

FCC Radio Test Report

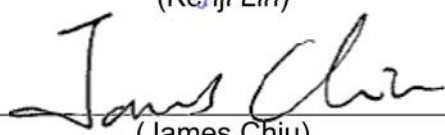
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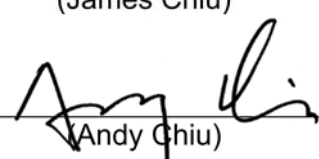
This report concerns (check one): ☒ Original Grant ☐ Class I Change ☐ Class II Change

Project No. : 1706188
Equipment : 802.11ac/a/b/g/n Wi-Fi+BT Module
Test Model : WPEQ-160ACN(BT)
Series Model : WPEQ-160ACN
Applicant : SparkLAN Communications, Inc.
Address : 8F., No.257, Sec.2, Tiding-Blvd., Nei-Hu District, Taipei
City 11493, Taiwan (R.O.C.)

Date of Receipt : Sep. 13, 2017
Date of Test : Sep. 13, 2017 ~ Jan. 05, 2018
Issued Date : Jan. 10, 2018
Tested by : BTL Inc.

Testing Engineer : 
(Kehji Lin)

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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-4-1706188	Original Issue.	Jan. 10, 2018

1. CERTIFICATION

Equipment : 802.11ac/a/b/g/n Wi-Fi+BT Module
Brand Name : SparkLAN
Test Model : WPEQ-160ACN(BT)
Series Model : WPEQ-160ACN
Applicant : SparkLAN Communications, Inc.
Manufacturer : SparkLAN Communications, Inc.
Address : 8F.,No.257,Sec.2,Tiding-Blvd.,Neihu District,Taipei City 11493,Taiwan (R.O.C.)
Date of Test : Sep. 13, 2017 ~ Jan. 05, 2018
Test Sample : Production Unit
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-4-1706188) 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:965108; FCC DN:TW1082)

No. 68-1, Ln. 169, Sec.2, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan

Radiated emission Test (Below 1 GHz):

CB15: (FCC RN:674415; FCC DN:TW0659)

No. 68-1, Ln. 169, Sec.2, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan

Radiated emission Test (Above 1 GHz):

CB15: (FCC RN:674415; FCC DN:TW0659)

No. 68-1, Ln. 169, Sec.2, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan

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 U_{cispr} requirement.

The reported uncertainty of measurement $y \pm U$, 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	802.11ac/a/b/g/n Wi-Fi+BT Module		
Brand Name	SparkLAN		
Test Model	WPEQ-160ACN(BT)		
Series Model	WPEQ-160ACN		
Model Difference	Model No.	WPEQ-160ACN(BT)	WPEQ-160ACN
	BT Function	○	×
EUT Power Rating	DC 3.3V (System supplied.)		
Output Power (Max.)	Operation Frequency	2402~2480 MHz	
	Modulation Technology	GFSK(1Mbps)	
	Bit Rate of Transmitter		
	Output Power (Max.)	1.80 dBm (1Mbps)	

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. The EUT doesn't support one or more than one antenna simultaneous transmitting for BT/WIFI 2.4G & 5G.

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	Wanshin	WSS038	Dipole	RP-SMA	4.6

Note: 2 U.FL connectors (main antenna 0 on, diversity antenna 1 off) for 1T1R.

3.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generated from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possibly 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)

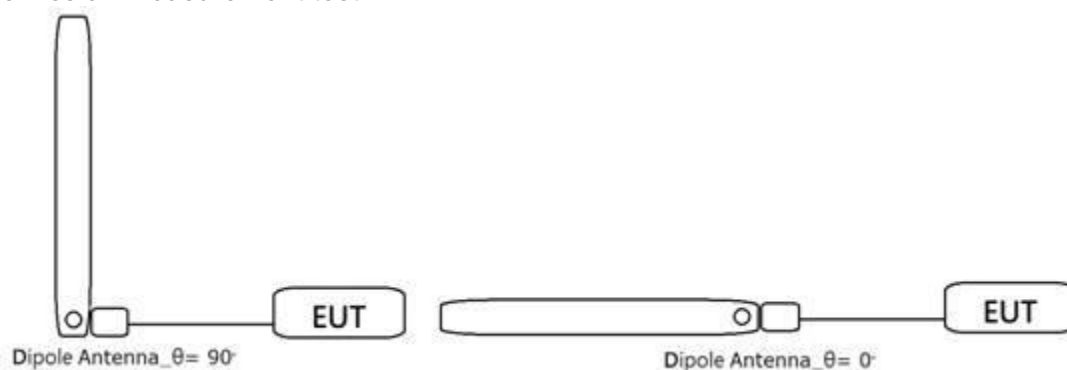
The EUT system operated these modes were found to be the worst case during the pre-scanning test as following:

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.
- (2) Orthogonal axis X is found to be the worst case and recorded.
- (3) For Dipole Antenna, the EUT has pre-tested on positioned of 0° & 90°. The worst case was found positioned on 90°. Therefore only the test data of this 90° was used for radiated emission measurement test.



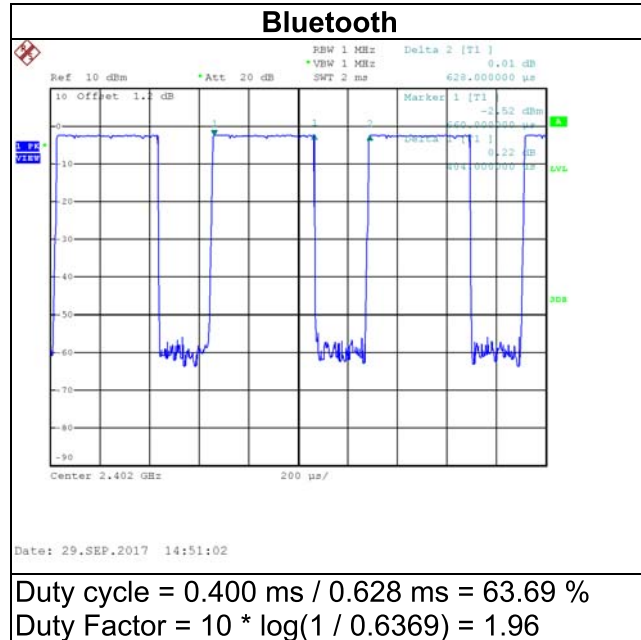
3.3 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING

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	QRCT		
Frequency (MHz)	2402	2440	2480
BT LE	Default	Default	Default

3.4 DUTY CYCLE

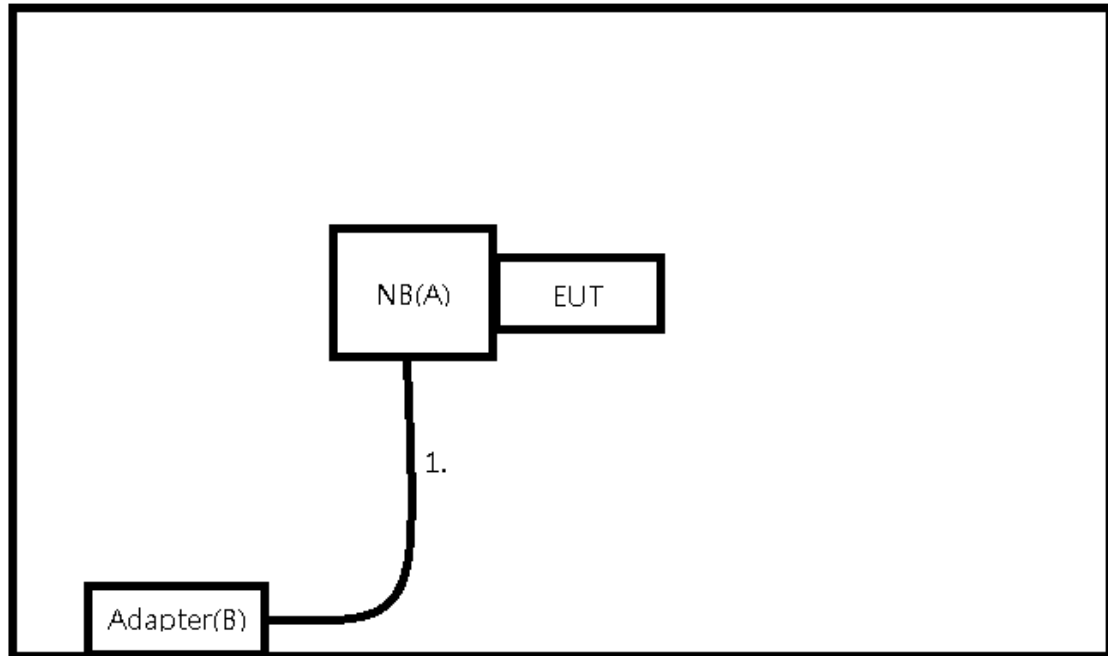
If duty cycle is $\geq 98\%$, duty factor is not required.
If duty cycle is $< 98\%$, duty factor shall be considered.



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	Notebook PC	HP	TPN-I119	N/A	N/A
B	Adapter	HP	HSTNN-CA40	N/A	N/A

Item	Shielded Type	Ferrite Core	Length	Note
1	YES	NO	1.5	Power 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 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

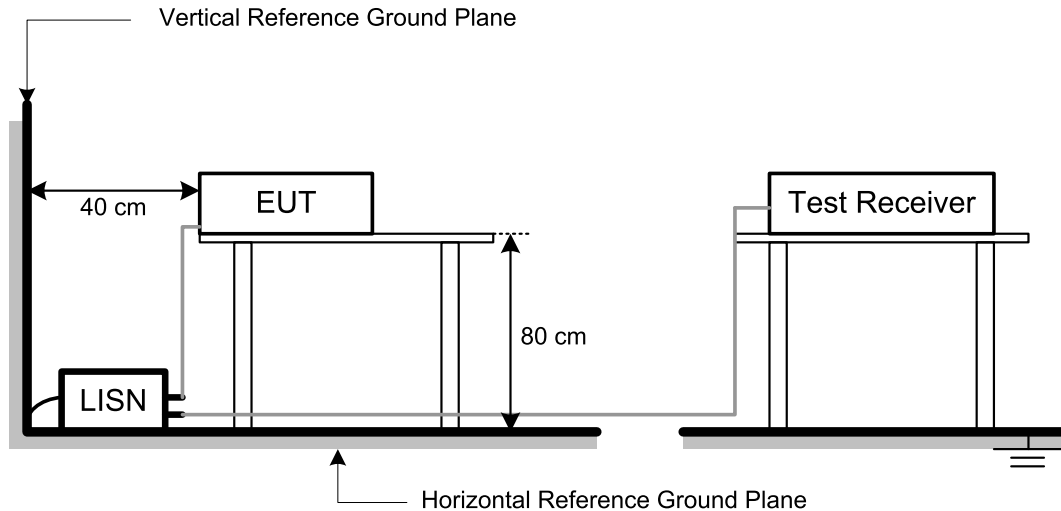
4.1.2 TEST PROCEDURE

- 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: 24°C Relative Humidity: 60% Test Voltage: AC 120V/60Hz

4.1.7 TEST RESULTS

Please refer to the Attachment 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

Notes:

- (1) The 9k ~ 30MHz radiated emissions have been verified between the Semi-anechoic chamber and Open site, it meets KDB414788 requirement.

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

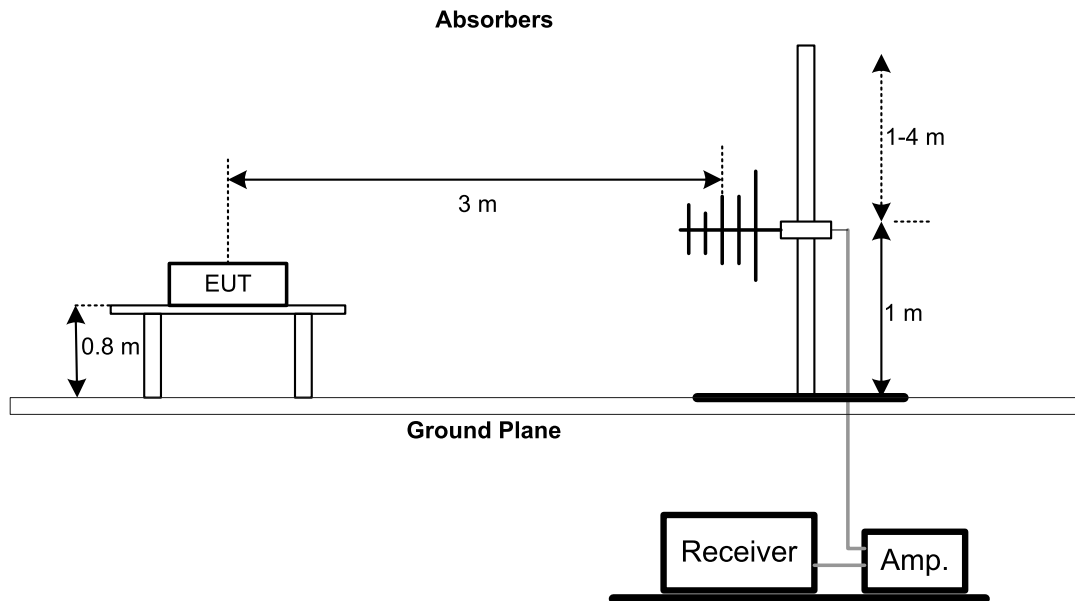
- The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1GHz)
- The measuring distance of 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)
- 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.
- 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).
- 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.
- 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.
- 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)
- 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)
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.2.3 DEVIATION FROM TEST STANDARD

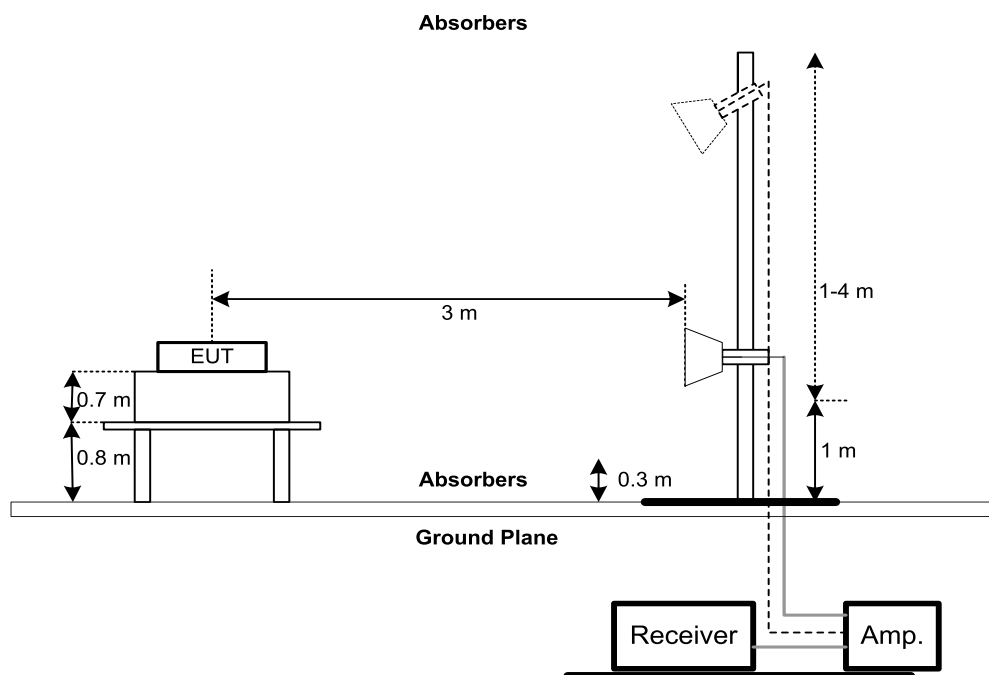
No deviation

4.2.4 TEST SETUP

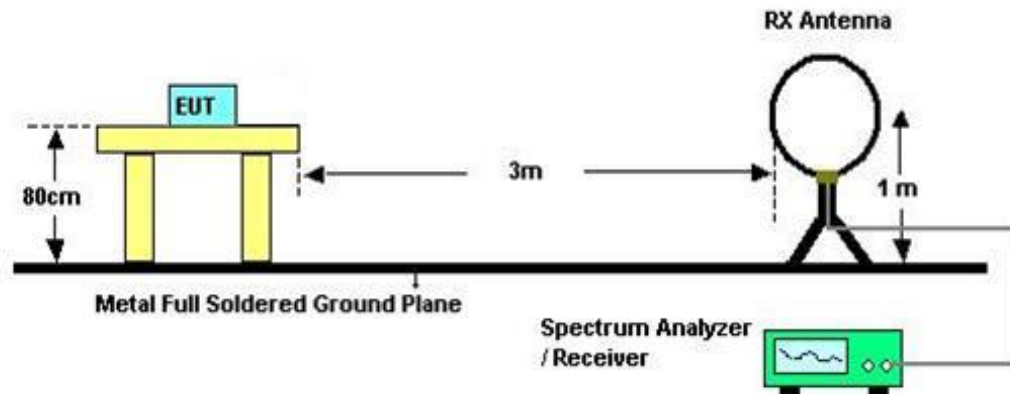
(A) Radiated Emission Test Set-Up Frequency Below 1 GHz



(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

4.2.7 TEST RESULTS (9KHZ TO 30MHZ)

Please refer to the Attachment 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 = $40 \log (\text{specific distance} / \text{test distance})$ (dB).
- (3) Limit line = specific limits (dBuV) + distance extrapolation factor.

4.2.8 TEST RESULTS (30MHZ TO 1000 MHZ)

Please refer to the Attachment C.

4.2.9 TEST RESULTS (ABOVE 1000 MHZ)

Please refer to the Attachment 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	$\geq 500\text{KHz}$ (6dB bandwidth)	2400-2483.5	PASS

5.1.1 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- 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 Attachment 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

- The EUT was directly connected to the power meter and antenna output port as show in the block diagram below,
- 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 Attachment 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

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting : RBW= 100KHz, VBW=300KHz, Sweep time = 10 ms.
- 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 Attachment 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

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- 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 Attachment 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. 25, 2018
2	Test Cable	TIMES	CFD300-NL	C02	Jun. 13, 2018
3	EMI Test Receiver	R&S	ESR7	101433	Dec. 08, 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. 28, 2018
2	Preamplifier	EMCI	EMC02325	980217	Dec. 28, 2018
3	Preamplifier	EMCI	EMC2654045	980030	Feb. 14, 2018
4	Test Cable	EMCI	EMC104-SM-S M-8000	8m	Jan. 04, 2018
5	Test Cable	EMCI	EMC104-SM-S M-800	150207	Jan. 04, 2018
6	Test Cable	EMCI	EEMC104-SM-S M-3000	151205	Jan. 04, 2018
7	MXE EMI Receiver	Agilent	N9038A	MY55420127	Jan. 09, 2018
8	Signal Analyzer	Agilent	N9010A	MY52220990	Feb. 22, 2018
9	Loop Ant	EMCO	6502	42960	Nov. 23, 2018
10	Horn Ant	SCHWARZBECK	BBHA 9120D	9120D-1342	Feb. 28, 2018
11	Horn Ant	Schwarzbeck	BBHA 9170	187	May 11, 2018
12	Trilog-Broadband Antenna	Schwarzbeck	VULB 9168	9168-548	Jan. 16, 2018
13	5dB Attenuator	EMCI	EMCI-N-6-05	AT-N0623	Jan. 16, 2018

6dB Bandwidth Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	R&S/FSP30	100854	May 25, 2018

Peak Output Power Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Power Meter	Anritsu	ML2495A	1128008	Aug. 17, 2018
2	Power Sensor	Anritsu	MA2411B	1126001	Aug. 17, 2018

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	May 25, 2018

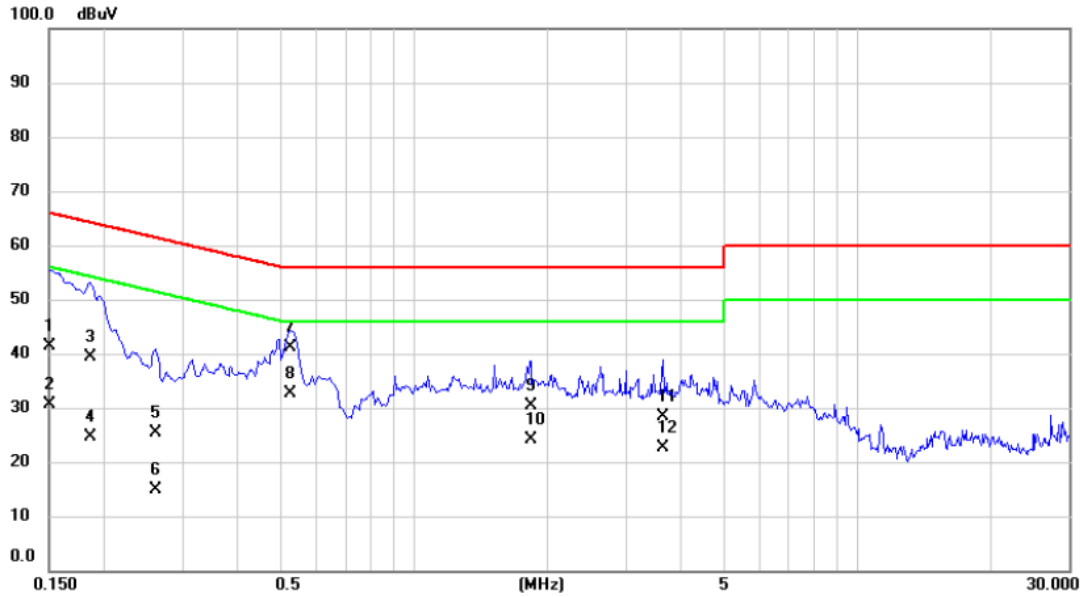
Power Spectral Density Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	R&S/FSP30	100854	May 25, 2018

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

ATTACHMENT A - CONDUCTED EMISSION

Test Mode:	TX Mode
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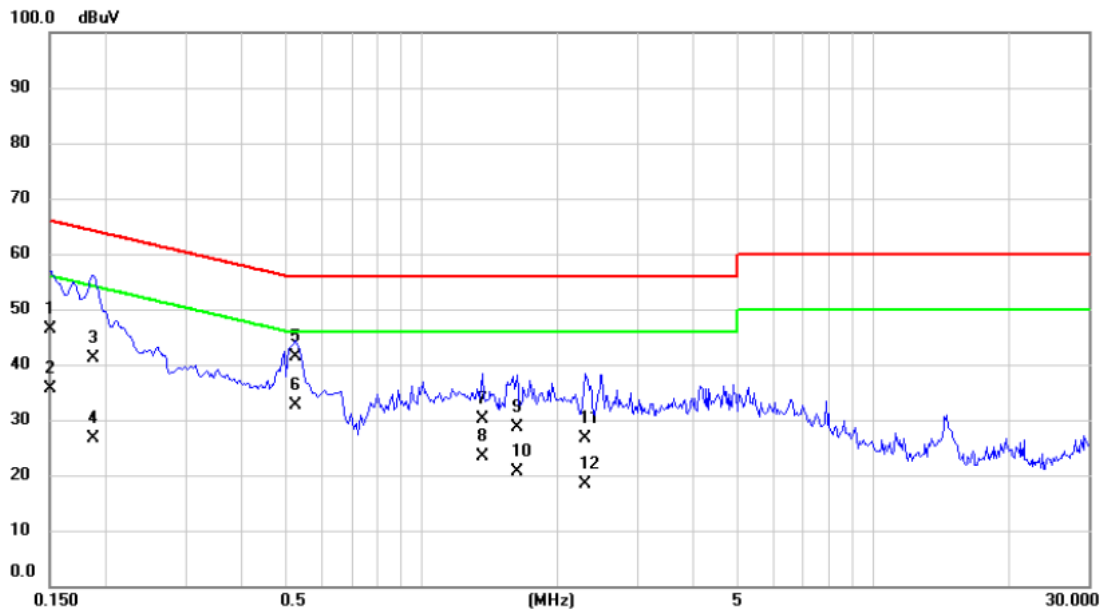
Line



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Margin dB	Detector	Comment
1		0.1507	31.60	9.73	41.33	65.96	-24.63	QP	
2		0.1507	21.00	9.73	30.73	55.96	-25.23	AVG	
3		0.1857	29.70	9.72	39.42	64.23	-24.81	QP	
4		0.1857	14.90	9.72	24.62	54.23	-29.61	AVG	
5		0.2613	15.60	9.73	25.33	61.39	-36.06	QP	
6		0.2613	5.20	9.73	14.93	51.39	-36.46	AVG	
7		0.5270	31.30	9.74	41.04	56.00	-14.96	QP	
8	*	0.5270	22.80	9.74	32.54	46.00	-13.46	AVG	
9		1.8320	20.70	9.77	30.47	56.00	-25.53	QP	
10		1.8320	14.40	9.77	24.17	46.00	-21.83	AVG	
11		3.6500	18.60	9.80	28.40	56.00	-27.60	QP	
12		3.6500	12.80	9.80	22.60	46.00	-23.40	AVG	

Test Mode: TX Mode

Neutral

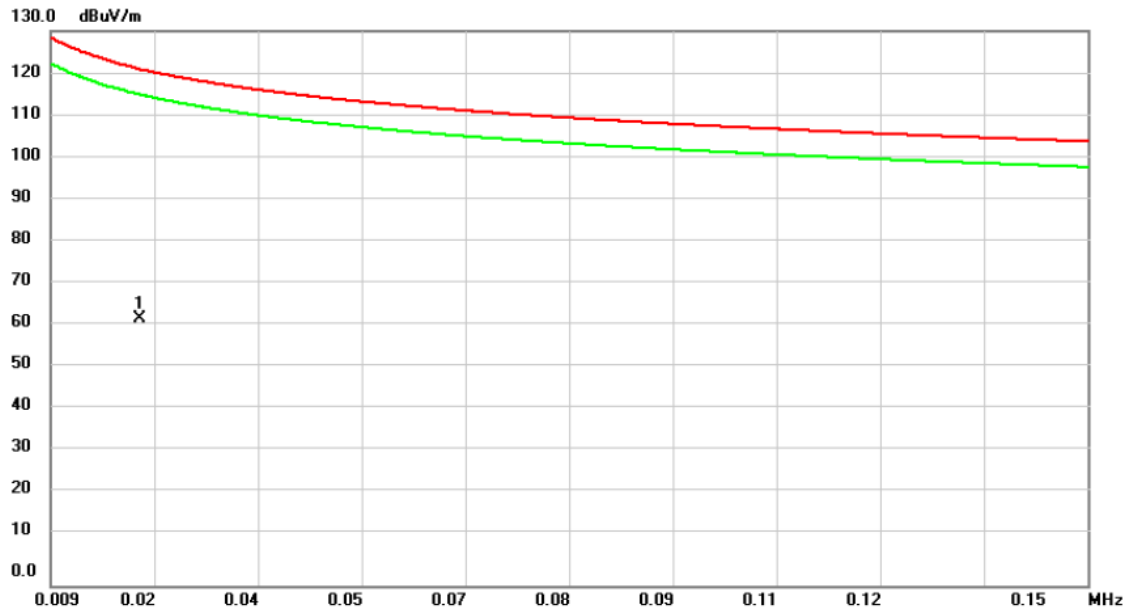


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Margin dB	Detector	Comment
1		0.1500	36.80	9.65	46.45	66.00	-19.55	QP	
2		0.1500	25.90	9.65	35.55	56.00	-20.45	AVG	
3		0.1870	31.50	9.65	41.15	64.17	-23.02	QP	
4		0.1870	16.90	9.65	26.55	54.17	-27.62	AVG	
5		0.5270	31.60	9.68	41.28	56.00	-14.72	QP	
6	*	0.5270	23.00	9.68	32.68	46.00	-13.32	AVG	
7		1.3640	20.50	9.69	30.19	56.00	-25.81	QP	
8		1.3640	13.70	9.69	23.39	46.00	-22.61	AVG	
9		1.6250	18.90	9.71	28.61	56.00	-27.39	QP	
10		1.6250	11.00	9.71	20.71	46.00	-25.29	AVG	
11		2.3000	16.80	9.72	26.52	56.00	-29.48	QP	
12		2.3000	8.60	9.72	18.32	46.00	-27.68	AVG	

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

Test Mode: TX 2480MHz _CH39_1Mbps _θ=90°

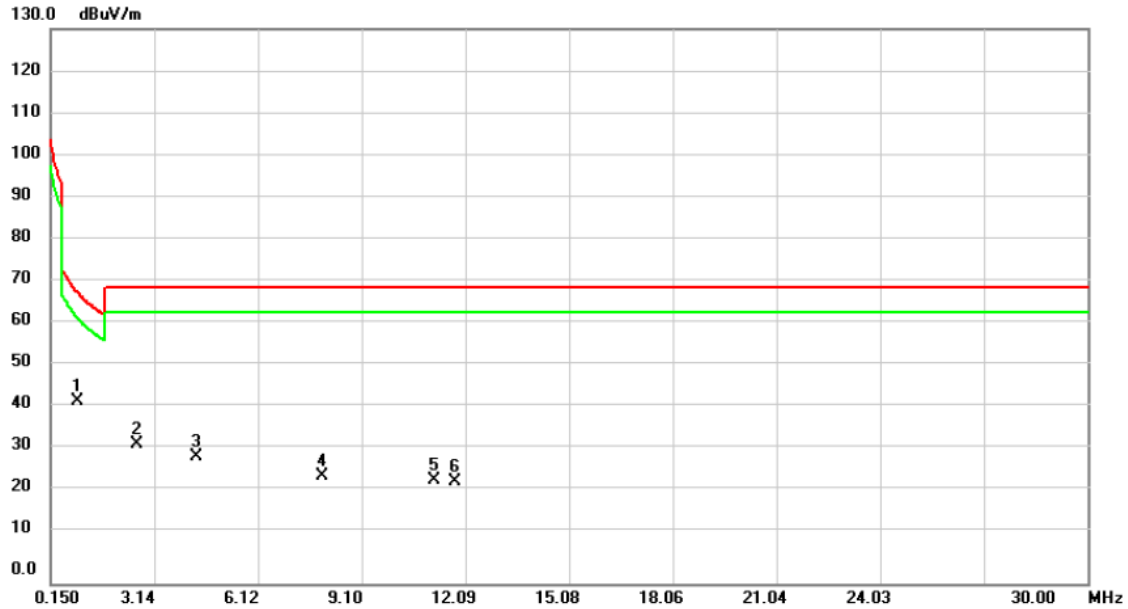
Ant 0°



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1	*	0.0212	45.16	17.42	62.58	121.08	-58.50	peak	

Test Mode: TX 2480MHz _CH39_1Mbps _θ=90°

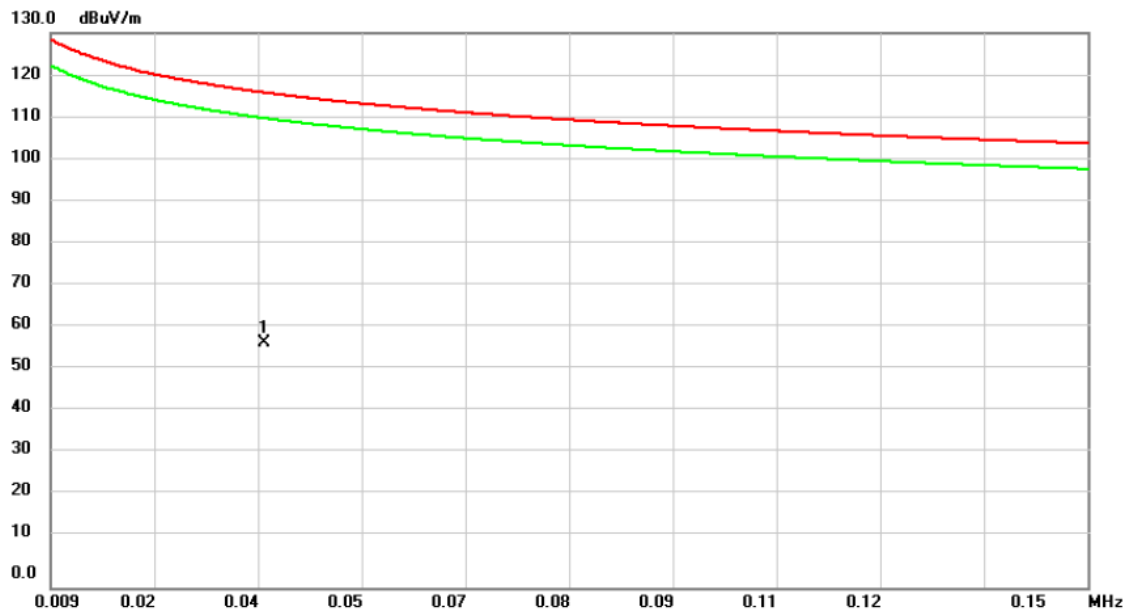
Ant 0°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	0.9261	30.79	11.97	42.76	68.27	-25.51	peak	
2		2.6274	21.29	11.27	32.56	69.54	-36.98	peak	
3		4.3290	18.38	11.30	29.68	69.54	-39.86	peak	
4		7.9706	13.82	11.34	25.16	69.54	-44.38	peak	
5		11.1942	12.82	11.26	24.08	69.54	-45.46	peak	
6		11.7911	12.65	11.25	23.90	69.54	-45.64	peak	

Test Mode:	TX 2480MHz _CH39_1Mbps _θ=90°
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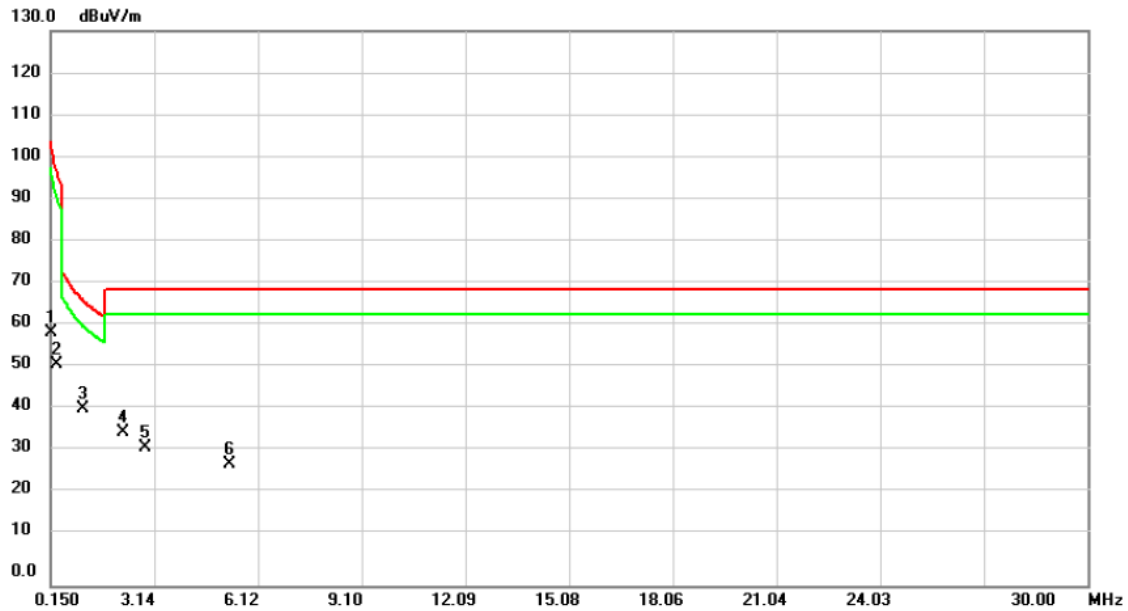
Ant 90°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	0.0380	43.20	14.20	57.40	116.01	-58.61	peak	

Test Mode: TX 2480MHz _CH39_1Mbps _θ=90°

Ant 90°

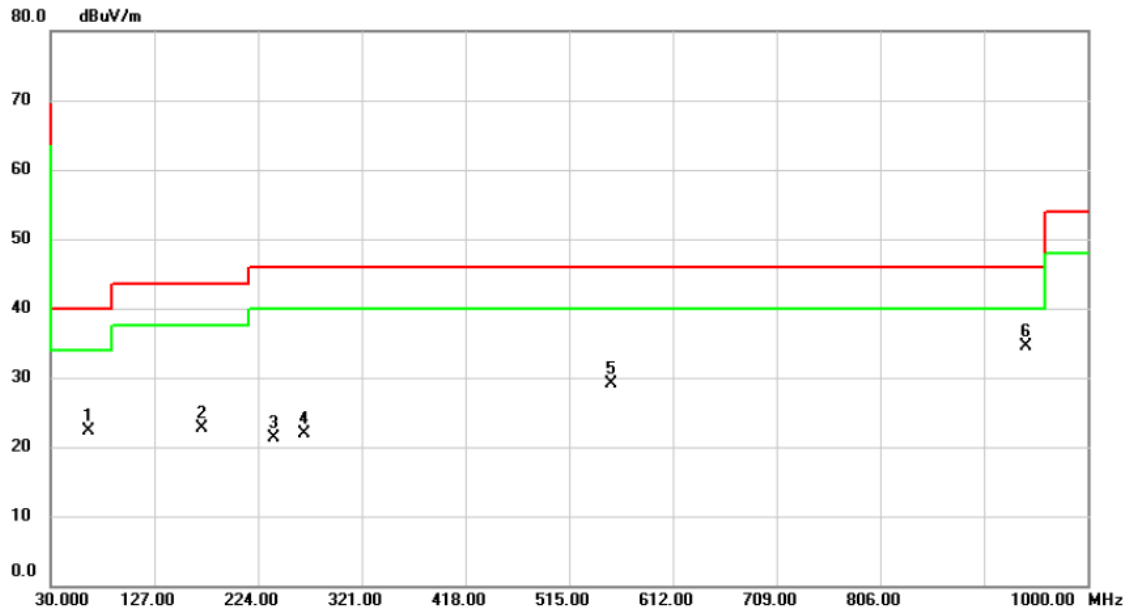


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		0.1500	47.16	12.03	59.19	104.08	-44.89	peak	
2		0.3291	40.16	11.80	51.96	97.26	-45.30	peak	
3	*	1.1050	29.36	11.95	41.31	66.74	-25.43	peak	
4		2.2395	24.62	11.44	36.06	69.54	-33.48	peak	
5		2.8664	21.25	11.16	32.41	69.54	-37.13	peak	
6		5.2842	16.97	11.39	28.36	69.54	-41.18	peak	

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

Test Mode: TX 2480MHz _CH39_1Mbps _θ=90°

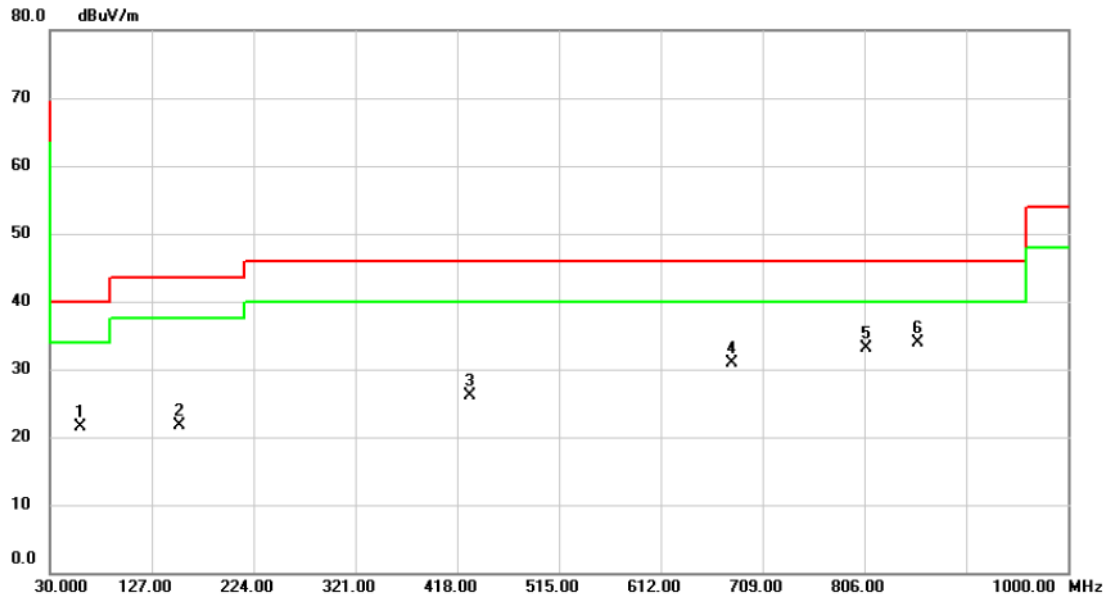
Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		65.8900	31.77	-9.52	22.25	40.00	-17.75	peak	
2		171.6200	31.56	-8.77	22.79	43.50	-20.71	peak	
3		238.5500	30.76	-9.49	21.27	46.00	-24.73	peak	
4		267.6500	30.50	-8.52	21.98	46.00	-24.02	peak	
5		554.7700	30.71	-1.60	29.11	46.00	-16.89	peak	
6	*	942.7700	29.63	4.78	34.41	46.00	-11.59	peak	

Test Mode: TX 2480MHz _CH39_ 1Mbps_ $\theta=90^\circ$

Horizontal

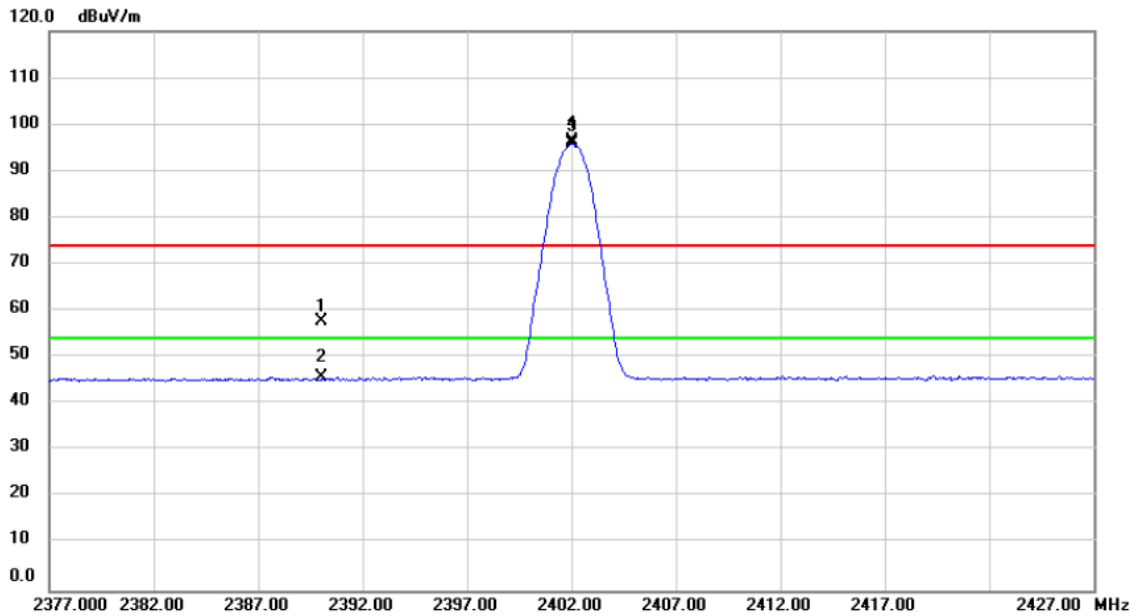


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		59.1000	30.06	-8.57	21.49	40.00	-18.51	peak	
2		153.1900	30.51	-8.83	21.68	43.50	-21.82	peak	
3		430.6100	30.24	-4.10	26.14	46.00	-19.86	peak	
4		679.9000	30.41	0.50	30.91	46.00	-15.09	peak	
5		807.9400	30.34	2.71	33.05	46.00	-12.95	peak	
6	*	857.4100	30.48	3.35	33.83	46.00	-12.17	peak	

ATTACHMENT D - RADIATED EMISSION (ABOVE 1000MHZ)

Test Mode : TX 2402MHz _CH00_1Mbps_θ=90°

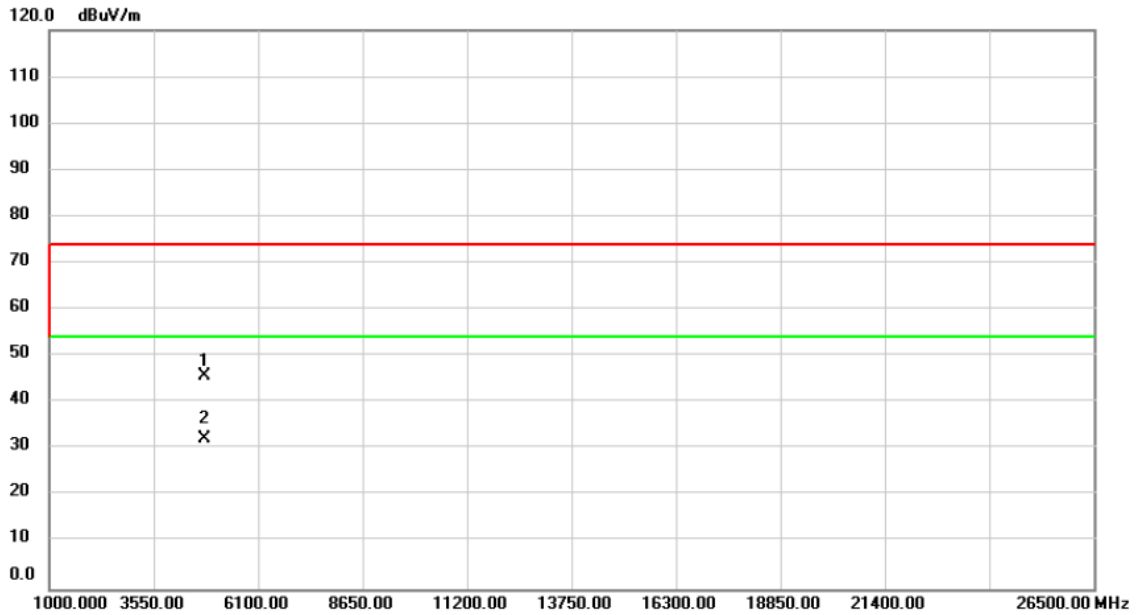
Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		2390.000	26.63	31.06	57.69	74.00	-16.31	peak	
2		2390.000	14.62	31.06	45.68	54.00	-8.32	AVG	
3	X	2402.000	65.37	31.11	96.48	74.00	22.48	peak	No Limit
4	*	2402.000	64.78	31.11	95.89	54.00	41.89	AVG	No Limit

Test Mode :	TX 2402MHz _CH00_1Mbps_θ=90°
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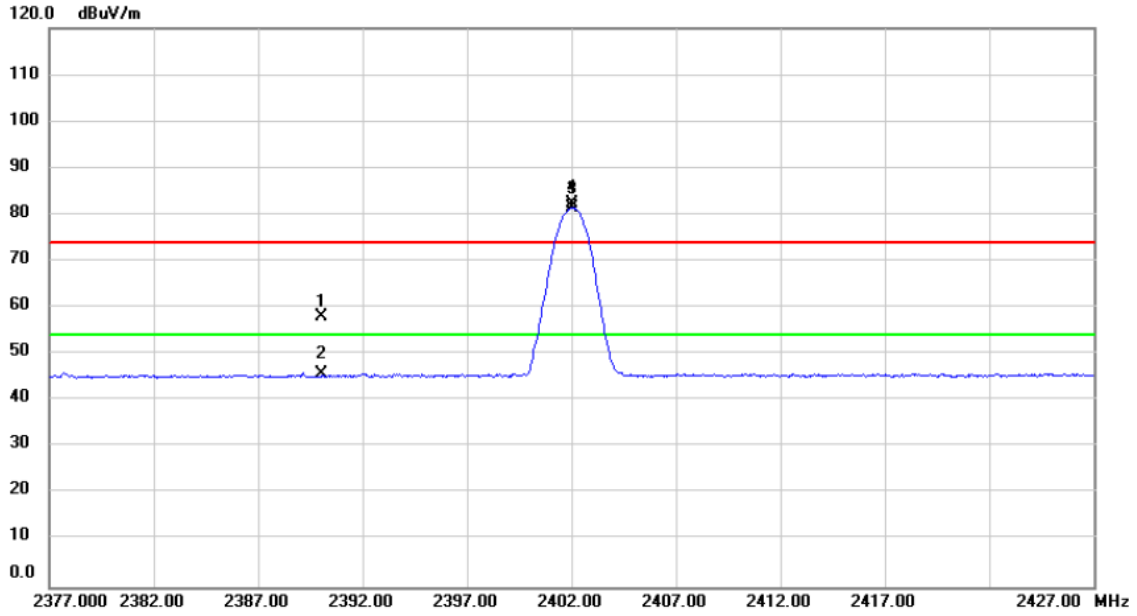
Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4804.000	57.23	-11.40	45.83	74.00	-28.17	peak	
2	*	4804.000	43.59	-11.40	32.19	54.00	-21.81	AVG	

Test Mode : TX 2402MHz _CH00_1Mbps_θ=90°

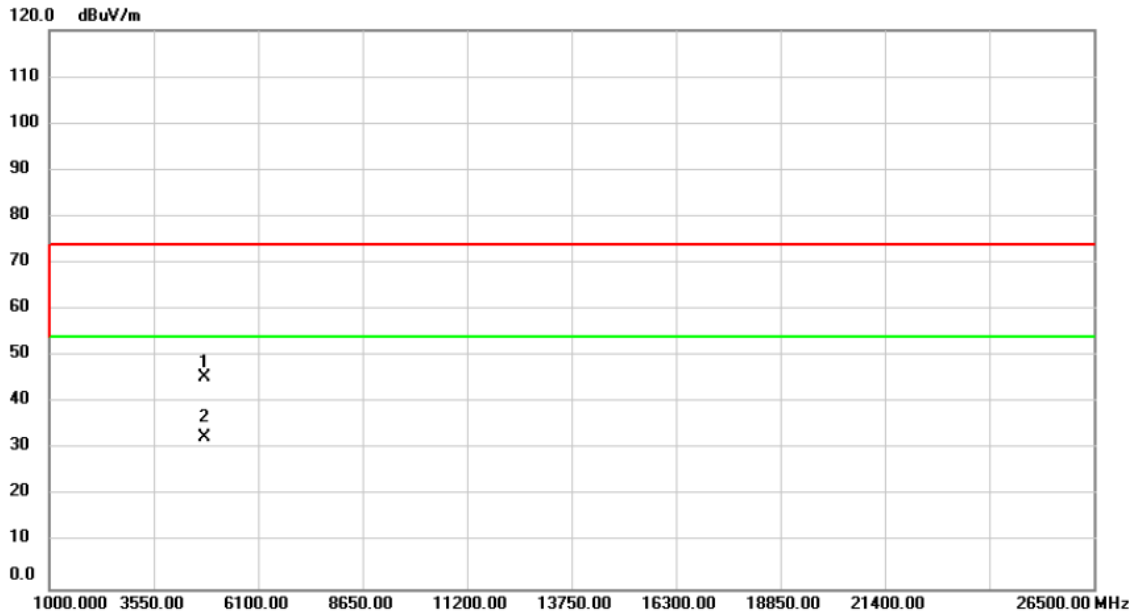
Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		2390.000	26.88	31.06	57.94	74.00	-16.06	peak	
2		2390.000	14.60	31.06	45.66	54.00	-8.34	AVG	
3	X	2402.000	51.14	31.11	82.25	74.00	8.25	peak	No Limit
4	*	2402.000	50.39	31.11	81.50	54.00	27.50	AVG	No Limit

Test Mode :	TX 2402MHz _CH00_ 1Mbps_ $\theta=90^\circ$
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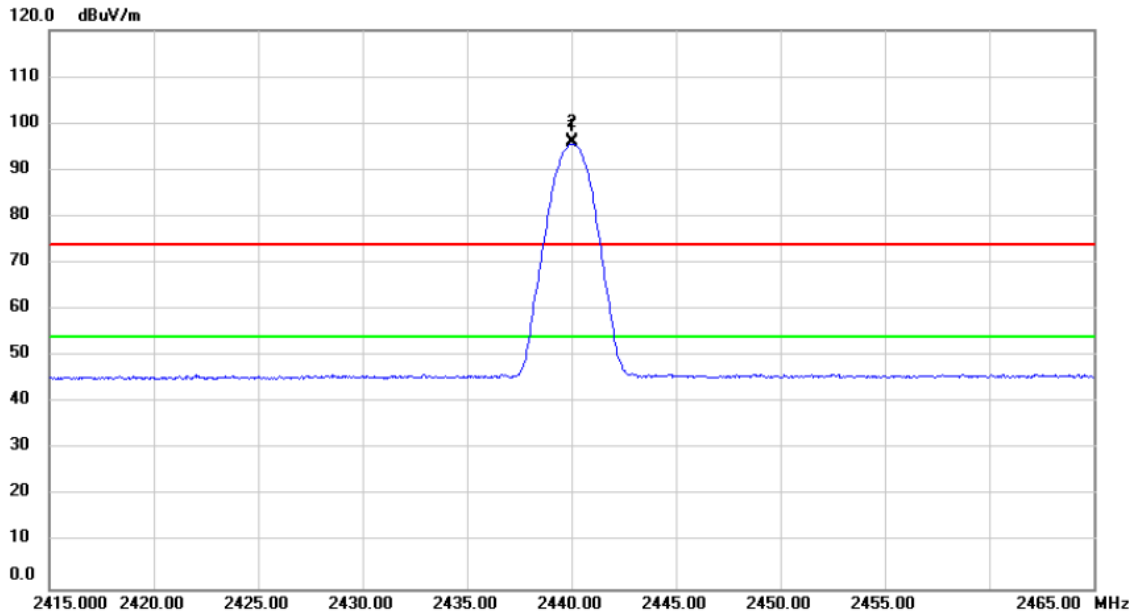
Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4804.000	56.71	-11.40	45.31	74.00	-28.69	peak	
2	*	4804.000	43.83	-11.40	32.43	54.00	-21.57	AVG	

Test Mode :	TX 2440MHz _CH19_ 1Mbps_ $\theta=90^\circ$
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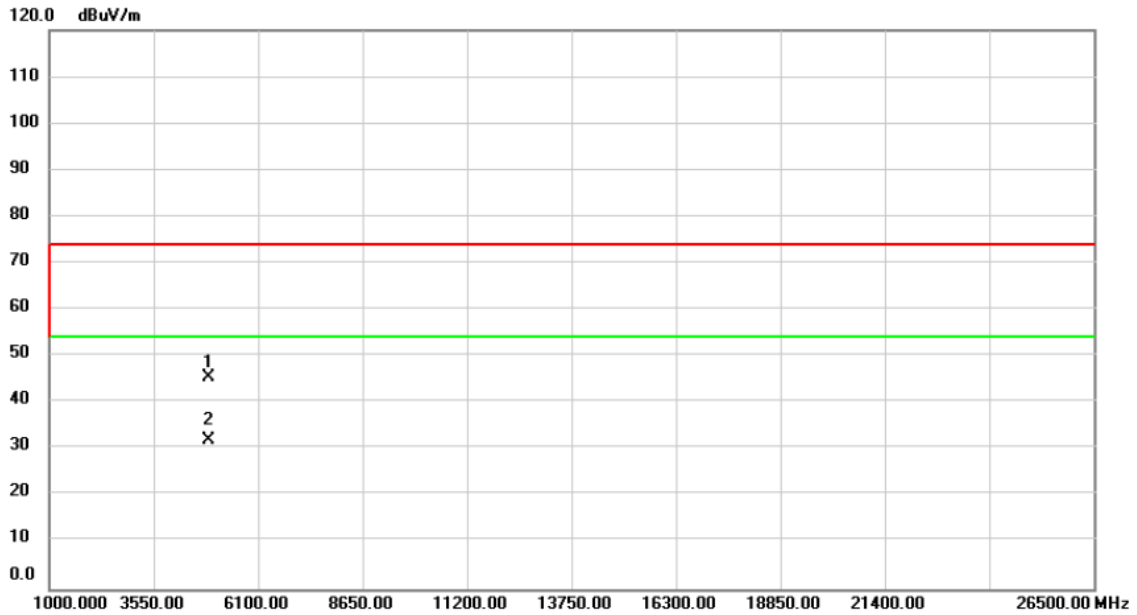
Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1	X	2440.000	65.03	31.25	96.28	74.00	22.28	peak	No Limit
2	*	2440.000	64.50	31.25	95.75	54.00	41.75	AVG	No Limit

Test Mode :	TX 2440MHz _CH19_ 1Mbps_θ=90°
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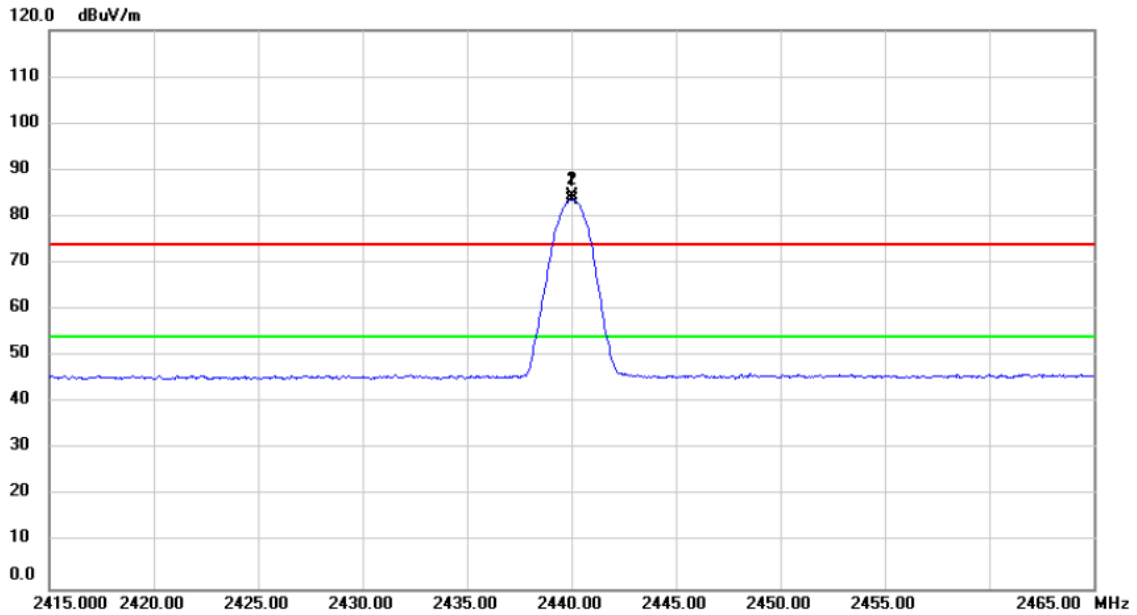
Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4880.000	56.82	-11.28	45.54	74.00	-28.46	peak	
2	*	4880.000	43.36	-11.28	32.08	54.00	-21.92	AVG	

Test Mode :	TX 2440MHz _CH19_ 1Mbps_ $\theta=90^\circ$
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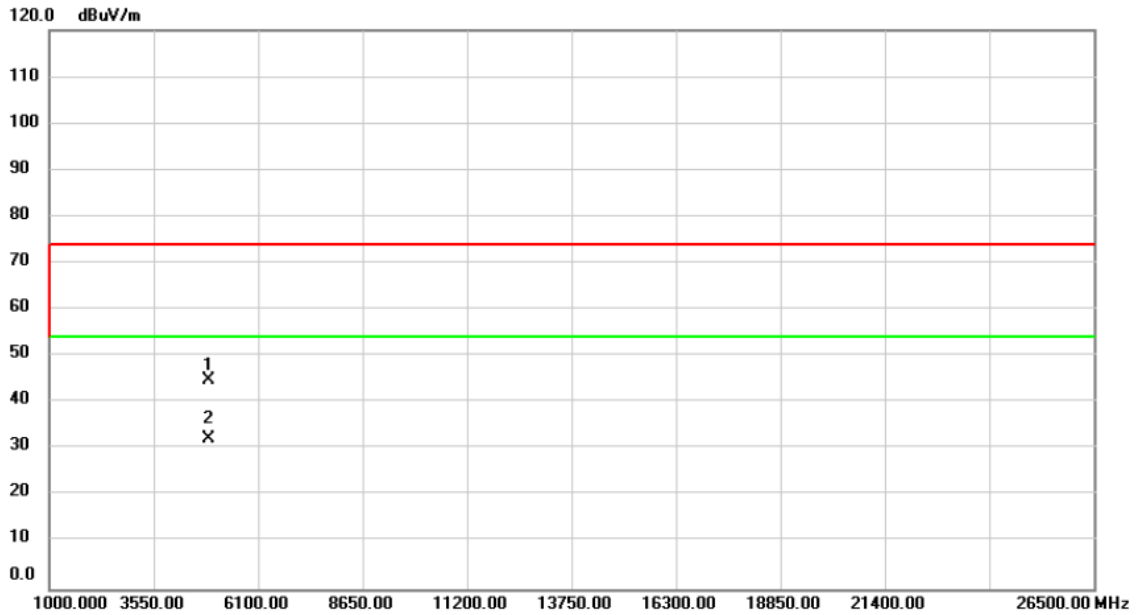
Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	X	2440.000	53.12	31.25	84.37	74.00	10.37	peak	No Limit
2	*	2440.000	52.43	31.25	83.68	54.00	29.68	AVG	No Limit

Test Mode :	TX 2440MHz _CH19_ 1Mbps_θ=90°
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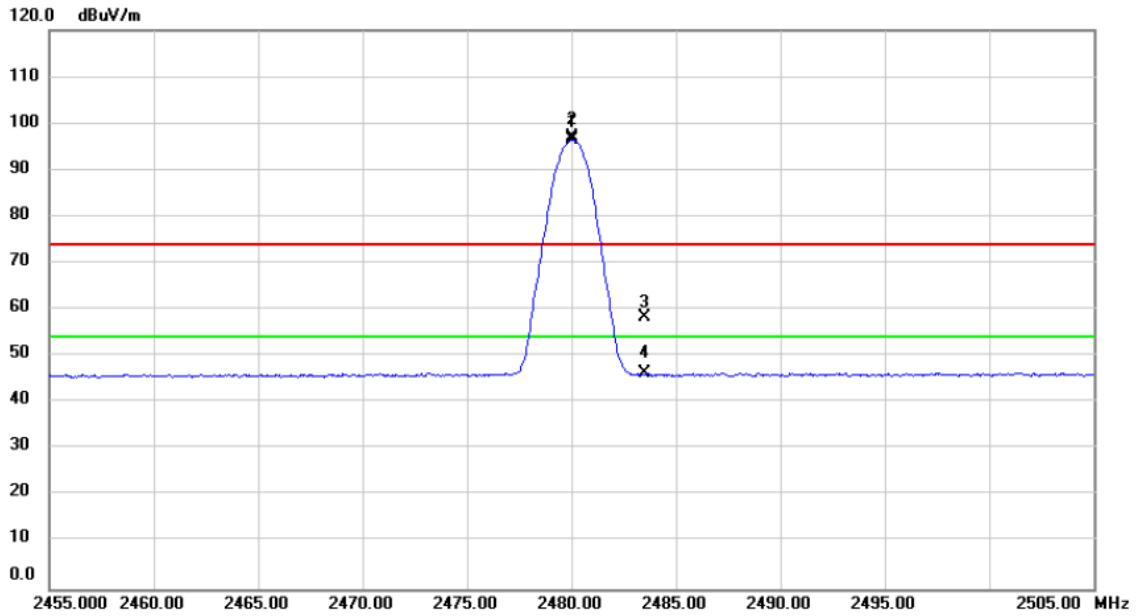
Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4880.000	56.21	-11.28	44.93	74.00	-29.07	peak	
2	*	4880.000	43.47	-11.28	32.19	54.00	-21.81	AVG	

Test Mode : TX 2480MHz _CH39_ 1Mbps_ $\theta=90^\circ$

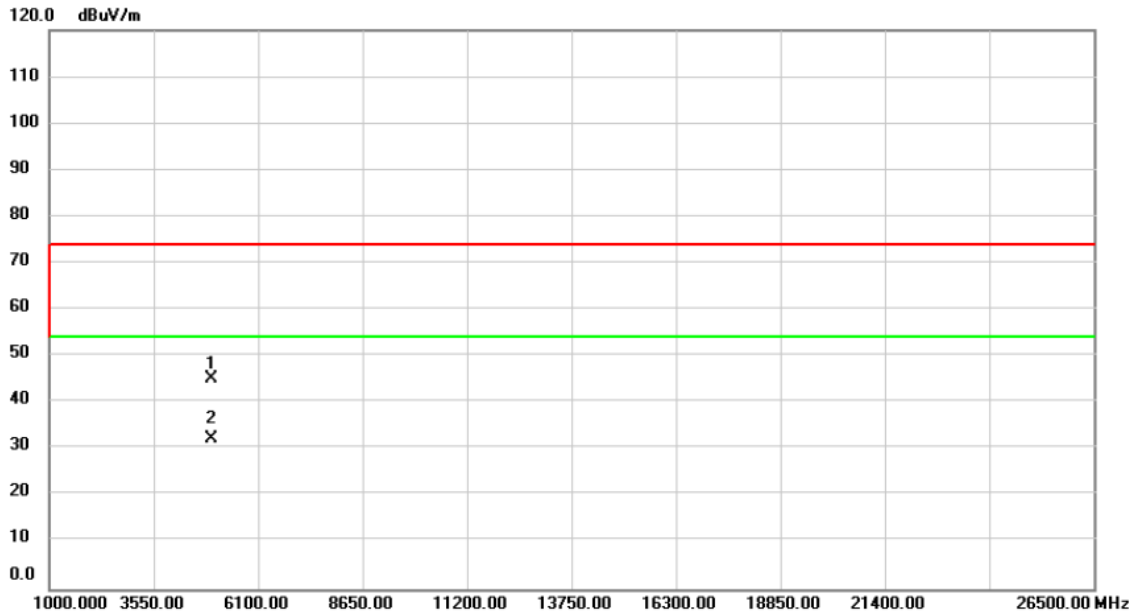
Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1	X	2480.000	65.79	31.39	97.18	74.00	23.18	peak	No Limit
2	*	2480.000	65.17	31.39	96.56	54.00	42.56	AVG	No Limit
3		2483.500	26.86	31.41	58.27	74.00	-15.73	peak	
4		2483.500	15.05	31.41	46.46	54.00	-7.54	AVG	

Test Mode :	TX 2480MHz _CH39_ 1Mbps_θ=90°
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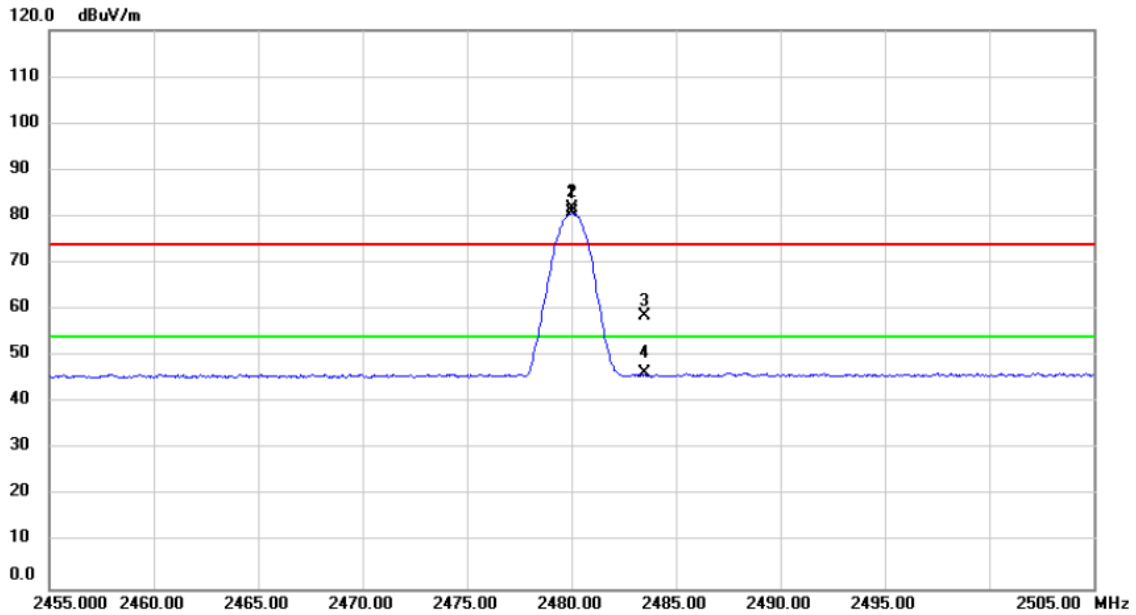
Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4960.000	56.22	-11.15	45.07	74.00	-28.93	peak	
2	*	4960.000	43.54	-11.15	32.39	54.00	-21.61	AVG	

Test Mode : TX 2480MHz _CH39_ 1Mbps_θ=90°

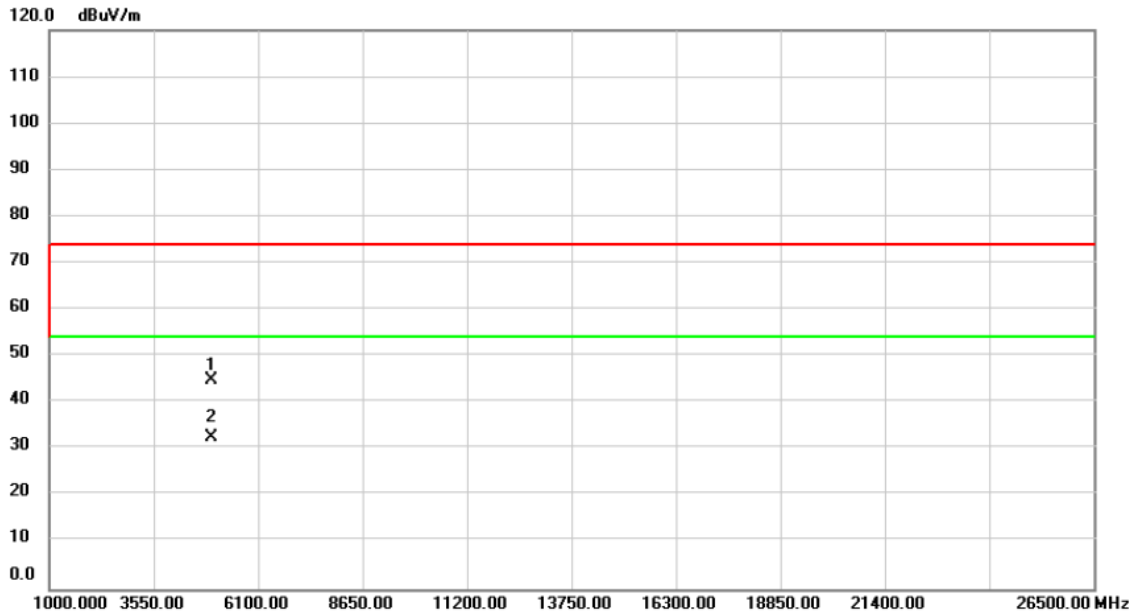
Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1	X	2480.000	50.23	31.39	81.62	74.00	7.62	peak	No Limit
2	*	2480.000	49.41	31.39	80.80	54.00	26.80	AVG	No Limit
3		2483.500	27.19	31.41	58.60	74.00	-15.40	peak	
4		2483.500	14.99	31.41	46.40	54.00	-7.60	AVG	

Test Mode : TX 2480MHz _CH39_1Mbps_θ=90°

Horizontal



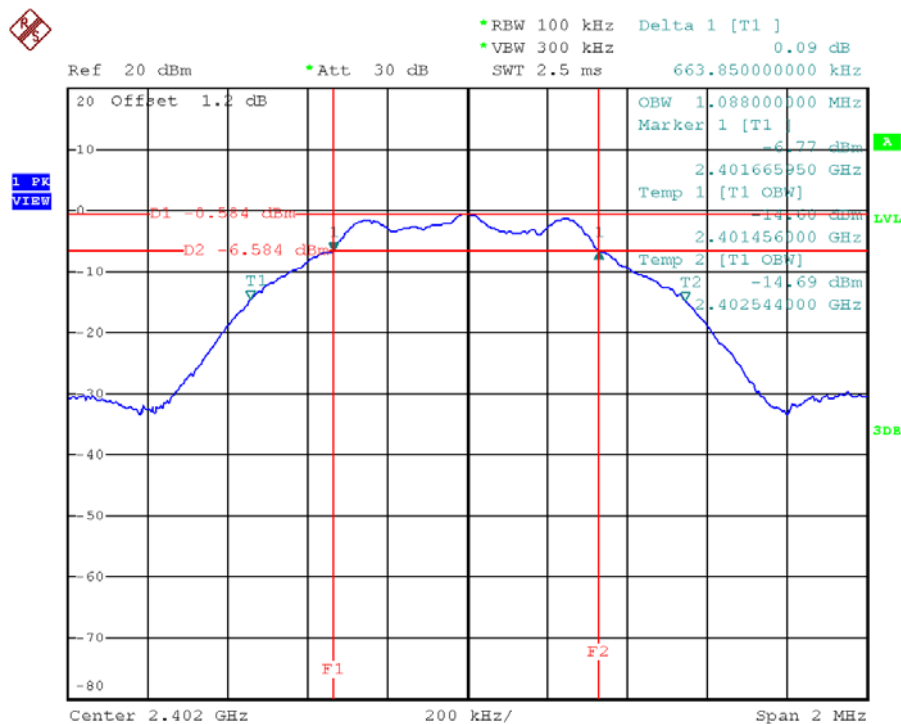
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4960.000	55.98	-11.15	44.83	74.00	-29.17	peak	
2	*	4960.000	43.56	-11.15	32.41	54.00	-21.59	AVG	

ATTACHMENT E - BANDWIDTH

Test Mode:	TX Mode
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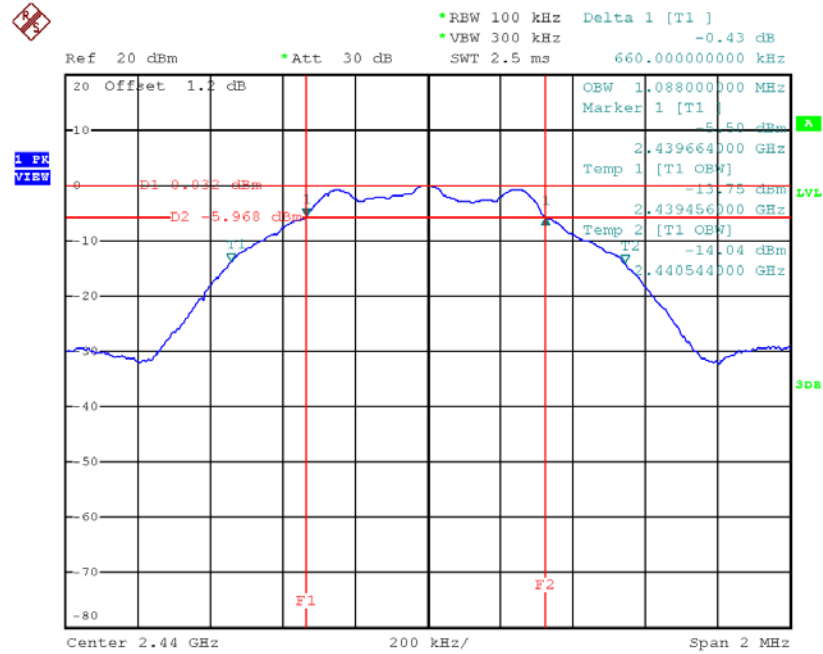
Frequency (MHz)	6dB Bandwidth (MHz)	99% Occupied BW (MHz)	Min. Limit (kHz)	Test Result
2402	0.66	1.09	500	Pass
2440	0.66	1.09	500	Pass
2480	0.67	1.09	500	Pass

TX CH00



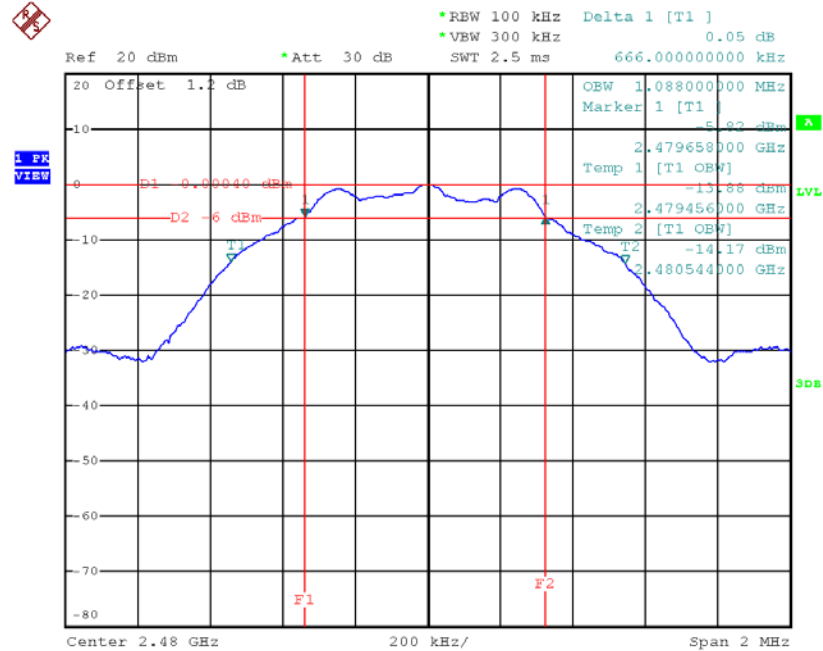
Date: 6.OCT.2017 16:03:27

TX CH19



Date: 6.OCT.2017 16:05:08

TX CH39



Date: 6.OCT.2017 16:06:53

ATTACHMENT F - MAXIMUM OUTPUT POWER TEST

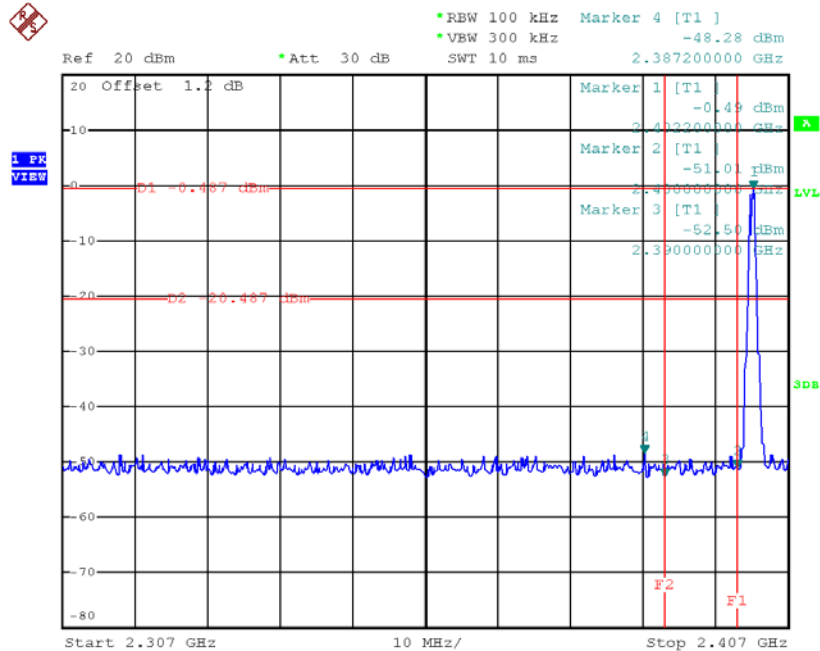
Test Mode :	CH00, CH19 , CH39 - 1Mbps
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Frequency (MHz)	Conducted Power (dBm)	Conducted Power (W)	Max. Limit (dBm)	Max. Limit (W)	Test Result
2402	1.29	0.0013	30.00	1.00	Pass
2440	1.80	0.0015	30.00	1.00	Pass
2480	1.51	0.0014	30.00	1.00	Pass

ATTACHMENT G - ANTENNA CONDUCTED SPURIOUS EMISSION

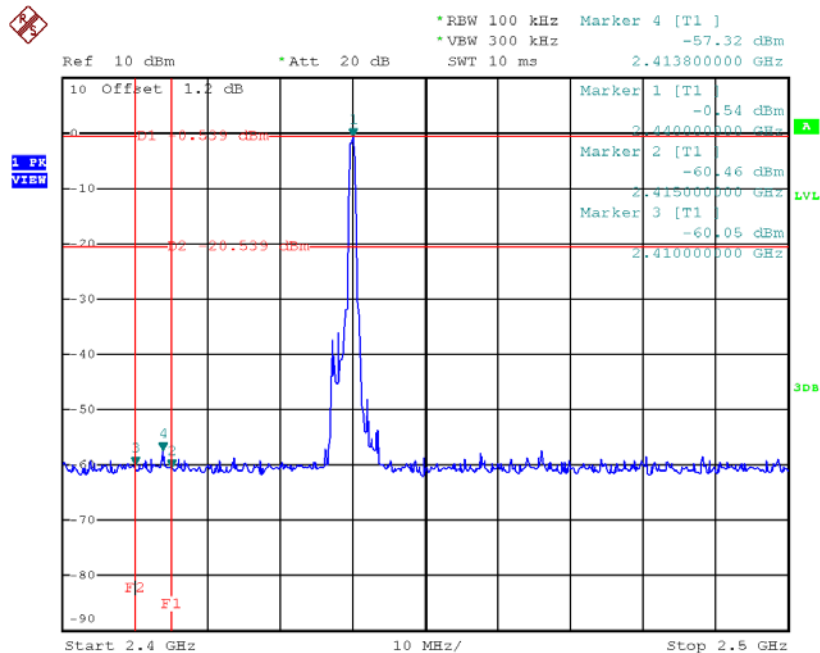
Test Mode : CH00, CH19 , CH39 - 1Mbps

CH00 (Lower) - 1Mbps



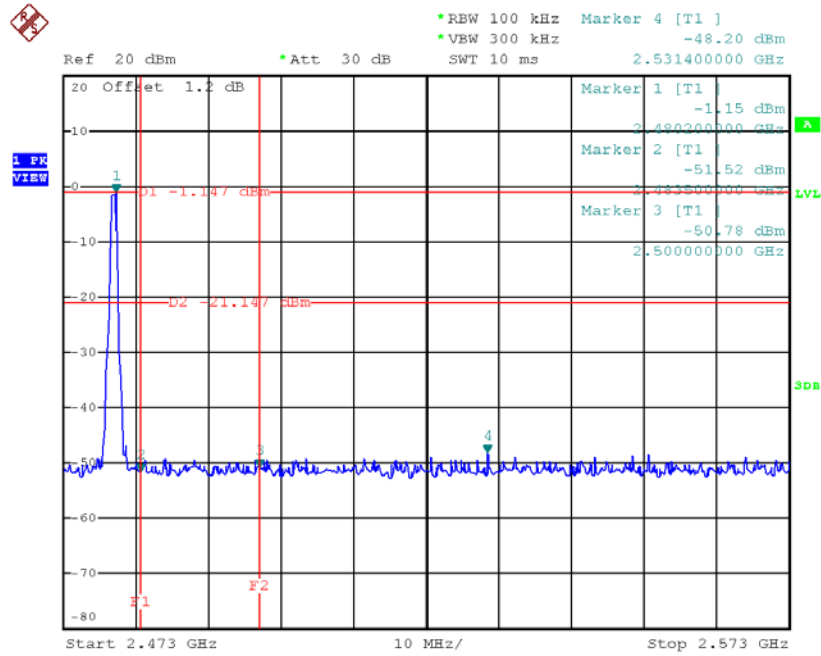
Date: 6.OCT.2017 16:03:36

CH19 (Middle) - 1Mbps



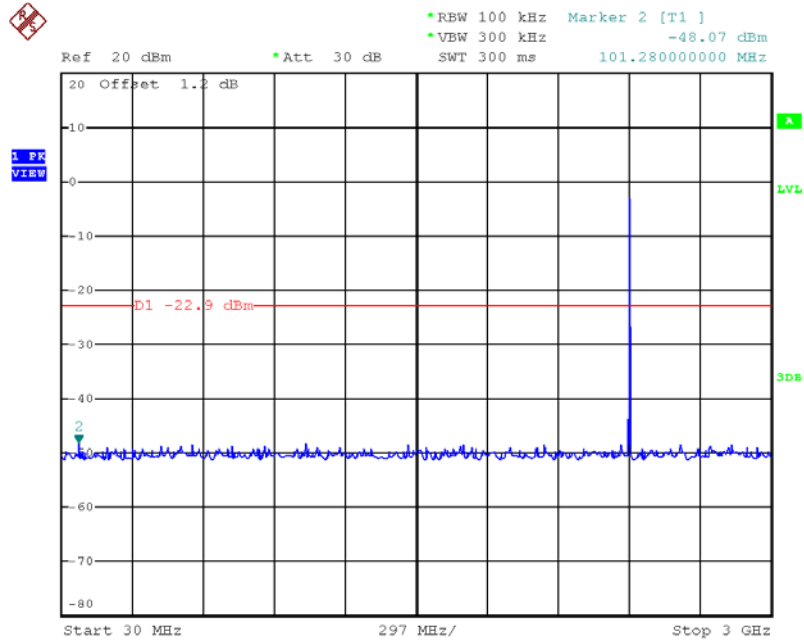
Date: 5.JAN.2018 10:25:22

CH39 (upper) - 1Mbps



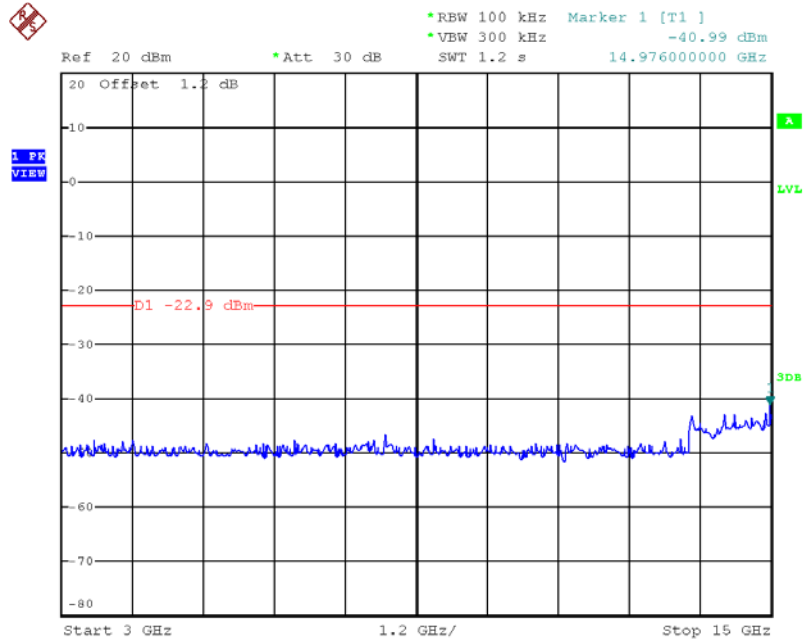
Date: 6.OCT.2017 16:07:01

CH00 (10 Harmonic of the frequency) 1



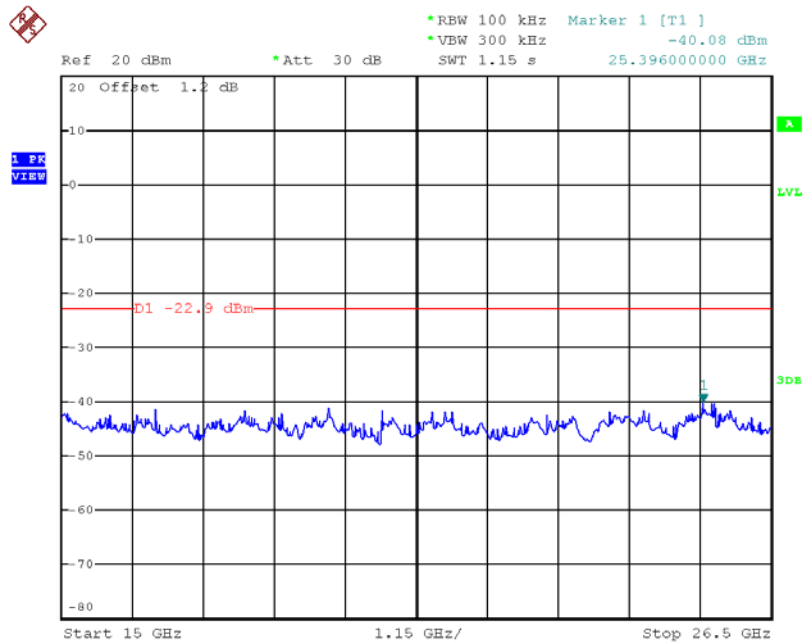
Date: 6.OCT.2017 16:03:49

CH00 (10 Harmonic of the frequency) 2



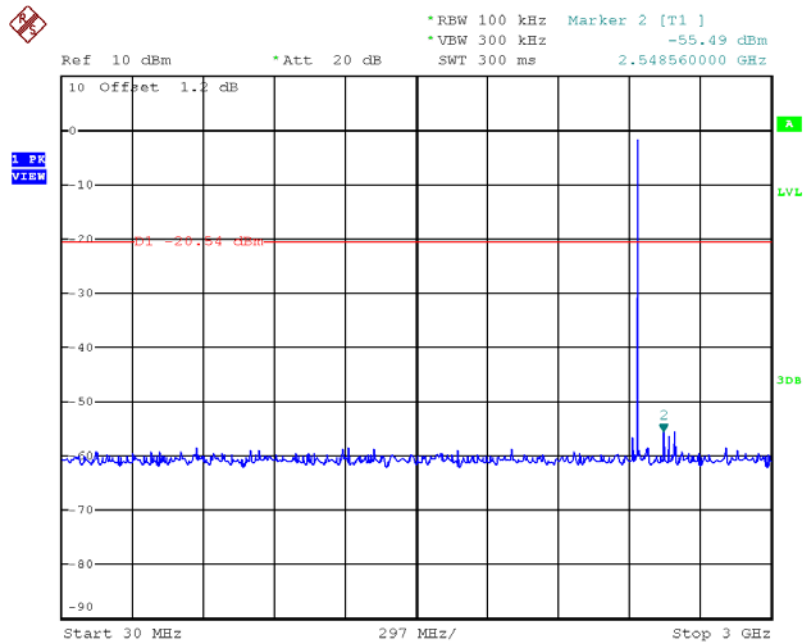
Date: 6.OCT.2017 16:03:56

CH00 (10 Harmonic of the frequency) 3



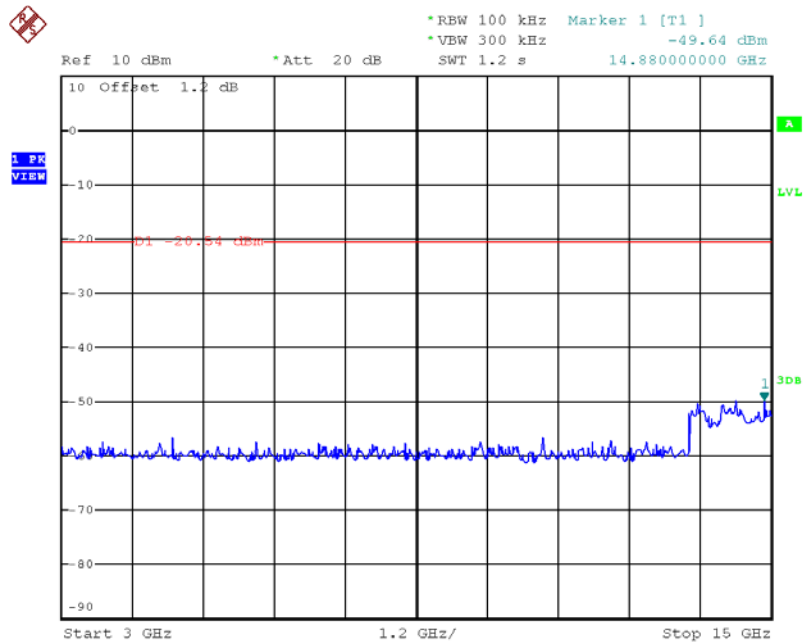
Date: 6.OCT.2017 16:04:03

CH19 (10 Harmonic of the frequency) 1



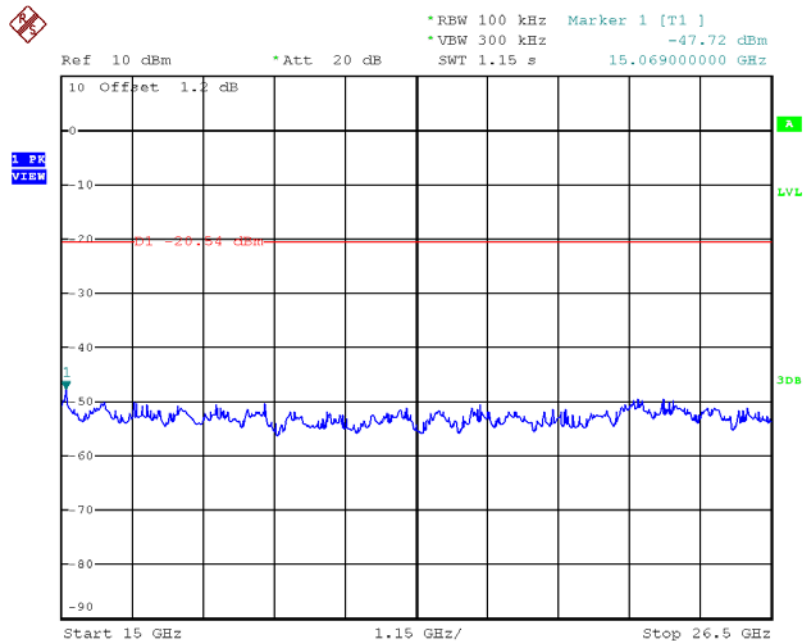
Date: 5.JAN.2018 10:25:35

CH19 (10 Harmonic of the frequency) 2



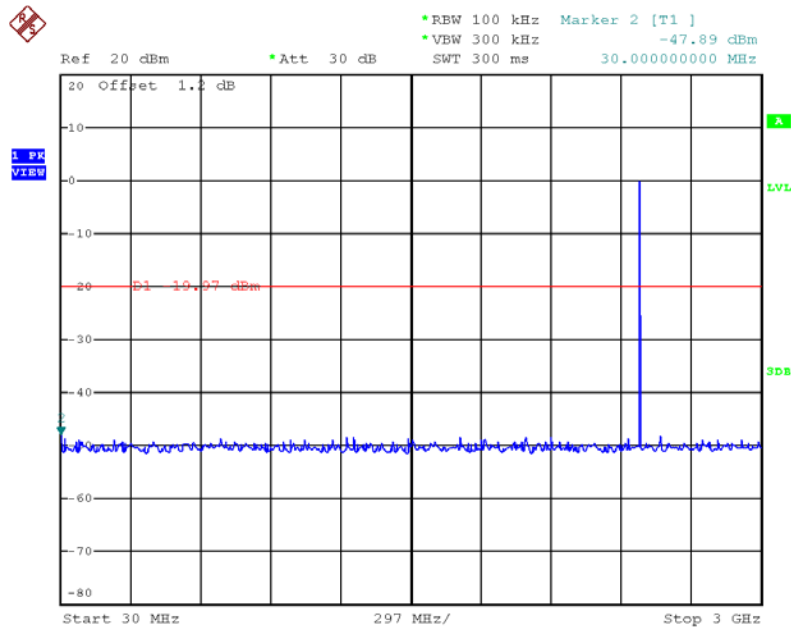
Date: 5.JAN.2018 10:25:42

CH19 (10 Harmonic of the frequency) 3



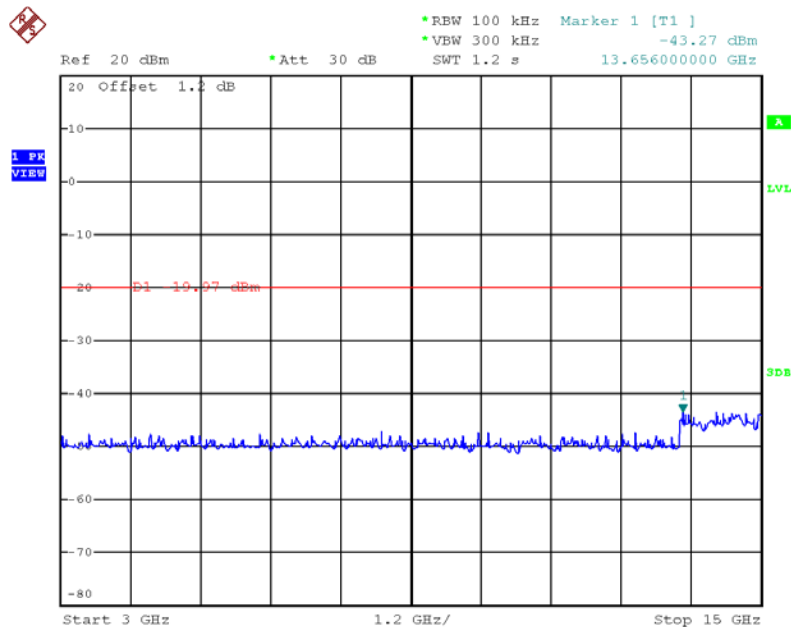
Date: 5.JAN.2018 10:25:49

CH39 (10 Harmonic of the frequency) 1



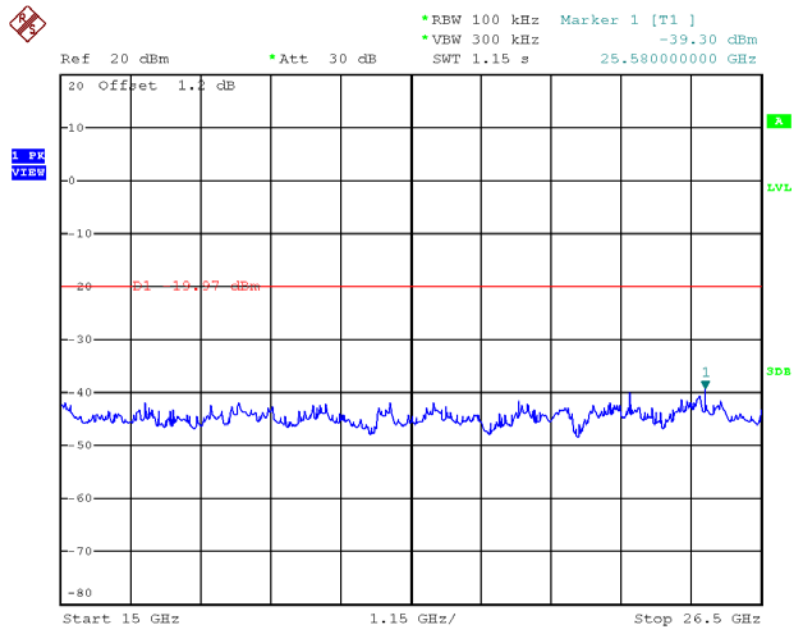
Date: 6.OCT.2017 16:07:14

CH39 (10 Harmonic of the frequency) 2



Date: 6.OCT.2017 16:07:21

CH39 (10 Harmonic of the frequency) 3

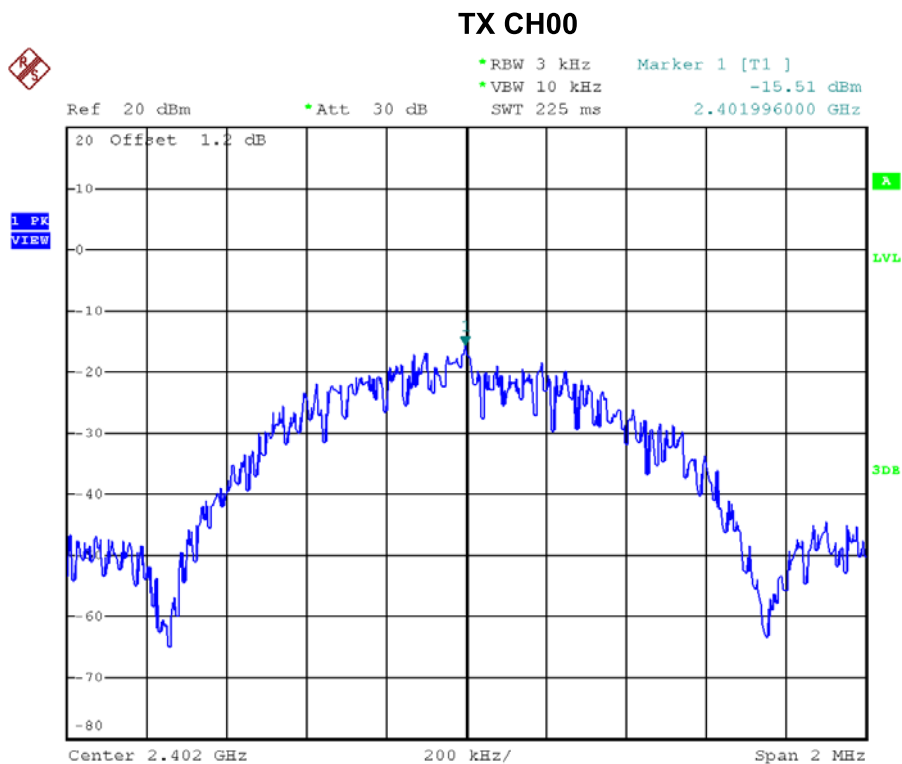


Date: 6.OCT.2017 16:07:27

ATTACHMENT H - POWER SPECTRAL DENSITY TEST

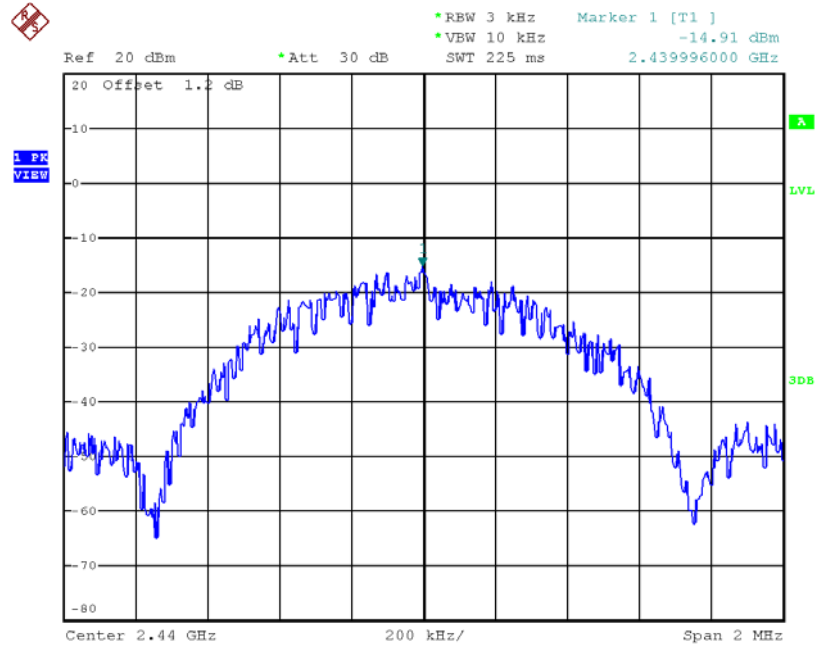
Test Mode:	CH00, CH19 , CH39 - 1Mbps
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Frequency (MHz)	Power Density (dBm/3kHz)	Max. Limit (dBm/3kHz)	Test Result
2402	-15.51	8.00	Pass
2440	-14.91	8.00	Pass
2480	-14.93	8.00	Pass



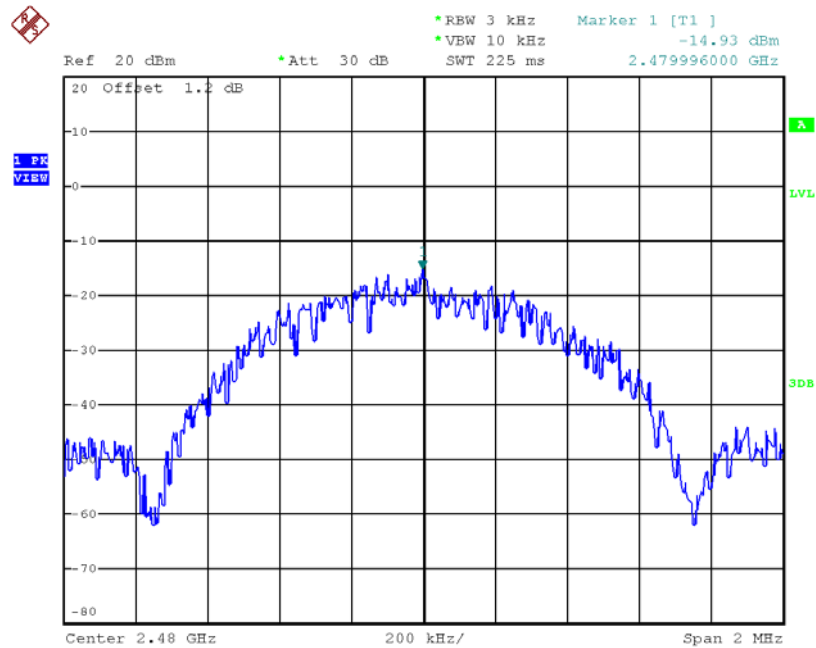
Date: 6.OCT.2017 16:04:08

TX CH19



Date: 6.OCT.2017 16:05:40

TX CH39



Date: 6.OCT.2017 16:07:33