

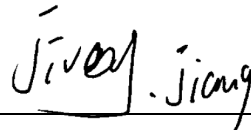
FCC Radio Test Report

FCC ID: QWHULM300RL

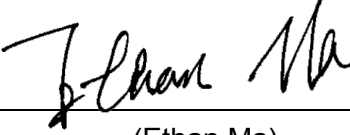
This report concerns: Original Grant

Project No. : 1711C003B
Equipment : ULTRALINK ULM300LAV
Test Model : ULM300RL
Series Model : N/A
Applicant : MUSIC Tribe Manufacturing PH Ltd.
Address : 17A Brunswick Street Hamilton HM 10 Bermuda

Date of Receipt : Jul. 09, 2019
Date of Test : Jul. 10, 2019 ~ Aug. 19, 2019
Issued Date : Nov. 19, 2019
Tested by : BTL Inc.

Testing Engineer : 
(Jivey Jiang)

Technical Manager : 
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Certificate #5123.02

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BTL's laboratory quality assurance procedures are in compliance with the **ISO/IEC 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 which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and 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.

Please note that the measurement uncertainty is provided for informational purpose only and are not use in determining the Pass/Fail results.

Table of Contents	Page
REPORT ISSUED HISTORY	6
1 . GENERAL SUMMARY	7
2 . SUMMARY OF TEST RESULTS	8
2.1 TEST FACILITY	9
2.2 MEASUREMENT UNCERTAINTY	9
2.3 TEST ENVIRONMENT CONDITIONS	10
3 . GENERAL INFORMATION	11
3.1 GENERAL DESCRIPTION OF EUT	11
3.2 DESCRIPTION OF TEST MODES	12
3.3 PARAMETERS OF TEST SOFTWARE	13
3.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED	14
3.5 SUPPORT UNITS	14
4 . AC POWER LINE CONDUCTED EMISSIONS TEST	15
4.1 LIMIT	15
4.2 TEST PROCEDURE	15
4.3 DEVIATION FROM TEST STANDARD	15
4.4 TEST SETUP	16
4.5 EUT OPERATING CONDITIONS	16
4.6 TEST RESULTS	16
5 . RADIATED EMISSION TEST	17
5.1 LIMIT	17
5.2 TEST PROCEDURE	18
5.3 DEVIATION FROM TEST STANDARD	18
5.4 TEST SETUP	19
5.5 EUT OPERATING CONDITIONS	20
5.6 TEST RESULTS - 9 KHZ TO 30 MHZ	20
5.7 TEST RESULTS - 30 MHZ TO 1000 MHZ	20
5.8 TEST RESULTS - ABOVE 1000 MHZ	20
6 . NUMBER OF HOPPING FREQUENCY	21
6.1 LIMIT	21
6.2 TEST PROCEDURE	21
6.3 DEVIATION FROM STANDARD	21
6.4 TEST SETUP	21

Table of Contents	Page
6.5 EUT OPERATION CONDITIONS	21
6.6 TEST RESULTS	21
7 . AVERAGE TIME OF OCCUPANCY	22
7.1 LIMIT	22
7.2 TEST PROCEDURE	22
7.3 DEVIATION FROM STANDARD	22
7.4 TEST SETUP	22
7.5 EUT OPERATION CONDITIONS	22
7.6 TEST RESULTS	22
8 . HOPPING CHANNEL SEPARATION MEASUREMENT	23
8.1 LIMIT	23
8.2 TEST PROCEDURE	23
8.3 DEVIATION FROM STANDARD	23
8.4 TEST SETUP	23
8.5 EUT OPERATION CONDITIONS	23
8.6 TEST RESULTS	23
9 . BANDWIDTH TEST	24
9.1 LIMIT	24
9.2 TEST PROCEDURE	24
9.3 DEVIATION FROM STANDARD	24
9.4 TEST SETUP	24
9.5 EUT OPERATION CONDITIONS	24
9.6 TEST RESULTS	24
10 . MAXIMUM OUTPUT POWER	25
10.1 LIMIT	25
10.2 TEST PROCEDURE	25
10.3 DEVIATION FROM STANDARD	25
10.4 TEST SETUP	25
10.5 EUT OPERATION CONDITIONS	25
10.6 TEST RESULTS	25
11 . CONDUCTED SPURIOUS EMISSION	26
11.1 LIMIT	26
11.2 TEST PROCEDURE	26
11.3 DEVIATION FROM STANDARD	26

Table of Contents	Page
11.4 TEST SETUP	26
11.5 EUT OPERATION CONDITIONS	26
11.6 TEST RESULTS	26
12 . MEASUREMENT INSTRUMENTS LIST	27
13 . EUT TEST PHOTO	29
APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS	33
APPENDIX B - RADIATED EMISSION - 9 KHZ-30 MHZ	36
APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1000 MHZ	41
APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ	44
APPENDIX E - NUMBER OF HOPPING FREQUENCY	57
APPENDIX F - AVERAGE TIME OF OCCUPANCY	59
APPENDIX G - HOPPING CHANNEL SEPARATION MEASUREMENT	61
APPENDIX H - BANDWIDTH	63
APPENDIX I - MAXIMUM OUTPUT POWER	65
APPENDIX J - CONDUCTED SPURIOUS EMISSION	68

REPORT ISSUED HISTORY

Report Version	Description	Issued Date
R00	Original Issue.	Sep. 06, 2019
R01	Remove the series model name.	Sep. 11, 2019
R02	Updated the product name which does not affect the test results, the rest are kept the same.	Sep. 23, 2019
R03	Update the descriptions in sections 3.1 and 3.2.	Oct. 31, 2019
R04	Updated the FCC ID, model name and the antenna gain.	Nov. 12, 2019
R05	Updated the antenna type.	Nov. 15, 2019
R06	Updated the modulation technology.	Nov. 19, 2019

1. GENERAL SUMMARY

Equipment : ULTRALINK ULM300LAV
Brand Name : BEHRINGER
Test Model : ULM300RL
Series Model : N/A
Applicant : MUSIC Tribe Manufacturing PH Ltd.
Manufacturer : MUSIC Tribe Manufacturing PH Ltd.
Address : 17A Brunswick Street Hamilton HM 10 Bermuda
Factory : Zhongshan Eurotec Electronics Ltd.
Address : No.10 Wanmei Road, South China Modern Chinese Medicine Park, Nanlang
Town, Zhongshan City, Guangdong Province, P.R. China
Date of Test : Jul. 10, 2019 ~ Aug. 19, 2019
Test Sample : Engineering Sample No.: DG19080169
Standard(s) : FCC Part15, Subpart C (15.247)
ANSI C63.10-2013
KDB 558074 D01 15.247 Meas Guidance V05r02

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-1-1711C003B) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of A2LA according to the ISO/IEC 17025 quality assessment standard and technical standard(s).

2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

FCC Part15, Subpart C (15.247)				
Standard(s) Section	Test Item	Test Result	Judgment	Remark
15.207	AC Power Line Conducted Emissions	APPENDIX A	PASS	-----
15.247(d) 15.205(a) 15.209(a)	Radiated Emissions	APPENDIX B APPENDIX C APPENDIX D	PASS	-----
15.247 (a)(1)(iii)	Number of Hopping Frequency	APPENDIX E	PASS	-----
15.247 (a)(1)(iii)	Average Time Of Occupancy	APPENDIX F	PASS	-----
15.247(a)(1)	Hopping Channel Separation	APPENDIX G	PASS	-----
15.247(a)(1)	Bandwidth	APPENDIX H	PASS	-----
15.247(a)(1)	Maximum Output Power	APPENDIX I	PASS	-----
15.247(d)	Conducted Spurious Emission	APPENDIX J	PASS	-----
15.203	Antenna Requirement	-----	PASS	Note (2)

Note:

- (1) "N/A" denotes test is not applicable in this test report
- (2) The device what use a permanently attached antenna were considered sufficient to comply with the provisions of 15.203.

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 Registration Number for FCC: 357015
 BTL's Designation Number for FCC: CN1240

2.2 MEASUREMENT UNCERTAINTY

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))

The BTL measurement uncertainty as below table:

A. AC power line conducted emissions test:

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

B. Radiated emissions test:

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	4.88
		30MHz ~ 200MHz	H	4.14
		200MHz ~ 1,000MHz	V	4.62
		200MHz ~ 1,000MHz	H	4.80
		1GHz ~ 6GHz	-	4.58
		6GHz ~ 18GHz	-	5.18
		18GHz ~ 26.5GHz	-	3.80
26.5GHz ~ 40GHz	-	4.30		

C. Other Measurement:

Test Item	Uncertainty
Conducted Spurious Emission	2.67 dB
Hopping Channel Separation	53.46 MHz
Output Power	0.95 dB
Number of Hopping Frequency	53.46 MHz
Temperature	0.08 °C
Humidity	1.5%

Note: Unless specifically mentioned, the uncertainty of measurement has not been taken into account to declare the compliance or non-compliance to the specification.

2.3 TEST ENVIRONMENT CONDITIONS

Test Item	Temperature	Humidity	Test Voltage
AC Power Line Conducted Emissions	25°C	60%	AC 120V/60Hz
Radiated Emissions-9K-30MHz	25°C	60%	AC 120V/60Hz
Radiated Emissions-30 MHz to 1GHz	24°C	68%	AC 120V/60Hz
Radiated Emissions-Above 1000 MHz	24°C	68%	AC 120V/60Hz
Number of Hopping Frequency	25°C	48%	AC 120V/60Hz
Average Time Of Occupancy	25°C	48%	AC 120V/60Hz
Hopping Channel Separation	25°C	48%	AC 120V/60Hz
Bandwidth	25°C	48%	AC 120V/60Hz
Maximum Output Power	25°C	48%	AC 120V/60Hz
Conducted Spurious Emission	25°C	48%	AC 120V/60Hz

3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Equipment	ULTRALINK ULM300LAV
Brand Name	BEHRINGER
Test Model	ULM300RL
Series Model	N/A
Model Difference(s)	N/A
Hardware Version	P0BQZ 17REVA
Software Version	P0BQZ 171001
Power Source	DC Voltage supplied from AC/DC adapter. (1) Model: BLJ06W050100P1-U (2) Model: S008ACM0500100
Power Rating	(1) I/P:100-240V~50/60Hz 0.2A O/P: 5V $\overline{\text{---}}$ 1000mA (2) I/P:100-240V~50/60Hz 300mA O/P: 5V $\overline{\text{---}}$ 1000mA
Operation Frequency	2408.5 MHz – 2475.5 MHz
Modulation Technology	GFSK
Bit Rate of Transmitter	2 Mbps
Max. Output Power	17.68 dBm (0.0586 W)

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)	Channel	Frequency (MHz)
01	2408.5	07	2432.5	13	2463.5
02	2412.5	08	2436.5	14	2467.5
03	2416.5	09	2444.5	15	2471.5
04	2420.5	10	2449.5	16	2475.5
05	2424.5	11	2454.5		
06	2428.5	12	2459.5		

3. Table for Filed Antenna:

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	N/A	N/A	Monopole	N/A	2.27

3.2 DESCRIPTION OF TEST MODES

The test system was pre-tested based on the consideration of all possible combinations of EUT operation mode.

Pretest Mode	Description
Mode 1	TX Mode NOTE (1)
Mode 2	TX Mode Channel 16

Following mode(s) was (were) found to be the worst case(s) and selected for the final test.

AC power line conducted emissions test	
Final Test Mode	Description
Mode 2	TX Mode Channel 16

Radiated emissions test - Below 1GHz	
Final Test Mode	Description
Mode 2	TX Mode Channel 16

Radiated emissions test - Above 1GHz	
Final Test Mode	Description
Mode 1	TX Mode NOTE (1)

Conducted test	
Final Test Mode	Description
Mode 1	TX Mode NOTE (1)

Note:

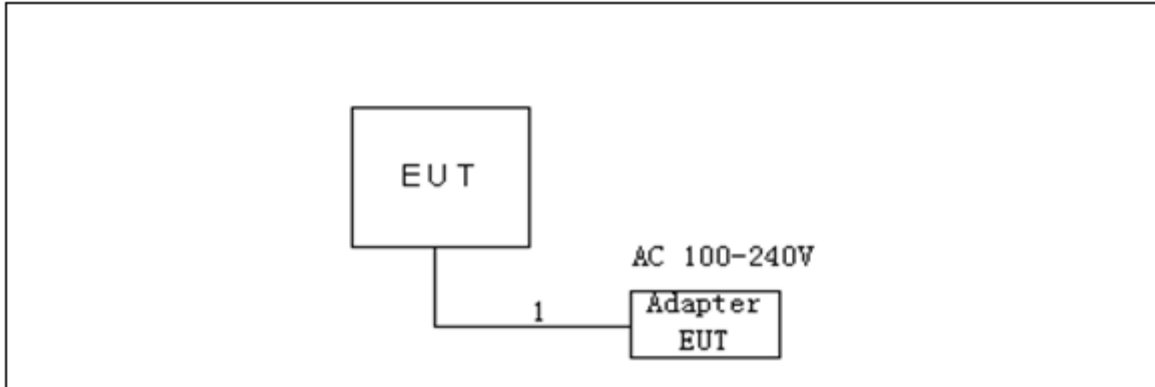
- (1) The measurements are performed at the high, middle, low available channels.

3.3 PARAMETERS OF TEST SOFTWARE

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 FHSS

Test Software	N/A		
Frequency (MHz)	2408.5	2444.5	2475.5
Parameters	N/A	N/A	N/A

3.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



3.5 SUPPORT UNITS

Item	Equipment	Mfr/Brad	Model/Type No.	Series No.
-	-	-	-	-

Item	Cable Type	Shielded Type	Ferrite Core	Length
1	DC Cable	NO	NO	1.5m

4. AC POWER LINE CONDUCTED EMISSIONS TEST

4.1 LIMIT

Frequency of Emission (MHz)	Limit (dB μ V)	
	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 tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

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

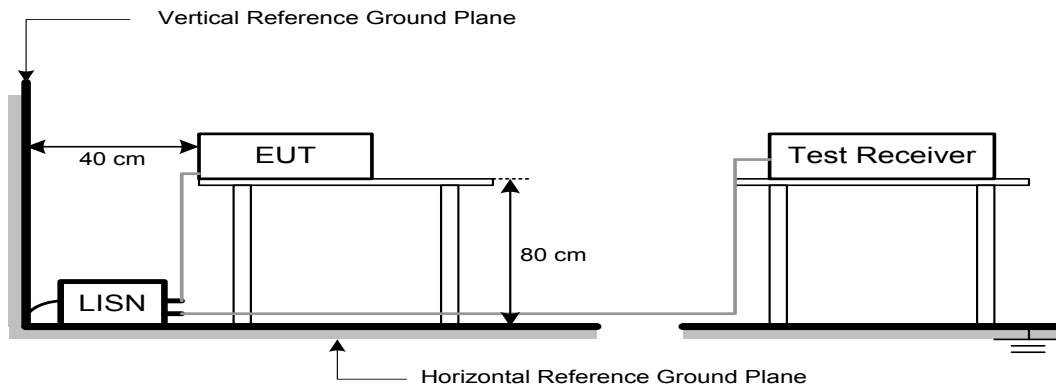
4.2 TEST PROCEDURE

- 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.

4.3 DEVIATION FROM TEST STANDARD

No deviation

4.4 TEST SETUP



4.5 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.

4.6 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 150 kHz to 30 MHz.

5. RADIATED EMISSION TEST

5.1 LIMIT

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 (9 kHz-1000 MHz)

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
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000 MHz)

Frequency (MHz)	(dBuV/m at 3 m)	
	Peak	Average
Above 1000	74	54

Note:

- (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).

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

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

5.2 TEST PROCEDURE

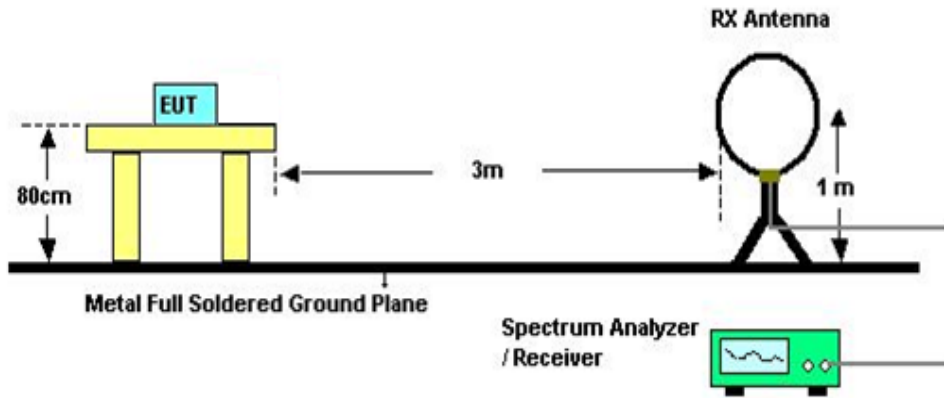
- a. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1 GHz)
- b. The measuring distance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

5.3 DEVIATION FROM TEST STANDARD

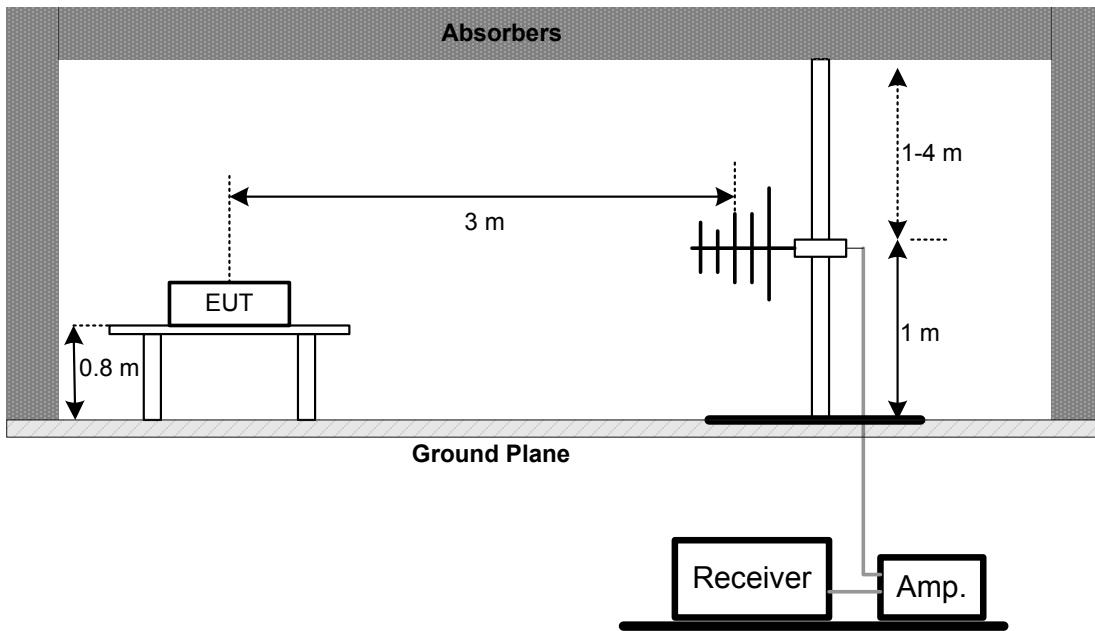
No deviation

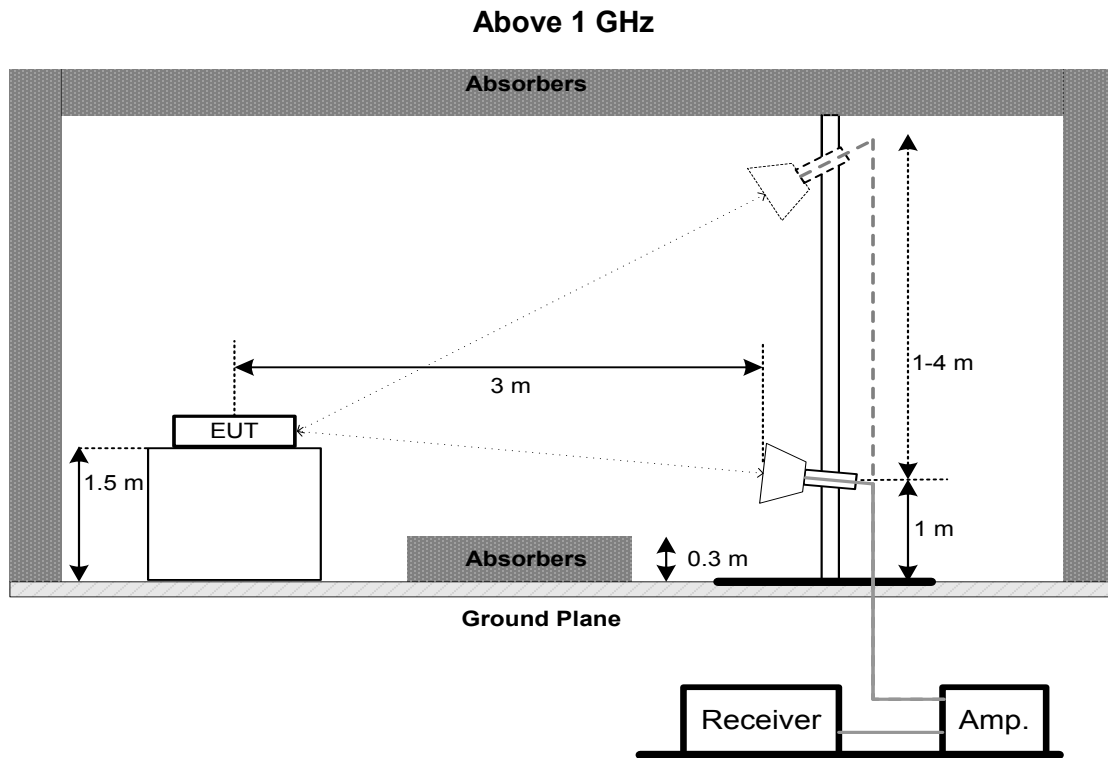
5.4 TEST SETUP

9 kHz-30 MHz



30 MHz to 1 GHz





5.5 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

5.6 TEST RESULTS - 9 kHz TO 30 MHz

Please refer to the APPENDIX B

Remark:

- (1) Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB).
- (2) Limit line = specific limits (dBuV) + distance extrapolation factor.

5.7 TEST RESULTS - 30 MHz TO 1000 MHz

Please refer to the APPENDIX C.

5.8 TEST 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.

6. NUMBER OF HOPPING FREQUENCY

6.1 LIMIT

FCC Part15, Subpart C (15.247)	
Section	Test Item
15.247(a)(1)(iii)	Number of Hopping Frequency

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating Frequency Range
RBW	100 kHz
VBW	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

6.2 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=100 kHz, VBW=100 kHz, Sweep time = Auto.

6.3 DEVIATION FROM STANDARD

No deviation.

6.4 TEST SETUP



6.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.5 unless otherwise a special operating condition is specified in the follows during the testing.

6.6 TEST RESULTS

Please refer to the APPENDIX E

7. AVERAGE TIME OF OCCUPANCY

7.1 LIMIT

FCC Part15, Subpart C (15.247)		
Section	Test Item	Limit
15.247(a)(1)(iii)	Average Time of Occupancy	0.4sec

7.2 TEST PROCEDURE

- The transmitter output (antenna port) was connected to the spectrum analyzer
- Set RBW of spectrum analyzer to 1 MHz and VBW to 1 MHz
- Use a video trigger with the trigger level set to enable triggering only on full pulses
- Sweep Time is more than once pulse time
- Set the center frequency on any frequency would be measure and set the frequency span to zero span
- Measure the maximum time duration of one single pulse
- Measure the maximum time duration of one single pulse

7.3 DEVIATION FROM STANDARD

No deviation.

7.4 TEST SETUP



7.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.5 unless otherwise a special operating condition is specified in the follows during the testing.

7.6 TEST RESULTS

Please refer to the APPENDIX F

8. HOPPING CHANNEL SEPARATION MEASUREMENT

8.1 LIMIT

Frequency hopping systems operating in the 2408.5-2475.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RBW	10 kHz
VBW	30 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

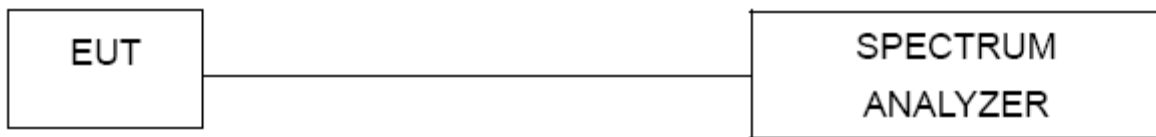
8.2 TEST PROCEDURE

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Span = wide enough to capture the peaks of two adjacent channels
 Resolution (or IF) Bandwidth (RBW) \geq 1% of the span
 Video (or Average) Bandwidth (VBW) \geq RBW
 Sweep = Auto
 Detector function = Peak
 Trace = Max Hold

8.3 DEVIATION FROM STANDARD

No deviation.

8.4 TEST SETUP



8.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.5 unless otherwise a special operating condition is specified in the follows during the testing.

8.6 TEST RESULTS

Please refer to the APPENDIX G

9. BANDWIDTH TEST

9.1 LIMIT

FCC Part15, Subpart C (15.247)	
Section	Test Item
15.247(a)(1)	Bandwidth

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth
RBW	10 kHz
VBW	30 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

9.2 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= 10 kHz, VBW=30 kHz, Sweep Time = Auto.

9.3 DEVIATION FROM STANDARD

No deviation.

9.4 TEST SETUP



9.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.5 unless otherwise a special operating condition is specified in the follows during the testing.

9.6 TEST RESULTS

Please refer to the APPENDIX H

10. MAXIMUM OUTPUT POWER

10.1 LIMIT

FCC Part15 , Subpart C (15.247)		
Section	Test Item	Limit
15.247(a)(1)	Maximum Output Power	0.125 Watt or 21 dBm

Note: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, For frequency hopping systems operating in the 2408.5-2475.5MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

10.2 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= 1 MHz/1 MHz, VBW= 1 MHz/1 MHz, Sweep time = Auto.

10.3 DEVIATION FROM STANDARD

No deviation.

10.4 TEST SETUP



10.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.5 unless otherwise a special operating condition is specified in the follows during the testing.

10.6 TEST RESULTS

Please refer to the APPENDIX I

11. CONDUCTED SPURIOUS EMISSION

11.1 LIMIT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 the transmitter demonstrates compliance with the peak Output Power limits. If the transmitter complies with the Output Power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required.

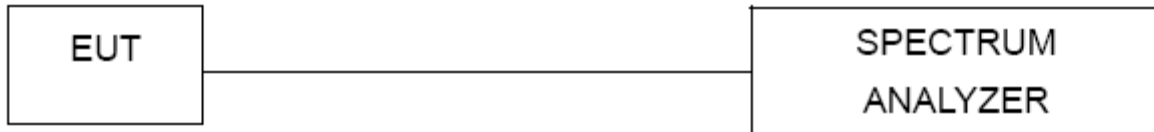
11.2 TEST PROCEDURE

- 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= 100 kHz, VBW=100 kHz, Sweep time = Auto.

11.3 DEVIATION FROM STANDARD

No deviation.

11.4 TEST SETUP



11.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.5 unless otherwise a special operating condition is specified in the follows during the testing.

11.6 TEST RESULTS

Please refer to the APPENDIX J

12. MEASUREMENT INSTRUMENTS LIST

AC Power Line Conducted Emissions					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	EMI Test Receiver	R&S	ESCI	100382	Mar. 10, 2020
2	LISN	EMCO	3816/2	52765	Mar. 10, 2020
3	50ohm Terminator	SHX	TF5-3	15041305	Mar. 10, 2020
4	Artificial-Mains Network	SCHWARZBECK	NSLK 8127	8127685	Mar. 10, 2020
5	TRANSIENT LIMITER	EM	EM-7600	772	Mar. 10, 2020
6	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
7	Cable	N/A	RG223	12m	Mar. 12, 2020

Radiated Emissions - 9 kHz to 30 MHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Loop Antenna	EM	EM-6876-1	230	Jan. 15, 2020
2	Cable	N/A	RG 213/U	C-102	May 31, 2020
3	EMI Test Receiver	R&S	ESCI	100895	Mar. 10, 2020
4	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A

Radiated Emissions - 30 MHz to 1 GHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Antenna	Schwarzbeck	VULB9160	9160-3232	Mar. 09, 2020
2	Amplifier	HP	8447D	2944A09673	Aug. 11, 2021
3	Receiver	Agilent	N9038A	MY52130039	Aug. 03, 2020
4	Cable	emci	LMR-400(30MHz-1GHz)(8m+5m)	N/A	May 24, 2020
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

Radiated Emissions - Above 1 GHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Double Ridged Guide Antenna	ETS	3115	75789	Mar. 09, 2020
2	Broad-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170319	Jun. 23, 2020
3	Amplifier	Agilent	8449B	3008A02333	Mar. 10, 2020
4	Microwave Preamplifier With Adaptor	EMC INSTRUMENT	EMC2654045	980039 & HA01	Mar. 10, 2020
5	Receiver	Agilent	N9038A	MY52130039	Aug. 03, 2020
6	Controller	CT	SC100	N/A	N/A
7	Controller	MF	MF-7802	MF780208416	N/A
8	Cable	mitron	B10-01-01-12M	18072744	Jun. 29, 2020
9	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A

Number of Hopping Frequency					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 03, 2020

Average Time of Occupancy					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 03, 2020

Hopping Channel Separation Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 03, 2020

Bandwidth					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 03, 2020

Maximum Output Power					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 03, 2020

Antenna Conducted Spurious Emission					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 03, 2020

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

13. EUT TEST PHOTO

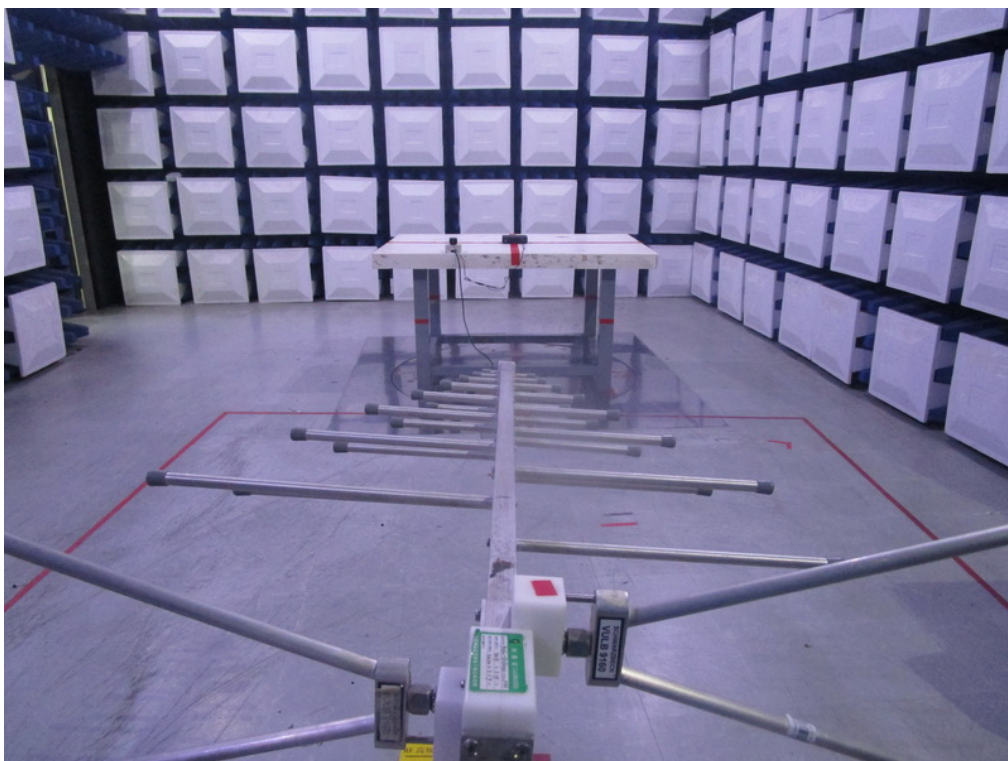
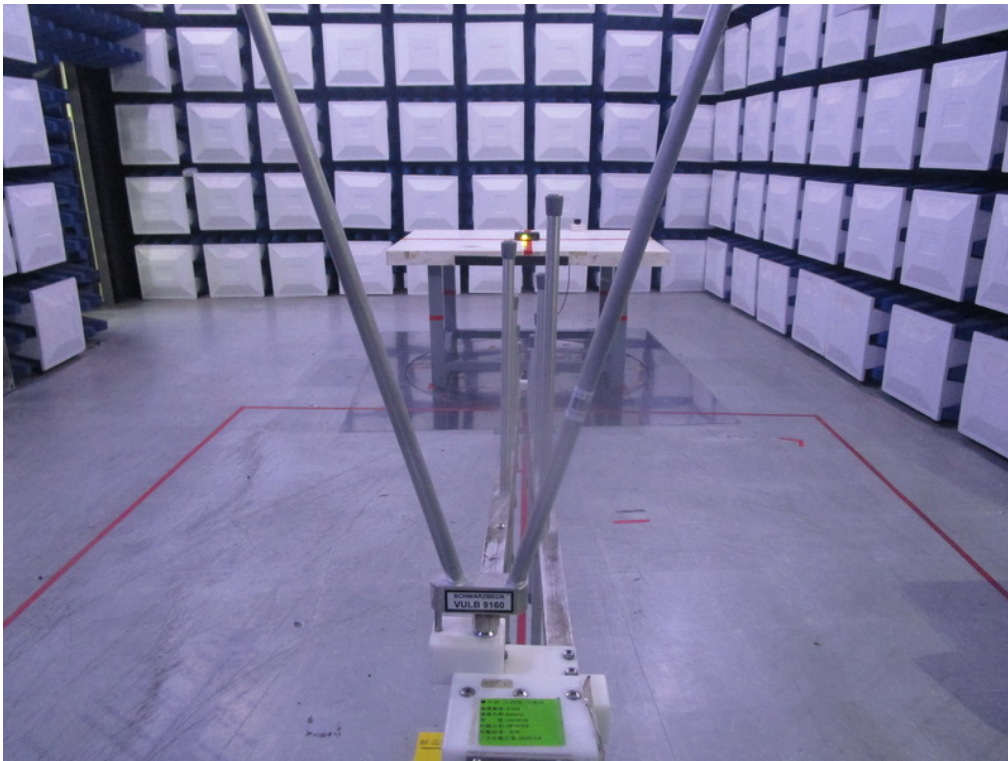
AC Power Line Conducted Emissions Test Photos



Radiated Emissions Test Photos**9 kHz to 30 MHz**

Radiated Emissions Test Photos

30 MHz to 1000 MHz



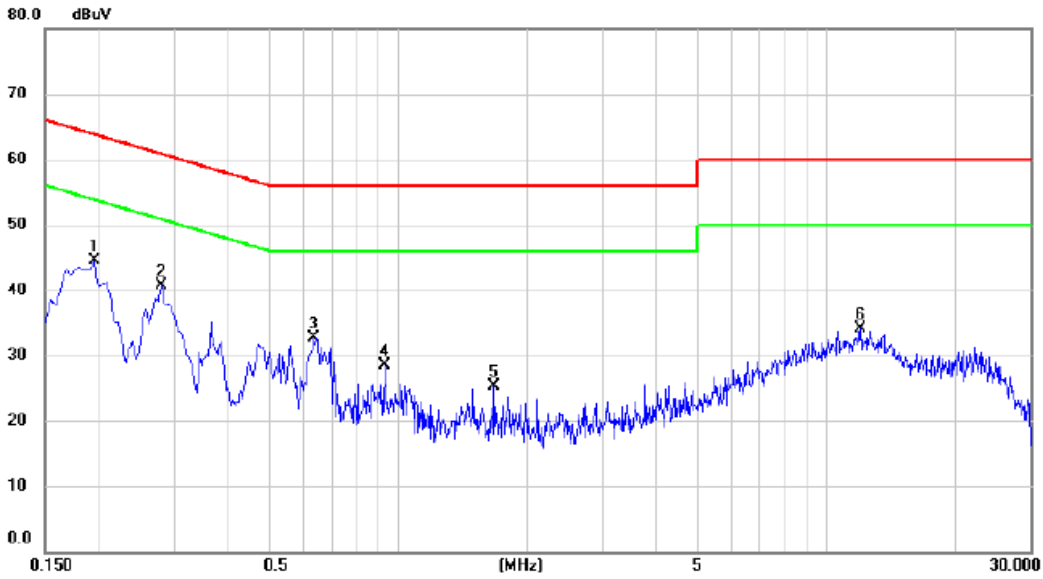
Radiated Emissions Test Photos
Above 1 GHz



APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS

Test Mode: TX Mode Channel 16

Line



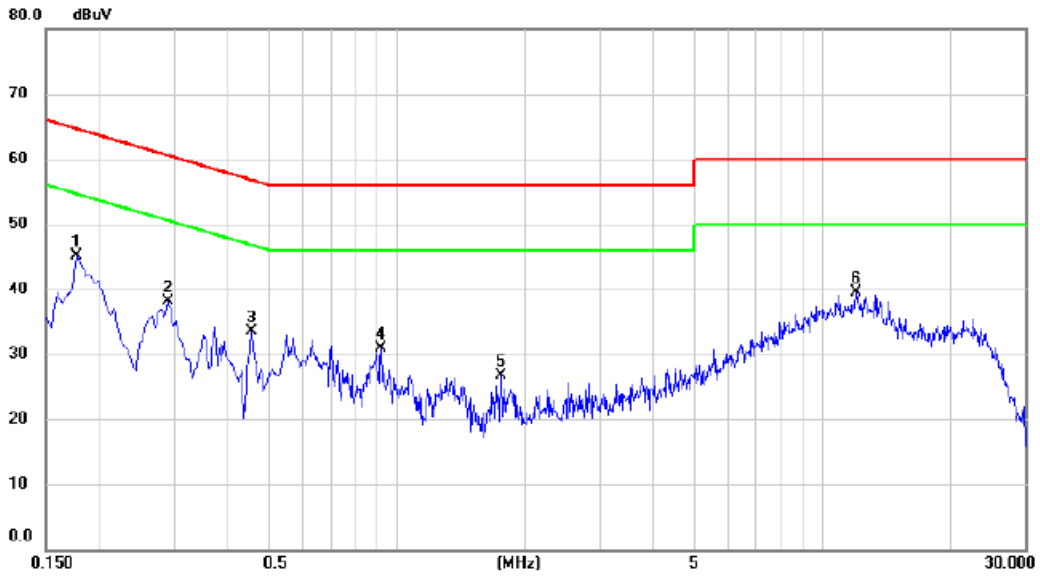
No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Margin dB	Detector	Comment
1 *	0.1950	34.71	9.81	44.52	63.82	-19.30	peak	
2	0.2805	30.77	9.84	40.61	60.80	-20.19	peak	
3	0.6360	22.85	9.89	32.74	56.00	-23.26	peak	
4	0.9285	18.53	9.92	28.45	56.00	-27.55	peak	
5	1.6800	15.40	9.97	25.37	56.00	-30.63	peak	
6	12.0570	23.43	10.60	34.03	60.00	-25.97	peak	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX Mode Channel 16

Neutral



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Margin dB	Detector	Comment
1	*	0.1770	35.17	9.91	45.08	64.63	-19.55	peak	
2		0.2895	28.10	9.95	38.05	60.54	-22.49	peak	
3		0.4560	23.50	10.02	33.52	56.77	-23.25	peak	
4		0.9195	20.76	10.10	30.86	56.00	-25.14	peak	
5		1.7565	16.63	10.17	26.80	56.00	-29.20	peak	
6		12.0075	28.61	10.88	39.49	60.00	-20.51	peak	

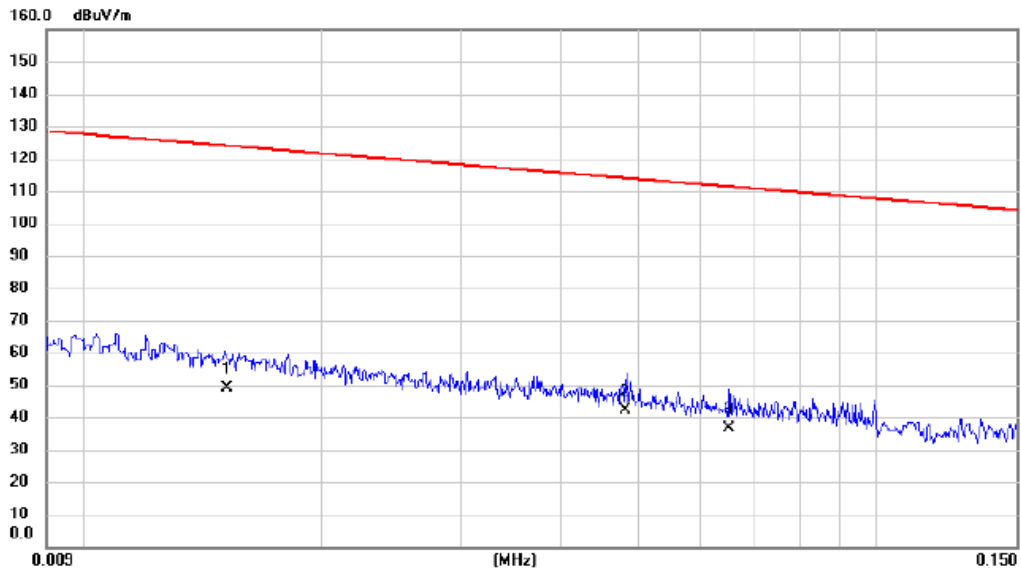
REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

APPENDIX B - RADIATED EMISSION - 9 KHZ-30 MHZ

Test Mode: TX Mode Channel 16

Ant 0°



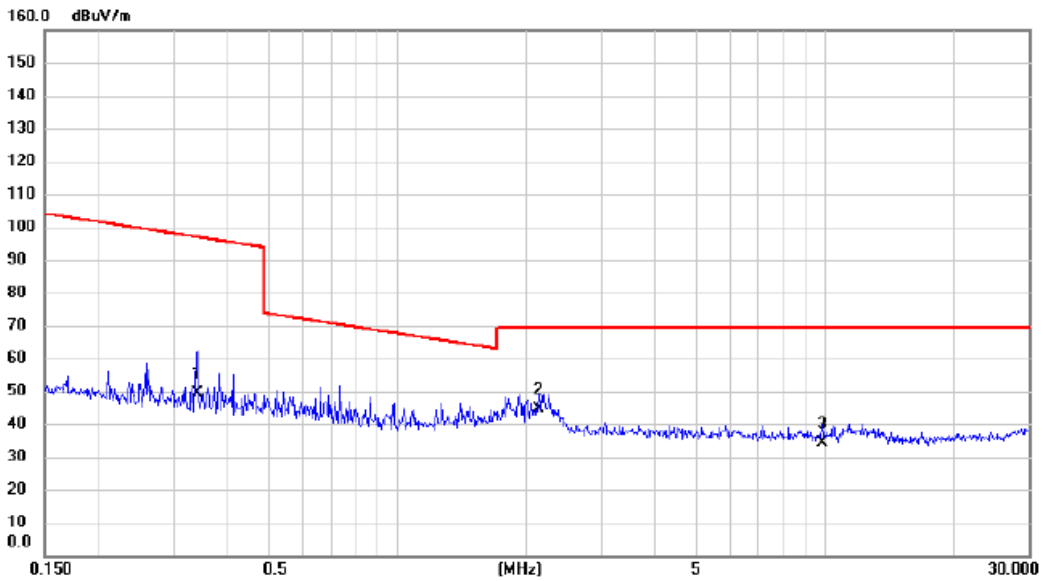
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin	Detector	Comment
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB		
1		0.0152	33.60	15.26	48.86	123.97	-75.11	AVG	
2	*	0.0483	28.20	13.92	42.12	113.93	-71.81	AVG	
3		0.0652	23.10	13.69	36.79	111.32	-74.53	AVG	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX Mode Channel 16

Ant 0°



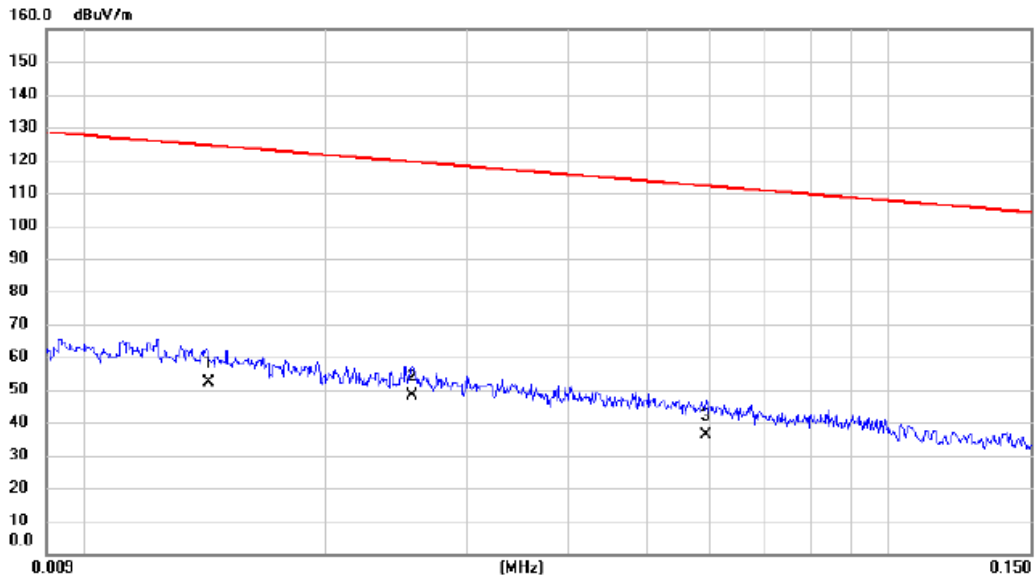
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		0.3410	36.10	13.44	49.54	96.95	-47.41	AVG	
2	*	2.1440	32.80	11.73	44.53	69.54	-25.01	QP	
3		9.8606	22.40	11.61	34.01	69.54	-35.53	QP	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX Mode Channel 16

Ant 90°



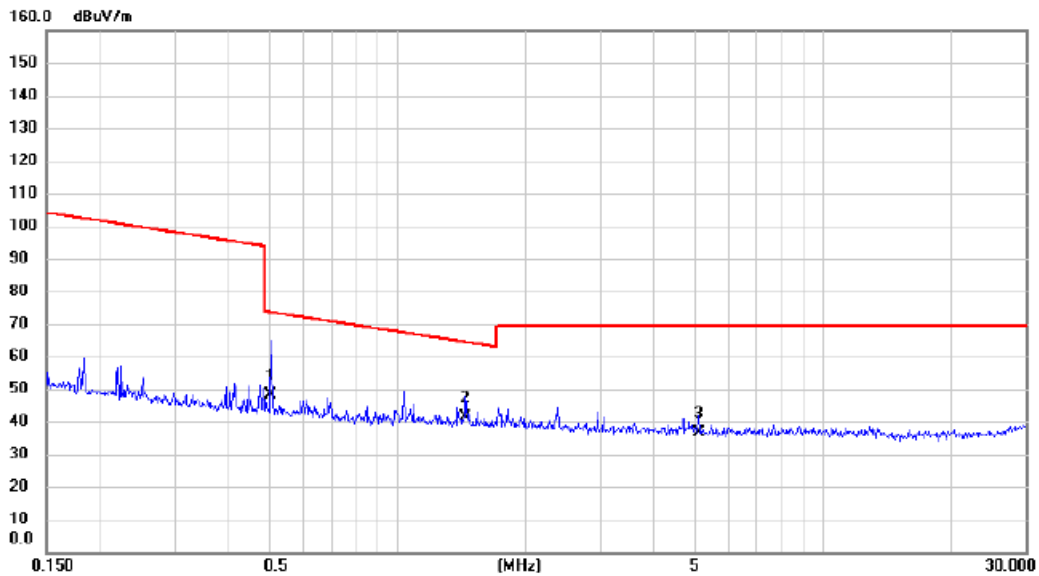
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		0.0143	36.80	15.53	52.33	124.50	-72.17	AVG	
2	*	0.0256	34.20	13.84	48.04	119.44	-71.40	AVG	
3		0.0593	22.50	13.78	36.28	112.14	-75.86	AVG	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX Mode Channel 16

Ant 90°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin	Detector	Comment
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB		
1		0.5047	35.20	13.05	48.25	73.54	-25.29	QP	
2	*	1.4485	29.30	12.20	41.50	64.39	-22.89	QP	
3		5.1118	25.70	10.88	36.58	69.54	-32.96	QP	

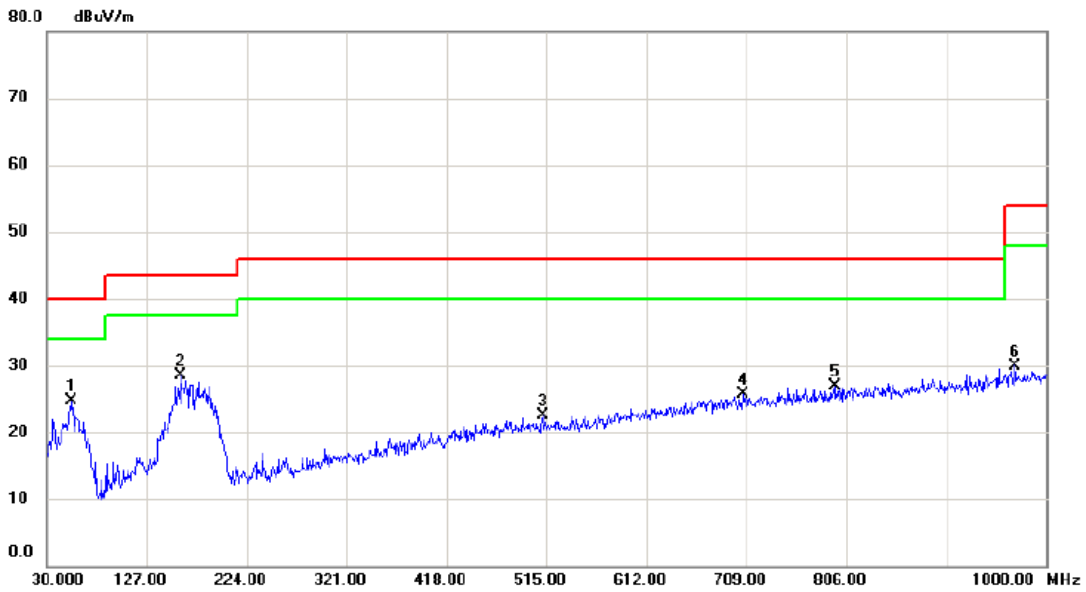
REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1000 MHZ

Test Mode: TX Mode Channel 16

Vertical



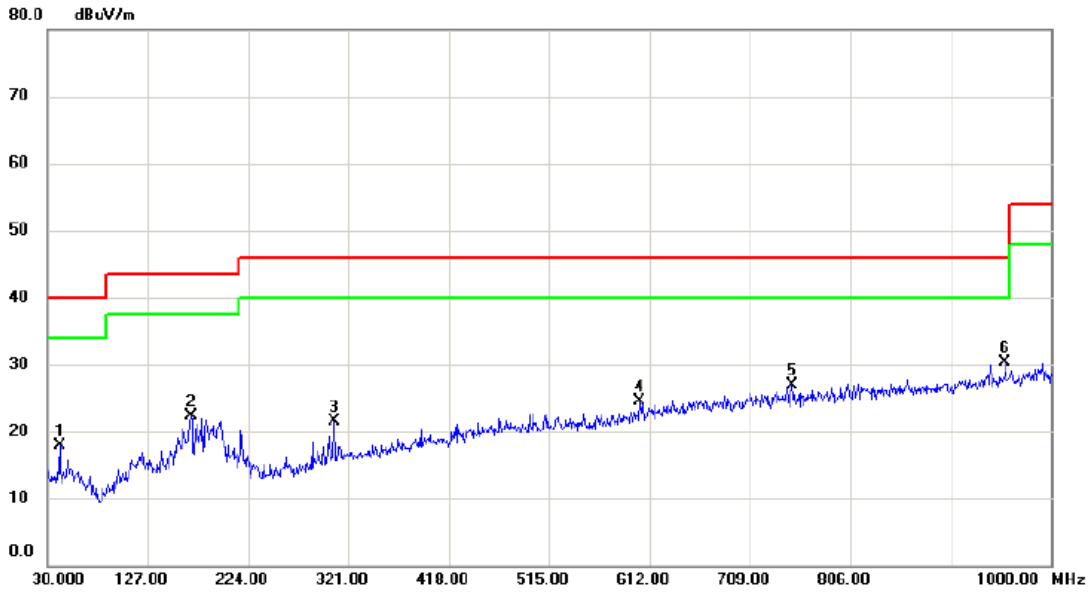
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		54.250	38.56	-13.92	24.64	40.00	-15.36	peak	
2	*	160.465	39.59	-11.07	28.52	43.50	-14.98	peak	
3		511.120	30.02	-7.58	22.44	46.00	-23.56	peak	
4		706.090	29.76	-3.97	25.79	46.00	-20.21	peak	
5		794.845	29.99	-3.07	26.92	46.00	-19.08	peak	
6		969.445	30.44	-0.44	30.00	54.00	-24.00	peak	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX Mode Channel 16

Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		42.125	32.39	-14.44	17.95	40.00	-22.05	peak	
2		168.710	34.47	-12.24	22.23	43.50	-21.27	peak	
3		307.420	32.88	-11.36	21.52	46.00	-24.48	peak	
4		602.785	30.11	-5.68	24.43	46.00	-21.57	peak	
5		750.225	30.66	-3.66	27.00	46.00	-19.00	peak	
6	*	955.380	30.89	-0.68	30.21	46.00	-15.79	peak	

REMARKS:

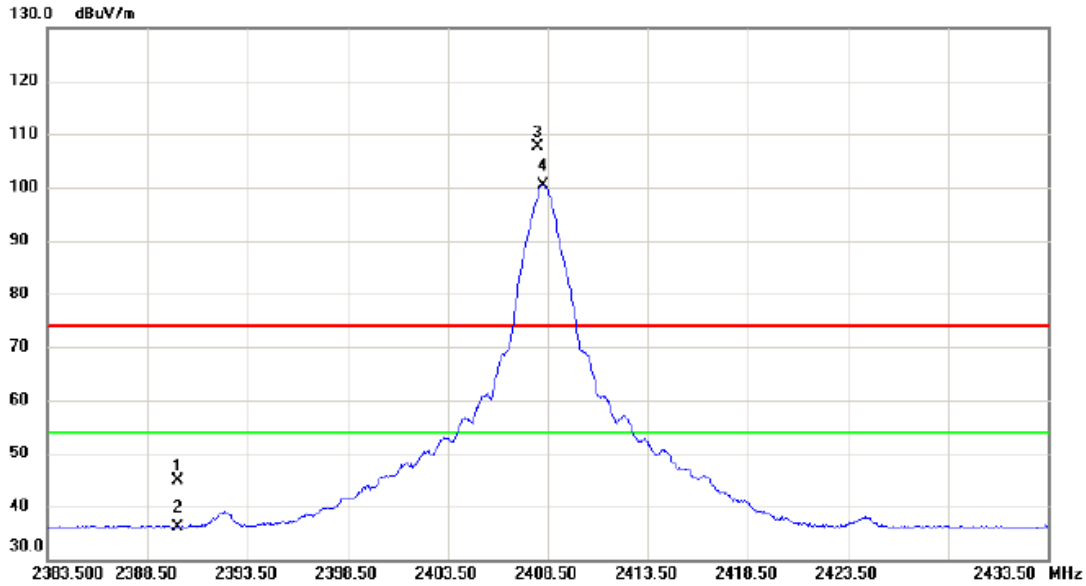
(1) Measurement Value = Reading Level + Correct Factor.

(2) Margin Level = Measurement Value - Limit Value.

APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ

Test Mode: TX 2408.5 MHz _CH01

Vertical



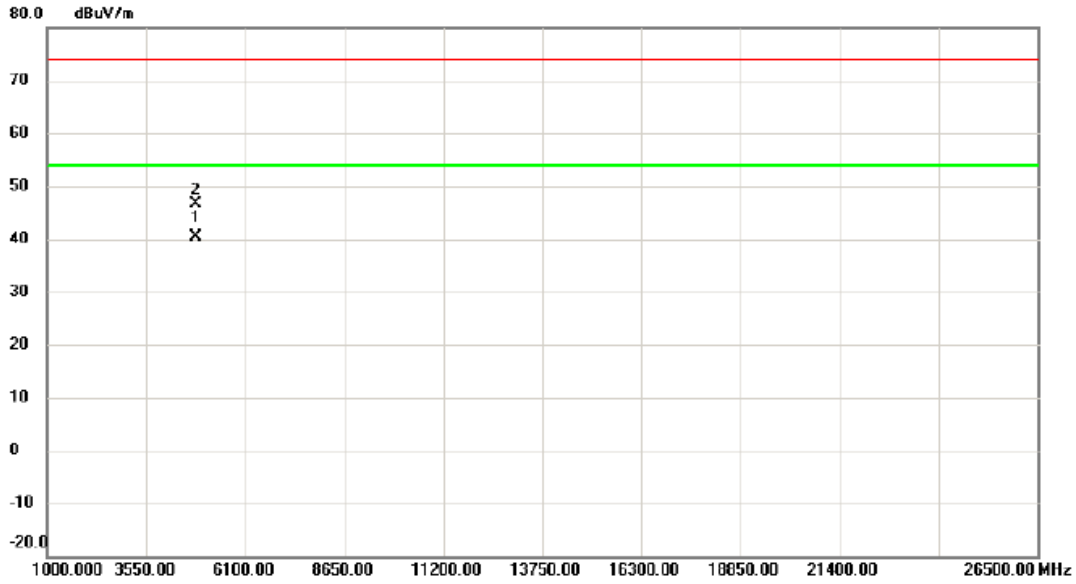
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		2390.000	38.27	6.53	44.80	74.00	-29.20	peak	
2		2390.000	29.67	6.53	36.20	54.00	-17.80	AVG	
3	X	2407.975	101.01	6.51	107.52	74.00	33.52	peak	No Limit
4	*	2408.275	93.89	6.51	100.40	54.00	46.40	AVG	No Limit

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2408.5 MHz _CH01

Vertical



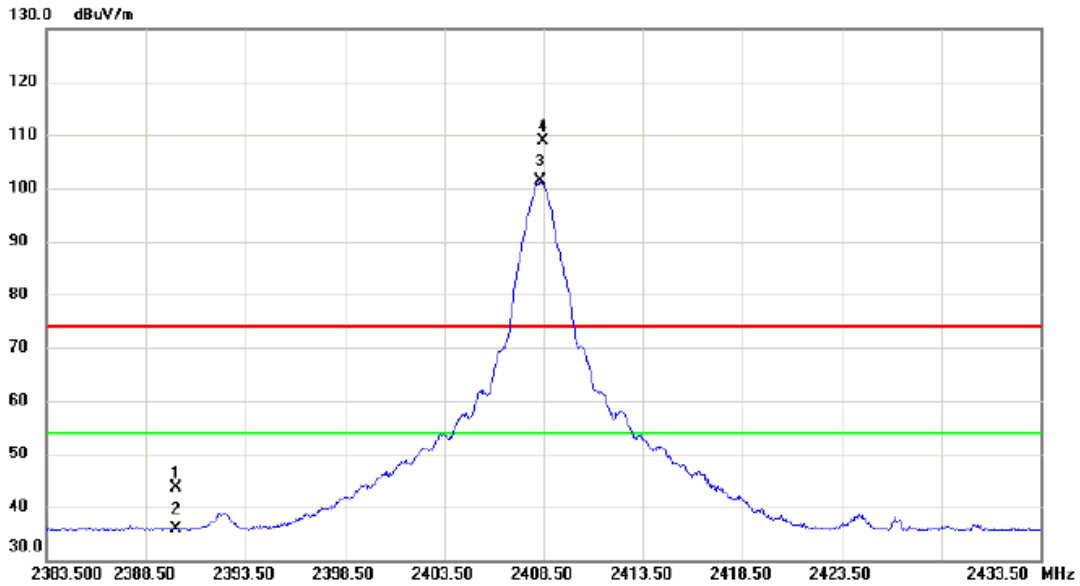
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	*	4816.880	37.08	3.41	40.49	54.00	-13.51	AVG	
2		4818.285	43.24	3.42	46.66	74.00	-27.34	peak	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2408.5 MHz _CH01

Horizontal



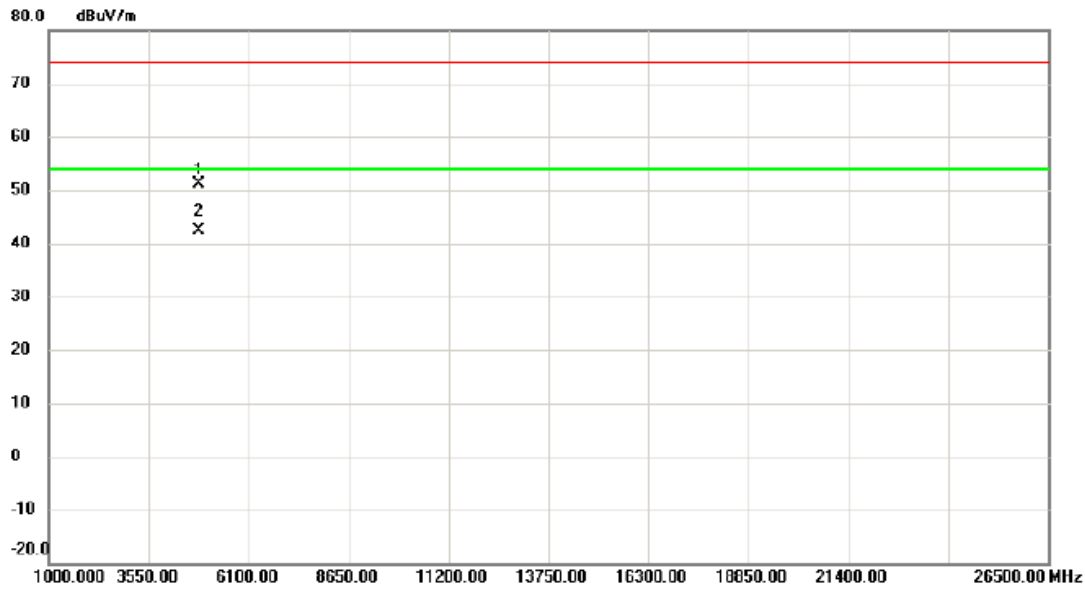
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		2390.000	37.17	6.53	43.70	74.00	-30.30	peak	
2		2390.000	29.26	6.53	35.79	54.00	-18.21	AVG	
3	*	2408.300	94.84	6.51	101.35	54.00	47.35	AVG	No Limit
4	X	2408.450	102.28	6.51	108.79	74.00	34.79	peak	No Limit

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2408.5 MHz _CH01

Horizontal



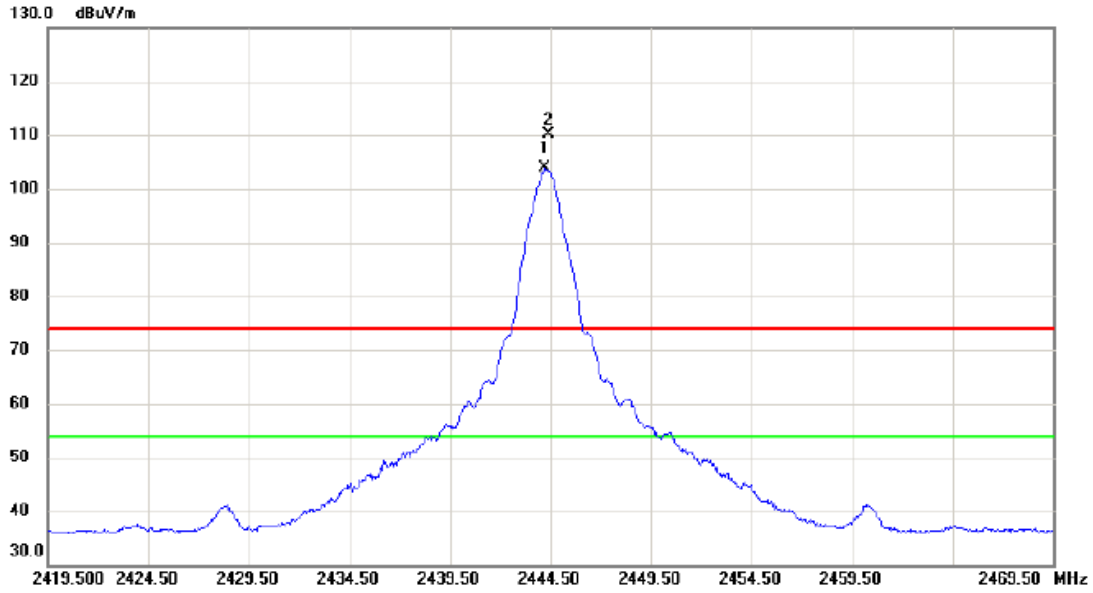
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		4815.865	47.66	3.41	51.07	74.00	-22.93	peak	
2	*	4816.785	39.06	3.41	42.47	54.00	-11.53	AVG	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2444.5 MHz _CH09

Vertical



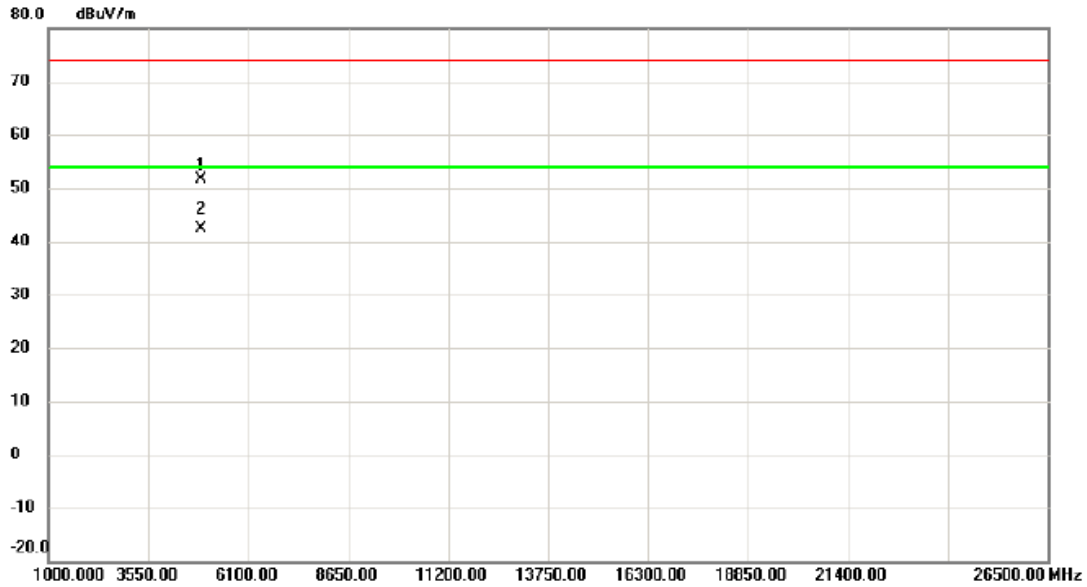
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	*	2444.225	97.49	6.47	103.96	54.00	49.96	AVG	No Limit
2	X	2444.400	103.61	6.47	110.08	74.00	36.08	peak	No Limit

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2444.5 MHz _CH09

Vertical



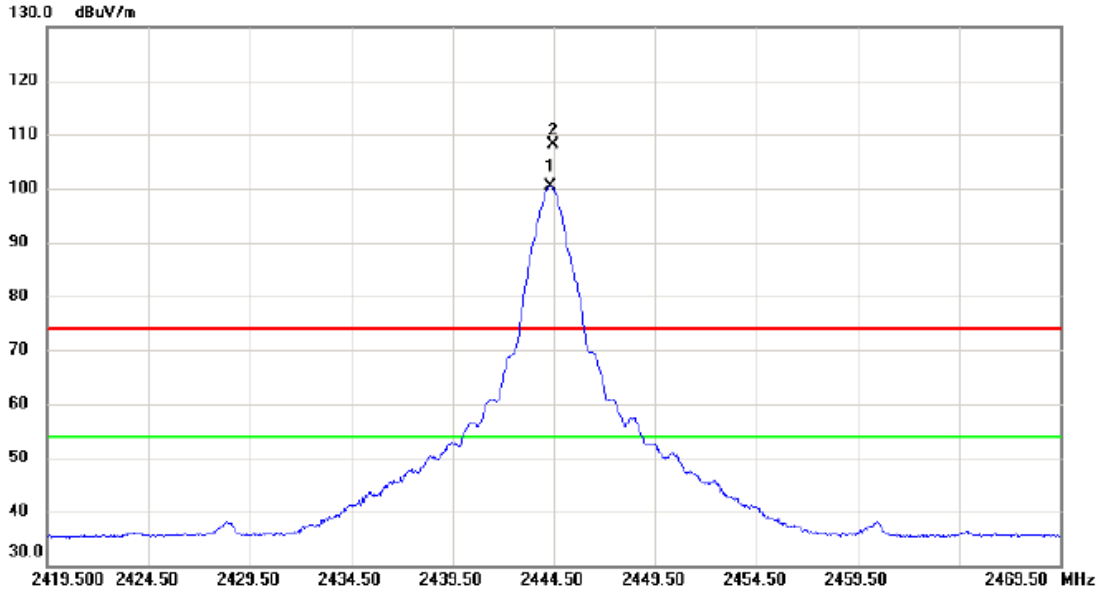
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		4887.770	48.00	3.63	51.63	74.00	-22.37	peak	
2	*	4888.750	38.64	3.63	42.27	54.00	-11.73	AVG	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2444.5 MHz _CH09

Horizontal



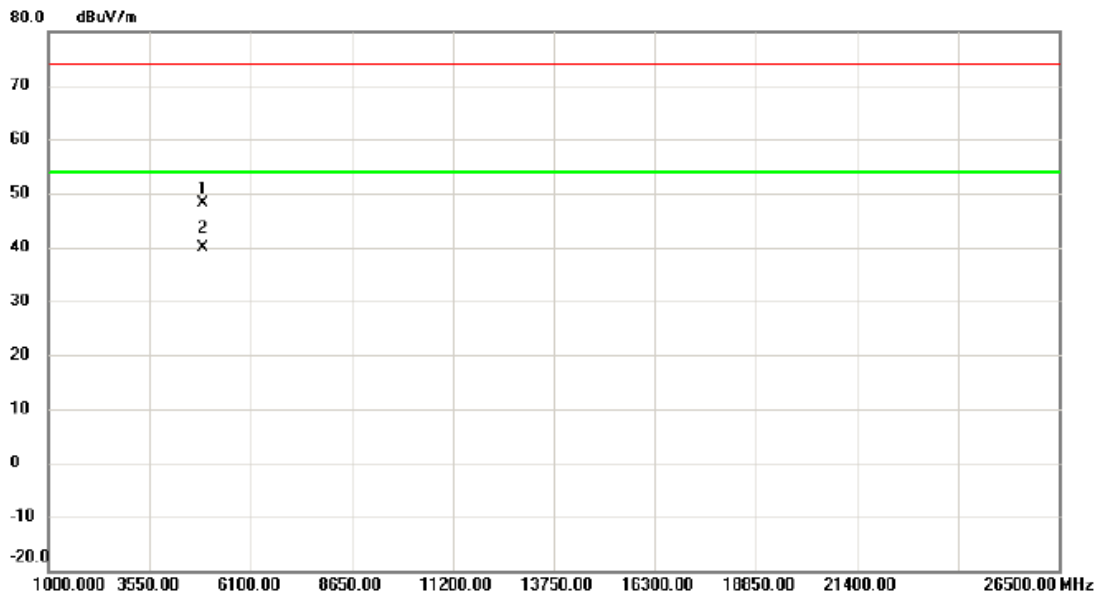
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	2444.350	93.94	6.47	100.41	54.00	46.41	AVG	No Limit
2	X	2444.475	101.54	6.47	108.01	74.00	34.01	peak	No Limit

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2444.5 MHz _CH09

Horizontal



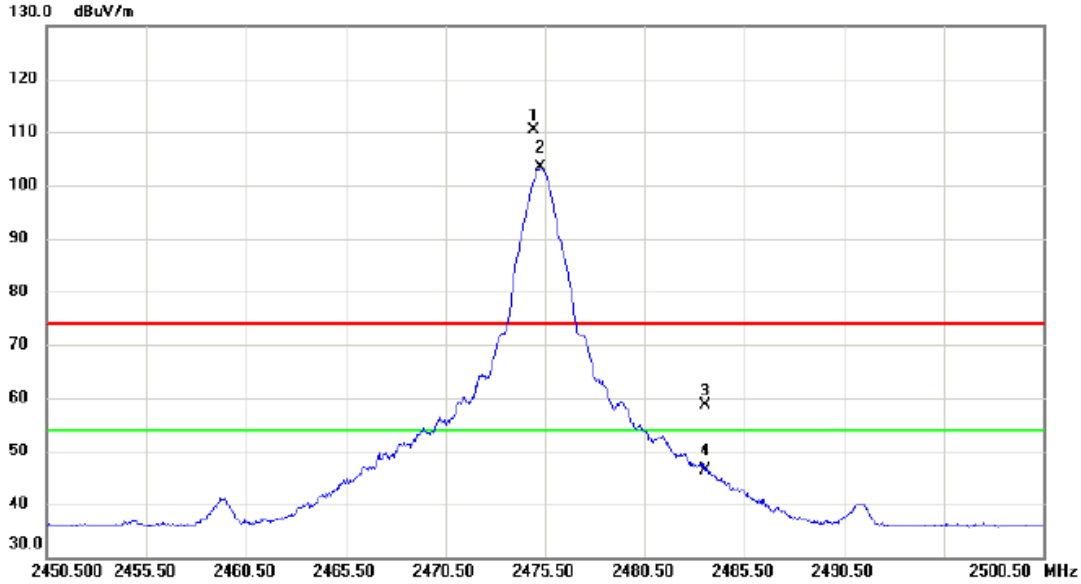
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		4888.045	44.62	3.63	48.25	74.00	-25.75	peak	
2	*	4888.765	36.33	3.63	39.96	54.00	-14.04	AVG	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2475.5 MHz _CH16

Vertical



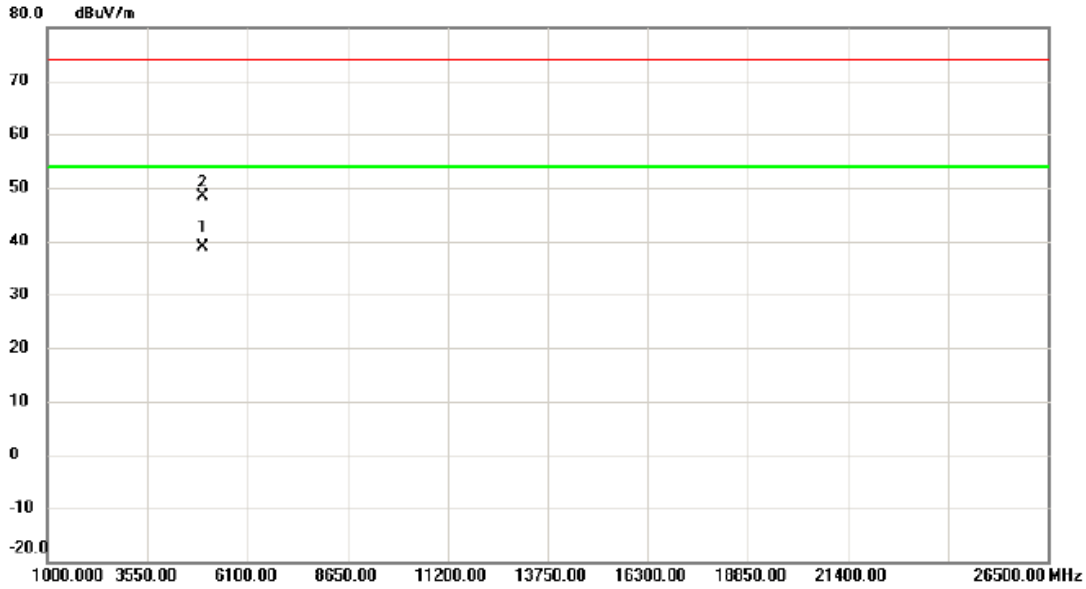
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	X	2474.900	104.02	6.43	110.45	74.00	36.45	peak	No Limit
2	*	2475.275	97.01	6.43	103.44	54.00	49.44	AVG	No Limit
3		2483.500	52.29	6.43	58.72	74.00	-15.28	peak	
4		2483.500	40.04	6.43	46.47	54.00	-7.53	AVG	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2475.5 MHz _CH16

Vertical



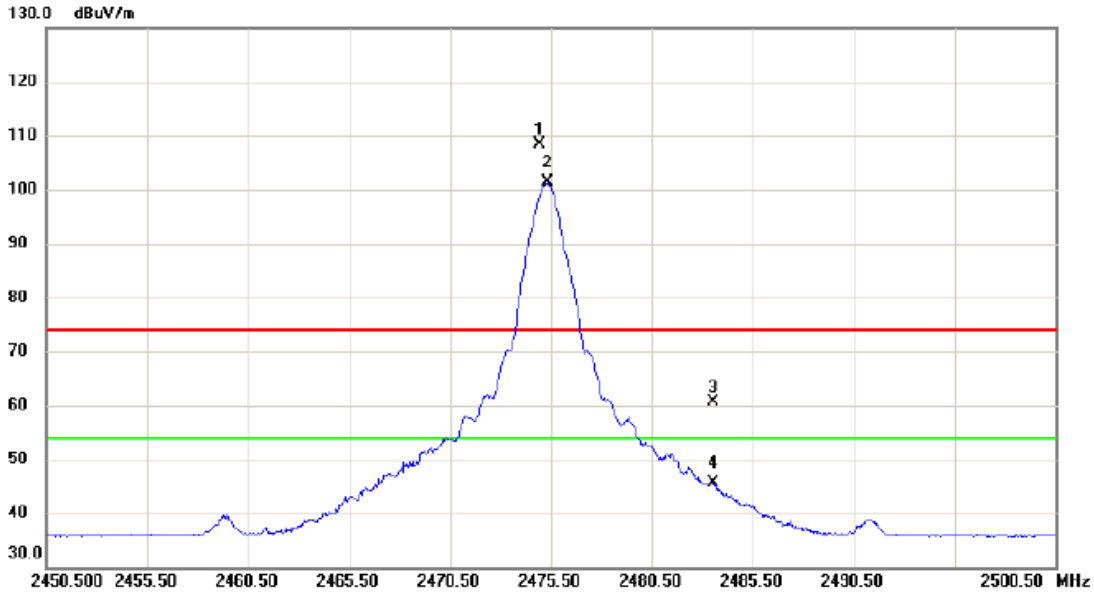
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	*	4950.815	35.05	3.81	38.86	54.00	-15.14	AVG	
2		4950.860	44.64	3.81	48.45	74.00	-25.55	peak	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2475.5 MHz _CH16

Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	X	2474.950	101.93	6.43	108.36	74.00	34.36	peak	No Limit
2	*	2475.300	94.92	6.43	101.35	54.00	47.35	AVG	No Limit
3		2483.500	54.08	6.43	60.51	74.00	-13.49	peak	
4		2483.500	39.25	6.43	45.68	54.00	-8.32	AVG	

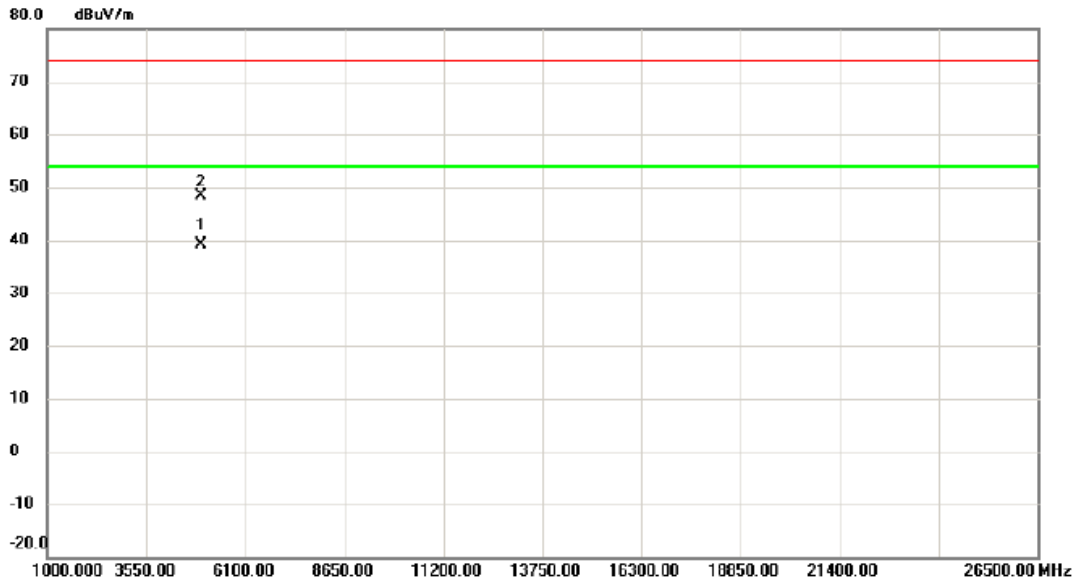
REMARKS:

(1) Measurement Value = Reading Level + Correct Factor.

(2) Margin Level = Measurement Value - Limit Value.

Test Mode: TX 2475.5 MHz _CH16

Horizontal



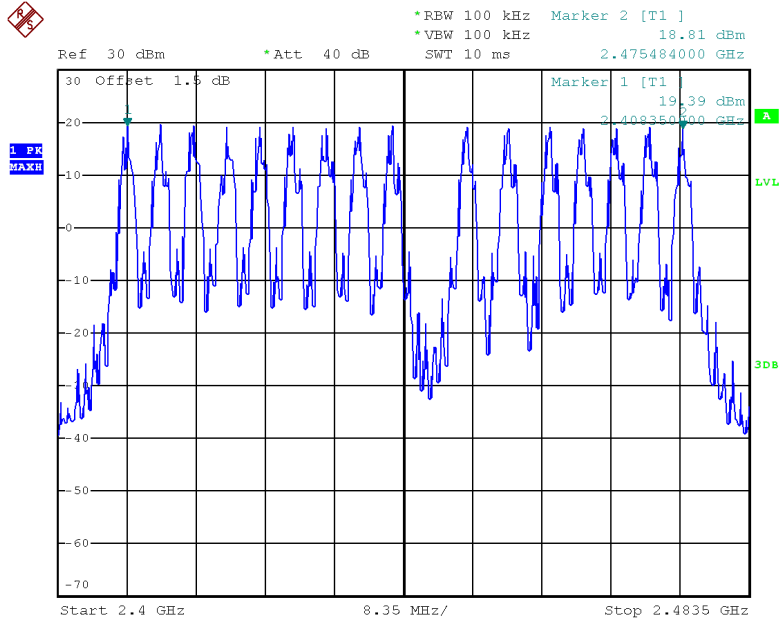
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	*	4950.885	35.43	3.81	39.24	54.00	-14.76	AVG	
2		4950.905	44.57	3.81	48.38	74.00	-25.62	peak	

REMARKS:

- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value - Limit Value.

APPENDIX E - NUMBER OF HOPPING FREQUENCY

Test Mode	Hopping Mode
Number of Hopping Frequency	16

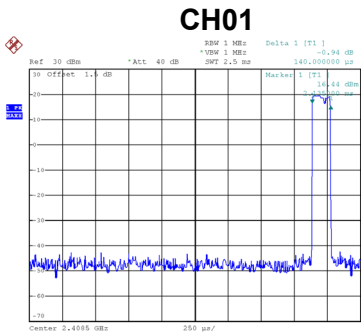


Date: 12.AUG.2019 11:38:07

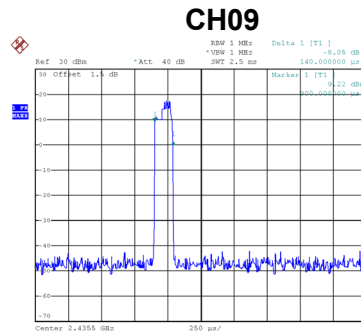
APPENDIX F - AVERAGE TIME OF OCCUPANCY

Test Mode:	TX Mode
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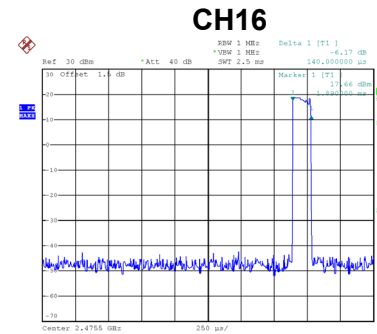
Channel (CH)	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Result
01	2408.5	0.140	0.0116	0.40	Pass
09	2444.5	0.140	0.0116	0.40	Pass
16	2475.5	0.140	0.0116	0.40	Pass



Date: 12.AUG.2019 11:41:07



Date: 12.AUG.2019 11:49:35



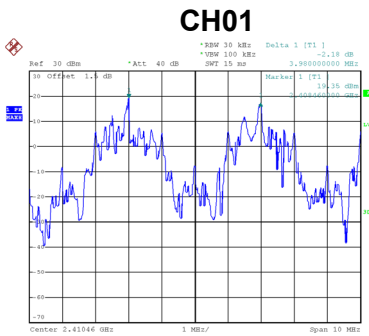
Date: 12.AUG.2019 11:47:29

Note: (hopping channel /1S) * total channel number*ON time*0.4≤0.4s.

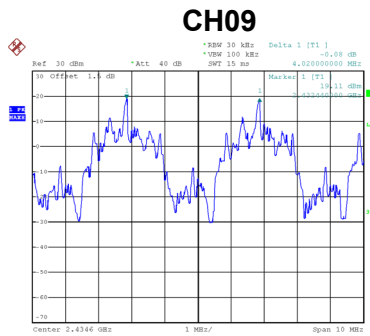
APPENDIX G - HOPPING CHANNEL SEPARATION MEASUREMENT

Test Mode: Hopping on

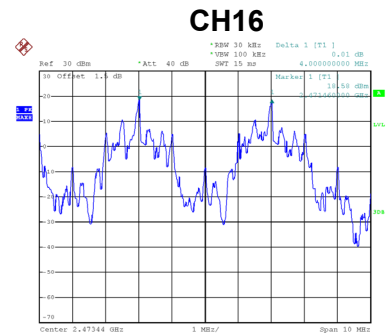
Channel (CH)	Frequency (MHz)	Channel Separation (MHz)	2/3 of 20 dB Bandwidth (MHz)	Test Result
01	2408.5	3.98	1.39	Pass
09	2444.5	4.02	1.40	Pass
16	2475.5	4.00	1.40	Pass



Date: 12_AUG.2019 10:58:36



Date: 12_AUG.2019 10:44:27

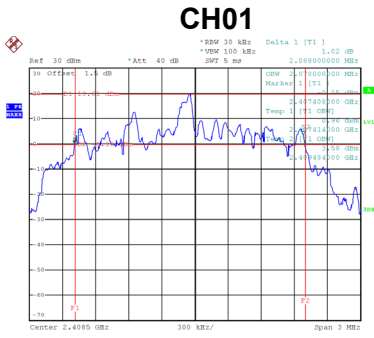


Date: 12_AUG.2019 11:10:15

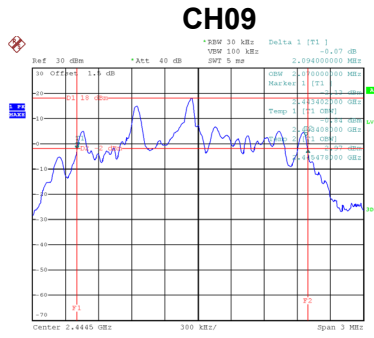
APPENDIX H - BANDWIDTH

Test Mode: TX Mode

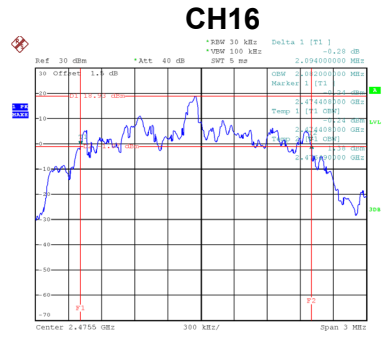
Channel (CH)	Frequency (MHz)	20 dB Bandwidth (MHz)	99 % Emission Bandwidth (MHz)
01	2408.5	2.09	2.07
09	2444.5	2.09	2.07
16	2475.5	2.09	2.08



Date: 13.AUG.2019 09:54:47



Date: 14.AUG.2019 10:08:18



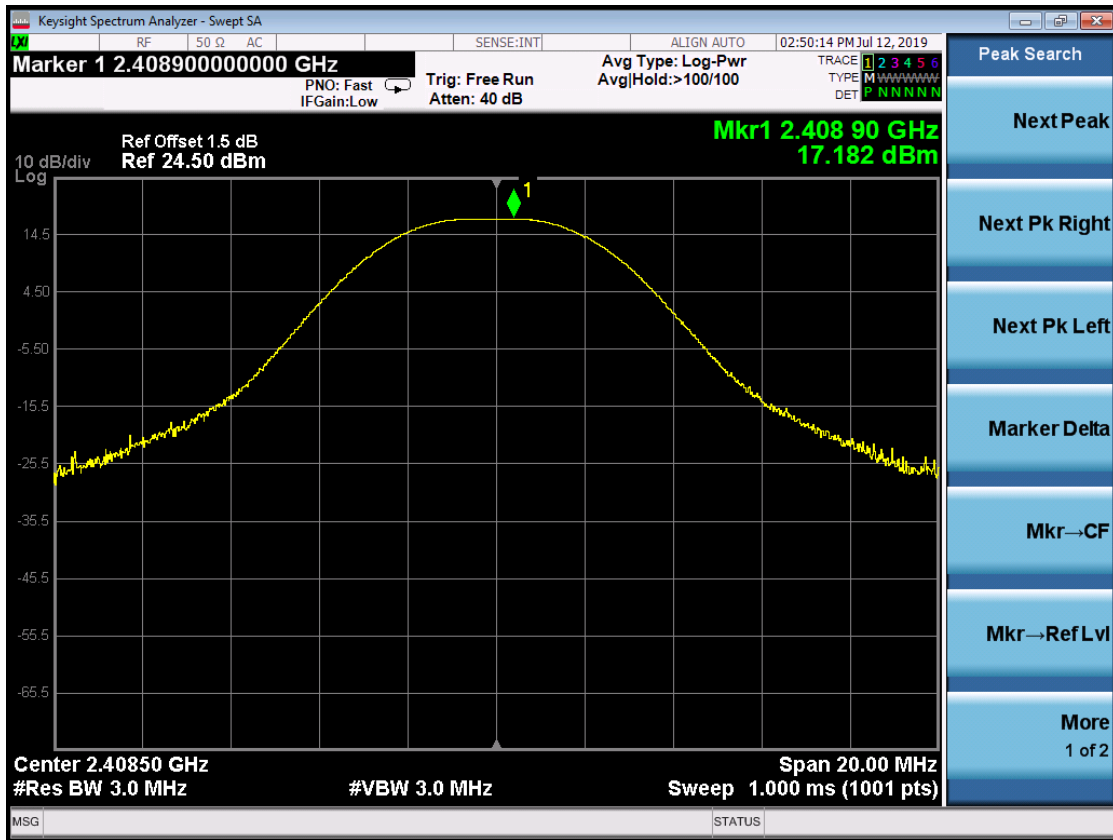
Date: 13.AUG.2019 09:59:06

APPENDIX I - MAXIMUM OUTPUT POWER

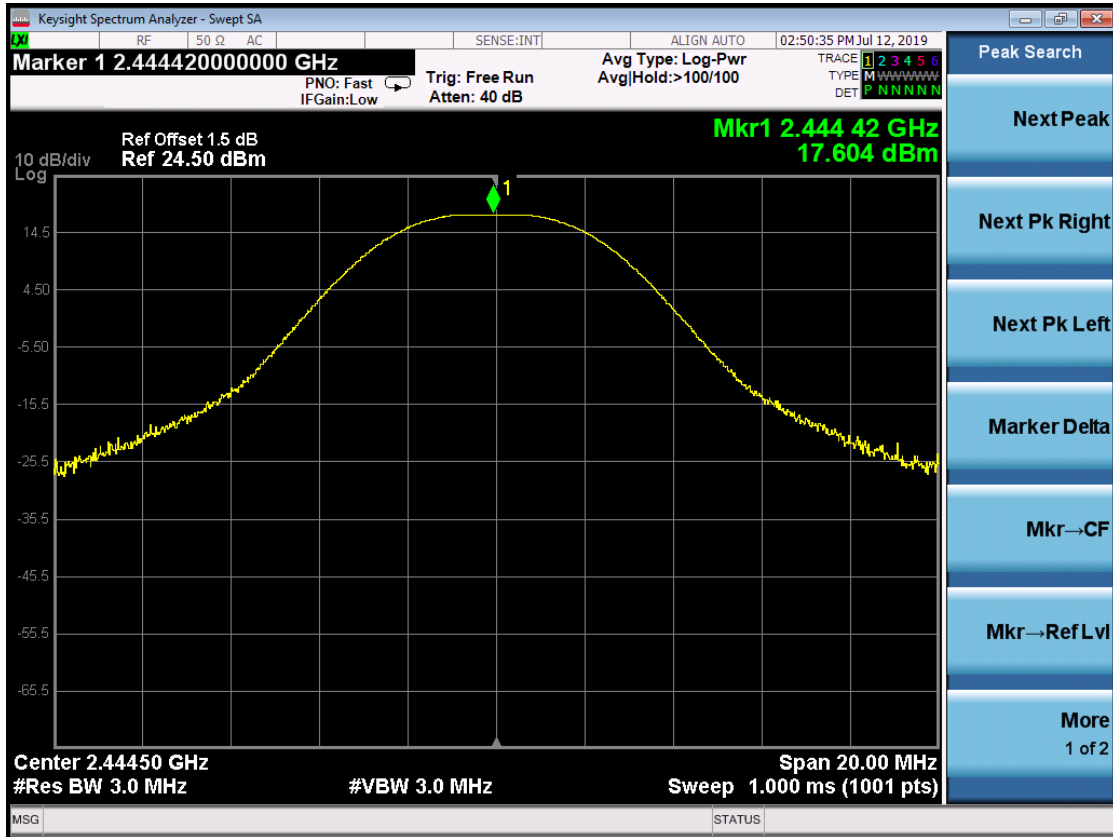
Test Mode: TX Mode

Channel (CH)	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Max. Limit (dBm)	Max. Limit (W)	Test Result
01	2408.5	17.18	0.0522	21.00	0.125	Pass
09	2444.5	17.60	0.0575	21.00	0.125	Pass
16	2475.5	17.68	0.0586	21.00	0.125	Pass

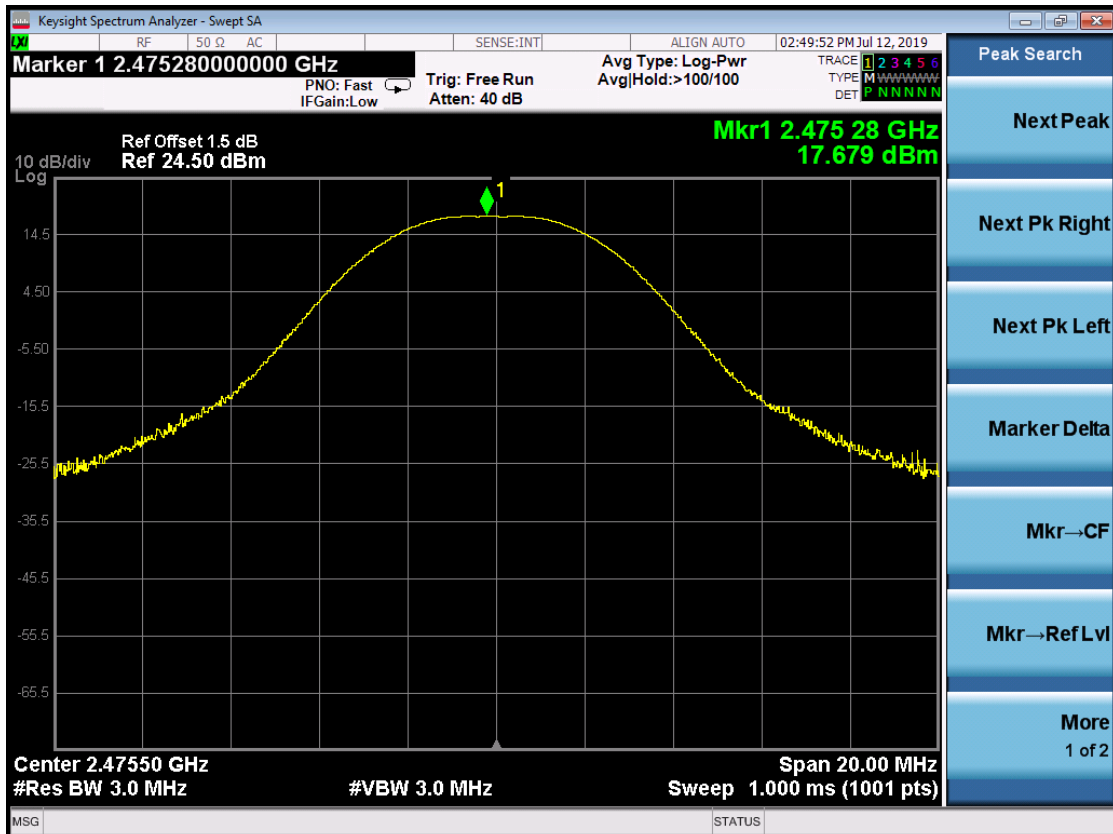
CH01



CH09



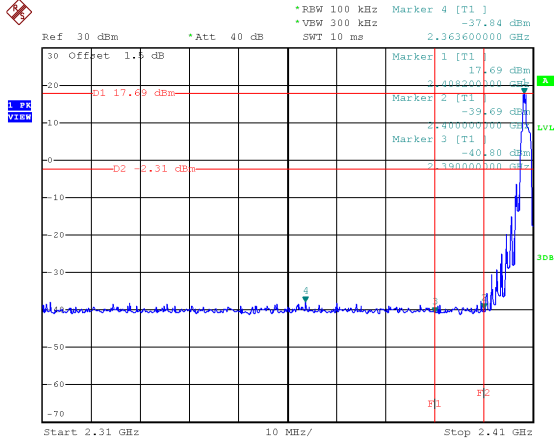
C16



APPENDIX J - CONDUCTED SPURIOUS EMISSION

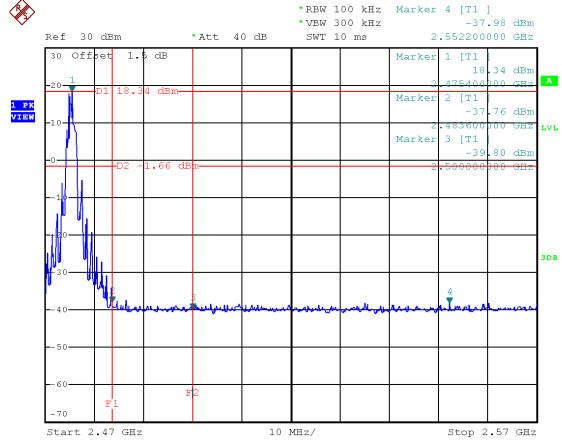
Test Mode : TX Mode

Bandedge- CH01 (Lower)



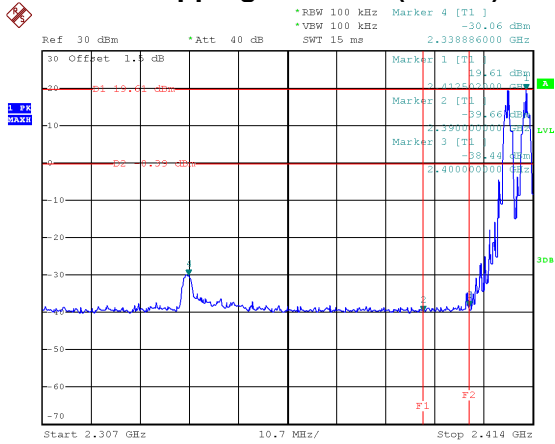
Date: 19.JUL.2019 17:16:19

Bandedge CH16 (Upper)



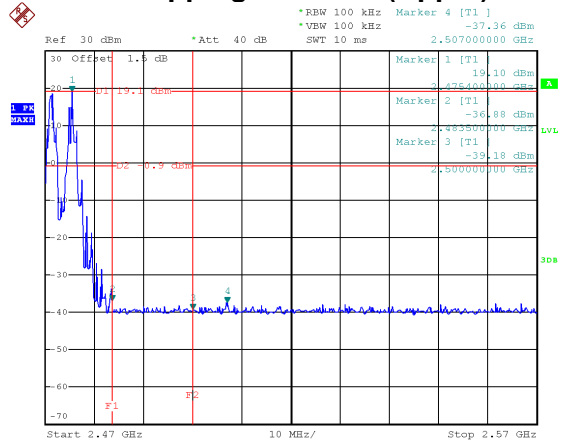
Date: 19.JUL.2019 17:12:43

Hopping on mode (Lower)



Date: 12.AUG.2019 11:18:45

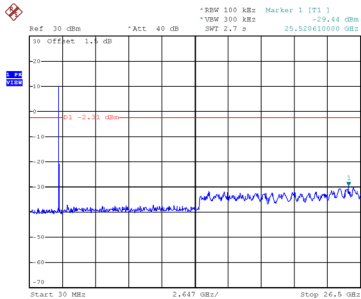
Hopping on mode (Upper)



Date: 12.AUG.2019 11:26:59

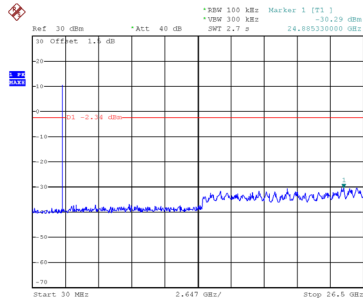
10th Harmonic of the fundamental frequency

CH01



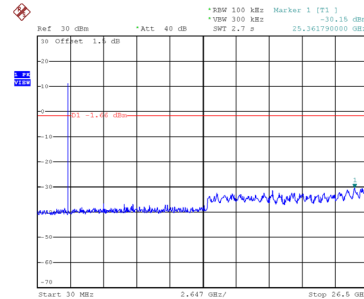
Date: 22.JUL.2019 10:13:08

CH09



Date: 22.JUL.2019 10:10:23

CH16



Date: 22.JUL.2019 10:14:56

End of Test Report