

FCC/ISED RF Test Report (BT-LE)

Report No.: FCC_IC_RF_SL19100101-CAE-01_BLE

FCC ID: 2AUTG-1003910ACC

IC: 25538-1003910ACC

Model No.: 1003910

Received Date: 10/01/2019

Test Date: 10/10/2019 – 10/11/2019

Issued Date: 10/17/2019

Applicant: Circuit Services LLC

Address: 9134 Independence Avenue Chatsworth, CA 91311, USA

Manufacturer: Circuit Services LLC

Address: 9134 Independence Avenue Chatsworth, CA 91311, USA

Issued By: Bureau Veritas Consumer Products Services, Inc.

Lab Address: 775 Montague Expressway, Milpitas, CA 95035

FCC Registration: 540430

ISED Test Site Number: 4842D



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification. The report must not be used by the client to claim product certification, approval, or endorsement by A2LA or any government agencies.

Table of Contents

Release Control Record	4
1 Certificate of Conformity	5
2 Summary of Test Results	6
2.1 Measurement Uncertainty	6
2.2 Modification Record	6
3 General Information	7
3.1 General Description of EUT	7
3.2 Description of Test Modes	8
3.2.1 Test Mode Applicability and Tested Channel Detail	9
3.3 Duty Cycle of Test Signal	10
3.4 Description of Support Units	11
3.4.1 Configuration of System under Test	11
3.5 General Description of Applied Standards	11
4 Test Types and Results	12
4.1 Radiated Emission and Bandedge Measurement	12
4.1.1 Limits of Radiated Emission and Bandedge Measurement	12
4.1.2 Test Instruments	13
4.1.3 Test Procedures	14
4.1.4 Deviation from Test Standard	14
4.1.5 Test Setup	15
4.1.6 EUT Operating Conditions	16
4.1.7 Test Results	17
4.2 Conducted Emission Measurement	22
4.2.1 Limits of Conducted Emission Measurement	22
4.2.2 Test Instruments	22
4.2.3 Test Procedures	23
4.2.4 Deviation from Test Standard	23
4.2.5 Test Setup	23
4.2.6 EUT Operating Conditions	23
4.2.7 Test Results	24
4.3 6dB Bandwidth Measurement & 99% Bandwidth Measurement	26
4.3.1 Limits of 6dB Bandwidth Measurement	26
4.3.2 Test Setup	26
4.3.3 Test Instruments	26
4.3.4 Test Procedure	26
4.3.5 Deviation from Test Standard	26
4.3.6 EUT Operating Conditions	26
4.3.7 Test Result	27
4.4 Conducted Output Power Measurement	29
4.4.1 Limits of Conducted Output Power Measurement	29
4.4.2 Test Setup	29
4.4.3 Test Instruments	29
4.4.4 Test Procedures	29
4.4.5 Deviation from Test Standard	29
4.4.6 EUT Operating Conditions	29
4.4.7 Test Results	30
4.5 Power Spectral Density Measurement	32
4.5.1 Limits of Power Spectral Density Measurement	32
4.5.2 Test Setup	32
4.5.3 Test Instruments	32
4.5.4 Test Procedure	32
4.5.5 Deviation from Test Standard	32
4.5.6 EUT Operating Condition	32

4.5.7 Test Results	33
4.6 Conducted Out of Band Emission Measurement	35
4.6.1 Limits of Conducted Out of Band Emission Measurement	35
4.6.2 Test Setup	35
4.6.3 Test Instruments	35
4.6.4 Test Procedure	35
4.6.5 Deviation from Test Standard	35
4.6.6 EUT Operating Condition	35
4.6.7 Test Results	36
5 Pictures of Test Arrangements	37
Appendix – Information on the Testing Laboratories	38

Release Control Record

Issue No.	Description	Date Issued
FCC_IC_RF_SL19100101-CAE-001_BLE	Original Release	10/17/2019

1 Certificate of Conformity

Product: General purpose BLE dongle

Brand: Circuit Services LLC

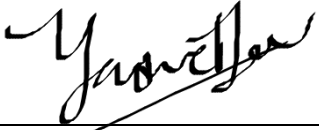
Model No.: 1003910


Applicant: Circuit Services LLC

Test Date: 10/10/2019 – 10/11/2019

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)
ISED RSS-247 Issue 2 2017
ANSI C63.10: 2013

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: 10/17/2019
Yao-Wei Lee / Test Engineer

Approved by :  , Date: 10/21/2019
Chen Ge / Engineer Reviewer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)/ISED RSS-247				
FCC Clause	RSS Section(s)	Test Item	Result	Remarks
15.207	RSS-Gen[8.8]	AC Power Conducted Emission	PASS	Meet the requirement of limit. Minimum passing margin is - 6.77 dB at 0.405 MHz.
15.205 & 15.209 & 15.247(d)	RSS-Gen[8.9] RSS-247[5.5]	Radiated Emissions and Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is - 7.08 dB at 671.96 MHz.
15.247(d)	RSS-247[5.5]	Antenna Port Emission	PASS	Meet the requirement of limit.
15.247(a)(2)	RSS-247[5.2]	6dB bandwidth & 99% bandwidth	PASS	Meet the requirement of limit.
15.247(b)	RSS-247[5.4(4)]	Conducted power	PASS	Meet the requirement of limit.
15.247(e)	RSS-247[5.2)]	Power Spectral Density	PASS	Meet the requirement of limit.

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:

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	USB BLE Dongle
Brand	Career Technologies
Test Model	Blue Adapter
Identification No. of EUT	1003910
Status of EUT	Engineering sample
Power Supply Rating	5V, 0.5A
Modulation Type	GFSK
Modulation Technology	GFSK
Transfer Rate	Up to 1Mbps
Operating Frequency	2402 ~ 2480MHz
Number of Channel	40
Antenna Type	Omni-directional PCB Antenna (inverse F), 5.3dBi Gain
Antenna Connector	N/A

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	19	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	0	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.

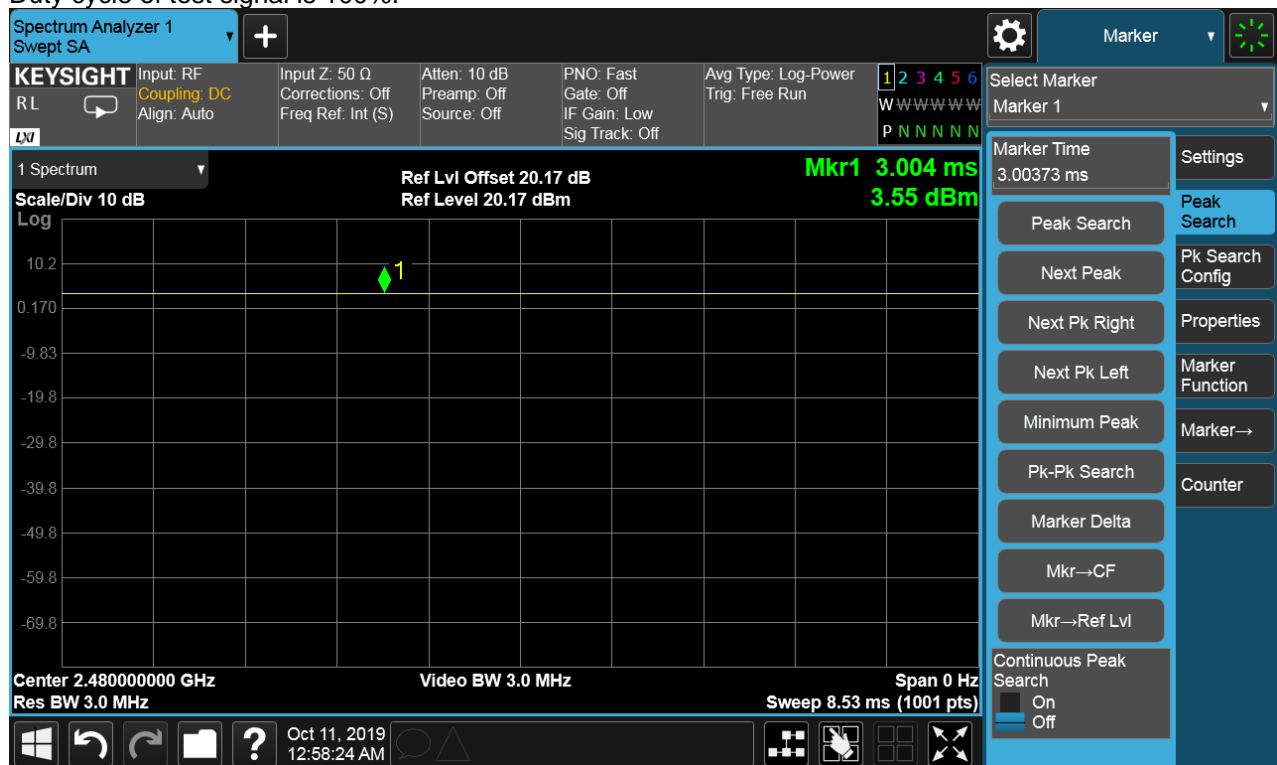
AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	19	GFSK	1

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE \geq 1G	25deg. C, 65%RH	120Vac, 60Hz	Yao Wei Lee
RE<1G	25deg. C, 65%RH	120Vac, 60Hz	Yao Wei Lee
PLC	25deg. C, 68%RH	120Vac, 60Hz	Yao Wei Lee
APCM	21deg. C, 60%RH	120Vac, 60Hz	Yao Wei Lee

3.3 Duty Cycle of Test Signal

Duty cycle of test signal is 100%.



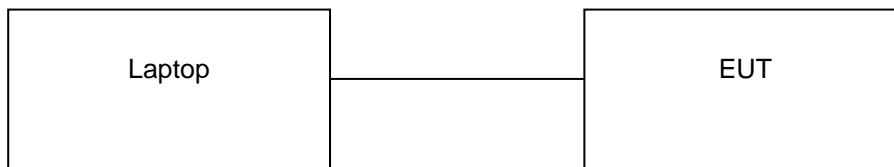
3.4 Description of Support Units

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 3550	2MHWY32	N/A	Provided by Lab

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

3.4.1 Configuration of System under Test



3.5 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:

FCC Part 15, Subpart C (15.247)
KDB 558074 D01 15.247 Meas Guidance v05r02
ANSI C63.10-2013

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

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 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.

4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
PXA Signal Analyzer KEYSIGHT	N9030B	MY57140584	03/05/2019	03/05/2020
Horn Antenna ETS-Lindgren	3117	218554	11/22/2017	11/22/2019
Biconilog Antenna Sunol	JB1	A030702	3/9/2018	3/9/2020
Preamplifier RF BAY INC	LPA-6-30	11170601	4/27/2019	4/27/2020

4.1.3 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:

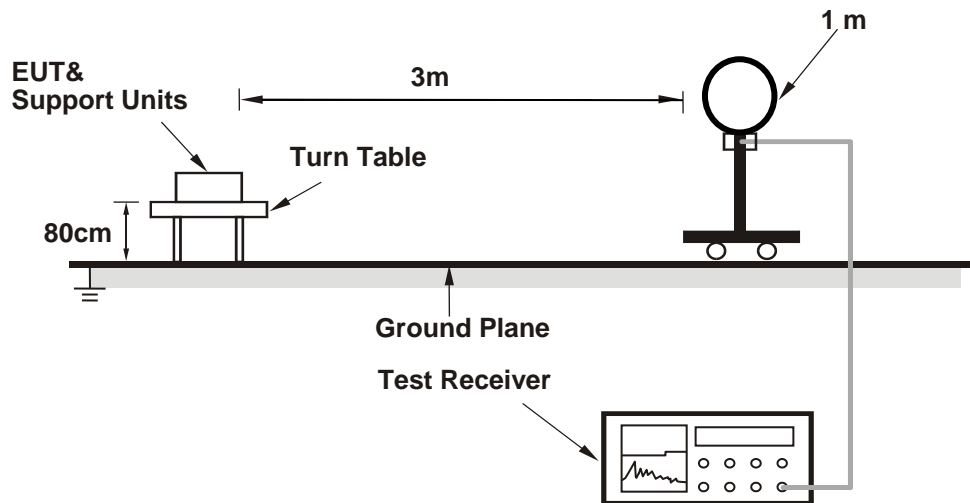
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (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.

4.1.4 Deviation from Test Standard

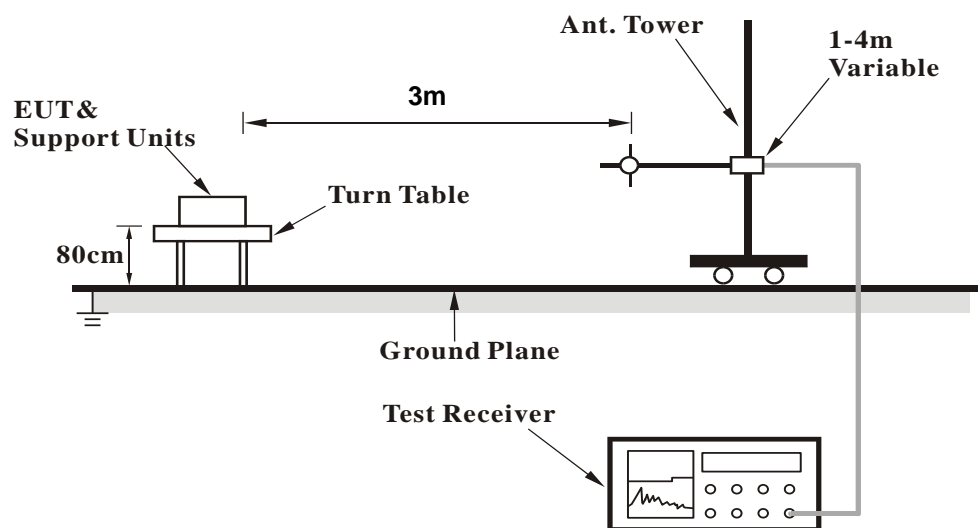
No deviation.

4.1.5 Test Setup

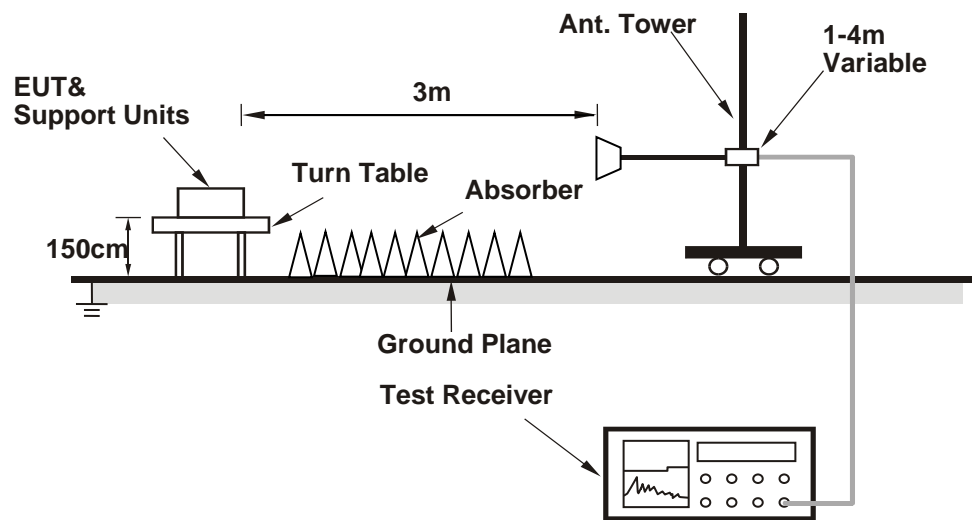
For Radiated emission below 30MHz



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).

4.1.6 EUT Operating Conditions

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

4.1.7 Test Results

BELOW 1GHz WORST-CASE DATA:

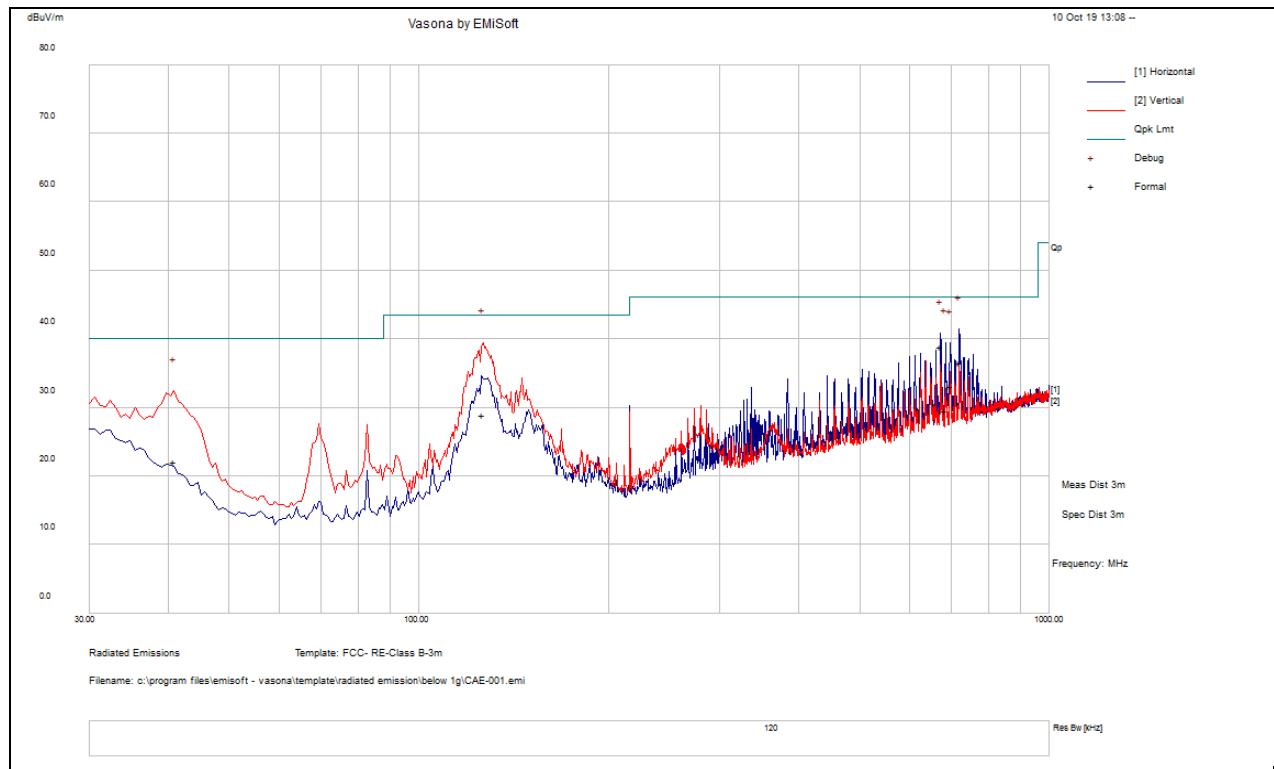
BT-LE (GFSK)

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

ANTENNA POLARITY & test distance: HORIZONTAL & Vertical at 3 m												
No	Freq. [MHz]	Raw (dB)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol	Hgt (cm)	Azt Deg	Limit (dBuV/m)	Margin (dB)	Pass /Fail
1	126.31	39.78	12.14	-22.91	29.01	Quasi Max	V	106	131	43.5	-14.5	Pass
2	720.03	36.89	15.2	-15.43	36.66	Quasi Max	H	107	246	46	-9.34	Pass
3	671.96	40.07	15.01	-16.16	38.92	Quasi Max	H	127	231	46	-7.08	Pass
4	683.92	30.64	14.98	-16.06	29.57	Quasi Max	H	115	246	46	-16.43	Pass
5	696.46	33.88	15.1	-15.78	33.2	Quasi Max	H	243	230	46	-12.8	Pass
6	40.957	31.36	11.32	-20.50	22.18	Quasi Max	V	124	229	40	-17.82	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss(dB) + AF (dB)
2. AF (dB) = Antenna Factor (dB) – 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.



ABOVE 1GHz TEST DATA:

BT-LE (GFSK)

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak
FREQUENCY RANGE	1GHz ~ 25GHz		Average

ANTENNA POLARITY & test distance: HORIZONTAL& Vertical at 3 m												
No	Freq.	Raw	Cable Loss	AF	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dB)	(dB)	(dB)	(dBu V/m)			(cm)	De g	(dBu V/m)	(dB)	
1	1509.6	54.36	2.81	-17.19	39.98	Peak Max	V	157	356	74	-34.02	Pass
2	1137.8	55.8	2.44	-16.84	41.4	Peak Max	H	152	71	74	-32.6	Pass
3	1010.2	55.35	2.29	-17.15	40.49	Peak Max	H	100	259	74	-33.51	Pass
4	1702.2	54.48	2.96	-15.59	41.85	Peak Max	H	133	352	74	-32.15	Pass
5	1509.6	42.25	2.81	-17.19	27.87	Average Max	V	157	356	54	-26.13	Pass
6	1137.8	43.03	2.44	-16.84	28.63	Average Max	H	152	71	54	-25.37	Pass
7	1010.2	44.73	2.29	-17.15	29.87	Average Max	H	100	259	54	-24.13	Pass
8	1702.2	42.16	2.96	-15.59	29.53	Average Max	H	133	352	54	-24.47	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss(dB) + AF (dB)
2. AF (dB) = Antenna Factor (dB) – 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.

CHANNEL	TX Channel 19	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	1GHz ~ 25GHz		

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

No	Freq.	Raw	Cable Loss	AF	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dB)	(dB)	(dB)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	4877.28	51.12	5.51	-11.05	45.58	Peak Max	H	147	180	74	-28.42	Pass
2	7322.142	47.55	6.41	-7.29	46.67	Peak Max	V	158	66	74	-27.33	Pass
3	3265.425	52.37	4.01	-12.52	43.86	Peak Max	V	183	265	74	-30.14	Pass
4	4877.28	39.21	5.51	-11.05	33.67	Average Max	H	147	180	54	-20.33	Pass
5	7322.142	35.67	6.41	-7.29	34.8	Average Max	V	158	66	54	-19.21	Pass
6	3265.425	40.34	4.01	-12.52	31.83	Average Max	V	183	265	54	-22.17	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss(dB) + AF (dB)
2. AF (dB) = Antenna Factor (dB) – 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.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	1GHz ~ 25GHz		

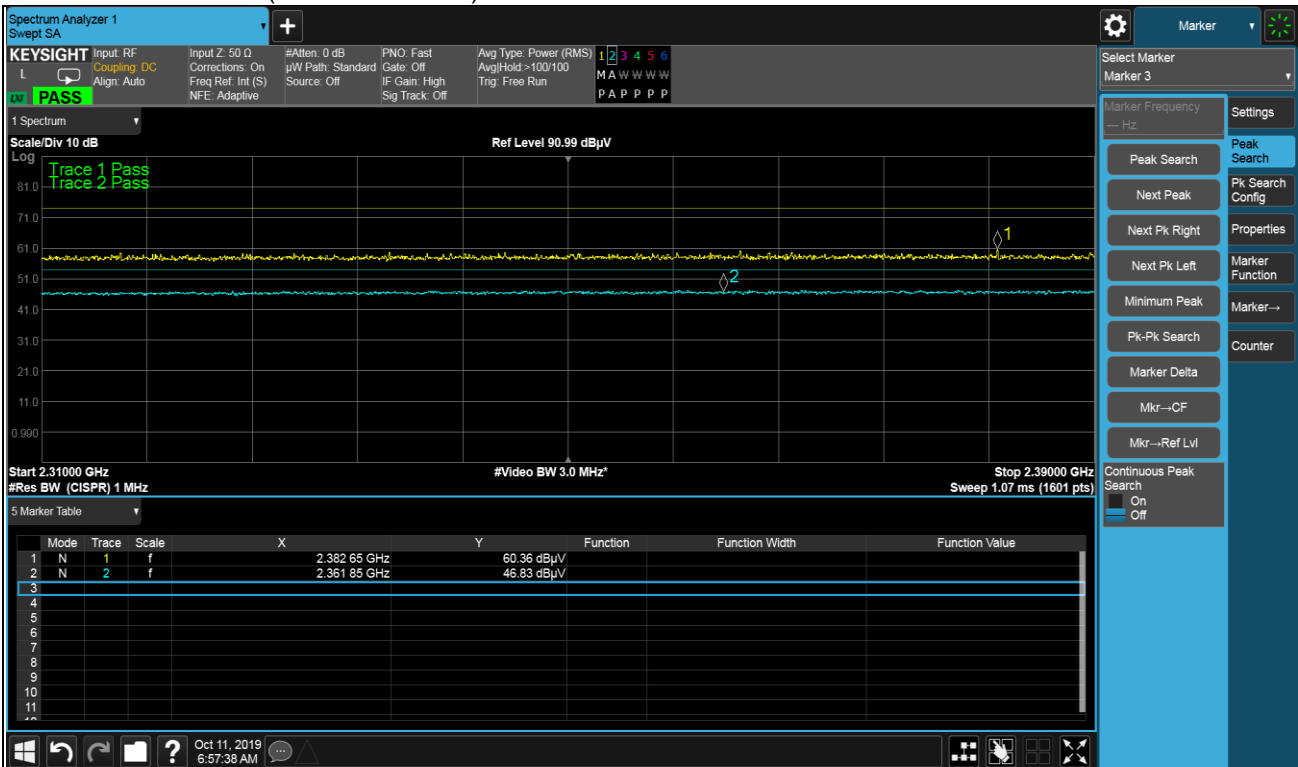
ANTENNA POLARITY & test distance: HORIZONTAL& VERTICAL at 3 m

No	Freq.	Raw	Cable Loss	AF	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dB)	(dB)	(dB)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	17371.56	38.55	8.16	1.34	48.05	Peak Max	H	186	268	74	-25.95	Pass
2	4961.128	49.2	4.25	-11.01	42.45	Peak Max	H	163	307	74	-31.56	Pass
3	9647.693	41.52	5.56	-5.03	42.06	Peak Max	V	125	116	74	-31.94	Pass
4	17371.56	24.1	8.16	1.34	33.6	Average Max	H	186	268	54	-20.4	Pass
5	4961.128	38.09	4.25	-11.01	31.33	Average Max	H	163	307	54	-22.67	Pass
6	9647.693	27.93	5.56	-5.03	28.47	Average Max	V	125	116	54	-25.53	Pass

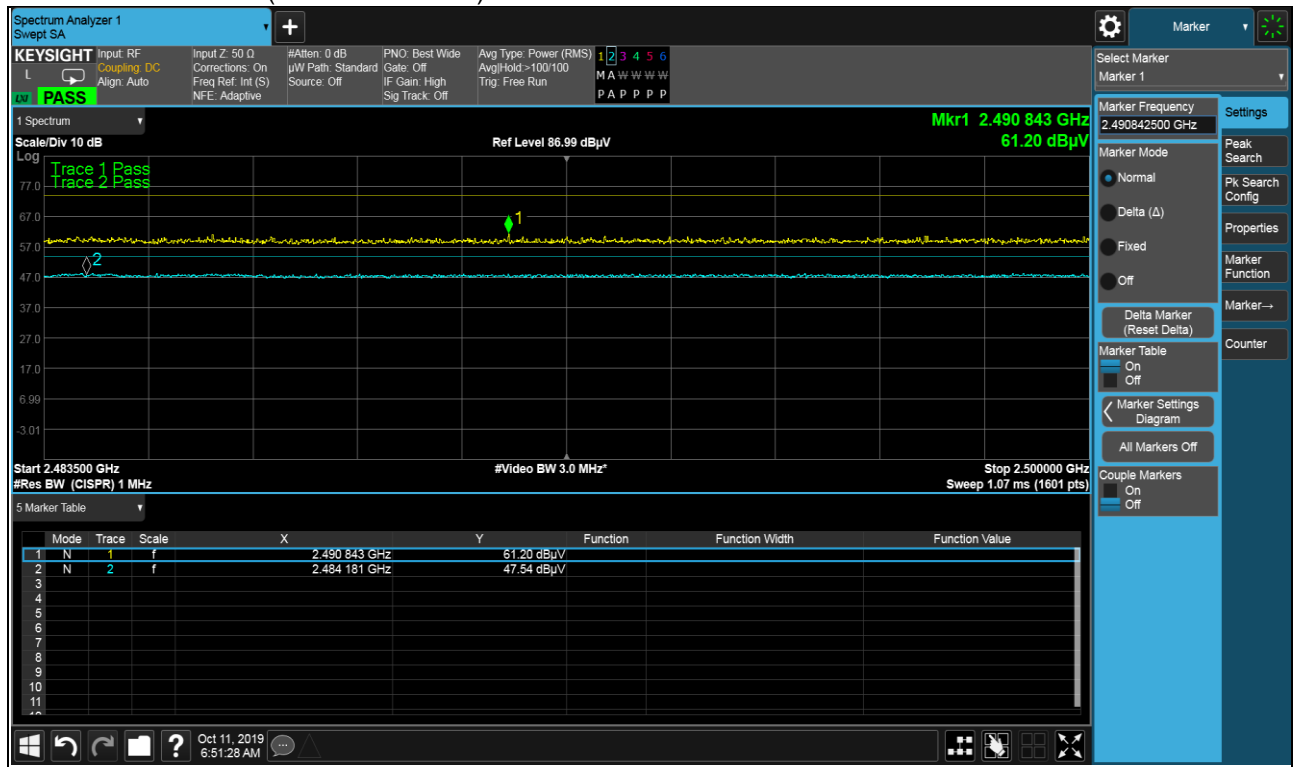
REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss(dB) + AF (dB)
2. AF (dB) = Antenna Factor (dB) – 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.

RESTRICTED BAND (LOW CHANNEL)



RESTRICTED BAND (HIGH CHANNEL)



4.2 Conducted Emission Measurement

4.2.1 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.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date Of Calibration	Due Date Of Calibration
EMI Test Receiver ROHDE & SCHWARZ	ESIB 40	100179	08/28/2018	11/28/2019
Transient Limiter ELECTRO-METRICS	EM-7600-5	106	12/31/2018	12/31/2019
LISN EMCO	3816/2NM	214372	01/10/2019	01/10/2020

4.2.3 Test Procedures

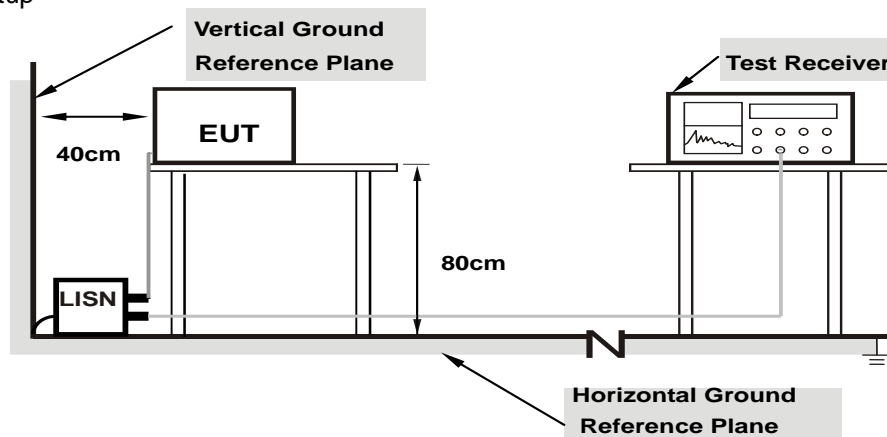
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 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).

4.2.6 EUT Operating Conditions

Same as 4.1.6.

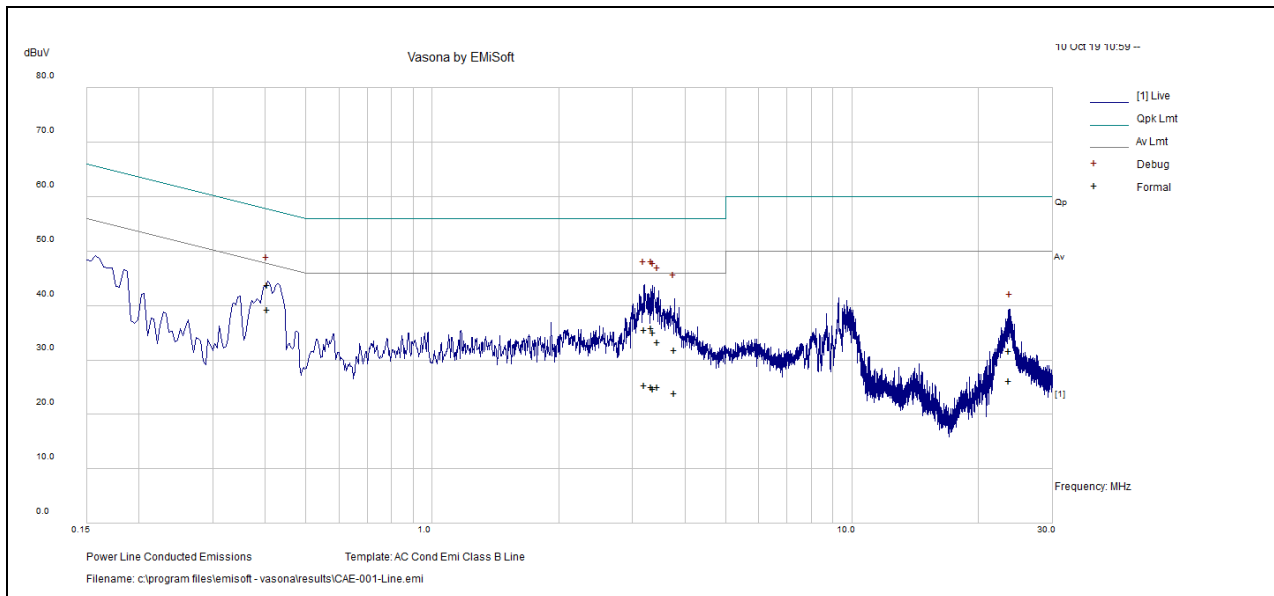
4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak / Average
-------	----------	-------------------	----------------------

No	Freq. [MHz]	Raw (dB)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
1	3.216615	27.51	7.92	0.07	35.5	Quasi Peak	Live	56	-20.5	Pass
2	3.346144	27.83	7.93	0.07	35.84	Quasi Peak	Live	56	-20.16	Pass
3	3.367445	27.11	7.94	0.07	35.12	Quasi Peak	Live	56	-20.88	Pass
4	0.405403	36.42	7.3	0.04	43.76	Quasi Peak	Live	57.74	-13.98	Pass
5	3.460649	25.37	7.94	0.07	33.39	Quasi Peak	Live	56	-22.61	Pass
6	3.793701	23.87	7.97	0.07	31.91	Quasi Peak	Live	56	-24.09	Pass
7	23.81111	22.28	8.92	0.52	31.72	Quasi Peak	Live	60	-28.28	Pass
8	3.216615	17.45	7.92	0.07	25.44	Average	Live	46	-20.56	Pass
9	3.346144	17.14	7.93	0.07	25.14	Average	Live	46	-20.86	Pass
10	3.367445	16.68	7.94	0.07	24.68	Average	Live	46	-21.32	Pass
11	0.405403	32.02	7.3	0.04	39.37	Average	Live	47.74	-8.38	Pass
12	3.460649	17.01	7.94	0.07	25.02	Average	Live	46	-20.98	Pass
13	3.793701	15.83	7.97	0.07	23.88	Average	Live	46	-22.12	Pass
14	23.81111	16.8	8.92	0.52	26.25	Average	Live	50	-23.75	Pass

REMARKS:

1. The emission levels of other frequencies were very low against the limit.
2. Margin value = Emission level - Limit value
3. Emission Level = Correction Factor + Raw Value + Factors Value.

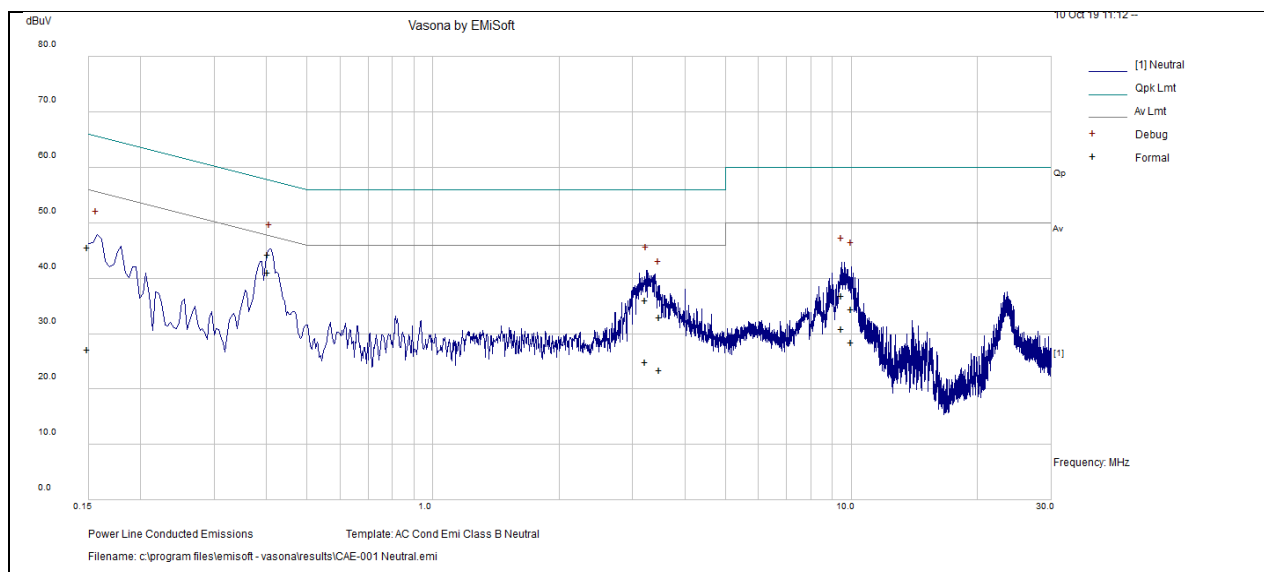


Phase	Neutral (N)	Detector Function	Quasi-Peak / Average
-------	-------------	-------------------	----------------------

No	Freq. [MHz]	Raw (dB)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
1	0.404525	36.97	7.3	0.03	44.31	Quasi Peak	Neutral	57.76	-13.45	Pass
2	3.231453	28.15	7.92	0.07	36.14	Quasi Peak	Neutral	56	-19.86	Pass
3	9.498429	28.31	8.27	0.23	36.81	Quasi Peak	Neutral	60	-23.19	Pass
4	3.483766	25.02	7.95	0.07	33.04	Quasi Peak	Neutral	56	-22.96	Pass
5	0.15	38.46	7.11	0.04	45.61	Quasi Peak	Neutral	66	-20.39	Pass
6	10.00825	25.91	8.25	0.25	34.42	Quasi Peak	Neutral	60	-25.58	Pass
7	0.404525	33.66	7.3	0.03	40.99	Average	Neutral	47.76	-6.77	Pass
8	3.231453	16.94	7.92	0.07	24.94	Average	Neutral	46	-21.06	Pass
9	9.498429	22.46	8.27	0.23	30.96	Average	Neutral	50	-19.04	Pass
10	3.483766	15.45	7.95	0.07	23.47	Average	Neutral	46	-22.53	Pass
11	0.15	20.06	7.11	0.04	27.21	Average	Neutral	56	-28.79	Pass
12	10.00825	20.01	8.25	0.25	28.51	Average	Neutral	50	-21.49	Pass

REMARKS:

1. The emission levels of other frequencies were very low against the limit.
2. Margin value = Emission level - Limit value
3. Emission Level = Correction Factor + Raw Value + Factors Value.

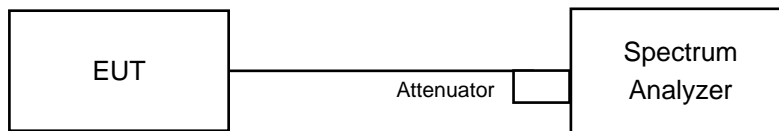


4.3 6dB Bandwidth Measurement & 99% Bandwidth Measurement

4.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedure

- Set resolution bandwidth (RBW) = 100kHz
- 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

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

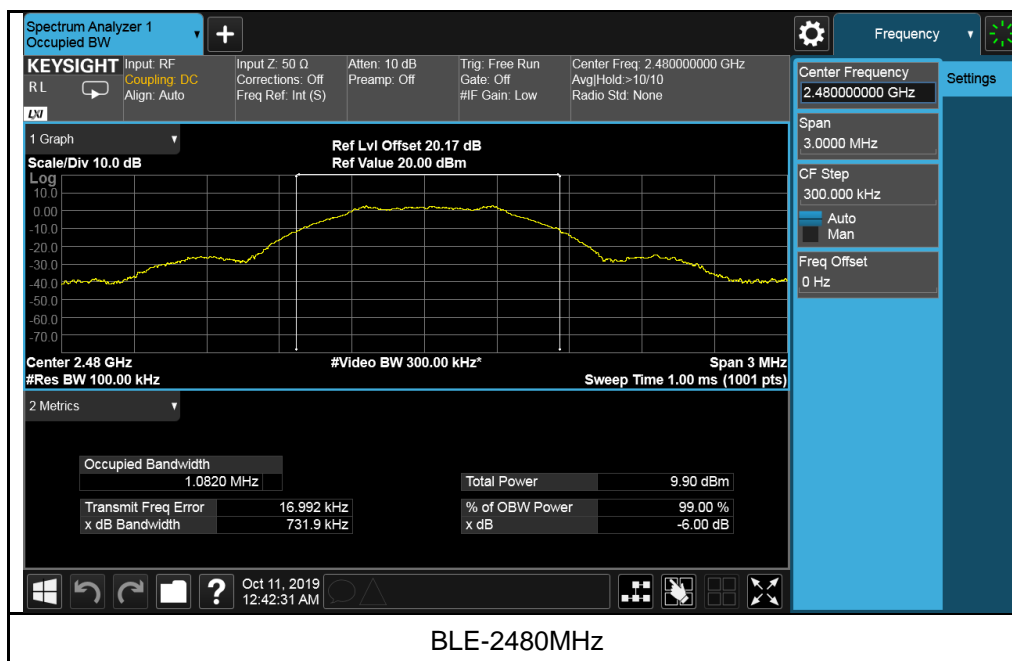
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 Test Result

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.705	1.064	0.5	PASS
19	2440	0.720	1.076	0.5	PASS
39	2480	0.732	1.082	0.5	PASS

Test Plots:



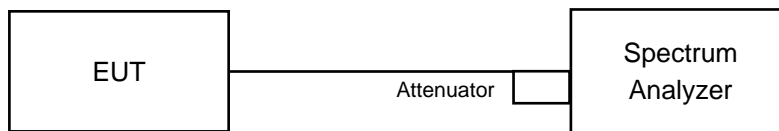


4.4 Conducted Output Power Measurement

4.4.1 Limits of Conducted Output Power Measurement

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

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 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.

4.4.5 Deviation from Test Standard

No deviation.

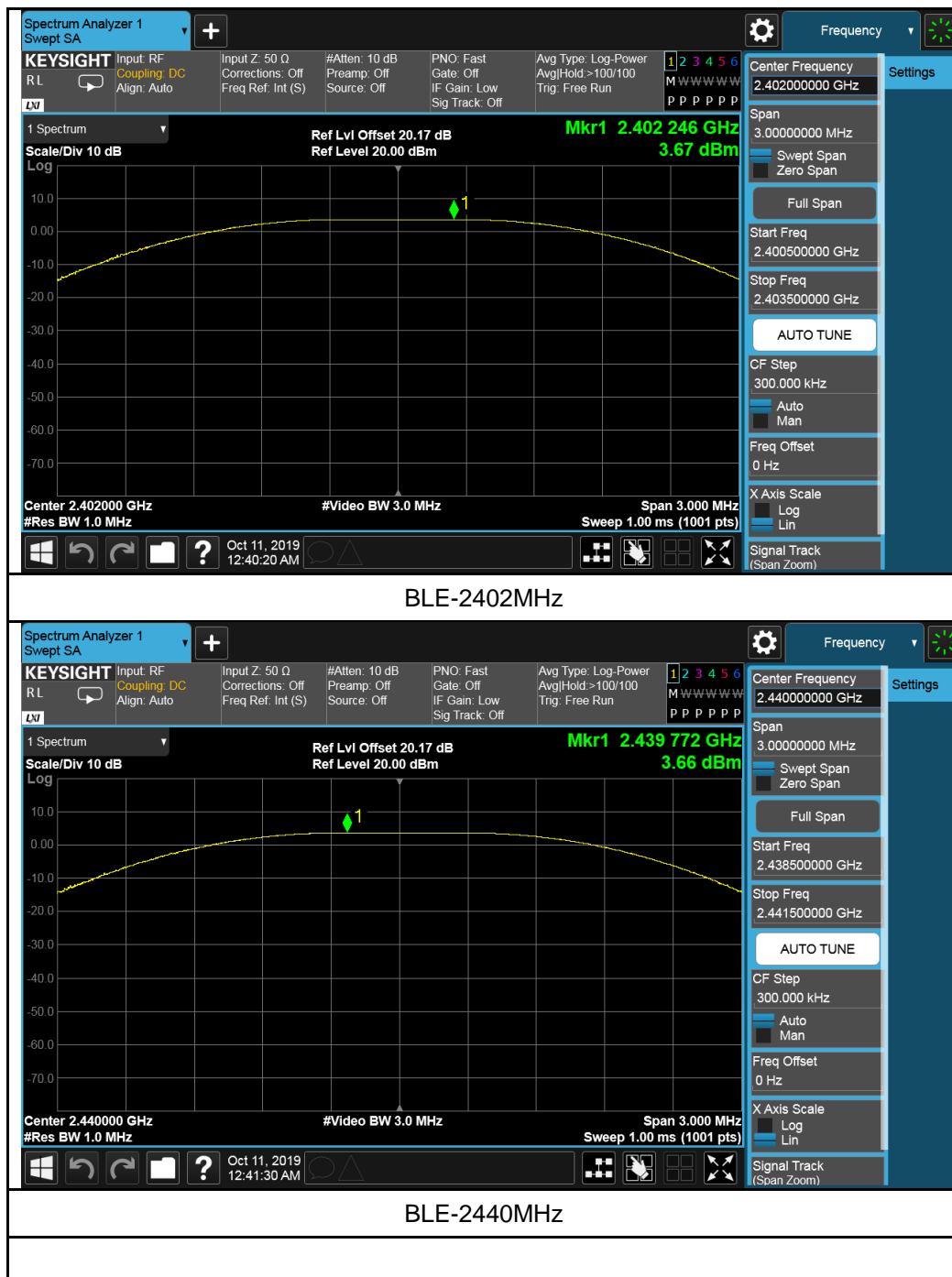
4.4.6 EUT Operating Conditions

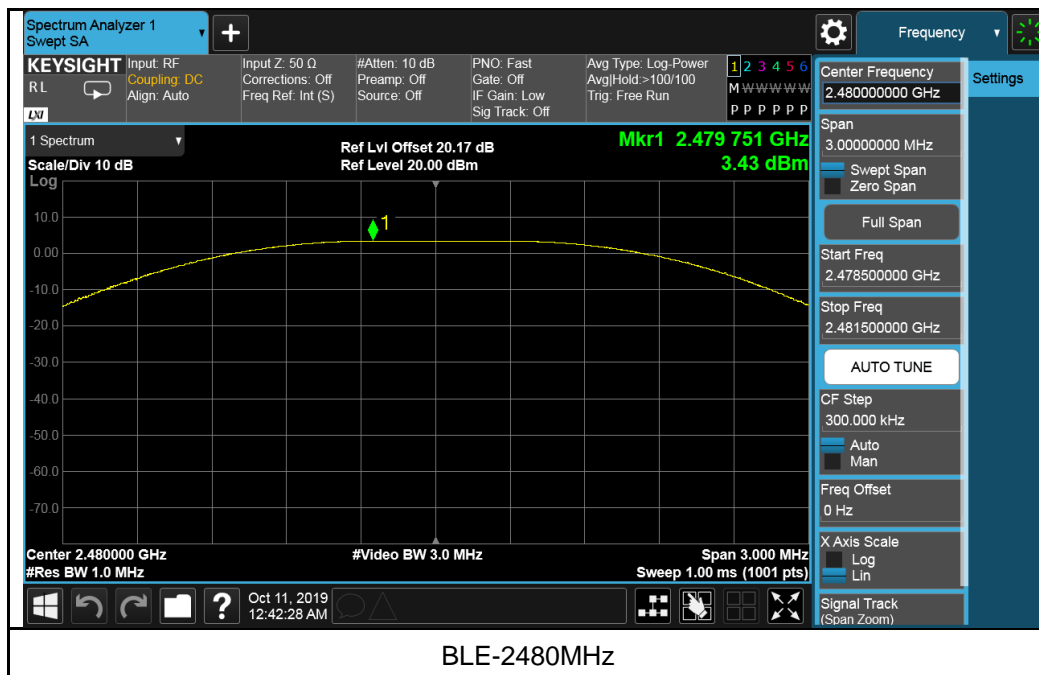
Same as Item 4.3.6.

4.4.7 Test Results

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Pass/Fail
0	2402	3.67	30	Pass
19	2440	3.66	30	Pass
39	2480	3.43	30	Pass

Test Plots:



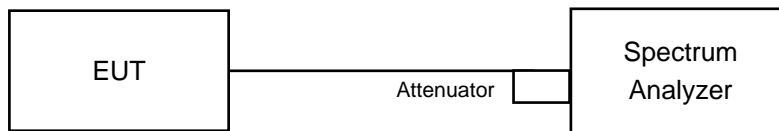


4.5 Power Spectral Density Measurement

4.5.1 Limits of Power Spectral Density Measurement

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

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.5.4 Test Procedure

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.

4.5.5 Deviation from Test Standard

No deviation.

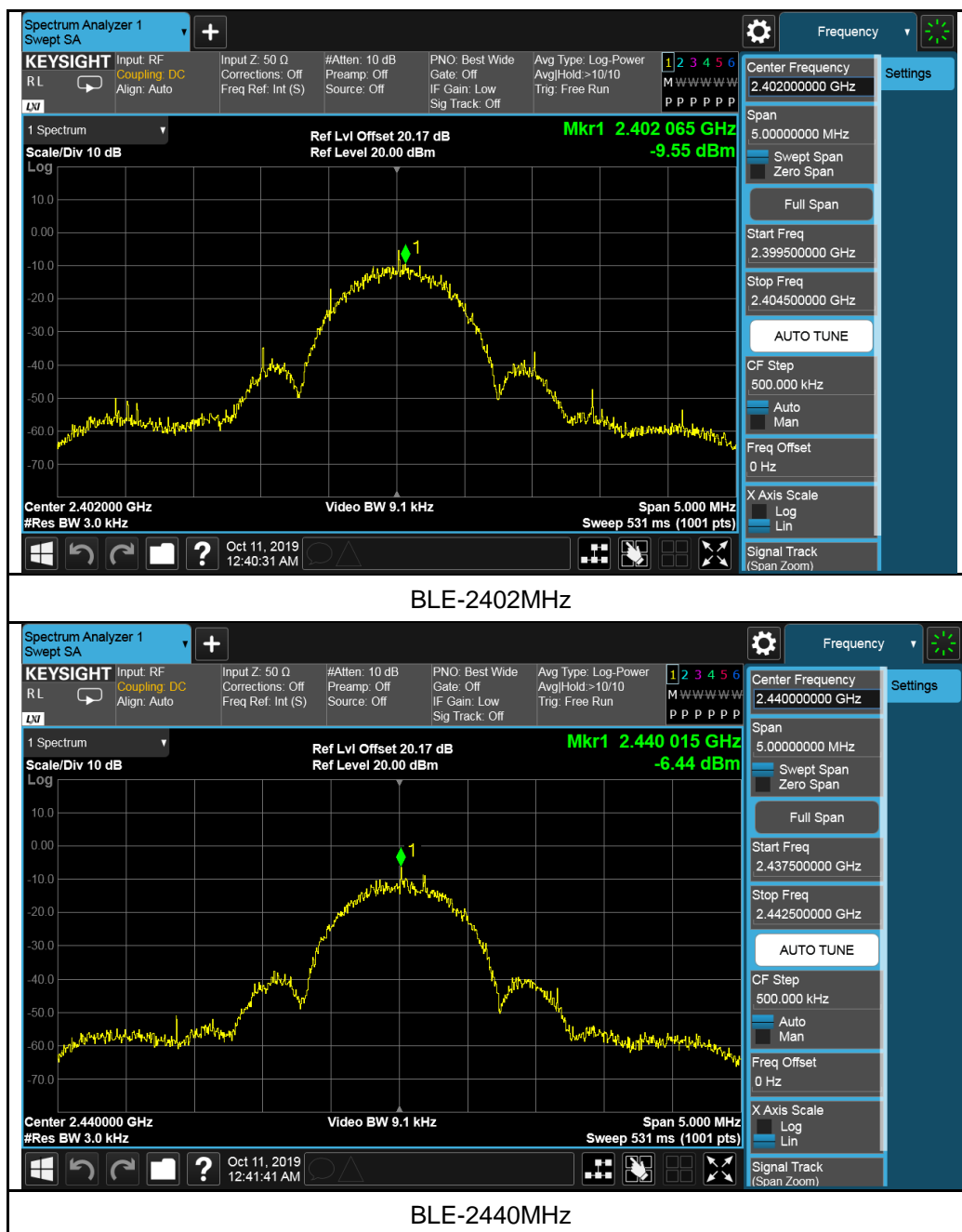
4.5.6 EUT Operating Condition

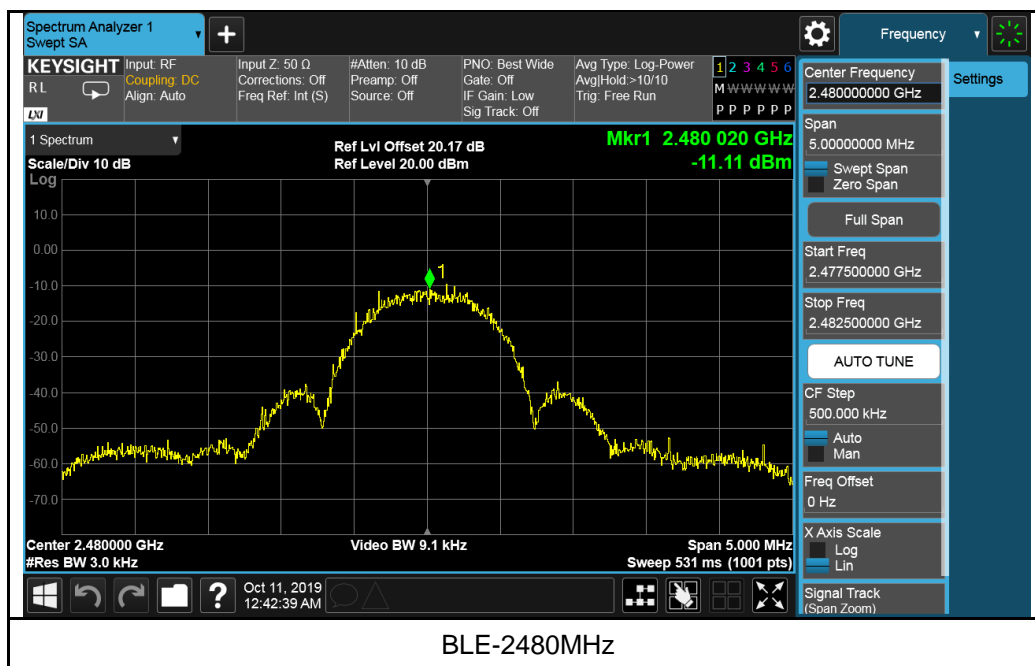
Same as Item 4.3.6

4.5.7 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass/Fail
0	2402	-9.55	8	Pass
19	2440	-6.44	8	Pass
39	2480	-11.11	8	Pass

Test Plots:



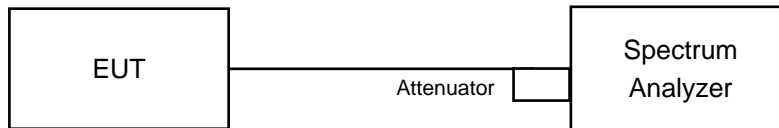


4.6 Conducted Out of Band Emission Measurement

4.6.1 Limits of Conducted Out of Band Emission Measurement

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

4.6.2 Test Setup



4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.6.4 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.

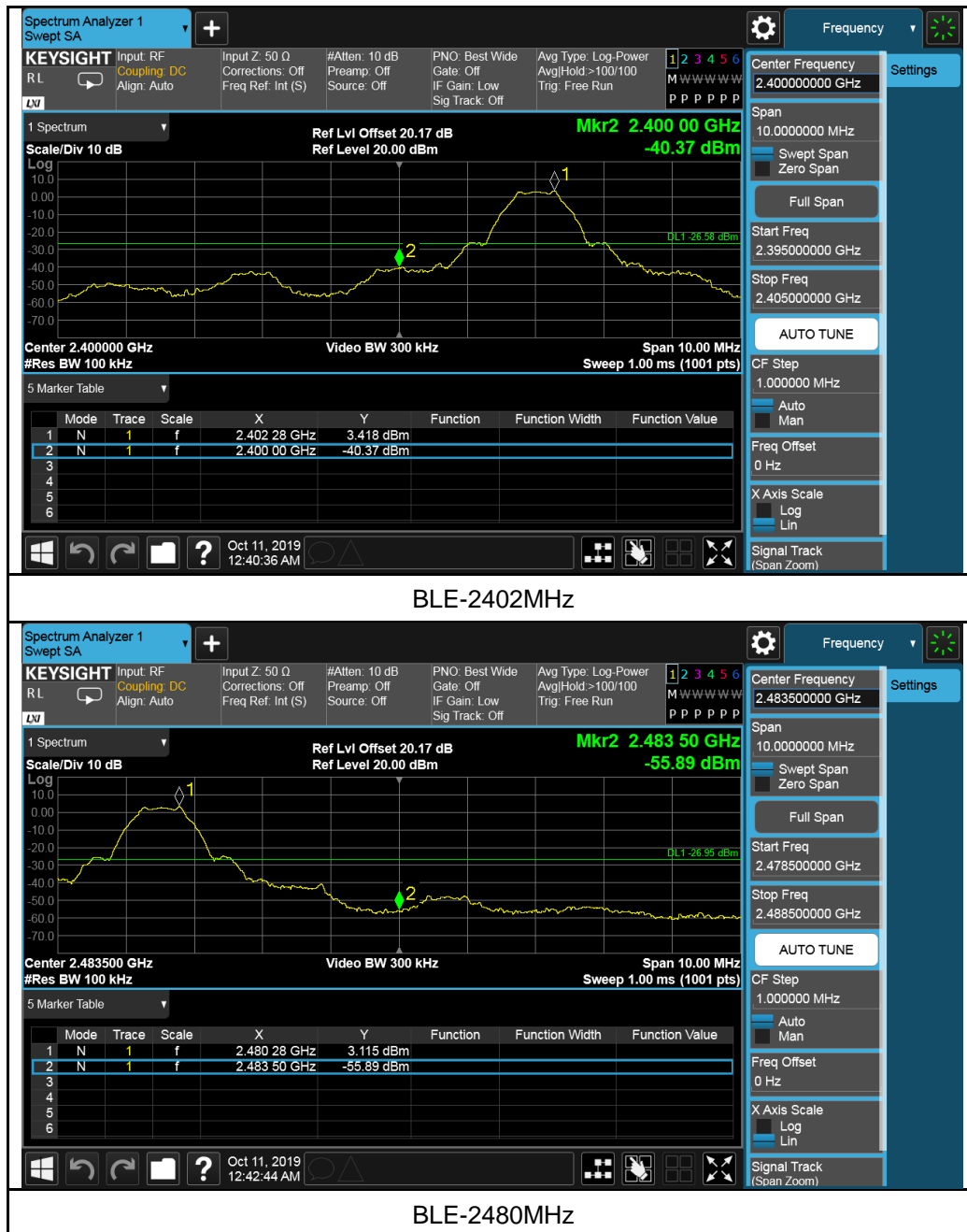
4.6.5 Deviation from Test Standard

No deviation.

4.6.6 EUT Operating Condition

Same as Item 4.3.6

4.6.7 Test Results



5 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:

Milpitas EMC/RF/Safety/Telecom Lab

775 Montague Expressway, Milpitas, CA 95035

Tel: +1 408 526 1188

Sunnyvale OTA/Bluetooth Lab

1293 Anvilwood Avenue, Sunnyvale, CA 94089

Tel: +1 669 600 5293

Littleton EMC/RF/Safety/Environmental Lab

1 Distribution Center Cir #1, Littleton, MA 01460

Tel: +1 978 486 8880

Irvine OTA/PTCRB/Bluetooth/V2X Lab

15 Musick, Irvine, CA 92618

Tel: +1 949 716 6512

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.

--- END ---