FCC Radio Test Report

FCC ID:2AP8HEMK

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

Project No.	:	1806C077
Equipment	:	eMark Pen
Test Model	:	EMK-P1
Series Model	:	N/A
Applicant	:	KOGA TOUCH CO., LTD
Address	:	5F, No.21 Huiguan Building, No.10 Xibeiwang East Road,Haidian District,Beijing,China

Date of Receipt	:	Jun. 14, 2018
Date of Test	:	Jul. 16, 2018 ~ Jul. 23, 2018
Issued Date	:	Sep. 19, 2018
Tested by	:	BTL Inc.

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NVLAP® TESTING NVLAP LAB CODE 200788-0

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.

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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-1-1806C077	Original Issue.	Sep. 19, 2018

1. CERTIFICATION

Equipment	:	eMark Pen
Brand Name	:	KOGA,eMark
Test Model	:	EMK-P1
Series Model	:	N/A
Applicant	:	KOGA TOUCH CO., LTD
Manufacturer	:	KOGA TOUCH CO., LTD
Address	:	5F, No.21 Huiguan Building,No.10 Xibeiwang East Road,Haidian District, Beijing,China
Date of Test	:	Jul. 16, 2018 ~ Jul. 23, 2018
Test Sample	:	Engineering Sample No.:D180705767 for radiated, No.:D180705768 for conducted.
Standard(s)	:	FCC Part15, Subpart C (15.247) ANSI C63.10-2013

The above equipment has been tested and found 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-1-1806C077) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of NVLAP according to the ISO-17025 quality assessment standard and technical standard(s).

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 is at the location of No.3, Jinshagang 1st Road, Shixia, Dalang Town, Dongguan, Guangdong, China.
BTL's test firm number for FCC: 854385
BTL's designation number for FCC: CN5020

2.2 MEASUREMENT UNCERTAINTY

The measurement uncertainty figures shall be calculated according the methods described in the ETSI TR 100 028 and shall correspond to an expansion factor (coverage factor) k=1.96 or k=2(which provide confidence levels of respectively 90% and 95.45% in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)). Measurement Uncertainty for a Level of Confidence of 95 %, U=2xUc(y).

The BTL measurement uncertainty as below table:

A. Conducted Measurement:

Test Site	Method	Measurement Frequency Range	U, (dB)
DG-C02	CISPR	150 KHz ~ 30MHz	2.32

B. Radiated Measurement:

Test Site	Method	Measurement Frequency Range	Ant. H / V	U, (dB)
DG-CB03	CISPR	9KHz~30MHz	V	3.79
		9KHz~30MHz	H	3.57
		30MHz ~ 200MHz	V	3.82
		30MHz ~ 200MHz	H	3.78
		200MHz ~ 1,000MHz	V	4.10
		200MHz ~ 1,000MHz	H	4.06
		1GHz~18GHz	V	3.12
		1GHz~18GHz	H	3.68
		18GHz~40GHz	V	4.15
		18GHz~40GHz	H	4.14

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	eMark Pen	
Brand Name	KOGA,eMark	
Test Model	EMK-P1	
Series Model	N/A	
Model Difference	N/A	
Product Description	Operation Frequency	2402~2480 MHz
	Modulation Technology	GFSK(1Mbps)
	Bit Rate of Transmitter	
	Output Power (Max.)	4.45 dBm
Power Source	For eMark Pen(EUT): 1# Supplied from battery. 2# Supplied from base. For base(EUT): 1# Supplied from Mirco-USB port.	
Power Rating	For eMark Pen(EUT): 1# DC 3.7V 400mAh 1.48Wh 2# 100-240V~ 50/60Hz For base(EUT): 100-240V~ 50/60Hz	

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	Model Name	Antenna Type	Connector	Gain (dBi)
1	TDK	N/A	Chip	N/A	2.3

3.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	TX Mode **NOTE (1)**

The EUT system operated these modes were found to be the worst case during the pre-scanning test as following:

For Conducted Test	
Final Test Mode	Description
Mode 1	TX Mode

For Radiated Test	
Final Test Mode	Description
Mode 1	TX Mode **NOTE (1)**

Note:

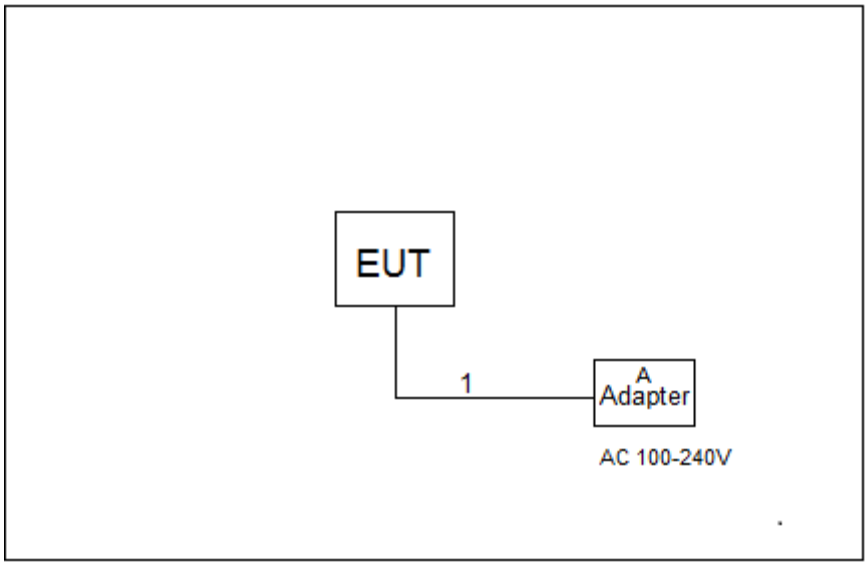
(1) The measurements are performed at the high, middle, low available channels.

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	N/A	N/A	N/A

3.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



3.5 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	Adapter	N/A	GAT-0501000	N/A	N/A

Item	Shielded Type	Ferrite Core	Length	Note
1	NO	NO	1.5M	DC Cable

4. EMC EMISSION TEST

4.1 CONDUCTED EMISSION MEASUREMENT

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

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 -0.50	66 to 56*	56 to 46*
0.50 -5.0	56	46
5.0 -30.0	60	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

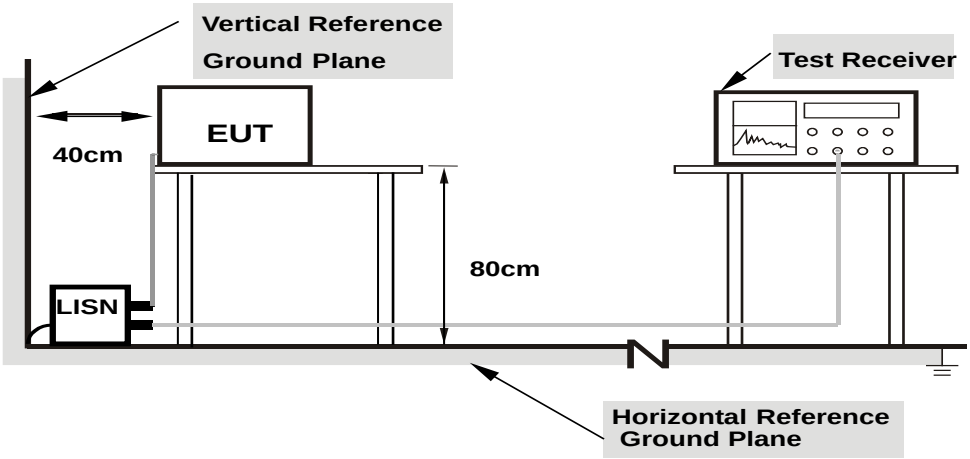
4.1.2 TEST PROCEDURE

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 equipment 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



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

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: 24°C Relative Humidity: 60% 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

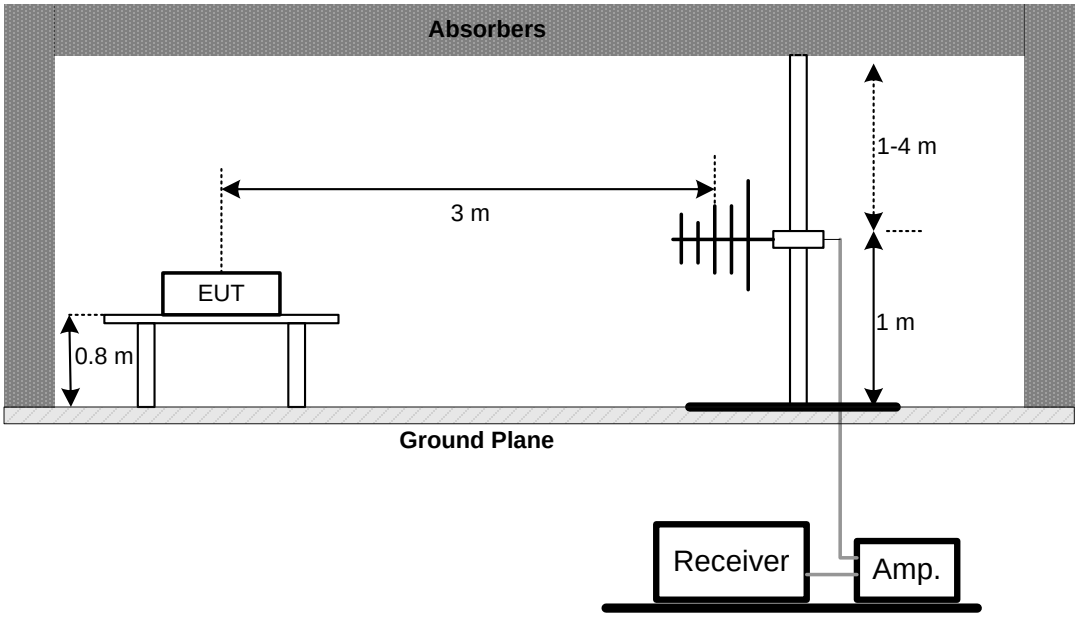
a. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1GHz)
b. The measuring distance 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

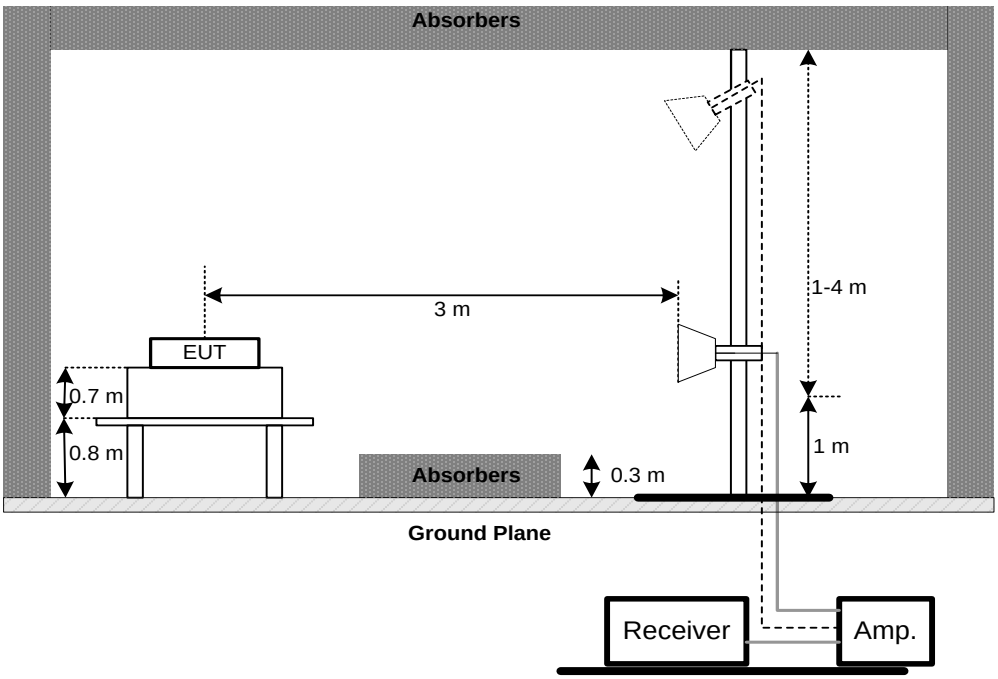
No deviation

4.2.4 TEST SETUP

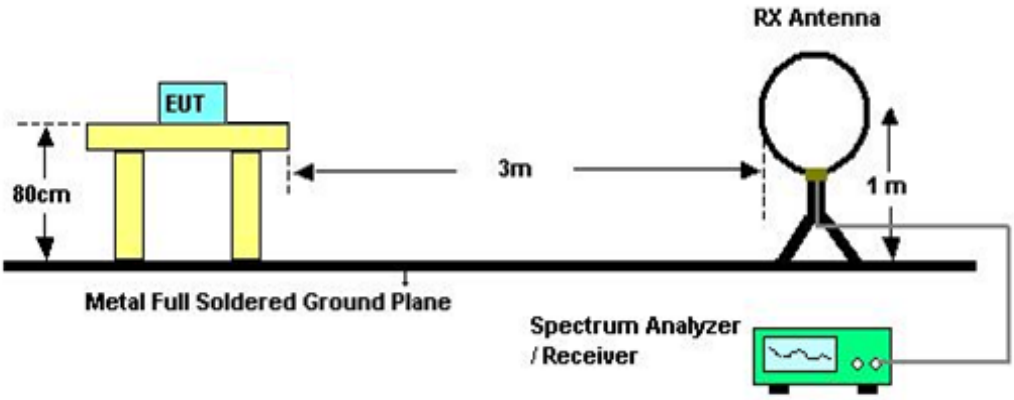
(A) Radiated Emission Test Set-Up Frequency Below 1 GHz



(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: 22°C Relative Humidity: 56% 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.

4.2.8TEST RESULTS (30MHZ TO 1000MHZ)

Please refer to the Appendix C.

4.2.9TEST RESULTS (ABOVE 1000MHZ)

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

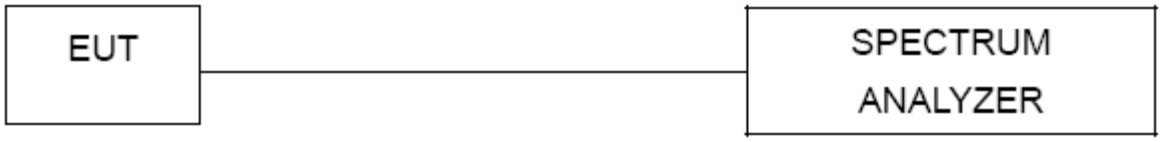
5.1.1 TEST PROCEDURE

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

Temperature: 24°C Relative Humidity: 60% 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

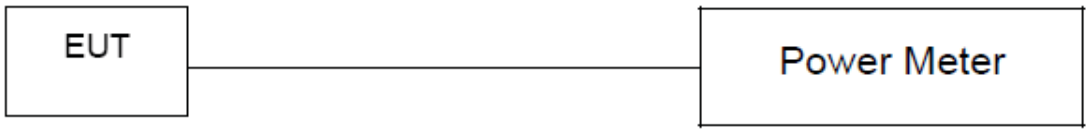
6.1.1 TEST PROCEDURE

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

Temperature: 24°C Relative Humidity: 60% 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.

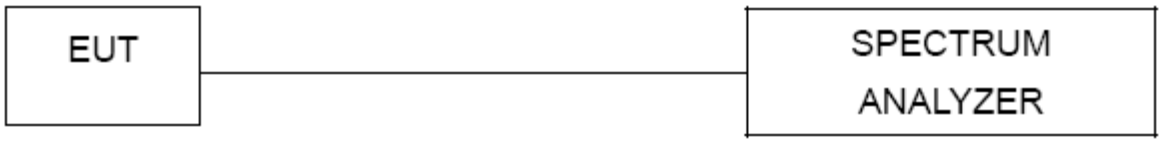
7.1.1 TEST PROCEDURE

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

Temperature: 24°C Relative Humidity: 60% 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

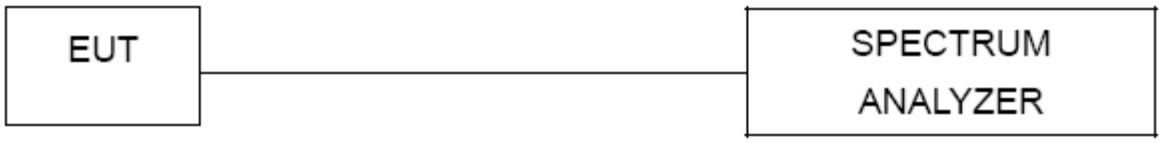
8.1.1 TEST PROCEDURE

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

Temperature: 24°C Relative Humidity: 60% 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	EMI Test Receiver	R&S	ESCI	100382	Mar. 11, 2019
2	LISN	EMCO	3816/2	52765	Mar. 11, 2019
3	50Ω Terminator	SHX	TF2-3G-A	8122901	Mar. 11, 2019
4	TWO-LINE V-NETWORK	R&S	ENV216	101447	Mar. 11, 2019
5	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
6	Cable	N/A	RG223	12m	Oct. 19, 2018

Radiated Emission Measurement - Below 1GHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Antenna	Schwarbeck	VULB9160	9160-3232	Mar. 11, 2019
2	Amplifier	HP	8447D	2944A09673	Oct. 19, 2018
3	Receiver	Agilent	N9038A	MY52130039	Aug. 20, 2018
4	Cable	emci	LMR-400(30MHz-1 GHz)(8m+5m)	N/A	Jun. 26, 2019
5	Controller	CT	SC100	N/A	N/A
6	Controller	MF	MF-7802	MF780208416	N/A
7	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
8	Antenna	EM	EM-6876-1	230	Feb. 07, 2019

Radiated Emission Measurement - Above 1GHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Double Ridged Guide Antenna	ETS	3115	75789	Mar. 11, 2019
2	Broad-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170319	Jun. 30, 2019
3	Amplifier	Agilent	8449B	3008A02274	Mar. 11, 2019
4	Microwave Preamplifier With Adaptor	EMC INSTRUMENT	EMC2654045	980039 & HA01	Mar. 11, 2019
5	Receiver	Agilent	N9038A	MY52130039	Aug. 20, 2018
6	Controller	CT	SC100	N/A	N/A
7	Controller	MF	MF-7802	MF780208416	N/A
8	Cable	emci	EMC104-SM-SM-1 2000(12m)	N/A	Jun. 26, 2019
9	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A

6dB Bandwidth Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 20, 2018

Peak Output Power Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Power Meter	ANRITSU	ML2495A	1128009	Mar. 11, 2019
2	Pulse Power Sensor	ANRITSU	MA 2411B	1027500	Mar. 11, 2019

Antenna Conducted Spurious Emission Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 20, 2018

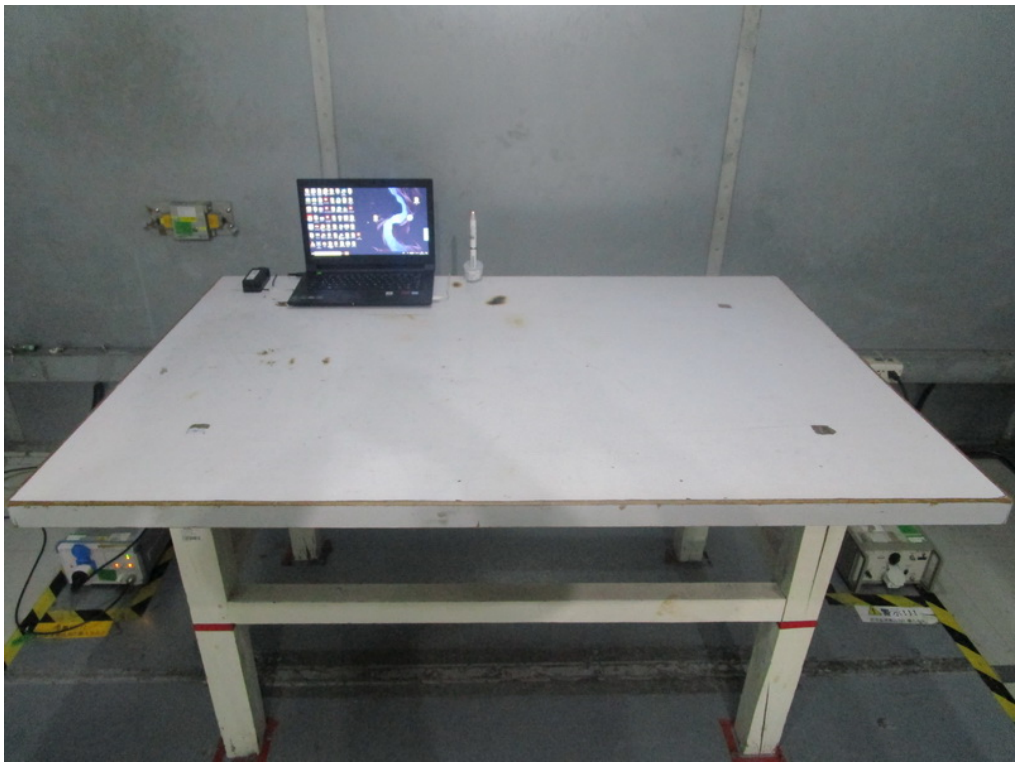
Power Spectral Density Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 20, 2018

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

10. EUT TEST PHOTO

Conducted Measurement Photos

For Notebook



Conducted Measurement Photos

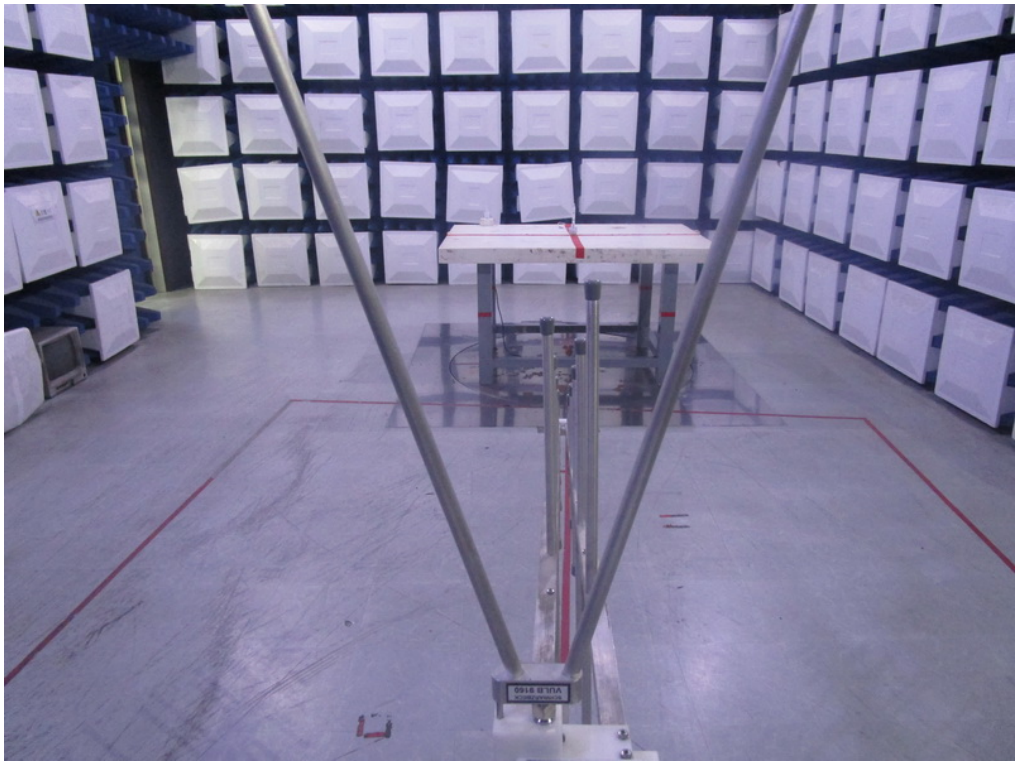
For Adapter

Radiated Measurement Photos

9KHz to 30MHz

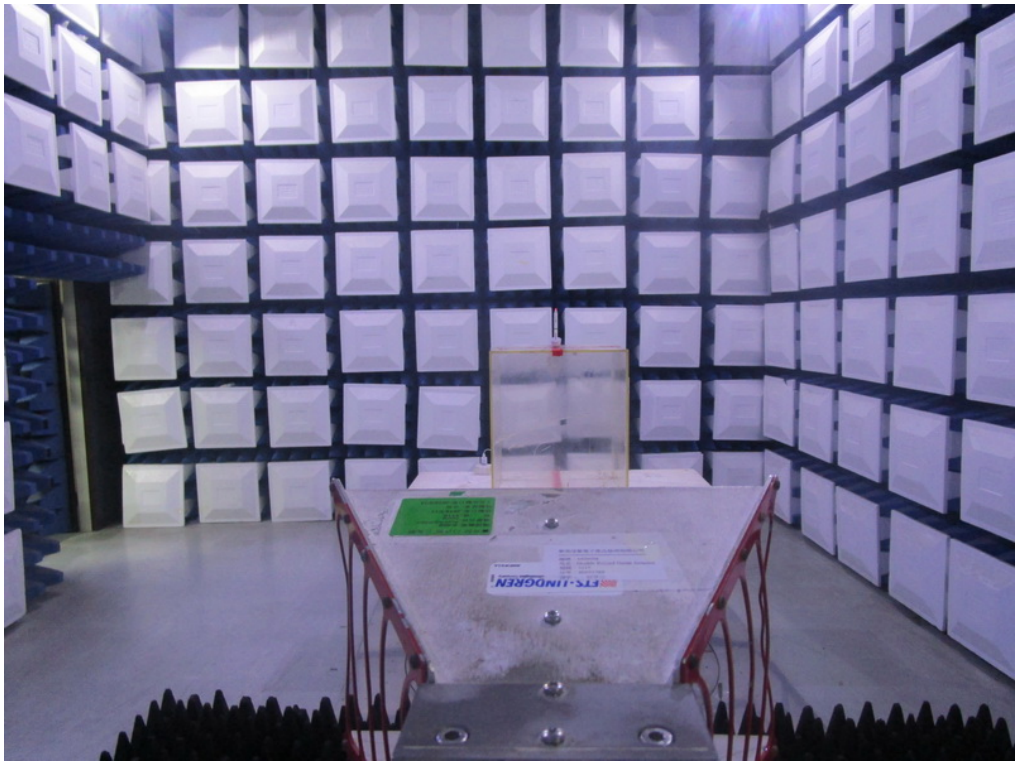
Radiated Measurement Photos

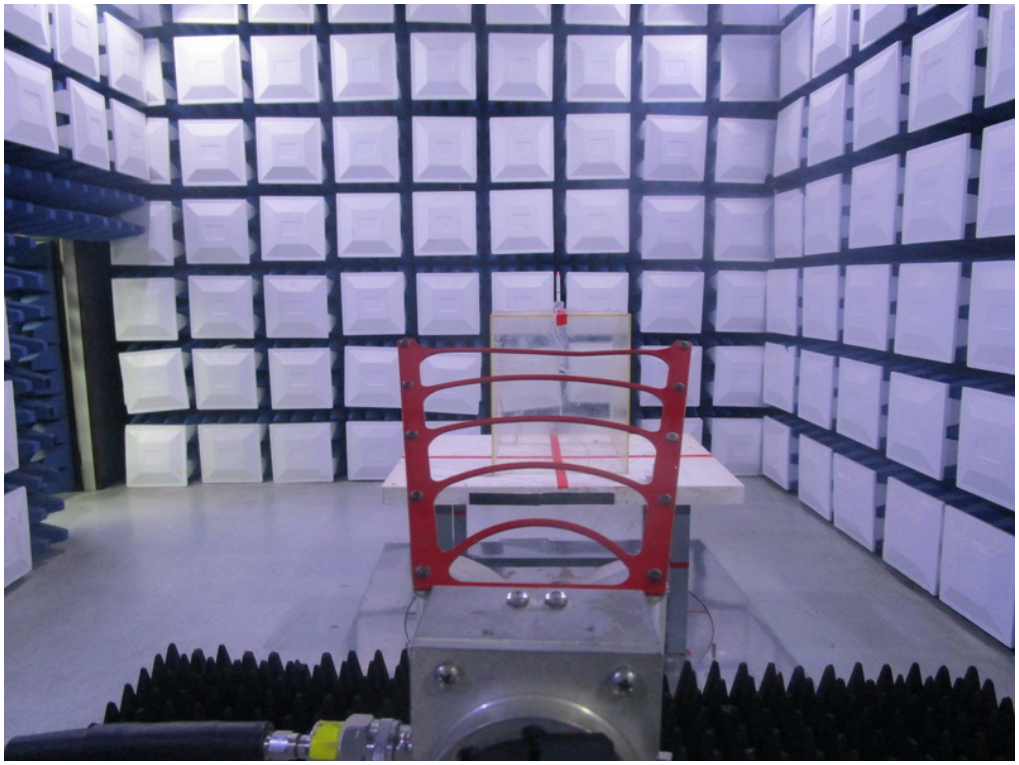
30MHz to 1000MHz



Radiated Measurement Photos

Above 1000MHz

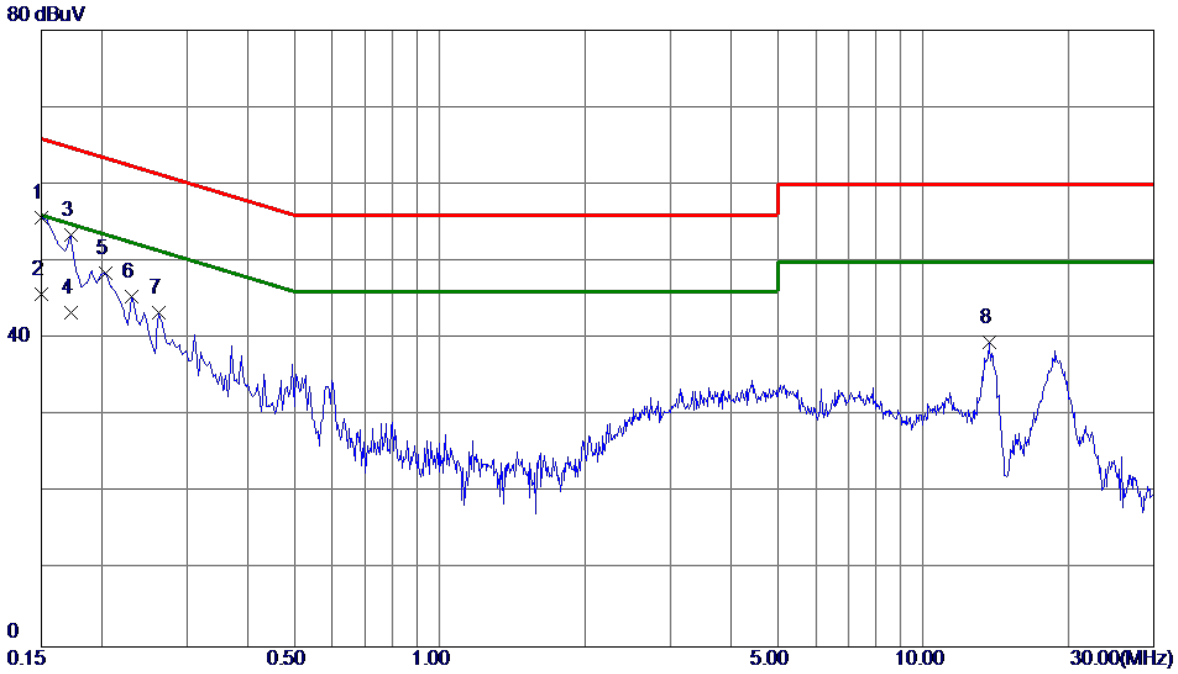




APPENDIX A - CONDUCTED EMISSION

Test Mode:	TX Mode(For Notebook)

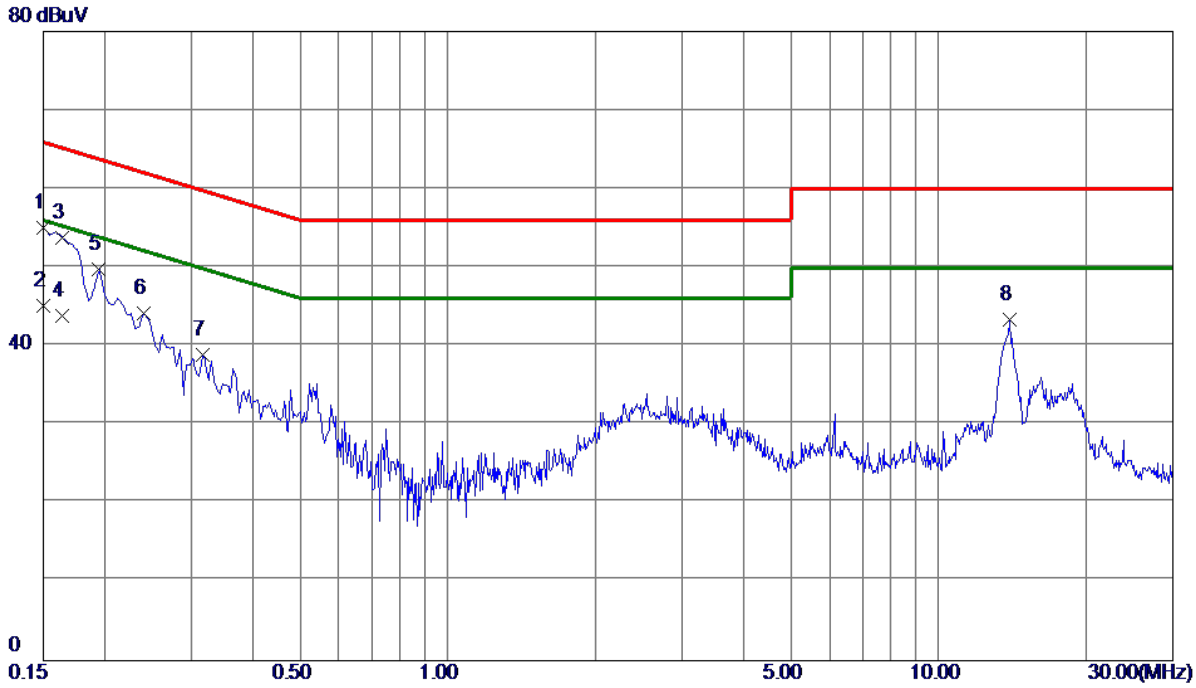
Line



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	0.1500	45.87	9.82	55.69	66.00	-10.31	Peak	
2 *	0.1500	35.90	9.82	45.72	56.00	-10.28	AVG	
3	0.1725	43.59	9.82	53.41	64.84	-11.43	Peak	
4	0.1725	33.60	9.82	43.42	54.84	-11.42	AVG	
5	0.2040	38.69	9.82	48.51	63.45	-14.94	Peak	
6	0.2310	35.65	9.82	45.47	62.41	-16.94	Peak	
7	0.2625	33.52	9.82	43.34	61.35	-18.01	Peak	
8	13.6815	28.89	10.68	39.57	60.00	-20.43	Peak	

Test Mode:	TX Mode(For Notebook)

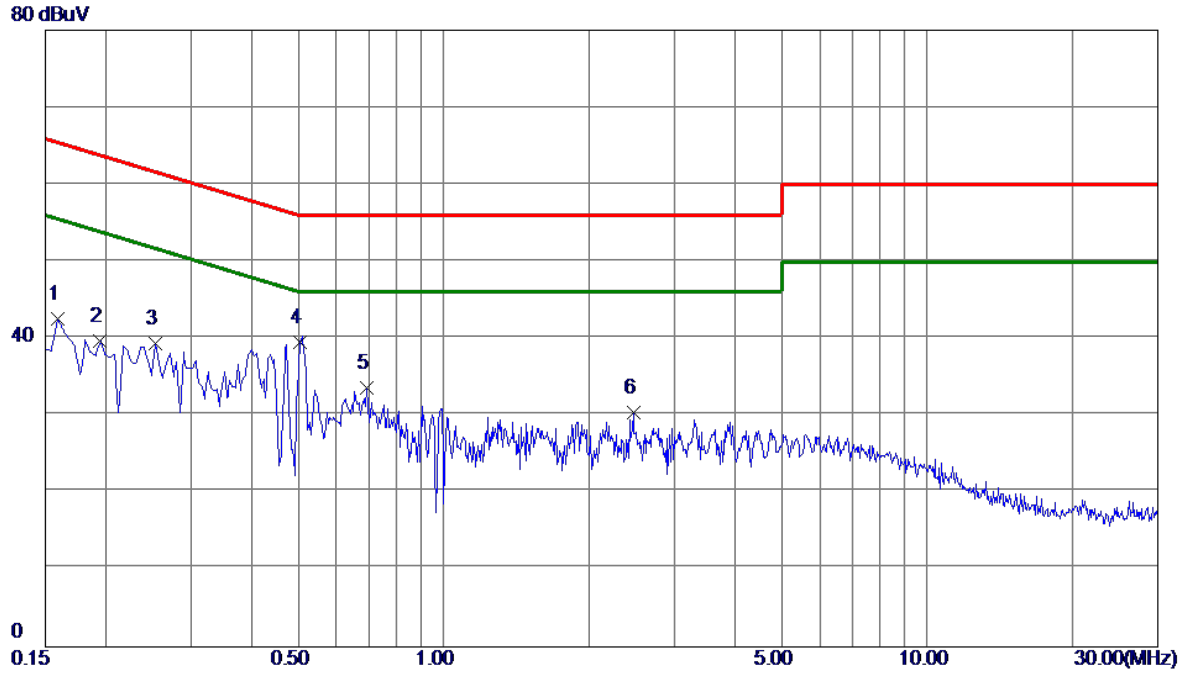
Neutral



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	0.1500	45.12	9.91	55.03	66.00	-10.97	Peak	
2 *	0.1500	35.20	9.91	45.11	56.00	-10.89	AVG	
3	0.1641	43.88	9.91	53.79	65.25	-11.46	Peak	
4	0.1641	33.90	9.91	43.81	55.25	-11.44	AVG	
5	0.1949	39.84	9.91	49.75	63.83	-14.08	Peak	
6	0.2400	34.21	9.92	44.13	62.10	-17.97	Peak	
7	0.3165	28.94	9.94	38.88	59.80	-20.92	Peak	
8	13.9560	32.31	11.02	43.33	60.00	-16.67	Peak	

Test Mode:	TX Mode (For Adapter)

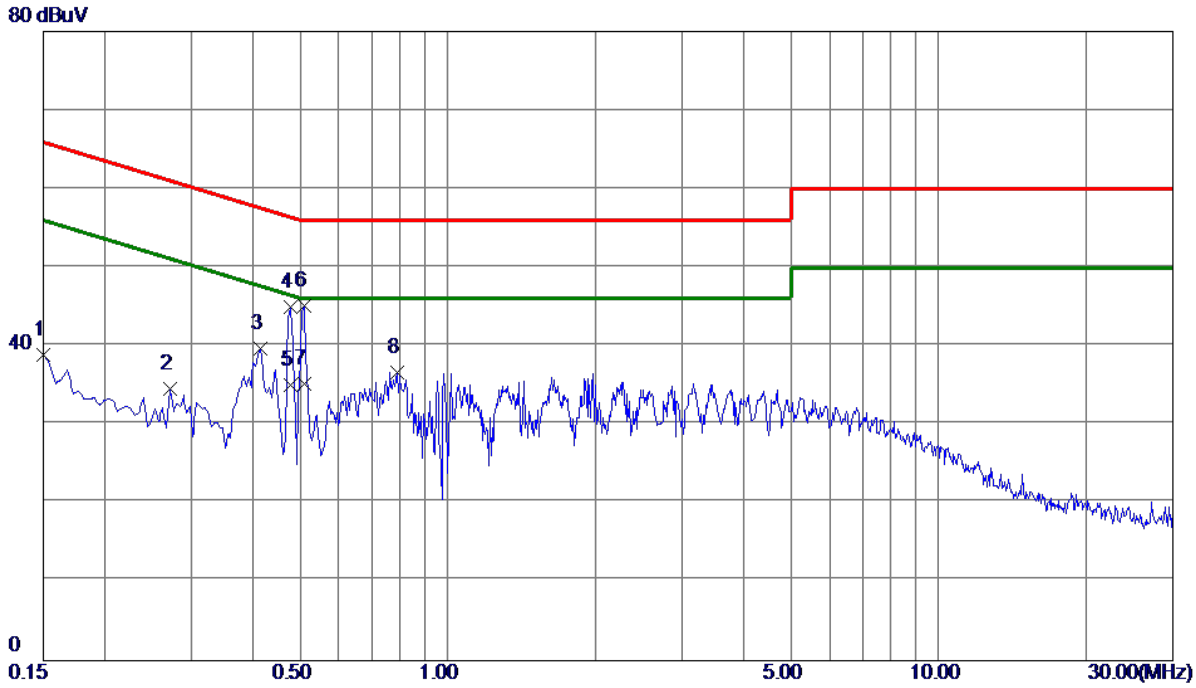
Line



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	0.1590	32.73	9.82	42.55	65.52	-22.97	Peak	
2	0.1949	29.85	9.82	39.67	63.83	-24.16	Peak	
3	0.2535	29.47	9.82	39.29	61.64	-22.35	Peak	
4 *	0.5055	29.66	9.79	39.45	56.00	-16.55	Peak	
5	0.6945	23.70	9.87	33.57	56.00	-22.43	Peak	
6	2.4675	20.41	10.02	30.43	56.00	-25.57	Peak	

Test Mode:	TX Mode (For Adapter)

Neutral

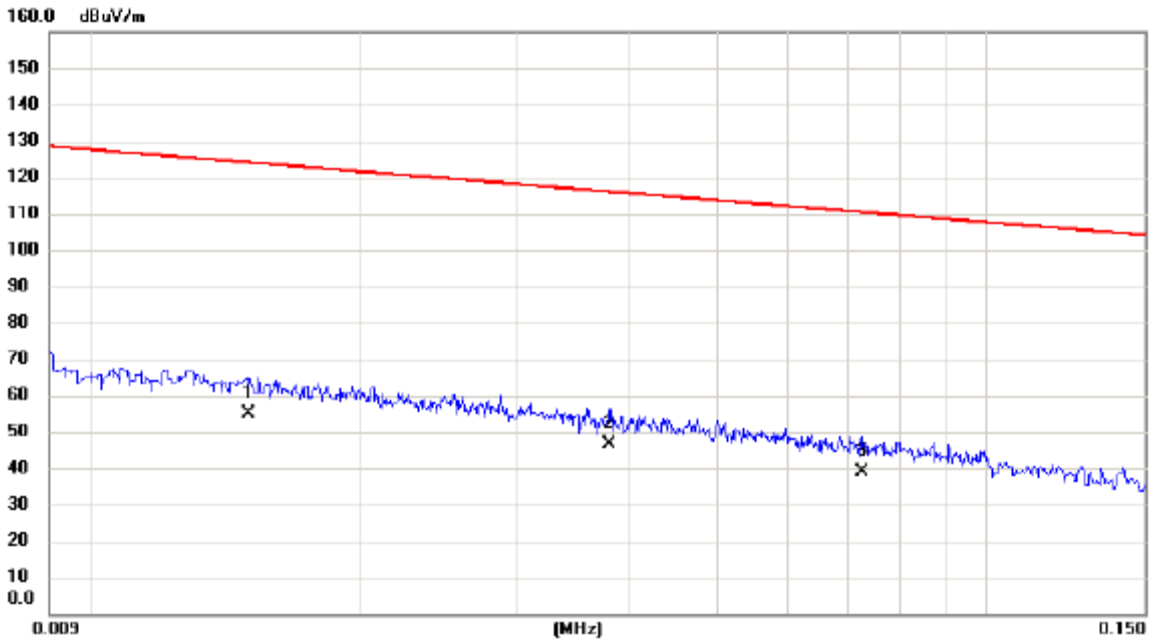


No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	0.1500	28.95	9.91	38.86	66.00	-27.14	Peak	
2	0.2714	24.58	9.92	34.50	61.07	-26.57	Peak	
3	0.4155	29.78	9.95	39.73	57.54	-17.81	Peak	
4	0.4785	34.98	9.94	44.92	56.37	-11.45	Peak	
5	0.4785	25.10	9.94	35.04	46.37	-11.33	AVG	
6	0.5100	35.22	9.94	45.16	56.00	-10.84	Peak	
7 *	0.5100	25.30	9.94	35.24	46.00	-10.76	AVG	
8	0.7890	26.52	10.08	36.60	56.00	-19.40	Peak	

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

Test Mode:	TX Mode

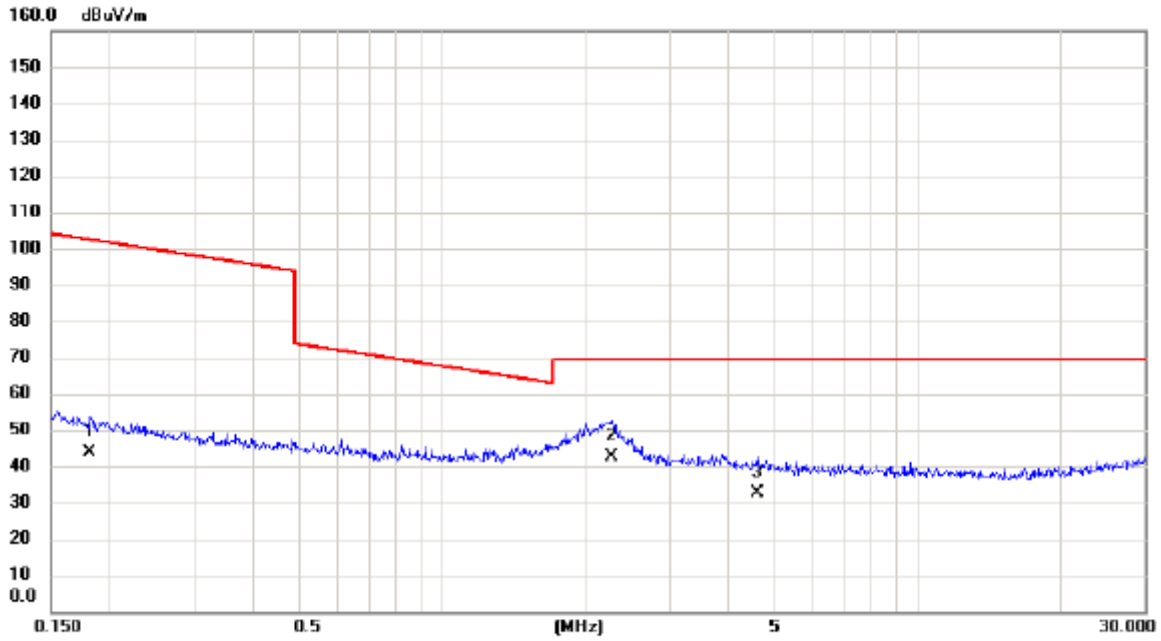
Ant 0°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	0.0150	34.31	20.72	55.03	124.08	-69.05	AVG	
2		0.0380	26.70	19.72	46.42	116.01	-69.59	AVG	
3		0.0726	19.80	19.08	38.88	110.39	-71.51	AVG	

Test Mode:	TX Mode

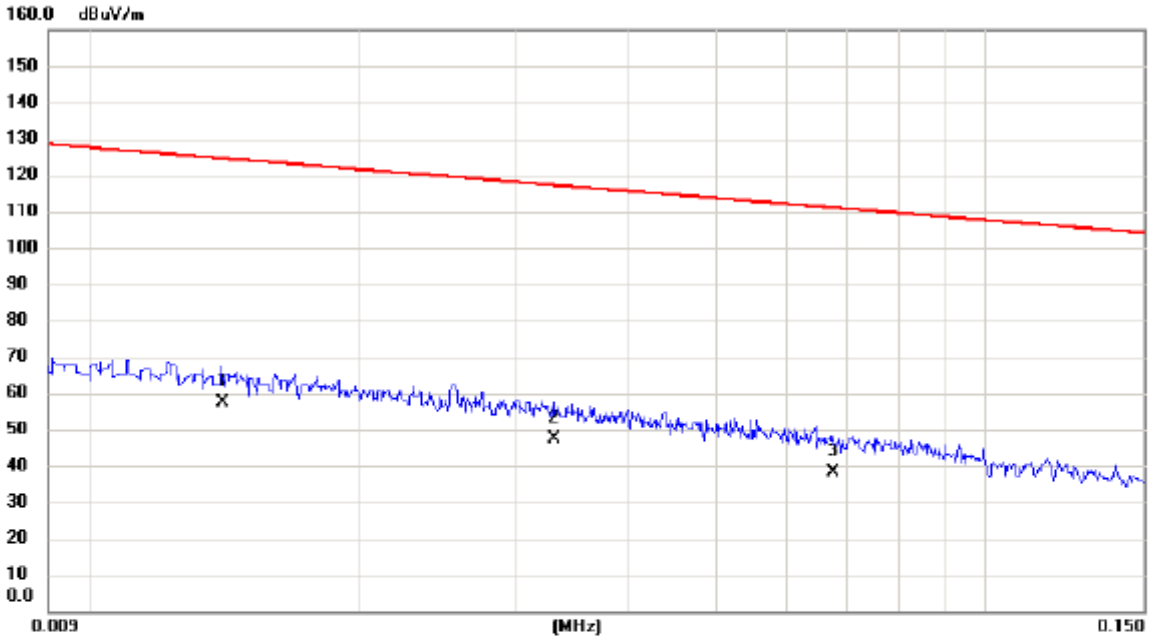
Ant 0°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		0.1815	26.50	17.19	43.69	102.43	-58.74	AVG	
2	*	2.2725	25.70	16.96	42.66	69.54	-26.88	QP	
3		4.5978	17.30	15.40	32.70	69.54	-36.84	QP	

Test Mode:	TX Mode

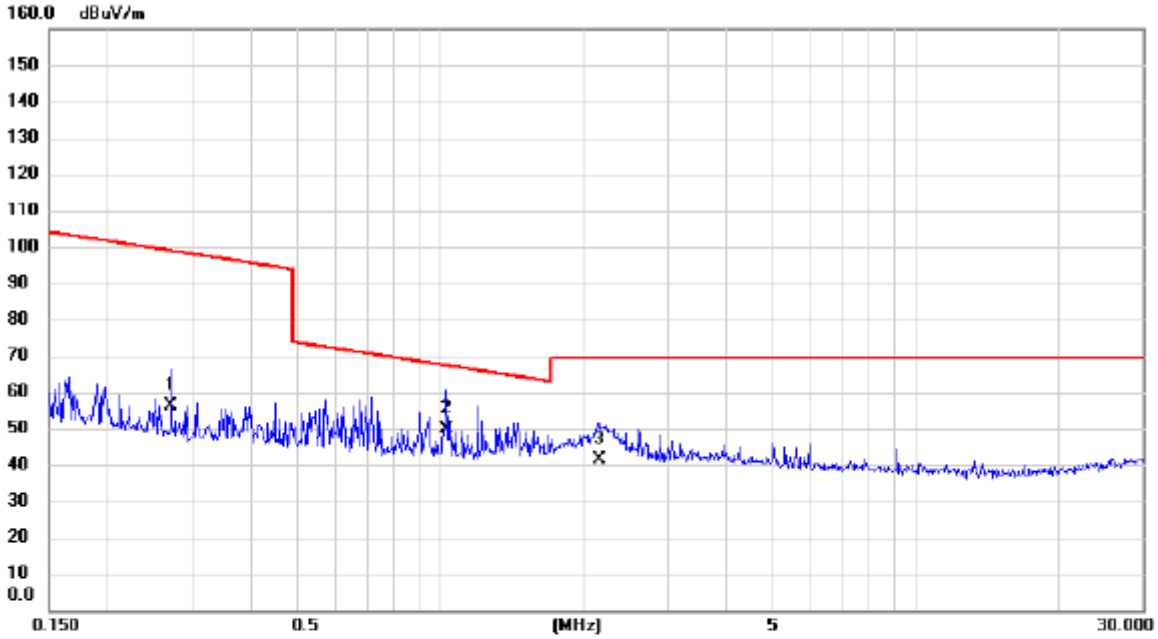
Ant 90°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	0.0141	36.60	20.85	57.45	124.62	-67.17	AVG	
2		0.0330	27.51	19.80	47.31	117.23	-69.92	AVG	
3		0.0675	19.20	19.18	38.38	111.02	-72.64	AVG	

Test Mode:	TX Mode

Ant 90°

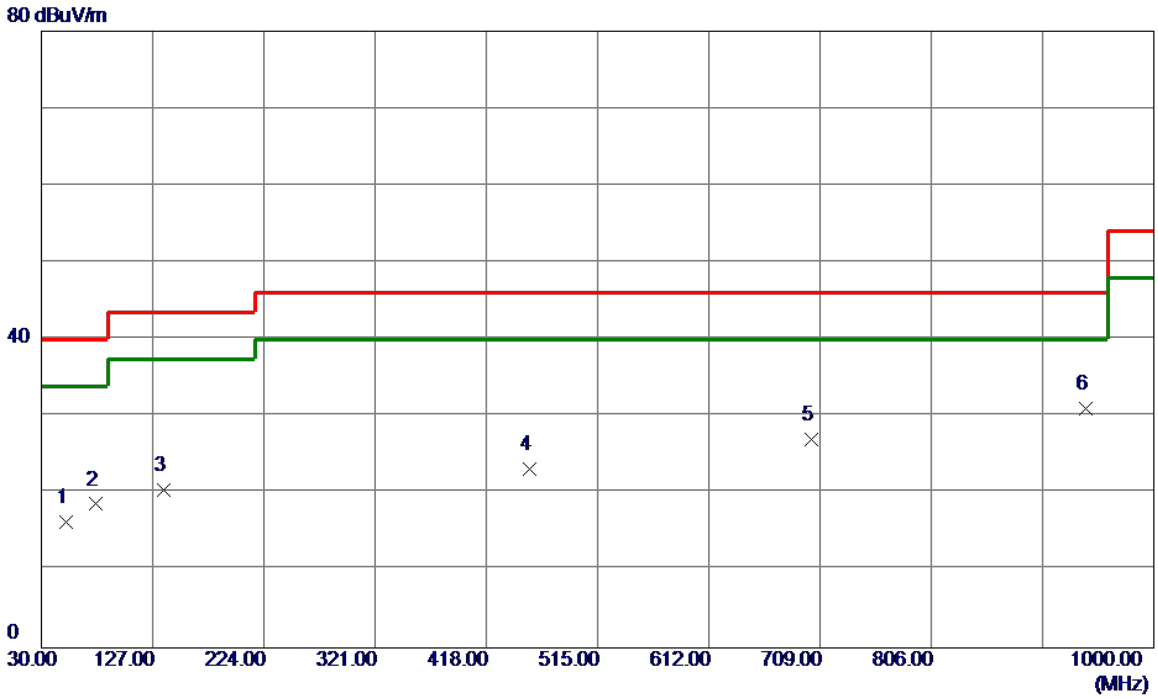


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		0.2701	39.10	17.05	56.15	98.97	-42.82	AVG	
2	*	1.0265	33.20	16.60	49.80	67.38	-17.58	QP	
3		2.1552	24.50	17.02	41.52	69.54	-28.02	QP	

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

Test Mode:	TX 2402MHz _CH00_1Mbps

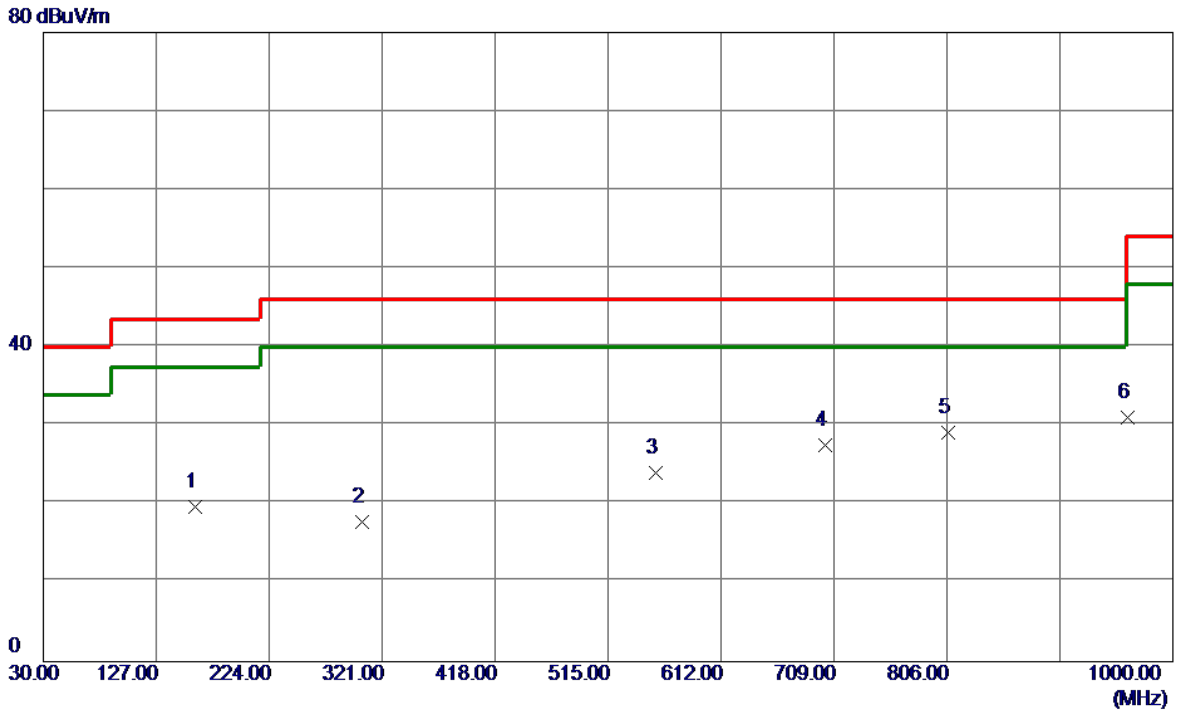
Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	51.3400	31.14	-14.85	16.29	40.00	-23.71	Peak	
2	77.5300	37.14	-18.50	18.64	40.00	-21.36	Peak	
3	136.7000	32.94	-12.52	20.42	43.50	-23.08	Peak	
4	455.8300	30.69	-7.54	23.15	46.00	-22.85	Peak	
5	701.2400	29.78	-2.78	27.00	46.00	-19.00	Peak	
6 *	940.8300	30.07	1.04	31.11	46.00	-14.89	Peak	

Test Mode:	TX 2402MHz _CH00_1Mbps

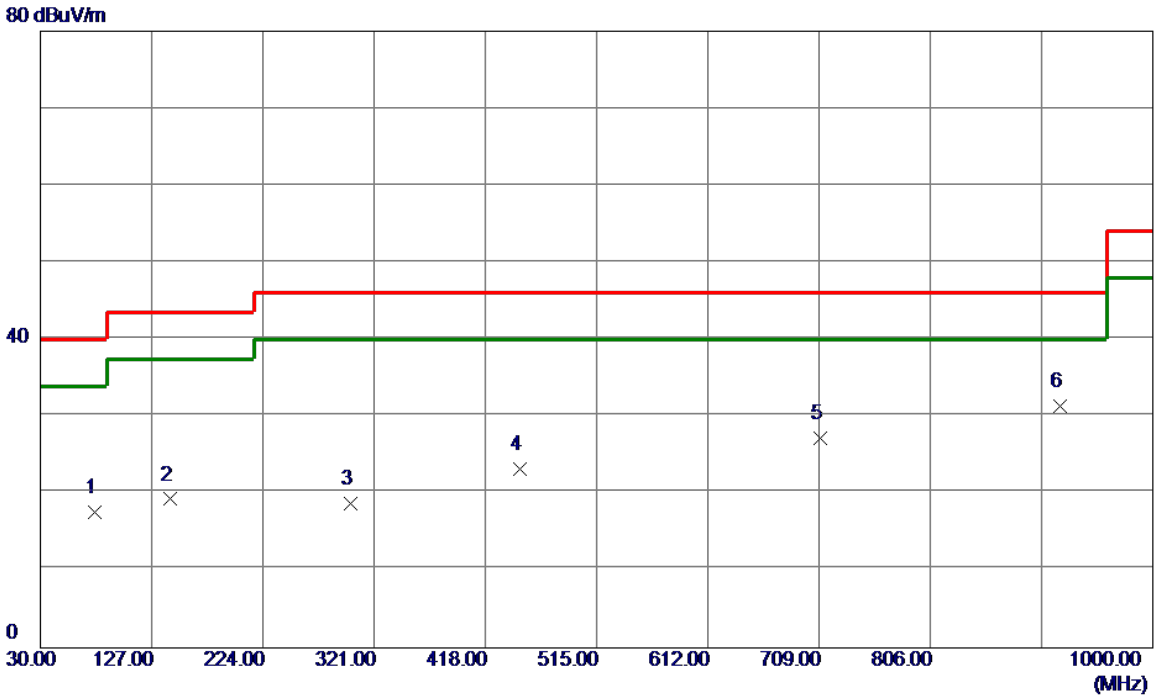
Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	159.9800	30.29	-10.60	19.69	43.50	-23.81	Peak	
2	303.5400	28.22	-10.42	17.80	46.00	-28.20	Peak	
3	555.7400	29.61	-5.56	24.05	46.00	-21.95	Peak	
4	701.2400	30.28	-2.78	27.50	46.00	-18.50	Peak	
5 *	806.9699	30.33	-1.15	29.18	46.00	-16.82	Peak	
6	961.2000	29.89	1.14	31.03	54.00	-22.97	Peak	

Test Mode:	TX 2440MHz _CH19_1Mbps

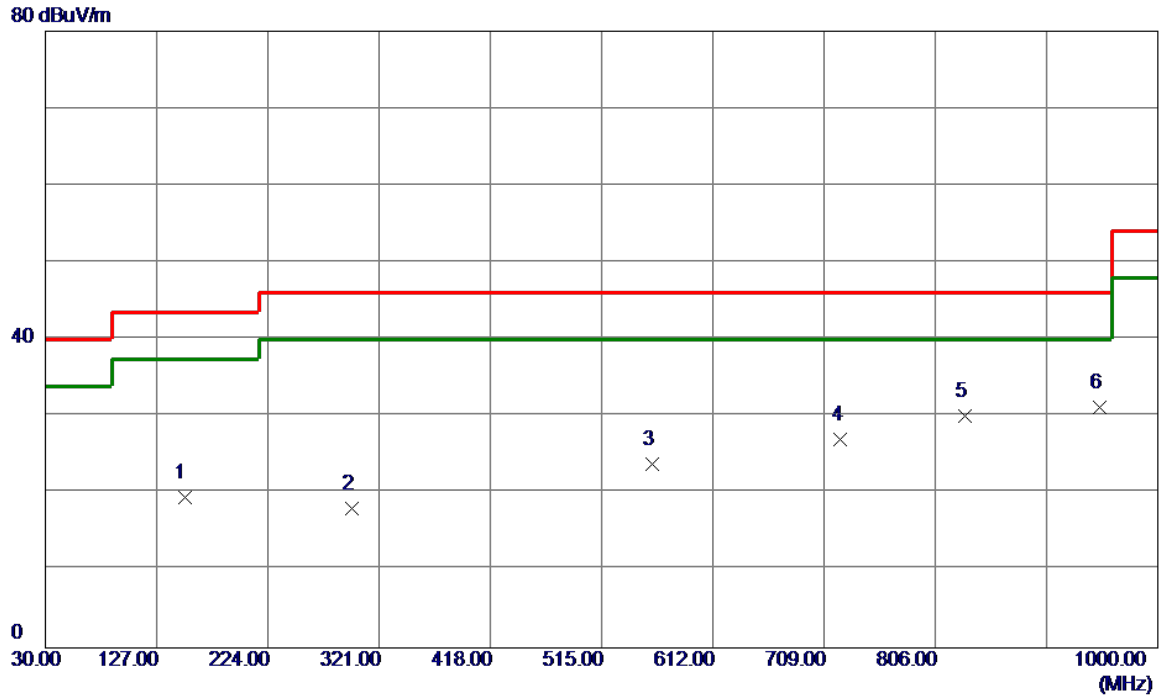
Vertical



No.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	77.5300	36.05	-18.50	17.55	40.00	-22.45	Peak	
2	143.4900	31.16	-11.88	19.28	43.50	-24.22	Peak	
3	300.6300	29.07	-10.38	18.69	46.00	-27.31	Peak	
4	448.0700	30.63	-7.48	23.15	46.00	-22.85	Peak	
5	709.9699	30.18	-3.00	27.18	46.00	-18.82	Peak	
6 *	919.4900	31.20	0.18	31.38	46.00	-14.62	Peak	

Test Mode:	TX 2440MHz _CH19_1Mbps

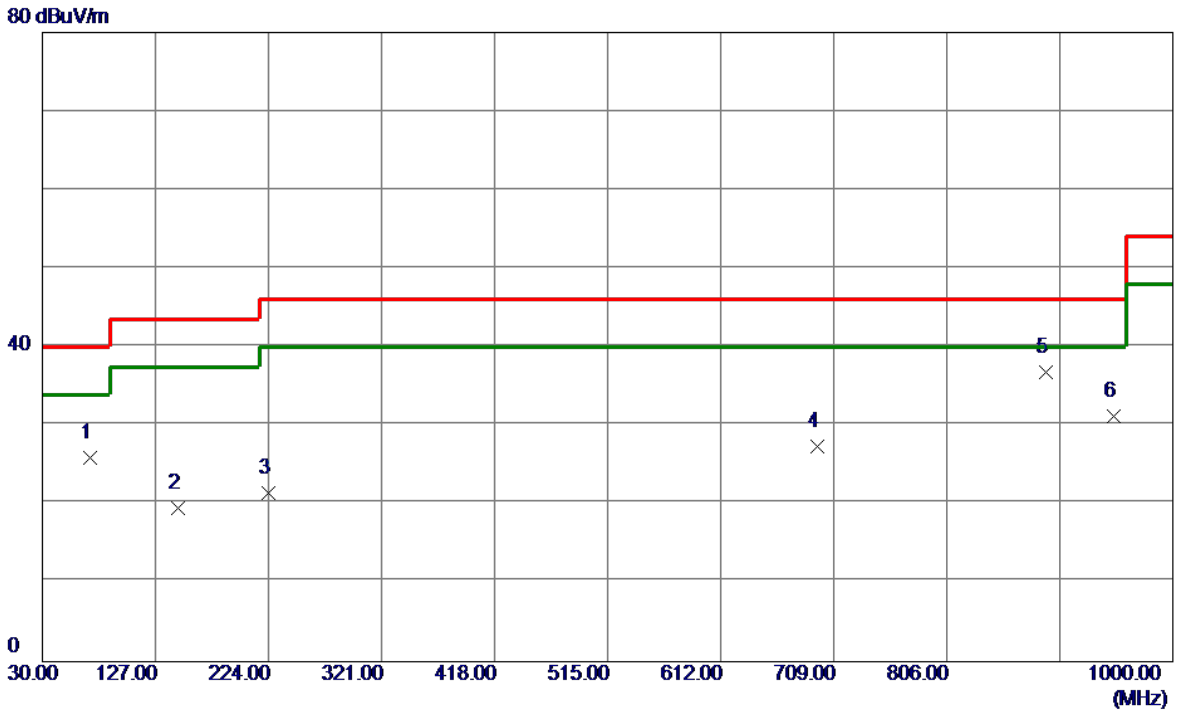
Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	151.2500	30.88	-11.38	19.50	43.50	-24.00	Peak	
2	297.7200	28.58	-10.50	18.08	46.00	-27.92	Peak	
3	559.6200	29.43	-5.62	23.81	46.00	-22.19	Peak	
4	723.5500	30.35	-3.36	26.99	46.00	-19.01	Peak	
5	832.1900	31.62	-1.54	30.08	46.00	-15.92	Peak	
6 *	949.5600	29.88	1.39	31.27	46.00	-14.73	Peak	

Test Mode:	TX 2480MHz _CH39_1Mbps

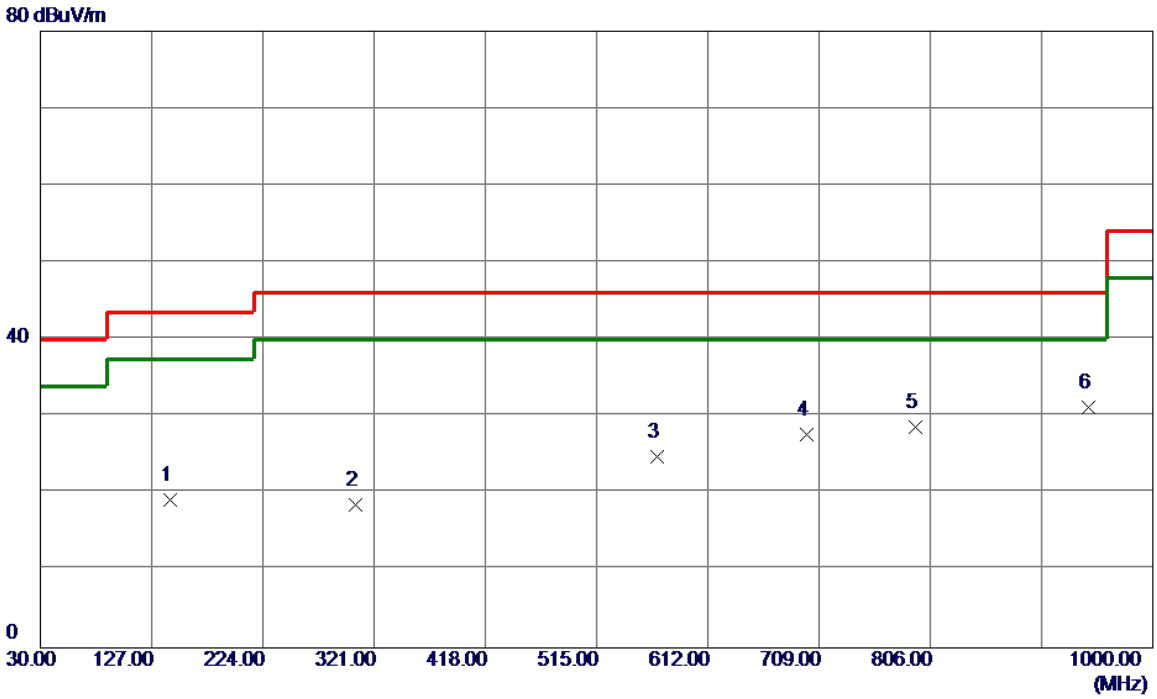
Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	70.7400	43.41	-17.52	25.89	40.00	-14.11	Peak	
2	146.4000	31.27	-11.71	19.56	43.50	-23.94	Peak	
3	224.0000	36.40	-14.89	21.51	46.00	-24.49	Peak	
4	694.4500	30.40	-3.01	27.39	46.00	-18.61	Peak	
5 *	891.3600	37.54	-0.81	36.73	46.00	-9.27	Peak	
6	949.5600	29.76	1.39	31.15	46.00	-14.85	Peak	

Test Mode:	TX 2480MHz _CH39_1Mbps

Horizontal

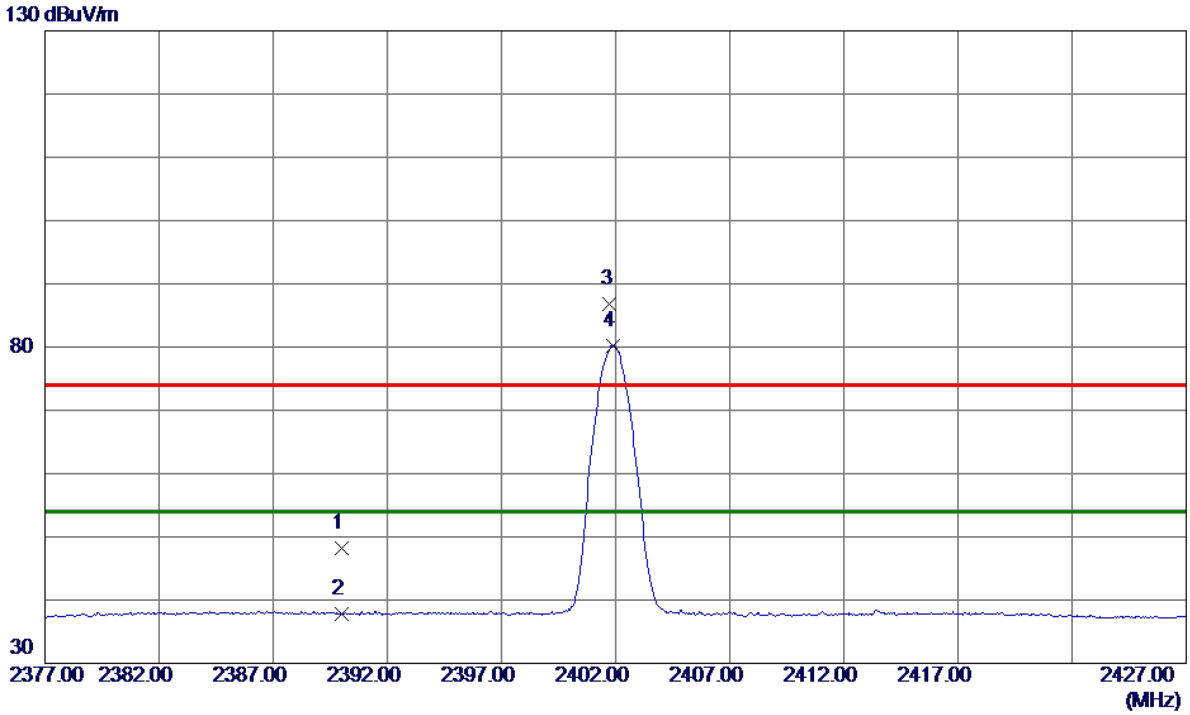


No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	143.4900	31.09	-11.88	19.21	43.50	-24.29	Peak	
2	304.5100	28.93	-10.43	18.50	46.00	-27.50	Peak	
3	567.3800	30.60	-5.75	24.85	46.00	-21.15	Peak	
4	698.3300	30.44	-2.83	27.61	46.00	-18.39	Peak	
5	793.3900	30.10	-1.44	28.66	46.00	-17.34	Peak	
6 *	943.7400	29.98	1.16	31.14	46.00	-14.86	Peak	

APPENDIX D - RADIATED EMISSION (ABOVE 1000MHZ)

Test Mode :	TX 2402MHz _CH00_1Mbps

Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	2390.0000	36.85	11.32	48.17	74.00	-25.83	Peak	
2	2390.0000	26.50	11.32	37.82	54.00	-16.18	AVG	
3	2401.7500	75.57	11.32	86.89	74.00	12.89	Peak	No Limit
4 *	2401.9000	68.97	11.32	80.29	54.00	26.29	AVG	No Limit

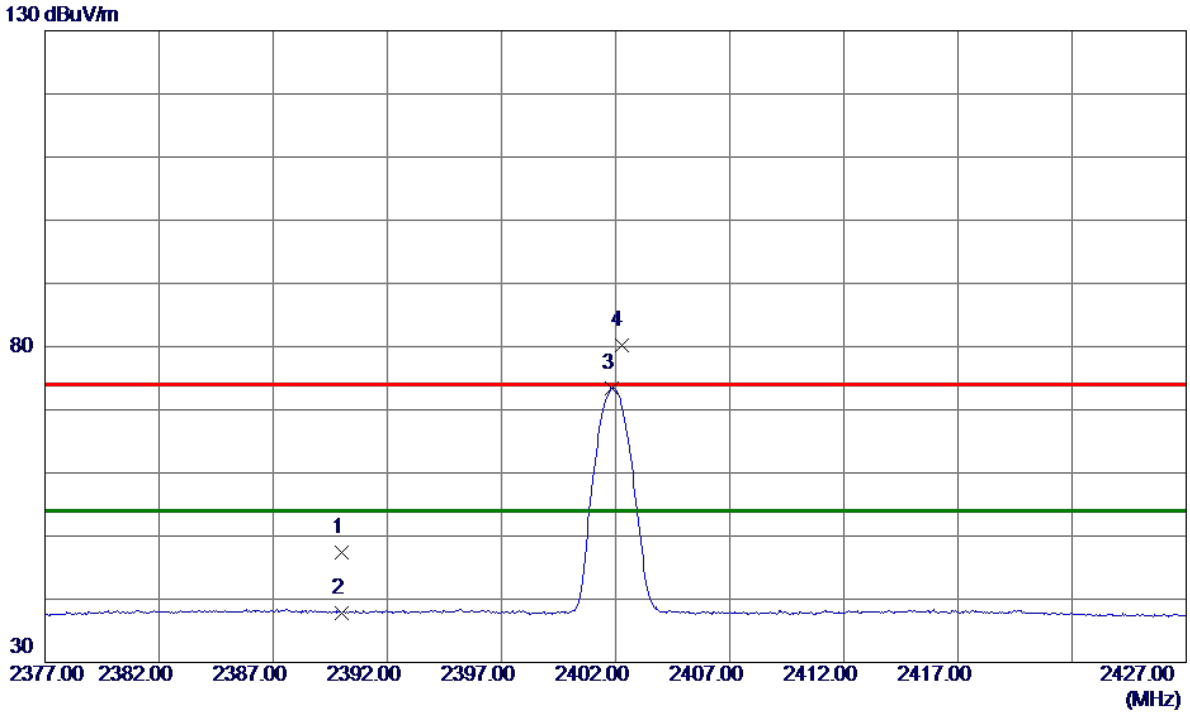
Test Mode :	TX 2402MHz _CH00_1Mbps

Vertical

No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	7205.6000	22.83	17.02	39.85	54.00	-14.15	AVG	
2	7206.2000	35.75	17.02	52.77	74.00	-21.23	Peak	

Test Mode :	TX 2402MHz _CH00_1Mbps

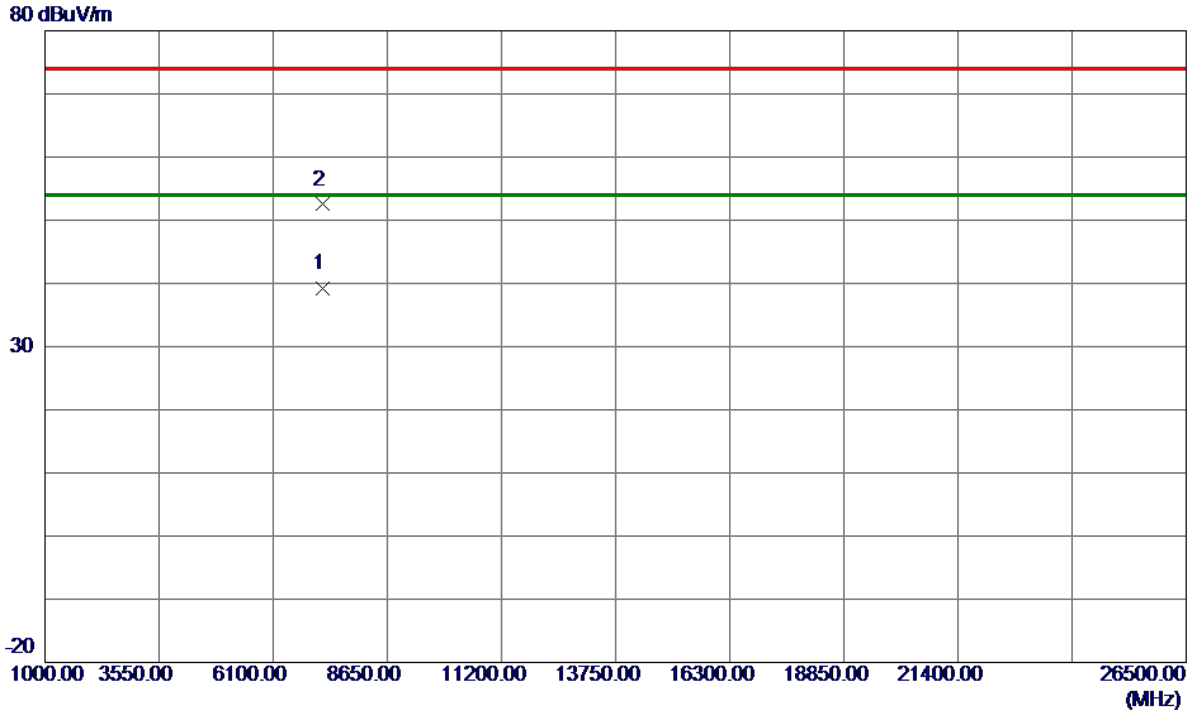
Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	2390.0000	36.09	11.32	47.41	74.00	-26.59	Peak	
2	2390.0000	26.53	11.32	37.85	54.00	-16.15	AVG	
3 *	2401.8500	62.07	11.32	73.39	54.00	19.39	AVG	No Limit
4	2402.2500	68.85	11.32	80.17	74.00	6.17	Peak	No Limit

Test Mode :	TX 2402MHz _CH00_1Mbps

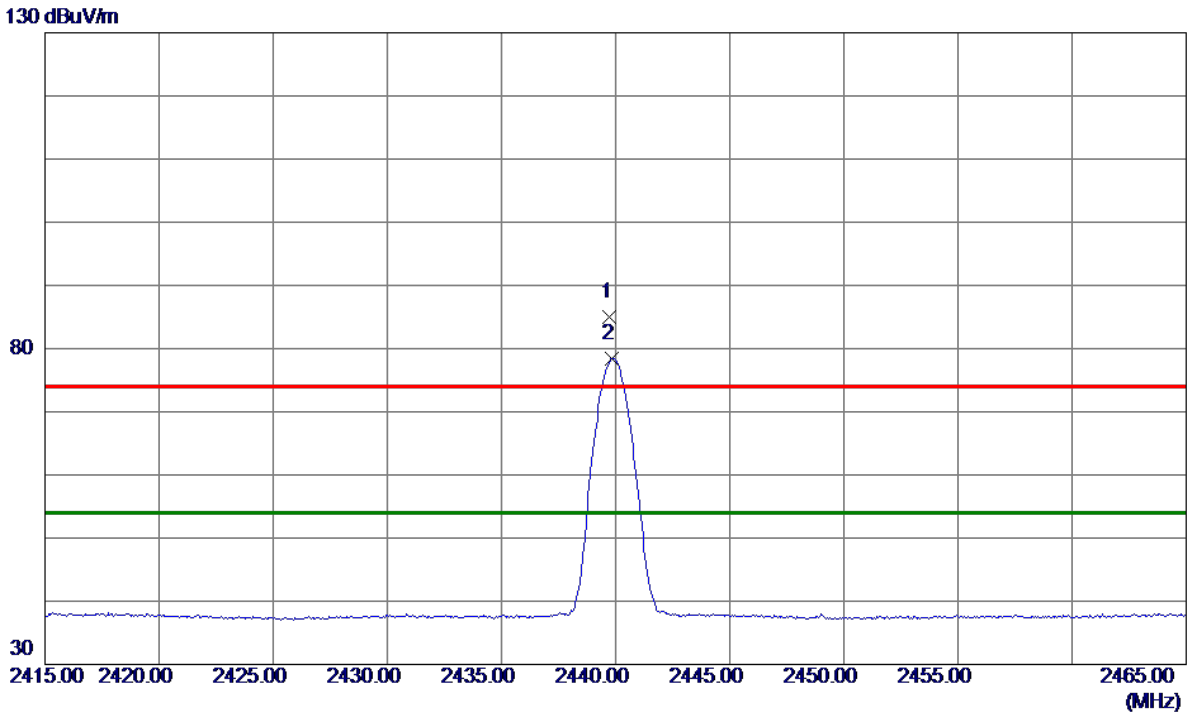
Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	7205.9000	22.21	17.02	39.23	54.00	-14.77	AVG	
2	7206.3900	35.48	17.02	52.50	74.00	-21.50	Peak	

Test Mode :	TX 2440MHz _CH19_1Mbps

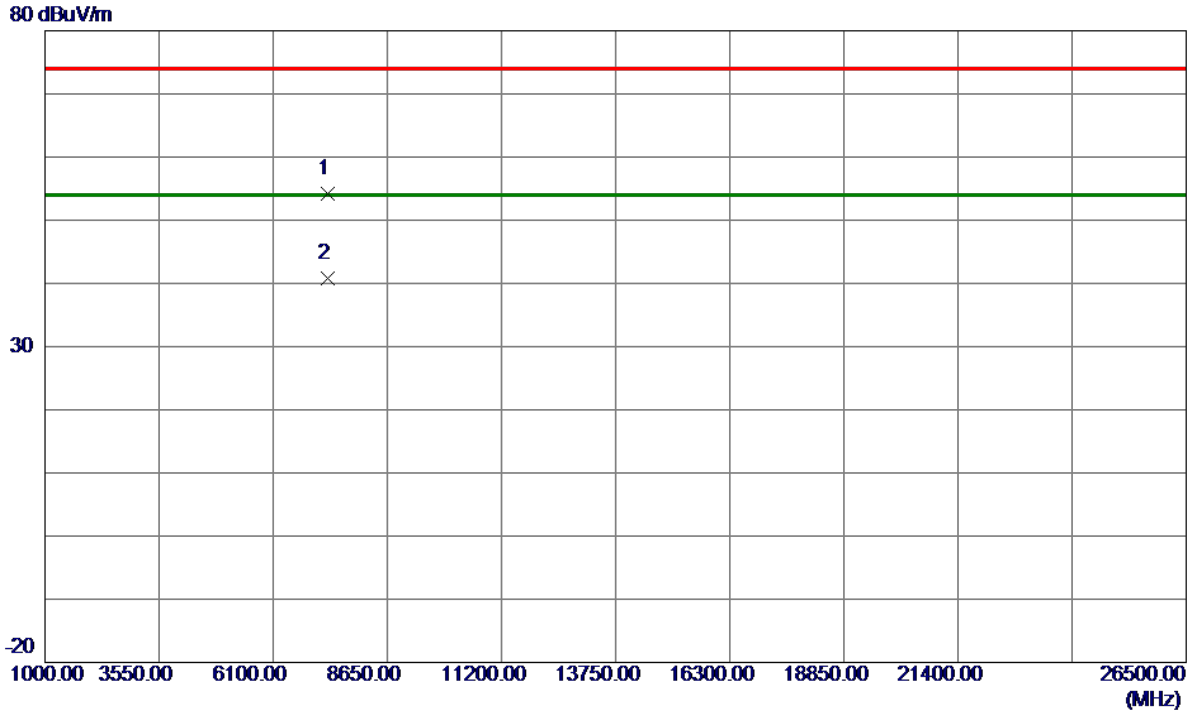
Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	2439.7500	73.68	11.33	85.01	74.00	11.01	Peak	No Limit
2 *	2439.8500	67.06	11.33	78.39	54.00	24.39	AVG	No Limit

Test Mode :	TX 2440MHz _CH19_1Mbps

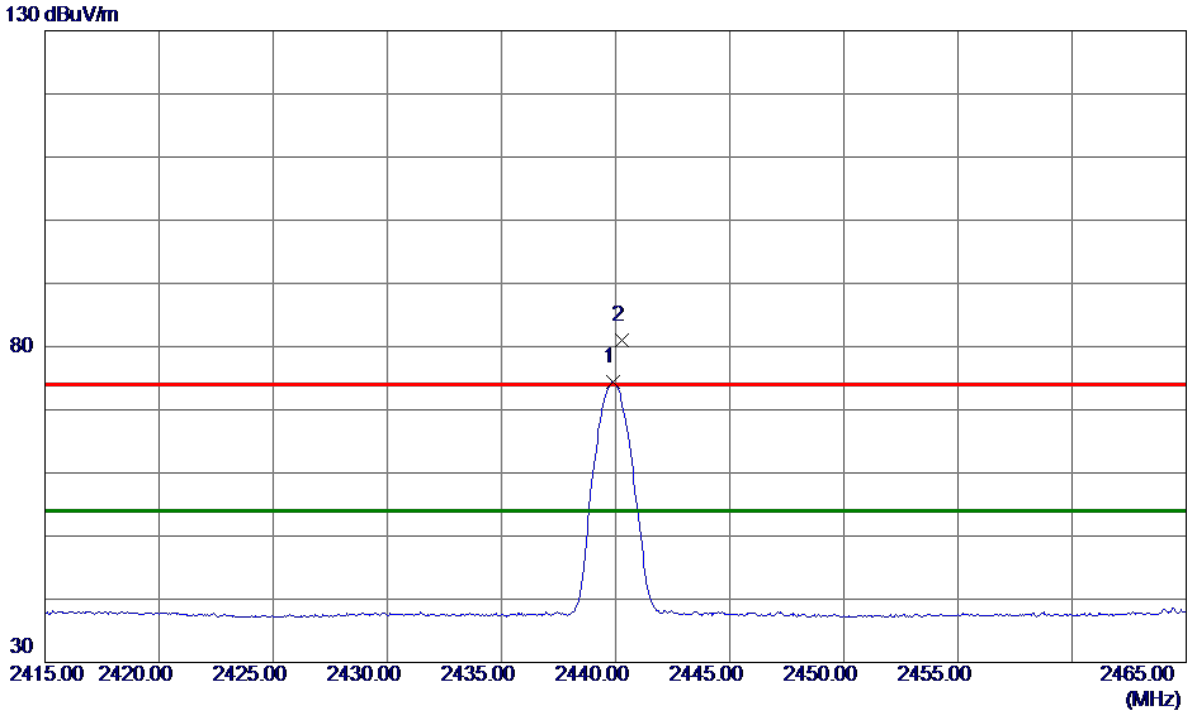
Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	7319.1800	36.75	17.36	54.11	74.00	-19.89	Peak	
2 *	7319.8200	23.52	17.37	40.89	54.00	-13.11	AVG	

Test Mode :	TX 2440MHz _CH19_1Mbps

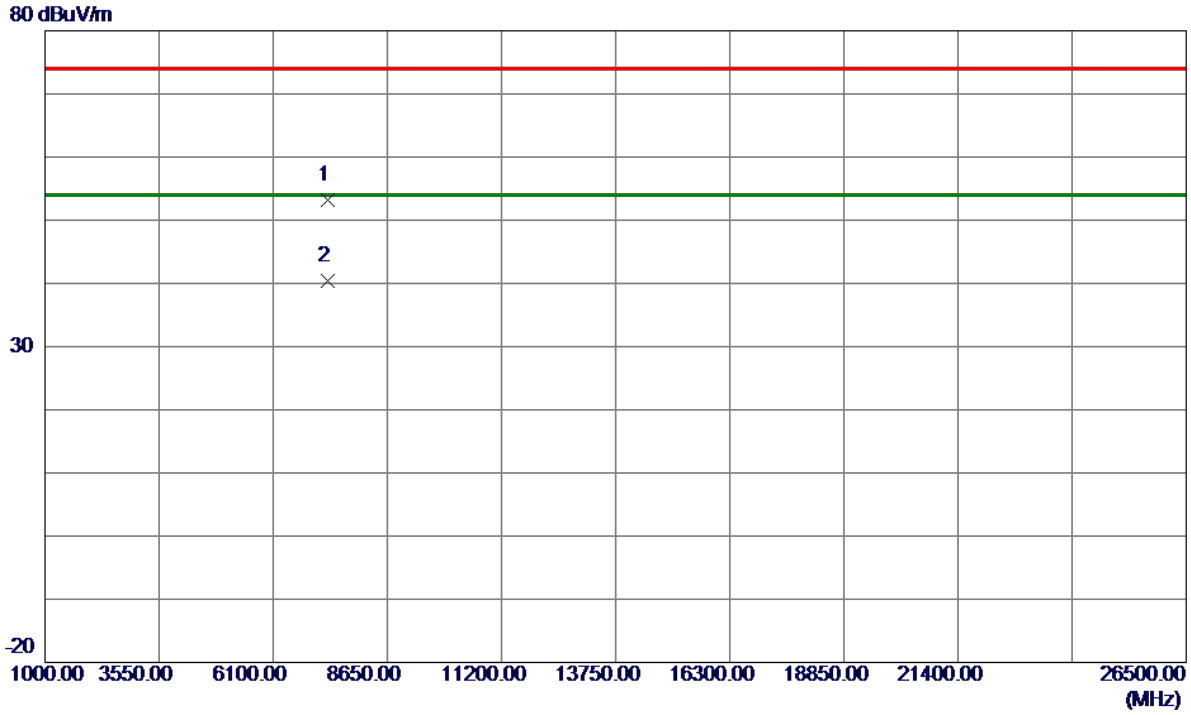
Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	2439.9000	63.00	11.33	74.33	54.00	20.33	AVG	No Limit
2	2440.3000	69.58	11.33	80.91	74.00	6.91	Peak	No Limit

Test Mode :	TX 2440MHz _CH19_1Mbps

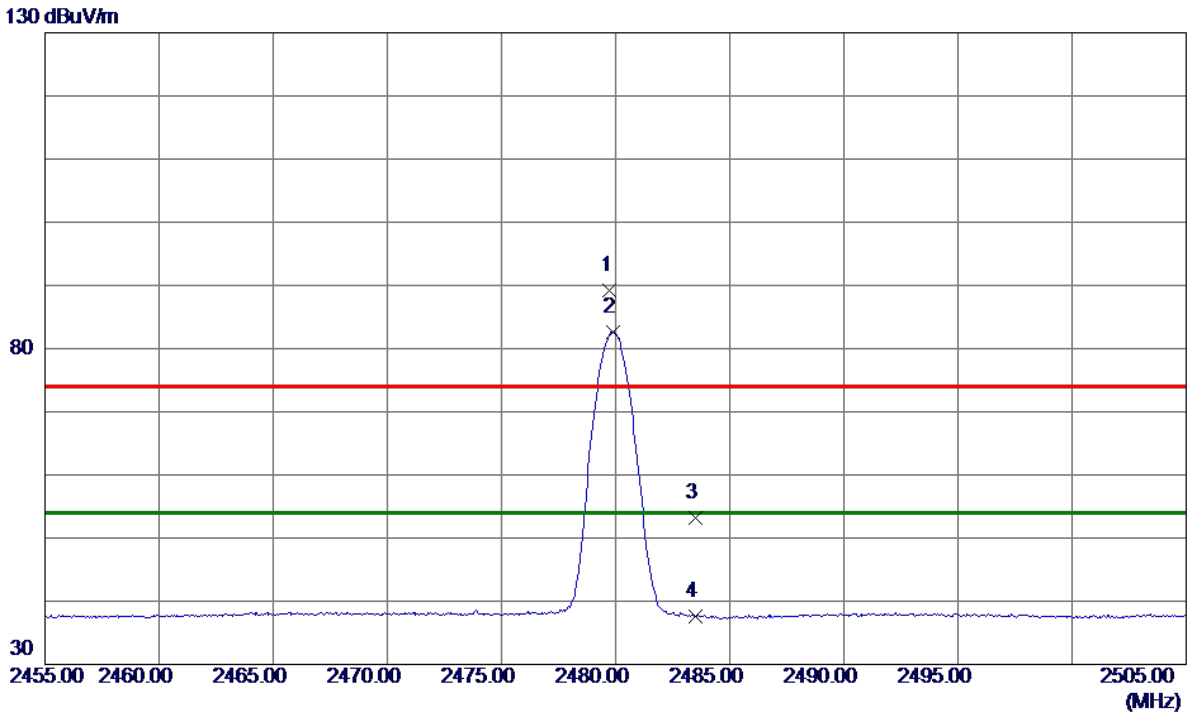
Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	7319.2900	35.81	17.36	53.17	74.00	-20.83	Peak	
2 *	7319.7800	22.97	17.37	40.34	54.00	-13.66	AVG	

Test Mode :	TX 2480MHz _CH39_1Mbps

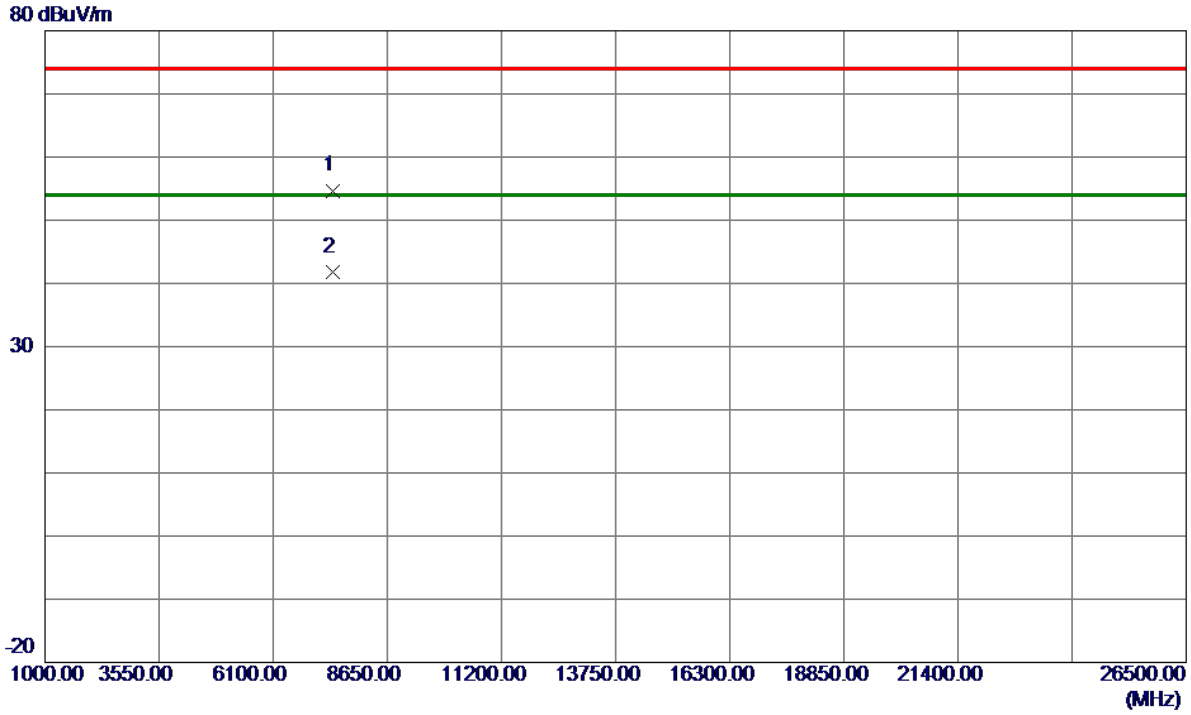
Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	2479.7500	77.95	11.34	89.29	74.00	15.29	Peak	No Limit
2 *	2479.9000	71.32	11.34	82.66	54.00	28.66	AVG	No Limit
3	2483.5000	41.93	11.35	53.28	74.00	-20.72	Peak	
4	2483.5000	26.26	11.35	37.61	54.00	-16.39	AVG	

Test Mode :	TX 2480MHz _CH39_1Mbps

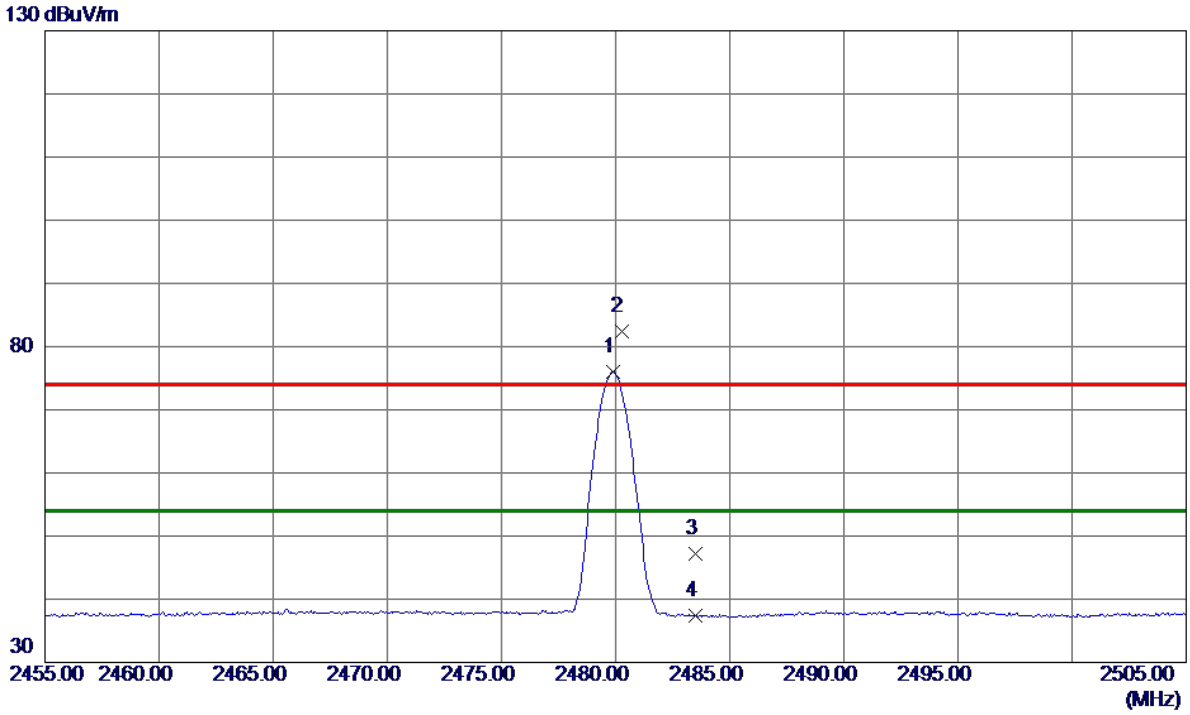
Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	7439.4400	36.97	17.73	54.70	74.00	-19.30	Peak	
2 *	7439.7200	24.05	17.73	41.78	54.00	-12.22	AVG	

Test Mode :	TX 2480MHz _CH39_1Mbps

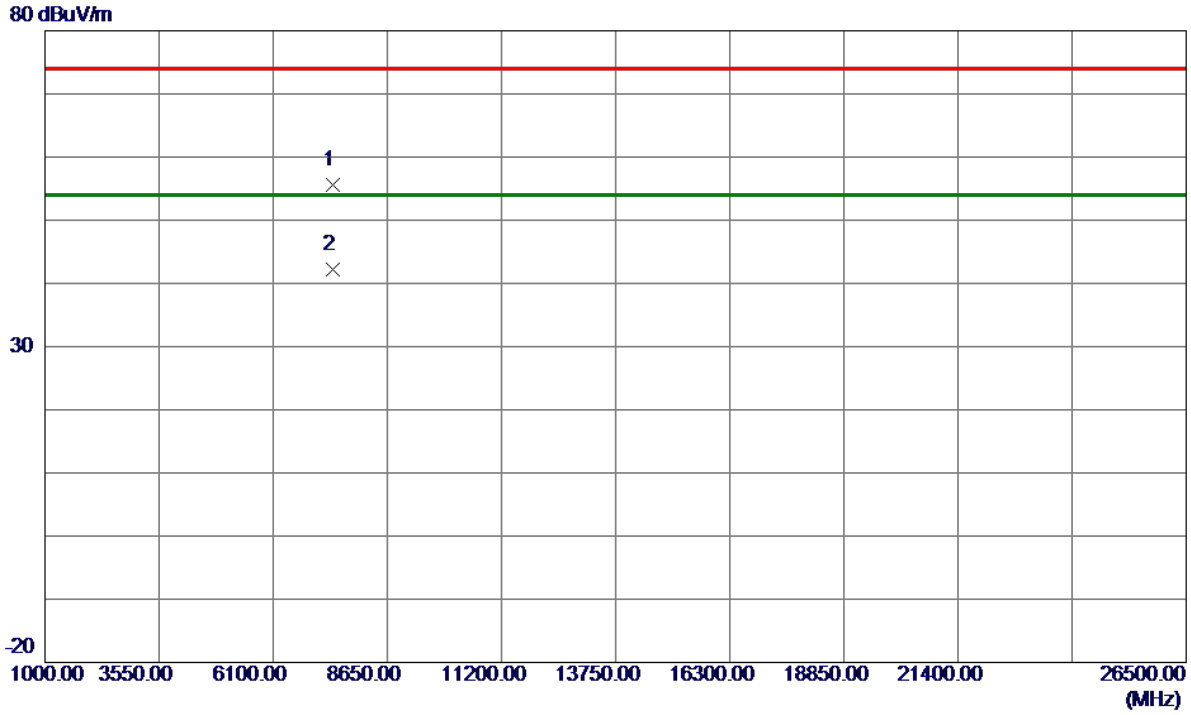
Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	2479.9000	64.61	11.34	75.95	54.00	21.95	AVG	No Limit
2	2480.2500	71.14	11.34	82.48	74.00	8.48	Peak	No Limit
3	2483.5000	35.84	11.35	47.19	74.00	-26.81	Peak	
4	2483.5000	26.07	11.35	37.42	54.00	-16.58	AVG	

Test Mode :	TX 2480MHz _CH39_1Mbps

Horizontal



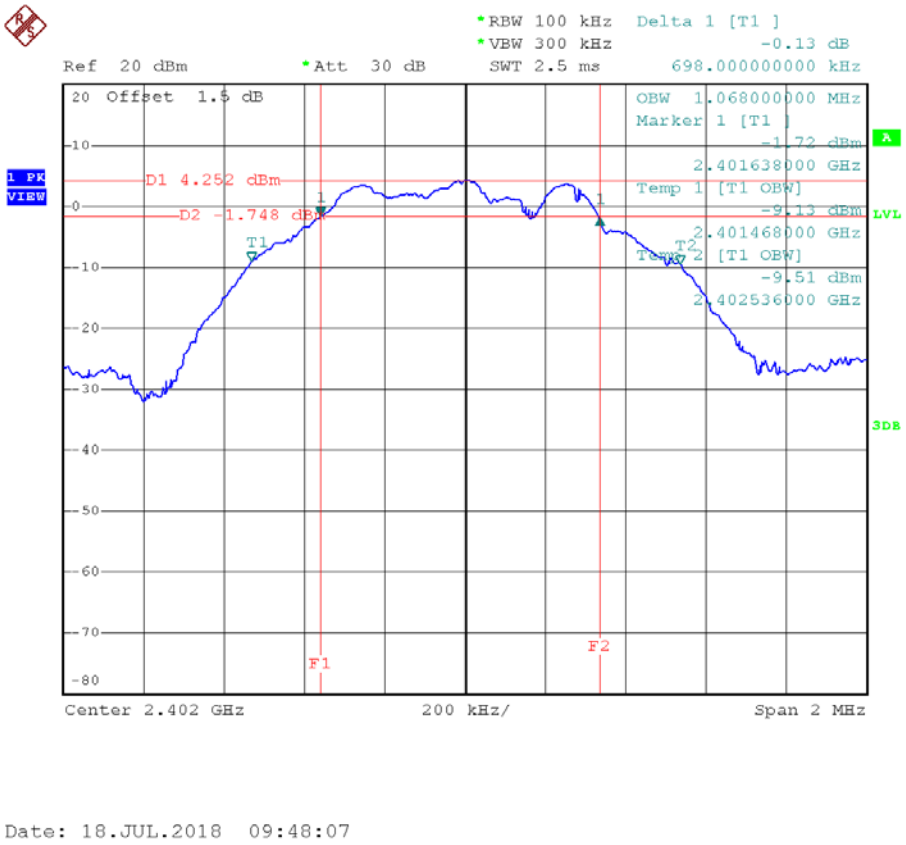
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	7439.2200	37.88	17.73	55.61	74.00	-18.39	Peak	
2 *	7439.9300	24.44	17.73	42.17	54.00	-11.83	AVG	

APPENDIX E - BANDWIDTH

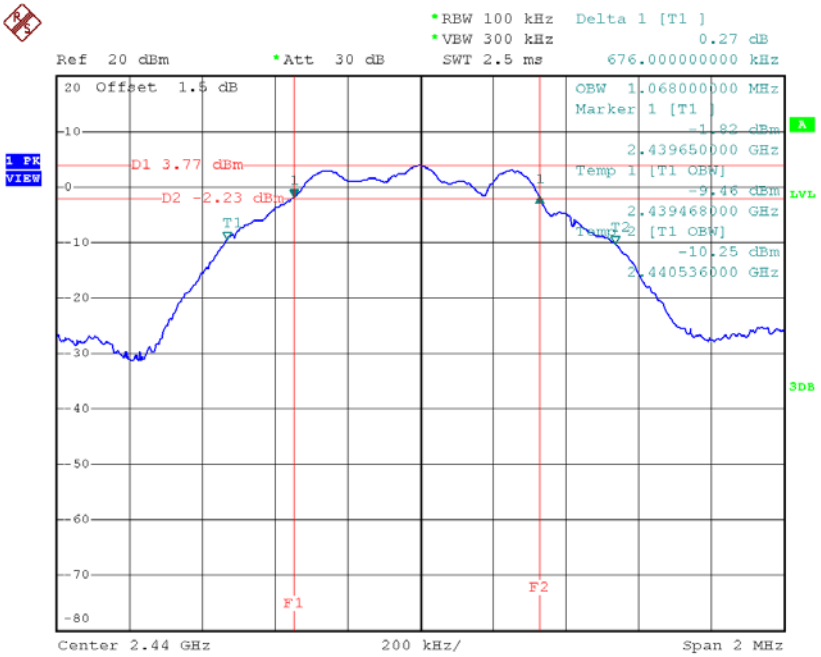
Test Mode:	TX Mode

Frequency (MHz)	6dB Bandwidth (MHz)	99% Occupied BW (MHz)	Min. Limit (kHz)	Test Result
2402	0.698	1.068	500	Pass
2440	0.676	1.068	500	Pass
2480	0.690	1.072	500	Pass

TX CH00

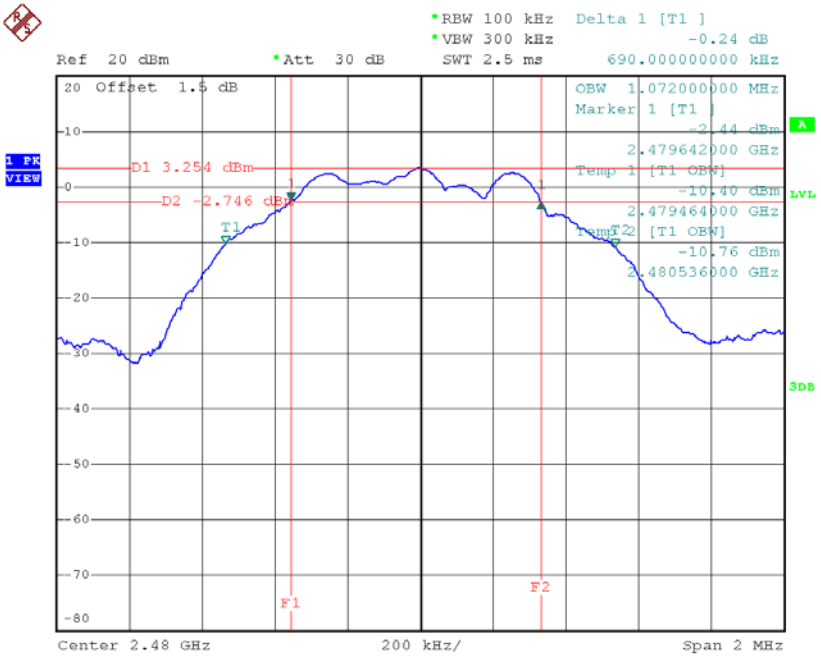


TX CH19



Date: 18.JUL.2018 09:50:19

TX CH39



Date: 18.JUL.2018 09:54:11

APPENDIX F - MAXIMUM OUTPUT POWER TEST

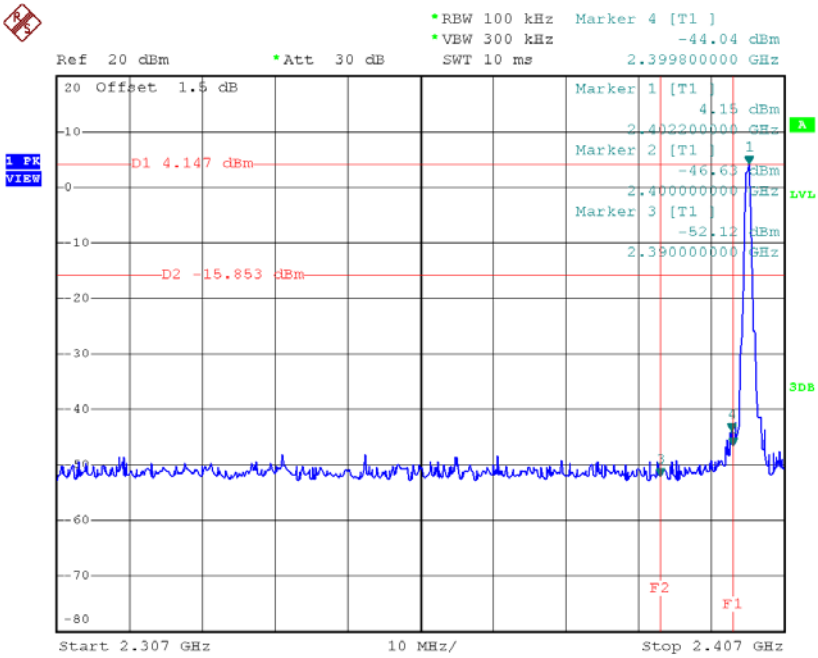
Test Mode :	CH00, CH19 , CH39 - 1Mbps

Frequency (MHz)	Conducted Power (dBm)	Conducted Power (W)	Max. Limit (dBm)	Max. Limit (W)	Test Result
2402	4.45	0.0028	30.00	1.00	Pass
2440	4.03	0.0025	30.00	1.00	Pass
2480	3.51	0.0022	30.00	1.00	Pass

APPENDIX G - ANTENNA CONDUCTED SPURIOUS EMISSION

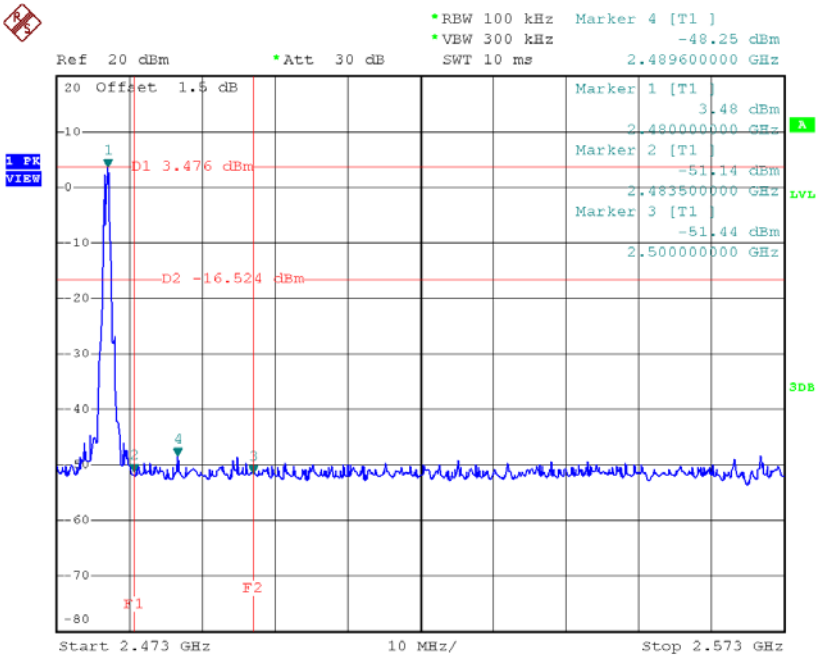
Test Mode :	CH00, CH19 , CH39 - 1Mbps

CH00 (Lower) - 1Mbps



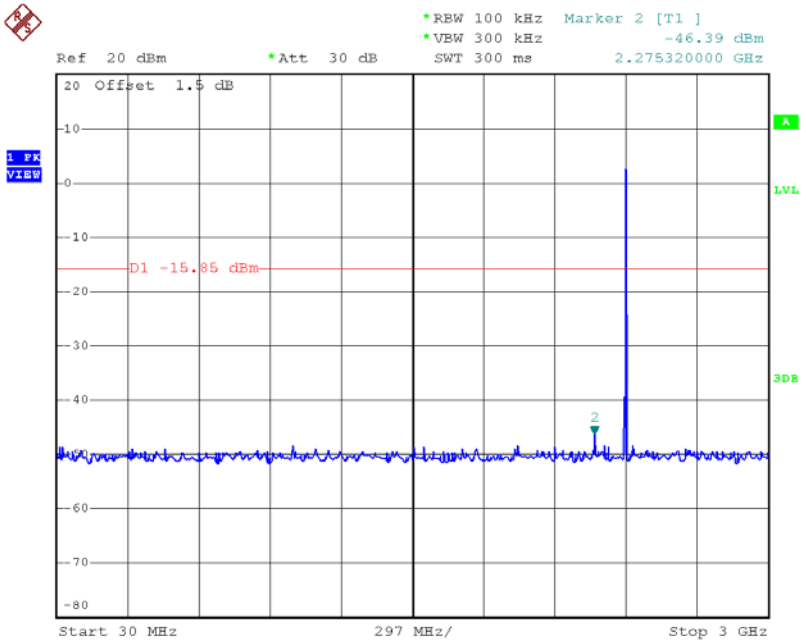
Date: 18.JUL.2018 09:48:16

CH39 (upper) - 1Mbps



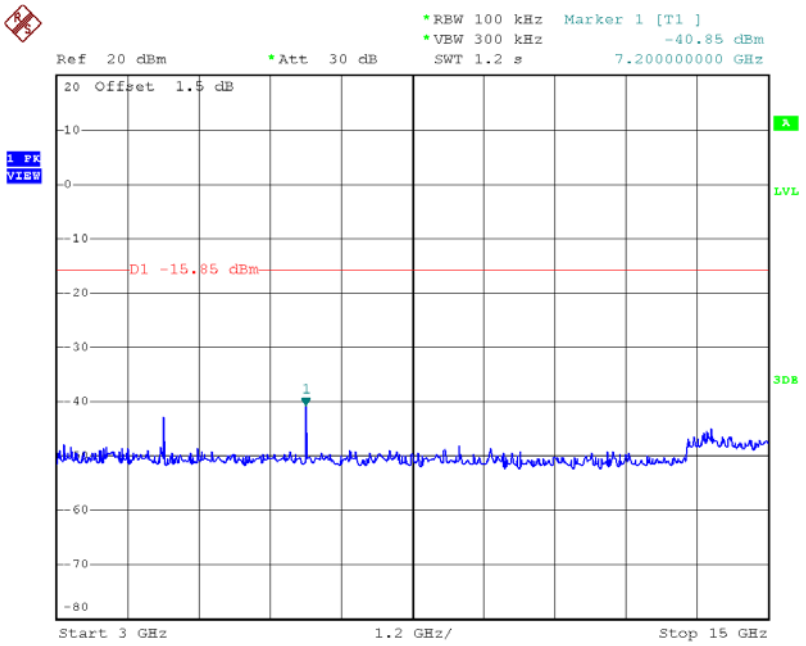
Date: 18.JUL.2018 09:54:20

CH00 (10 Harmonic of the frequency) 1



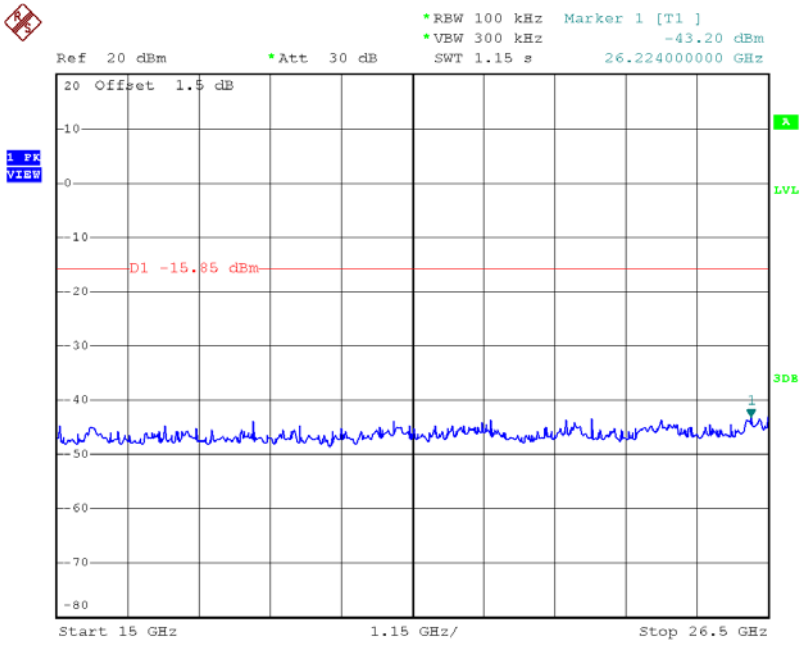
Date: 18.JUL.2018 09:48:30

CH00 (10 Harmonic of the frequency) 2



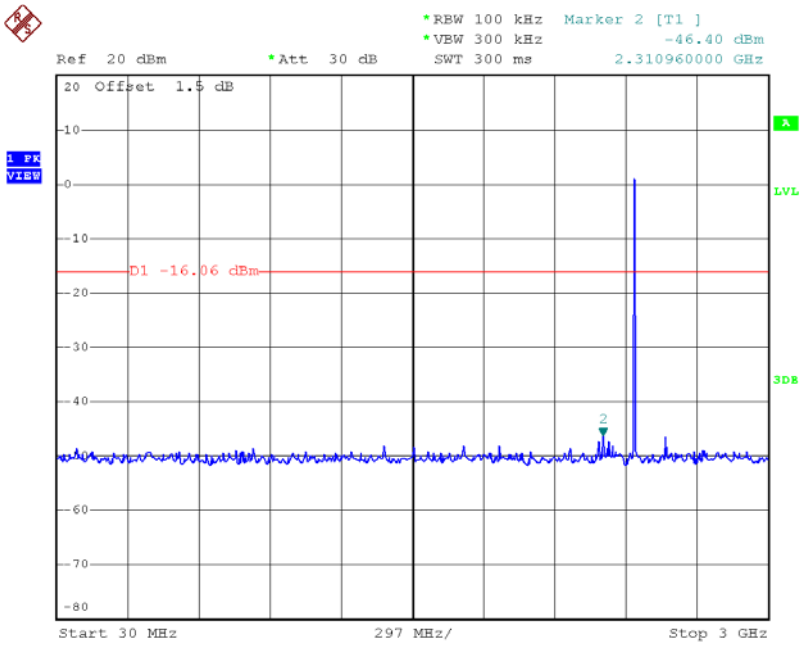
Date: 18.JUL.2018 09:48:39

CH00 (10 Harmonic of the frequency) 3



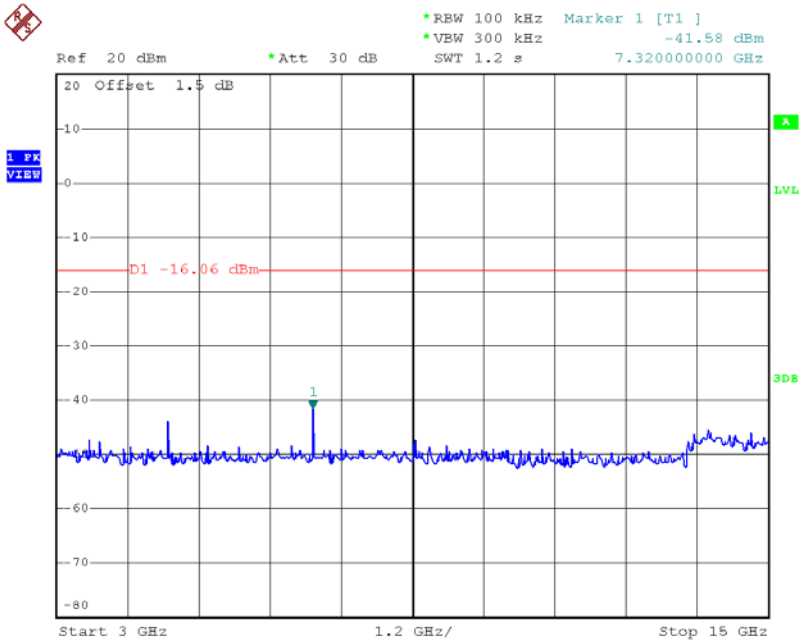
Date: 18.JUL.2018 09:48:49

CH19 (10 Harmonic of the frequency) 1



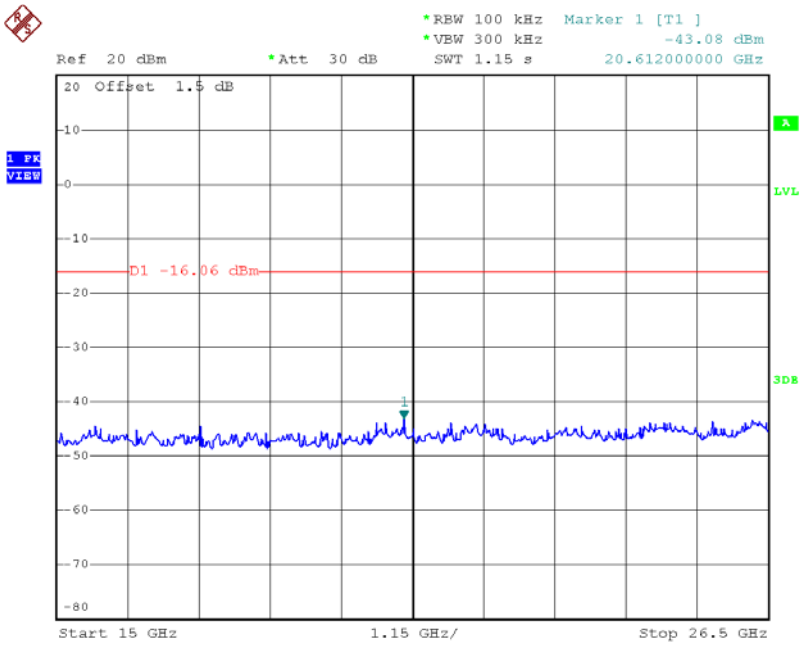
Date: 18.JUL.2018 09:50:43

CH19 (10 Harmonic of the frequency) 2



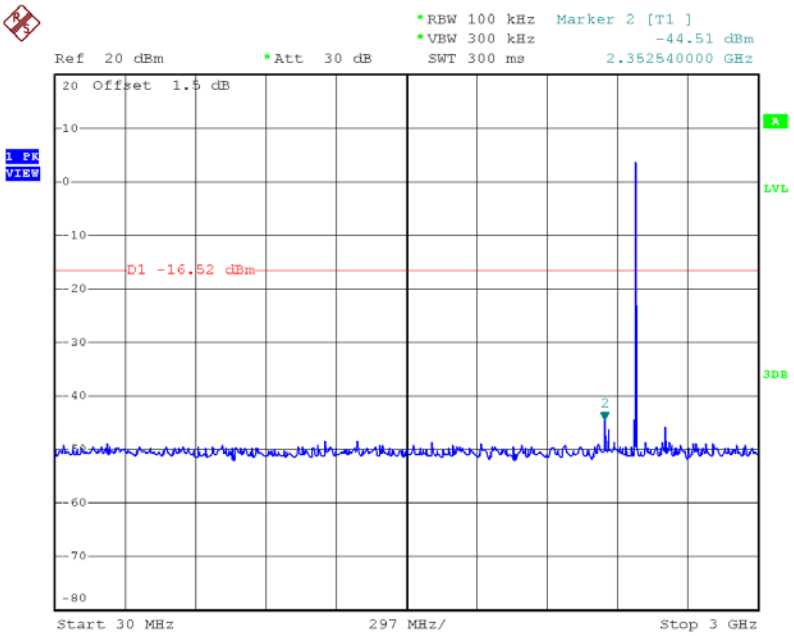
Date: 18.JUL.2018 09:50:52

CH19 (10 Harmonic of the frequency) 3



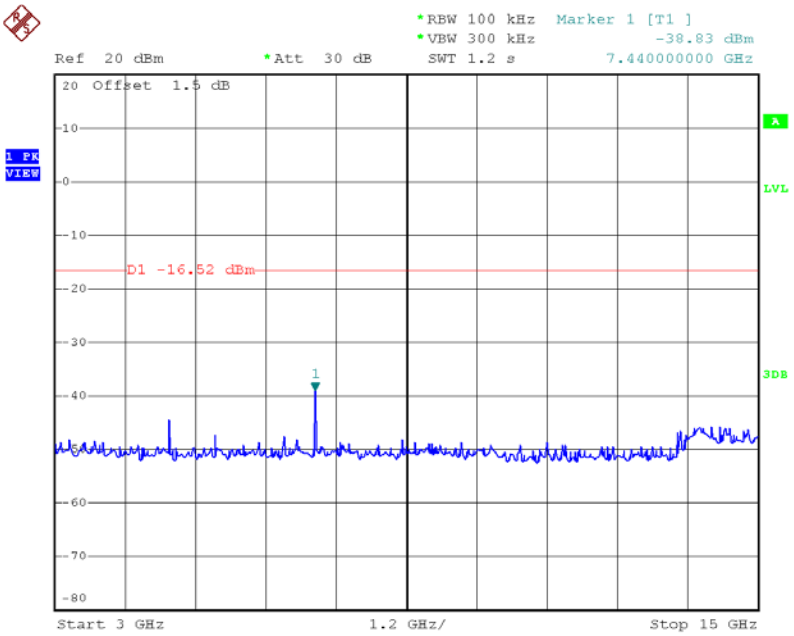
Date: 18.JUL.2018 09:51:02

CH39 (10 Harmonic of the frequency) 1



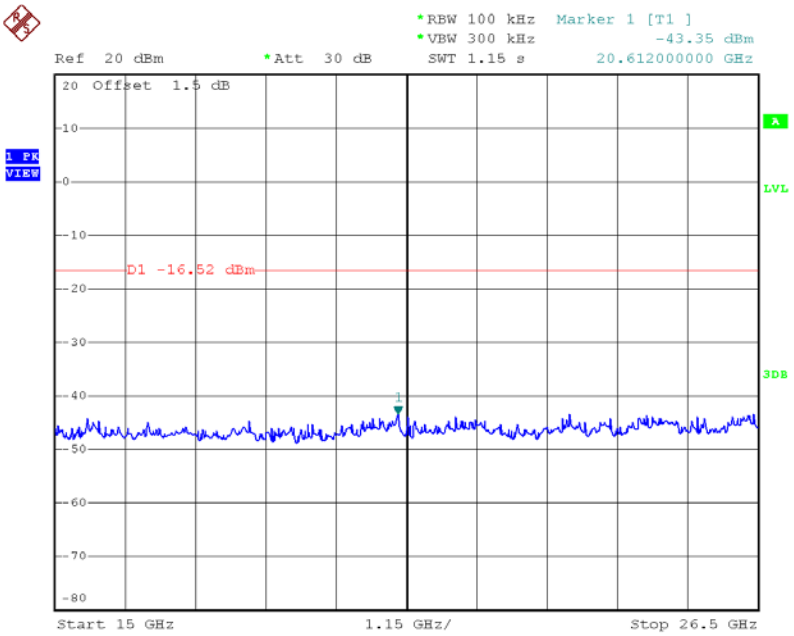
Date: 18.JUL.2018 09:54:35

CH39 (10 Harmonic of the frequency) 2



Date: 18.JUL.2018 09:54:45

CH39 (10 Harmonic of the frequency) 3



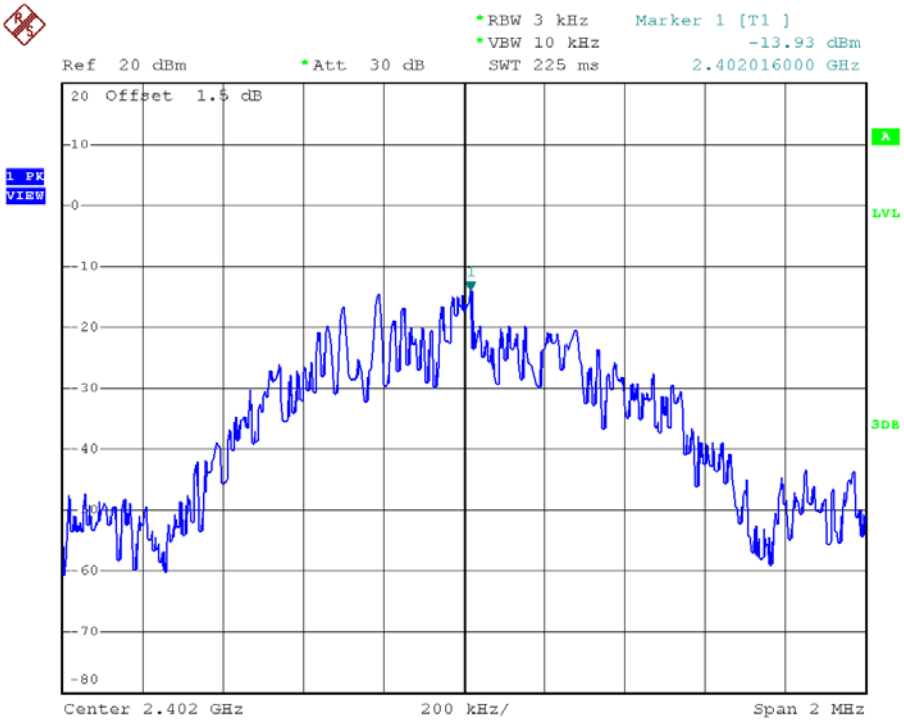
Date: 18.JUL.2018 09:54:54

APPENDIX H - POWER SPECTRAL DENSITY TEST

Test Mode:	CH00, CH19 , CH39 - 1Mbps

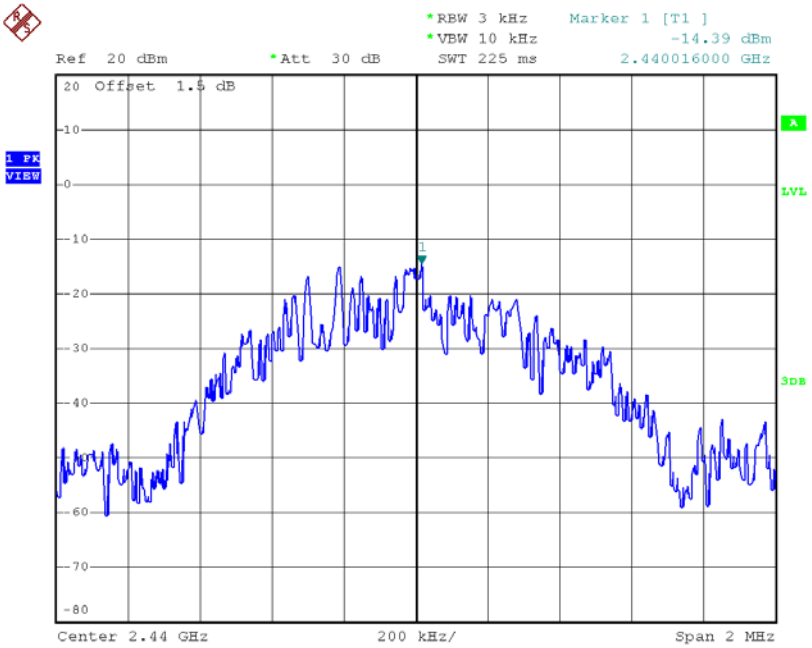
Frequency (MHz)	Power Density (dBm/3kHz)	Power Density (mW/3kHz)	Max. Limit (dBm/3kHz)	Test Result
2402	-13.930	0.040	8.00	Pass
2440	-14.390	0.036	8.00	Pass
2480	-14.990	0.032	8.00	Pass

TX CH00



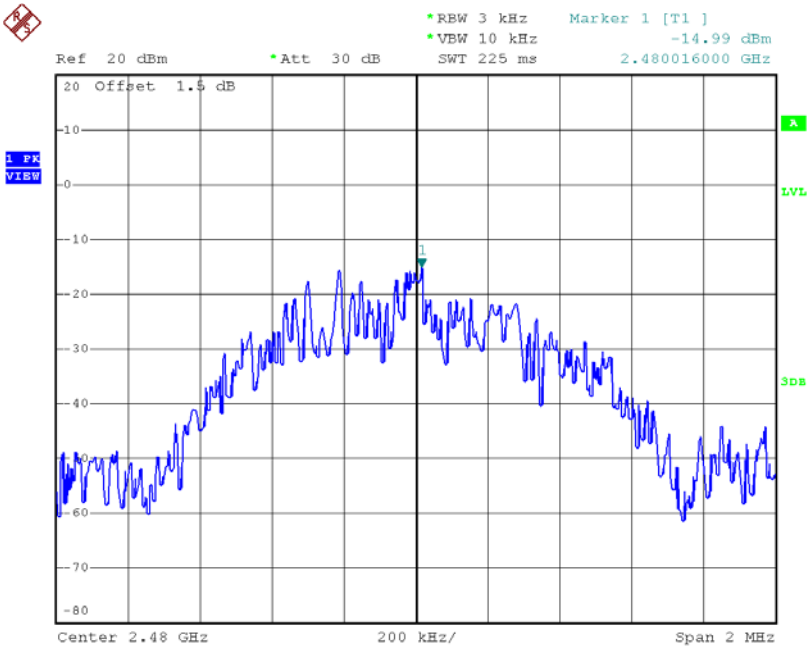
Date: 18.JUL.2018 09:48:55

TX CH19



Date: 18.JUL.2018 09:51:09

TX CH39



Date: 18.JUL.2018 09:55:01