FCC Radio Test Report

FCC ID: Q3N-82312

This report concerns (check one): ☒**Original Grant** ☐**Class I Change** ☐**Class II Change**

Project No.	:	1808T030
Equipment	:	Terminal
Test Model	:	8231
Series Model	:	N/A
Applicant	:	CIPHERLAB CO., LTD.
Address	:	12F, 333, Dunhua S. Rd., Sec. 2, Taipei, Taiwan

Date of Receipt	:	Aug. 10, 2018
Date of Test	:	Aug. 10, 2018 ~ Sep. 04, 2018
Issued Date	:	Sep. 05, 2018
Tested by	:	BTL Inc.

Testing Engineer : (Kenji Lin)

Technical Manager : (James Chiu)

Authorized Signatory : (Andy Chiu)

BTL INC.

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Testing Laboratory
0659

Declaration

BTL represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with standards traceable to international standard(s) and/or national standard(s).

BTL's reports apply only to the specific samples tested under conditions. It is manufacture's responsibility to ensure that additional production units of this model are manufactured with the identical electrical and mechanical components. **BTL** shall have no liability for any declarations, inferences or generalizations drawn by the client or others from **BTL** issued reports.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

This report is the confidential property of the client. As a mutual protection to the clients, the public and ourselves, the test report shall not be reproduced, except in full, without our written approval.

BTL's laboratory quality assurance procedures are in compliance with the **ISO Guide 17025** requirements, and accredited by the conformity assessment authorities listed in this test report.

BTL is not responsible for the sampling stage, so the results only apply to the sample as received.

The information, data and test plan are provided by manufacturer, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements in all the possible configurations as representative of its intended use.

Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

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REPORT ISSUED HISTORY

Issued No.	Description	Issued Date
BTL-FCCP-2-1808T030	Original Issue.	Sep. 05, 2018

1. CERTIFICATION

Equipment	:	Terminal
Brand Name	:	CIPHERLAB
Test Model	:	8231
Series Model	:	N/A
Applicant	:	CIPHERLAB CO., LTD.
Manufacturer	:	CIPHERLAB CO., LTD.
Address	:	12F, 333, Dunhua S. Rd., Sec. 2, Taipei, Taiwan
Date of Test	:	Aug. 10, 2018 ~ Sep. 04, 2018
Test Sample	:	Engineering Sample
Standard(s)	:	FCC Part15, Subpart C (15.247) ANSI C63.10-2013

The above equipment has been tested and found in compliance with the requirement of the relative standards by BTL Inc.
The test data, data evaluation, and equipment configuration contained in our test report (Ref No. BTL-FCCP-2-1808T030) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of TAF according to the ISO-17025 quality assessment standard and technical standard(s).

Test results included in this report is only for the Bluetooth LE part.

2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

Applied Standard(s): FCC Part15 (15.247) , Subpart C			
Standard(s) Section	Test Item	Judgment	Remark
15.207	Conducted Emission	PASS	
15.247(d)	Antenna conducted Spurious Emission	PASS	
15.247(a)(2)	6dB Bandwidth	PASS	
15.247(b)(3)	Peak Output Power	PASS	
15.247(e)	Power Spectral Density	PASS	
15.203	Antenna Requirement	PASS	
15.247(d)/ 15.205/ 15.209	Transmitter Radiated Emissions	PASS	

NOTE:

(1)" N/A" denotes test is not applicable to this device.

2.1 TEST FACILITY

The test facilities used to collect the test data in this report:

Conducted emission Test:

C05: (VCCI RN: C-4742; FCC RN:674415; FCC DN:TW0659)
No. 68-1, Ln. 169, Sec. 2, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan (R.O.C.)

Radiated emission Test (Below 1 GHz):

CB15: (VCCI RN: R-20020; FCC RN:674415; FCC DN:TW0659; ISED Assigned Code:20088-5)
No. 68-1, Ln. 169, Sec. 2, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan (R.O.C.)

Radiated emission Test (Above 1 GHz):

CB15: (VCCI RN: G-20031; FCC RN:674415; FCC DN:TW0659; ISED Assigned Code:20088-5)
No. 68-1, Ln. 169, Sec. 2, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan (R.O.C.)

2.2 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. The BTL measurement uncertainty is less than the CISPR 16-4-2 Ucispr requirement.

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

A. Conducted emission test:

Test Site	Method	Measurement Frequency Range	U,(dB)
C05	CISPR	150 kHz ~ 30MHz	2.68

B. Radiated emission test:

Test Site	Method	Measurement Frequency Range	U,(dB)
CB15 (3m)	CISPR	9kHz ~ 150kHz	2.82
		150kHz ~ 30MHz	2.58

Test Site	Method	Measurement Frequency Range	Ant.	U,(dB)
CB15 (3m)	CISPR	30MHz ~ 200MHz	V	4.20
		30MHz ~ 200MHz	H	3.64
		200MHz ~ 1,000MHz	V	4.56
		200MHz ~ 1,000MHz	H	3.90

Test Site	Method	Measurement Frequency Range	Ant.	U,(dB)
CB15 (3m)	CISPR	1GHz ~ 6GHz	V	4.46
		1GHz ~ 6GHz	H	4.40
		6GHz ~ 18GHz	V	3.88
		6GHz ~ 18GHz	H	4.00

Test Site	Method	Measurement Frequency Range	U,(dB)
CB15 (1m)	CISPR	18 ~ 26.5 GHz	4.62
		26.5 ~ 40 GHz	5.12

Our calculated Measurement Instrumentation Uncertainty is shown in the tables above.
These are our U_{lab} values in CISPR 16-4-2 terminology.
Since Table 1 of CISPR 16-4-2 has values of measurement instrumentation uncertainty, called U_{CISPR}, as follows:

Conducted Disturbance (mains port) – 150 kHz – 30 MHz: 3.6 dB
Radiated Disturbance (electric field strength on an open area test site or alternative test site) – 30 MHz – 1000 MHz: 5.2 dB

It can be seen that our U_{lab} values are smaller than U_{CISPR}.
Note: unless specifically mentioned, the uncertainty of measurement has not been taken into account to declare the compliance or non-compliance to the specification.

3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Equipment	Terminal
Brand Name	CIPHERLAB
Test Model	8231
Series Model	N/A
Model Difference	N/A
Power Source	#1 DC Voltage supplied from AC adapter. Model: SYS1561-1005 #2 Supplied from Li-ion Battery. Model: BA-80S1A2
Power Rating	#1 I/P: 100-240V~1.0A MAX 50-60Hz O/P: 5V⎓2A10W MAX #2 DC 3.7V 1200mAh, 4.44Wh
BT Version	4.0
Operation Frequency	2402~2480 MHz
Modulation Technology	GFSK
Bit Rate of Transmitter	1Mbps
Conducted Power (Max.)	6.15 dBm (1Mbps)
Average Power (Max.)	5.84 dBm (1Mbps)

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2. Channel List:

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

3. Table for Filed Antenna

Ant.	Brand	Test Model	Antenna Type	Connector	Gain (dBi)
1	CipherLab	8231 BT Antenna	PIFA	U.FL	1.71

3.2 DESCRIPTION OF TEST MODES

The test system was pre-tested based on the consideration of all possible combinations of EUT operation mode.
Following mode(s) as (were) found to be the worst case(s) and selected for the final test.

Test Items	Test mode	Channel	Note
Conducted Emission	1 Mbps	00	-
Transmitter Radiated Emissions (BELOW 1GHz)	1 Mbps	00	-
Transmitter Radiated Emissions (ABOVE 1GHz)	1 Mbps	00/19/39	-
6dB Bandwidth	1 Mbps	00/19/39	-
Peak Output Power	1 Mbps	00/19/39	-
Antenna conducted Spurious Emission	1 Mbps	00/19/39	-
Power Spectral Density	1 Mbps	00/19/39	-

Note:

(1) The measurements are performed at the high, middle, low available channels.

3.3 TABLE OF PARAMETERS OF TEXT SOFTWARE SETTING

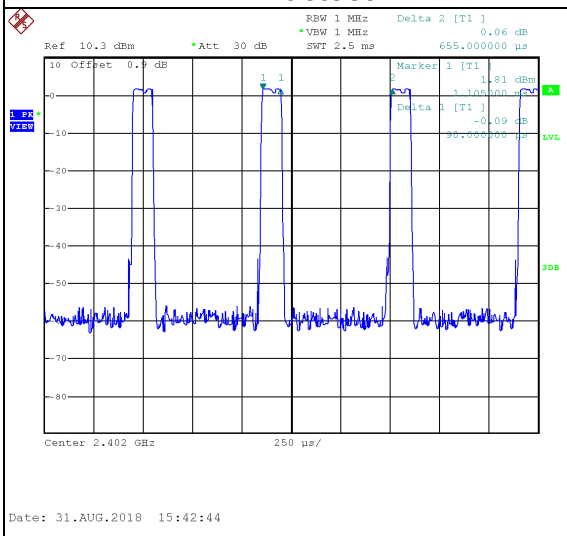
During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of BT LE

Test Software Version	N/A		
Frequency (MHz)	2402	2440	2480
BT LE	DEF	DEF	DEF

3.4 DUTY CYCLE

If duty cycle is ≥ 98 %, duty factor is not required.
If duty cycle is < 98 %, duty factor shall be considered.

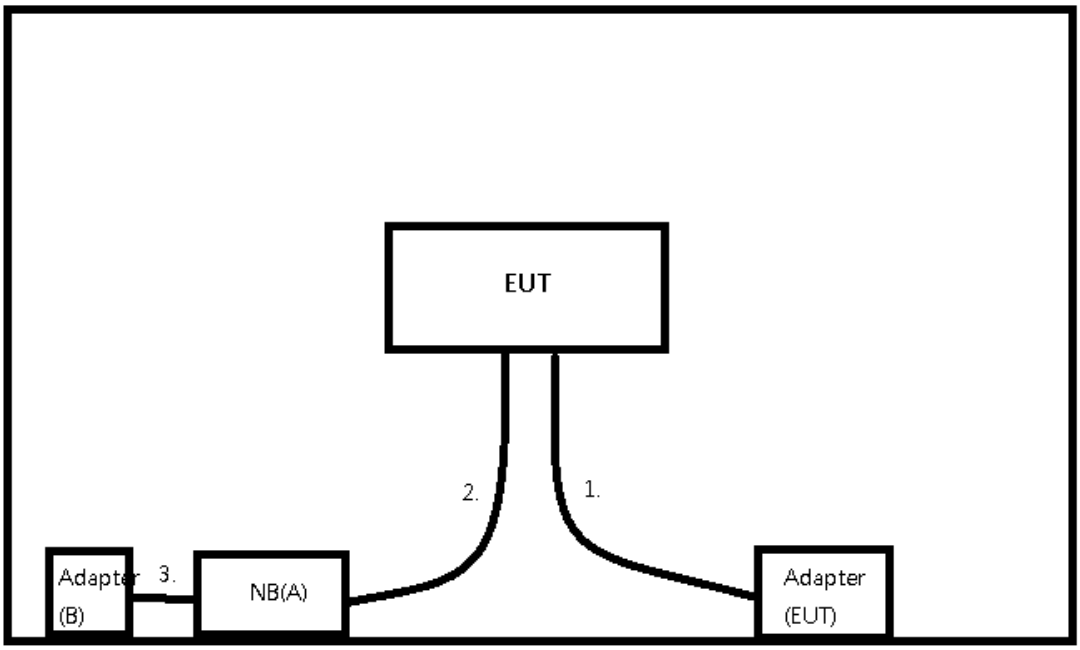
Bluetooth



Duty cycle = 0.0900 ms / 0.6550 ms = 13.74 %
Duty Factor = 10 * log(1 / 0.7278) = 8.62

Note:
For radiated emissions frequency above 1 GHz, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 kHz (Duty cycle < 98%).

3.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



3.6 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.

Item	Equipment	Mfr/Brand	Model/Type No.	FCC ID	Series No.
A	NB	HP	TPN-I119	-	N/A
B	Adapter	HP	HSTNN-CA40	-	1588-3003

Item	Shielded Type	Ferrite Core	Length	Note
1	YES	NO	1.0m	Power Cable
2	YES	YES	1.5m	USB Cable
3	YES	NO	2.0m	Power Cable

4. EMC EMISSION TEST

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 POWER LINE CONDUCTED EMISSION LIMITS (Frequency Range 150KHz-30MHz)

F equency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 -0 5	66 to 56*	56 to 46*
0.50 -5.0	56	46
5.0 -30.0	0	50

Note:

(1) The limit of " * " decreases with the logarithm of the frequency

(2) The test result calculated as following:
Measurement Value = Reading Level + Correct Factor
Correct Factor = Insertion Loss + Cable Loss + Attenuator Factor(if use)
Margin Level = Measurement Value - Limit Value

The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

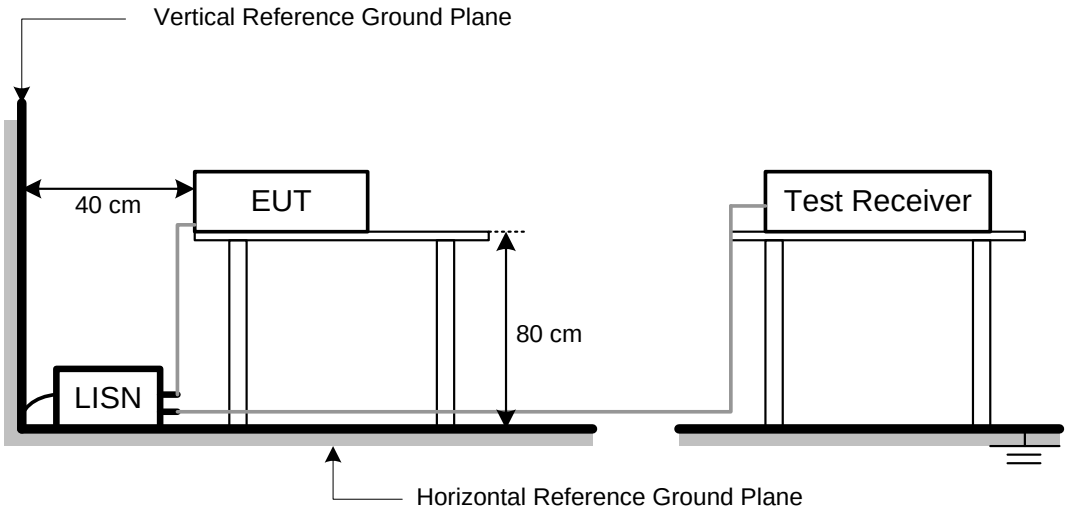
4.1.2 TEST PROCEDURE

a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN at least 80 cm from nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.1.3 DEVIATION FROM TEST STANDARD

No deviation

4.1.4 TEST SETUP



4.1.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

4.1.6 EUT TEST CONDITIONS

Temperature: 25°C
Relative Humidity: 45%
Test Voltage: AC 120V/60Hz

4.1.7 TEST RESULTS

Please refer to the Appendix A.

Remark:

(1) All readings are QP Mode value unless otherwise stated AVG in column of『Note』. If the QP Mode Measured value compliance with the QP Limits and lower than AVG Limits, the EUT shall be deemed to meet both QP & AVG Limits and then only QP Mode was measured, but AVG Mode didn't perform.In this case, a " * " marked in AVG Mode column of Interference Voltage Measured.
(2) Measuring frequency range from 150KHz to 30MHz.
(3) " N/A" denotes test is not applicable to this device.

4.2 RADIATED EMISSION MEASUREMENT

4.2.1 RADIATED EMISSION LIMITS

In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (9KHz-1000MHz)

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

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

Frequency (MHz)	(dBuV/m) (at 3 meters)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

(4) The test result calculated as following:
Measurement Value = Reading Level + Correct Factor
Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain(if use)
Margin Level = Measurement Value - Limit Value

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RBW / VBW (Emission in restricted band)	RBW 1MHz VBW 3MHz peak detector for Pk value RMS detector for AV value

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9KHz~90KHz for PK/AVG detector
Start ~ Stop Frequency	90KHz~110KHz for QP detector
Start ~ Stop Frequency	110KHz~490KHz for PK/AVG detector
Start ~ Stop Frequency	490KHz~30MHz for QP detector
Start ~ Stop Frequency	30MHz~1000MHz for QP detector

4.2.2 TEST PROCEDURE

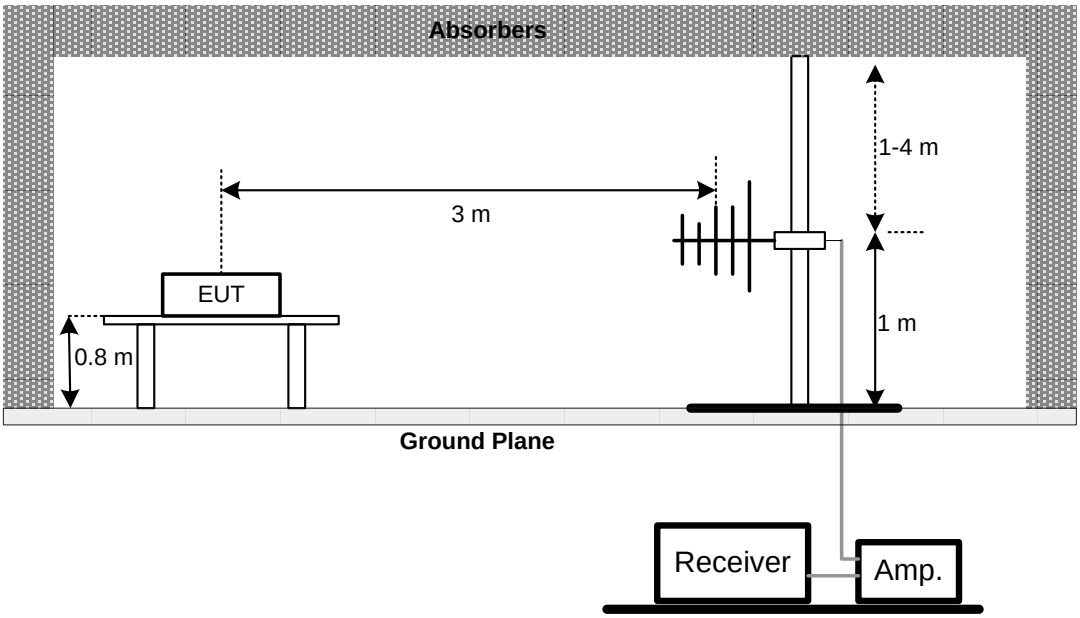
a. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1GHz)
b. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 1.5 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(above 1GHz)
c. The height of the equipment or of the substitution antenna shall be 0.8m or 1.5m; the height of the test antenna shall vary between 1 m to 4 m. 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 find the maximum reading (used Bore sight function).
e. The receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1GHz.
f. The initial step in collecting radiated emission data is a receiver peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
g. All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn‘t perform. (below 1GHz)
h. All readings are Peak Mode value unless otherwise stated AVG in column of Note. If the Peak Mode Measured value compliance with the Peak Limits and lower than AVG Limits, the EUT shall be deemed to meet both Peak & AVG Limits and then only Peak Mode was measured, but AVG Mode didn‘t perform. (above 1GHz)
i. For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.2.3 DEVIATION FROM TEST STANDARD

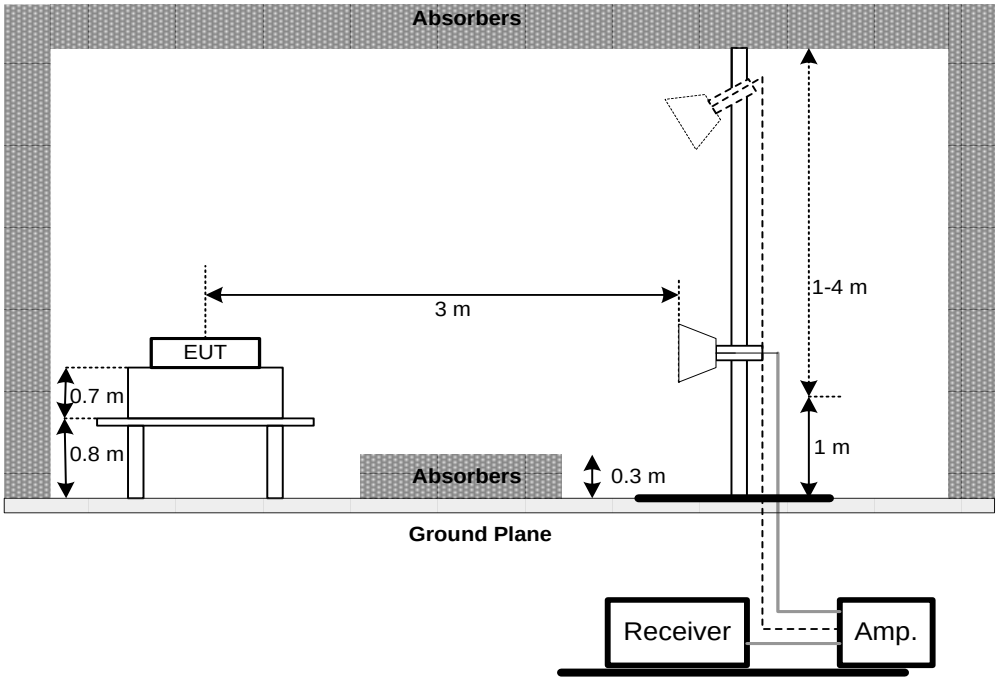
No deviation

4.2.4 TEST SETUP

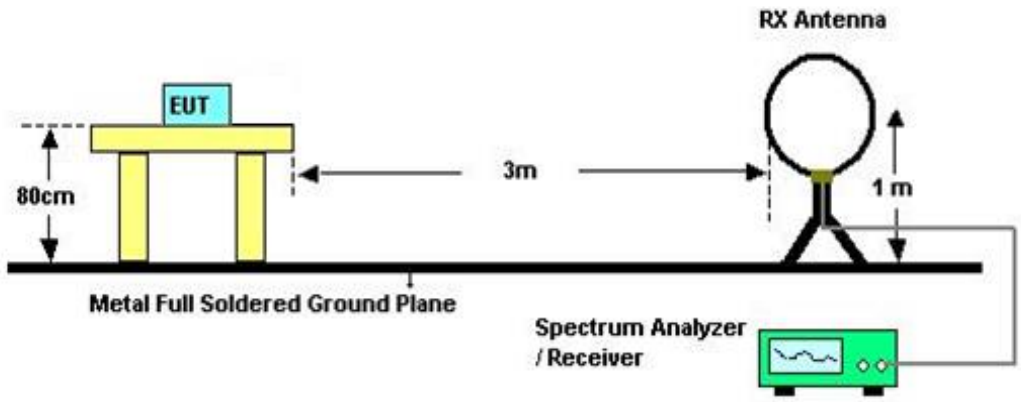
(A) Radiated Emission Test Set-Up Frequency Below 1 GHz



(B) Radiated Emission Test Set-Up Frequency Above 1 GHz



(C) For radiated emissions below 30MHz



4.2.5 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

4.2.6 EUT TEST CONDITIONS

Temperature: 23°C
Relative Humidity: 70%
Test Voltage: AC 120V/60Hz

4.2.7TEST RESULTS (9KHZ TO 30MHZ)

Please refer to the Appendix B

Remark:

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

4.2.7TEST RESULTS (30MHZ TO 1000 MHZ)

Please refer to the Appendix C.

4.2.7TEST RESULTS (ABOVE 1000 MHZ)

Please refer to the Appendix D.

Remark:

(1) No limit: This is fundamental signal, the judgment is not applicable.
For fundamental signal judgment was referred to Peak output test.

5. BANDWIDTH TEST

5.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	>= 500KHz (6dB bandwidth)	2400-2483.5	PASS

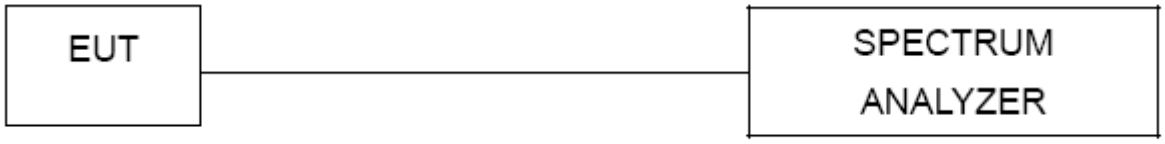
5.1.1 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
b. Spectrum Setting : RBW= 100KHz, VBW=300KHz, Sweep time = 2.5 ms.

5.1.2 DEVIATION FROM STANDARD

No deviation.

5.1.3 TEST SETUP



5.1.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.1.5 unless otherwise a special operating condition is specified in the follows during the testing.

5.1.5 EUT TEST CONDITIONS

Test Voltage: AC 120V/60Hz

5.1.6 TEST RESULTS

Please refer to the Appendix E.

6. MAXIMUM OUTPUT POWER TEST

6.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Maximum Output Power	1 watt or 30dBm	2400-2483.5	PASS

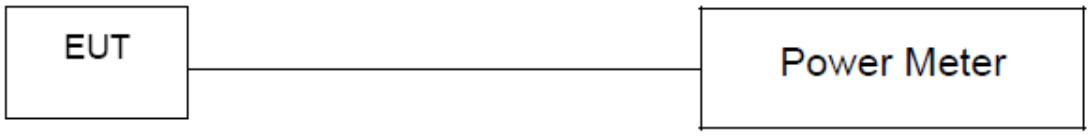
6.1.1 TEST PROCEDURE

a. The EUT was directly connected to the power meter and antenna output port as show in the block diagram below,
b. The maximum peak conducted output power was performed in accordance with method 9.1.2 of FCC KDB 558074 D01 DTS Meas Guidance.

6.1.2 DEVIATION FROM STANDARD

No deviation.

6.1.3 TEST SETUP



6.1.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.1.5 unless otherwise a special operating condition is specified in the follows during the testing.

6.1.5 EUT TEST CONDITIONS

Test Voltage: AC 120V/60Hz

6.1.6 TEST RESULTS

Please refer to the Appendix F.

7. ANTENNA CONDUCTED SPURIOUS EMISSION

7.1 APPLIED PROCEDURES / LIMIT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

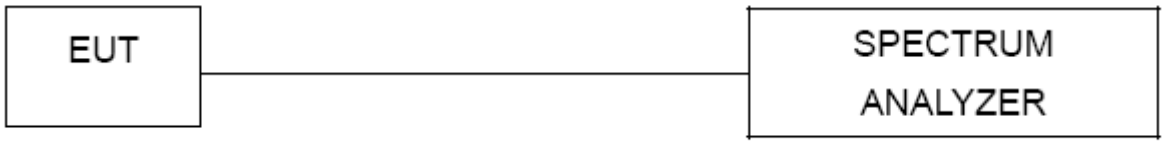
7.1.1 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
b. Spectrum Setting : RBW= 100KHz, VBW=300KHz, Sweep time = 10 ms.
c. Offset=antenna gain+cable loss

7.1.2 DEVIATION FROM STANDARD

No deviation.

7.1.3 TEST SETUP



7.1.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.1.5 unless otherwise a special operating condition is specified in the follows during the testing.

7.1.5 EUT OPERATION CONDITIONS

Test Voltage: AC 120V/60Hz

7.1.6 TEST RESULTS

Please refer to the Appendix G.

8. POWER SPECTRAL DENSITY TEST

8.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(e)	Power Spectral Density	8 dBm (in any 3KHz)	2400-2483.5	PASS

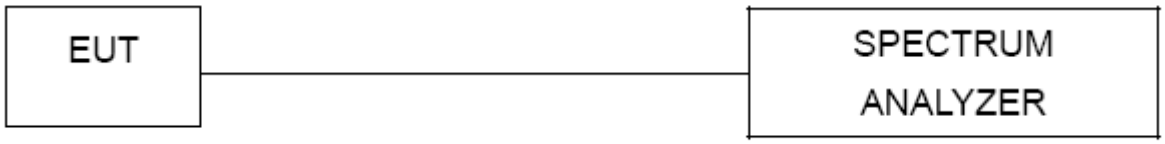
8.1.1 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
b. Spectrum Setting: RBW=3KHz, VBW=10 KHz, Sweep time = auto.

8.1.2 DEVIATION FROM STANDARD

No deviation.

8.1.3 TEST SETUP



8.1.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.1.5 unless otherwise a special operating condition is specified in the follows during the testing.

8.1.5 EUT TEST CONDITIONS

Test Voltage: AC 120V/60Hz

8.1.6 TEST RESULTS

Please refer to the Appendix H.

9. MEASUREMENT INSTRUMENTS LIST

Conducted Emission Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	TWO-LINE V-NETWORK	R&S	ENV216	101050	Jan. 24, 2019
2	Test Cable	TIMES	CFD300-NL	C02	Jun. 13, 2019
3	EMI Test Receiver	R&S	ESR7	101433	Dec. 07, 2018
4	Measurement Software	EZ	EZ_EMC (Version NB-03A)	N/A	N/A

Radiated Emission Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Preamplifier	EMCI	012645B	980267	Feb. 27, 2019
2	Preamplifier	EMCI	EMC02325	980217	Dec. 27, 2019
3	Test Cable	EMCI	EMC104-SM-SM-8000	8m	Jan. 03, 2019
4	Test Cable	EMCI	EMC104-SM-SM-800	150207	Jan. 03, 2019
5	Test Cable	EMCI	EEMC104-SM-SM-3000	151205	Jan. 03, 2019
6	MXE EMI Receiver	Agilent	N9038A	MY55420127	Jan. 08, 2019
7	Signal Analyzer	Agilent	N9010A	MY52220990	Feb. 21, 2019
8	Loop Ant	EMCI	LPA600	274	May 03, 2019
9	Horm Ant	SCHWARZBECK	BBHA 9120D	9120D-1342	Feb. 27, 2019
10	Horm Ant	Schwarzbeck	BBHA 9170	187	Dec. 05, 2018
11	Trilog-Broadband Antenna	Schwarzbeck	VULB 9168	9168-548	Jan. 15, 2019
12	5dB Attenuator	EMCI	EMCI-N-6-05	AT-N0623	Jan. 15, 2019

6dB Bandwidth Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	R&S/FSP30	100854(E-208)	May 25, 2019

Peak Output Power Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Power Meter	Anritsu	ML2487A	6K00004714	Sep.10, 2018
2	Power Sensor	Anritsu	MA2411B	1126001	Aug. 15, 2019

Antenna Conducted Spurious Emission Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	R&S/FSP30	100854(E-208)	May 25, 2019

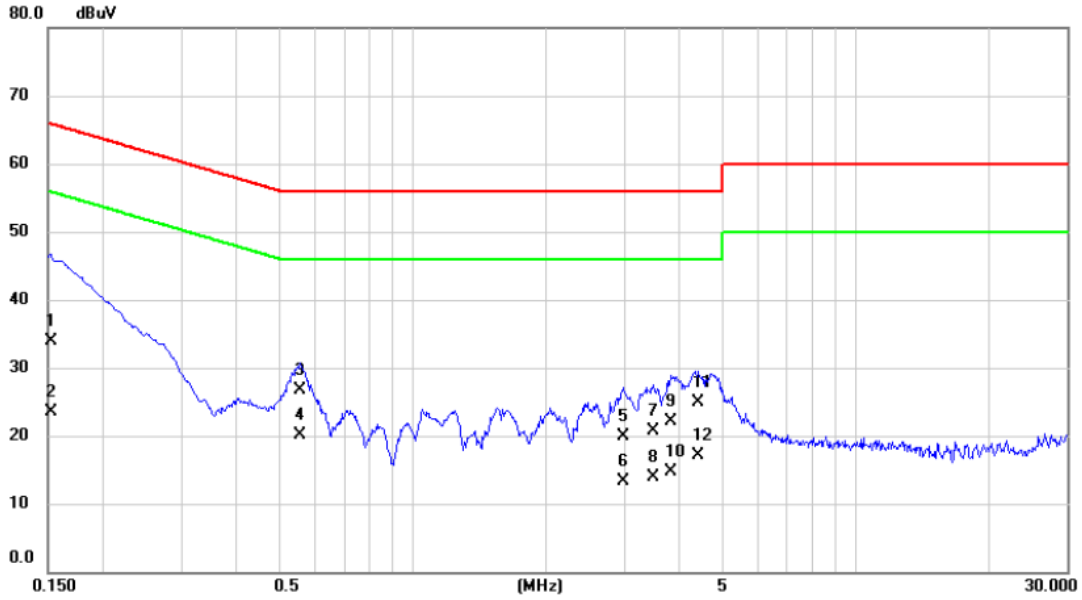
Power Spectral Density Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	R&S/FSP30	100854(E-208)	May 25, 2019

Remark: ”N/A” denotes no model name, serial no. or calibration specified.
All calibration period of equipment list is one year.

APPENDIX A - CONDUCTED EMISSION

Test Mode:	TX Mode 2402MHz _CH00_1Mbps

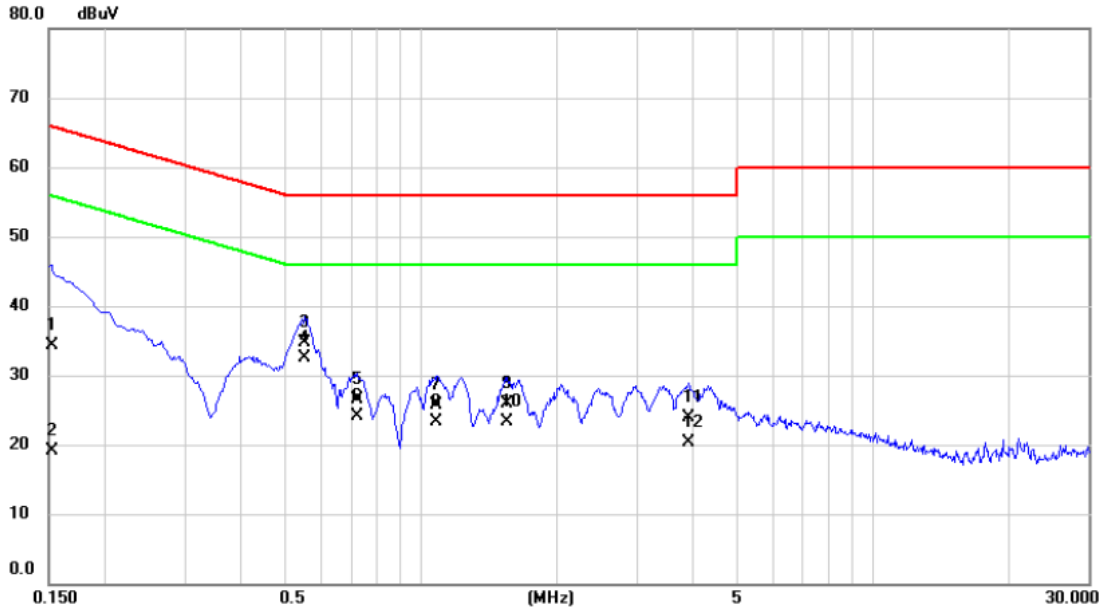
Line



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1522	24.20	9.63	33.83	65.88	-32.05	QP	
2		0.1522	13.80	9.63	23.43	55.88	-32.45	AVG	
3		0.5550	17.00	9.66	26.66	56.00	-29.34	QP	
4	*	0.5550	10.50	9.66	20.16	46.00	-25.84	AVG	
5		2.9918	10.10	9.71	19.81	56.00	-36.19	QP	
6		2.9918	3.50	9.71	13.21	46.00	-32.79	AVG	
7		3.4935	10.90	9.73	20.63	56.00	-35.37	QP	
8		3.4935	4.10	9.73	13.83	46.00	-32.17	AVG	
9		3.8355	12.40	9.73	22.13	56.00	-33.87	QP	
10		3.8355	5.00	9.73	14.73	46.00	-31.27	AVG	
11		4.4093	15.20	9.74	24.94	56.00	-31.06	QP	
12		4.4093	7.40	9.74	17.14	46.00	-28.86	AVG	

Test Mode:	TX Mode 2402MHz _CH00_1Mbps

Neutral

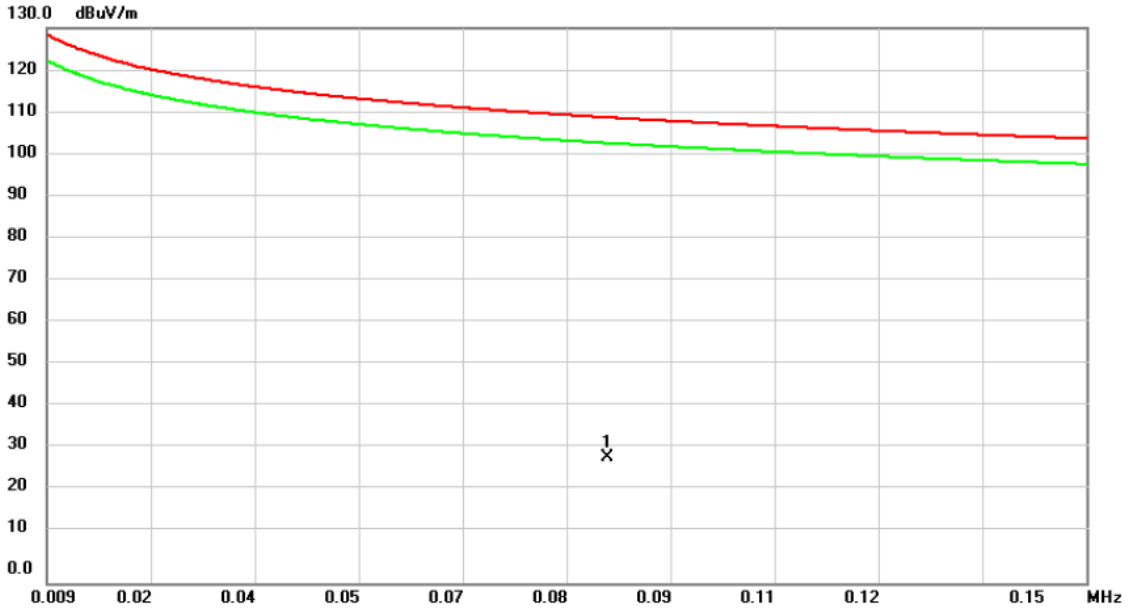


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1522	24.60	9.62	34.22	65.88	-31.66	QP	
2		0.1522	9.50	9.62	19.12	55.88	-36.76	AVG	
3		0.5527	25.10	9.65	34.75	56.00	-21.25	QP	
4	*	0.5527	22.80	9.65	32.45	46.00	-13.55	AVG	
5		0.7215	16.90	9.66	26.56	56.00	-29.44	QP	
6		0.7215	14.40	9.66	24.06	46.00	-21.94	AVG	
7		1.0837	16.10	9.66	25.76	56.00	-30.24	QP	
8		1.0837	13.70	9.66	23.36	46.00	-22.64	AVG	
9		1.5473	16.20	9.67	25.87	56.00	-30.13	QP	
10		1.5473	13.60	9.67	23.27	46.00	-22.73	AVG	
11		3.9165	14.20	9.72	23.92	56.00	-32.08	QP	
12		3.9165	10.60	9.72	20.32	46.00	-25.68	AVG	

APPENDIX B - RADIATED EMISSION (9KHZ TO 30MHZ)

Test Mode:	TX Mode 2402MHz _CH00_1Mbps

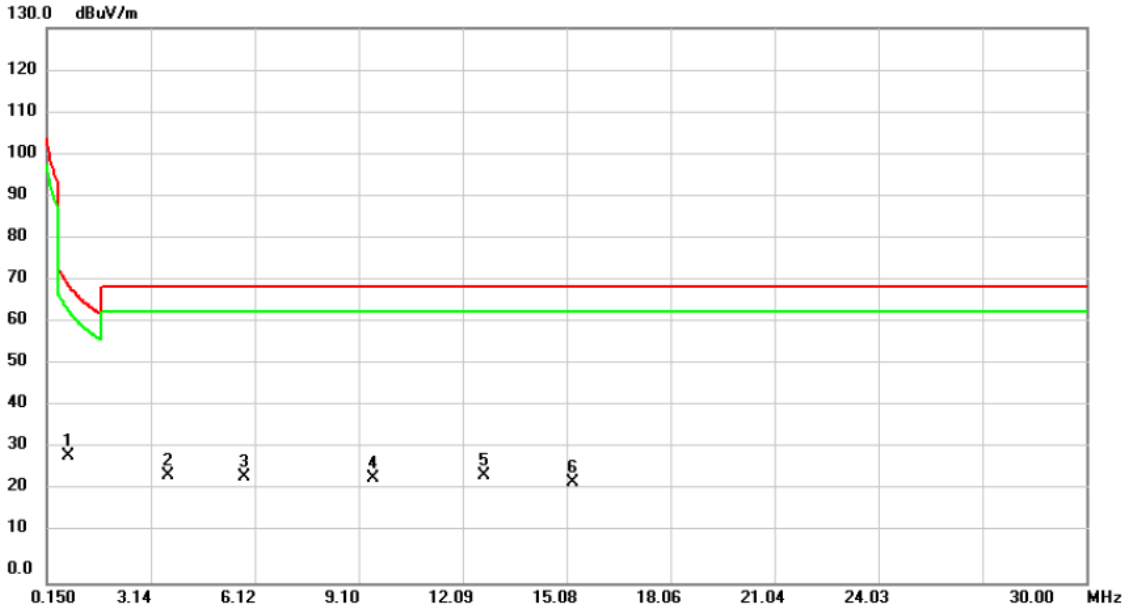
Ant 90°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	0.0851	11.79	17.75	29.54	109.01	-79.47	peak	

Test Mode:	TX Mode 2402MHz _CH00_1Mbps

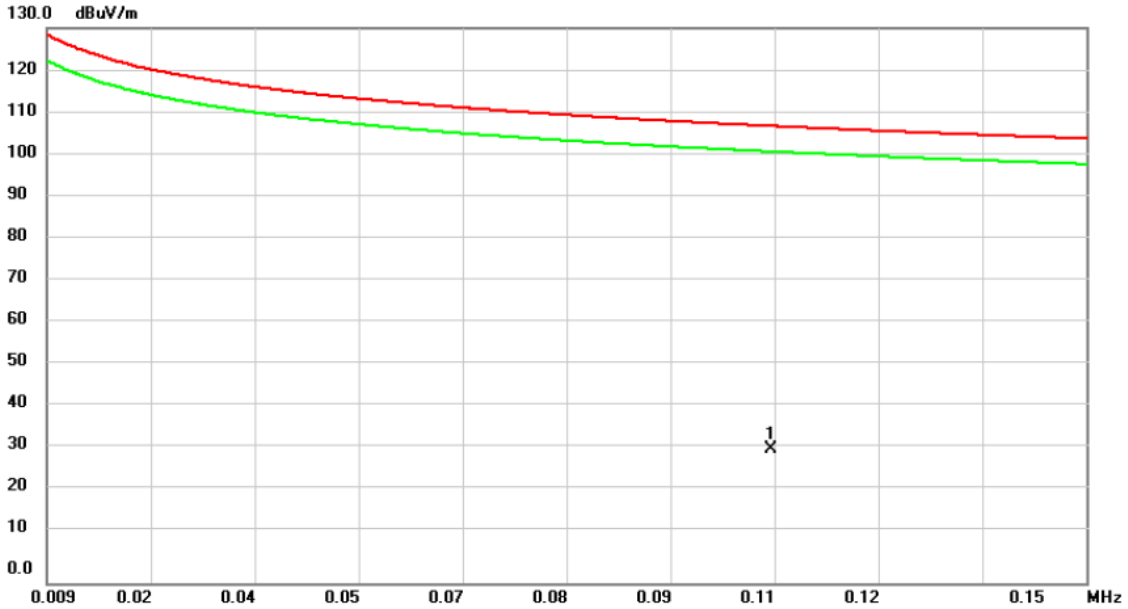
Ant 90°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	0.7867	28.99	0.64	29.63	69.69	-40.06	peak	
2		3.6126	29.00	-3.74	25.26	69.54	-44.28	peak	
3		5.8016	28.97	-4.01	24.96	69.54	-44.58	peak	
4		9.5030	29.23	-4.71	24.52	69.54	-45.02	peak	
5		12.6870	30.13	-4.82	25.31	69.54	-44.23	peak	
6		15.2342	28.51	-5.10	23.41	69.54	-46.13	peak	

Test Mode:	TX Mode 2402MHz _CH00_1Mbps

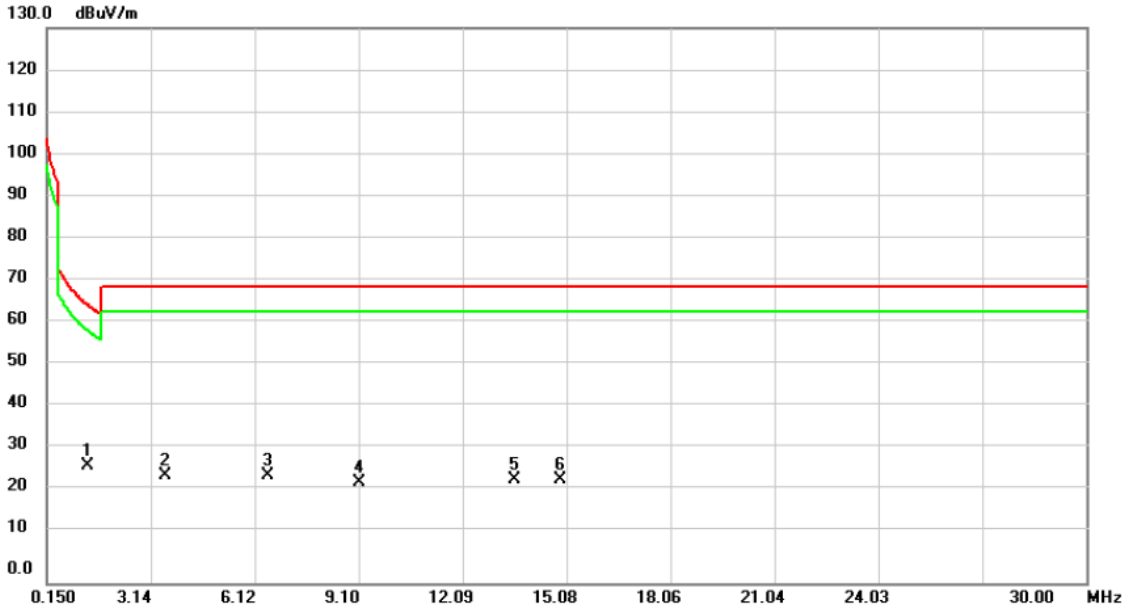
Ant 0°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	0.1073	15.74	15.62	31.36	106.99	-75.63	peak	

Test Mode:	TX Mode 2402MHz _CH00_1Mbps

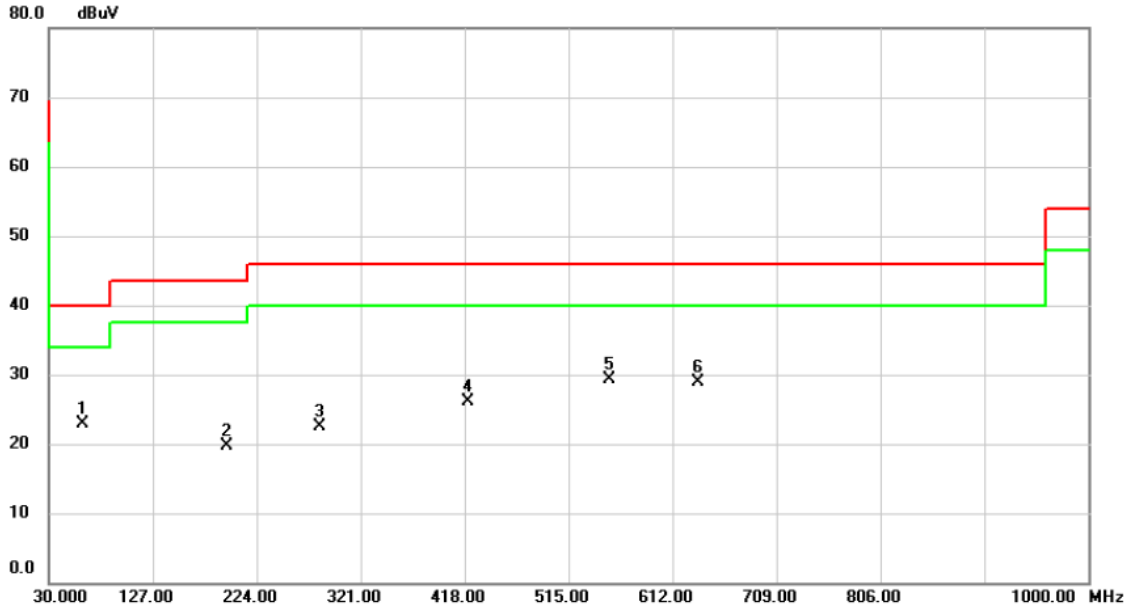
Ant 0°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	1.3042	28.53	-1.14	27.39	65.30	-37.91	peak	
2		3.5330	28.79	-3.73	25.06	69.54	-44.48	peak	
3		6.4782	29.30	-4.07	25.23	69.54	-44.31	peak	
4		9.1050	28.14	-4.71	23.43	69.54	-46.11	peak	
5		13.5626	29.13	-4.82	24.31	69.54	-45.23	peak	
6		14.8760	29.14	-5.00	24.14	69.54	-45.40	peak	

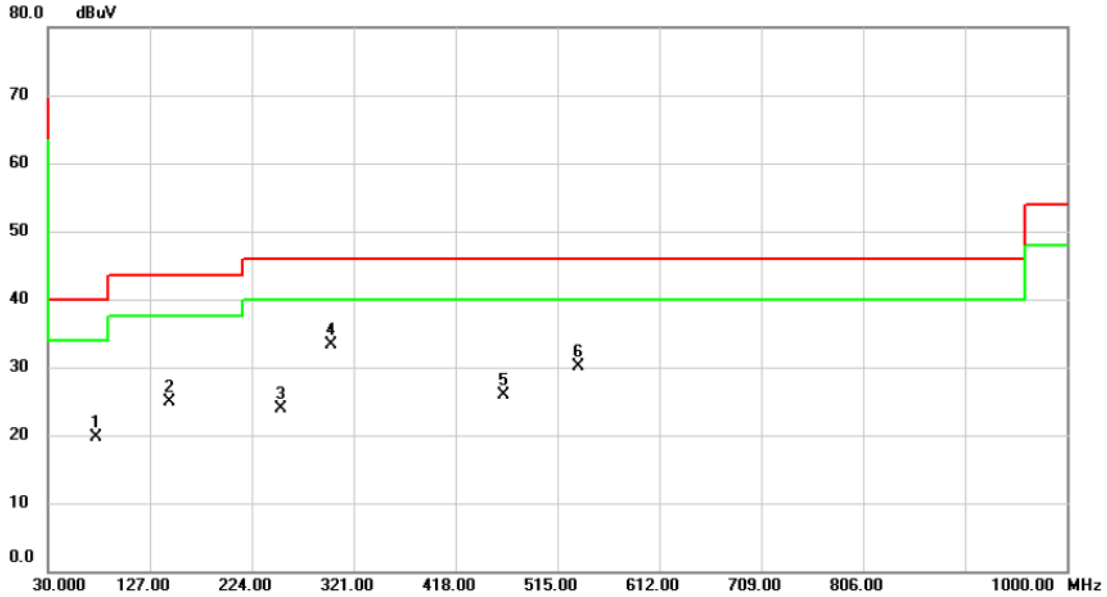
APPENDIX C - RADIATED EMISSION (30MHZ TO 1000MHZ)

Test Mode	TX Mode 2402MHz _CH00_1Mbps	Polarization	Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		62.3333	32.14	-9.17	22.97	40.00	-17.03	peak	
2		195.5467	30.58	-10.86	19.72	43.50	-23.78	peak	
3		283.4932	30.22	-7.78	22.44	46.00	-23.56	peak	
4		420.5867	30.57	-4.55	26.02	46.00	-19.98	peak	
5	*	553.8000	31.26	-1.89	29.37	46.00	-16.63	peak	
6		636.5732	28.85	0.02	28.87	46.00	-17.13	peak	

Test Mode	TX Mode 2402MHz _CH00_1Mbps	Polarization	Horizontal

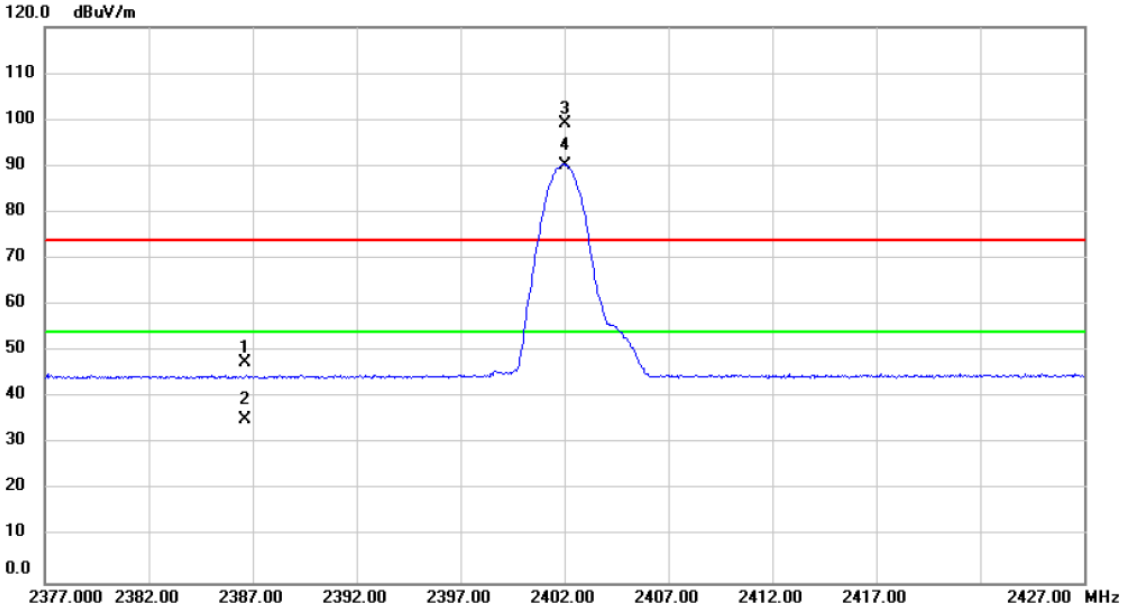


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		75.2667	31.44	-11.66	19.78	40.00	-20.22	peak	
2		145.1067	33.63	-8.72	24.91	43.50	-18.59	peak	
3		252.4533	33.01	-9.01	24.00	46.00	-22.00	peak	
4	*	299.6600	40.76	-7.52	33.24	46.00	-12.76	peak	
5		463.2667	29.50	-3.57	25.93	46.00	-20.07	peak	
6		534.4000	32.31	-2.30	30.01	46.00	-15.99	peak	

APPENDIX D - RADIATED EMISSION (ABOVE 1000MHZ)

Test Mode	TX Mode 2402MHz _CH00_1Mbps	Polarization	Vertical

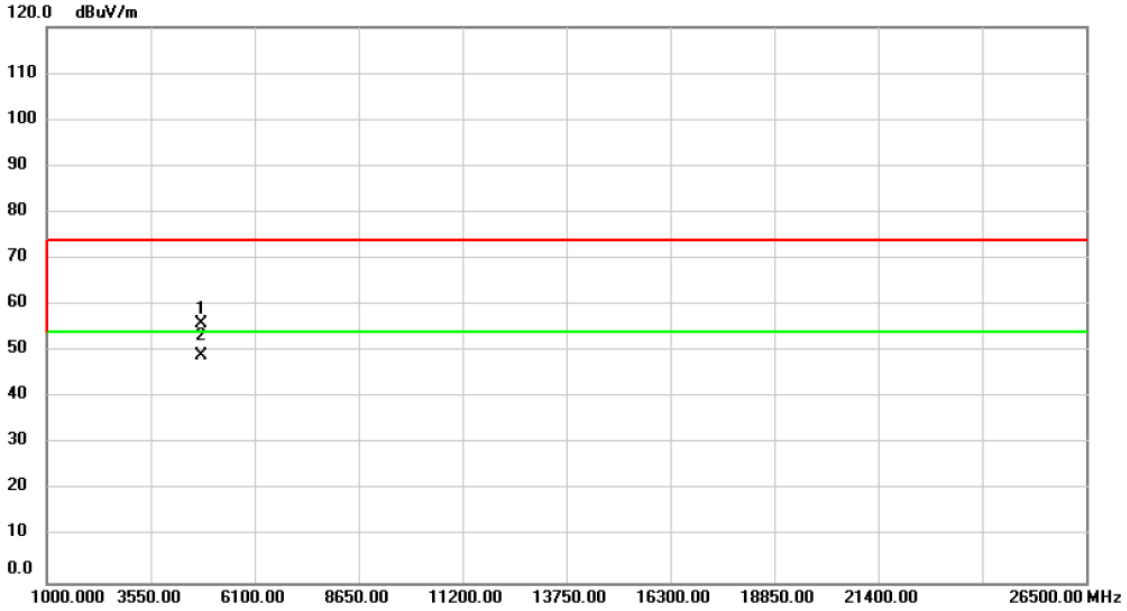
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		2386.659	16.84	30.83	47.67	74.00	-26.33	peak	
2		2386.659	4.45	30.83	35.28	54.00	-18.72	AVG	
3	X	2402.000	68.32	30.89	99.21	74.00	25.21	peak	No Limit
4	*	2402.000	59.41	30.89	90.30	54.00	36.30	AVG	No Limit

Test Mode	TX Mode 2402MHz _CH00_1Mbps	Polarization	Vertical

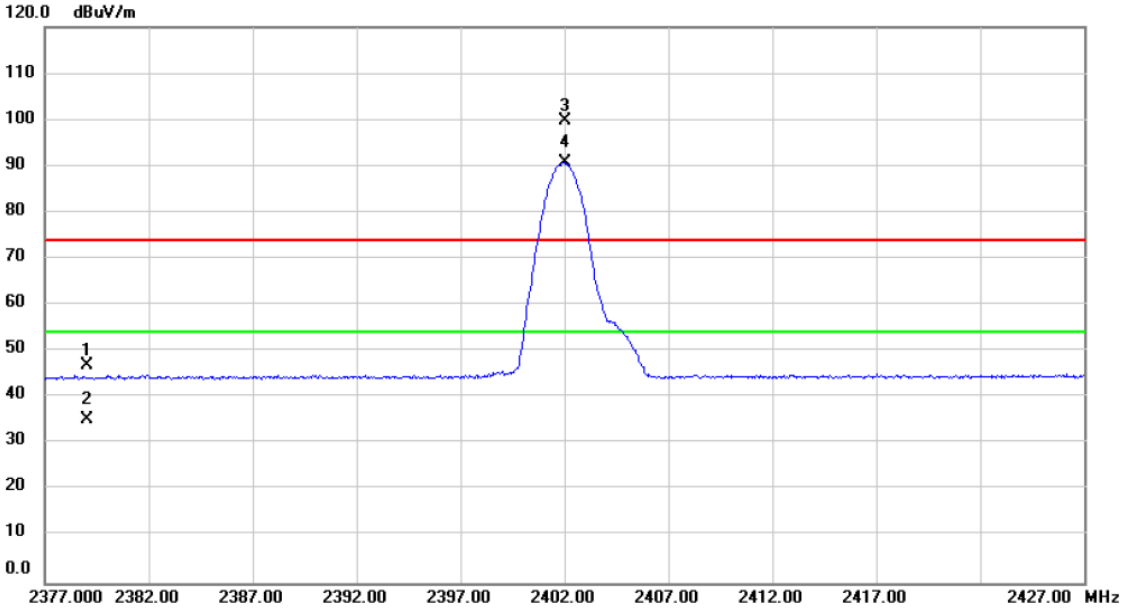
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4804.000	67.56	-11.49	56.07	74.00	-17.93	peak	
2	*	4804.000	60.62	-11.49	49.13	54.00	-4.87	AVG	

Test Mode	TX Mode 2402MHz _CH00_1Mbps	Polarization	Horizontal

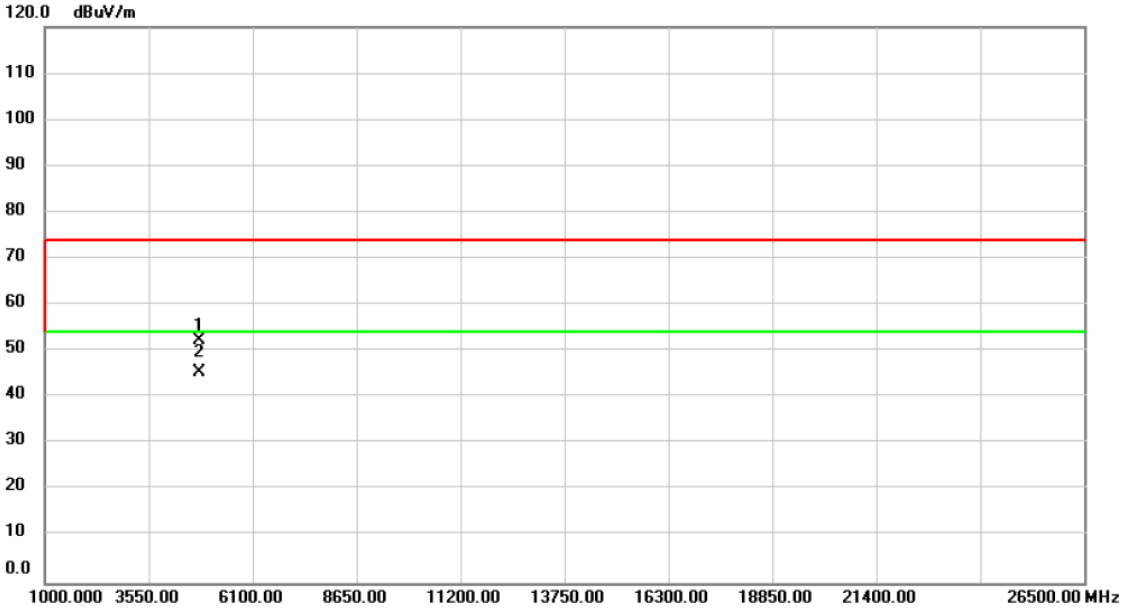
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		2379.015	16.05	30.81	46.86	74.00	-27.14	peak	
2		2379.015	4.36	30.81	35.17	54.00	-18.83	AVG	
3	X	2402.000	68.72	30.89	99.61	74.00	25.61	peak	No Limit
4	*	2402.000	59.76	30.89	90.65	54.00	36.65	AVG	No Limit

Test Mode	TX Mode 2402MHz _CH00_1Mbps	Polarization	Horizontal

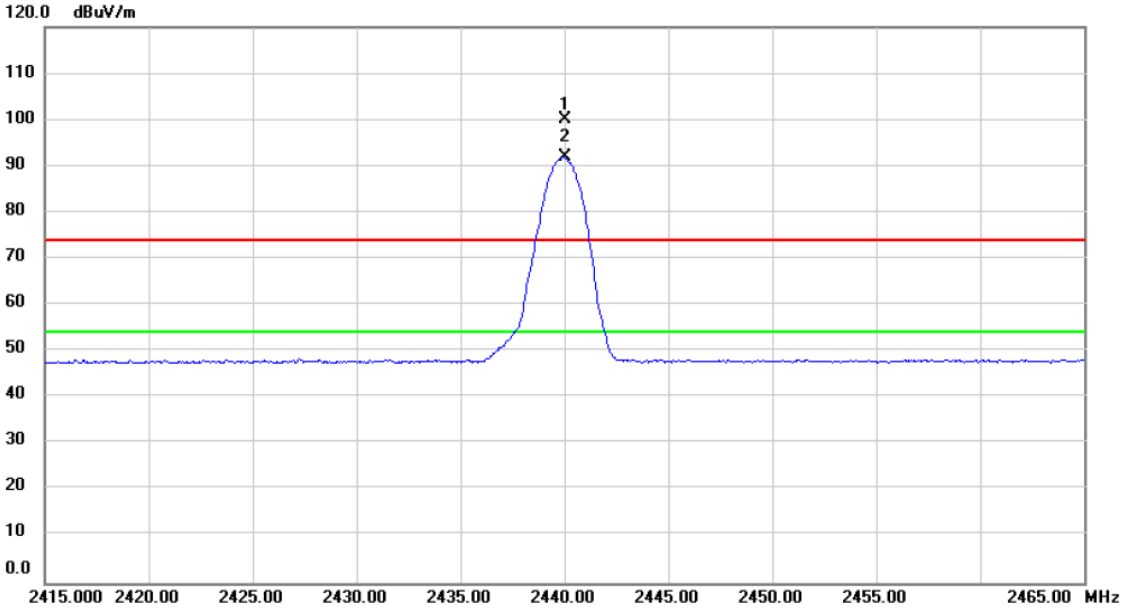
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4804.000	63.81	-11.49	52.32	74.00	-21.68	peak	
2	*	4804.000	56.82	-11.49	45.33	54.00	-8.67	AVG	

Test Mode	TX Mode 2440MHz _CH19_1Mbps	Polarization	Vertical

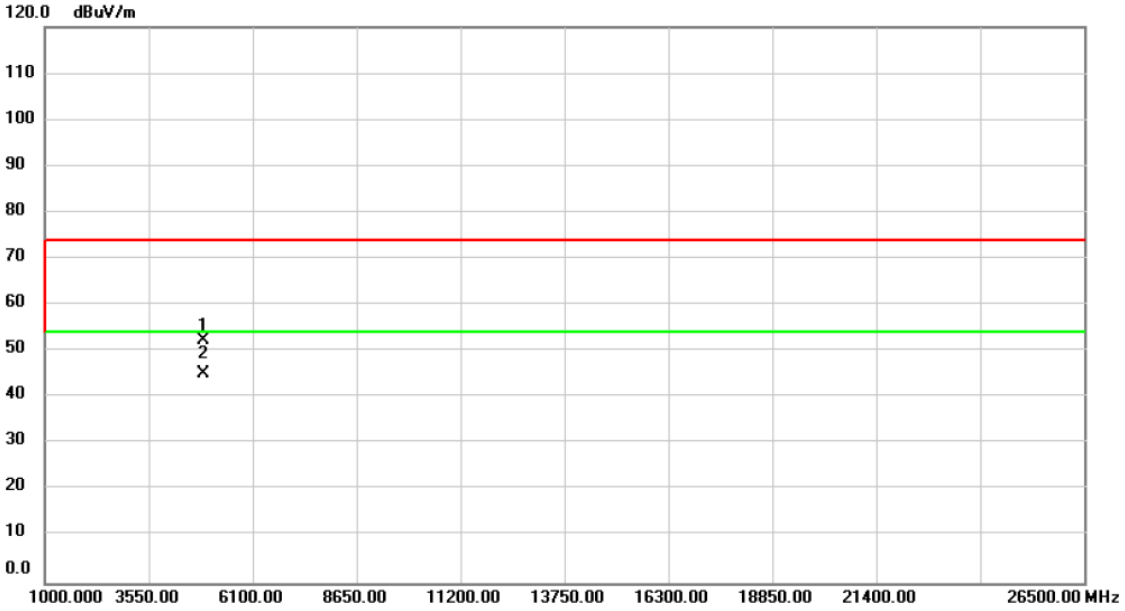
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	X	2440.000	69.05	31.02	100.07	74.00	26.07	peak	No Limit
2	*	2440.000	60.83	31.02	91.85	54.00	37.85	AVG	No Limit

Test Mode	TX Mode 2440MHz _CH19_1Mbps	Polarization	Vertical

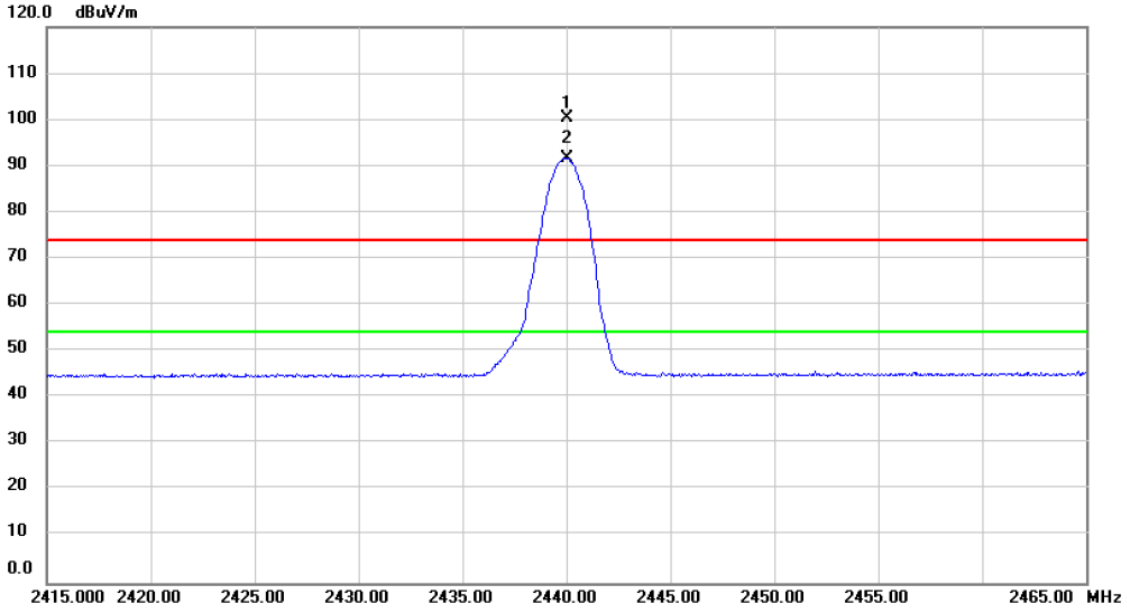
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4880.000	63.67	-11.42	52.25	74.00	-21.75	peak	
2	*	4880.000	56.64	-11.42	45.22	54.00	-8.78	AVG	

Test Mode	TX Mode 2440MHz _CH19_1Mbps	Polarization	Horizontal

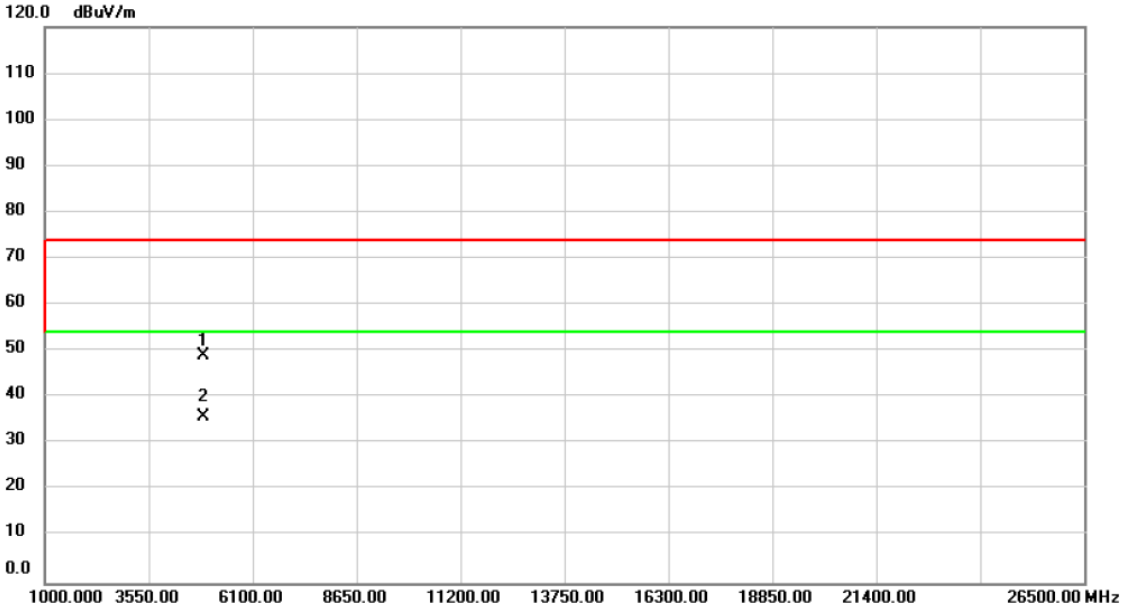
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	X	2440.000	69.48	31.02	100.50	74.00	26.50	peak	No Limit
2	*	2440.000	60.61	31.02	91.63	54.00	37.63	AVG	No Limit

Test Mode	TX Mode 2440MHz _CH19_1Mbps	Polarization	Horizontal

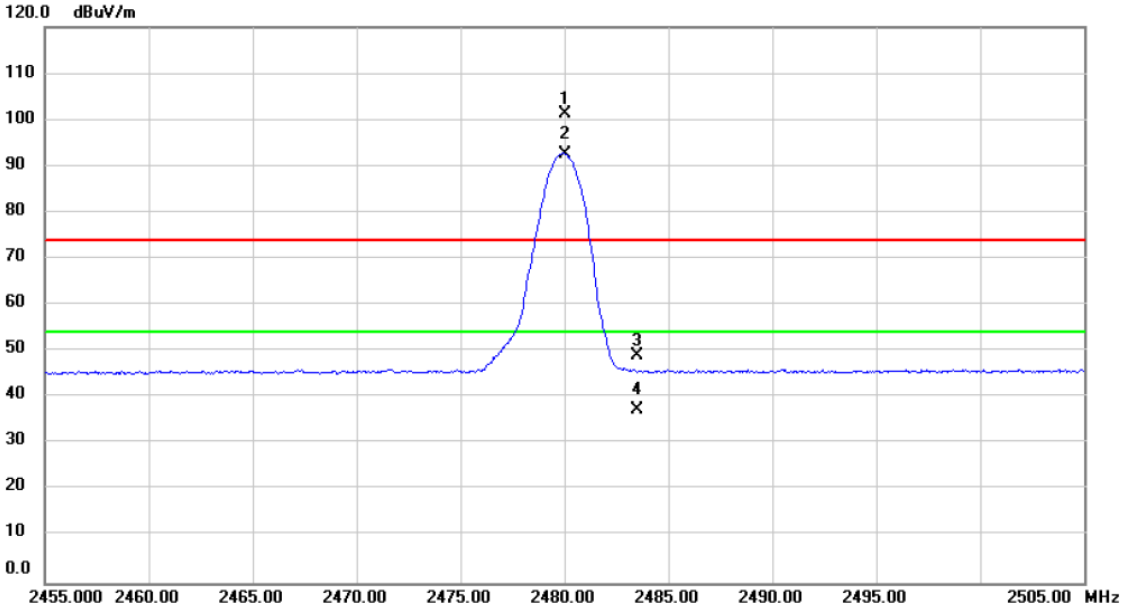
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4880.000	60.41	-11.42	48.99	74.00	-25.01	peak	
2	*	4880.000	47.31	-11.42	35.89	54.00	-18.11	AVG	

Test Mode	TX Mode 2480MHz _CH39_1Mbps	Polarization	Vertical

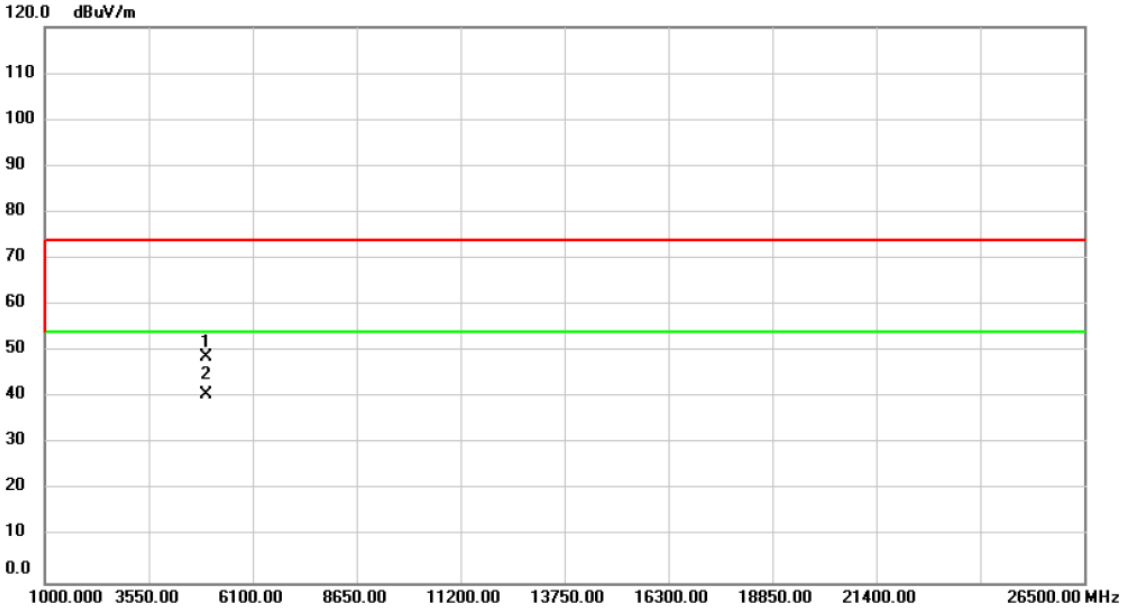
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	X	2480.000	70.20	31.16	101.36	74.00	27.36	peak	No Limit
2	*	2480.000	61.54	31.16	92.70	54.00	38.70	AVG	No Limit
3		2483.517	17.92	31.17	49.09	74.00	-24.91	peak	
4		2483.517	6.09	31.17	37.26	54.00	-16.74	AVG	

Test Mode	TX Mode 2480MHz _CH39_1Mbps	Polarization	Vertical

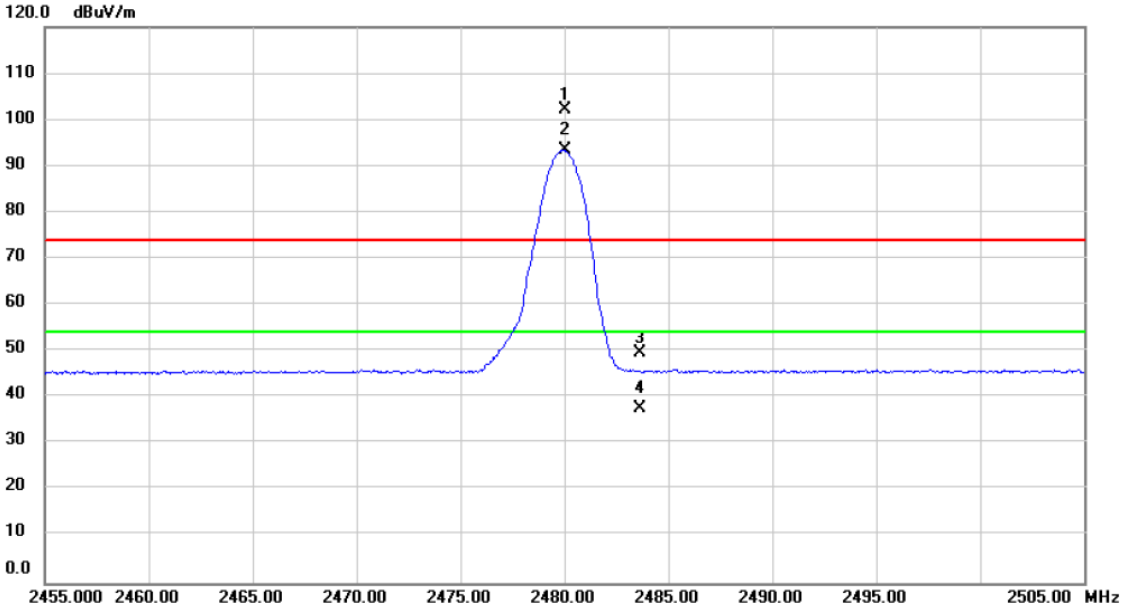
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4960.000	59.96	-11.33	48.63	74.00	-25.37	peak	
2	*	4960.000	52.06	-11.33	40.73	54.00	-13.27	AVG	

Test Mode	TX Mode 2480MHz _CH39_1Mbps	Polarization	Horizontal

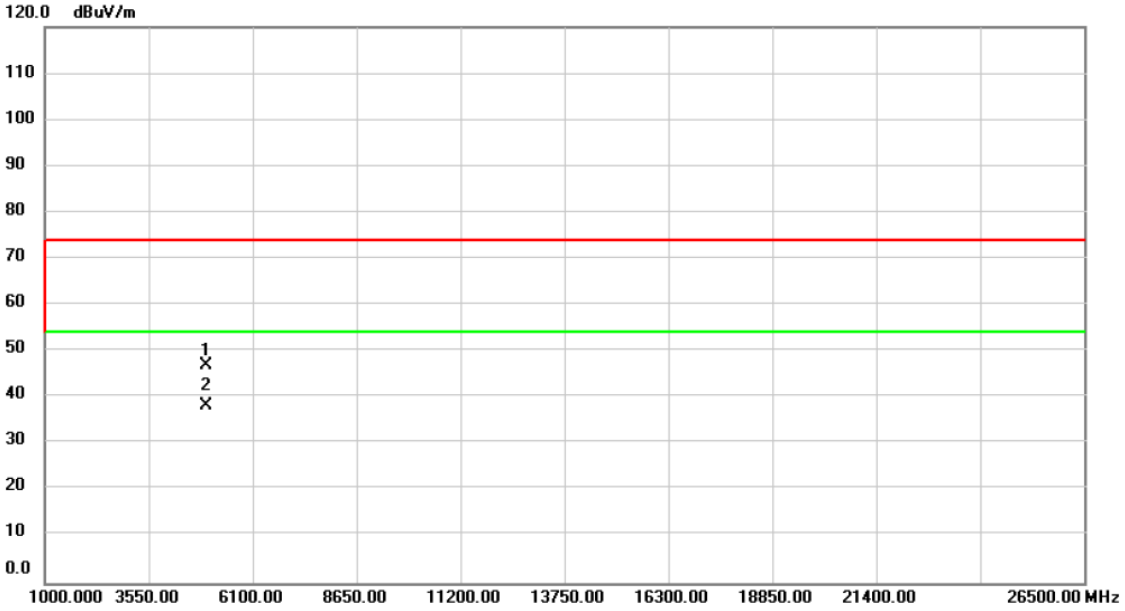
Orthogonal Axis: X



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	X	2480.000	70.91	31.16	102.07	74.00	28.07	peak	No Limit
2	*	2480.000	62.25	31.16	93.41	54.00	39.41	AVG	No Limit
3		2483.615	18.35	31.17	49.52	74.00	-24.48	peak	
4		2483.615	6.50	31.17	37.67	54.00	-16.33	AVG	

Test Mode	TX Mode 2480MHz _CH39_1Mbps	Polarization	Horizontal

Orthogonal Axis: X

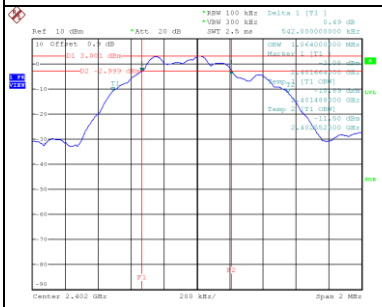
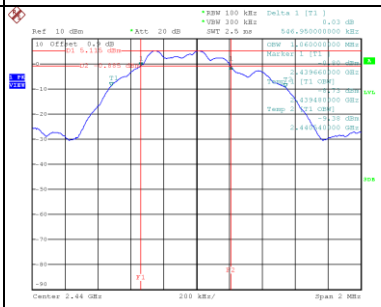
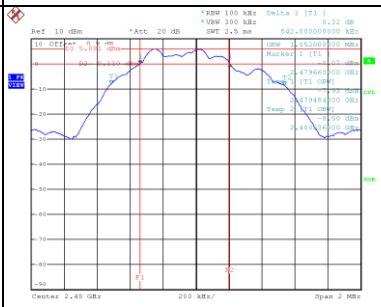


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4960.000	58.30	-11.33	46.97	74.00	-27.03	peak	
2	*	4960.000	49.46	-11.33	38.13	54.00	-15.87	AVG	

APPENDIX E - BANDWIDTH

Test Mode:	TX Mode 2402MHz/2440MHz/2480MHz_1Mbps

Frequency (MHz)	6dB Bandwidth (MHz)	99% Occupied BW (MHz)	Min. Limit (kHz)	Test Result
2402	0.54	1.06	500	Pass
2440	0.55	1.06	500	Pass
2480	0.54	1.05	500	Pass

2402 MHz	2440 MHz	2480 MHz
		

APPENDIX F - MAXIMUM OUTPUT POWER TEST

Test Mode :	TX Mode 2402MHz/2440MHz/2480MHz_1Mbps

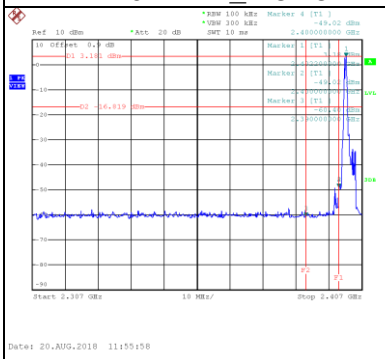
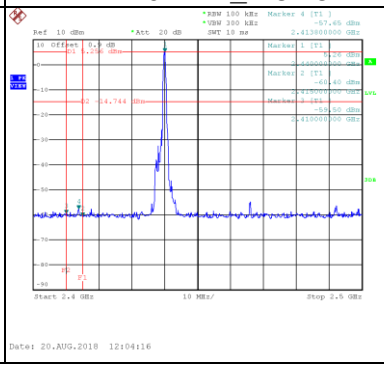
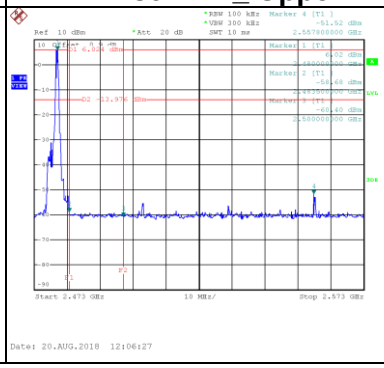
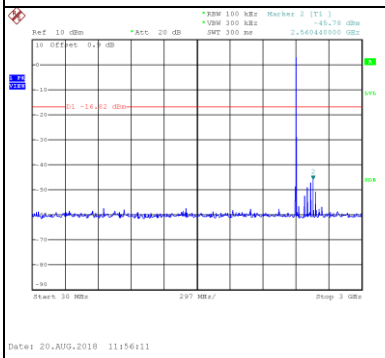
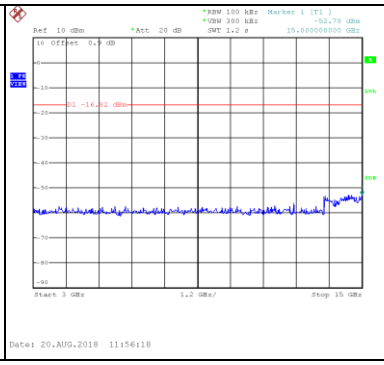
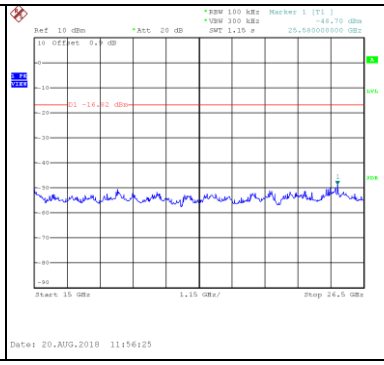
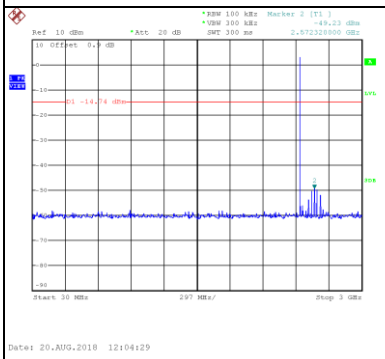
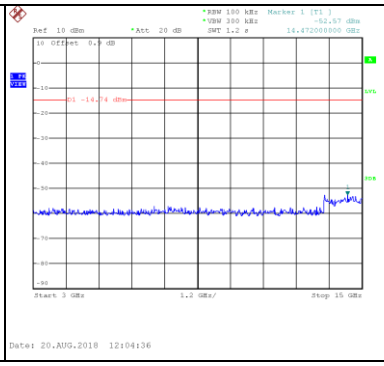
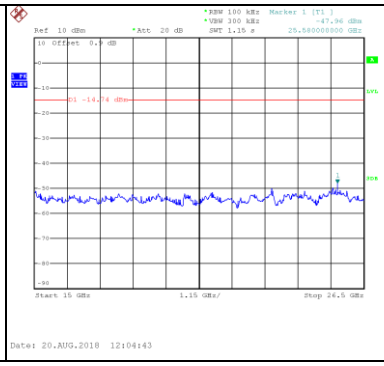
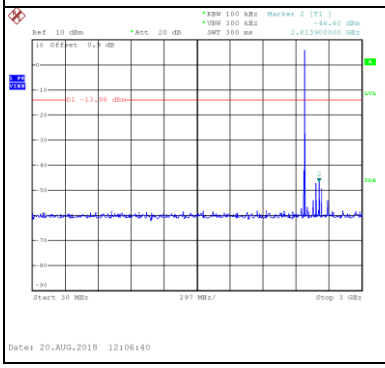
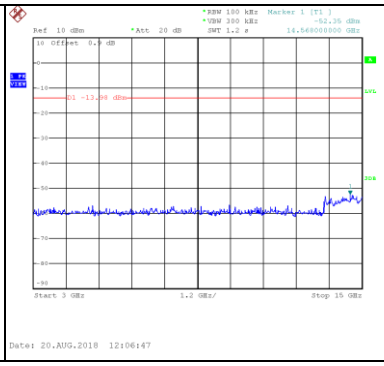
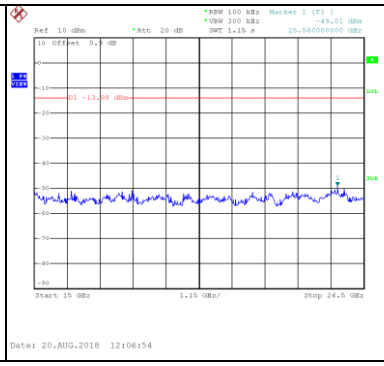
Frequency (MHz)	Conducted Power (dBm)	Conducted Power (W)	Max. Limit (dBm)	Max. Limit (W)	Test Result
2402	3.80	0.0024	30.00	1.00	Pass
2440	5.28	0.0034	30.00	1.00	Pass
2480	6.15	0.0041	30.00	1.00	Pass

Test Mode :	TX Mode 2402MHz/2440MHz/2480MHz_1Mbps

Frequency (MHz)	Average Power (dBm)	Average Power (W)	Max. Limit (dBm)	Max. Limit (W)	Test Result
2402	3.37	0.0022	30.00	1.00	Pass
2440	4.95	0.0031	30.00	1.00	Pass
2480	5.84	0.0038	30.00	1.00	Pass

APPENDIX G - ANTENNA CONDUCTED SPURIOUS EMISSION

Test Mode :	TX Mode 2402MHz/2440MHz/2480MHz_1Mbps

2402 MHz_ Lower	2440 MHz_ Lower	2480 MHz_ Upper
		
2402 MHz – 10 Harmonics		
		
2440 MHz – 10 Harmonics		
		
2480 MHz – 10 Harmonics		
		

APPENDIX H - POWER SPECTRAL DENSITY TEST

Test Mode:	TX Mode 2402MHz/2440MHz/2480MHz_1Mbps

Frequency (MHz)	Power Density (dBm/3kHz)	Max. Limit (dBm/3kHz)	Test Result
2402	-15.40	8.00	Pass
2440	-13.42	8.00	Pass
2480	-12.61	8.00	Pass

2402 MHz	2440 MHz	2480 MHz