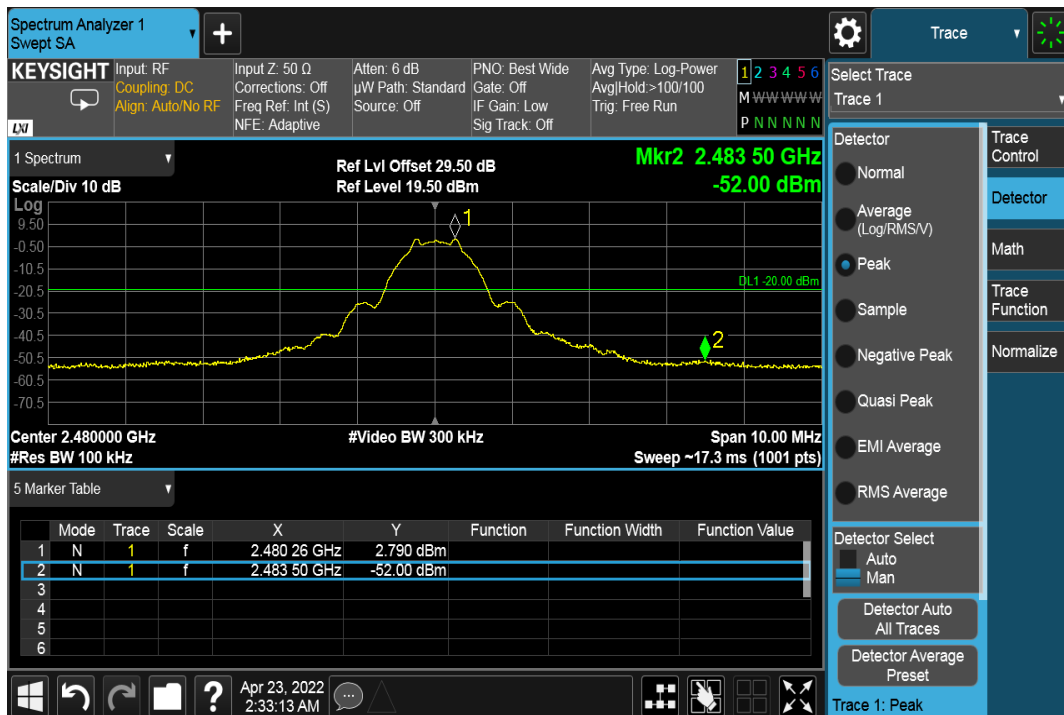
3.11.6 EUT Operating Condition

Same as Item 3.5

3.11.7 Test Results of Conducted Band Edges Plots



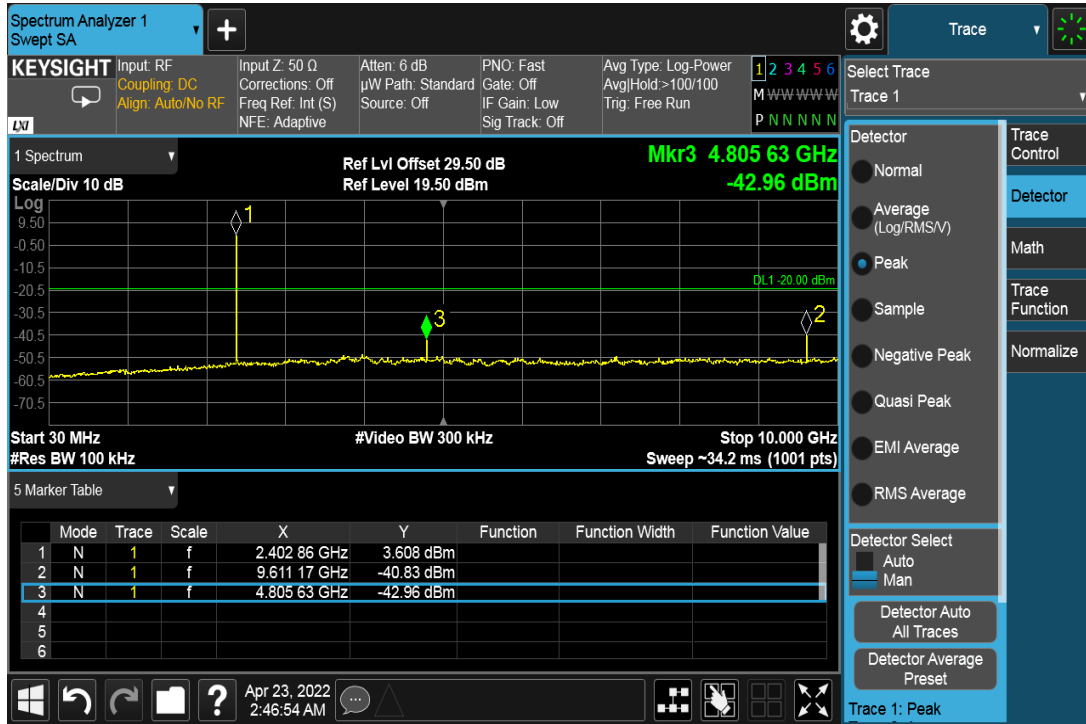
CH 0



CH 39

otep

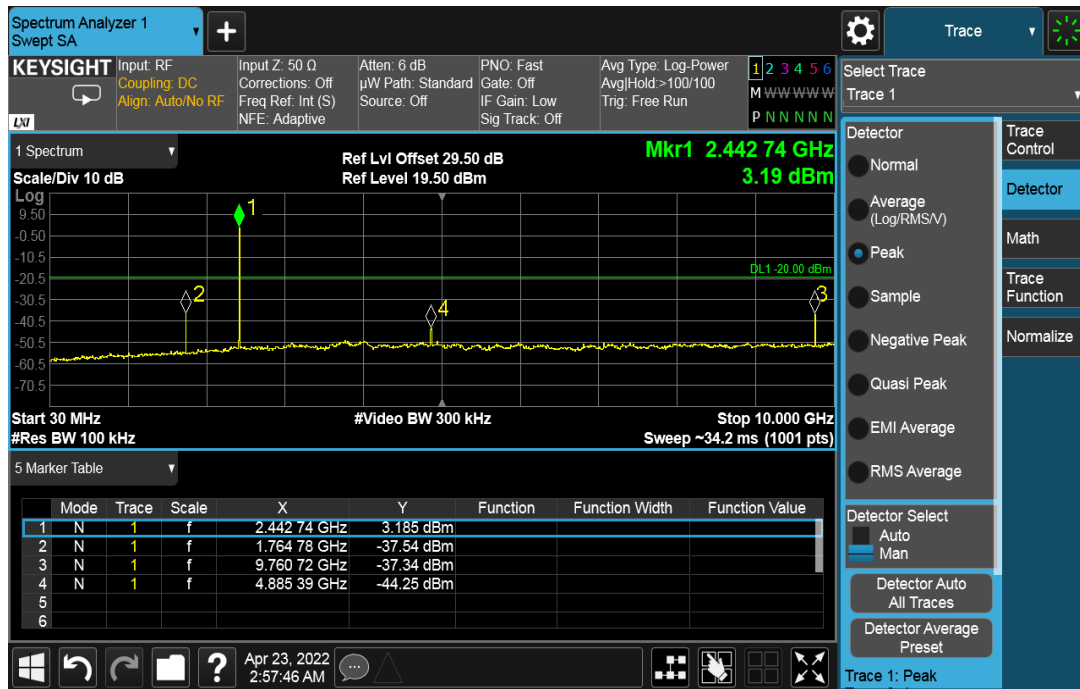
4.1.1 Test Results of Conducted Spurious Emission Plots



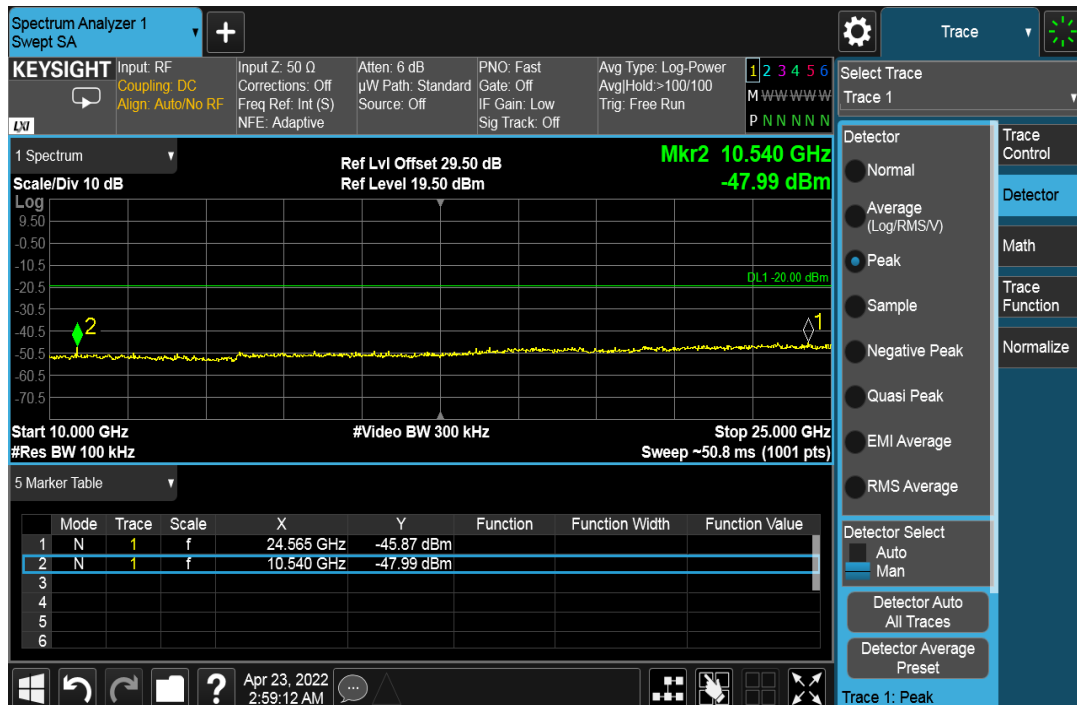
CH 0 – Plot 1



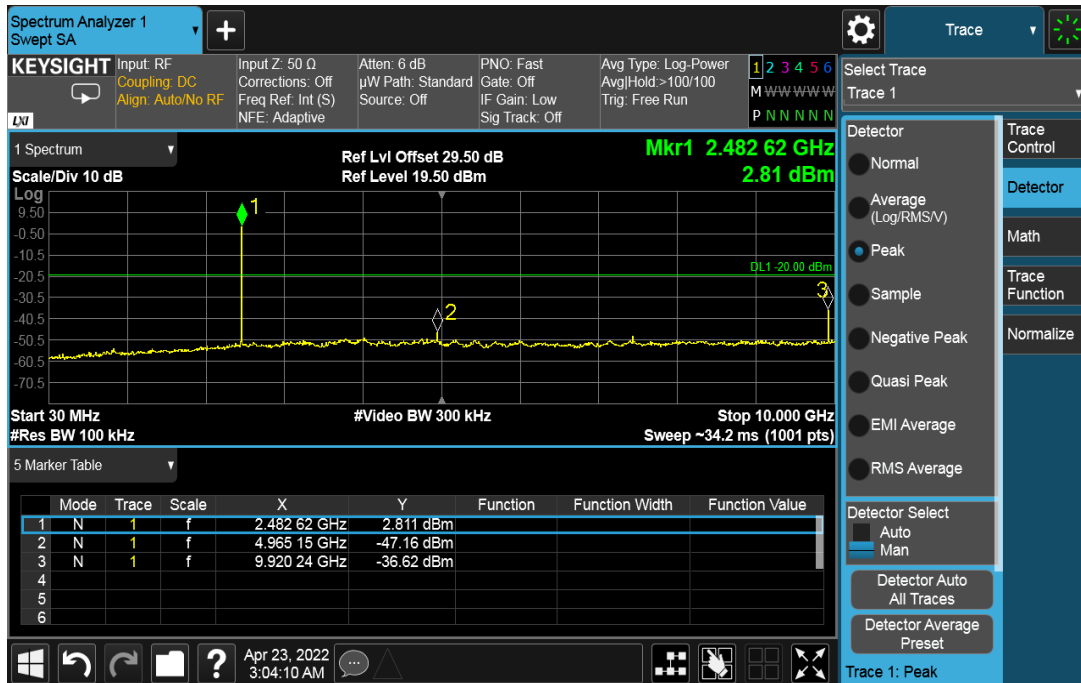
CH 0 – Plot 2



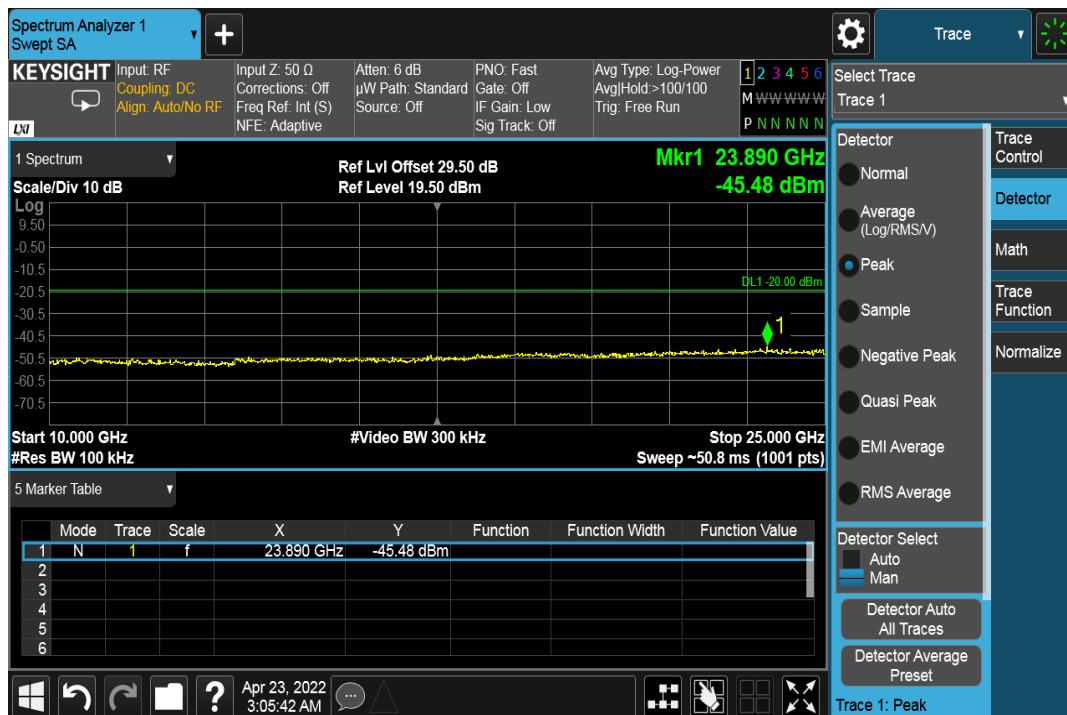
CH 19 – Plot 1



CH 19 – Plot 2



CH 39 – Plot 1



CH 39 – Plot 2

3.12 Radiated Emission and Bandedge Measurement

3.12.1 Limits of Radiated Emission and Bandedge 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.

3.12.2 Test Instruments

Test Instruments for Testing Conducted in 2021

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Test Receiver Keysight	ESW 44	1328.4100K- 101662-MH	08/30/2020	08/30/2021
Spectrum Analyzer Keysight	N9030B	0240376	06/15/2020	06/15/2021
Hybrid Antenna Sunoi	JB1	A030702	03/09/2020	03/09/2021
Horn Antenna ETS-Lindgren	3117	218554	11/22/2020	11/22/2021
Preamplifier RF-Lambda	RAMP00M50GA	17032300048	06/18/2020	06/18/2021
Preamplifier RF Bay, Inc.	LPA-6-30	11170601	04/27/2020	04/27/2021
FSB Antenna Cable, 0.5m (Microwave Town)	FSB360PK-KMKM- 00.50M	201906110002	10/1/2020	10/1/2021
FSB Antenna Cable, 4m (Microwave Town)	FSB360PK-KMKM- 400M	202103270001	10/1/2020	10/1/2021
10m Semi-Anechoic Chamber (ETS-Lindgren)	S2010BL8X8	1462	07/21/2020	07/21/2021

Test Instruments for Testing Conducted in 2022

Description & Manufacturer	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
Spectrum Analyzer Keysight	N9030B	MY57140100	9/22/2021	9/22/2022
EMI Test Receiver Rohde & Schwarz	ESW44	1328.4100K44-101662-MH	9/22/2021	9/22/2022
Horn Antenna ETS-Lindgren	3117	214309	4/21/2021	4/21/2023
Horn Antenna, Sunol	DRH-118	A070605	8/5/2020	08/05//2022
Pre-Amplifier RF-Lambda	RAMP00M50GA	1.8E+10	5/7/2021	5/7/2022
Biconilog Antenna, Sunol	JB1	A111717	9/4/2020	9/4/2022
Agilent Signal Generator	MXG- N5182A	MY47071065	9/22/2021	9/22/2022
Tuned Dipole Antenna 30 - 1000 MHz (4pcs set)	AD-100	40133	1/23/2022	1/23/2023
SMA Fixed Attenuator (50ohm, 2w, 30dB, DC-6GHz)	VAT-03W2+	N/A	7/21/2021	7/21/2022
FSB Antenna Cable, 0.5m (Microwave Town)	FSB360PK-KMKM- 00.50M	2.02E+11	10/1/2021	10/1/2022
FSB Antenna Cable, 4m (Microwave Town)	FSB360PK-KMKM- 400M	2.02E+11	10/1/2021	10/1/2022
10m Semi- Anechoic Chamber (ETS- Lindgren)	S2010BL8X8	1462	7/21/2020	7/21/2022

3.12.3 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 and perpendicular 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 9 kHz 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:

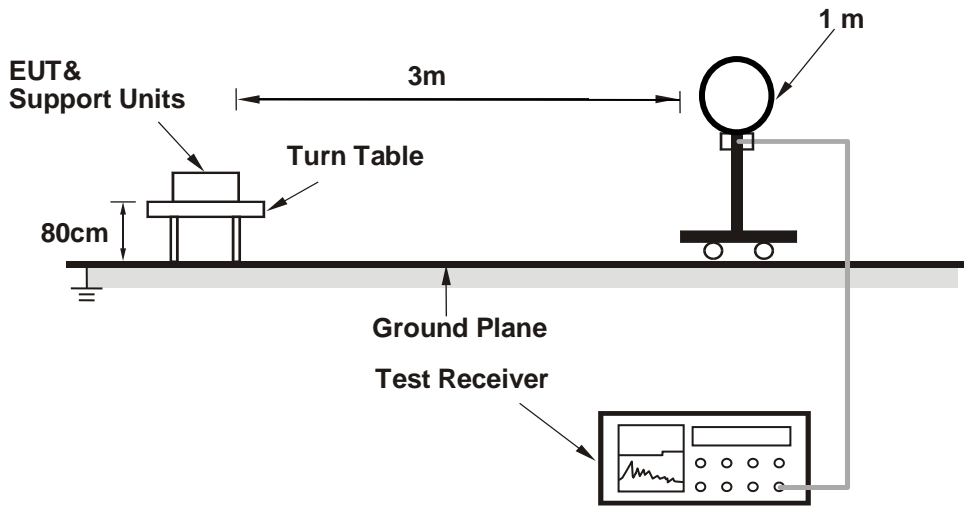
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

3.12.4 Deviation from Test Standard

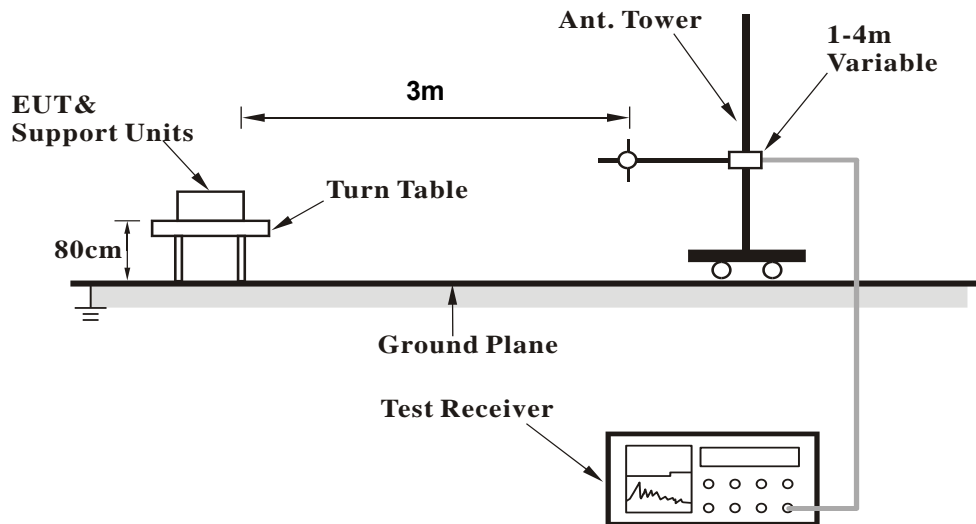
No deviation.

3.12.5 Test Setup

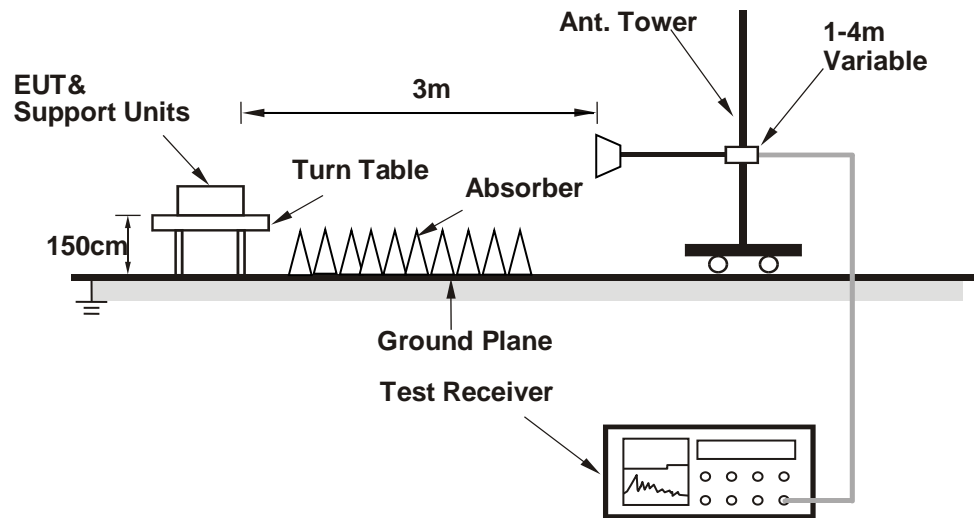
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



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

3.12.6 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.

3.12.7 Test Results

Radiated Emissions (9 kHz~30 MHz)

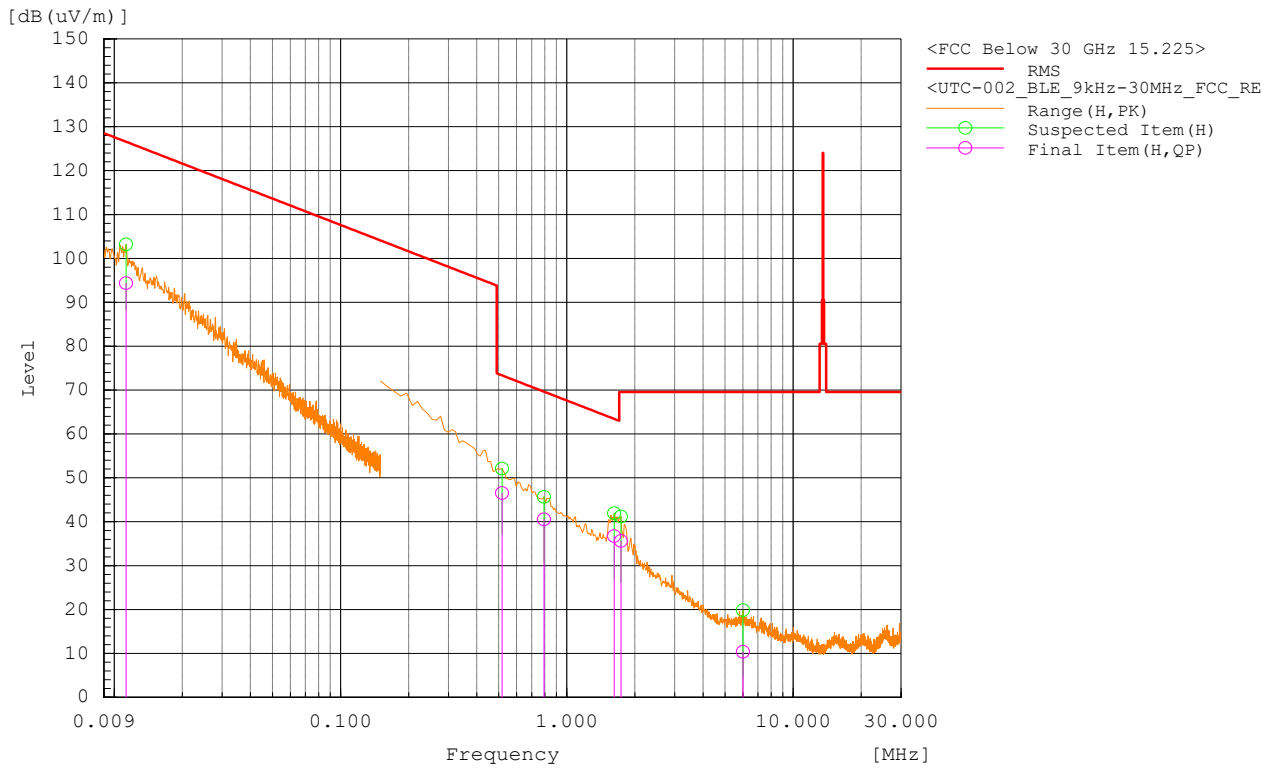
Date Tested	08/18/2022		
Channel	Channel 0	Frequency Range	13.56MHz
Input Power	DC6V	Detector Function	Quasi-Peak
Environmental Conditions	24.5 deg. C, 43.7% RH	Tested By	Brandon Quan

Antenna Polarity & Test Distance: Loop Antenna H-Polarity At 3m

No.	Frequency (MHz)	Polarization	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	0.011	H	43.1	51.3	94.4	126.6	32.2	100	142.8	Pass
2	0.517	H	28.6	18	46.6	73.3	26.7	100	47.3	Pass
3	0.793	H	25.5	15	40.5	69.6	29.1	100	0	Pass
4	1.62	H	27.1	9.6	36.7	63.4	26.7	100	5.9	Pass
5	1.734	H	26.6	9	35.6	69.5	33.9	100	228	Pass
6	6.005	H	7.2	3.2	10.4	69.5	59.1	100	180.4	Pass

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB)
3. Margin value = Emission level – Limit value.
4. All emissions higher than the fundamental are noise floor measurements.



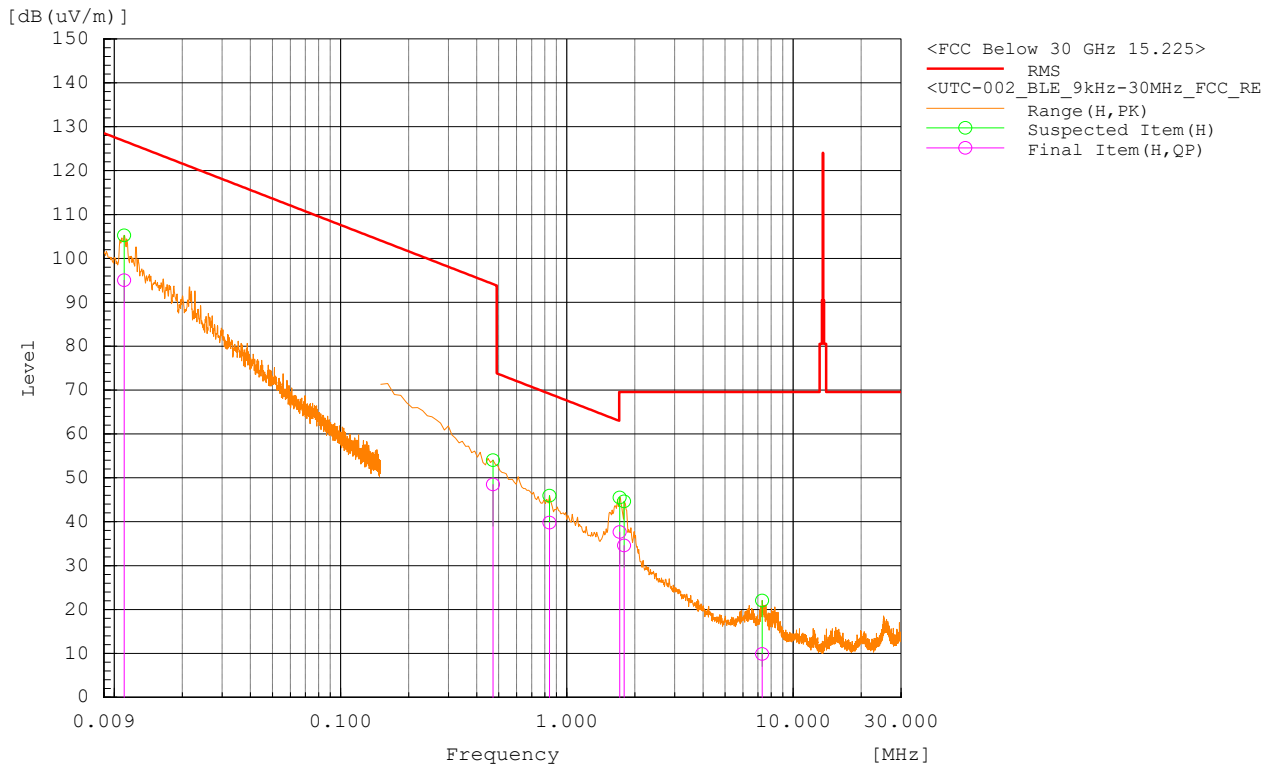
Date Tested	08/18/2022		
Channel	Channel 19	Frequency Range	Below 30MHz
Input Power	DC6V	Detector Function	Quasi-Peak
Environmental Conditions	24.5 deg. C, 43.7% RH	Tested By	Brandon Quan

Antenna Polarity & Test Distance: Loop Antenna V-Polarity At 3m

No.	Frequency (MHz)	Polarization	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	0.011	V	43.6	51.4	95	126.7	31.7	100	330.5	Pass
2	0.471	V	29.6	18.9	48.5	94.1	45.6	100	316.5	Pass
3	0.839	V	25.2	14.6	39.8	69.1	29.3	100	265.5	Pass
4	1.711	V	28.5	9.1	37.6	69.5	31.9	100	8	Pass
5	1.792	V	25.9	8.7	34.6	69.5	34.9	100	358.2	Pass
6	7.303	V	6.7	3.1	9.8	69.5	59.7	100	132.4	Pass

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB)
3. Margin value = Emission level – Limit value.
4. All emissions higher than the fundamental are noise floor measurements.



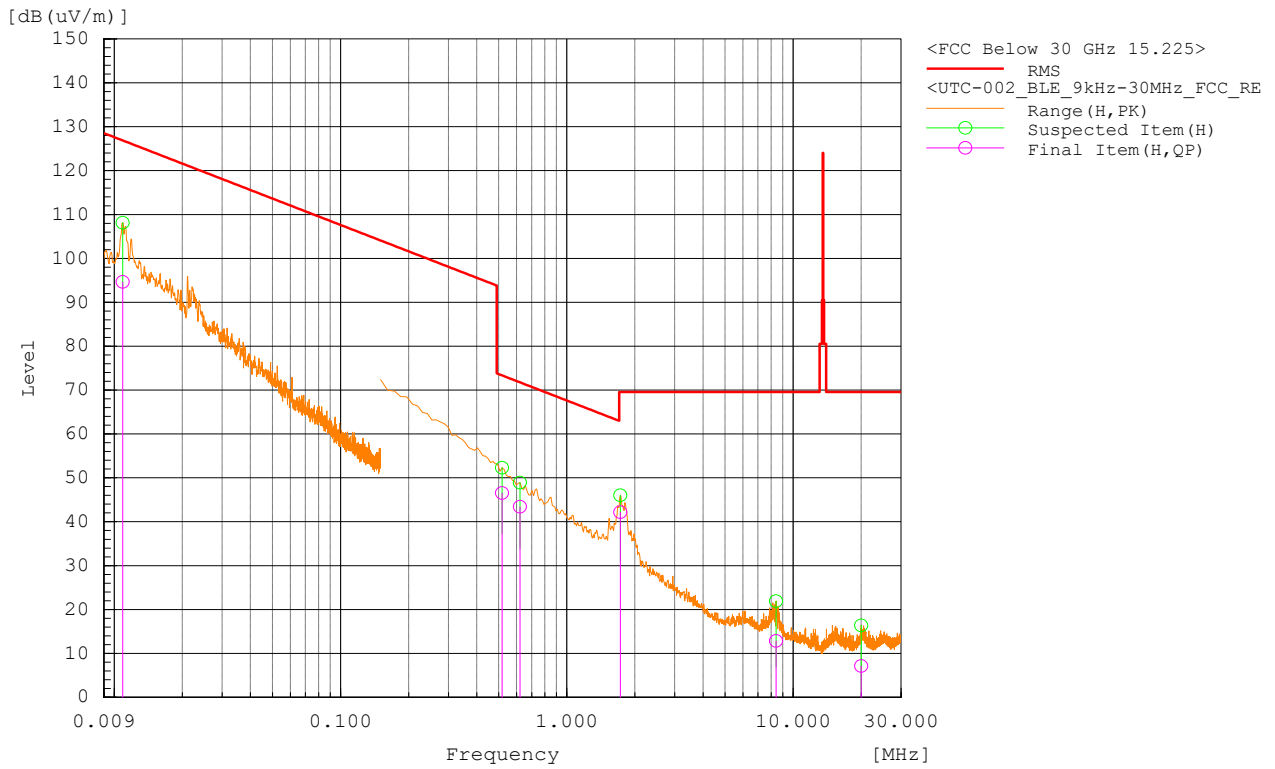
Date Tested	08/18/2022		
Channel	Channel 39	Frequency Range	Below 30MHz
Input Power	DC6V	Detector Function	Quasi-Peak
Environmental Conditions	24.5 deg. C, 43.7% RH	Tested By	Brandon Quan

Antenna Polarity & Test Distance: Loop Antenna Z-Polarity At 3m

No.	Frequency (MHz)	Polarization	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	0.011	Z	43.2	51.4	94.6	126.9	32.3	100	29.3	Pass
2	0.517	Z	28.5	18	46.5	73.3	26.8	100	0	Pass
3	0.621	Z	26.9	16.5	43.4	71.7	28.3	100	238.4	Pass
4	1.723	Z	33.2	9	42.2	69.5	27.3	100	65.4	Pass
5	8.416	Z	9.7	3.1	12.8	69.5	56.7	100	81.2	Pass
6	20.012	Z	4.1	3	7.1	69.5	62.4	100	5.8	Pass

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB)
3. Margin value = Emission level – Limit value.
4. All emissions higher than the fundamental are noise floor measurements.



BELOW 1GHz WORST-CASE DATA:

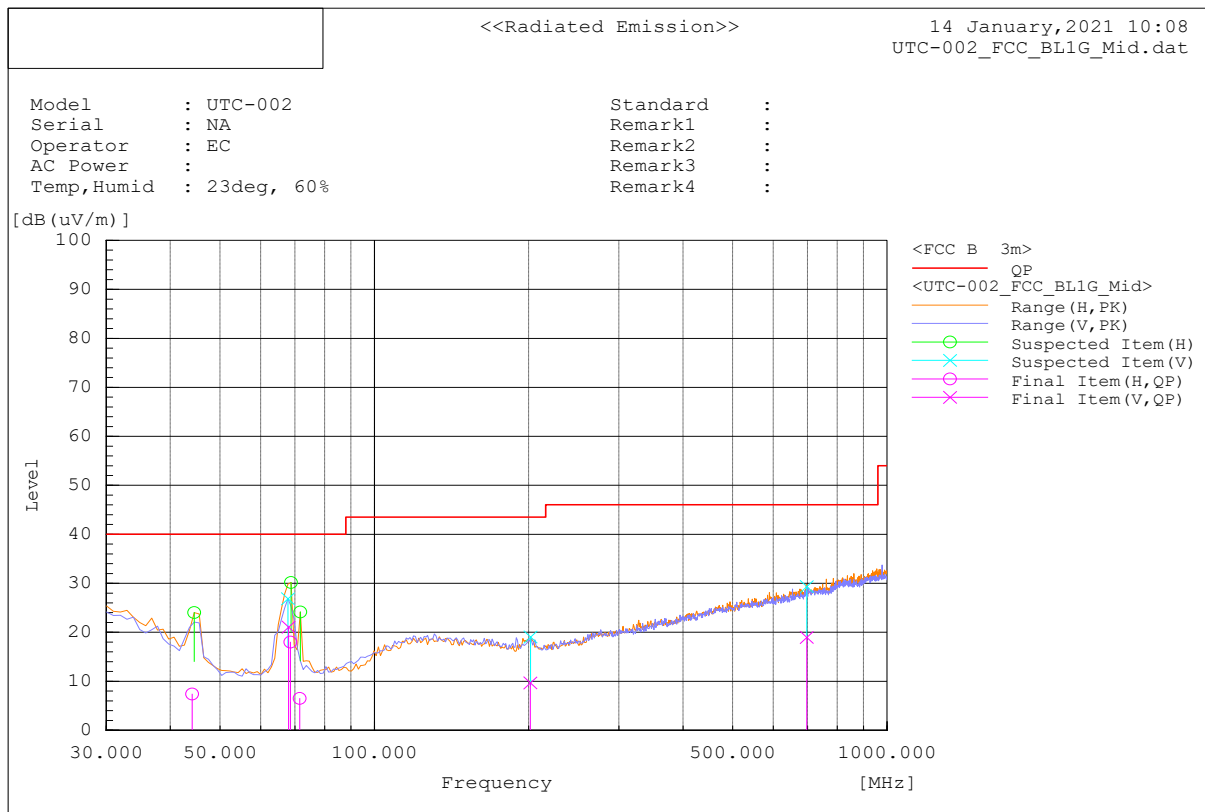
BT-LE (GFSK)

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

ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m											
No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	44.139	-9.4	16.8	7.4	Quasi Max	H	209	133.5	40	-32.6	Pass
2	68.024	7.9	13.2	21.2	Quasi Max	V	100	274.1	40	-18.9	Pass
3	68.601	4.6	13.4	18.0	Quasi Max	H	115	273.8	40	-22.0	Pass
4	71.489	-6.9	13.4	6.5	Quasi Max	H	181	288	40	-33.5	Pass
5	201.521	-9.6	19.3	9.7	Quasi Max	V	162	316.3	43.5	-33.8	Pass
6	697.531	-8.9	27.9	19	Quasi Max	V	252	57.3	46	-27.0	Pass

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)



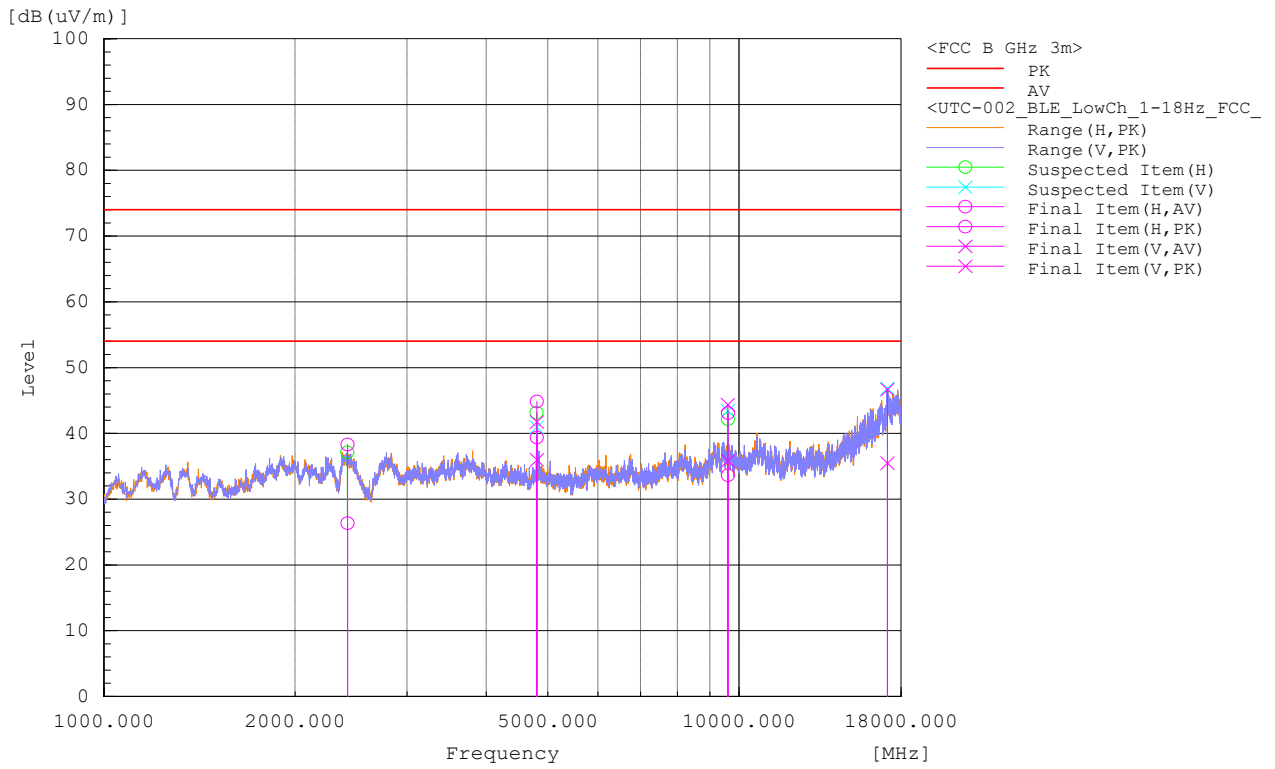
ABOVE 1GHz TEST DATA:
BT-LE (GFSK)

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

ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m												
No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail	
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)		
1	2418.55	57.3	-19	38.3	Peak	H	342.2	260.1	74	35.7	Pass	
2	4803.767	62.7	-17.9	44.8	Peak	H	256.6	193	74	29.2	Pass	
3	4803.761	59.6	-17.9	41.7	Peak	V	190.8	158.1	74	32.3	Pass	
4	9607.359	55	-10.6	44.4	Peak	V	103.8	136.3	74	29.6	Pass	
5	9608.99	53.8	-10.7	43.1	Peak	H	180.1	264.1	74	30.9	Pass	
6	17126.52	46.7	0.1	46.7	Peak	V	137	139.5	74	27.3	Pass	
7	2418.55	45.4	-19	26.4	Average	H	342.2	260.1	54	27.6	Pass	
8	4803.767	57.3	-17.9	39.4	Average	H	256.6	193	54	14.6	Pass	
9	4803.761	53.9	-17.9	36	Average	V	190.8	158.1	54	18	Pass	
10	9607.359	46.5	-10.6	35.9	Average	V	103.8	136.3	54	18.1	Pass	
11	9608.99	44.3	-10.7	33.6	Average	H	180.1	264.1	54	20.4	Pass	
12	17126.52	35.4	0.1	35.5	Average	V	137	139.5	54	18.5	Pass	

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. All other emissions are more than 20 dB below the limit.



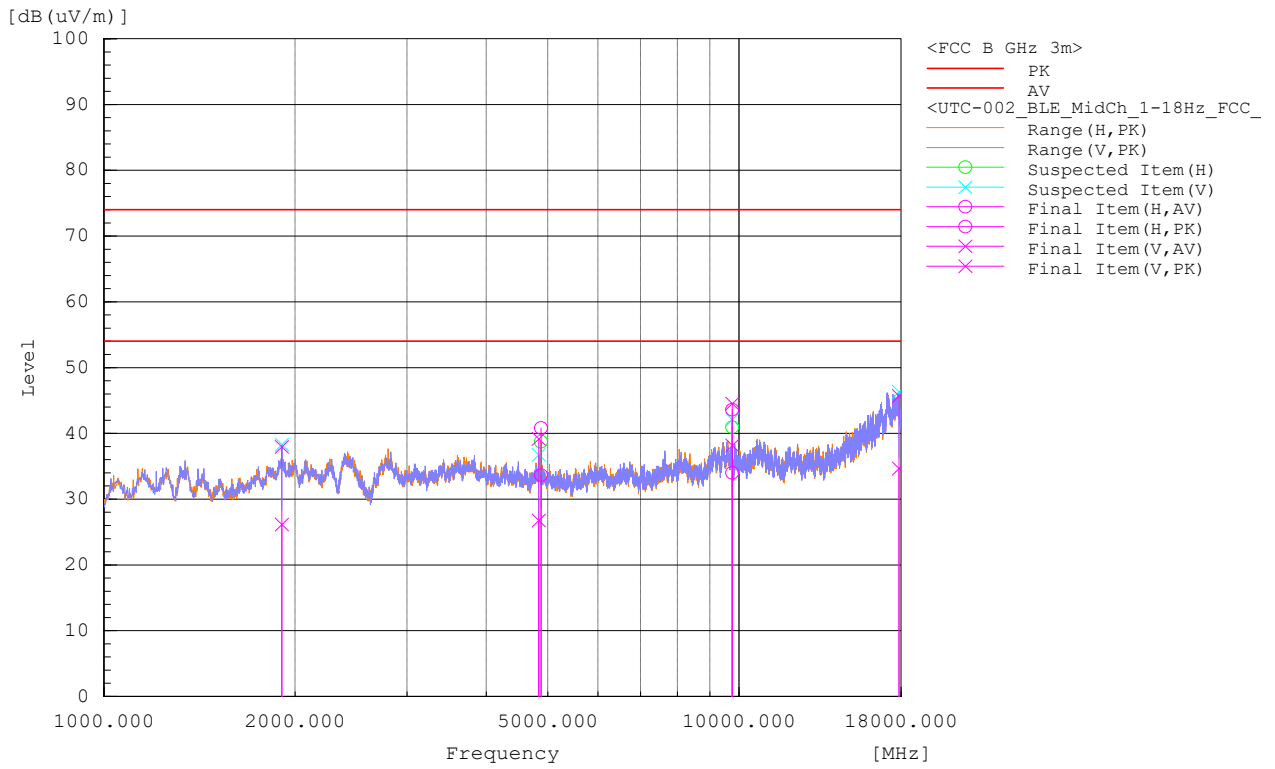
CHANNEL	TX Channel 19	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	1GHz - 18GHz		

ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	1905.875	56.6	-18.5	38	Peak	V	126.5	127.5	74	36	Pass
2	4839.448	54.8	-15.6	39.2	Peak	V	265.3	45.8	74	34.8	Pass
3	4879.725	59.4	-18.6	40.8	Peak	H	192.1	186.1	74	33.2	Pass
4	9759.135	54.6	-11	43.6	Peak	H	212.3	210.1	74	30.4	Pass
5	9761.05	55.5	-11	44.5	Peak	V	148.3	118.6	74	29.5	Pass
6	17860.42	46	-0.3	45.7	Peak	V	375.4	96.4	74	28.3	Pass
7	1905.875	44.6	-18.5	26.1	Average	V	126.5	127.5	54	27.9	Pass
8	4839.448	42.4	-15.6	26.8	Average	V	265.3	45.8	54	27.2	Pass
9	4879.725	52.2	-18.6	33.6	Average	H	192.1	186.1	54	20.4	Pass
10	9759.135	45	-11	34	Average	H	212.3	210.1	54	20	Pass
11	9761.05	49.2	-11	38.2	Average	V	148.3	118.6	54	15.8	Pass
12	17860.42	35	-0.3	34.7	Average	V	375.4	96.4	54	19.3	Pass

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. All other emissions are more than 20 dB below the limit.



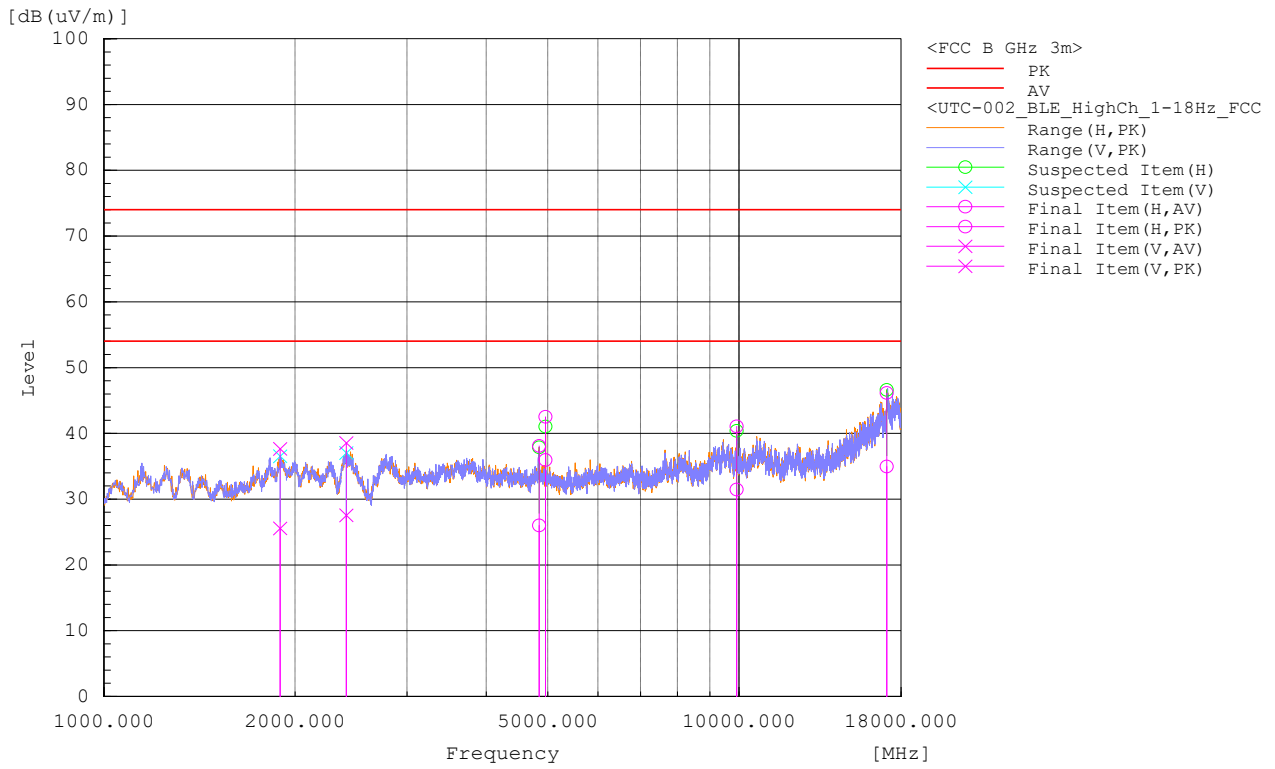
CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	1GHz - 18GHz		

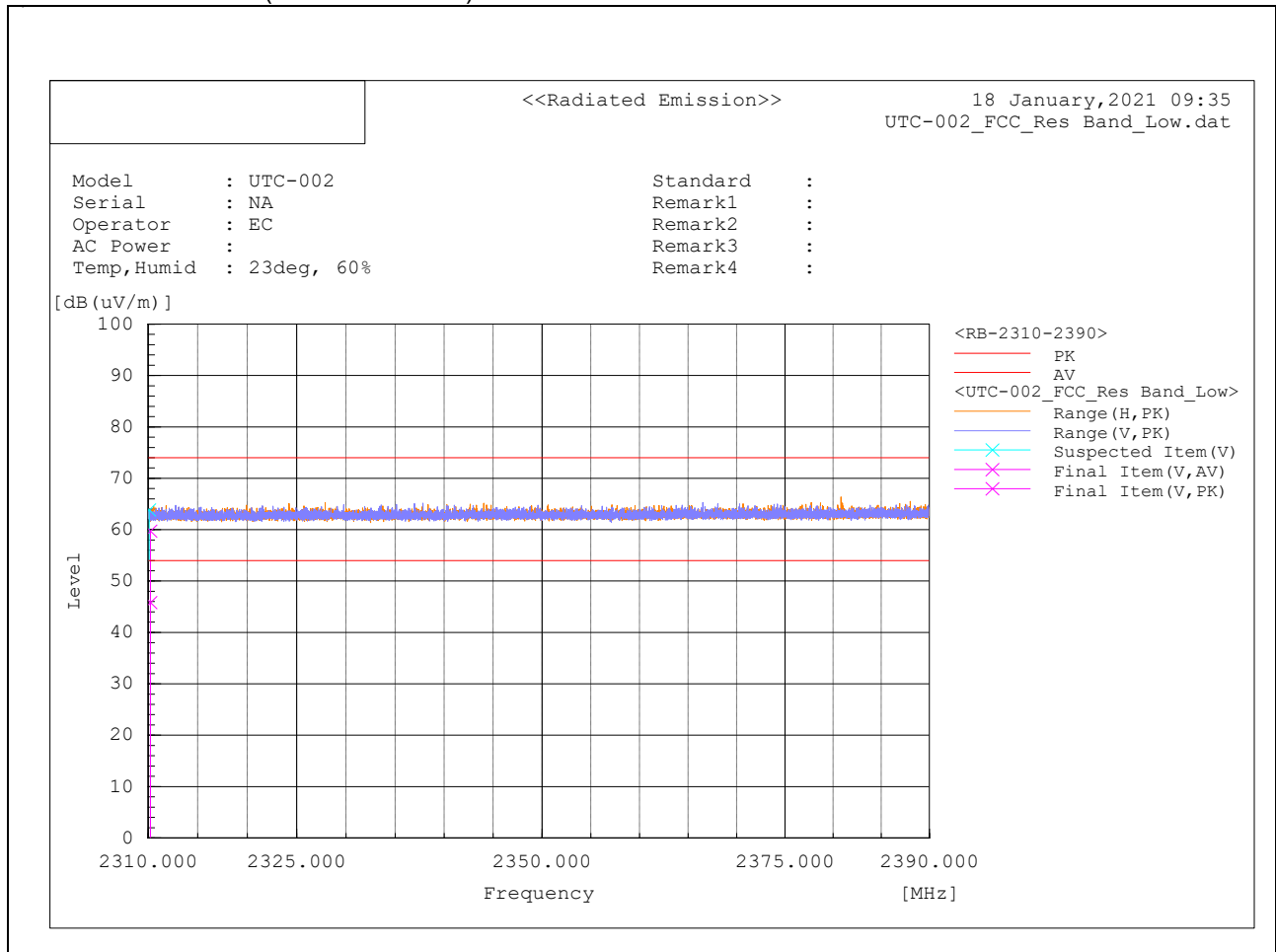
ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	1894.897	56.2	-18.5	37.7	Peak	V	400	0.1	74	36.3	Pass
2	2407.517	57.3	-18.8	38.5	Peak	V	278.3	263.4	74	35.5	Pass
3	4846.061	53.9	-15.9	38.1	Peak	H	177.5	45.7	74	35.9	Pass
4	4959.836	61.3	-18.8	42.5	Peak	H	191.2	184.7	74	31.5	Pass
5	9919.235	52.5	-11.5	41	Peak	H	103.6	209.6	74	33	Pass
6	17091.39	46.6	-0.5	46.1	Peak	H	223.2	291.2	74	27.9	Pass
7	1894.897	44.1	-18.5	25.6	Average	V	400	0.1	54	28.4	Pass
8	2407.517	46.3	-18.8	27.5	Average	V	278.3	263.4	54	26.5	Pass
9	4846.061	41.9	-15.9	26	Average	H	177.5	45.7	54	28	Pass
10	4959.836	54.8	-18.8	36	Average	H	191.2	184.7	54	18	Pass
11	9919.235	43	-11.5	31.5	Average	H	103.6	209.6	54	22.5	Pass
12	17091.39	35.5	-0.5	35	Average	H	223.2	291.2	54	19	Pass

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. All other emissions are more than 20 dB below the limit.



RESTRICTED BAND (LOW CHANNEL)


ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m											
No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	2310.224	21	38.7	59.7	Peak Max	V	266	255.4	74	-14.3	Pass
4	2310.224	7.1	38.7	45.8	Average Max	V	266	255.4	54	-8.2	Pass

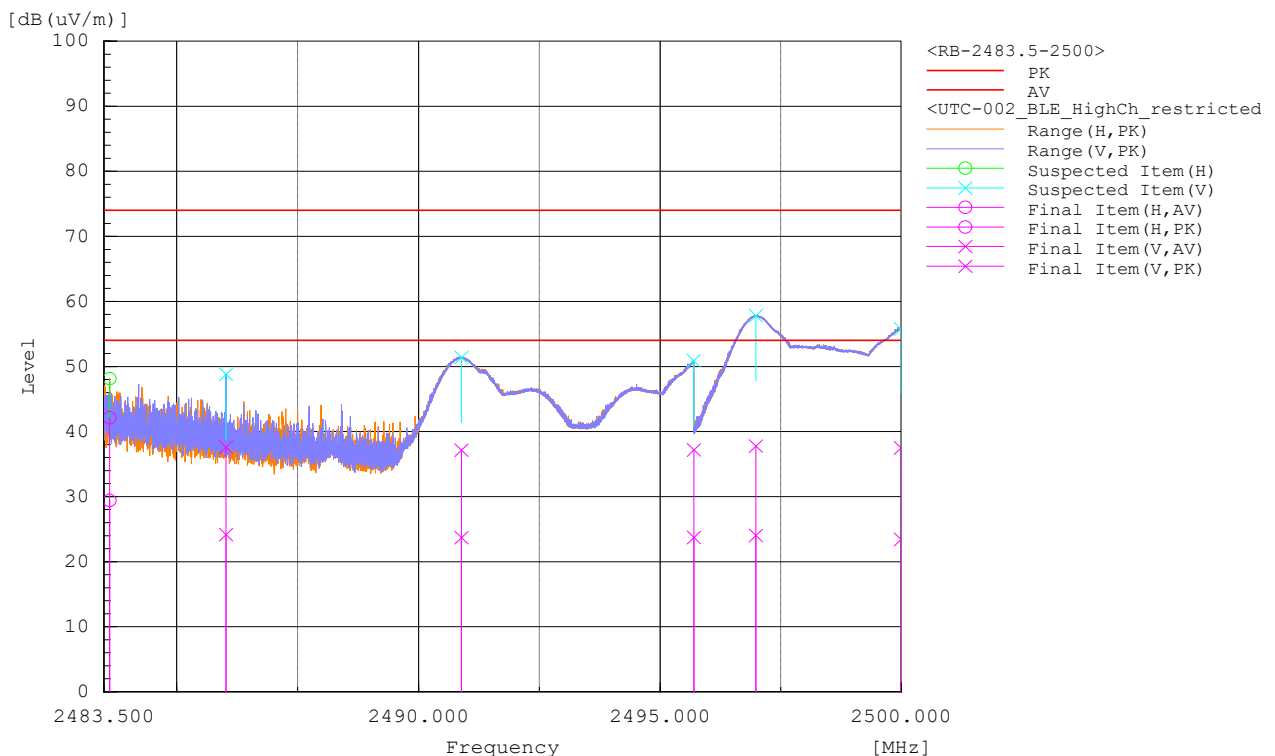
REMARKS:

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, 2Mbps)

ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	2483.619	61.2	-19.1	42.1	Peak	H	175.6	241.9	74	31.9	Pass
2	2486.018	56.6	-19	37.6	Peak	V	307.6	183.9	74	36.4	Pass
3	2490.884	55.9	-18.8	37.1	Peak	V	226.3	176.1	74	36.9	Pass
4	2495.699	55.9	-18.7	37.2	Peak	V	143.7	193.3	74	36.8	Pass
5	2496.986	56.5	-18.7	37.8	Peak	V	233.8	186.2	74	36.2	Pass
6	2499.995	56.3	-18.8	37.5	Peak	V	230.7	171.7	74	36.5	Pass
7	2483.619	48.5	-19.1	29.4	Average	H	175.6	241.9	54	24.6	Pass
8	2486.018	43.2	-19	24.2	Average	V	307.6	183.9	54	29.8	Pass
9	2490.884	42.5	-18.8	23.7	Average	V	226.3	176.1	54	30.3	Pass
10	2495.699	42.4	-18.7	23.7	Average	V	143.7	193.3	54	30.3	Pass
11	2496.986	42.8	-18.7	24.1	Average	V	233.8	186.2	54	29.9	Pass
12	2499.995	42.2	-18.8	23.4	Average	V	230.7	171.7	54	30.6	Pass



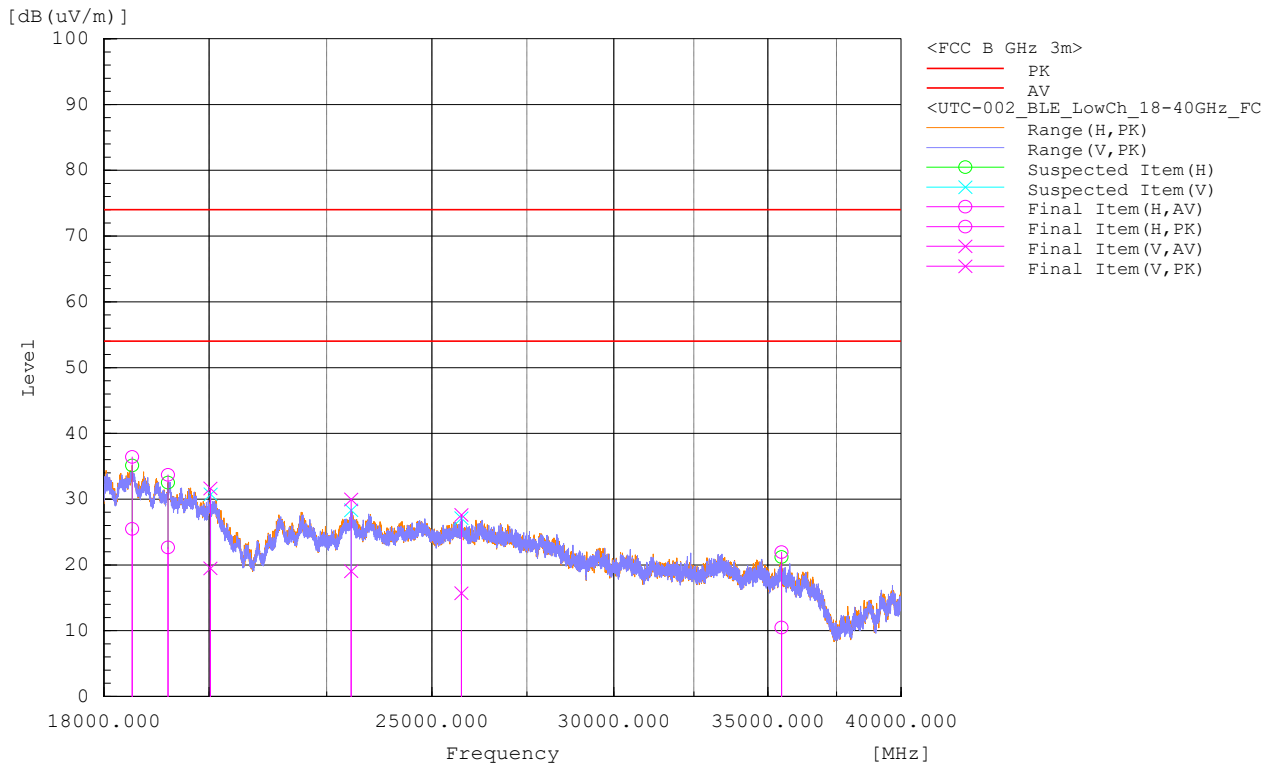
CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	18GHz - 40GHz		

ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	18515.34	34.6	1.8	36.4	Peak	H	103.9	92.7	74	37.6	Pass
2	19193.54	33.4	0.3	33.7	Peak	H	213	123.2	74	40.3	Pass
3	20027.24	32.3	-0.7	31.6	Peak	V	244.7	0	74	42.4	Pass
4	23060.66	33.6	-3.6	30	Peak	V	100.1	288.3	74	44	Pass
5	25751.36	31.1	-3.5	27.6	Peak	V	191.3	354	74	46.4	Pass
6	35485.88	25.1	-3.2	21.9	Peak	H	396.4	333	74	52.1	Pass
7	18515.34	23.7	1.8	25.5	Average	H	103.9	92.7	54	28.5	Pass
8	19193.54	22.3	0.3	22.6	Average	H	213	123.2	54	31.4	Pass
9	20027.24	20.2	-0.7	19.5	Average	V	244.7	0	54	34.5	Pass
10	23060.66	22.6	-3.6	19	Average	V	100.1	288.3	54	35	Pass
11	25751.36	19.2	-3.5	15.7	Average	V	191.3	354	54	38.3	Pass
12	35485.88	13.7	-3.2	10.5	Average	H	396.4	333	54	43.5	Pass

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. All other emissions are more than 20 dB below the limit.



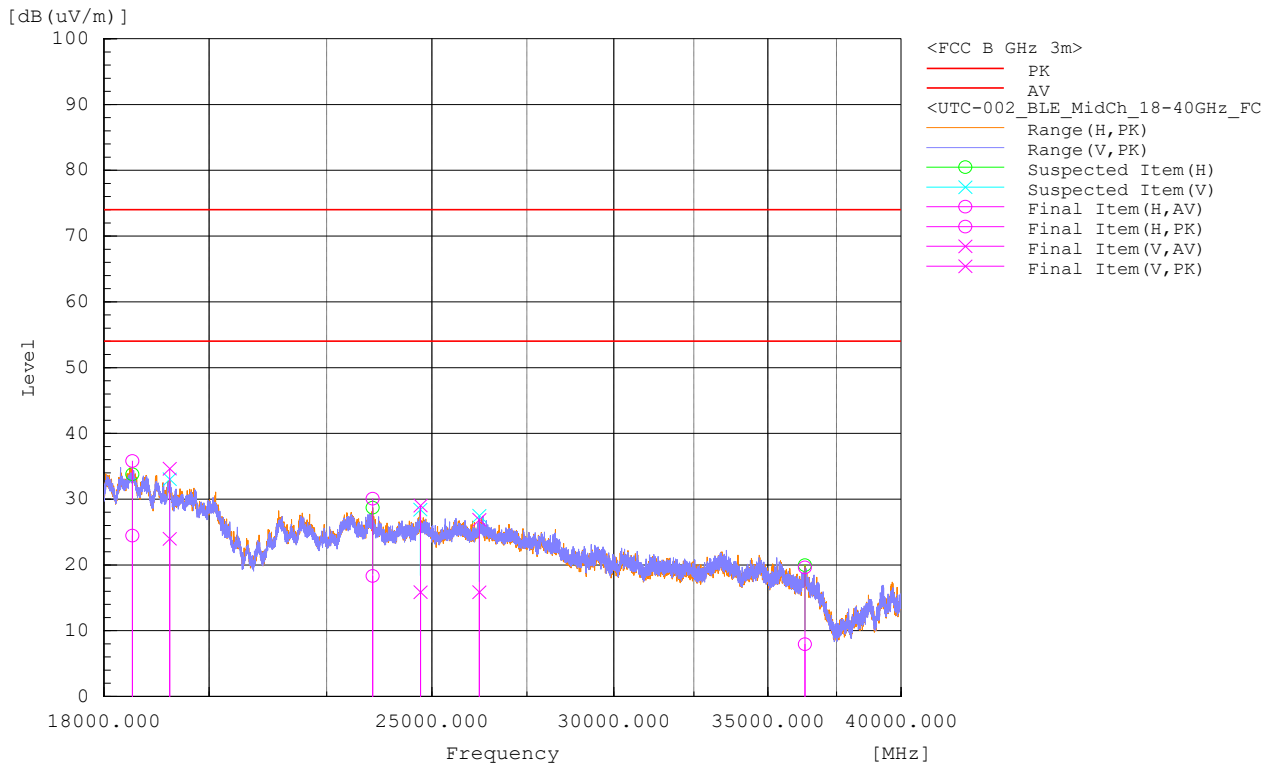
CHANNEL	TX Channel 19	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	18GHz - 40GHz		

ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	18520.83	33.9	1.9	35.8	Peak	H	200.9	122.8	74	38.2	Pass
2	19225.59	34.2	0.5	34.7	Peak	V	400	192.5	74	39.3	Pass
3	23560.86	33.9	-3.8	30.1	Peak	H	100	124.5	74	43.9	Pass
4	24714.51	32.3	-3.3	29	Peak	V	288.2	258.9	74	45	Pass
5	26216.74	30.4	-3.5	26.9	Peak	V	191.3	119.3	74	47.1	Pass
6	36329.34	23.6	-4	19.6	Peak	H	331	315.5	74	54.4	Pass
7	18520.83	22.6	1.9	24.5	Average	H	200.9	122.8	54	29.5	Pass
8	19225.59	23.5	0.5	24	Average	V	400	192.5	54	30	Pass
9	23560.86	22.1	-3.8	18.3	Average	H	100	124.5	54	35.7	Pass
10	24714.51	19.2	-3.3	15.9	Average	V	288.2	258.9	54	38.1	Pass
11	26216.74	19.4	-3.5	15.9	Average	V	191.3	119.3	54	38.1	Pass
12	36329.34	11.9	-4	7.9	Average	H	331	315.5	54	46.1	Pass

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. All other emissions are more than 20 dB below the limit.



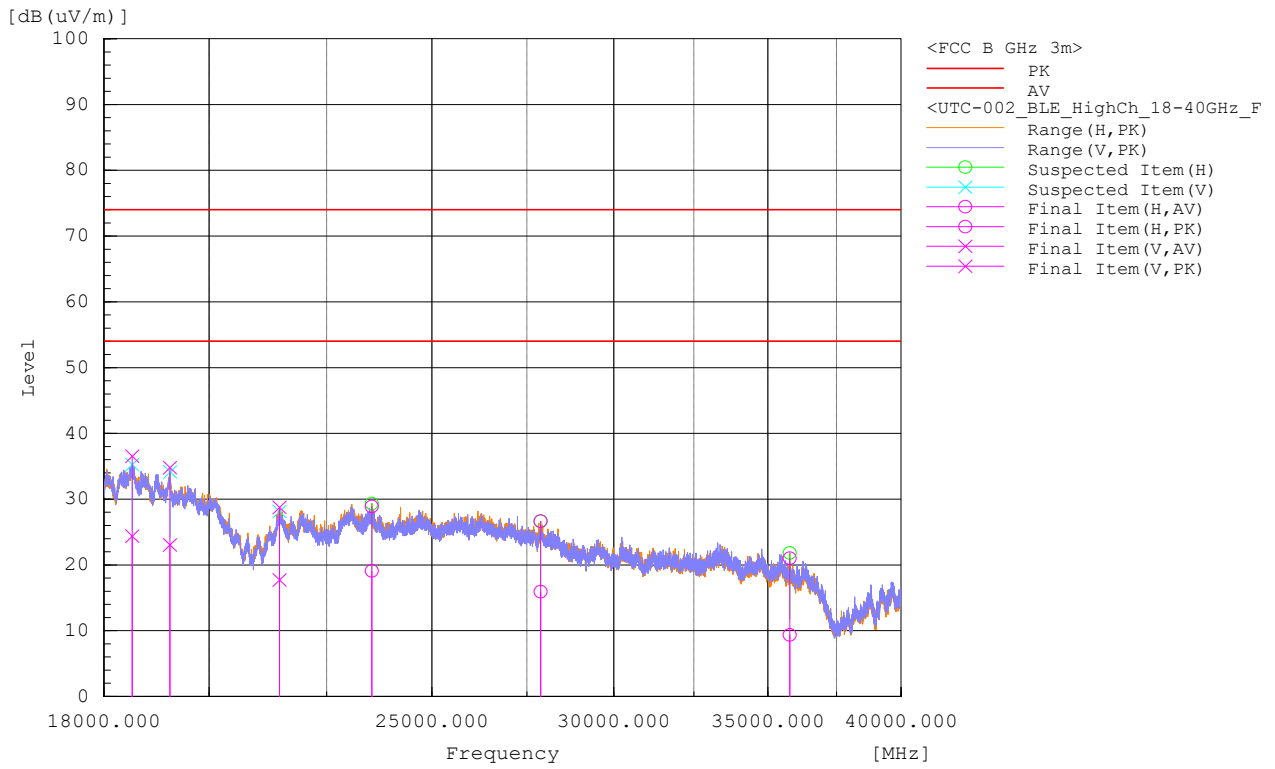
CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	18GHz - 40GHz		

ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	18514.99	34.7	1.8	36.5	Peak	V	354.1	259.8	74	37.5	Pass
2	19230.87	34.3	0.5	34.8	Peak	V	288.5	322.9	74	39.2	Pass
3	21461.44	33.3	-4.4	28.8	Peak	V	277.9	61.5	74	45.2	Pass
4	23538.98	32.6	-3.7	28.9	Peak	H	169.2	325.9	74	45.1	Pass
5	27880.38	30.6	-3.9	26.7	Peak	H	104.4	237.6	74	47.3	Pass
6	35776.84	24.3	-3.3	21	Peak	H	201.8	0.1	74	53	Pass
7	18514.99	22.6	1.8	24.4	Average	V	354.1	259.8	54	29.6	Pass
8	19230.87	22.6	0.5	23.1	Average	V	288.5	322.9	54	30.9	Pass
9	21461.44	22.1	-4.4	17.7	Average	V	277.9	61.5	54	36.3	Pass
10	23538.98	22.8	-3.7	19.1	Average	H	169.2	325.9	54	34.9	Pass
11	27880.38	19.8	-3.9	15.9	Average	H	104.4	237.6	54	38.1	Pass
12	35776.84	12.7	-3.3	9.4	Average	H	201.8	0.1	54	44.6	Pass

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. All other emissions are more than 20 dB below the limit.



4.2 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.

4 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

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

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