FCC Test Report

(Bluetooth LE_Hopping)

Report No.:	RF191225C12
FCC ID:	QOQ-GM220P
Test Model:	MGM220P22A
Series Model:	BGM220P22A, BGX220P22A (refer to item 3.1 for more details)
Received Date:	Dec. 25, 2019
Test Date:	Feb. 12 ~ Feb. 15, 2020
Issued Date:	Feb. 26, 2020
Applicant:	Silicon Laboratories Finland Oy
Address:	Alberga Business Park - Bldg D/Floor 5, Bertel Jungin aukio 3, 02600 ESPOO, FINLAND
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Lin Kou Laboratories
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan
Test Location:	No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN
FCC Registration / Designation Number:	788550 / TW0003

Table of Contents

Release Control Record

Issue No.	Description	Date Issued
RF191225C12	Original release.	Feb. 26, 2020

1 Certificate of Conformity

Product:	Zigbee and Bluetooth Low Energy wireless radio modules (Refer to item 3.1 for the more details)
Brand:	Silicon Labs
Test Model:	MGM220P22A
Series Model:	BGM220P22A, BGX220P22A (refer to item 3.1 for more details)
Sample Status:	Engineering sample fully representing the production model
Applicant:	Silicon Laboratories Finland Oy
Test Date:	Feb. 12 ~ Feb. 15, 2020
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) ANSI C63.10:2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan 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 RF characteristics under the conditions specified in this report.

Prepared by : Polly Chien , **Date:** Feb. 26, 2020

Polly Chien / Specialist

Approved by : Bruce Chen , **Date:** Feb. 26, 2020

Bruce Chen / Senior Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (SECTION 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit. Minimum passing margin is -15.07dB at 0.43400MHz.
15.247(a)(1)(iii)	Number of Hopping Frequency Used	Pass	Meet the requirement of limit.
15.247(a)(1)(iii)	Dwell Time on Each Channel	Pass	Meet the requirement of limit.
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	Pass	Meet the requirement of limit.
15.247(b)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -5.0dB at 2483.50MHz.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

Note:
1. If the Frequency Hopping System operating in 2400-2483.5MHz band and the output power less than 125mW. The hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of hopping channel whichever is greater.
2. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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	2.79 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.04 dB
	30MHz ~ 200MHz	3.59 dB
	200MHz ~ 1000MHz	3.60 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Zigbee and Bluetooth Low Energy wireless radio modules (Refer to note)
Brand	Silicon Labs
Test Model	MGM220P22A
Series Model	BGM220P22A, BGX220P22A
Model Difference	Refer to note
Sample Status	Engineering sample fully representing the production model
Power Supply Rating	3Vdc from host equipment
Modulation Type	GFSK
Modulation Technology	Hopping
Transfer Rate	1Mbps, 2Mbps
Operating Frequency	2402~2480MHz
Number of Channel	40
Output Power	LE 1M: 8.128mW LE 2M: 8.091mW
Antenna Type	Refer to Note
Antenna Connector	NA
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. All models are listed as below. Model MGM220P22A is the representative for final test.

Product	Zigbee and Bluetooth Low Energy wireless radio modules	Bluetooth Low Energy wireless radio modules
Model	MGM220P22A	BGM220P22A and BGX220P22A
Spec.	Zigbee and/or BLE and/or SRD	BLE and/or SRD
Antenna Type	On board ceramic chip antenna with 1.86dBi of gain	
Hardware	Hardware-wise the modules are identical. These are fully internally regulated and shielded PCB modules with a single integral ceramic chip antenna. There are no separate variants with an RF pin or a connector for using external antennas.	
RF max TX power	8.2 dBm	8.2 dBm
Model differences	The only difference in these modules concern the factory software configuration defining which wireless protocol are allowed: - The MGM220P22A can run Zigbee and/or BLE and/or SRD - The BGM220P22A can run BLE and/or SRD - The BGX220P22A is identical to the BGM220P22A, but with another name for marketing differentiation	

*SRD = Short Range Device.

2. The EUT is capable of running the Zigbee and Bluetooth Low Energy protocols, and an additional custom protocol. However, in no circumstance the module will transmit using two or more protocols at the same time.
3. Spurious emission of the simultaneous operation (Zigbee, DTS, Hopping and SRD) has been evaluated and no non-compliance was found.

4. The power setting is list as below.

Test Mode	LE 1M	Test Mode	LE 2M
CH 0	82	CH 1	82
CH 1	82	CH 19	82
CH 19	82	CH 38	82
CH 38	82		
CH 39	82		

3.2 Description of Test Modes

40 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (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

* That the channels 2402MHz, 2426MHz, and 2480MHz are used for primary advertising only, and these advertisement packets are never being sent over the 2M PHY, meaning that when testing band edges the 2M PHY should not be taken into account with the upper and lower channels.

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to				Description
	RE≥1G	RE<1G	PLC	APCM	
-	√	√	√	√	-

Where RE≥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 Z-plane.

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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Data Rate (Mbps)
-	0 to 39	0, 1, 19, 38, 39	GFSK	1.0
-	0 to 39	1, 19, 38	GFSK	2.0

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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Data Rate (Mbps)
-	0 to 39	0	GFSK	1.0

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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Data Rate (Mbps)
-	0 to 39	0	GFSK	1.0

Antenna Port Conducted Measurement:

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

☒ 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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Data Rate (Mbps)
-	0 to 39	0, 1, 19, 38, 39	GFSK	1.0
-	0 to 39	1, 19, 38	GFSK	2.0

Test Condition:

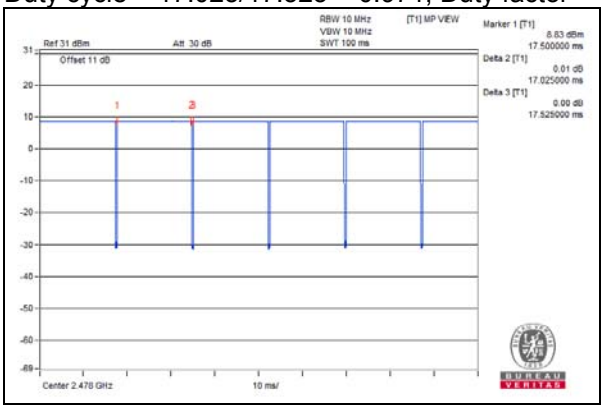
Applicable to	Environmental Conditions	Input Power (System)	Tested by
RE≥1G	22 deg. C, 66% RH	120Vac, 60Hz	Greg Lin
RE<1G	22 deg. C, 66% RH	120Vac, 60Hz	Greg Lin
PLC	25 deg. C, 75% RH	120Vac, 60Hz	Greg Lin
APCM	25 deg. C, 60% RH	120Vac, 60Hz	Chris Lin

3.1 Duty Cycle of Test Signal

Duty cycle of test signal is < 98 %, duty factor shall be considered.

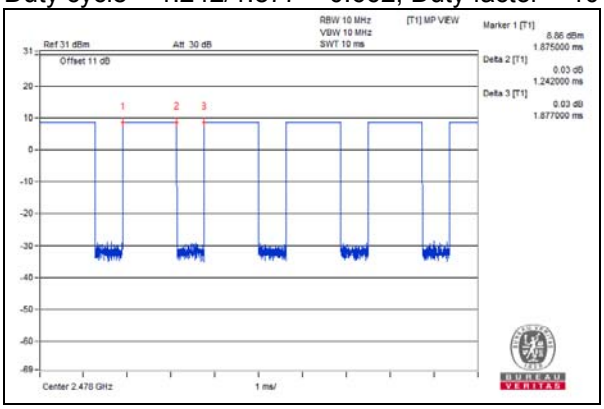
LE 1M:

Duty cycle = 17.025/17.525 = 0.971, Duty factor = 10 * log(1/0.971) = 0.13



LE 2M:

Duty cycle = 1.242/1.877 = 0.662, Duty factor = 10 * log(1/0.662) = 1.79



3.2 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.

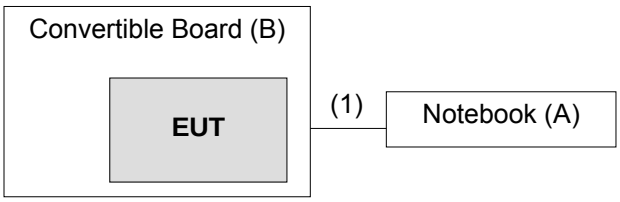
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Notebook	Lenovo	81A4	YD02TWF5	FCC DoC Approved	-
B.	Convertible Board	NA	NA	NA	NA	Provided by client

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Items A acted as a communication partner to transfer data.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB cable	1	1	Y	0	-

3.2.1 Configuration of System under Test



3.3 General Description of Applied Standards and References

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

Test standard:

FCC Part 15, Subpart C (15.247)

ANSI C63.10-2013

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

References Test Guidance:
KDB 558074 D01 15.247 Meas Guidance v05r02

All test items have been performed as a reference to the above KDB test guidance.

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.	Cal. Date	Cal. Due
Test Receiver KEYSIGHT	N9038A	MY55420137	Apr. 15, 2019	Apr. 14, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100269	Jun. 04, 2019	Jun. 03, 2020
BILOG Antenna SCHWARZBECK	VULB9168	9168-160	Nov. 07, 2019	Nov. 06, 2020
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-1169	Nov. 24, 2019	Nov. 23, 2020
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Nov. 24, 2019	Nov. 23, 2020
Preamplifier Agilent (Below 1GHz)	8447D	2944A10638	Jul. 11, 2019	Jul. 10, 2020
Preamplifier Agilent (Above 1GHz)	8449B	3008A02367	Feb. 19, 2019	Feb. 18, 2020
RF signal cable HUBER+SUHNER&EMCI	SUCOFLEX 104 & EMC104-SM-SM8000	CABLE-CH9-02 (248780+171006)	Jan. 18, 2020	Jan. 17, 2021
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-(250795/4)	Jul. 11, 2019	Jul. 10, 2020
RF signal cable Woken	8D-FB	Cable-CH9-01	Jul. 30, 2019	Jul. 29, 2020
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower EMCO	2070/2080	512.835.4684	NA	NA
Turn Table EMCO	2087-2.03	NA	NA	NA
Antenna Tower &Turn BV ADT	AT100	AT93021705	NA	NA
Turn Table BV ADT	TT100	TT93021705	NA	NA
Turn Table Controller BV ADT	SC100	SC93021705	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY55190004/MY55190007/MY55210005	Jul. 15, 2019	Jul. 14, 2020

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 9.

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 detect 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:

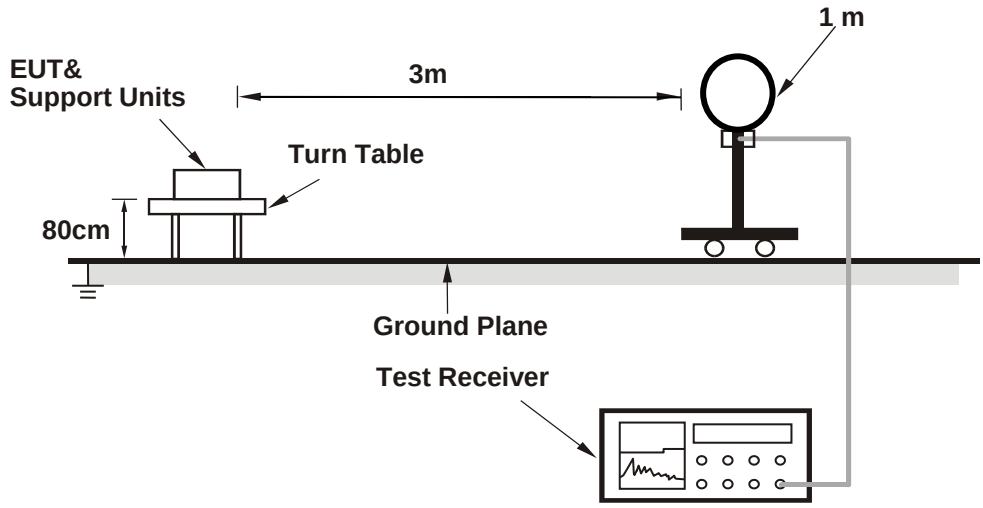
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 3 x RBW (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.

4.1.4 Deviation from Test Standard

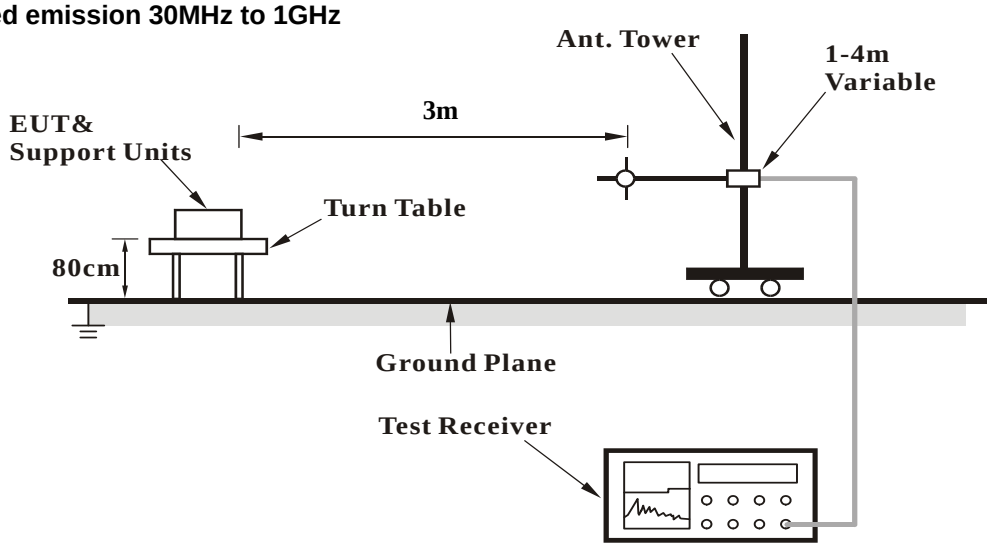
No deviation.

4.1.5 Test Setup

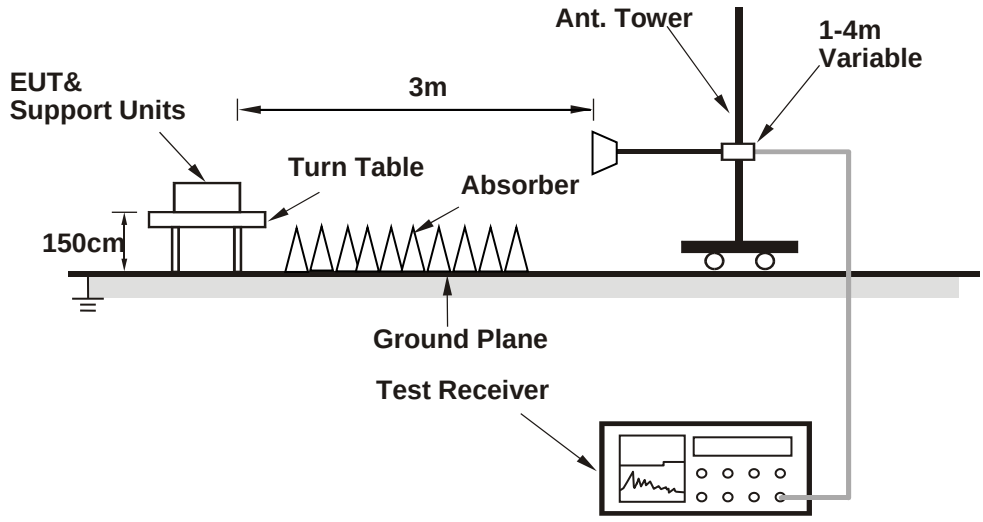
For Radiated emission below 30MHz



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

a. Placed the EUT on the testing table.
b. Prepared a notebook to act as a communication partner and placed it outside of testing area.
c. The communication partner connected with EUT via a USB cable and ran a test program (CMD) to enable EUT under transmission condition continuously at specific channel frequency.
d. The necessary accessories enable the system in full functions.

4.1.7 Test Results

Above 1GHz Data:

LE 1M:

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	55.3 PK	74.0	-18.7	1.48 H	346	24.1	31.2
2	2390.00	43.5 AV	54.0	-10.5	1.48 H	346	12.3	31.2
3	*2402.00	104.1 PK			1.56 H	355	73.0	31.1
4	*2402.00	102.6 AV			1.56 H	355	71.5	31.1
5	4804.00	43.2 PK	74.0	-30.8	1.16 H	332	41.1	2.1
6	4804.00	29.4 AV	54.0	-24.6	1.16 H	332	27.3	2.1
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	54.9 PK	74.0	-19.1	1.13 V	294	23.7	31.2
2	2390.00	42.9 AV	54.0	-11.1	1.13 V	294	11.7	31.2
3	*2402.00	98.3 PK			1.02 V	307	67.2	31.1
4	*2402.00	96.7 AV			1.02 V	307	65.6	31.1
5	4804.00	42.6 PK	74.0	-31.4	1.83 V	215	40.5	2.1
6	4804.00	29.1 AV	54.0	-24.9	1.83 V	215	27.0	2.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	55.2 PK	74.0	-18.8	1.51 H	347	24.0	31.2
2	2390.00	43.4 AV	54.0	-10.6	1.51 H	347	12.2	31.2
3	*2404.00	103.9 PK			1.57 H	356	72.8	31.1
4	*2404.00	102.5 AV			1.57 H	356	71.4	31.1
5	4808.00	43.3 PK	74.0	-30.7	1.05 H	338	41.2	2.1
6	4808.00	29.6 AV	54.0	-24.4	1.05 H	338	27.5	2.1
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	54.7 PK	74.0	-19.3	1.07 V	302	23.5	31.2
2	2390.00	42.9 AV	54.0	-11.1	1.07 V	302	11.7	31.2
3	*2404.00	98.5 PK			1.02 V	298	67.4	31.1
4	*2404.00	96.9 AV			1.02 V	298	65.8	31.1
5	4808.00	42.4 PK	74.0	-31.6	1.79 V	208	40.3	2.1
6	4808.00	29.3 AV	54.0	-24.7	1.79 V	208	27.2	2.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 19	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2440.00	104.2 PK			1.62 H	357	73.1	31.1
2	*2440.00	102.8 AV			1.62 H	357	71.7	31.1
3	4880.00	42.7 PK	74.0	-31.3	1.09 H	341	40.8	1.9
4	4880.00	29.3 AV	54.0	-24.7	1.09 H	341	27.4	1.9
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2440.00	98.5 PK			1.11 V	303	67.4	31.1
2	*2440.00	97.1 AV			1.11 V	303	66.0	31.1
3	4880.00	42.1 PK	74.0	-31.9	1.69 V	196	40.2	1.9
4	4880.00	28.9 AV	54.0	-25.1	1.69 V	196	27.0	1.9

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 38	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2478.00	103.7 PK			1.53 H	359	72.6	31.1
2	*2478.00	102.1 AV			1.53 H	359	71.0	31.1
3	2483.50	56.4 PK	74.0	-17.6	1.48 H	352	25.2	31.2
4	2483.50	44.3 AV	54.0	-9.7	1.48 H	352	13.1	31.2
5	4956.00	42.9 PK	74.0	-31.1	1.38 H	327	40.8	2.1
6	4956.00	29.4 AV	54.0	-24.6	1.38 H	327	27.3	2.1
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2478.00	98.0 PK			1.08 V	297	66.9	31.1
2	*2478.00	96.5 AV			1.08 V	297	65.4	31.1
3	2483.50	55.4 PK	74.0	-18.6	1.02 V	292	24.2	31.2
4	2483.50	43.2 AV	54.0	-10.8	1.02 V	292	12.0	31.2
5	4956.00	42.3 PK	74.0	-31.7	1.81 V	223	40.2	2.1
6	4956.00	29.1 AV	54.0	-24.9	1.81 V	223	27.0	2.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	103.3 PK			1.53 H	356	72.2	31.1
2	*2480.00	101.9 AV			1.53 H	356	70.8	31.1
3	2483.50	60.1 PK	74.0	-13.9	1.46 H	351	28.9	31.2
4	**2483.50**	**49.0 AV**	**54.0**	**-5.0**	**1.46 H**	**351**	**17.8**	**31.2**
5	4960.00	43.4 PK	74.0	-30.6	1.11 H	328	41.2	2.2
6	4960.00	29.6 AV	54.0	-24.4	1.11 H	328	27.4	2.2
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	97.8 PK			1.04 V	298	66.7	31.1
2	*2480.00	96.2 AV			1.04 V	298	65.1	31.1
3	2483.50	56.9 PK	74.0	-17.1	1.09 V	291	25.7	31.2
4	2483.50	44.5 AV	54.0	-9.5	1.09 V	291	13.3	31.2
5	4960.00	42.4 PK	74.0	-31.6	1.71 V	200	40.2	2.2
6	4960.00	28.9 AV	54.0	-25.1	1.71 V	200	26.7	2.2

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

LE 2M:

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	56.1 PK	74.0	-17.9	1.46 H	348	24.9	31.2
2	2390.00	43.8 AV	54.0	-10.2	1.46 H	348	12.6	31.2
3	*2404.00	104.0 PK			1.53 H	357	72.9	31.1
4	*2404.00	100.7 AV			1.53 H	357	69.6	31.1
5	4808.00	43.4 PK	74.0	-30.6	1.18 H	336	41.3	2.1
6	4808.00	29.5 AV	54.0	-24.5	1.18 H	336	27.4	2.1
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	56.1 PK	74.0	-17.9	1.46 V	348	24.9	31.2
2	2390.00	43.8 AV	54.0	-10.2	1.46 V	348	12.6	31.2
3	*2404.00	104.0 PK			1.53 V	357	72.9	31.1
4	*2404.00	100.7 AV			1.53 V	357	69.6	31.1
5	4808.00	43.4 PK	74.0	-30.6	1.18 V	336	41.3	2.1
6	4808.00	29.5 AV	54.0	-24.5	1.18 V	336	27.4	2.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 19	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2440.00	103.6 PK			1.51 H	355	72.5	31.1
2	*2440.00	101.2 AV			1.51 H	355	70.1	31.1
3	4880.00	43.2 PK	74.0	-30.8	2.20 H	159	41.3	1.9
4	4880.00	29.5 AV	54.0	-24.5	2.20 H	159	27.6	1.9
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2440.00	98.1 PK			1.19 V	301	67.0	31.1
2	*2440.00	95.6 AV			1.19 V	301	64.5	31.1
3	4880.00	42.2 PK	74.0	-31.8	1.79 V	208	40.3	1.9
4	4880.00	28.9 AV	54.0	-25.1	1.79 V	208	27.0	1.9

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 38	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2478.00	103.7 PK			1.49 H	358	72.6	31.1
2	*2478.00	101.3 AV			1.49 H	358	70.2	31.1
3	2483.50	60.5 PK	74.0	-13.5	1.58 H	347	29.3	31.2
4	2483.50	48.7 AV	54.0	-5.3	1.58 H	347	17.5	31.2
5	4956.00	43.3 PK	74.0	-30.7	1.26 H	334	41.2	2.1
6	4956.00	29.3 AV	54.0	-24.7	1.26 H	334	27.2	2.1
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2478.00	98.3 PK			1.05 V	297	67.2	31.1
2	*2478.00	95.7 AV			1.05 V	297	64.6	31.1
3	2483.50	56.9 PK	74.0	-17.1	1.17 V	306	25.7	31.2
4	2483.50	44.2 AV	54.0	-9.8	1.17 V	306	13.0	31.2
5	4956.00	42.5 PK	74.0	-31.5	1.68 V	205	40.4	2.1
6	4956.00	29.1 AV	54.0	-24.9	1.68 V	205	27.0	2.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

Below 1GHz worst-case data:

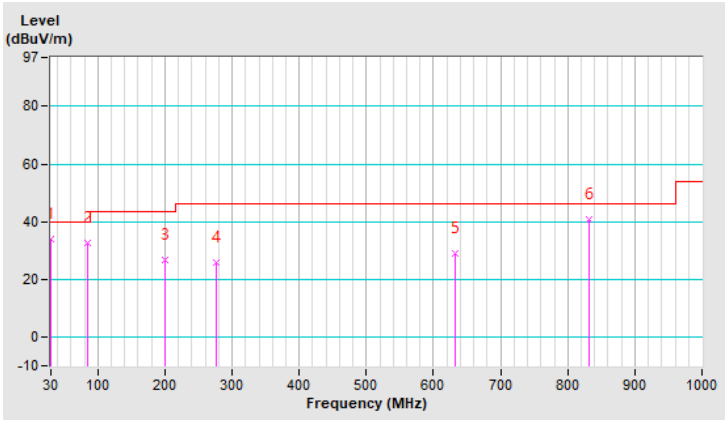
LE 1M

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	30.00	34.0 QP	40.0	-6.0	1.00 H	171	45.3	-11.3
2	84.32	32.4 QP	40.0	-7.6	1.25 H	184	47.1	-14.7
3	200.72	26.9 QP	43.5	-16.6	1.50 H	310	39.0	-12.1
4	276.38	25.7 QP	46.0	-20.3	1.50 H	201	34.2	-8.5
5	631.40	28.8 QP	46.0	-17.2	1.50 H	198	30.2	-1.4
6	831.22	40.6 QP	46.0	-5.4	1.00 H	137	38.7	1.9

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

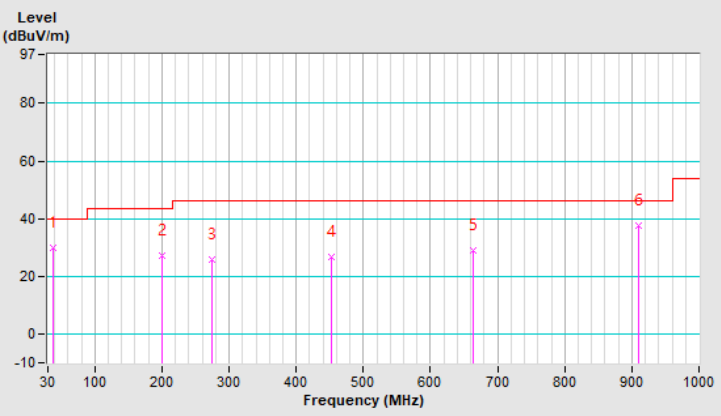


CHANNEL	TX Channel 0	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	37.76	30.0 QP	40.0	-10.0	1.25 V	180	40.7	-10.7
2	200.72	27.2 QP	43.5	-16.3	1.00 V	76	39.3	-12.1
3	274.44	25.7 QP	46.0	-20.3	1.50 V	115	34.3	-8.6
4	452.92	26.6 QP	46.0	-19.4	1.00 V	37	30.9	-4.3
5	663.41	29.2 QP	46.0	-16.8	1.50 V	225	30.2	-1.0
6	909.79	37.7 QP	46.0	-8.3	1.25 V	180	33.9	3.8

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



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.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Dec. 11, 2019	Dec. 10, 2020
RF signal cable Woken	5D-FB	Cable-cond1-01	Sep. 05, 2019	Sep. 04, 2020
LISN ROHDE & SCHWARZ (EUT)	ENV216	101826	Feb. 21, 2019	Feb. 20, 2020
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Aug. 22, 2019	Aug. 21, 2020
Software ADT	BV ADT_Cond_ V7.3.7.4	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Shielded Room 1.
3. The VCCI Site Registration No. is C-12040.
4. Test date: Feb. 12, 2020

4.2.3 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.

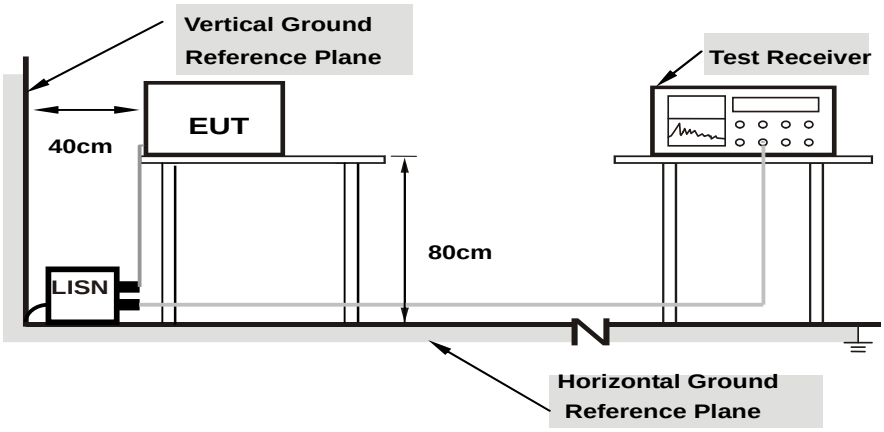
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

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.

4.2.4 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 item 4.1.6.

4.2.7 Test Results

Worst-case data:

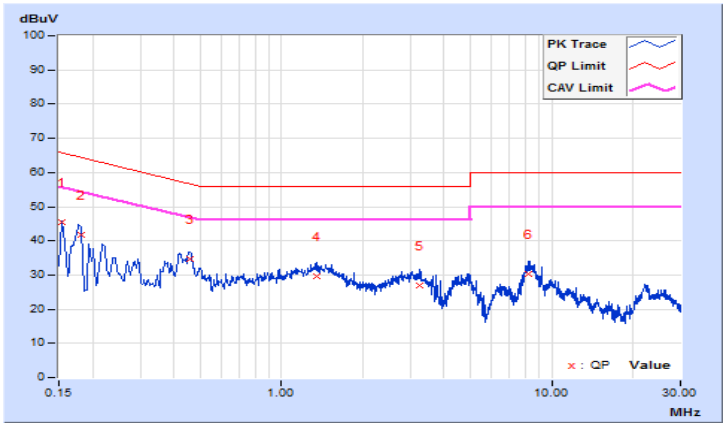
LE 1M

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

No	Freq.	Corr. Factor	Reading Value		Emission Level		Limit		Margin	
			[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15400	9.67	35.76	20.82	45.43	30.49	65.78	55.78	-20.35	-25.29
2	0.18200	9.66	32.13	18.80	41.79	28.46	64.39	54.39	-22.60	-25.93
3	0.45596	9.69	24.96	18.11	34.65	27.80	56.77	46.77	-22.12	-18.97
4	1.35400	9.75	20.00	15.75	29.75	25.50	56.00	46.00	-26.25	-20.50
5	3.24200	9.82	17.10	11.73	26.92	21.55	56.00	46.00	-29.08	-24.45
6	8.25400	9.90	20.43	15.10	30.33	25.00	60.00	50.00	-29.67	-25.00

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

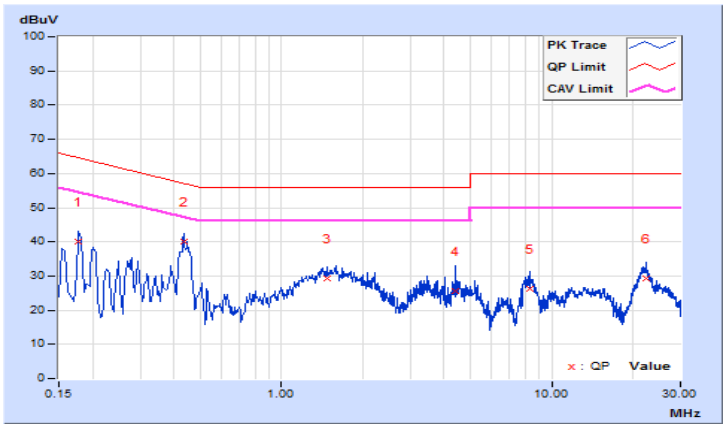


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.17800	9.64	30.36	15.33	40.00	24.97	64.58	54.58	-24.58	-29.61
2	**0.43400**	**9.66**	**30.36**	**22.45**	**40.02**	**32.11**	**57.18**	**47.18**	**-17.16**	**-15.07**
3	1.47400	9.72	19.67	14.96	29.39	24.68	56.00	46.00	-26.61	-21.32
4	4.42200	9.82	15.87	7.38	25.69	17.20	56.00	46.00	-30.31	-28.80
5	8.28200	9.88	16.32	9.11	26.20	18.99	60.00	50.00	-33.80	-31.01
6	22.43800	10.07	19.08	14.40	29.15	24.47	60.00	50.00	-30.85	-25.53

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.



4.3 Number of Hopping Frequency Used

4.3.1 Limits of Hopping Frequency Used Measurement

At least 15 channels frequencies, and should be equally spaced.

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

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.

c. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.

d. Set the SA on View mode and then plot the result on SA screen.

e. Repeat above procedures until all frequencies measured were complete.

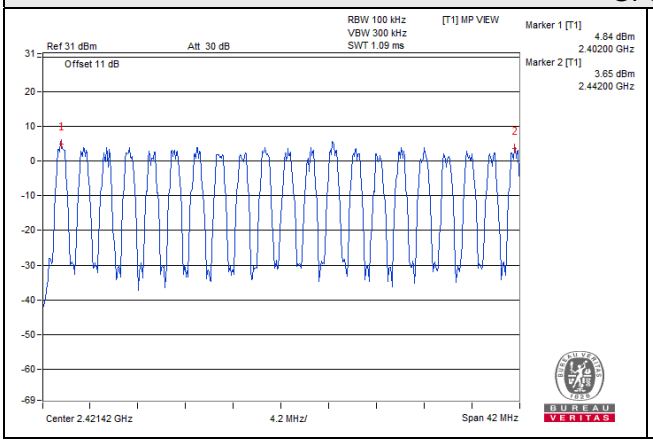
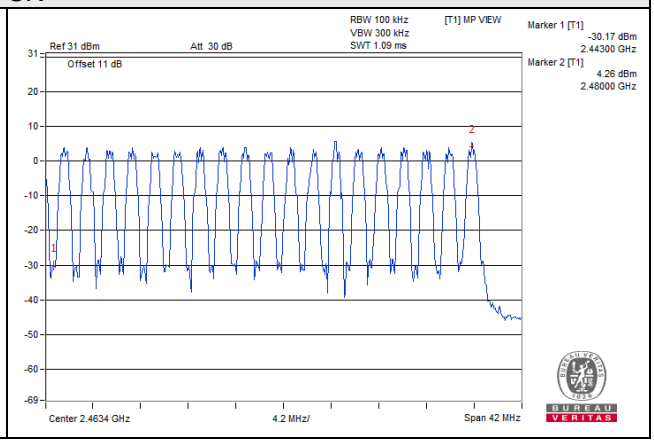
4.3.5 Deviation from Test Standard

No deviation.

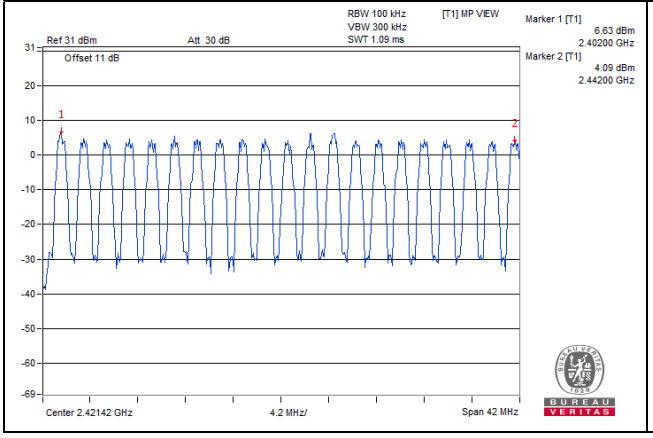
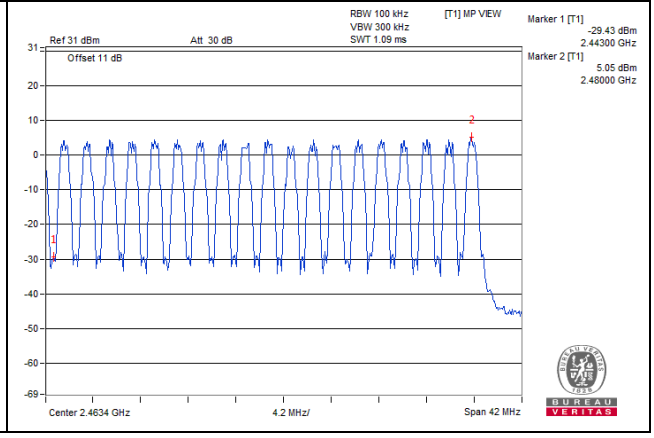
4.3.6 Test Results

There are 38 hopping frequencies in the hopping mode. Please refer to next page for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

LE 1M

GFSK	
	

LE 2M

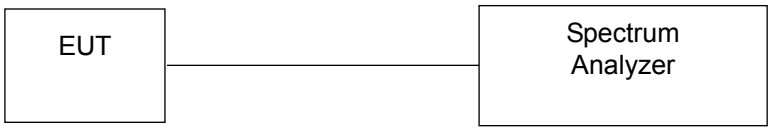
GFSK	
	

4.4 Dwell Time on Each Channel

4.4.1 Limits of Dwell Time on Each Channel Measurement

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

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. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.

c. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.

d. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.

e. Repeat above procedures until all different time-slot modes have been completed.

4.4.5 Deviation from Test Standard

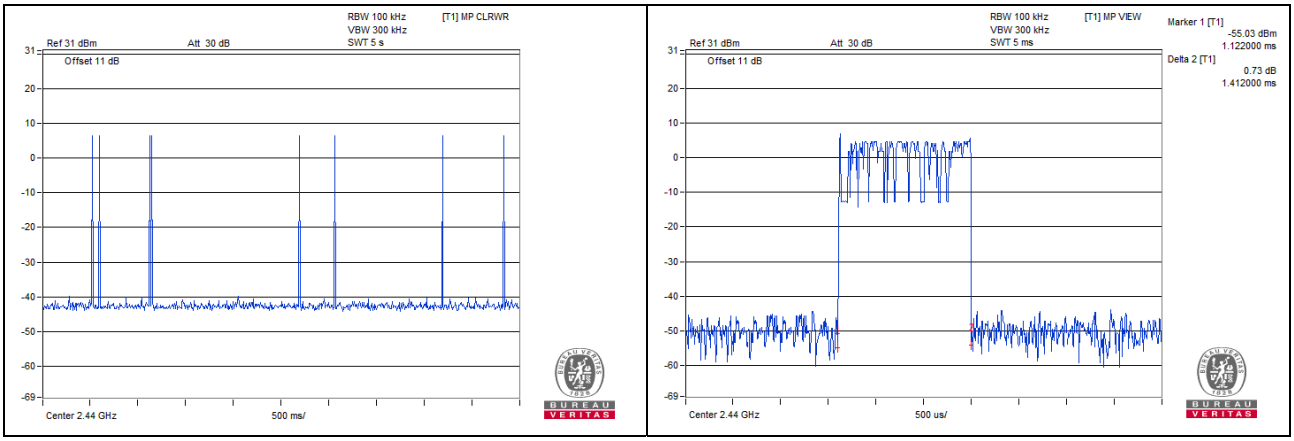
No deviation.

4.4.6 Test Results

LE 1M

Mode	Number of transmission in a 14.8 (37Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
Hopping	8 (times / 5 sec) * 2.96 = 24 times	1.412	33.888	400

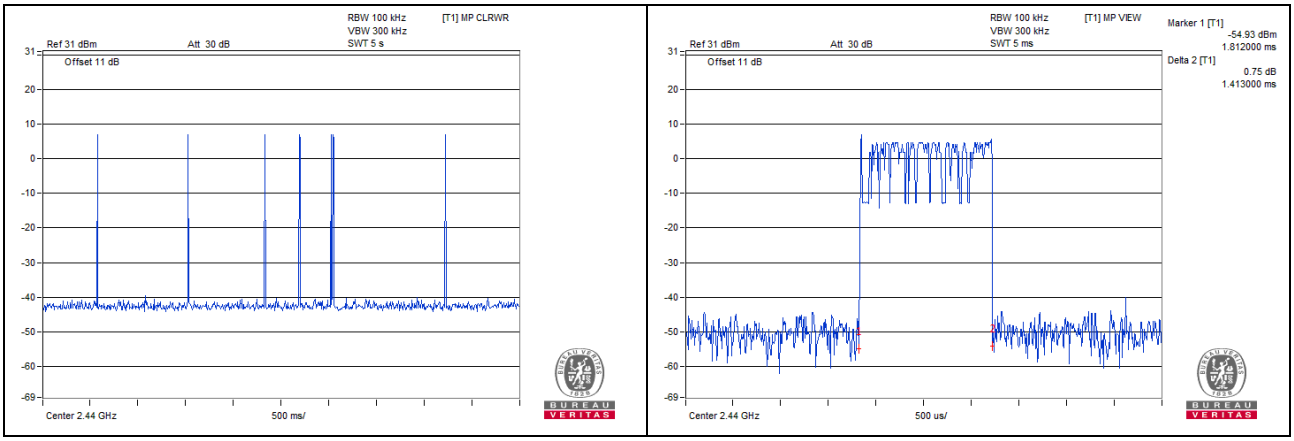
Note: Test plots of the transmitting time slot are shown as below.



LE 2M

Mode	Number of transmission in a 14.8 (37Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
Hopping	7 (times / 5 sec) * 2.96 = 21 times	1.413	29.673	400

Note: Test plots of the transmitting time slot are shown as below.

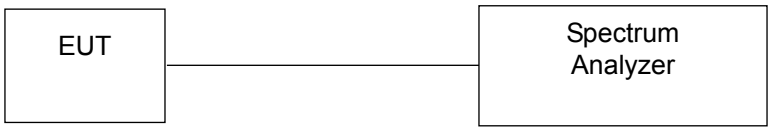


4.5 Channel Bandwidth

4.5.1 Limits of Channel Bandwidth Measurement

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dBbandwidth of hopping channel shell be a minimum limit for the hopping channel separation.

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

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.

d. Repeat above procedures until all frequencies measured were complete.

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 EUT Operating Condition

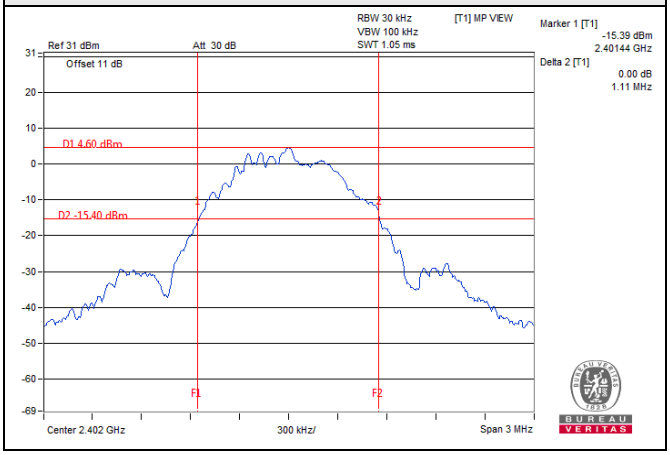
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.5.7 Test Results

LE 1M

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
0	2402	1.11
1	2404	1.11
19	2440	1.11
38	2478	1.11
39	2480	1.11

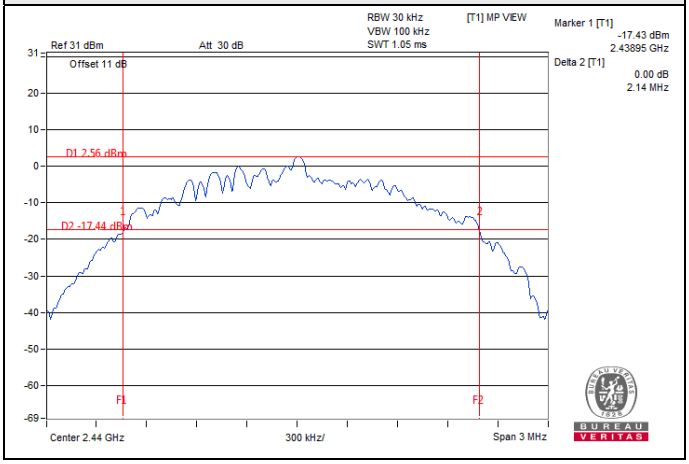
SPECTRUM PLOT OF WORST VALUE



LE 2M

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
1	2404	2.10
19	2440	2.14
38	2478	2.10

SPECTRUM PLOT OF WORST VALUE



4.6 Hopping Channel Separation

4.6.1 Limits of Hopping Channel Separation Measurement

At least 25kHz or two-third of 20dB hopping channel bandwidth (whichever is greater).

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

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.

c. By using the MaxHold function record the separation of two adjacent channels.

d. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.

e. Repeat above procedures until all frequencies measured were complete.

4.6.5 Deviation from Test Standard

No deviation.

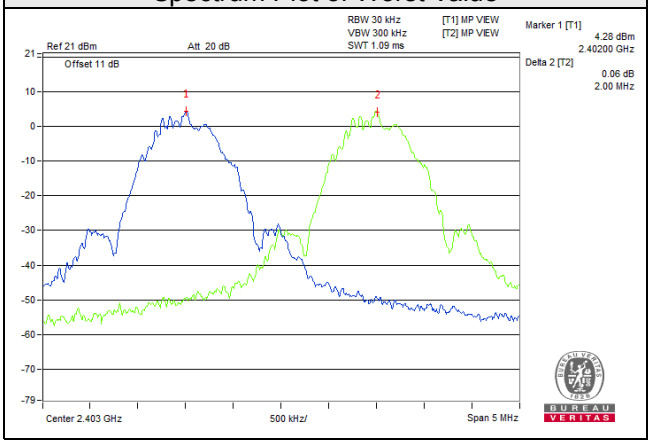
4.6.6 Test Results

LE 1M

Channel	Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	2.00	1.11	0.74	Pass
1	2404	2.00	1.11	0.74	Pass
19	2440	2.00	1.11	0.74	Pass
38	2478	2.00	1.11	0.74	Pass
39	2480	2.00	1.11	0.74	Pass

Note: The minimum limit is two-third 20dB bandwidth.

Spectrum Plot of Worst Value

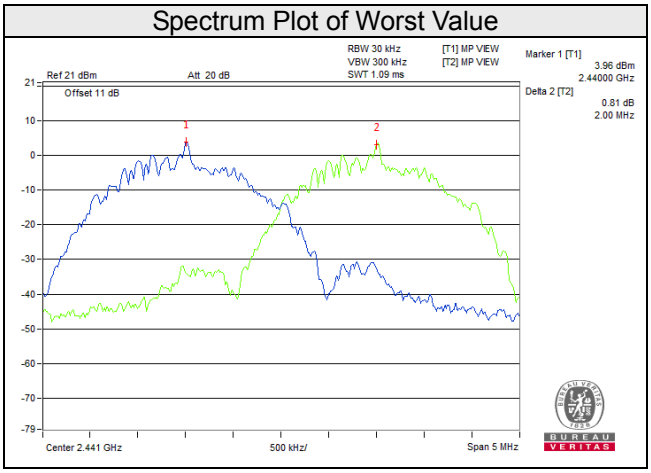


LE 2M

Channel	Frequency (MHz)	Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2404	2.00	2.10	1.40	Pass
19	2440	2.00	2.14	1.43	Pass
38	2478	2.00	2.10	1.40	Pass

Note: The minimum limit is two-third 20dB bandwidth.

Spectrum Plot of Worst Value

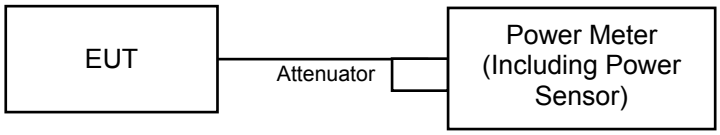


4.7 Maximum Output Power

4.7.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125mW.

4.7.2 Test Setup



4.7.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.7.4 Test Procedure

For Peak Power
A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

For Average Power
Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

4.7.5 Deviation fromTest Standard

No deviation.

4.7.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.7.7 Test Results

For Peak Power

LE 1M

Channel	Frequency (MHz)	Output Power (mW)	Output Power (dBm)	Power Limit (mW)	Pass / Fail
0	2402	**8.128**	9.10	125	Pass
1	2404	8.072	9.07	125	Pass
19	2440	7.998	9.03	125	Pass
38	2478	7.907	8.98	125	Pass
39	2480	7.87	8.96	125	Pass

LE 2M

Channel	Frequency (MHz)	Output Power (mW)	Output Power (dBm)	Power Limit (mW)	Pass / Fail
1	2404	**8.091**	9.08	125	Pass
19	2440	7.962	9.01	125	Pass
38	2478	7.852	8.95	125	Pass

For Average Power

LE 1M

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
0	2402	7.621	8.82
1	2404	7.586	8.80
19	2440	7.499	8.75
38	2478	7.379	8.68
39	2480	7.534	8.77

LE 2M

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
1	2404	7.551	8.78
19	2440	7.447	8.72
38	2478	7.328	8.65

4.8 Conducted Out of Band Emission Measurement

4.8.1 Limits Of Conducted Out Of Band Emission Measurement

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

4.8.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.8.3 Test Procedure

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100 kHz and 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.

4.8.4 Deviation from Test Standard

No deviation.

4.8.5 EUT Operating Condition

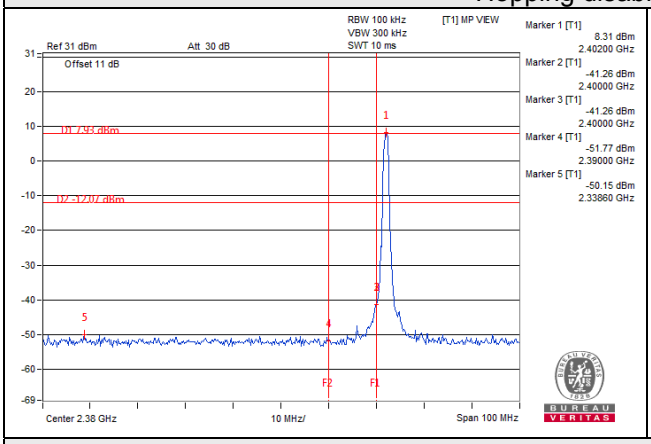
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

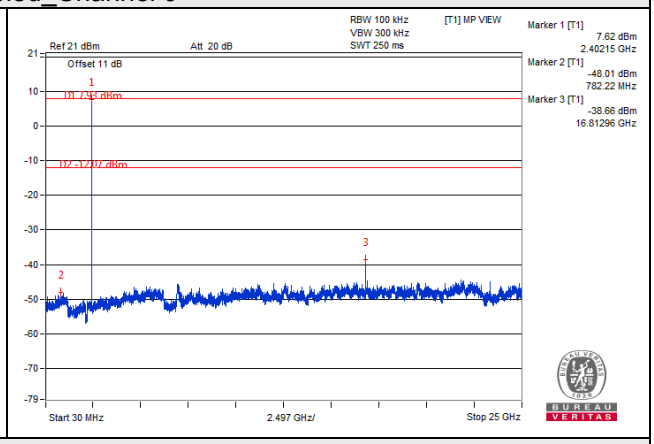
4.8.6 Test Results

The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

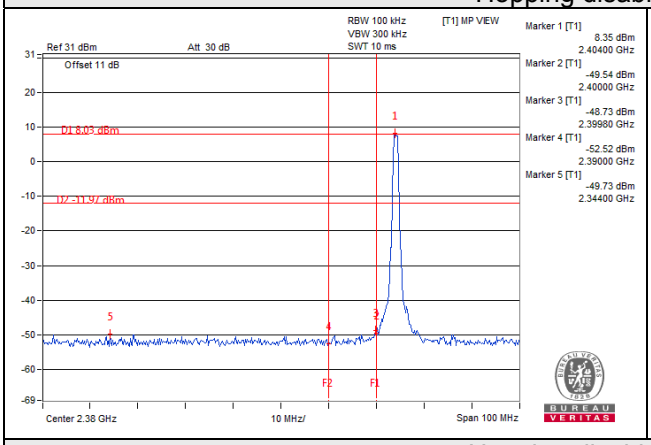
LE 1M

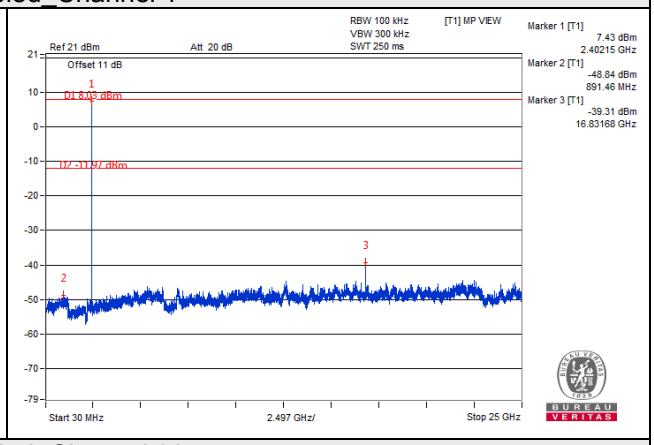
Hopping disabled_Channel 0



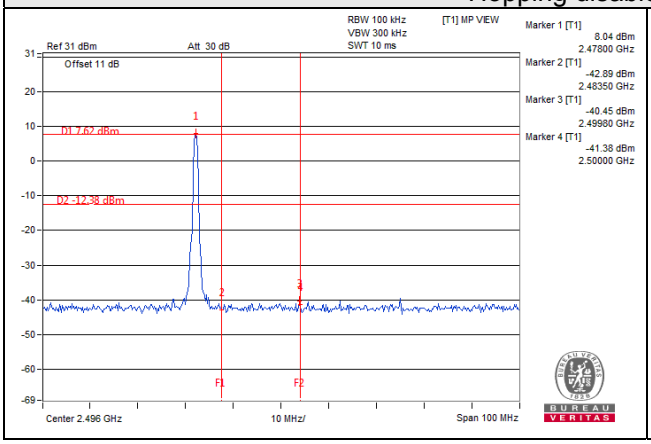


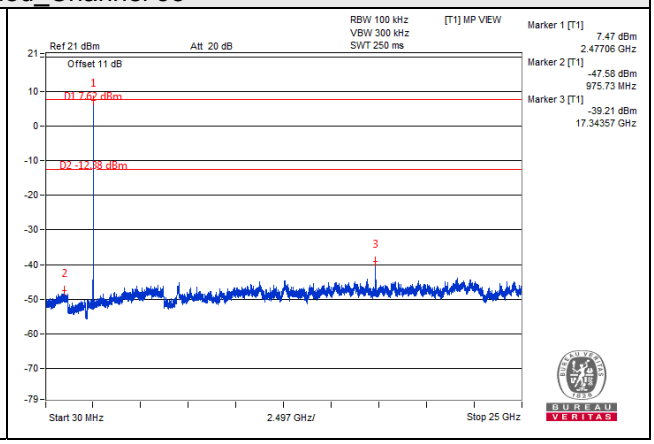
Hopping disabled_Channel 1



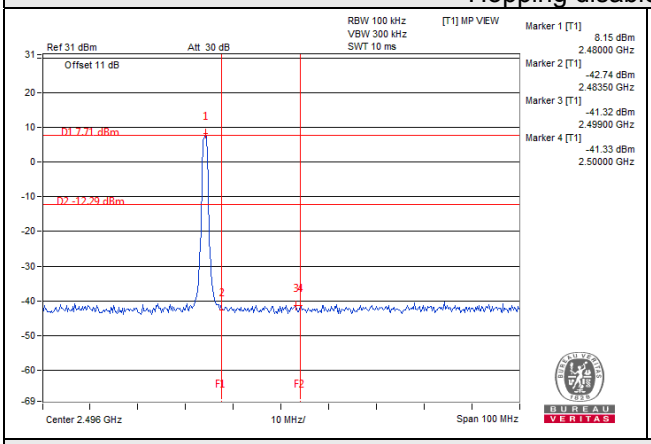


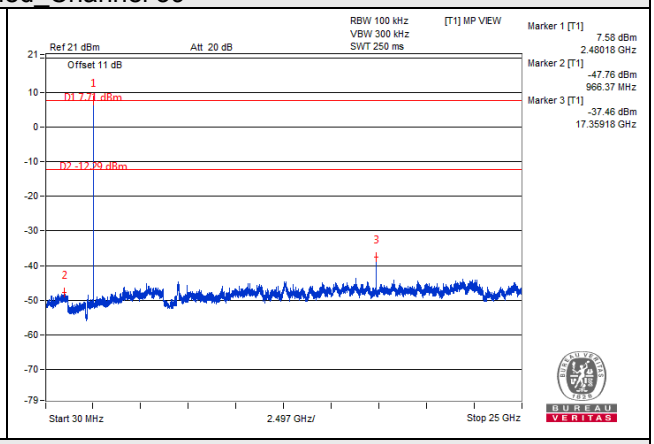
Hopping disabled_Channel 38



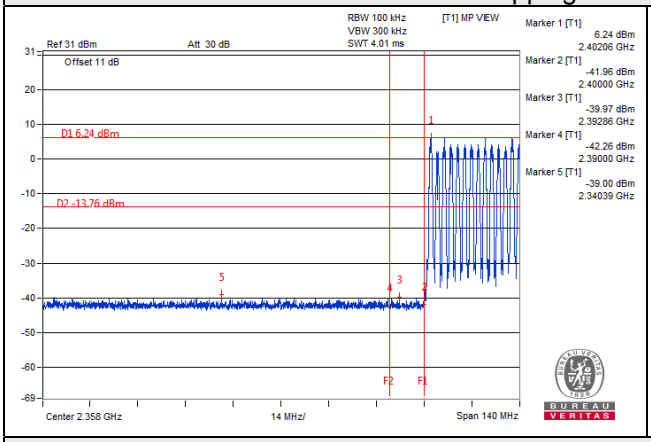


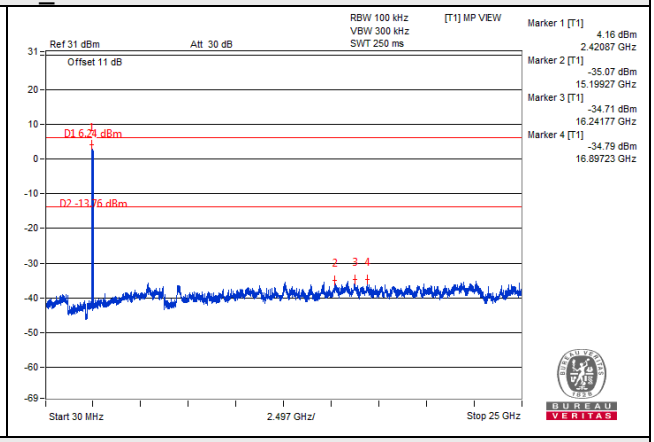
Hopping disabled_Channel 39



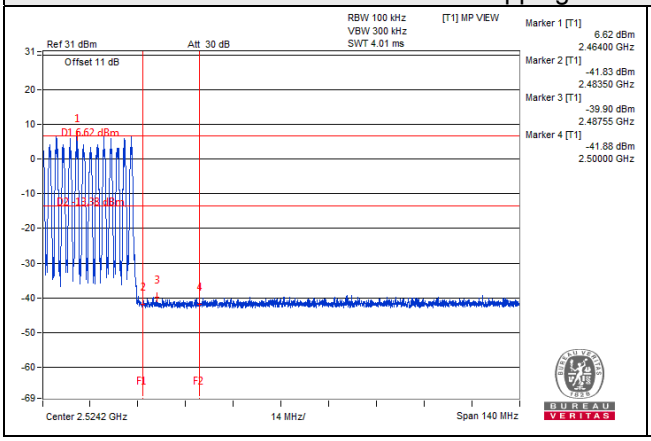


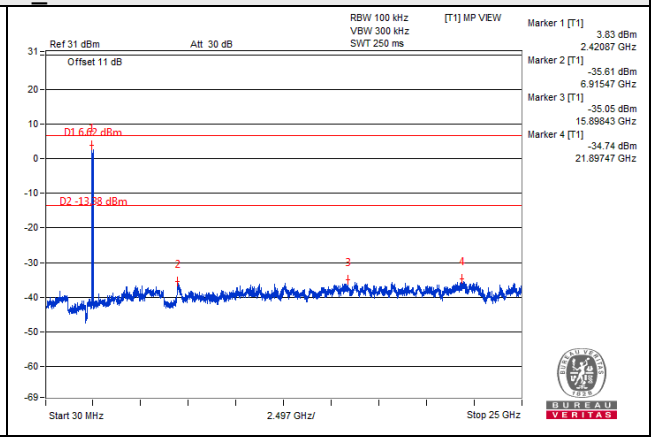
Hopping enabled_Channel 0





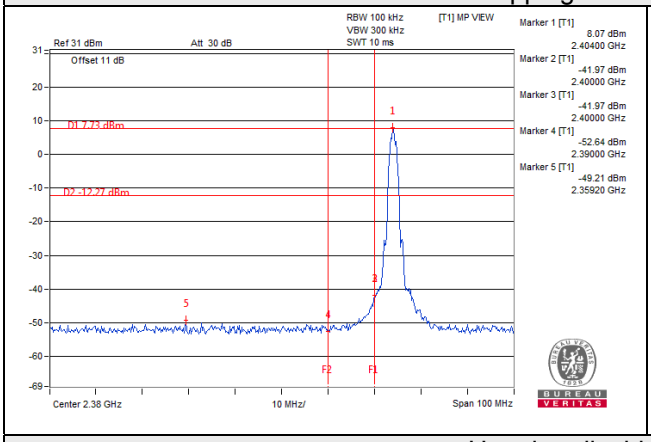
Hopping enabled_Channel 39

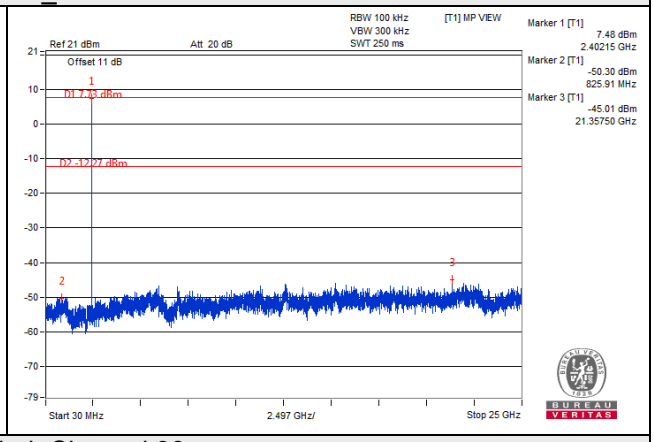




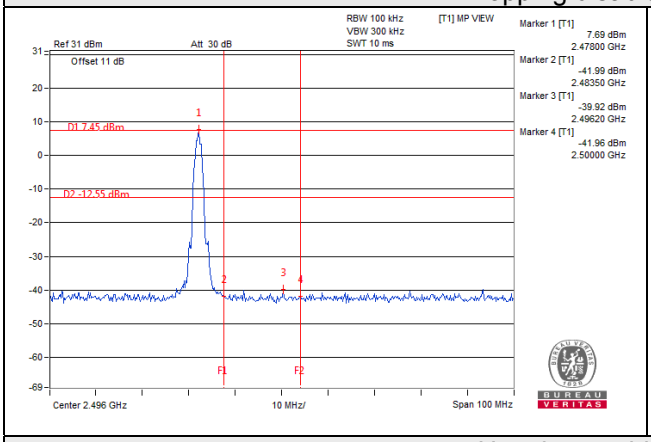
LE 2M

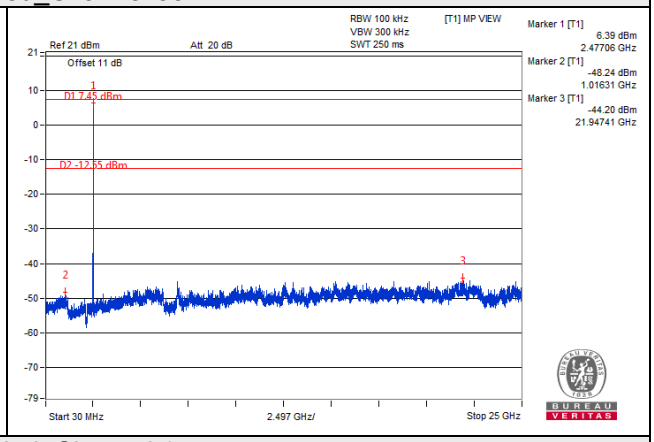
Hopping disabled_Channel 1



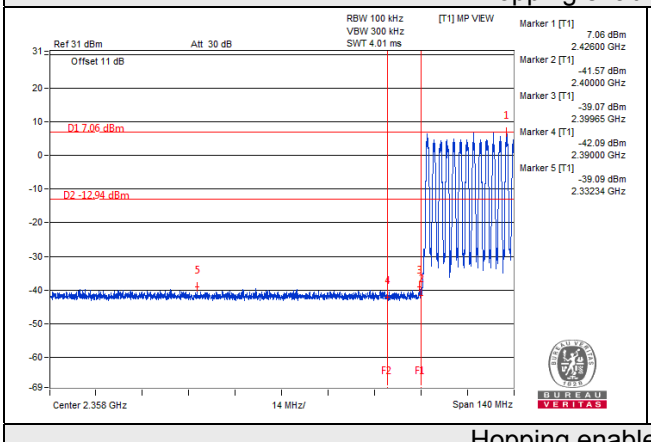


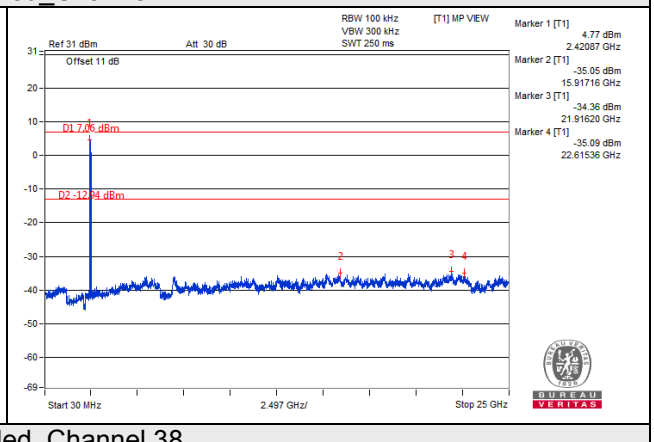
Hopping disabled_Channel 38



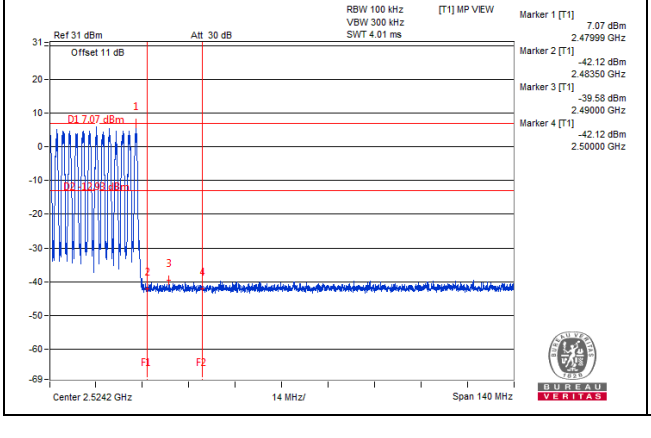


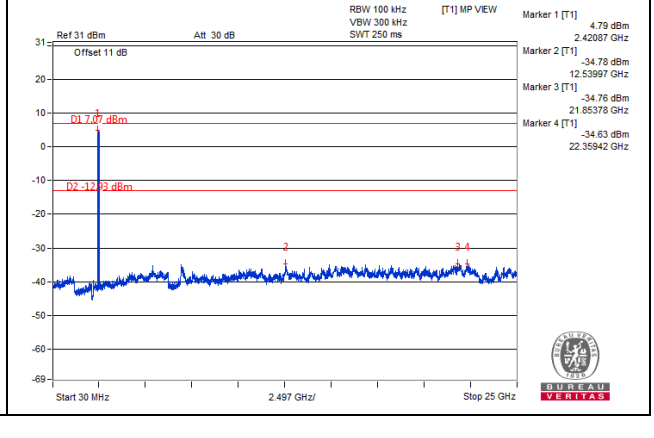
Hopping enabled_Channel 1





Hopping enabled_Channel 38





5 Pictures of Test Arrangements

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

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

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

Lin Kou EMC/RF Lab
Tel: 886-2-26052180
Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab
Tel: 886-3-6668565
Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety
Tel: 886-3-3183232
Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com
Web Site: www.bureauveritas-adt.com

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

--- END ---