FCC RF TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

LoRa Module

ISSUED TO
SG Wireless Limited

Unit 4, 5/F, Sun Fung Industrial Building, 8 Ma Kok Street, Tsuen Wan New Territories, Hong Kong

Tested by: Ye Hongji
Date: Apr. 30, 2020

Approved by: Wei Yanquan (Chief Engineer)
Date: Apr. 30, 2020

Report No.:	BL-SZ2030163-601
EUT Name:	LoRa Module
Model Name:	SGW2828-01A
Brand Name:	SG Wireless
Test Standard:	47 CFR Part 15 Subpart C
FCC ID:	2AS9404
Test Conclusion:	Pass
Test Date:	Mar. 21, 2020 ~ Apr. 27, 2020
Date of Issue:	Apr. 30, 2020

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Revision History

Version	Issue Date	Revisions Content
Rev. 01	Apr. 30, 2020	Initial Issue

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1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100
Fax Number	+86 755 6182 4271

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. The laboratory is a testing organization accredited by American Association for Laboratory Accreditation (A2LA) according to ISO/IEC 17025.The accreditation certificate is 4344.01. The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Laboratory Condition

Ambient Temperature	20℃ to 25℃
Ambient Relative Humidity	45% to 55%
Ambient Pressure	100 kPa to 102 kPa

1.4 Announce

(1) The test report reference to the report template version v2.2.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

(7) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	SG Wireless Limited
Address	Unit 4, 5/F, Sun Fung Industrial Building, 8 Ma Kok Street, Tsuen Wan New Territories, Hong Kong

2.2 Manufacturer Information

Manufacturer	SG Wireless Limited
Address	Unit 4, 5/F, Sun Fung Industrial Building, 8 Ma Kok Street, Tsuen Wan New Territories, Hong Kong

2.3 Factory Information

Factory	Dongguan Macson Electronics Ltd.
Address	No.5, Jun Da Lu, DongKeng, Dongguan, Guangdong China 523451

2.4 General Description for Equipment under Test (EUT)

EUT Name	LoRa Module
Model Name Under Test	SGW2828-01A
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	V1.0
Software Version	V1.00
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.5 Technical Information

Network and Wireless connectivity	LoRa

The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology	Hybrid system, DTS
Modulation Type	LoRa
Product Type	☐ Mobile ☐ Portable ☒ Fix Location
Frequency Range	The frequency range used is 902 MHz to 928 MHz.
Number of channel	128 for FHSS, 79 for FHSS, and 33 for DTS
Tested Channel	125KHz: 0 (902.3 MHz), 64 (915.1 MHz), 127 (927.7 MHz) 250KHz: 0 (902.40 MHz), 50 (914.94 MHz), 100 (927.48 MHz) 500KHz: 0 (903.0 MHz), 15 (915.0 MHz), 32 (927.5 MHz)
Antenna Type	Dipole Antenna
Antenna Gain	2 dBi (In test items related to antenna gain, the final results reflect this figure. This value is provided by the applicant.)
Antenna System(MIMO Smart Antenna)	N/A

All channel was listed on the following table:

125KHz for FHSS

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
0	**902.3**	32	908.7	**64**	**915.1**	96	921.5
1	902.5	33	908.9	65	915.3	97	921.7
2	902.7	34	909.1	66	915.5	98	921.9
3	902.9	35	909.3	67	915.7	99	922.1
4	903.1	36	909.5	68	915.9	100	922.3
5	903.3	37	909.7	69	916.1	101	922.5
6	903.5	38	909.9	70	916.3	102	922.7
7	903.7	39	910.1	71	916.5	103	922.9
8	903.9	40	910.3	72	916.7	104	923.1
9	904.1	41	910.5	73	916.9	105	923.3
10	904.3	42	910.7	74	917.1	106	923.5
11	904.5	43	910.9	75	917.3	107	923.7
12	904.7	44	911.1	76	917.5	108	923.9
13	904.9	45	911.3	77	917.7	109	924.1
14	905.1	46	911.5	78	917.9	110	924.3
15	905.3	47	911.7	79	918.1	111	924.5
16	905.5	48	911.9	80	918.3	112	924.7
17	905.7	49	912.1	81	918.5	113	924.9
18	905.9	50	912.3	82	918.7	114	925.1
19	906.1	51	912.5	83	918.9	115	925.3
20	906.3	52	912.7	84	919.1	116	925.5
21	906.5	53	912.9	85	919.3	117	925.7
22	906.7	54	913.1	86	919.5	118	925.9
23	906.9	55	913.3	87	919.7	119	926.1
24	907.1	56	913.5	88	919.9	120	926.3
25	907.3	57	913.7	89	920.1	121	926.5
26	907.5	58	913.9	90	920.3	122	926.7
27	907.7	59	914.1	91	920.5	123	926.9
28	907.9	60	914.3	92	920.7	124	927.1
29	908.1	61	914.5	93	920.9	125	927.3
30	908.3	62	914.7	94	921.1	126	927.5
31	908.5	63	914.9	95	921.3	**127**	**927.7**

250KHz for FHSS

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
0	**902.4**	20	909	40	915.6	60	922.2
1	902.73	21	909.33	41	915.93	61	922.53
2	903.06	22	909.66	42	916.26	62	922.86
3	903.39	23	909.99	43	916.59	63	923.19
4	903.72	24	910.32	44	916.92	64	923.52
5	904.05	25	910.65	45	917.25	65	923.85
6	904.38	26	910.98	46	917.58	66	924.18
7	904.71	27	911.31	47	917.91	67	924.51
8	905.04	28	911.64	48	918.24	68	924.84
9	905.37	29	911.97	49	918.57	69	925.17
10	905.7	30	912.3	50	918.9	70	925.5
11	906.03	31	912.63	51	919.23	71	925.83
12	906.36	32	912.96	52	919.56	72	926.16
13	906.69	33	913.29	53	919.89	73	926.49
14	907.02	34	913.62	54	920.22	74	926.82
15	907.35	35	913.95	55	920.55	75	927.15
16	907.68	36	914.28	56	920.88	**76**	**927.48**
17	908.01	37	914.61	57	921.21		
18	908.34	**38**	**914.94**	58	921.54		
19	908.67	39	915.27	59	921.87		

500KHz for DTS

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
0	**903**	9	910.2	18	917.4	27	924.5
1	903.8	10	911	19	918.2	28	925.1
2	904.6	11	911.8	20	919	29	925.7
3	905.4	12	912.6	21	919.8	30	926.3
4	906.2	13	913.4	22	920.6	31	926.9
5	907	14	914.2	23	921.4	**32**	**927.5**
6	907.8	**15**	**915**	24	922.2		
7	908.6	16	915.8	25	923.3		
8	909.4	17	916.6	26	923.9		

2.6 Additional Instructions

EUT Software Settings:

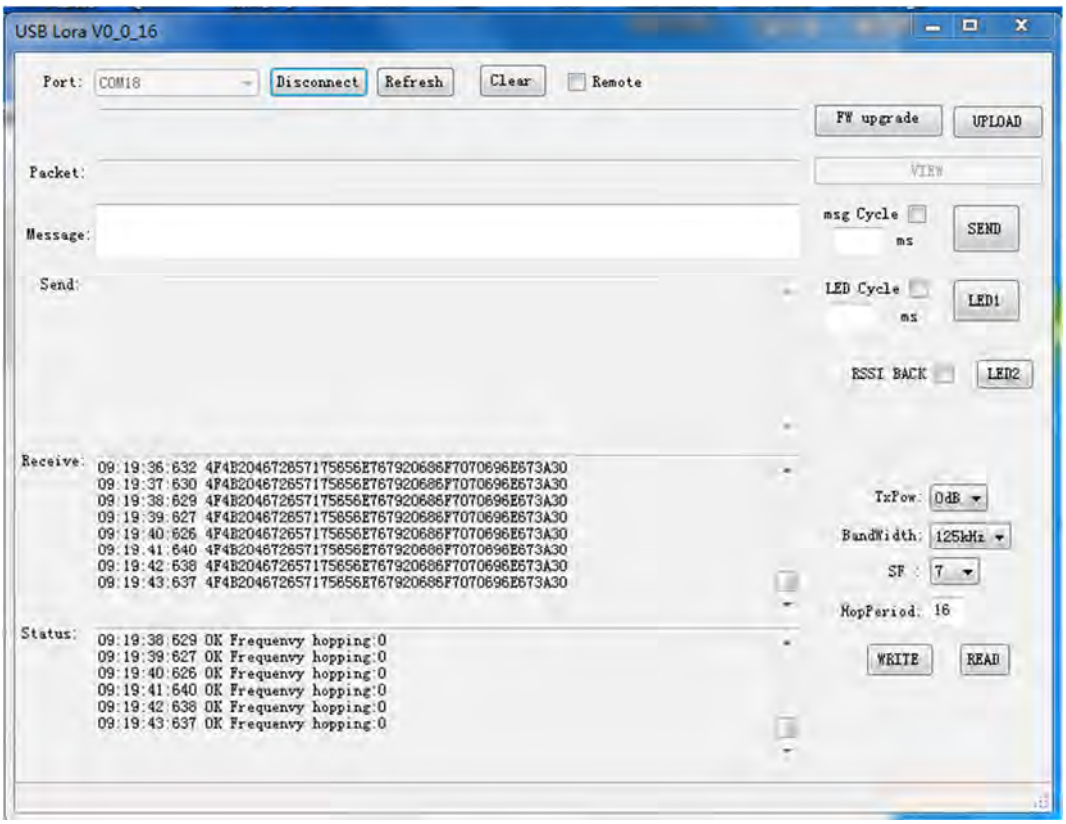
Mode	☒ Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

During testing, Channel and 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 level setup in software			
Test Software Version	UsbLora		
Support Units (Software installation media)	Description	Manufacturer	Model
	Notebook	Lenovo	X220

Mode	Channel	Soft Set
125KHz	902.3 MHz	TX LEVEL is built-in set parameters and cannot be changed and selected.
	915.1 MHz	
	927.7 MHz	
250KHz	902.3 MHz	
	914.9 MHz	
	927.4 MHz	
500KHz	903.0 MHz	
	915.0 MHz	
	927.5 MHz	

Run Software



3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C	Miscellaneous Wireless Communications Services
2	FCC PUBLIC NOTICE DA 00-705 (Mar. 30, 2000)	Filling and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
4	KDB Publication 558074 D01v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

3.2 Verdict

No.	Description	FCC Part No.	Modulation Technology	Channel	Test Result	Verdict	Remark
1	Antenna Requirement	15.203	N/A	N/A	--	Pass	Note [1]
2	Peak Output Power	15.247(b)	Hybrid system	Low/Middle/High	ANNEX A.1	Pass	--
3	Occupied Bandwidth	15.247(a)	Hybrid system	Low/Middle/High	ANNEX A.2	Pass	--
4	Carrier Frequency Separation	15.247(a)	Frequency hopping mode	Hopping Mode	ANNEX A.3	Pass	--
5	Time of Occupancy (Dwell time)	15.247(a)	Frequency hopping mode	Hopping Mode	ANNEX A.4	Pass	--
6	Conducted Spurious Emission & Authorized-band band-edge	15.247(d)	Hybrid system	Low/Middle/High, Hopping Mode	ANNEX A.5	Pass	--
7	Conducted Emission	15.207	Hybrid system	Low/Middle/High	ANNEX A.6	Pass	--
8	Radiated Spurious Emission	15.209 15.247(d)	Hybrid system	Low/Middle/High, Hopping Mode	ANNEX A.7	Pass	--
9	Band Edge(Restricted-band band-edge)	15.209 15.247(d)	Hybrid system	Low/Middle/High, Hopping Mode	ANNEX A.8	Pass	--
10	Power spectral density (PSD)	15.247(e)	Hybrid system	Low/Middle/High	ANNEX A.9	Pass	--
Note [1]: Please refer to section 5.1							

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	45% to 55%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	+22℃ to +25℃
Working Voltage of the EUT	NV (Normal Voltage)	5.0 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-30	103118	2019.06.13	2020.06.12
Vector Signal Generator	ROHDE&SCHWARZ	SMBV100A	260592	2019.06.13	2020.06.12
Signal Generator	ROHDE&SCHWARZ	SMB100A	177746	2019.08.23	2020.08.22
Switch Unit with OSP-B157	ROHDE&SCHWARZ	OSP120	101270	2019.06.13	2020.06.12
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2019.06.13	2020.06.12
LISN	SCHWARZBECK	NSLK 8127	8127-687	2019.06.13	2020.06.12
Bluetooth Tester	ROHDE&SCHWARZ	CBT	101005	2019.06.13	2020.06.12
DC Power Supply	ROHDE&SCHWARZ	HMP2020	018141664	2019.06.18	2020.06.17
Power Splitter	KMW	DCPD-LDC	1305003215	--	--
Power Sensor	ROHDE&SCHWARZ	NRP-Z21	103971	2019.06.13	2020.06.12
Attenuator (20 dB)	KMW	ZA-S1-201	110617091	--	--
Attenuator (6 dB)	KMW	ZA-S1-61	1305003189	--	--
DC Power Supply	ROHDE&SCHWARZ	HMP2020	018141664	2019.06.13	2020.06.12
Temperature Chamber	AHK	SP20	1412	2019.06.24	2020.06.23
Test Antenna-Loop(9 kHz-30 MHz)	SCHWARZBECK	FMZB 1519	1519-037	2017.11.07	2020.11.08
Test Antenna-Bi-Log(30 MHz-3 GHz)	SCHWARZBECK	VULB 9163	9163-624	2019.07.22	2020.07.21
Test Antenna-Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	9120D-1148	2019.07.22	2021.07.21
Test Antenna-Horn (18-40 GHz)	A-INFO	LB-180400KF	J211060273	2019.01.06	2021.01.05
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2017.02.21	2022.02.20
Anechoic Chamber	EMC TECHNOLOGY LTD	21.1m*11.6m*7.35m	N/A	2018.08.09	2020.08.08
Shielded Enclosure	ChangNing	CN-130701	130703	--	--
Signal Generator	ROHDE&SCHWARZ	SMB100A	177746	2019.06.12	2020.06.11
Power Amplifier	OPHIR RF	5225F	1037	2020.02.19	2021.02.18
Power Amplifier	OPHIR RF	5273F	1016	2020.02.19	2021.02.18
Directional Coupler	Werlantone	C5982-10	109275	N/A	N/A
Directional Coupler	Werlantone	CHP-273E	S00801z-01	N/A	N/A
Feld Strength Meter	Narda	EP601	511WX51129	2019.05.22	2020.05.21

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Mouth Simulator	B&K	4227	2423931	2019.11.12	2020.11.11
Sound Calibrator	B&K	4231	2430337	2019.11.12	2020.11.11
Sound Level Meter	B&K	NL-20	00844023	2019.11.12	2020.11.11
Ear Simulator	B&K	4185	2409449	2019.11.12	2020.11.11
Ear Simulator	B&K	4195	2418189	2019.11.12	2020.11.11
Audio analyzer	B&K	UPL 16	100129	2019.11.12	2020.11.11

4.3 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

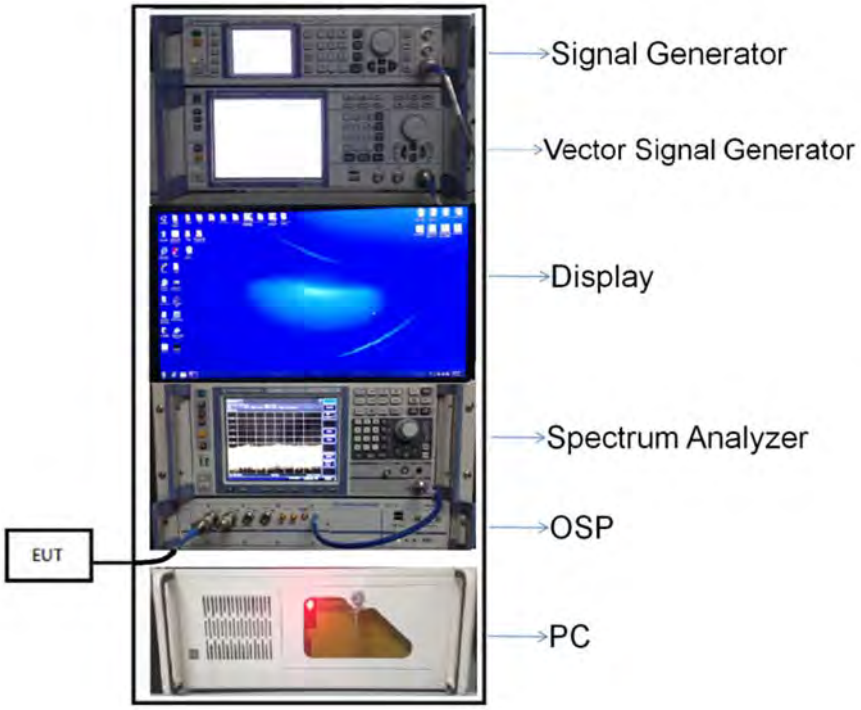
Measurement	Value
Occupied Channel Bandwidth	±4%
RF output power, conducted	±1.4 dB
Power Spectral Density, conducted	±2.5 dB
Unwanted Emissions, conducted	±2.8 dB
All emissions, radiated	±5.4 dB
Temperature	±1°C
Humidity	±4%

4.4 Description of Test Setup

4.4.1 For Antenna Port Test

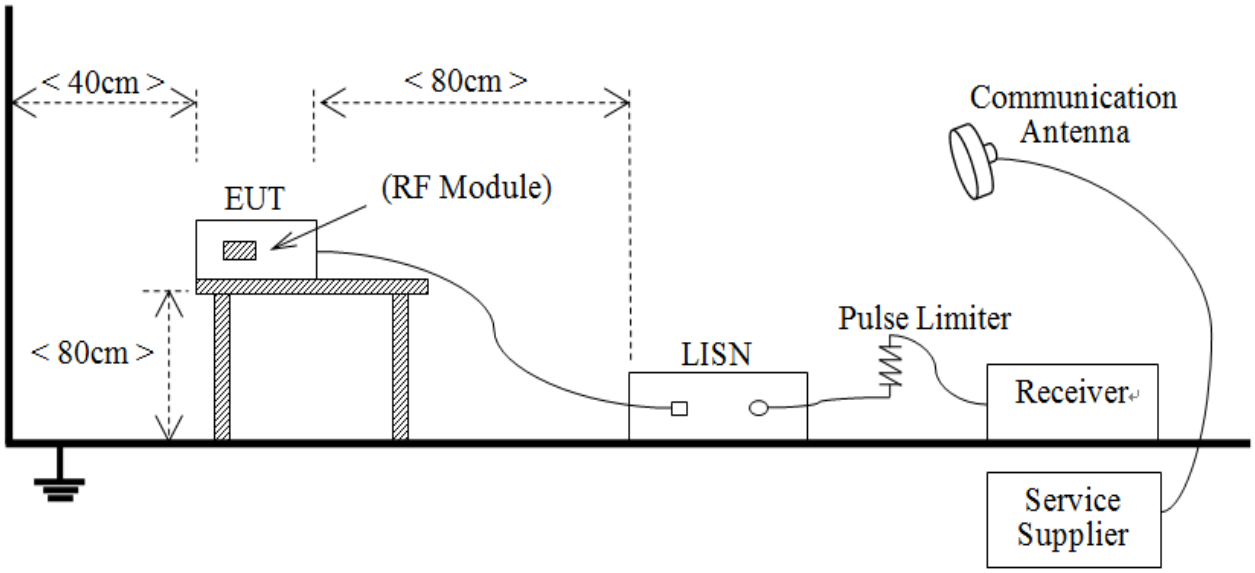
Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:
Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



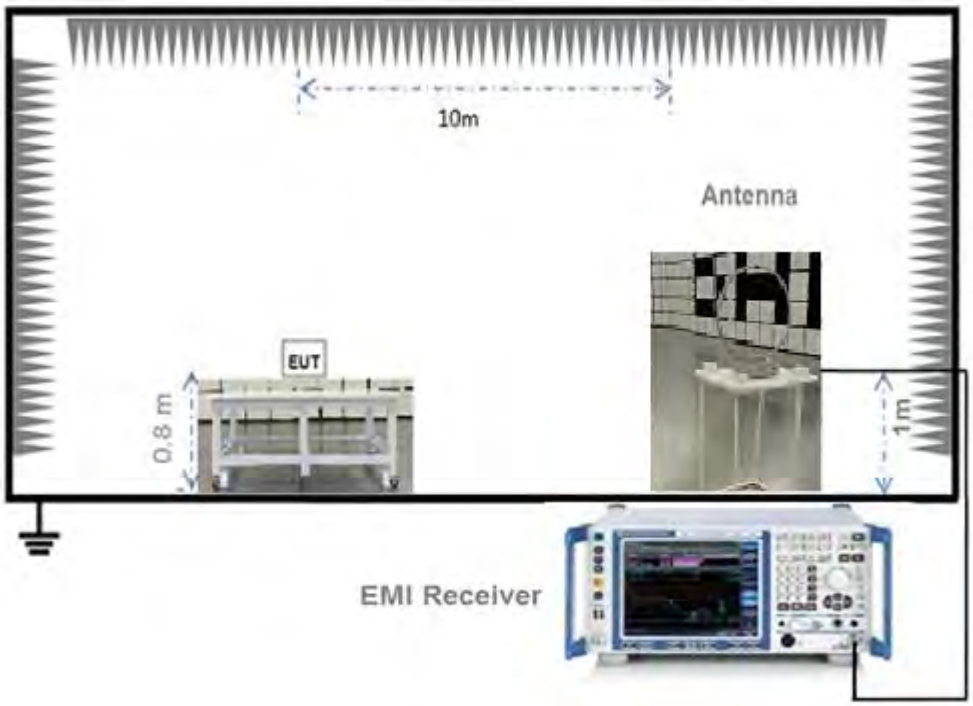
(Diagram 1)

4.4.2 For AC Power Supply Port Test



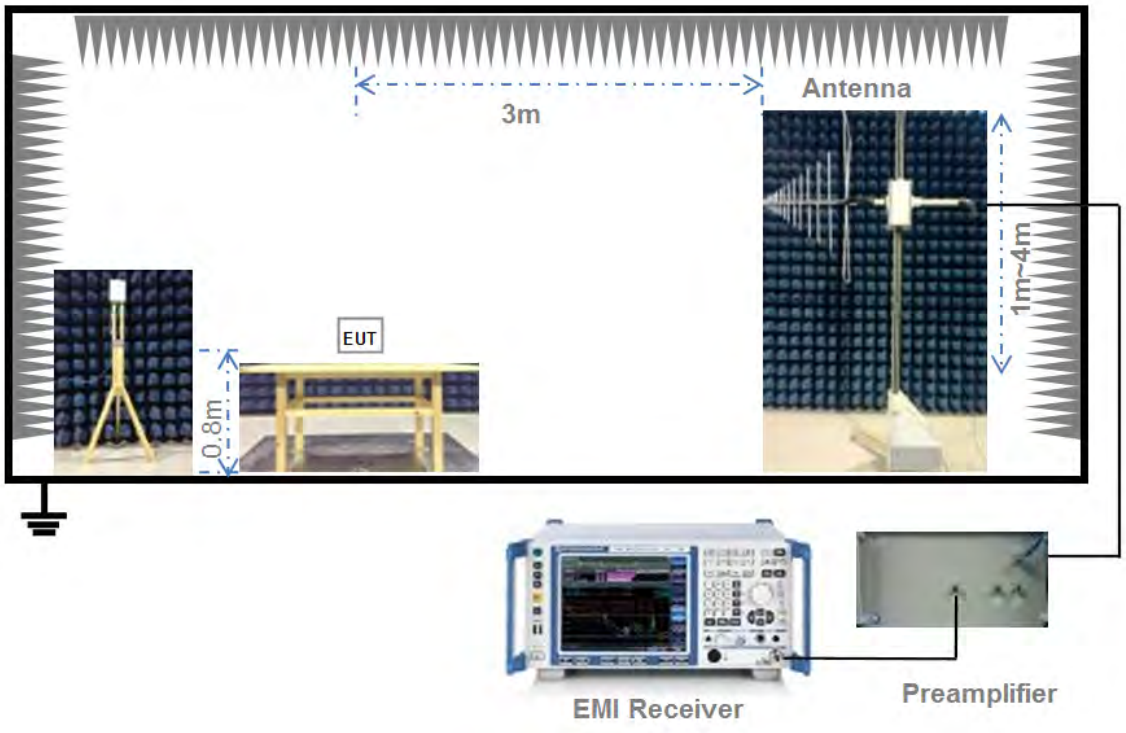
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



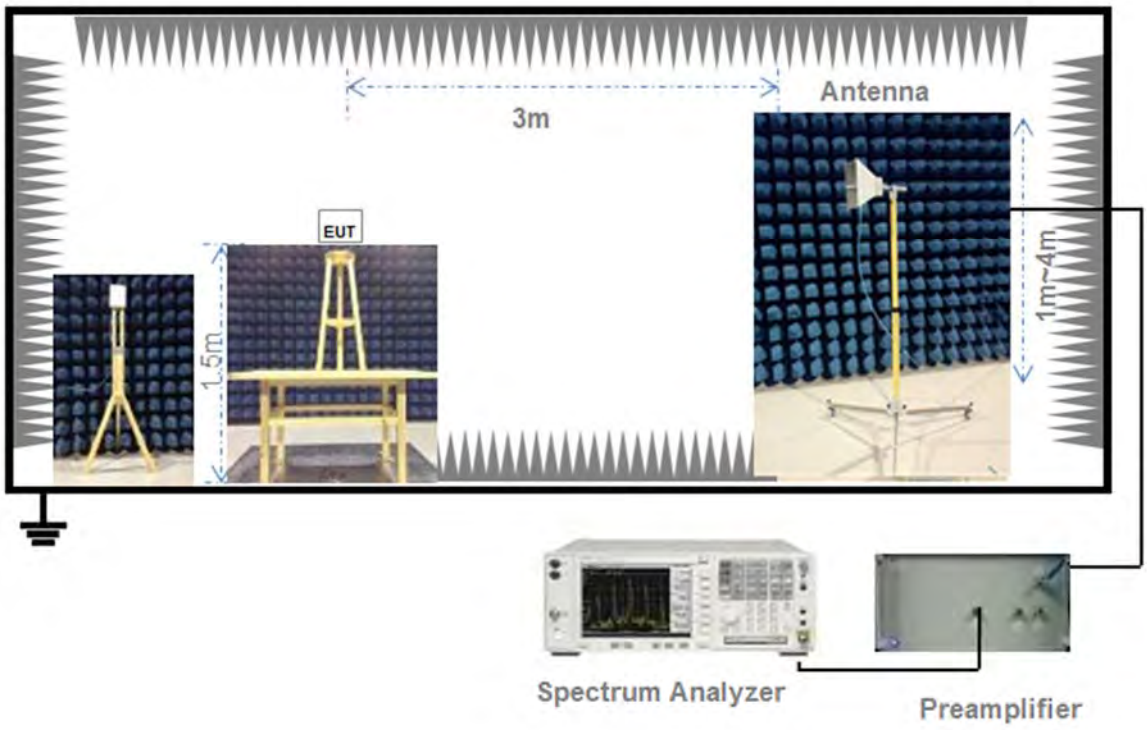
(Diagram 3)

4.4.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.4.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.5 Measurement Results Explanation Example

4.5.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.

5 TEST ITEMS - Hybrid

5.1 Antenna Requirements

5.1.1 Relevant Standards

FCC §15.203 & 15.247(b); RSS-247, 5.4 (6)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is embedded in the product	The antenna is the unique connector with a wire antenna.

Reference Documents	Item
Photo	Please refer to the EUT Photo documents.

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Peak Output Power and E.I.R.P

5.2.1 Test Limit

FCC § 15.247(b)(1)

For frequency hopping systems operating in the 902-928 MHz 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.

RSS-247, 5.4 (2)

For FHSS operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

5.2.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

The Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Occupied Bandwidth

5.3.1 Limit

FCC §15.247(a)(1)(i); RSS-247, 5.1 (1)

Measurement of the 20dB bandwidth of the modulated signal. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

5.3.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW = in the range of 1% to 5% of the OBW

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Carrier Frequency Separation

5.4.1 Limit

FCC §15.247(a)(1); RSS-247, 5.1 (2)

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.

5.4.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span

Video (or Average) Bandwidth (VBW) ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Time of Occupancy (Dwell time)

5.5.1 Limit

FCC §15.247(a)(1)(i); RSS-247, 5.1 (4)

For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4.

5.5.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Conducted Spurious Emission & Authorized-band band-edge

5.6.1 Limit

FCC §15.247(d); RSS-247, 5.5

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.

5.6.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize

5.6.4 Test Result

Please refer to ANNEX A.6 and A.5

5.7 Conducted Emission

5.7.1 Limit

FCC §15.207; RSS-GEN, 8.8

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.7.2 Test Setup

See section 4.4.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.
Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

5.7.4 Test Result

Please refer to ANNEX A.6.

5.8 Radiated Spurious Emission

5.8.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	902/F(kHz)	300
0.490 - 1.705	9020/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note:

1. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.8.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.8.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW

Sweep = auto
Detector function = peak
Trace = max hold
For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Band Edge (Restricted-band band-edge)

5.9.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.9.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.9.4 Test Result

Please refer to ANNEX A.8.

5.10 Power Spectral density (PSD)

5.10.1 Limit

FCC §15.247(e); RSS-247, 5.2 (2)

The same method of determining the conducted output power shall be used to determine the power spectral density. If a peak output power is measured, then a peak power spectral density measurement is required. If an average output power is measured, then an average power spectral density measurement should be used.

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

5.10.2 Test Setup

See section 4.4.1 (Diagram 1) for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.10.3 Test Procedure

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.

Set the VBW ≥ 3 RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.10.4 Test Result

Please refer to ANNEX A.9.

6 TEST ITEMS - DTS

6.1 Output Power

6.1.1 Test Limit

FCC § 15.247(b)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements.

RSS-247, 5.4 (4)

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

6.1.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

6.1.3 Test Procedure

a) Maximum peak conducted output power

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

Set the RBW ≥ DTS bandwidth.

Set VBW ≥ 3 x RBW.

Set span ≥ 3 x RBW

Sweep time = auto couple.

Detector = peak.

Trace mode = max hold.

Allow trace to fully stabilize.

Use peak marker function to determine the peak amplitude level.

b) Measurements of duty cycle

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

Set the center frequency of the instrument to the center frequency of the transmission.

Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.

Set VBW ≥ RBW. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of

sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

6.1.4 Test Result

Please refer to ANNEX A.1.

6.2 Occupied Bandwidth

6.2.1 Limit

FCC §15.247(a); RSS-247, 5.1 (1); RSS-GEN, 6.6

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW. The 6 dB bandwidth must be greater than 500 kHz.

6.2.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

6.2.3 Test Procedure

Use the following spectrum analyzer settings:

Set RBW = 100 kHz.

Set the video bandwidth (VBW) ≥ 3 RBW.

Detector = Peak.

Trace mode = max hold.

Sweep = auto couple.

Allow the trace to stabilize.

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.2.4 Test Result

Please refer to ANNEX A.2.

6.3 Conducted Spurious Emission

6.3.1 Limit

FCC §15.247(d); RSS-247, 5.5

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.

6.3.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

6.3.3 Test Procedure

The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:

a) If the maximum peak conducted output power procedure was used to demonstrate compliance as described in 9.1, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

c) In either case, attenuation to levels below the 15.209 general radiated emissions limits is not required.

The following procedures shall be used to demonstrate compliance to these limits. Note that these procedures can be used in either an antenna-port conducted or radiated test set-up. Radiated tests must conform to the test site requirements and utilize maximization procedures defined herein.

Reference level measurement:

Establish a reference level by using the following procedure:

Set instrument center frequency to DTS channel center frequency.

Set the span to ≥ 1.5 times the DTS bandwidth.

Set the RBW = 100 kHz.

Set the VBW ≥ 3 x RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum PSD level.

Emission level measurement:

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

Set the RBW = 100 kHz.

Set the VBW ≥ 3 x RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

6.3.4 Test Result

Please refer to ANNEX A.5.

6.4 Band Edge (Authorized-band band-edge)

6.4.1 Limit

FCC §15.247(d); RSS-247, 5.5

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.

6.4.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

6.4.3 Test Procedure

The following procedures may be used to determine the peak or average field strength or power of an unwanted emission that is within 2 MHz of the authorized band edge. If a peak detector is utilized, use the procedure described in 13.2.1. Use the procedure described in 13.2.2 when using an average detector and the EUT can be configured to transmit continuously (i.e., duty cycle ≥ 98%). Use the procedure described in 13.2.3 when using an average detector and the EUT cannot be configured to transmit continuously but the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent). Use the procedure described in 13.2.4 when using an average detector for those cases where the EUT cannot be configured to transmit continuously and the duty cycle is not constant (duty cycle variations equal or exceed 2 percent).

When using a peak detector to measure unwanted emissions at or near the band edge (within 2 MHz of the authorized band), the following integration procedure can be used.

Set instrument center frequency to the frequency of the emission to be measured (must be within 2 MHz of the authorized band edge).

Set span to 2 MHz

RBW = 100 kHz.

VBW ≥ 3 x RBW.

Detector = peak.

Sweep time = auto.

Trace mode = max hold.

Allow sweep to continue until the trace stabilizes (required measurement time may increase for low duty cycle applications)

Compute the power by integrating the spectrum over 1 MHz using the analyzer’s band power measurement function with band limits set equal to the emission frequency (femission) ± 0.5 MHz. If the instrument does not have a band power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by femission ± 0.5 MHz.

6.4.4 Test Result

Please refer to ANNEX A.5.

6.5 Conducted Emission

6.5.1 Limit

FCC §15.207; RSS-GEN, 8.8

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

6.5.2 Test Setup

See section 4.4.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

6.5.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.
Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

6.5.4 Test Result

Please refer to ANNEX A.6.

6.6 Radiated Spurious Emission

6.6.1 Limit

FCC §15.209&15.247(d); RSS-GEN, 8.9; RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note:

5. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
6. In the emission tables above, the tighter limit applies at the band edges.
7. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
8. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

6.6.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

6.6.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW

Sweep = auto
Detector function = peak
Trace = max hold
For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

6.6.4 Test Result

Please refer to ANNEX A.7.

6.7 Band Edge (Restricted-band band-edge)

6.7.1 Limit

FCC §15.209&15.247(d); RSS-GEN, 8.9; RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

6.7.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

6.7.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

For transmitters operating above 1 GHz repeat the measurement with an average detector.

1.1.1 Test Result

Please refer to ANNEX A.8.

6.8 Power Spectral density (PSD)

6.8.1 Limit

FCC §15.247(e); RSS-247, 5.2 (2)

The same method of determining the conducted output power shall be used to determine the power spectral density. If a peak output power is measured, then a peak power spectral density measurement is required. If an average output power is measured, then an average power spectral density measurement should be used.

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

6.8.2 Test Setup

See section 4.4.1 (Diagram 1) for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

6.8.3 Test Procedure

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.

Set the VBW ≥ 3 RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.8.4 Test Result

Please refer to ANNEX A.9.

ANNEX A TEST RESULT

A.1 Peak Output Power

Peak Power Test Data

Channel	Measured Output Peak Power		Limit		Verdict
	LoRa (125KHz)		dBm	mW	
	dBm	mW			
Low	27.82	605.34	30	1000	Pass
Middle	27.42	552.08			Pass
High	27.33	540.75			Pass

Channel	Measured Output Peak Power		Limit		Verdict
	LoRa (250KHz)		dBm	mW	
	dBm	mW			
Low	27.08	510.50	30	1000	Pass
Middle	27.11	514.04			Pass
High	27.22	527.23			Pass

Channel	Measured Output Peak Power		Limit		Verdict
	LoRa (500KHz)		dBm	mW	
	dBm	mW			
Low	19.10	81.28	30	1000	Pass
Middle	18.88	77.27			Pass
High	18.72	74.47			Pass

Test plots

125KHz

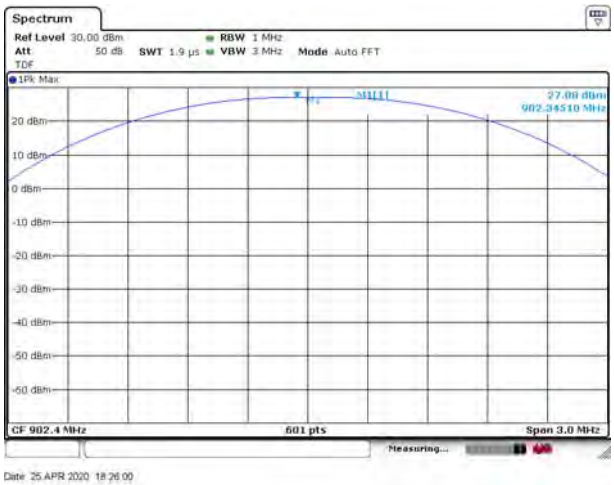
LOW CHANNEL

MIDDLE CHANNEL

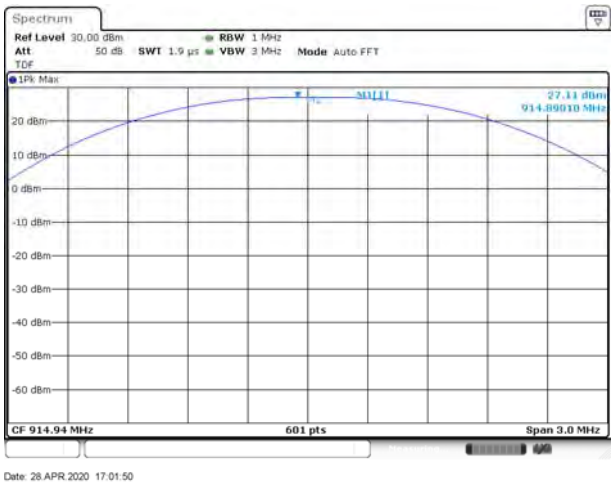
HIGH CHANNEL

250KHz

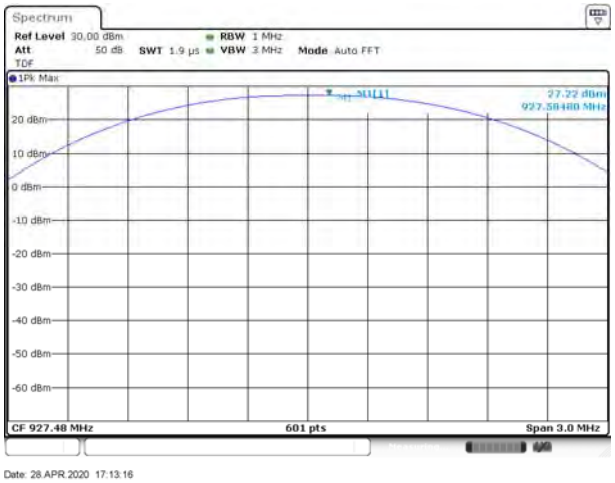
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



500KHz

LOW CHANNEL

MIDDLE CHANNEL

HIGH CHANNEL

A.2 20 dB and 99% bandwidth

Test Data

LoRa (125KHz)			
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Verdict
Low	0.140625	0.127000	Pass
Middle	0.141296	0.125500	Pass
High	0.140564	0.127000	Pass

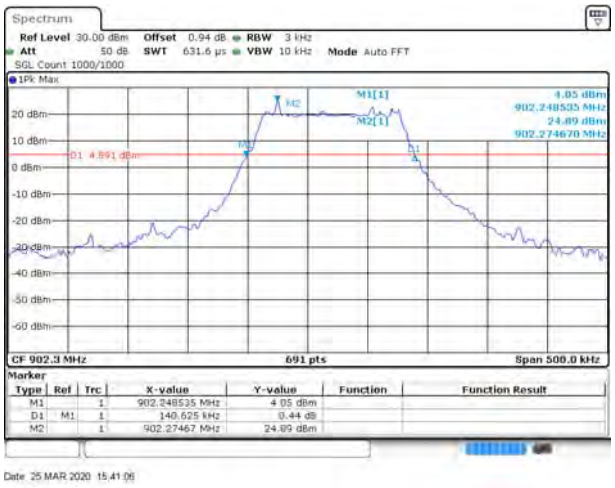
LoRa (250KHz)			
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Verdict
Low	0.298889	0.250500	Pass
Middle	0.304382	0.259500	Pass
High	0.303284	0.262500	Pass

LoRa (500KHz)			
Channel	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Verdict
Low	0.743469	0.734000	Pass
Middle	0.708679	0.792000	Pass
High	0.708679	0.742000	Pass

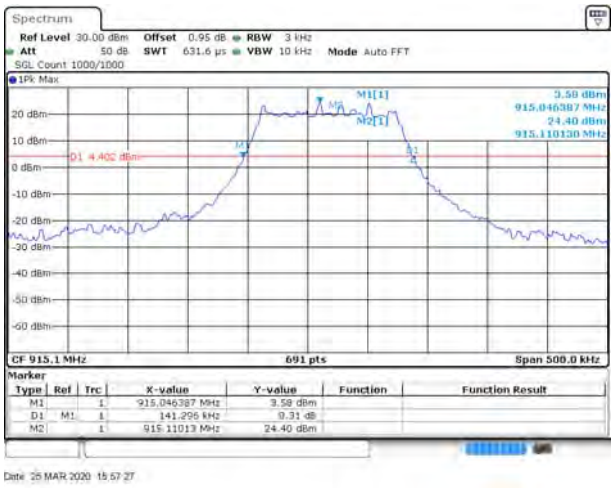
Test plots (20 dB Bandwidth)

125KHz

LOW CHANNEL



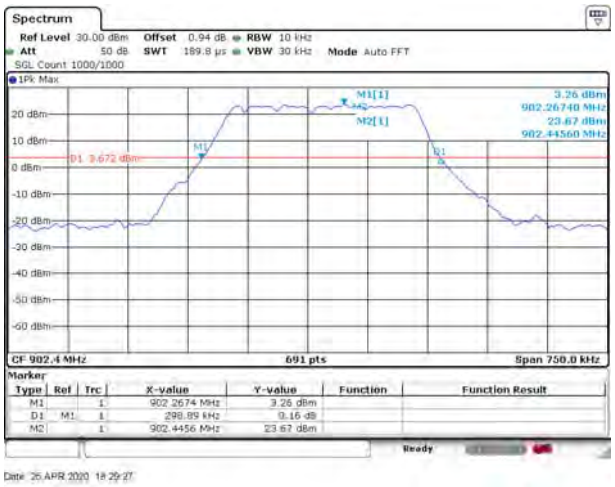
MIDDLE CHANNEL



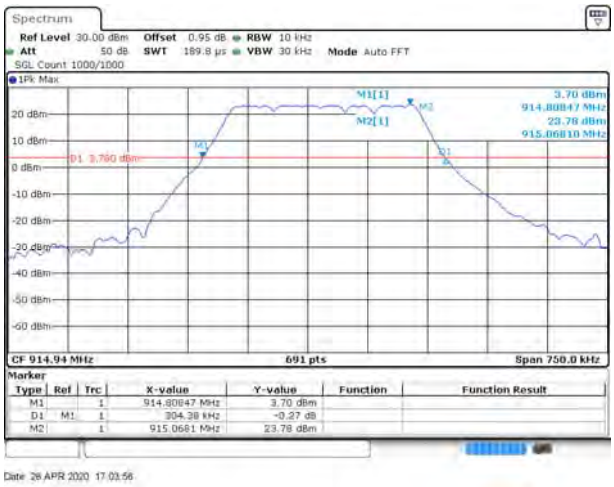
HIGH CHANNEL

250KHz

LOW CHANNEL



MIDDLE CHANNEL

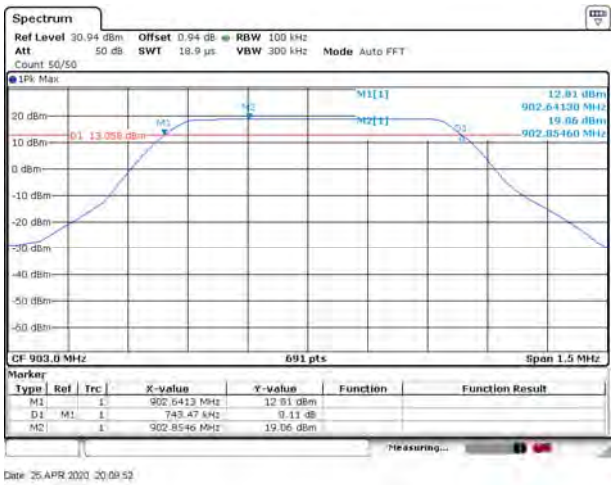


HIGH CHANNEL

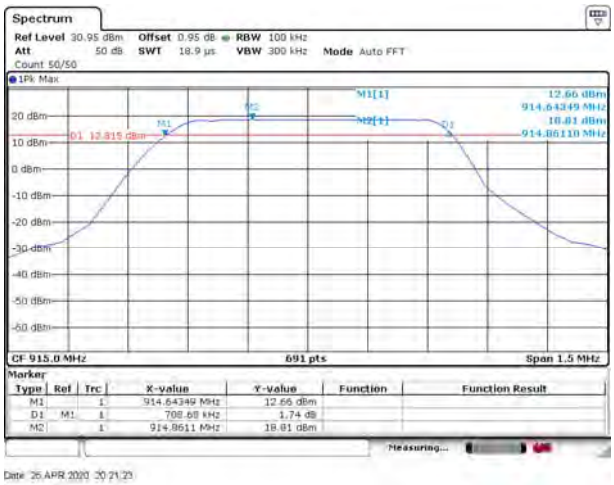
Test plots (6 dB Bandwidth)

500KHz

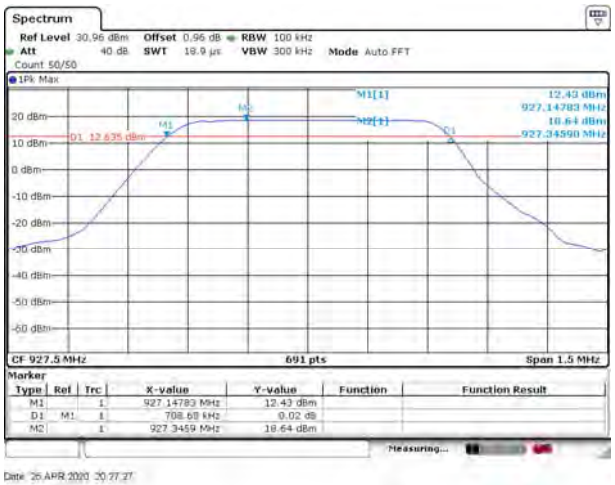
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL

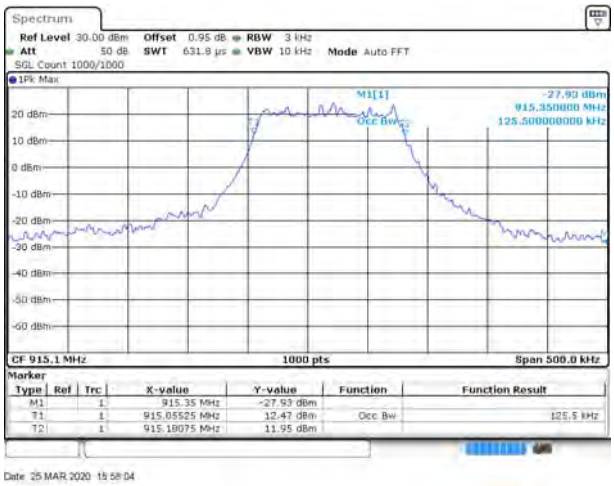


Test plots (99% Bandwidth)

125KHz

LOW CHANNEL

MIDDLE CHANNEL



HIGH CHANNEL

250KHz

LOW CHANNEL

MIDDLE CHANNEL

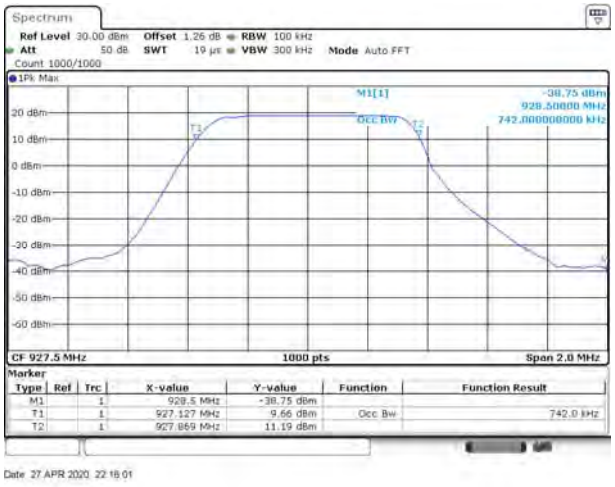
HIGH CHANNEL

500KHz

LOW CHANNEL

MIDDLE CHANNEL

HIGH CHANNEL



A.3 Hopping Frequency Separation

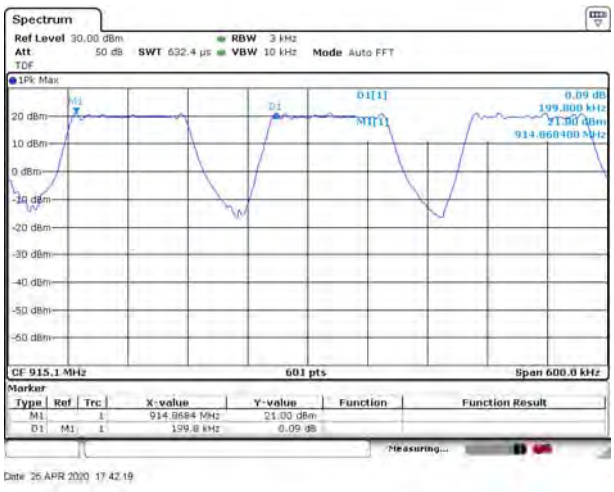
Test Data

Mode	Frequency separation (MHz)	Max 20 dB Bandwidth (MHz)	Verdict
LoRa (125KHz)	0.1998	0.141296	Pass

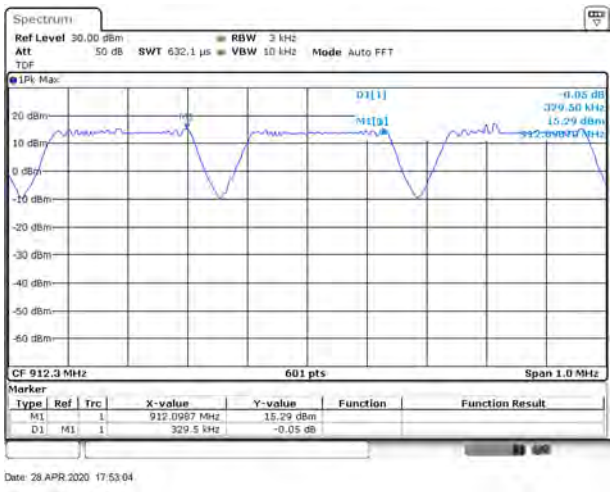
Mode	Frequency separation (MHz)	Max 20 dB Bandwidth (MHz)	Verdict
LoRa (250KHz)	0.3295	0.304382	Pass

Test Plots

LoRa (125KHz)



LoRa (250KHz)



A.4 Average Time of Occupancy

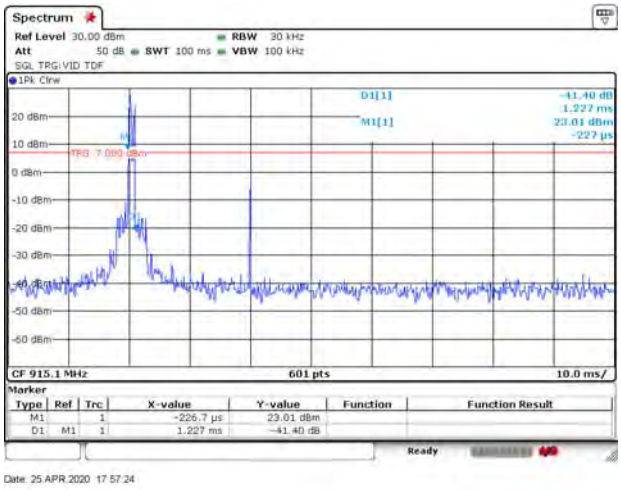
Test Data

Mode	Total of Dwell (ms)	Limit (sec)	Verdict
LoRa (125KHz)	39.264	0.4	Pass

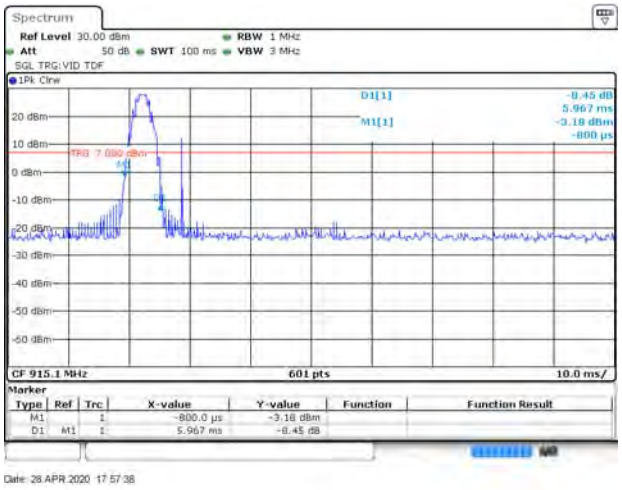
Mode	Total of Dwell (ms)	Limit (sec)	Verdict
LoRa (250KHz)	113.373	0.4	Pass

Test Plots

LoRa (125KHz)



LoRa (250KHz)



A.5 Conducted Spurious Emissions & Authorized-band band-edge

Test Data

LoRa (125KHz)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-16.08	27.68	7.68	Pass
Middle	-18.12	27.09	7.09	Pass
High	-10.89	27.00	7.00	Pass
LoRa (125KHz)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Hopping	-10.20	27.69	7.69	Pass

LoRa (250KHz)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-11.08	26.88	6.88	Pass
Middle	-18.35	27.05	7.05	Pass
High	-17.59	27.15	7.15	Pass
LoRa (250KHz)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Hopping	-18.25	27.80	7.80	Pass

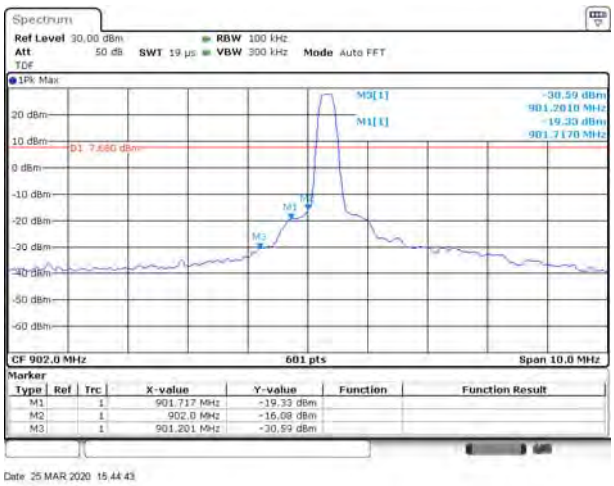
LoRa (500KHz)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-18.79	19.02	-0.98	Pass
Middle	-18.83	18.78	-1.22	Pass
High	-18.49	18.59	-1.41	Pass
LoRa (500KHz)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-36.08	19.02	-0.98	Pass
High	-12.53	18.59	-1.41	Pass

Test Plots

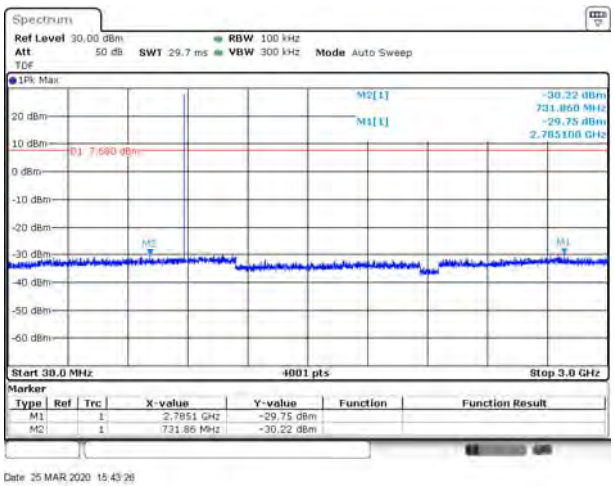
125KHz

LOW CHANNEL, CARRIER LEVEL

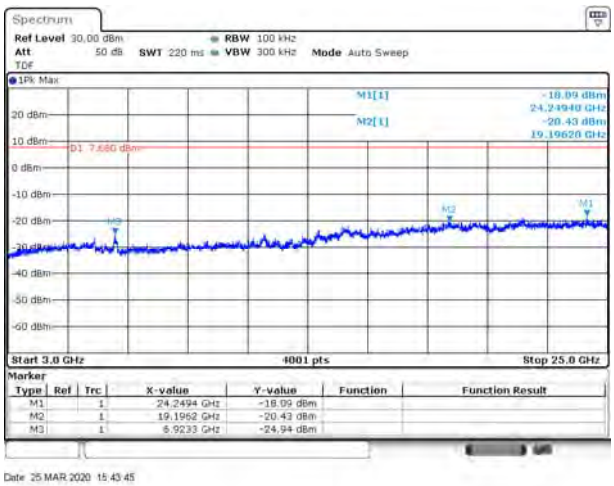
LOW CHANNEL, Band Edge



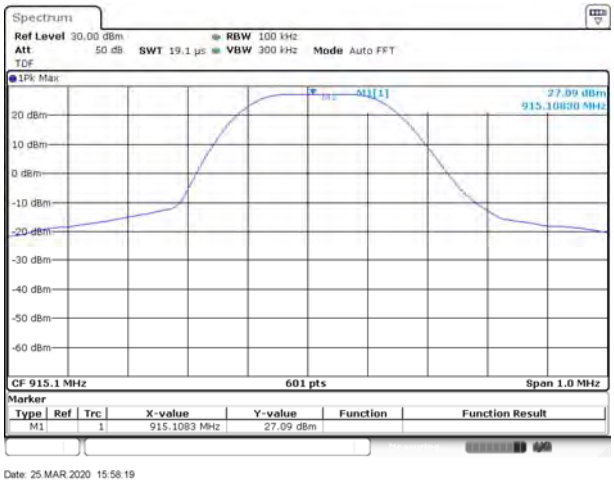
LOW CHANNEL , SPURIOUS 30 MHz ~ 1 GHz



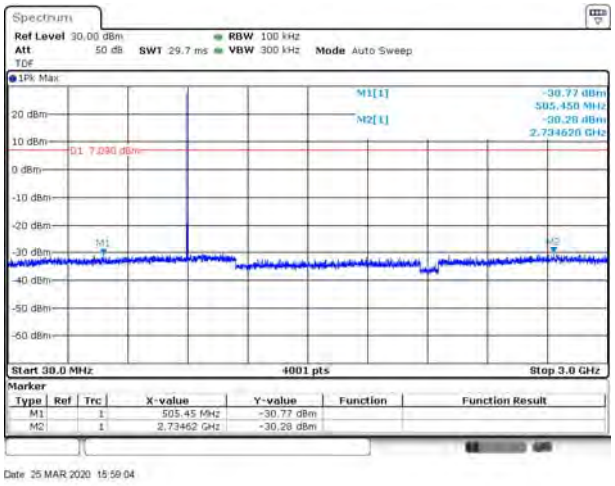
LOW CHANNEL , SPURIOUS 1 GHz ~ 10 GHz



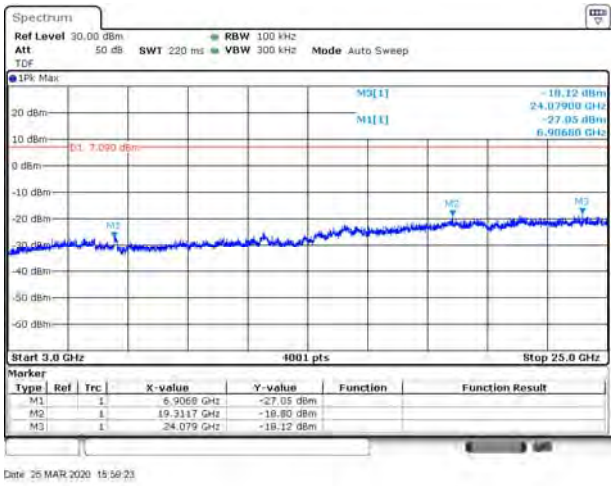
MIDDLE CHANNEL, CARRIER LEVEL



MIDDLE CHANNEL , SPURIOUS 30 MHz ~ 1 GHz

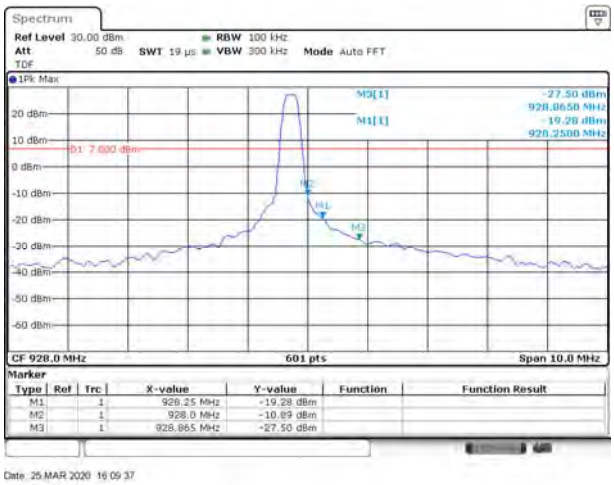


MIDDLE CHANNEL , SPURIOUS 1 GHz ~ 10 GHz

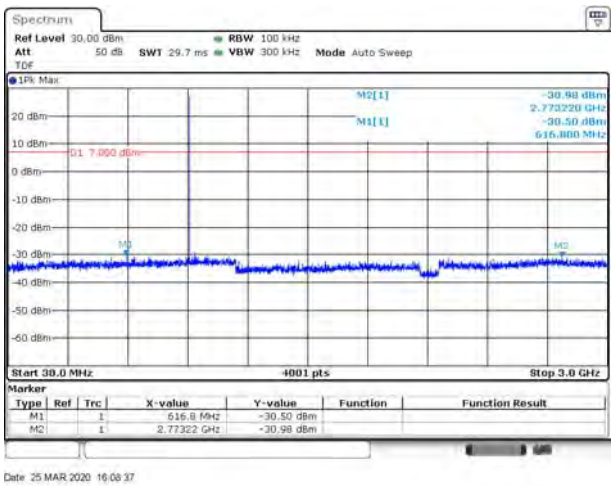


HIGH CHANNEL, CARRIER LEVEL

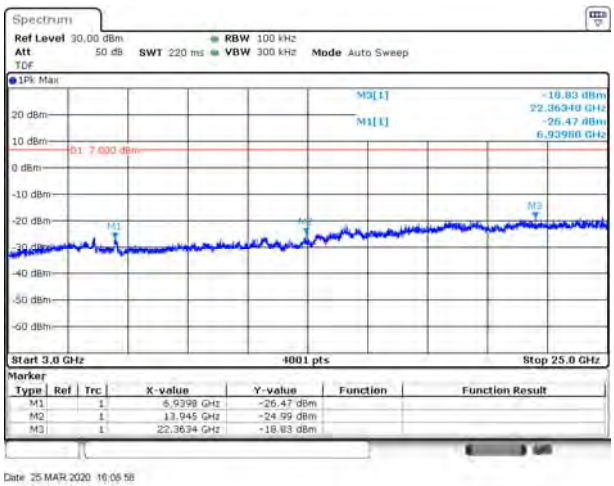
HIGH CHANNEL , BAND EDGE



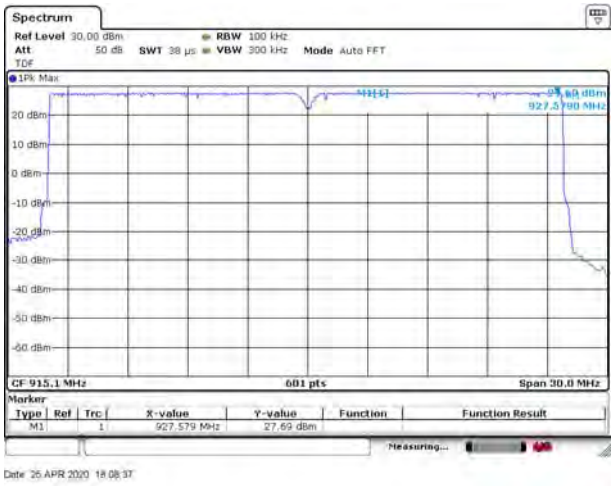
HIGH CHANNEL , SPURIOUS 30 MHz ~ 1 GHz



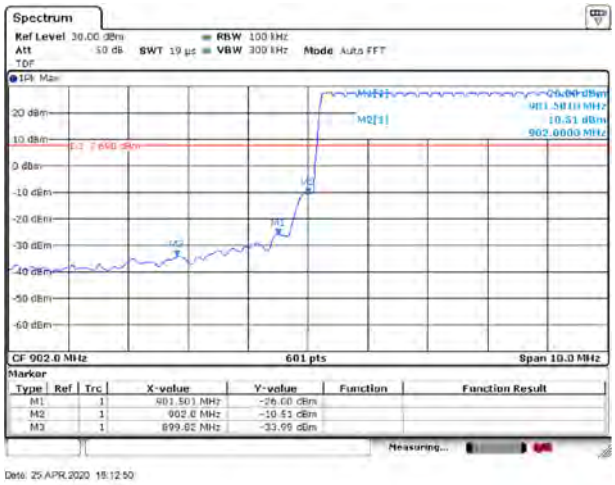
HIGH CHANNEL , SPURIOUS 1 GHz ~ 10 GHz



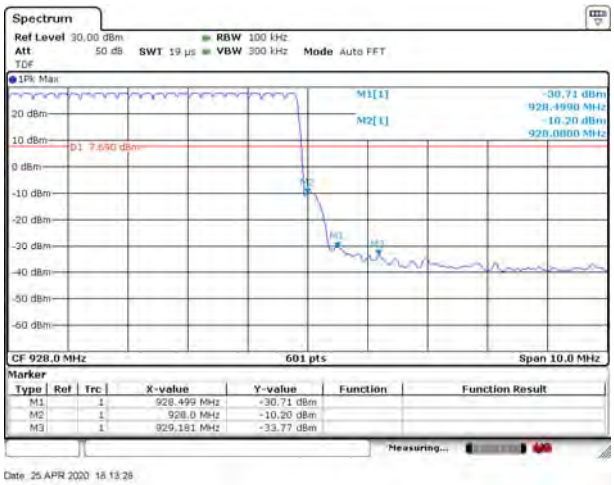
HOPPING, CARRIER LEVEL



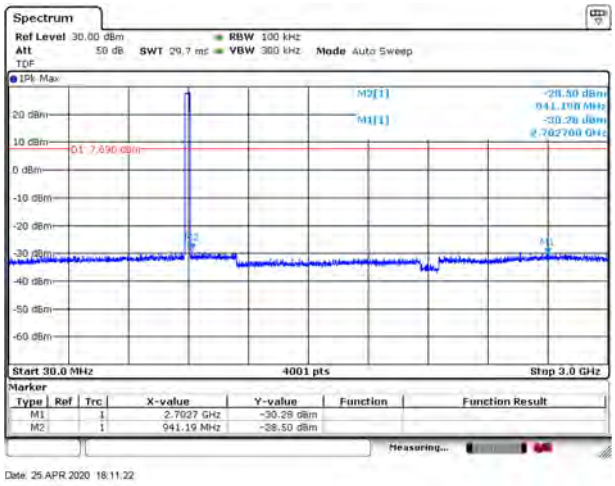
HOPPING BAND EDGE (LOW)



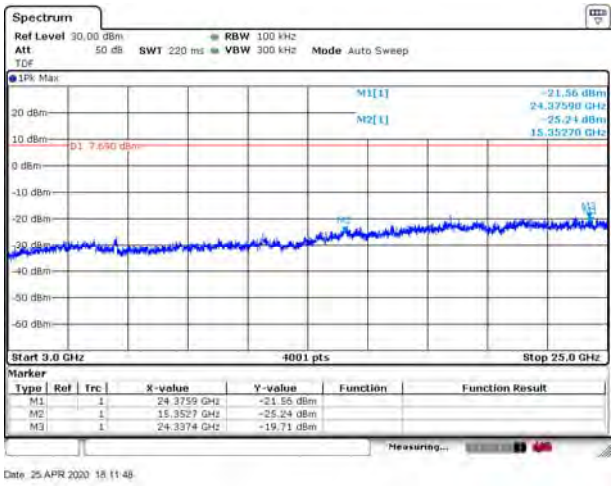
HOPPING BAND EDGE (HIGH)



HOPPING, SPURIOUS 30 MHz ~ 3 GHz



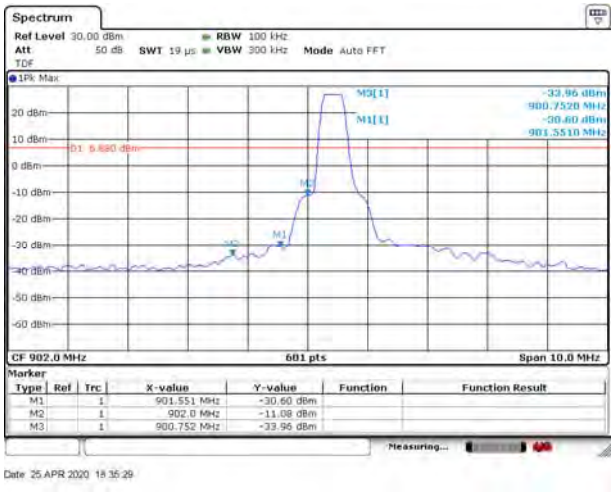
HOPPING, SPURIOUS 30 3GHz ~ 25 GHz



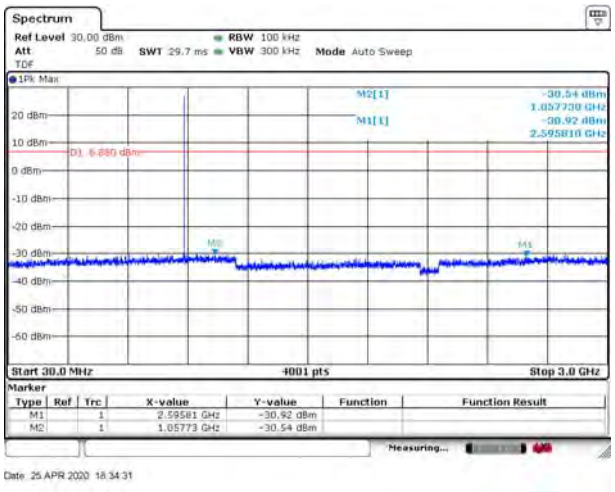
250KHz

LOW CHANNEL, CARRIER LEVEL

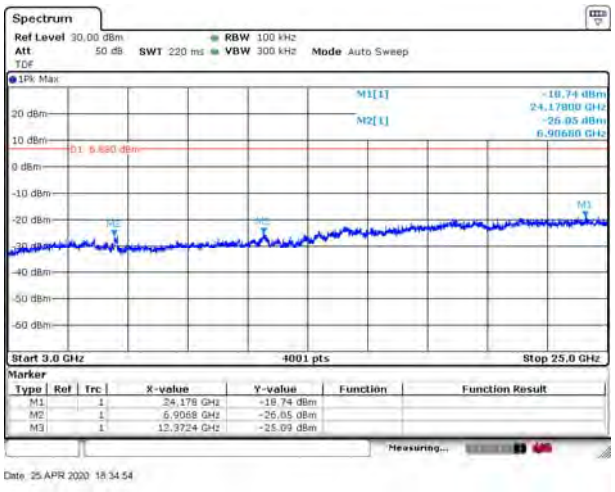
LOW CHANNEL, Band Edge



LOW CHANNEL , SPURIOUS 30 MHz ~ 1 GHz

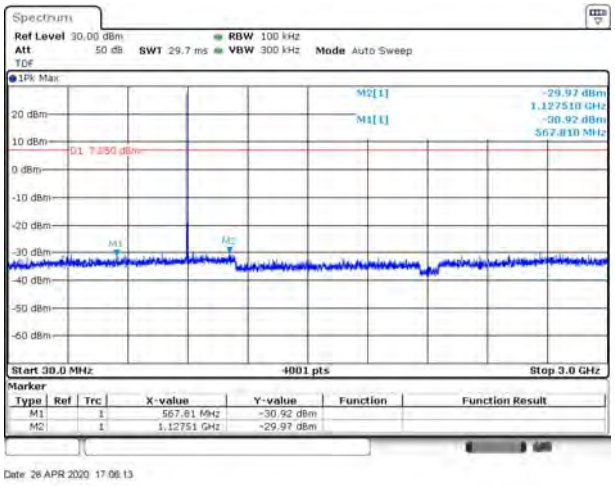


LOW CHANNEL , SPURIOUS 1 GHz ~ 10 GHz

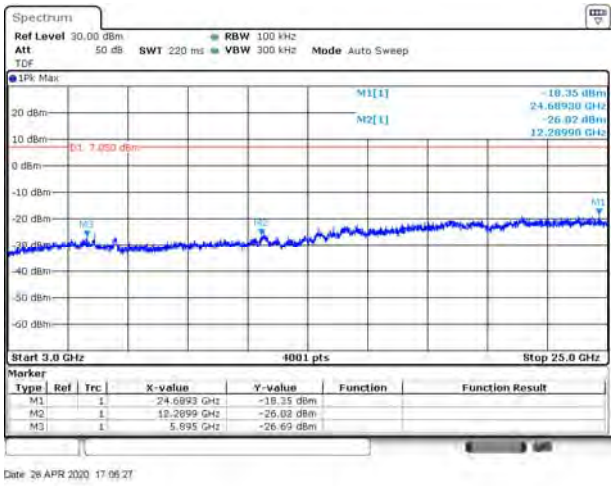


MIDDLE CHANNEL, CARRIER LEVEL

MIDDLE CHANNEL , SPURIOUS 30 MHz ~ 1 GHz

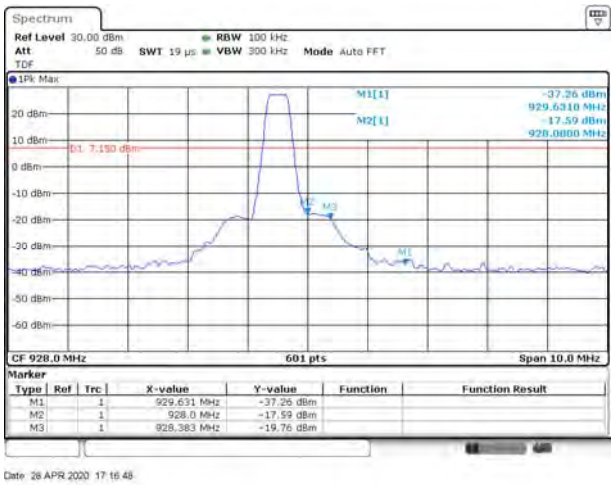


MIDDLE CHANNEL , SPURIOUS 1 GHz ~ 10 GHz

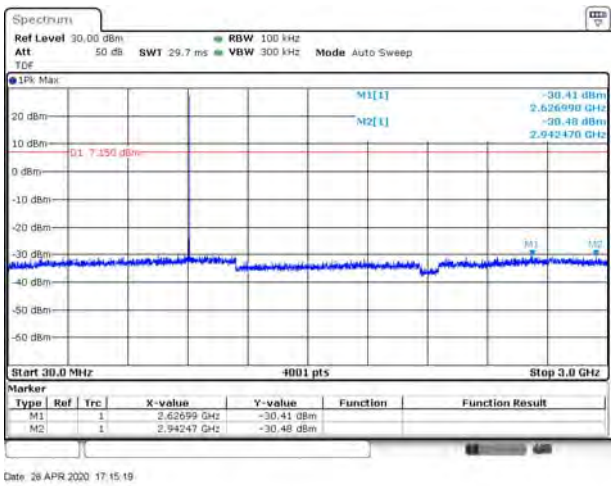


HIGH CHANNEL, CARRIER LEVEL

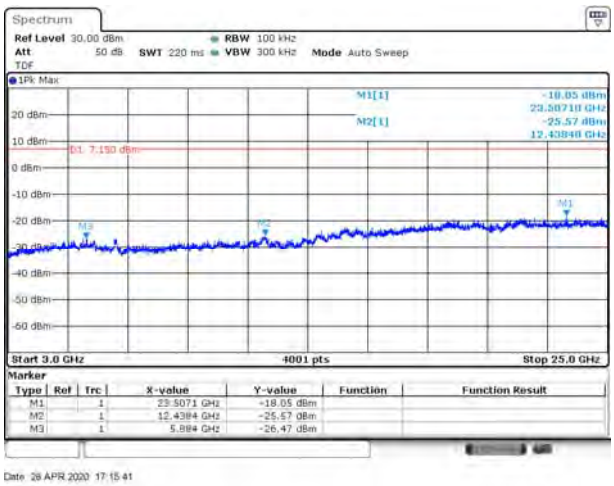
HIGH CHANNEL , BAND EDGE



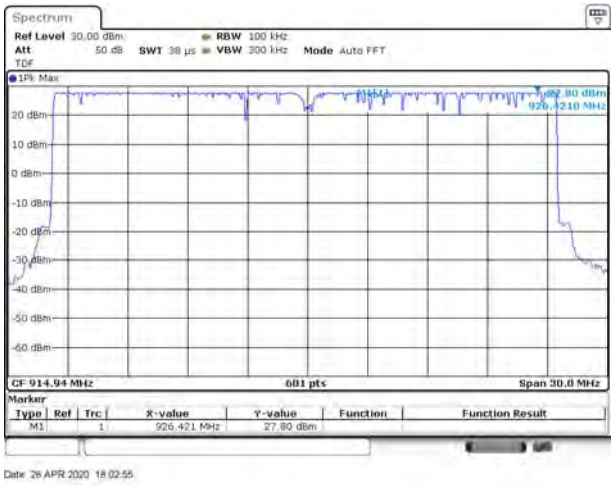
HIGH CHANNEL , SPURIOUS 30 MHz ~ 1 GHz



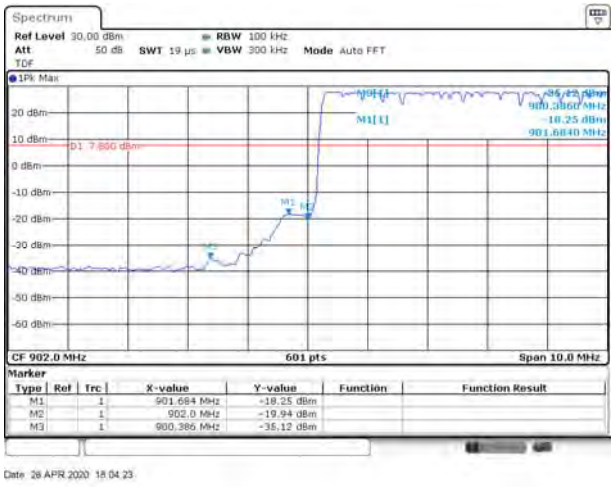
HIGH CHANNEL , SPURIOUS 1 GHz ~ 10 GHz



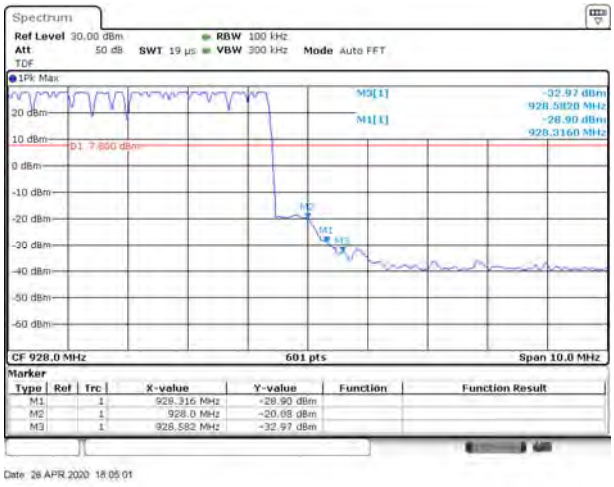
HOPPING, CARRIER LEVEL



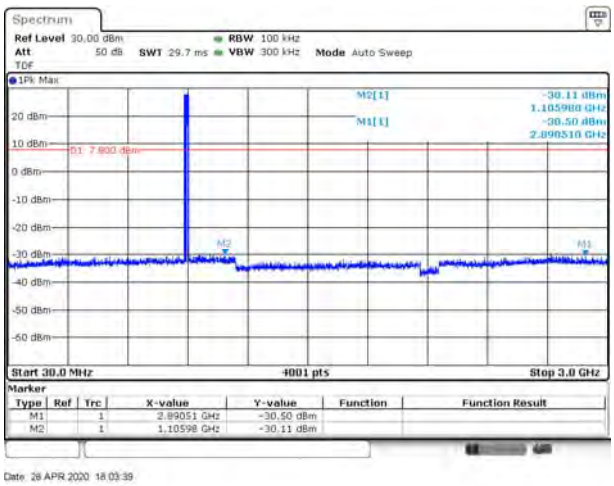
HOPPING BAND EDGE (LOW)



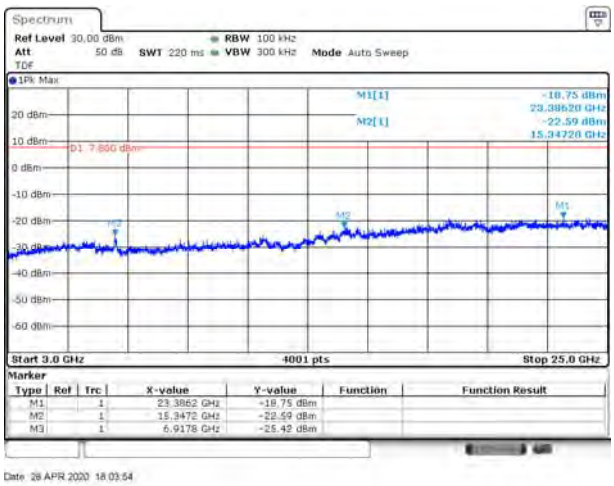
HOPPING BAND EDGE (HIGH)



HOPPING, SPURIOUS 30 MHz ~ 3 GHz



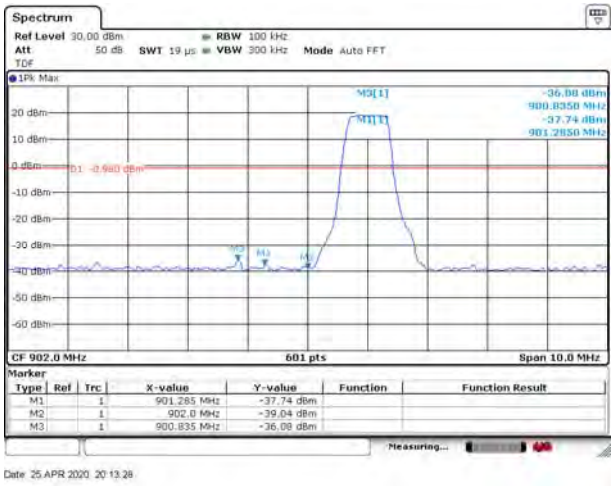
HOPPING, SPURIOUS 30 3GHz ~ 25 GHz



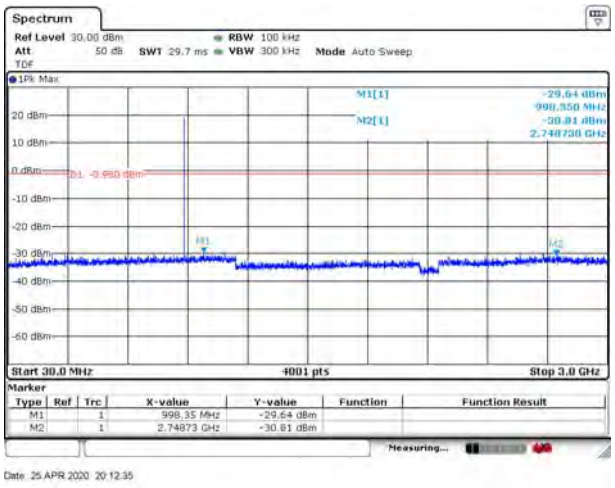
500KHz

LOW CHANNEL, CARRIER LEVEL

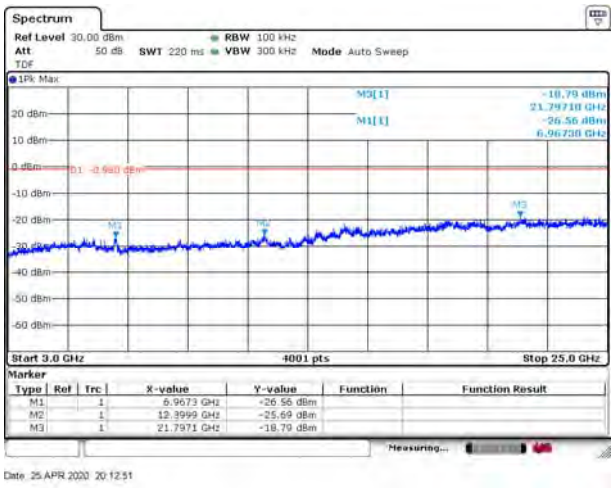
LOW CHANNEL, Band Edge



LOW CHANNEL , SPURIOUS 30 MHz ~ 1 GHz

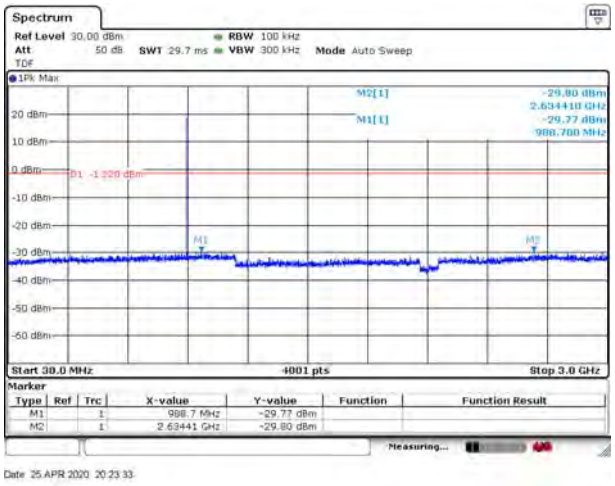


LOW CHANNEL , SPURIOUS 1 GHz ~ 10 GHz

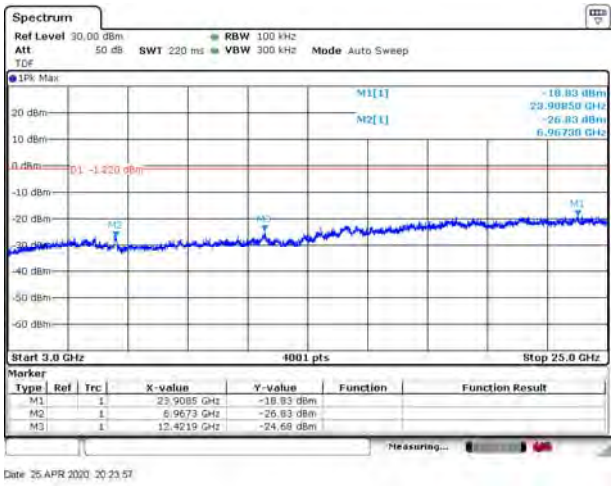


MIDDLE CHANNEL, CARRIER LEVEL

MIDDLE CHANNEL , SPURIOUS 30 MHz ~ 1 GHz

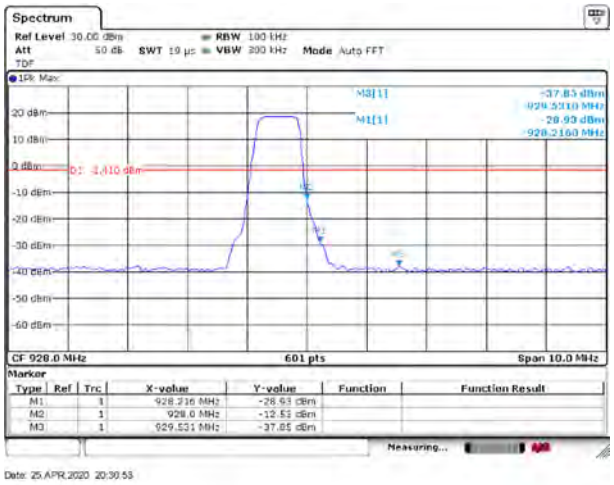


MIDDLE CHANNEL , SPURIOUS 1 GHz ~ 10 GHz

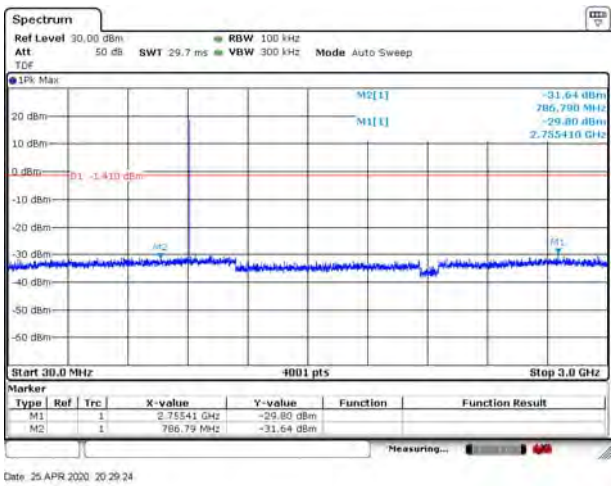


HIGH CHANNEL, CARRIER LEVEL

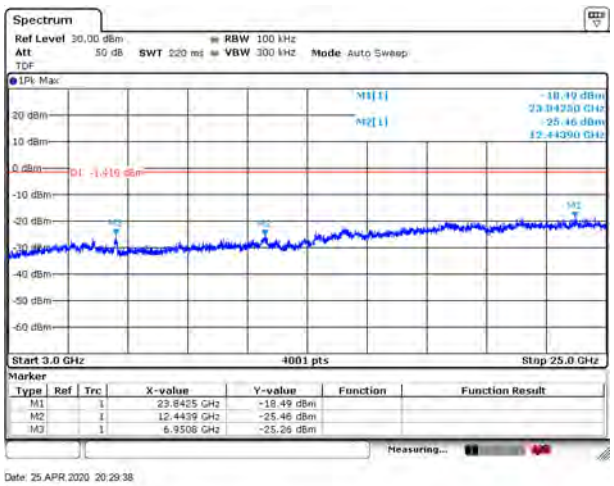
HIGH CHANNEL , BAND EDGE



HIGH CHANNEL , SPURIOUS 30 MHz ~ 1 GHz



HIGH CHANNEL , SPURIOUS 1 GHz ~ 10 GHz

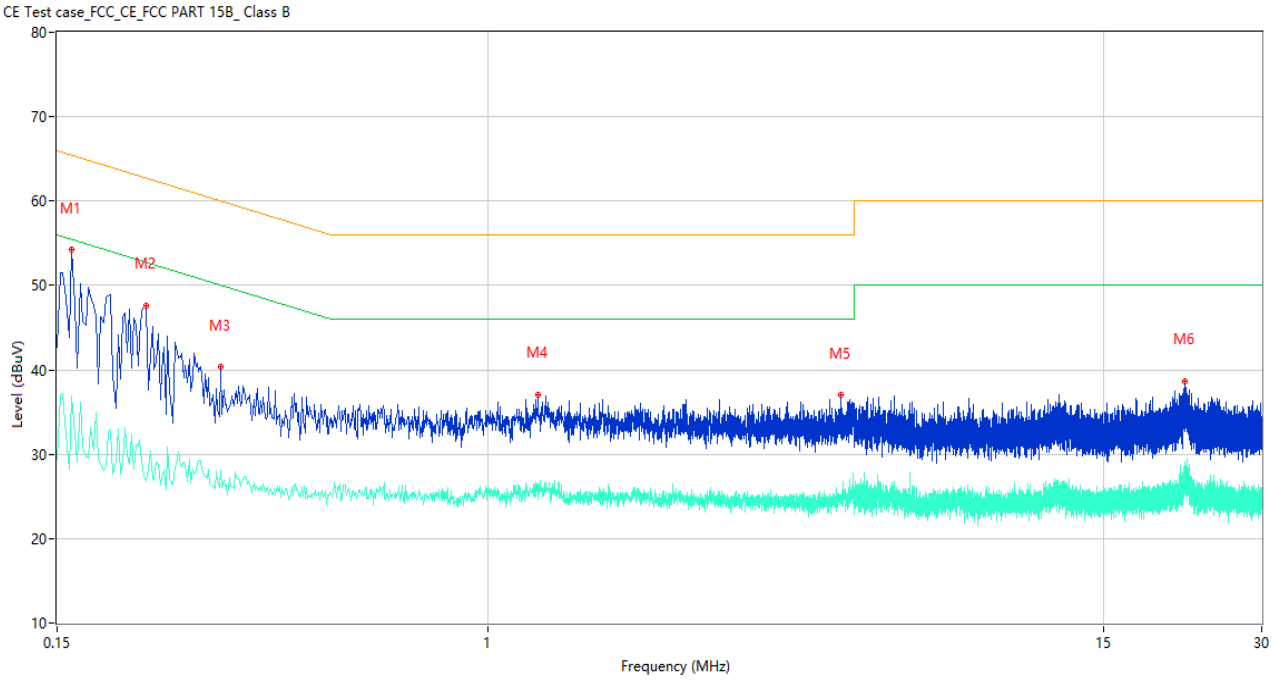


A.6 Conducted Emissions

Note [1]: The EUT is working in the Normal link mode. All modes have been tested and normal link mode is worst.
Note [2]: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 60 Hz and 240 VAC, 50 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz) shown here.
Note [3]: Results (dBuV) = Original reading level of Spectrum Analyzer (dBuV) + Factor (dB)

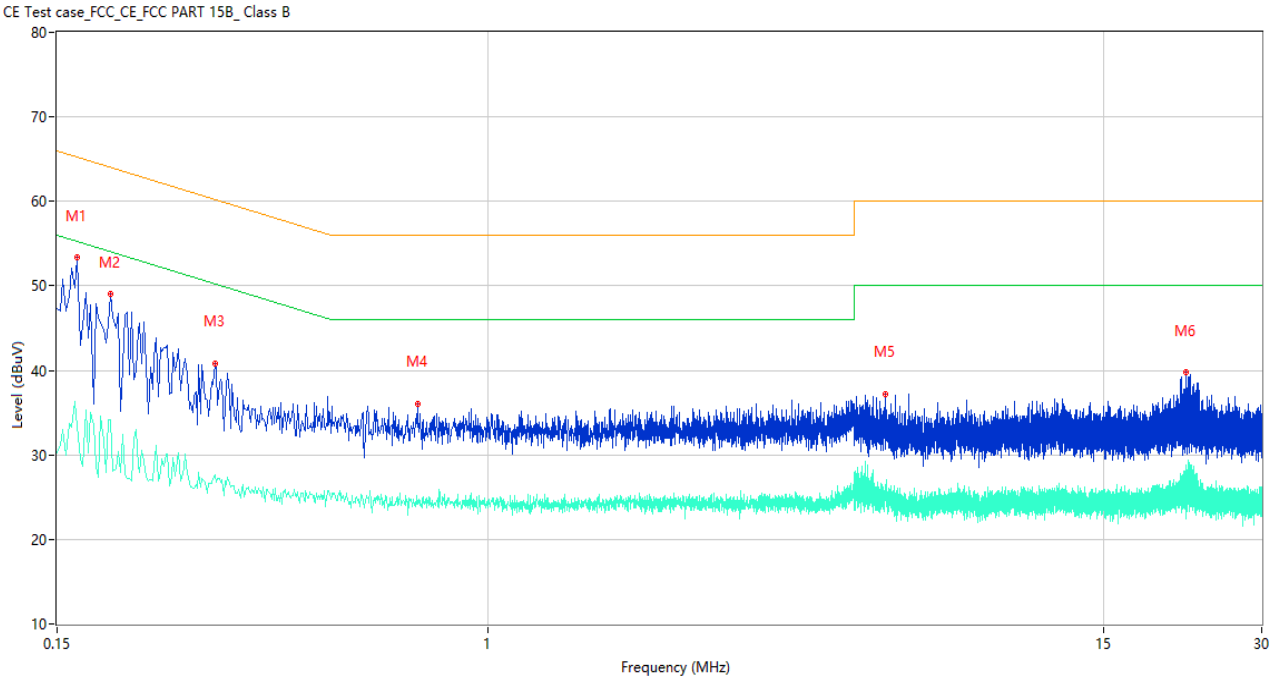
Test Data and Plots

PHASE L



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.154	51.54	10.41	65.78	-14.24	Peak	L	Pass
1**	0.154	37.20	10.41	55.78	-18.58	AV	L	Pass
2	0.222	47.66	10.37	62.74	-15.08	Peak	L	Pass
2**	0.222	26.77	10.37	52.74	-25.97	AV	L	Pass
3	0.308	40.33	10.33	60.02	-19.69	Peak	L	Pass
3**	0.308	28.05	10.33	50.02	-21.97	AV	L	Pass
4	1.244	37.06	10.25	56.00	-18.94	Peak	L	Pass
4**	1.244	26.33	10.25	46.00	-19.67	AV	L	Pass
5	4.710	37.00	10.30	56.00	-19.00	Peak	L	Pass
5**	4.710	25.24	10.30	46.00	-20.76	AV	L	Pass
6	21.364	38.69	10.57	60.00	-21.31	Peak	L	Pass
6**	21.364	27.99	10.57	50.00	-22.01	AV	L	Pass

PHASE N



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.162	49.74	10.40	65.36	-15.62	Peak	N	Pass
1**	0.162	36.35	10.40	55.36	-19.01	AV	N	Pass
2	0.190	49.02	10.38	64.04	-15.02	Peak	N	Pass
2**	0.190	34.09	10.38	54.04	-19.95	AV	N	Pass
3	0.300	40.83	10.33	60.24	-19.41	Peak	N	Pass
3**	0.300	27.66	10.33	50.24	-22.58	AV	N	Pass
4	0.732	36.03	10.27	56.00	-19.97	Peak	N	Pass
4**	0.732	24.21	10.27	46.00	-21.79	AV	N	Pass
5	5.720	37.19	10.32	60.00	-22.81	Peak	N	Pass
5**	5.720	26.43	10.32	50.00	-23.57	AV	N	Pass
6	21.464	39.77	10.58	60.00	-20.23	Peak	N	Pass
6**	21.464	28.74	10.58	50.00	-21.26	AV	N	Pass

A.7 Radiated Spurious Emission

Note [1]: The symbol of “--” in the table which means not application.

Note [2]: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

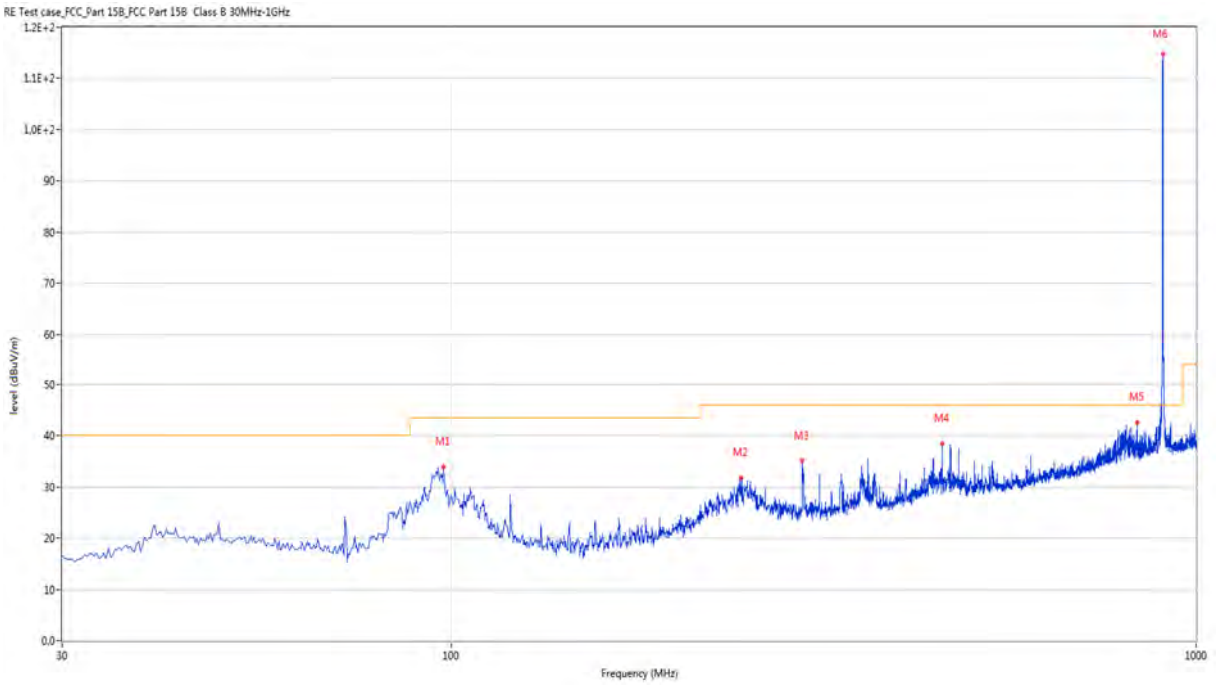
Note [3]: The low frequency, which started from 9 KHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

Note [4]: The marked spikes near 900MHz with circle should be ignored because they are Fundamental signal.

Test Data and Plots

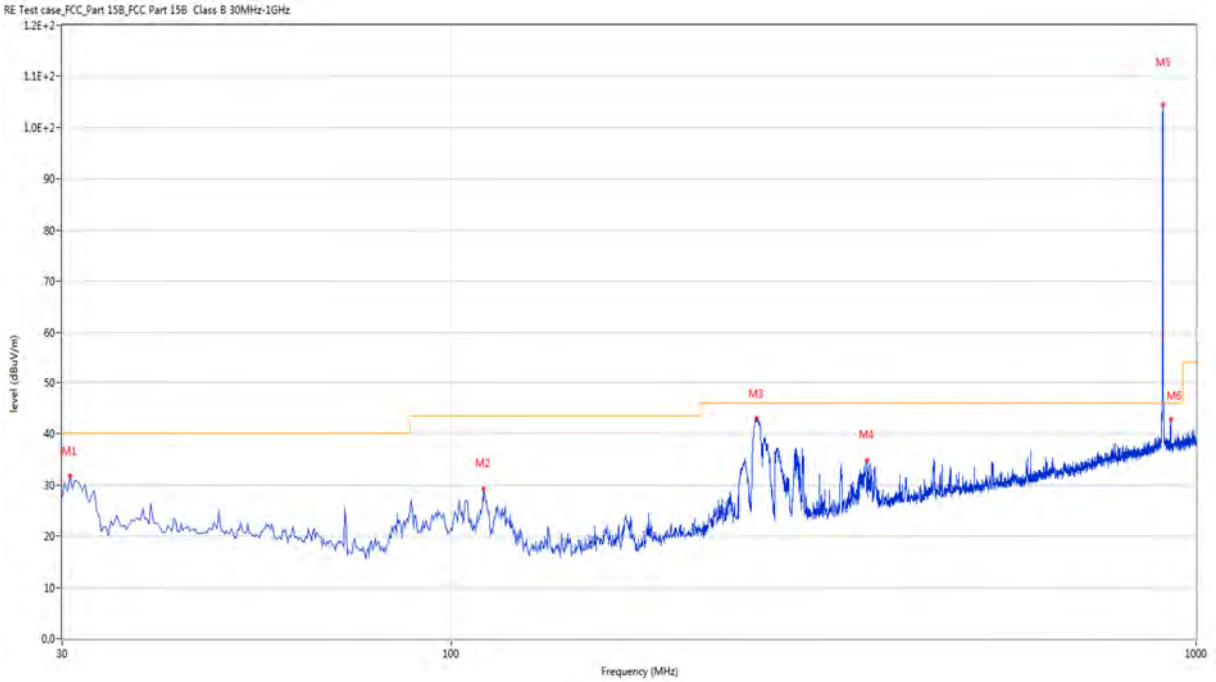
125KHz

LOW CHANNEL, ANT H



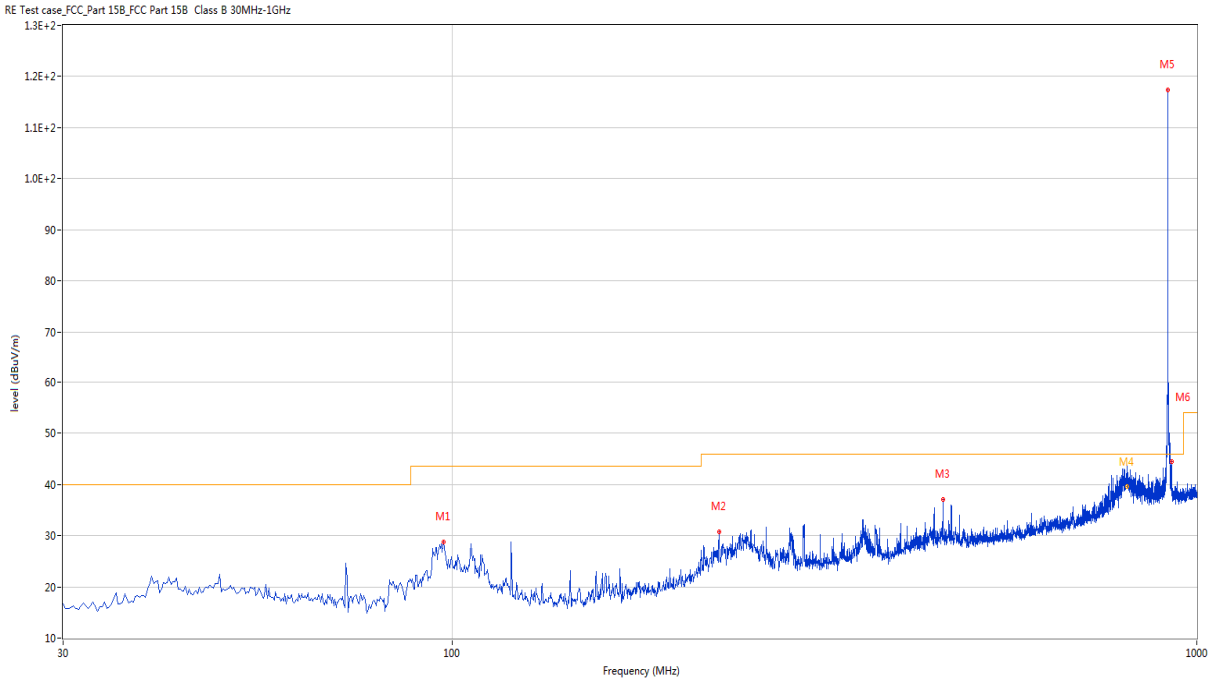
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	97.658	33.97	-25.58	43.5	-9.53	Peak	211.60	200	Horizontal	Pass
2	244.612	31.81	-22.76	46.0	-14.19	Peak	226.30	100	Horizontal	Pass
3	296.022	35.13	-21.54	46.0	-10.87	Peak	88.50	100	Horizontal	Pass
4	456.073	38.51	-17.01	46.0	-7.49	Peak	255.70	200	Horizontal	Pass
5	834.615	42.50	-8.85	46.0	-3.50	Peak	309.60	100	Horizontal	Pass
6	902.758	114.23	-7.16	46.0	68.23	Peak	269.90	100	Horizontal	N/A

LOW CHANNEL, ANT V



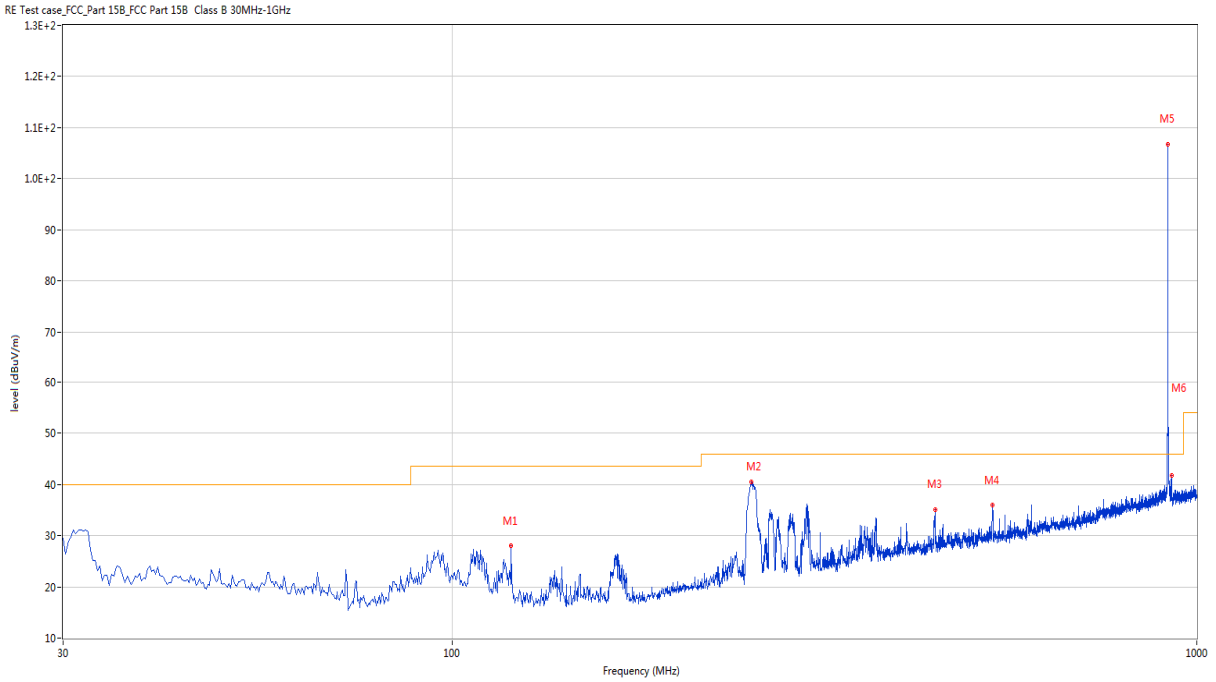
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	30.727	31.73	-27.30	40.0	-8.27	Peak	359.60	100	Vertical	Pass
2	110.268	29.27	-25.11	43.5	-14.23	Peak	113.50	100	Vertical	Pass
3	256.737	42.88	-22.51	46.0	-3.12	Peak	35.60	100	Vertical	Pass
4	361.740	34.82	-19.38	46.0	-11.18	Peak	138.60	200	Vertical	Pass
5	902.758	103.45	-7.16	46.0	57.45	Peak	0.00	200	Vertical	N/A
6	924.340	42.68	-2.31	46.0	-3.32	Peak	188.00	100	Vertical	Pass

MIDDLE CHANNEL, ANT H



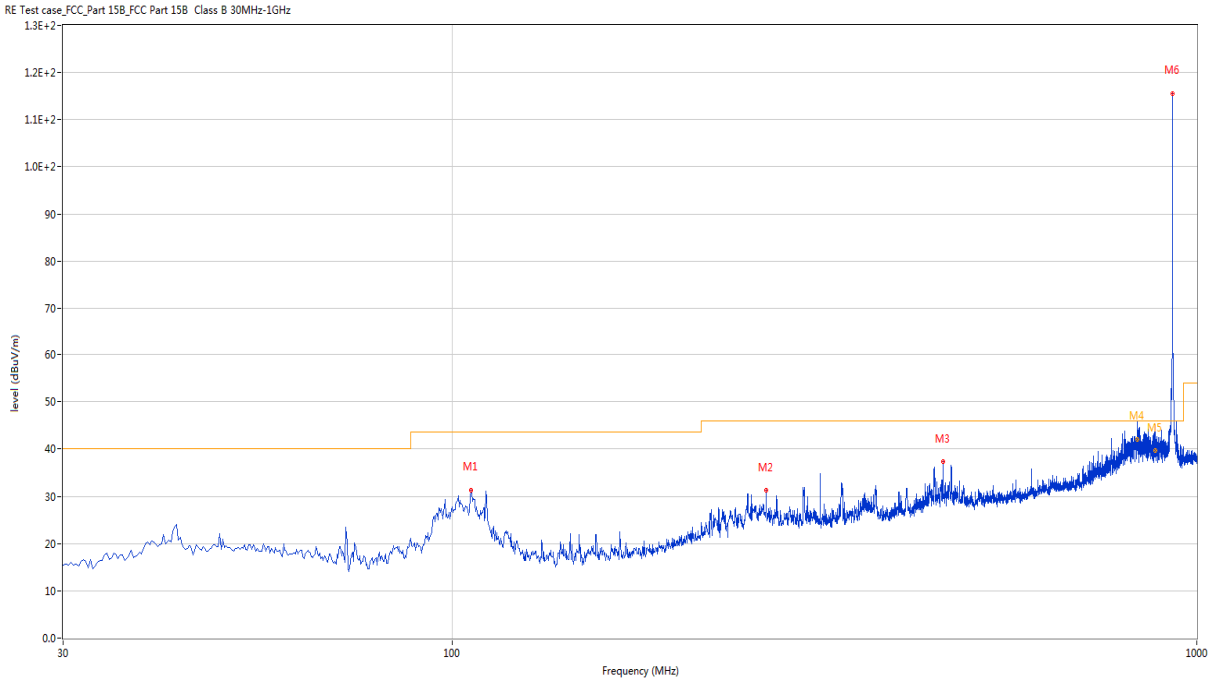
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	97.415	28.77	-25.58	43.5	-14.73	Peak	224.20	100	Horizontal	Pass
2	228.122	30.81	-23.76	46.0	-15.19	Peak	83.20	200	Horizontal	Pass
3	456.073	37.06	-17.01	46.0	-8.94	Peak	101.20	100	Horizontal	Pass
4	805.529	45.51	-8.70	46.0	-0.49	Peak	75.90	198	Horizontal	N/A
4*	805.529	39.67	-8.70	46.0	-6.33	QP	75.90	198	Horizontal	Pass
5	914.640	117.33	-7.19	46.0	71.33	Peak	54.40	100	Horizontal	N/A
6	924.340	44.42	-2.31	46.0	-1.58	Peak	285.50	100	Horizontal	N/A

MIDDLE CHANNEL, ANT V



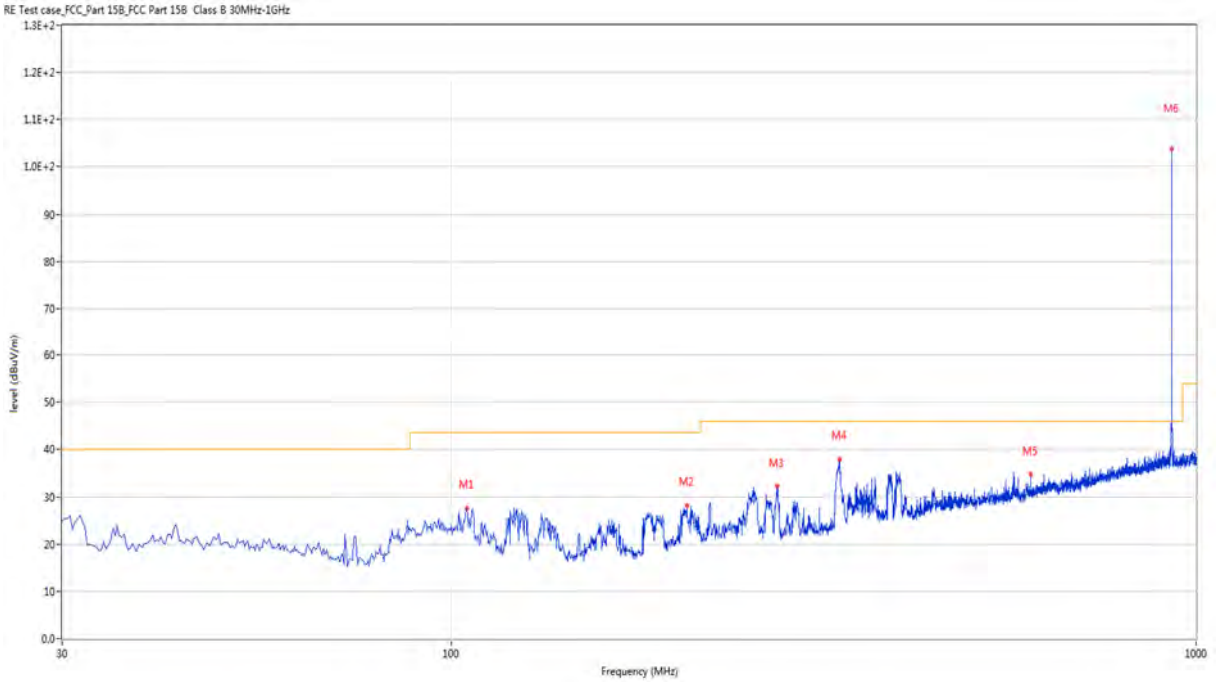
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	119.967	27.98	-26.38	43.5	-15.52	Peak	45.40	100	Vertical	Pass
2	251.888	40.52	-22.73	46.0	-5.48	Peak	24.10	200	Vertical	Pass
3	445.645	35.00	-16.96	46.0	-11.00	Peak	232.40	100	Vertical	Pass
4	531.005	35.90	-14.80	46.0	-10.10	Peak	207.20	100	Vertical	Pass
5	914.640	107.74	-7.19	46.0	61.74	Peak	250.50	200	Vertical	N/A
6	924.340	41.75	-2.31	46.0	-4.25	Peak	279.90	100	Vertical	N/A

HIGH CHANNEL, ANT H



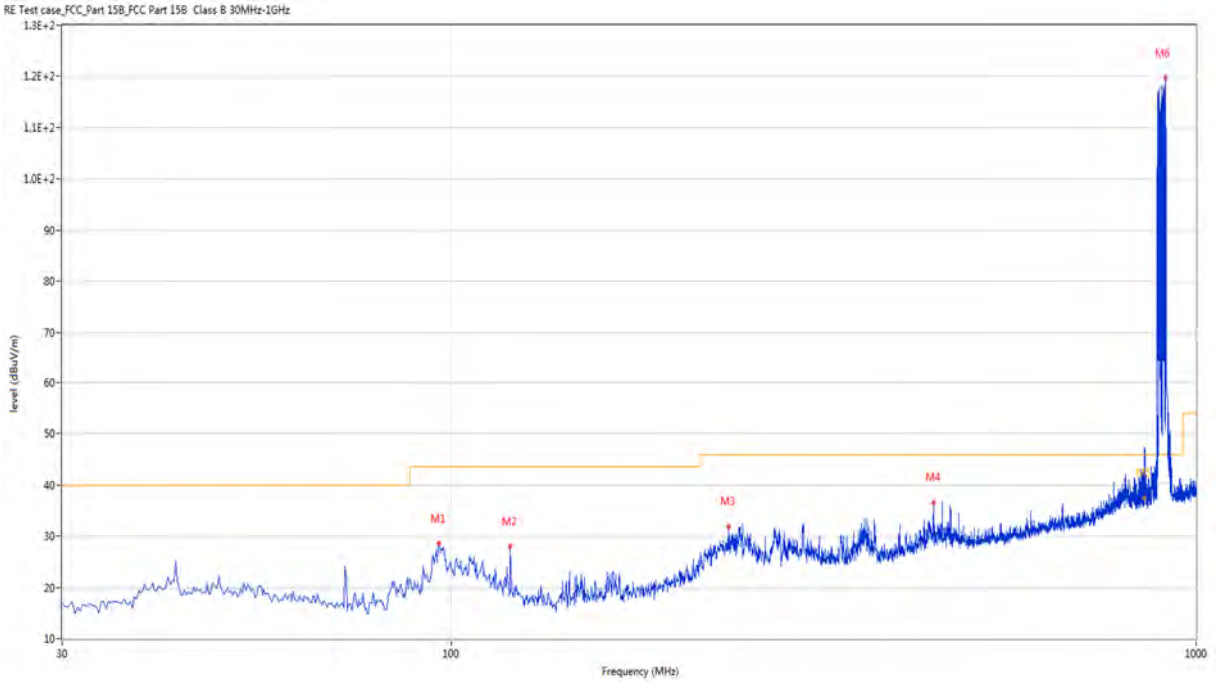
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	105.902	31.34	-24.97	43.5	-12.16	Peak	236.90	100	Horizontal	Pass
2	264.013	31.18	-22.23	46.0	-14.82	Peak	244.00	200	Horizontal	Pass
3	456.073	37.34	-17.01	46.0	-8.66	Peak	258.20	100	Horizontal	Pass
4	832.018	46.44	-9.10	46.0	0.44	Peak	84.70	123	Horizontal	N/A
4*	832.018	41.96	-9.10	46.0	-4.04	QP	84.70	123	Horizontal	Pass
5	878.678	44.65	-8.26	46.0	-1.35	Peak	52.00	100	Horizontal	N/A
5*	878.678	39.74	-8.26	46.0	-6.26	QP	52.00	100	Horizontal	Pass
6	927.735	115.54	-7.43	46.0	69.54	Peak	106.30	100	Horizontal	N/A

HIGH CHANNEL, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	104.933	27.62	-24.97	43.5	-15.88	Peak	353.10	100	Vertical	Pass
2	207.025	28.20	-24.35	43.5	-15.30	Peak	60.10	200	Vertical	Pass
3	273.712	32.18	-21.92	46.0	-13.82	Peak	327.60	100	Vertical	Pass
4	331.913	37.91	-20.11	46.0	-8.09	Peak	255.80	200	Vertical	Pass
5	599.875	34.70	-13.07	46.0	-11.30	Peak	270.30	100	Vertical	Pass
6	927.735	103.89	-7.43	46.0	57.89	Peak	259.50	100	Vertical	N/A

HOPPING MODE, ANT H



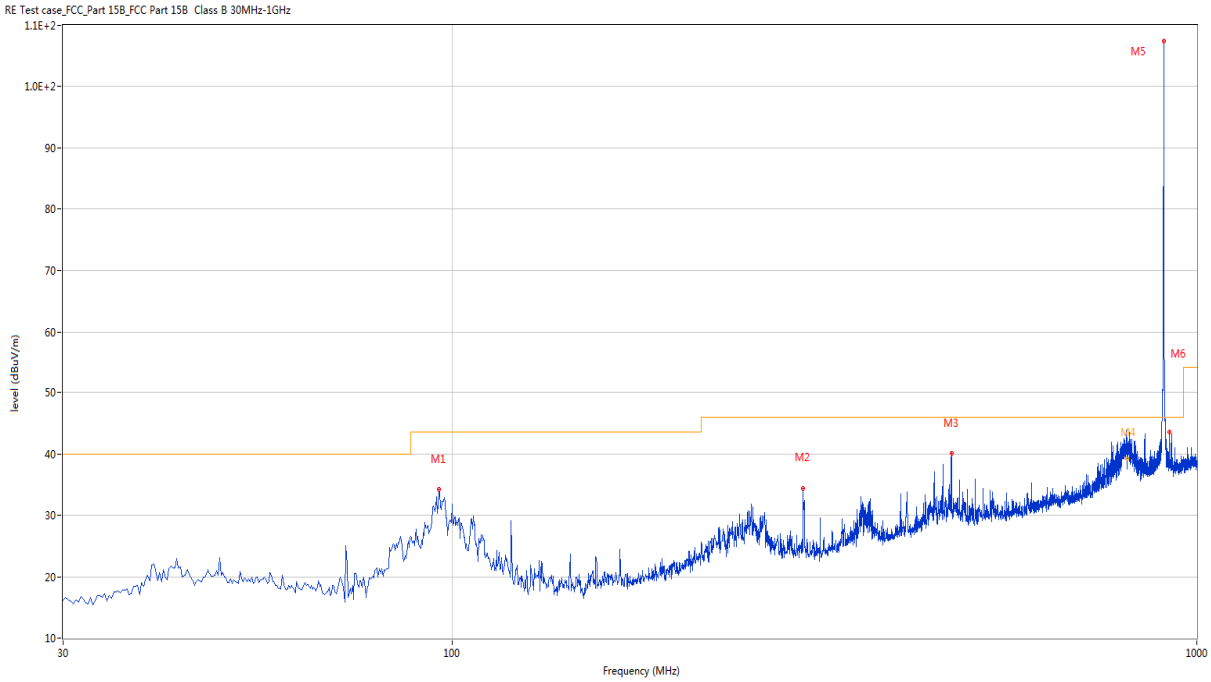
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	96.202	28.54	-25.68	43.5	-14.96	Peak	201.70	100	Horizontal	Pass
2	119.967	27.97	-26.38	43.5	-15.53	Peak	176.80	200	Horizontal	Pass
3	235.398	31.83	-23.00	46.0	-14.17	Peak	89.70	100	Horizontal	Pass
4	443.948	36.46	-17.15	46.0	-9.54	Peak	333.90	100	Horizontal	Pass
5	852.995	46.27	-8.42	46.0	0.27	Peak	270.70	169	Horizontal	N/A
5*	852.995	37.49	-8.42	46.0	-8.51	QP	270.70	169	Horizontal	Pass
6	902.273	119.55	-7.19	46.0	73.55	Peak	67.50	100	Horizontal	N/A

HOPPING MODE, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	102.265	30.73	-24.94	43.5	-12.77	Peak	24.10	100	Vertical	Pass
2	253.342	37.93	-22.60	46.0	-8.07	Peak	20.70	100	Vertical	Pass
3	371.198	37.36	-18.94	46.0	-8.64	Peak	245.30	200	Vertical	Pass
4	902.758	105.56	-7.16	46.0	59.56	Peak	189.20	100	Vertical	N/A
5	924.825	105.23	-5.73	46.0	59.23	Peak	256.30	100	Vertical	N/A
6	976.235	40.61	-6.42	54.0	-13.39	Peak	301.30	200	Vertical	Pass

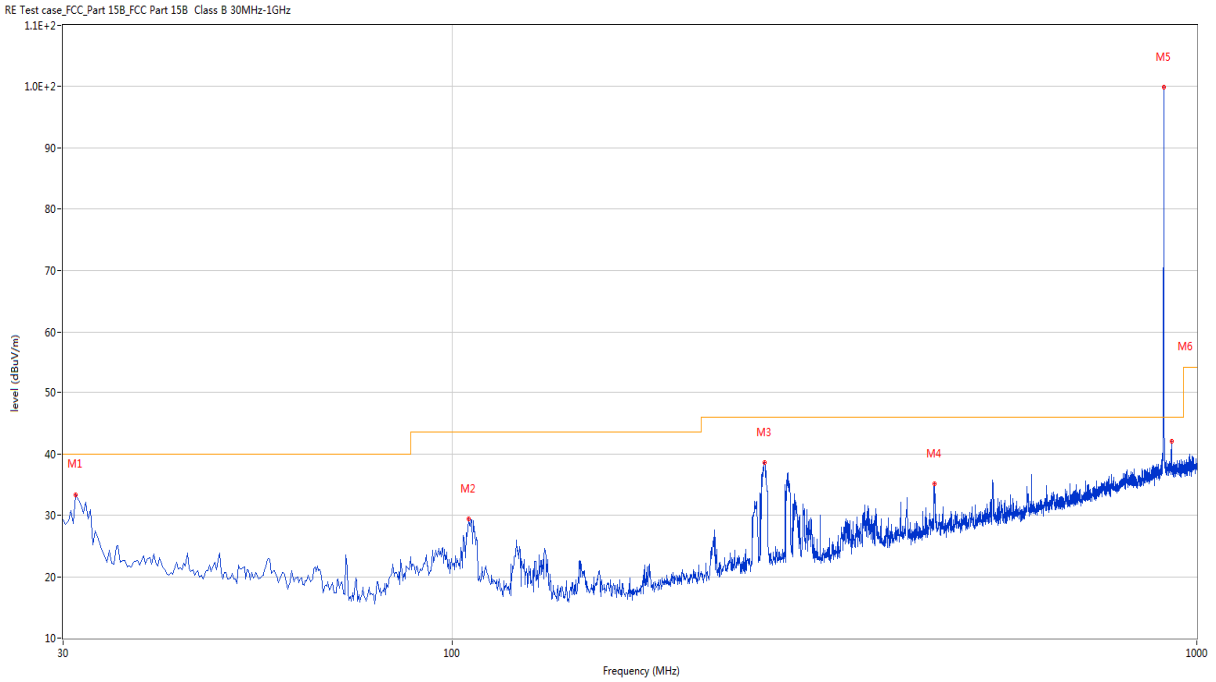
250KHz

LOW CHANNEL, ANT H



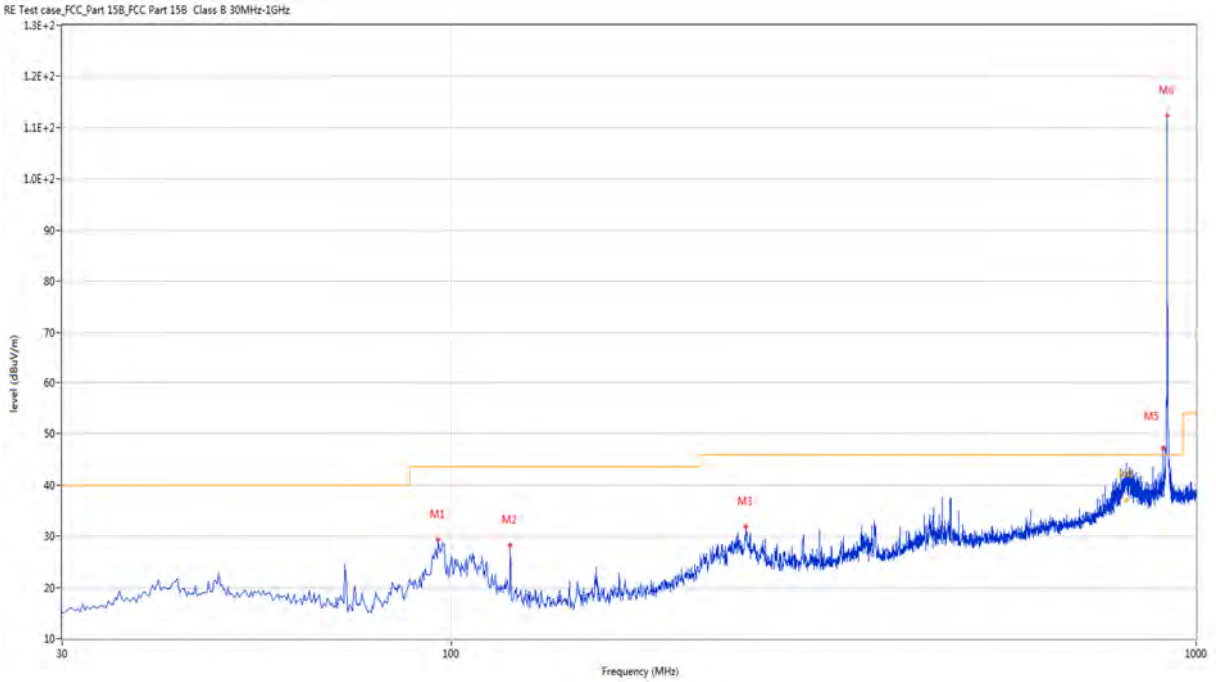
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	95.960	34.20	-25.75	43.5	-9.30	Peak	198.70	200	Horizontal	Pass
2	295.780	34.29	-21.56	46.0	-11.71	Peak	90.60	100	Horizontal	Pass
3	468.198	40.05	-16.64	46.0	-5.95	Peak	256.70	200	Horizontal	Pass
4	805.215	45.26	-8.76	46.0	-0.74	Peak	76.30	100	Horizontal	N/A
4*	805.215	39.24	-8.76	46.0	-6.76	QP	76.30	100	Horizontal	Pass
5	902.515	107.49	-7.16	46.0	61.49	Peak	76.30	100	Horizontal	N/A
6	919.490	43.52	-6.83	46.0	-2.48	Peak	76.30	100	Horizontal	N/A

LOW CHANNEL, ANT V



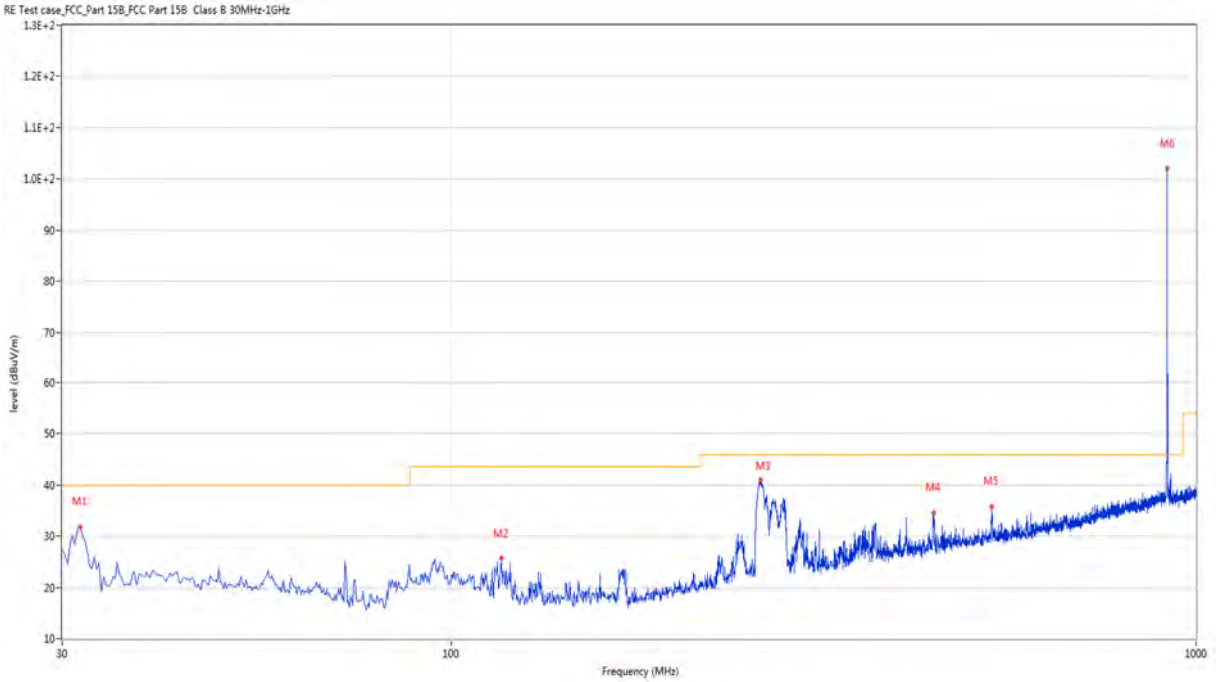
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	30.727	30.74	-27.30	40.0	-9.26	Peak	349.20	200	Vertical	Pass
2	105.175	29.43	-24.97	43.5	-14.07	Peak	1.30	100	Vertical	Pass
3	262.557	38.58	-22.37	46.0	-7.42	Peak	269.70	200	Vertical	Pass
4	444.190	35.06	-17.17	46.0	-10.94	Peak	244.30	100	Vertical	Pass
5	902.515	99.95	-7.16	46.0	53.95	Peak	251.60	100	Vertical	N/A
6	924.340	41.97	-2.31	46.0	-4.03	Peak	320.30	100	Vertical	N/A

MIDDLE CHANNEL, ANT H



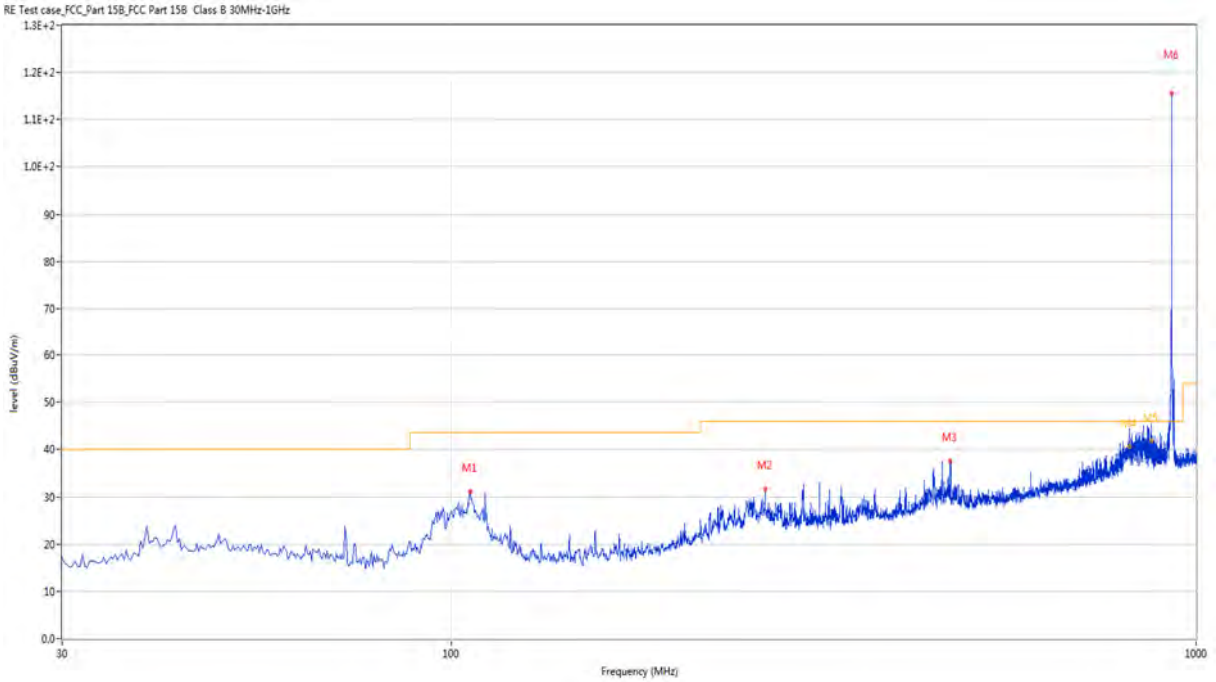
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	95.960	29.35	-25.75	43.5	-14.15	Peak	197.20	100	Horizontal	Pass
2	119.967	28.24	-26.38	43.5	-15.26	Peak	207.50	200	Horizontal	Pass
3	248.735	31.80	-22.75	46.0	-14.20	Peak	226.00	100	Horizontal	Pass
4	805.971	46.60	-8.65	46.0	0.60	Peak	60.00	103	Horizontal	N/A
4*	805.971	37.12	-8.65	46.0	-8.88	QP	60.00	103	Horizontal	Pass
5	902.758	47.24	-7.16	46.0	1.24	Peak	302.20	100	Horizontal	N/A
6	914.882	112.50	-7.19	46.0	66.50	Peak	38.40	100	Horizontal	N/A

MIDDLE CHANNEL, ANT V



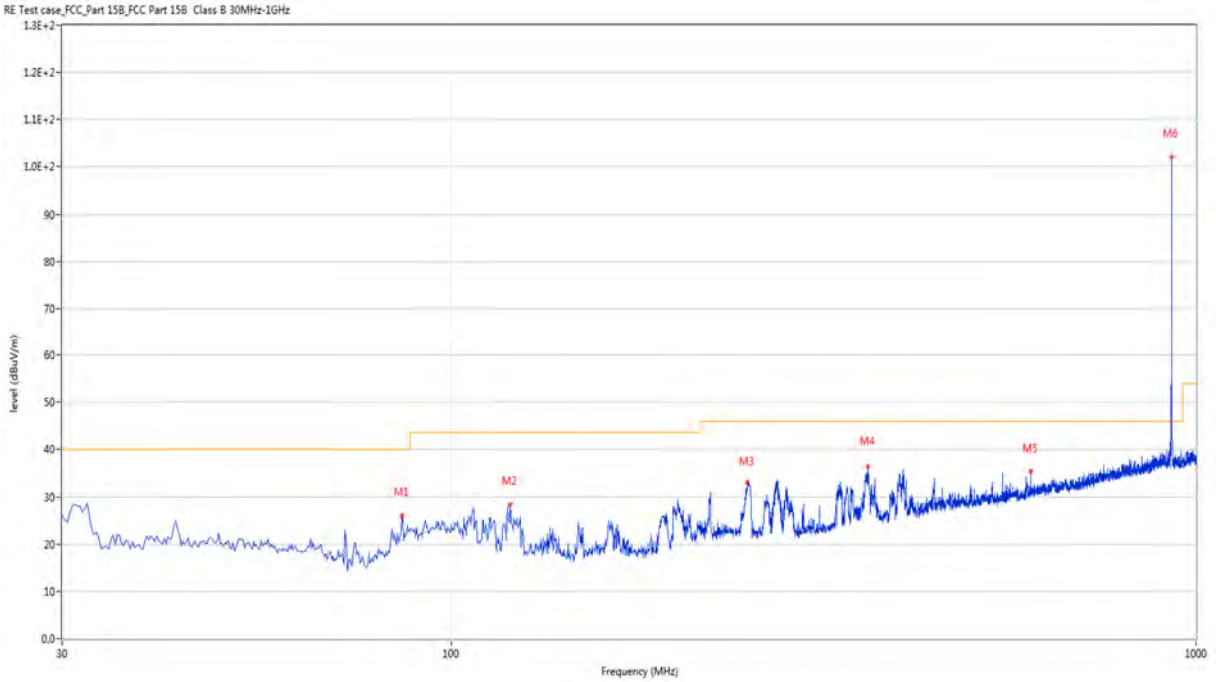
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	31.698	31.91	-27.54	40.0	-8.09	Peak	27.10	100	Vertical	Pass
2	116.815	25.63	-26.09	43.5	-17.87	Peak	16.20	100	Vertical	Pass
3	260.375	41.01	-22.41	46.0	-4.99	Peak	48.70	200	Vertical	Pass
4	443.948	34.51	-17.15	46.0	-11.49	Peak	237.90	100	Vertical	Pass
5	531.005	35.83	-14.80	46.0	-10.17	Peak	194.30	200	Vertical	Pass
6	914.882	102.60	-7.19	46.0	56.60	Peak	295.80	100	Vertical	N/A

HIGH CHANNEL, ANT H



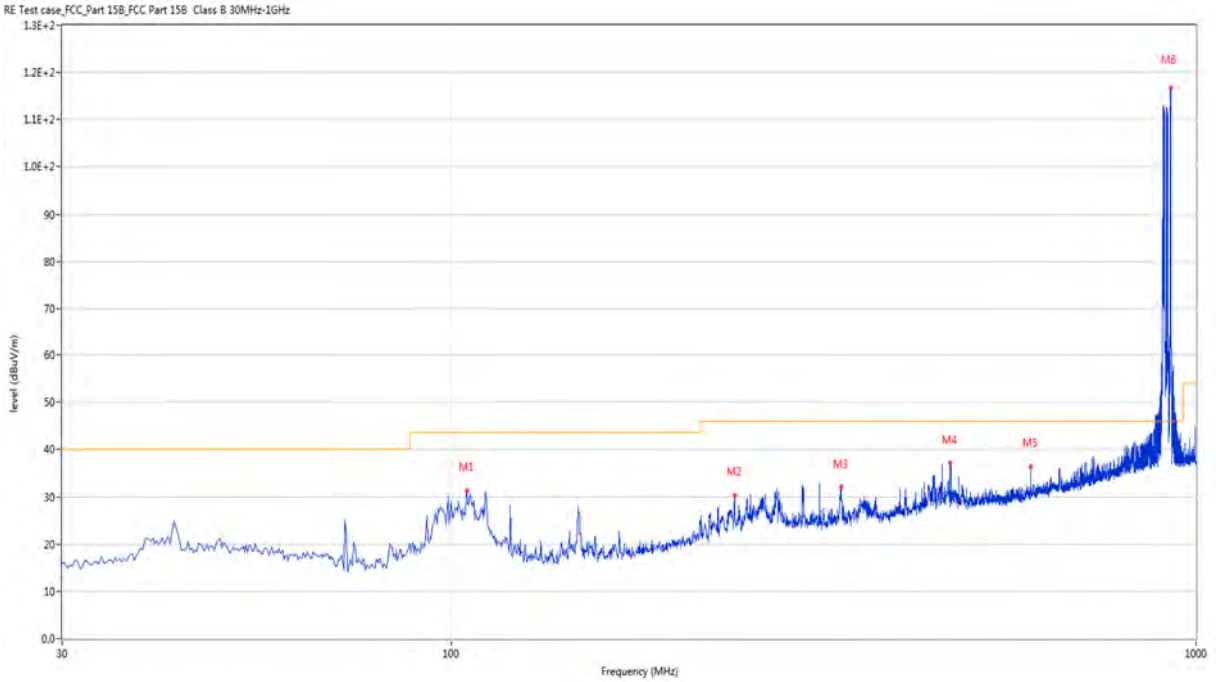
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	105.902	31.12	-24.97	43.5	-12.38	Peak	240.70	200	Horizontal	Pass
2	264.013	31.71	-22.23	46.0	-14.29	Peak	248.00	100	Horizontal	Pass
3	467.955	37.47	-16.64	46.0	-8.53	Peak	273.20	200	Horizontal	Pass
4	814.002	44.33	-9.33	46.0	-1.67	Peak	70.00	100	Horizontal	N/A
4*	814.002	40.67	-9.33	46.0	-5.33	QP	70.00	100	Horizontal	Pass
5	870.020	45.28	-8.16	46.0	-0.72	Peak	70.00	100	Horizontal	N/A
5*	870.020	41.84	-8.16	46.0	-4.16	QP	70.00	100	Horizontal	Pass
6	927.250	115.14	-7.26	46.0	69.14	Peak	135.40	100	Horizontal	N/A

HIGH CHANNEL, ANT V



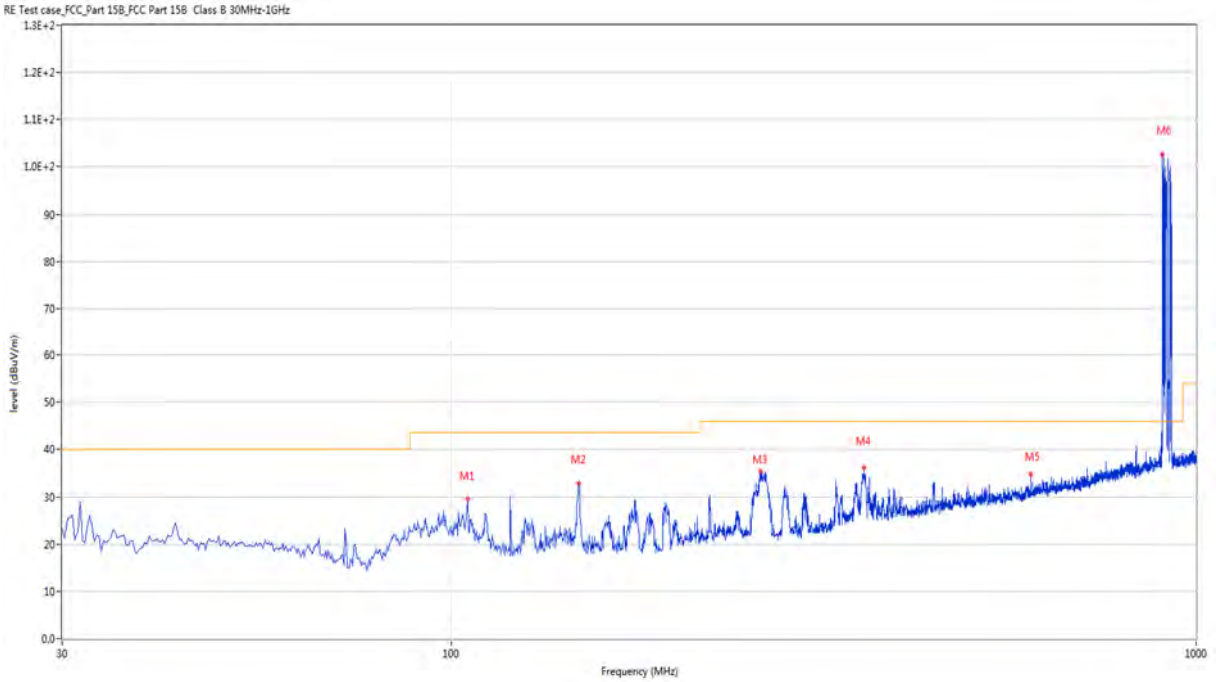
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	85.775	26.00	-28.15	40.0	-14.00	Peak	328.40	100	Vertical	Pass
2	119.967	28.33	-26.38	43.5	-15.17	Peak	359.70	200	Vertical	Pass
3	249.947	32.95	-22.77	46.0	-13.05	Peak	263.20	100	Vertical	Pass
4	362.467	36.28	-19.30	46.0	-9.72	Peak	248.50	200	Vertical	Pass
5	600.118	35.41	-13.06	46.0	-10.59	Peak	194.70	100	Vertical	Pass
6	927.250	102.64	-7.26	46.0	56.64	Peak	183.60	100	Vertical	N/A

HOPPING MODE, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	104.933	31.30	-24.97	43.5	-12.20	Peak	49.20	100	Horizontal	Pass
2	240.005	30.29	-23.08	46.0	-15.71	Peak	245.40	100	Horizontal	Pass
3	334.095	32.06	-19.79	46.0	-13.94	Peak	332.00	200	Horizontal	Pass
4	467.955	37.12	-16.64	46.0	-8.88	Peak	274.40	100	Horizontal	Pass
5	600.118	36.43	-13.06	46.0	-9.57	Peak	310.60	100	Horizontal	Pass
6	924.340	116.75	-2.31	46.0	70.75	Peak	74.60	200	Horizontal	N/A

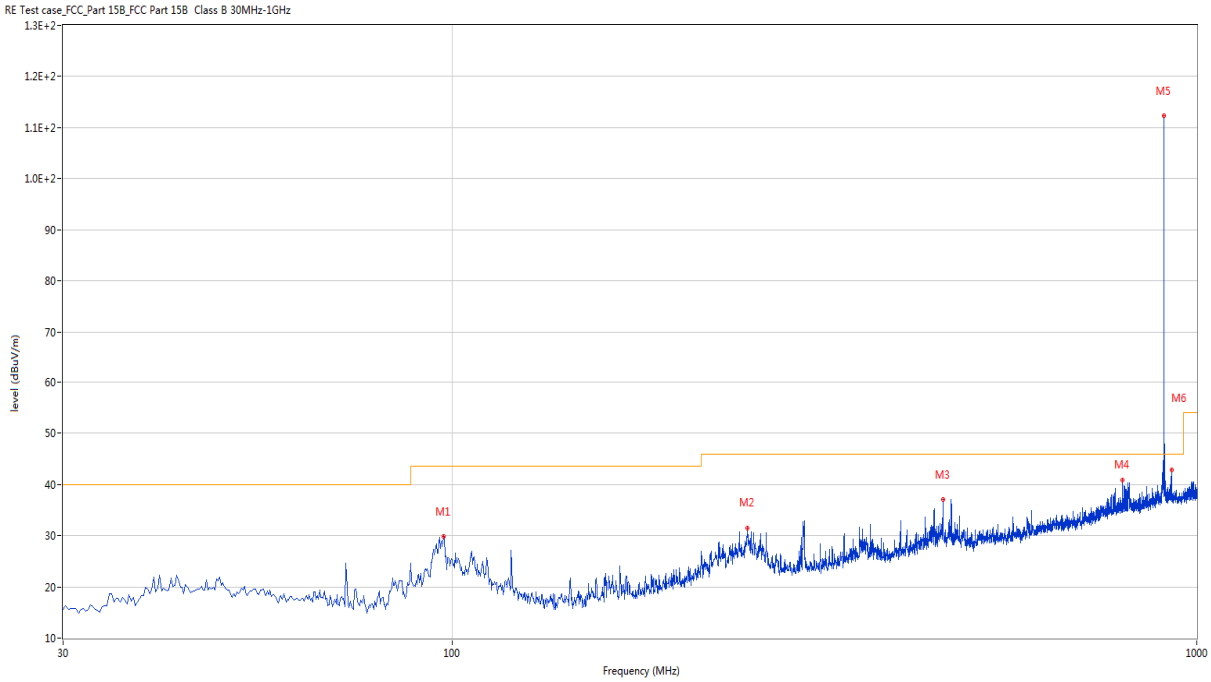
HOPPING MODE, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	105.175	29.50	-24.97	43.5	-14.00	Peak	277.40	100	Vertical	Pass
2	148.340	32.83	-28.31	43.5	-10.67	Peak	100.00	100	Vertical	Pass
3	259.890	35.40	-22.42	46.0	-10.60	Peak	321.00	200	Vertical	Pass
4	358.345	36.20	-19.31	46.0	-9.80	Peak	281.10	100	Vertical	Pass
5	600.118	34.76	-13.06	46.0	-11.24	Peak	1.40	100	Vertical	Pass
6	902.273	102.36	-7.19	46.0	56.36	Peak	306.50	100	Vertical	N/A

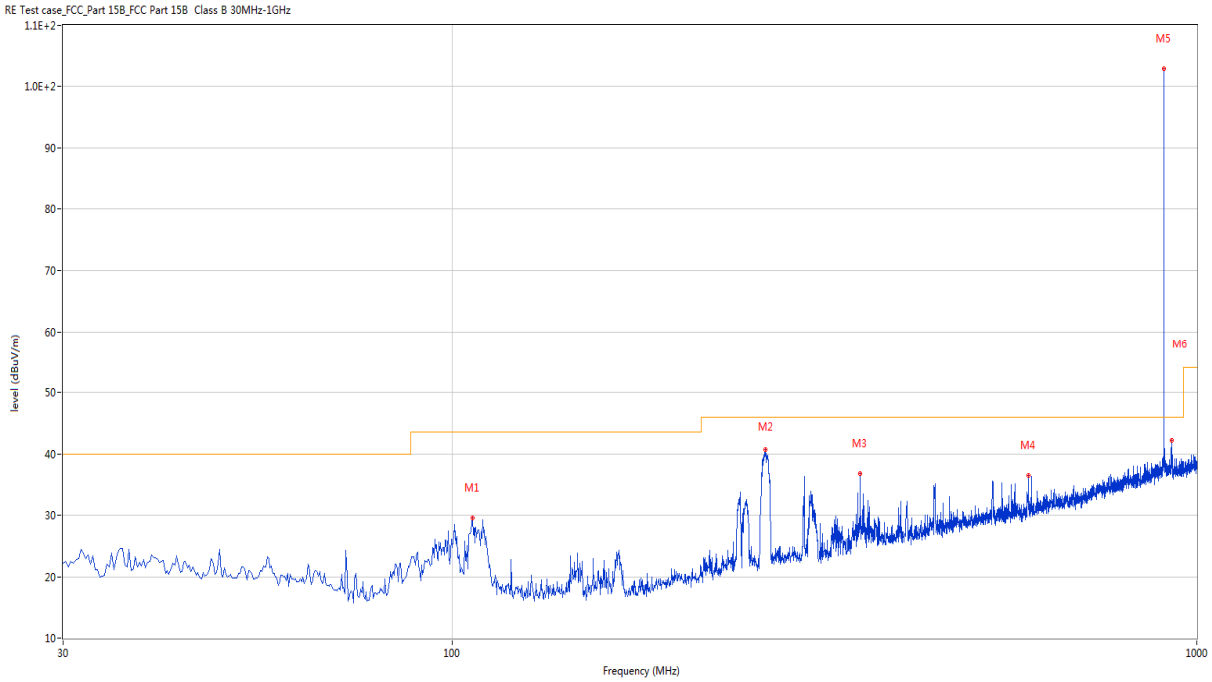
500KHz

LOW CHANNEL, ANT H



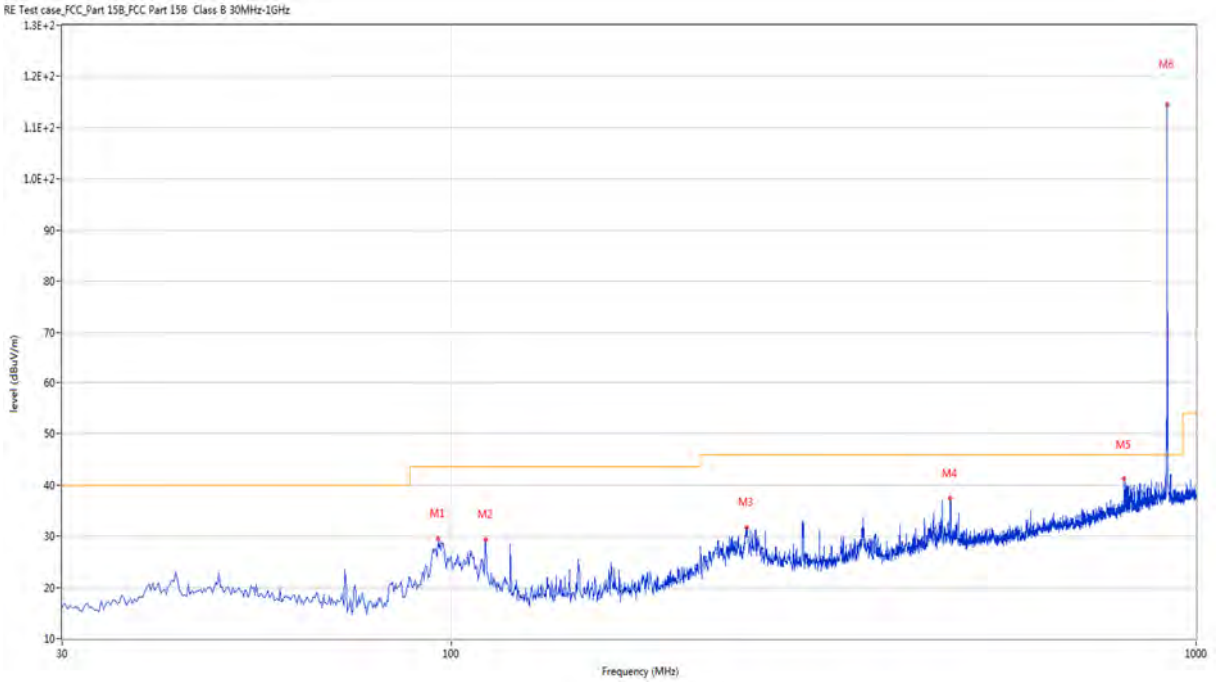
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	97.415	29.77	-25.58	43.5	-13.73	Peak	216.40	100	Horizontal	Pass
2	248.977	31.47	-22.76	46.0	-14.53	Peak	234.70	100	Horizontal	Pass
3	456.073	37.11	-17.01	46.0	-8.89	Peak	115.40	100	Horizontal	Pass
4	794.360	40.94	-9.53	46.0	-5.06	Peak	100.70	100	Horizontal	Pass
5	903.242	112.27	-7.14	46.0	66.27	Peak	220.00	200	Horizontal	N/A
6	924.340	42.79	-2.31	46.0	-3.21	Peak	14.10	100	Horizontal	N/A

LOW CHANNEL, ANT V



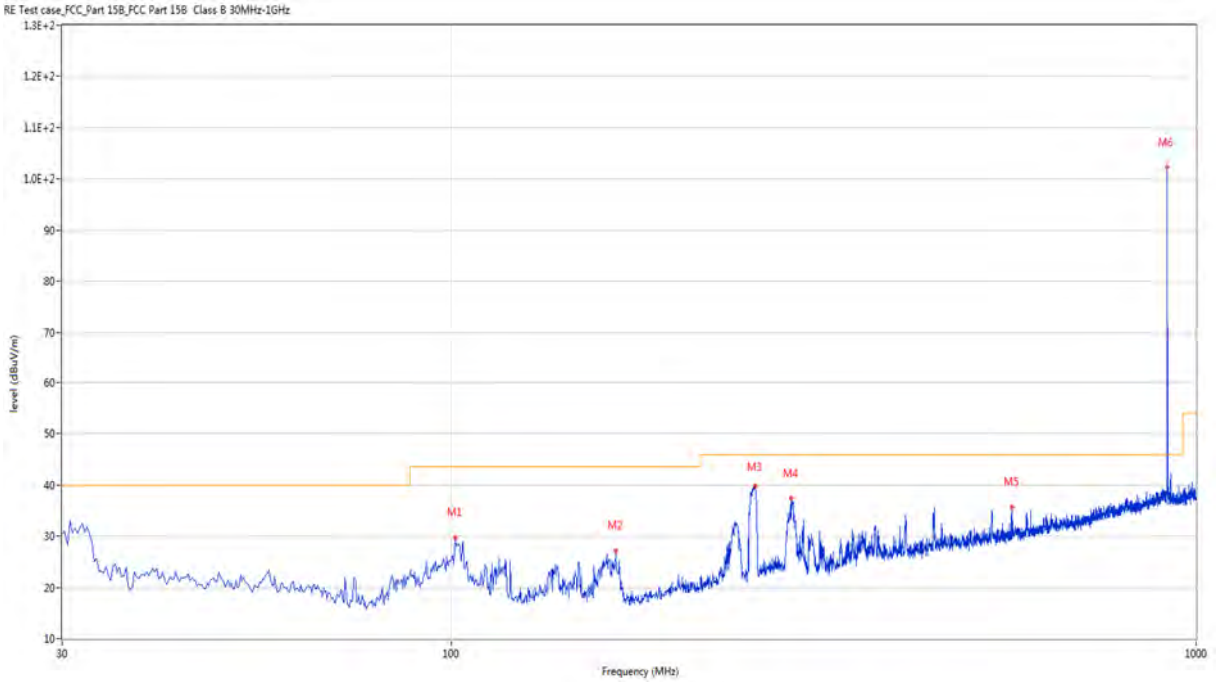
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	106.387	29.49	-25.01	43.5	-14.01	Peak	64.20	100	Vertical	Pass
2	263.043	40.60	-22.29	46.0	-5.40	Peak	327.80	100	Vertical	Pass
3	353.010	36.72	-19.71	46.0	-9.28	Peak	219.00	200	Vertical	Pass
4	594.055	36.49	-13.34	46.0	-9.51	Peak	230.10	100	Vertical	Pass
5	903.242	102.88	-7.14	46.0	56.88	Peak	240.90	100	Vertical	N/A
6	924.340	42.19	-2.31	46.0	-3.81	Peak	269.70	100	Vertical	N/A

MIDDLE CHANNEL, ANT H



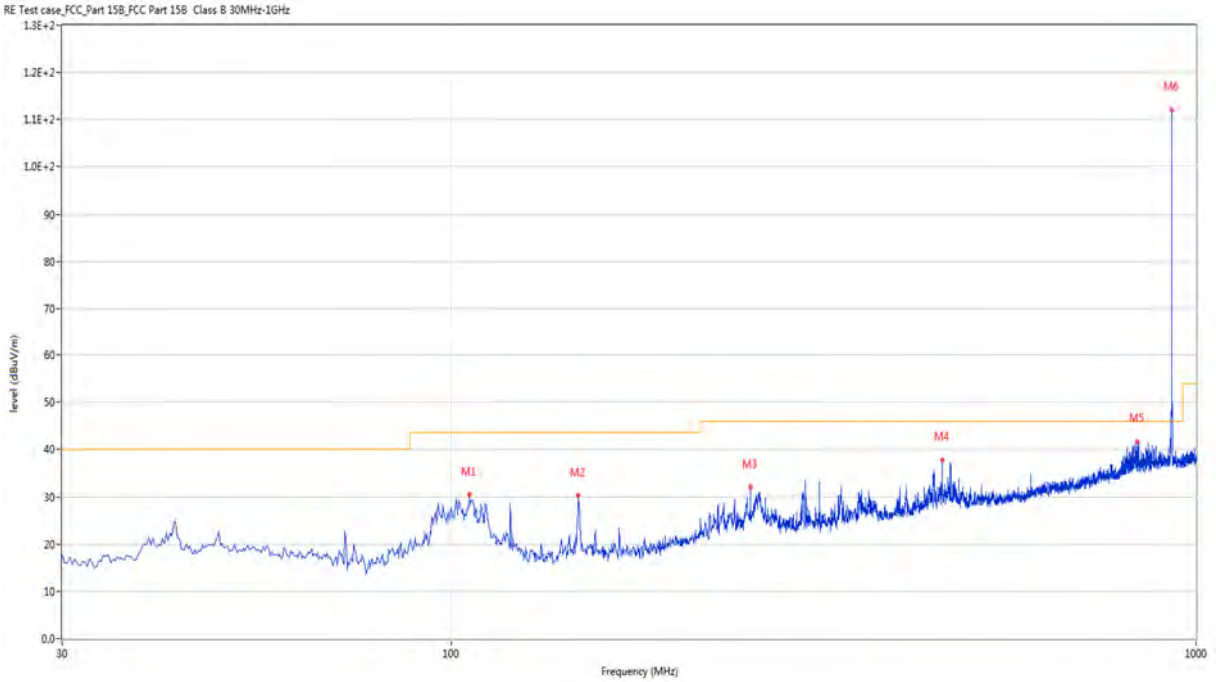
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	95.960	29.52	-25.75	43.5	-13.98	Peak	233.80	200	Horizontal	Pass
2	111.238	29.35	-25.15	43.5	-14.15	Peak	5.70	100	Horizontal	Pass
3	248.977	31.67	-22.76	46.0	-14.33	Peak	284.70	200	Horizontal	Pass
4	467.955	37.39	-16.64	46.0	-8.61	Peak	99.70	100	Horizontal	Pass
5	800.907	41.26	-9.57	46.0	-4.74	Peak	91.20	100	Horizontal	Pass
6	914.640	114.65	-7.19	46.0	68.65	Peak	161.40	100	Horizontal	N/A

MIDDLE CHANNEL, ANT V



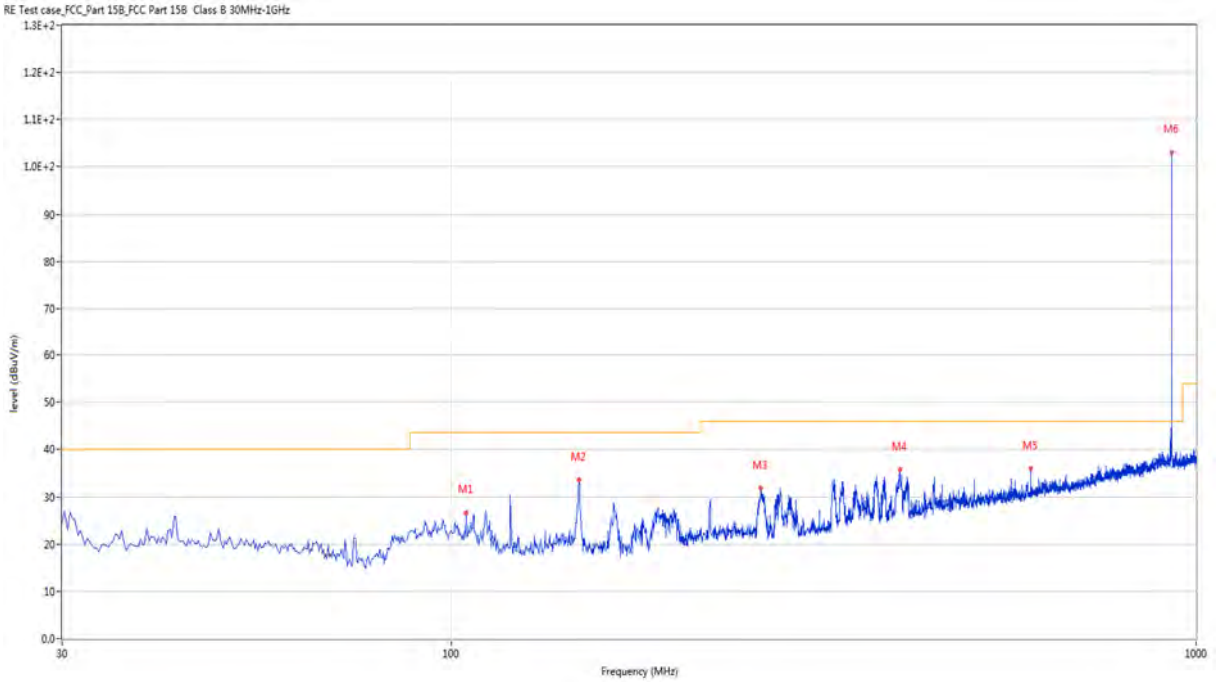
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	101.295	29.71	-25.04	43.5	-13.79	Peak	266.20	100	Vertical	Pass
2	166.042	27.17	-26.99	43.5	-16.33	Peak	136.10	100	Vertical	Pass
3	255.525	39.84	-22.44	46.0	-6.16	Peak	327.90	200	Vertical	Pass
4	286.080	37.35	-21.31	46.0	-8.65	Peak	82.00	100	Vertical	Pass
5	566.653	35.62	-13.62	46.0	-10.38	Peak	215.40	100	Vertical	Pass
6	915.367	102.43	-7.14	46.0	56.43	Peak	288.20	100	Vertical	N/A

HIGH CHANNEL, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	105.660	30.47	-24.98	43.5	-13.03	Peak	227.80	100	Horizontal	Pass
2	148.098	30.21	-28.30	43.5	-13.29	Peak	310.60	100	Horizontal	Pass
3	252.130	31.97	-22.69	46.0	-14.03	Peak	227.80	200	Horizontal	Pass
4	456.073	37.72	-17.01	46.0	-8.28	Peak	261.80	100	Horizontal	Pass
5	834.857	41.67	-8.78	46.0	-4.33	Peak	72.20	100	Horizontal	Pass
6	927.250	112.67	-7.26	46.0	66.67	Peak	303.60	100	Horizontal	N/A

HIGH CHANNEL, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	104.690	26.67	-24.96	43.5	-16.83	Peak	344.60	100	Vertical	Pass
2	148.340	33.57	-28.31	43.5	-9.93	Peak	104.40	200	Vertical	Pass
3	260.375	31.84	-22.41	46.0	-14.16	Peak	358.80	100	Vertical	Pass
4	400.297	35.68	-17.99	46.0	-10.32	Peak	122.50	100	Vertical	Pass
5	600.118	36.03	-13.06	46.0	-9.97	Peak	162.40	200	Vertical	Pass
6	927.492	103.45	-7.34	46.0	57.45	Peak	10.40	100	Vertical	N/A

Test Data and Plots

125KHz

LOW CHANNEL, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1109.500	35.58	-18.65	74.0	-38.42	Peak	82.00	150	Horizontal	Pass
1**	1109.500	23.11	-18.65	54.0	-30.89	AV	82.00	150	Horizontal	Pass
2	1714.000	39.54	-17.51	74.0	-34.46	Peak	30.00	150	Horizontal	Pass
2**	1714.000	26.73	-17.51	54.0	-27.27	AV	30.00	150	Horizontal	Pass
3	3121.000	45.37	-8.51	74.0	-28.63	Peak	46.00	150	Horizontal	Pass
3**	3121.000	28.61	-8.51	54.0	-25.39	AV	46.00	150	Horizontal	Pass
4	4787.000	48.87	-2.39	74.0	-25.13	Peak	10.00	150	Horizontal	Pass
4**	4787.000	33.72	-2.39	54.0	-20.28	AV	10.00	150	Horizontal	Pass
5	6690.000	54.93	0.05	74.0	-19.07	Peak	128.00	150	Horizontal	Pass
5**	6690.000	38.65	0.05	54.0	-15.35	AV	128.00	150	Horizontal	Pass
6	12285.688	53.17	2.07	74.0	-20.83	Peak	238.00	150	Horizontal	Pass
6**	12285.688	36.58	2.07	54.0	-17.42	AV	238.00	150	Horizontal	Pass

LOW CHANNEL, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1246.000	40.27	-17.64	74.0	-33.73	Peak	124.00	150	Vertical	Pass
1**	1246.000	23.45	-17.64	54.0	-30.55	AV	124.00	150	Vertical	Pass
2	1794.000	40.42	-16.56	74.0	-33.58	Peak	32.00	150	Vertical	Pass
2**	1794.000	24.41	-16.56	54.0	-29.59	AV	32.00	150	Vertical	Pass
3	3098.000	46.53	-8.23	74.0	-27.47	Peak	295.00	150	Vertical	Pass
3**	3098.000	28.84	-8.23	54.0	-25.16	AV	295.00	150	Vertical	Pass
4	4790.000	49.28	-2.33	74.0	-24.72	Peak	249.00	150	Vertical	Pass
4**	4790.000	33.52	-2.33	54.0	-20.48	AV	249.00	150	Vertical	Pass
5	6677.000	53.52	-0.01	74.0	-20.48	Peak	189.00	150	Vertical	Pass
5**	6677.000	37.67	-0.01	54.0	-16.33	AV	189.00	150	Vertical	Pass
6	11727.938	52.25	1.32	74.0	-21.75	Peak	217.00	150	Vertical	Pass
6**	11727.938	36.34	1.32	54.0	-17.66	AV	217.00	150	Vertical	Pass

MIDDLE CHANNEL, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1111.500	36.73	-18.49	74.0	-37.27	Peak	79.00	150	Horizontal	Pass
1**	1111.500	24.35	-18.49	54.0	-29.65	AV	79.00	150	Horizontal	Pass
2	1790.500	39.79	-17.00	74.0	-34.21	Peak	53.00	150	Horizontal	Pass
2**	1790.500	24.58	-17.00	54.0	-29.42	AV	53.00	150	Horizontal	Pass
3	2683.500	43.48	-11.09	74.0	-30.52	Peak	359.00	150	Horizontal	Pass
3**	2683.500	26.91	-11.09	54.0	-27.09	AV	359.00	150	Horizontal	Pass
4	4918.000	50.43	-2.32	74.0	-23.57	Peak	84.00	150	Horizontal	Pass
4**	4918.000	34.02	-2.32	54.0	-19.98	AV	84.00	150	Horizontal	Pass
5	6679.000	53.55	0.19	74.0	-20.45	Peak	38.00	150	Horizontal	Pass
5**	6679.000	39.36	0.19	54.0	-14.64	AV	38.00	150	Horizontal	Pass
6	12488.375	52.77	1.88	74.0	-21.23	Peak	322.00	150	Horizontal	Pass
6**	12488.375	36.22	1.88	54.0	-17.78	AV	322.00	150	Horizontal	Pass

MIDDLE CHANNEL, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1112.500	36.51	-18.62	74.0	-37.49	Peak	78.00	150	Vertical	Pass
1**	1112.500	23.67	-18.62	54.0	-30.33	AV	78.00	150	Vertical	Pass
2	1795.500	40.16	-16.70	74.0	-33.84	Peak	39.00	150	Vertical	Pass
2**	1795.500	24.99	-16.70	54.0	-29.01	AV	39.00	150	Vertical	Pass
3	3186.000	45.64	-8.46	74.0	-28.36	Peak	11.00	150	Vertical	Pass
3**	3186.000	30.26	-8.46	54.0	-23.74	AV	11.00	150	Vertical	Pass
4	5160.000	50.98	-2.56	74.0	-23.02	Peak	259.00	150	Vertical	Pass
4**	5160.000	34.36	-2.56	54.0	-19.64	AV	259.00	150	Vertical	Pass
5	6744.000	53.02	-0.09	74.0	-20.98	Peak	281.00	150	Vertical	Pass
5**	6744.000	36.90	-0.09	54.0	-17.10	AV	281.00	150	Vertical	Pass
6	11694.875	52.24	0.61	74.0	-21.76	Peak	195.00	150	Vertical	Pass
6**	11694.875	35.72	0.61	54.0	-18.28	AV	195.00	150	Vertical	Pass

HIGH CHANNEL, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1164.500	35.94	-17.94	74.0	-38.06	Peak	142.00	150	Horizontal	Pass
1**	1164.500	23.16	-17.94	54.0	-30.84	AV	142.00	150	Horizontal	Pass
2	1805.500	39.02	-16.78	74.0	-34.98	Peak	54.00	150	Horizontal	Pass
2**	1805.500	25.17	-16.78	54.0	-28.83	AV	54.00	150	Horizontal	Pass
3	3054.000	45.42	-7.71	74.0	-28.58	Peak	141.00	150	Horizontal	Pass
3**	3054.000	29.42	-7.71	54.0	-24.58	AV	141.00	150	Horizontal	Pass
4	4515.000	49.09	-3.70	74.0	-24.91	Peak	161.00	150	Horizontal	Pass
4**	4515.000	32.78	-3.70	54.0	-21.22	AV	161.00	150	Horizontal	Pass
5	6680.000	53.39	0.11	74.0	-20.61	Peak	116.00	150	Horizontal	Pass
5**	6680.000	38.51	0.11	54.0	-15.49	AV	116.00	150	Horizontal	Pass
6	11374.312	51.81	-0.09	74.0	-22.19	Peak	51.00	150	Horizontal	Pass
6**	11374.312	34.77	-0.09	54.0	-19.23	AV	51.00	150	Horizontal	Pass

HIGH CHANNEL, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1087.000	36.26	-18.46	74.0	-37.74	Peak	268.00	150	Vertical	Pass
1**	1087.000	22.26	-18.46	54.0	-31.74	AV	268.00	150	Vertical	Pass
2	1762.500	39.70	-17.12	74.0	-34.30	Peak	54.00	150	Vertical	Pass
2**	1762.500	23.91	-17.12	54.0	-30.09	AV	54.00	150	Vertical	Pass
3	3189.000	47.75	-8.28	74.0	-26.25	Peak	325.00	150	Vertical	Pass
3**	3189.000	30.48	-8.28	54.0	-23.52	AV	325.00	150	Vertical	Pass
4	4534.000	48.91	-4.33	74.0	-25.09	Peak	230.00	150	Vertical	Pass
4**	4534.000	32.67	-4.33	54.0	-21.33	AV	230.00	150	Vertical	Pass
5	6679.000	53.31	0.19	74.0	-20.69	Peak	283.00	150	Vertical	Pass
5**	6679.000	38.39	0.19	54.0	-15.61	AV	283.00	150	Vertical	Pass
6	11893.250	52.28	2.15	74.0	-21.72	Peak	207.00	150	Vertical	Pass
6**	11893.250	36.03	2.15	54.0	-17.97	AV	207.00	150	Vertical	Pass

HOPPING MODE, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1322.000	38.53	-17.71	74.0	-35.47	Peak	340.00	100	Horizontal	Pass
1**	1322.000	24.43	-17.71	54.0	-29.57	AV	340.00	100	Horizontal	Pass
2	1744.500	39.95	-17.14	74.0	-34.05	Peak	19.00	100	Horizontal	Pass
2**	1744.500	28.50	-17.14	54.0	-25.50	AV	19.00	100	Horizontal	Pass
3	3190.000	46.16	-8.25	74.0	-27.84	Peak	103.00	100	Horizontal	Pass
3**	3190.000	29.76	-8.25	54.0	-24.24	AV	103.00	100	Horizontal	Pass
4	4791.000	50.44	-2.29	74.0	-23.56	Peak	103.00	100	Horizontal	Pass
4**	4791.000	34.55	-2.29	54.0	-19.45	AV	103.00	100	Horizontal	Pass
5	6683.000	53.47	0.11	74.0	-20.53	Peak	1.00	100	Horizontal	Pass
5**	6683.000	38.31	0.11	54.0	-15.69	AV	1.00	100	Horizontal	Pass
6	12213.812	52.85	1.53	74.0	-21.15	Peak	305.00	100	Horizontal	Pass
6**	12213.812	37.02	1.53	54.0	-16.98	AV	305.00	100	Horizontal	Pass

HOPPING MODE, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1326.500	41.70	-17.54	74.0	-32.30	Peak	326.00	100	Vertical	Pass
1**	1326.500	24.56	-17.54	54.0	-29.44	AV	326.00	100	Vertical	Pass
2	1787.000	41.50	-16.82	74.0	-32.50	Peak	31.00	100	Vertical	Pass
2**	1787.000	30.62	-16.82	54.0	-23.38	AV	31.00	100	Vertical	Pass
3	3006.000	45.51	-8.32	74.0	-28.49	Peak	244.00	100	Vertical	Pass
3**	3006.000	28.94	-8.32	54.0	-25.06	AV	244.00	100	Vertical	Pass
4	4796.000	49.79	-2.34	74.0	-24.21	Peak	124.00	100	Vertical	Pass
4**	4796.000	33.96	-2.34	54.0	-20.04	AV	124.00	100	Vertical	Pass
5	6659.000	54.19	-0.08	74.0	-19.81	Peak	295.00	100	Vertical	Pass
5**	6659.000	38.08	-0.08	54.0	-15.92	AV	295.00	100	Vertical	Pass
6	10974.687	51.66	0.00	74.0	-22.34	Peak	182.00	100	Vertical	Pass
6**	10974.687	34.93	0.00	54.0	-19.07	AV	182.00	100	Vertical	Pass

250KHz

LOW CHANNEL, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1113.000	36.11	-18.70	74.0	-37.89	Peak	76.00	150	Horizontal	Pass
1**	1113.000	22.41	-18.70	54.0	-31.59	AV	76.00	150	Horizontal	Pass
2	1757.000	40.29	-17.02	74.0	-33.71	Peak	41.00	150	Horizontal	Pass
2**	1757.000	23.51	-17.02	54.0	-30.49	AV	41.00	150	Horizontal	Pass
3	2679.500	43.69	-11.02	74.0	-30.31	Peak	235.00	150	Horizontal	Pass
3**	2679.500	27.41	-11.02	54.0	-26.59	AV	235.00	150	Horizontal	Pass
4	4594.000	49.75	-3.37	74.0	-24.25	Peak	213.00	150	Horizontal	Pass
4**	4594.000	33.48	-3.37	54.0	-20.52	AV	213.00	150	Horizontal	Pass
5	6662.000	54.41	0.01	74.0	-19.59	Peak	320.00	150	Horizontal	Pass
5**	6662.000	37.46	0.01	54.0	-16.54	AV	320.00	150	Horizontal	Pass
6	11877.437	51.99	1.77	74.0	-22.01	Peak	40.00	150	Horizontal	Pass
6**	11877.437	35.60	1.77	54.0	-18.40	AV	40.00	150	Horizontal	Pass

LOW CHANNEL, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1330.000	40.89	-17.33	74.0	-33.11	Peak	333.00	150	Vertical	Pass
1**	1330.000	25.41	-17.33	54.0	-28.59	AV	333.00	150	Vertical	Pass
2	1768.500	38.94	-17.29	74.0	-35.06	Peak	32.00	150	Vertical	Pass
2**	1768.500	27.39	-17.29	54.0	-26.61	AV	32.00	150	Vertical	Pass
3	2677.500	43.91	-10.96	74.0	-30.09	Peak	28.00	150	Vertical	Pass
3**	2677.500	27.22	-10.96	54.0	-26.78	AV	28.00	150	Vertical	Pass
4	3960.000	47.65	-4.87	74.0	-26.35	Peak	137.00	150	Vertical	Pass
4**	3960.000	30.65	-4.87	54.0	-23.35	AV	137.00	150	Vertical	Pass
5	6608.000	53.49	0.51	74.0	-20.51	Peak	157.00	150	Vertical	Pass
5**	6608.000	38.25	0.51	54.0	-15.75	AV	157.00	150	Vertical	Pass
6	11197.500	52.30	0.02	74.0	-21.70	Peak	318.00	150	Vertical	Pass
6**	11197.500	34.93	0.02	54.0	-19.07	AV	318.00	150	Vertical	Pass

MIDDLE CHANNEL, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1245.500	42.57	-17.65	74.0	-31.43	Peak	143.00	150	Horizontal	Pass
1**	1245.500	23.59	-17.65	54.0	-30.41	AV	143.00	150	Horizontal	Pass
2	1783.500	39.59	-17.04	74.0	-34.41	Peak	58.00	150	Horizontal	Pass
2**	1783.500	27.14	-17.04	54.0	-26.86	AV	58.00	150	Horizontal	Pass
3	2435.000	42.99	-12.75	74.0	-31.01	Peak	58.00	150	Horizontal	Pass
3**	2435.000	33.27	-12.75	54.0	-20.73	AV	58.00	150	Horizontal	Pass
4	4066.000	47.78	-5.34	74.0	-26.22	Peak	348.00	150	Horizontal	Pass
4**	4066.000	31.99	-5.34	54.0	-22.01	AV	348.00	150	Horizontal	Pass
5	6675.000	53.34	0.09	74.0	-20.66	Peak	87.00	150	Horizontal	Pass
5**	6675.000	37.85	0.09	54.0	-16.15	AV	87.00	150	Horizontal	Pass
6	11722.188	51.98	1.30	74.0	-22.02	Peak	0.00	150	Horizontal	Pass
6**	11722.188	35.79	1.30	54.0	-18.21	AV	0.00	150	Horizontal	Pass

MIDDLE CHANNEL, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1365.000	40.16	-17.54	74.0	-33.84	Peak	351.00	150	Vertical	Pass
1**	1365.000	23.60	-17.54	54.0	-30.40	AV	351.00	150	Vertical	Pass
2	1721.500	39.26	-17.49	74.0	-34.74	Peak	20.00	150	Vertical	Pass
2**	1721.500	28.52	-17.49	54.0	-25.48	AV	20.00	150	Vertical	Pass
3	3189.000	46.90	-8.28	74.0	-27.10	Peak	13.00	150	Vertical	Pass
3**	3189.000	30.34	-8.28	54.0	-23.66	AV	13.00	150	Vertical	Pass
4	4285.000	47.88	-4.82	74.0	-26.12	Peak	273.00	150	Vertical	Pass
4**	4285.000	31.53	-4.82	54.0	-22.47	AV	273.00	150	Vertical	Pass
5	6653.000	53.90	-0.23	74.0	-20.10	Peak	221.00	150	Vertical	Pass
5**	6653.000	37.22	-0.23	54.0	-16.78	AV	221.00	150	Vertical	Pass
6	10842.438	51.56	0.97	74.0	-22.44	Peak	-1.00	150	Vertical	Pass
6**	10842.438	35.02	0.97	54.0	-18.98	AV	-1.00	150	Vertical	Pass

HIGH CHANNEL, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1195.500	36.29	-18.04	74.0	-37.71	Peak	292.00	150	Horizontal	Pass
1**	1195.500	23.68	-18.04	54.0	-30.32	AV	292.00	150	Horizontal	Pass
2	1724.000	40.71	-17.37	74.0	-33.29	Peak	18.00	150	Horizontal	Pass
2**	1724.000	23.58	-17.37	54.0	-30.42	AV	18.00	150	Horizontal	Pass
3	3154.000	46.13	-8.40	74.0	-27.87	Peak	119.00	150	Horizontal	Pass
3**	3154.000	29.53	-8.40	54.0	-24.47	AV	119.00	150	Horizontal	Pass
4	5233.000	50.90	-2.75	74.0	-23.10	Peak	99.00	150	Horizontal	Pass
4**	5233.000	34.86	-2.75	54.0	-19.14	AV	99.00	150	Horizontal	Pass
5	6603.000	53.20	0.44	74.0	-20.80	Peak	2.00	150	Horizontal	Pass
5**	6603.000	37.59	0.44	54.0	-16.41	AV	2.00	150	Horizontal	Pass
6	10625.375	51.27	-0.70	74.0	-22.73	Peak	1.00	150	Horizontal	Pass
6**	10625.375	34.03	-0.70	54.0	-19.97	AV	1.00	150	Horizontal	Pass

HIGH CHANNEL, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1171.000	37.06	-18.03	74.0	-36.94	Peak	329.00	150	Vertical	Pass
1**	1171.000	22.75	-18.03	54.0	-31.25	AV	329.00	150	Vertical	Pass
2	1773.000	38.79	-17.07	74.0	-35.21	Peak	48.00	150	Vertical	Pass
2**	1773.000	24.35	-17.07	54.0	-29.65	AV	48.00	150	Vertical	Pass
3	3191.000	45.55	-8.31	74.0	-28.45	Peak	310.00	150	Vertical	Pass
3**	3191.000	29.46	-8.31	54.0	-24.54	AV	310.00	150	Vertical	Pass
4	4784.000	49.51	-2.33	74.0	-24.49	Peak	229.00	150	Vertical	Pass
4**	4784.000	33.61	-2.33	54.0	-20.39	AV	229.00	150	Vertical	Pass
5	6694.000	53.73	0.12	74.0	-20.27	Peak	96.00	150	Vertical	Pass
5**	6694.000	38.13	0.12	54.0	-15.87	AV	96.00	150	Vertical	Pass
6	12258.375	52.70	1.23	74.0	-21.30	Peak	44.00	150	Vertical	Pass
6**	12258.375	36.06	1.23	54.0	-17.94	AV	44.00	150	Vertical	Pass

HOPPING MODE, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1198.000	37.96	-18.16	74.0	-36.04	Peak	74.00	100	Horizontal	Pass
1**	1198.000	23.06	-18.16	54.0	-30.94	AV	74.00	100	Horizontal	Pass
2	1771.000	40.08	-17.00	74.0	-33.92	Peak	19.00	100	Horizontal	Pass
2**	1771.000	25.64	-17.00	54.0	-28.36	AV	19.00	100	Horizontal	Pass
3	3074.000	45.50	-7.93	74.0	-28.50	Peak	17.00	100	Horizontal	Pass
3**	3074.000	29.17	-7.93	54.0	-24.83	AV	17.00	100	Horizontal	Pass
4	4805.000	50.02	-2.78	74.0	-23.98	Peak	248.00	100	Horizontal	Pass
4**	4805.000	34.70	-2.78	54.0	-19.30	AV	248.00	100	Horizontal	Pass
5	6671.000	53.28	-0.13	74.0	-20.72	Peak	144.00	100	Horizontal	Pass
5**	6671.000	37.72	-0.13	54.0	-16.28	AV	144.00	100	Horizontal	Pass
6	11042.250	51.94	0.01	74.0	-22.06	Peak	183.00	100	Horizontal	Pass
6**	11042.250	35.18	0.01	54.0	-18.82	AV	183.00	100	Horizontal	Pass

HOPPING MODE, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1329.000	40.46	-17.45	74.0	-33.54	Peak	347.00	100	Vertical	Pass
1**	1329.000	23.99	-17.45	54.0	-30.01	AV	347.00	100	Vertical	Pass
2	1762.000	40.94	-17.11	74.0	-33.06	Peak	49.00	100	Vertical	Pass
2**	1762.000	24.44	-17.11	54.0	-29.56	AV	49.00	100	Vertical	Pass
3	3187.000	46.53	-8.39	74.0	-27.47	Peak	4.00	100	Vertical	Pass
3**	3187.000	29.97	-8.39	54.0	-24.03	AV	4.00	100	Vertical	Pass
4	5245.000	51.49	-2.38	74.0	-22.51	Peak	254.00	100	Vertical	Pass
4**	5245.000	35.43	-2.38	54.0	-18.57	AV	254.00	100	Vertical	Pass
5	6660.000	53.43	-0.09	74.0	-20.57	Peak	59.00	100	Vertical	Pass
5**	6660.000	37.74	-0.09	54.0	-16.26	AV	59.00	100	Vertical	Pass
6	11959.375	52.37	1.09	74.0	-21.63	Peak	44.00	100	Vertical	Pass
6**	11959.375	35.83	1.09	54.0	-18.17	AV	44.00	100	Vertical	Pass

500KHz

LOW CHANNEL, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1330.500	39.08	-17.27	74.0	-34.92	Peak	110.00	150	Horizontal	Pass
1**	1330.500	23.83	-17.27	54.0	-30.17	AV	110.00	150	Horizontal	Pass
2	1760.500	42.73	-16.90	74.0	-31.27	Peak	35.00	150	Horizontal	Pass
2**	1760.500	32.36	-16.90	54.0	-21.64	AV	35.00	150	Horizontal	Pass
3	3055.000	46.40	-7.68	74.0	-27.60	Peak	135.00	150	Horizontal	Pass
3**	3055.000	29.02	-7.68	54.0	-24.98	AV	135.00	150	Horizontal	Pass
4	4438.000	48.77	-4.01	74.0	-25.23	Peak	215.00	150	Horizontal	Pass
4**	4438.000	32.69	-4.01	54.0	-21.31	AV	215.00	150	Horizontal	Pass
5	6665.000	52.99	-0.00	74.0	-21.01	Peak	189.00	150	Horizontal	Pass
5**	6665.000	37.82	-0.00	54.0	-16.18	AV	189.00	150	Horizontal	Pass
6	12057.125	52.43	1.34	74.0	-21.57	Peak	5.00	150	Horizontal	Pass
6**	12057.125	36.19	1.34	54.0	-17.81	AV	5.00	150	Horizontal	Pass

LOW CHANNEL, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1327.000	38.60	-17.53	74.0	-35.40	Peak	325.00	150	Vertical	Pass
1**	1327.000	24.35	-17.53	54.0	-29.65	AV	325.00	150	Vertical	Pass
2	1795.000	40.60	-16.65	74.0	-33.40	Peak	42.00	150	Vertical	Pass
2**	1795.000	27.50	-16.65	54.0	-26.50	AV	42.00	150	Vertical	Pass
3	3193.000	47.54	-8.35	74.0	-26.46	Peak	7.00	150	Vertical	Pass
3**	3193.000	31.08	-8.35	54.0	-22.92	AV	7.00	150	Vertical	Pass
4	4455.000	48.78	-3.64	74.0	-25.22	Peak	23.00	150	Vertical	Pass
4**	4455.000	32.82	-3.64	54.0	-21.18	AV	23.00	150	Vertical	Pass
5	6657.000	54.46	-0.16	74.0	-19.54	Peak	106.00	150	Vertical	Pass
5**	6657.000	37.50	-0.16	54.0	-16.50	AV	106.00	150	Vertical	Pass
6	12295.750	52.78	1.90	74.0	-21.22	Peak	216.00	150	Vertical	Pass
6**	12295.750	36.16	1.90	54.0	-17.84	AV	216.00	150	Vertical	Pass

MIDDLE CHANNEL, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1244.500	38.14	-17.62	74.0	-35.86	Peak	144.00	150	Horizontal	Pass
1**	1244.500	23.60	-17.62	54.0	-30.40	AV	144.00	150	Horizontal	Pass
2	1759.000	39.87	-16.86	74.0	-34.13	Peak	19.00	150	Horizontal	Pass
2**	1759.000	29.68	-16.86	54.0	-24.32	AV	19.00	150	Horizontal	Pass
3	2491.500	43.29	-11.94	74.0	-30.71	Peak	276.00	150	Horizontal	Pass
3**	2491.500	26.85	-11.94	54.0	-27.15	AV	276.00	150	Horizontal	Pass
4	3731.000	47.33	-6.41	74.0	-26.67	Peak	108.00	150	Horizontal	Pass
4**	3731.000	30.78	-6.41	54.0	-23.22	AV	108.00	150	Horizontal	Pass
5	6602.000	53.57	0.38	74.0	-20.43	Peak	254.00	150	Horizontal	Pass
5**	6602.000	37.34	0.38	54.0	-16.66	AV	254.00	150	Horizontal	Pass
6	11970.875	52.73	1.00	74.0	-21.27	Peak	0.00	150	Horizontal	Pass
6**	11970.875	35.64	1.00	54.0	-18.36	AV	0.00	150	Horizontal	Pass

MIDDLE CHANNEL, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1329.500	39.61	-17.39	74.0	-34.39	Peak	331.00	150	Vertical	Pass
1**	1329.500	25.75	-17.39	54.0	-28.25	AV	331.00	150	Vertical	Pass
2	1729.500	39.88	-17.28	74.0	-34.12	Peak	42.00	150	Vertical	Pass
2**	1729.500	23.74	-17.28	54.0	-30.26	AV	42.00	150	Vertical	Pass
3	3188.000	46.36	-8.32	74.0	-27.64	Peak	6.00	150	Vertical	Pass
3**	3188.000	29.73	-8.32	54.0	-24.27	AV	6.00	150	Vertical	Pass
4	5158.000	50.21	-2.40	74.0	-23.79	Peak	270.00	150	Vertical	Pass
4**	5158.000	36.17	-2.40	54.0	-17.83	AV	270.00	150	Vertical	Pass
5	6670.000	53.85	-0.11	74.0	-20.15	Peak	234.00	150	Vertical	Pass
5**	6670.000	38.22	-0.11	54.0	-15.78	AV	234.00	150	Vertical	Pass
6	11933.500	53.05	1.78	74.0	-20.95	Peak	164.00	150	Vertical	Pass
6**	11933.500	36.50	1.78	54.0	-17.50	AV	164.00	150	Vertical	Pass

HIGH CHANNEL, 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1245.500	38.84	-17.65	74.0	-35.16	Peak	281.00	150	Horizontal	Pass
1**	1245.500	23.59	-17.65	54.0	-30.41	AV	281.00	150	Horizontal	Pass
2	1763.000	38.75	-17.14	74.0	-35.25	Peak	11.00	150	Horizontal	Pass
2**	1763.000	27.22	-17.14	54.0	-26.78	AV	11.00	150	Horizontal	Pass
3	2782.500	43.91	-10.42	74.0	-30.09	Peak	288.00	150	Horizontal	Pass
3**	2782.500	27.95	-10.42	54.0	-26.05	AV	288.00	150	Horizontal	Pass
4	4794.000	49.96	-2.21	74.0	-24.04	Peak	348.00	150	Horizontal	Pass
4**	4794.000	34.09	-2.21	54.0	-19.91	AV	348.00	150	Horizontal	Pass
5	6665.000	54.17	-0.00	74.0	-19.83	Peak	10.00	150	Horizontal	Pass
5**	6665.000	37.07	-0.00	54.0	-16.93	AV	10.00	150	Horizontal	Pass
6	12103.125	51.92	0.88	74.0	-22.08	Peak	184.00	150	Horizontal	Pass
6**	12103.125	36.07	0.88	54.0	-17.93	AV	184.00	150	Horizontal	Pass

HIGH CHANNEL, 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1327.000	39.92	-17.53	74.0	-34.08	Peak	330.00	150	Vertical	Pass
1**	1327.000	23.46	-17.53	54.0	-30.54	AV	330.00	150	Vertical	Pass
2	1692.500	40.79	-17.34	74.0	-33.21	Peak	43.00	150	Vertical	Pass
2**	1692.500	23.30	-17.34	54.0	-30.70	AV	43.00	150	Vertical	Pass
3	3189.000	49.94	-8.28	74.0	-24.06	Peak	0.00	150	Vertical	Pass
3**	3189.000	36.14	-8.28	54.0	-17.86	AV	0.00	150	Vertical	Pass
4	4808.000	49.71	-2.76	74.0	-24.29	Peak	51.00	150	Vertical	Pass
4**	4808.000	33.95	-2.76	54.0	-20.05	AV	51.00	150	Vertical	Pass
5	6697.000	52.93	-0.16	74.0	-21.07	Peak	360.00	150	Vertical	Pass
5**	6697.000	37.63	-0.16	54.0	-16.37	AV	360.00	150	Vertical	Pass
6	12318.750	53.69	1.71	74.0	-20.31	Peak	24.00	150	Vertical	Pass
6**	12318.750	36.62	1.71	54.0	-17.38	AV	24.00	150	Vertical	Pass

A.8 Band Edge (Restricted-band band-edge)

Note [1]: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.
Note [2]: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.
Note [3]: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.
Note [4]: The Level (dBuV/m) has been corrected by factor.

Test Data

125KHz

Test Mode	Test Channel	Frequency (MHz)	Level (dBuV/m)	Factor (dB)	Limit Line (dBuV/m)	Margin (dB)	Remark	Verdict
LoRa	Low	614	42.866	3.16	74	31.134	PEAK	Pass
		614	N/A	N/A	54	N/A	AVERAGE	Pass
LoRa	HIGH	960	47.746	28	74	26.254	PEAK	Pass
		960	N/A	N/A	54	N/A	AVERAGE	Pass
LoRa	Hopping Low	614	42.797	3.16	74	31.203	PEAK	Pass
		614	N/A	N/A	54	N/A	AVERAGE	Pass
LoRa	Hopping HIGH	960	49.813	28	74	24.187	PEAK	Pass
		960	N/A	N/A	54	N/A	AVERAGE	Pass

250KHz

Test Mode	Test Channel	Frequency (MHz)	Level (dBuV/m)	Factor (dB)	Limit Line (dBuV/m)	Margin (dB)	Remark	Verdict
LoRa	Low	614	41.483	3.16	74	32.517	PEAK	Pass
		614	N/A	N/A	54	N/A	AVERAGE	Pass
LoRa	HIGH	960	48.625	28	74	25.375	PEAK	Pass
		960	N/A	N/A	54	N/A	AVERAGE	Pass
LoRa	Hopping Low	614	42.326	3.16	74	31.674	PEAK	Pass
		614	N/A	N/A	54	N/A	AVERAGE	Pass
LoRa	Hopping HIGH	960	48.786	28	74	25.214	PEAK	Pass
		960	N/A	N/A	54	N/A	AVERAGE	Pass

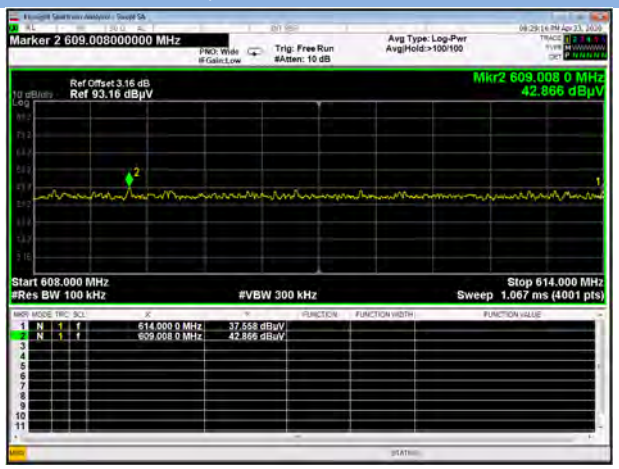
500KHz

Test Mode	Test Channel	Frequency (MHz)	Level (dBuV/m)	Factor (dB)	Limit Line (dBuV/m)	Margin (dB)	Remark	Verdict
LoRa	Low	614	42.556	3.16	74	31.444	PEAK	Pass
		614	N/A	N/A	54	N/A	AVERAGE	Pass
LoRa	HIGH	960	48.071	28	74	25.929	PEAK	Pass
		960	N/A	N/A	54	N/A	AVERAGE	Pass

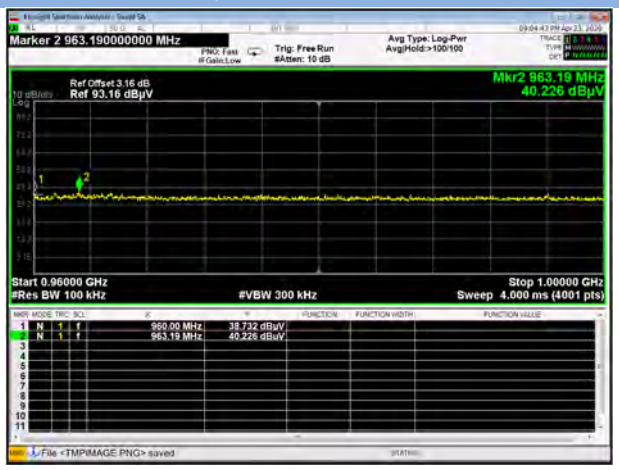
Test Plots

125KHz

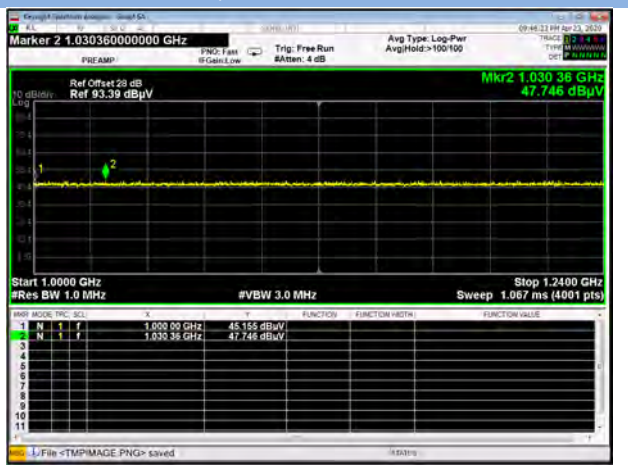
LOW CHANNEL, PEAK



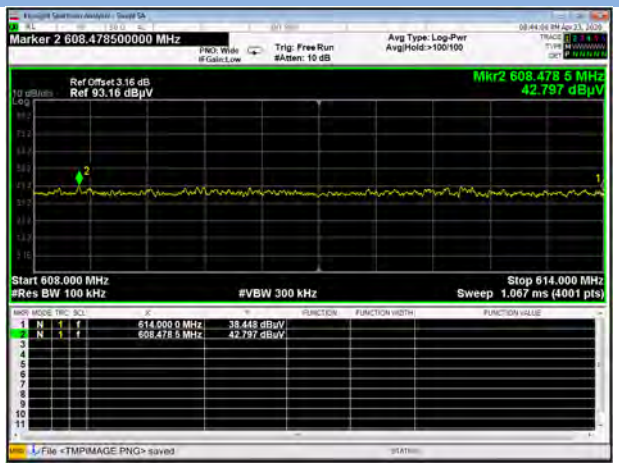
HIGH CHANNEL, PEAK



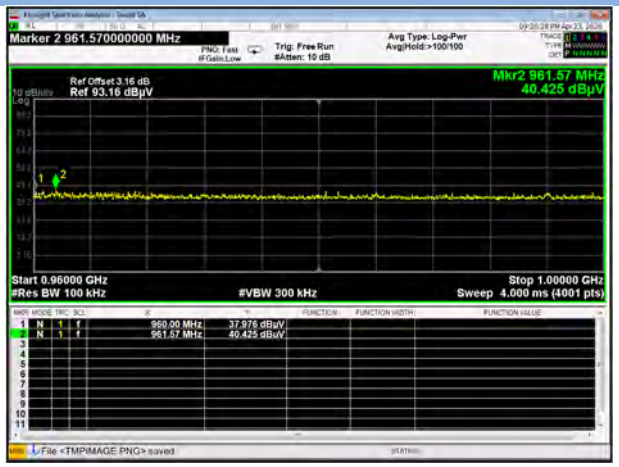
HIGH CHANNEL, AV



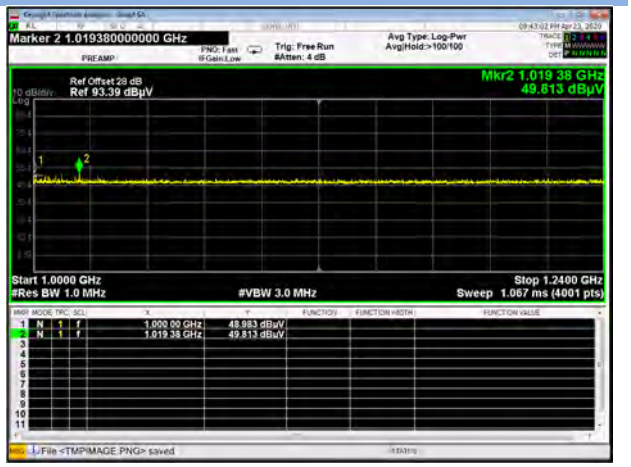
HOPPING LOW CHANNEL, PEAK



HOPPING HIGH CHANNEL, PEAK

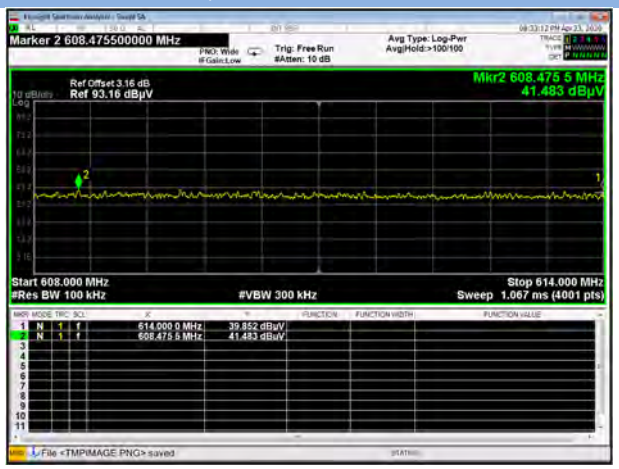


HOPPING HIGH CHANNEL, AV

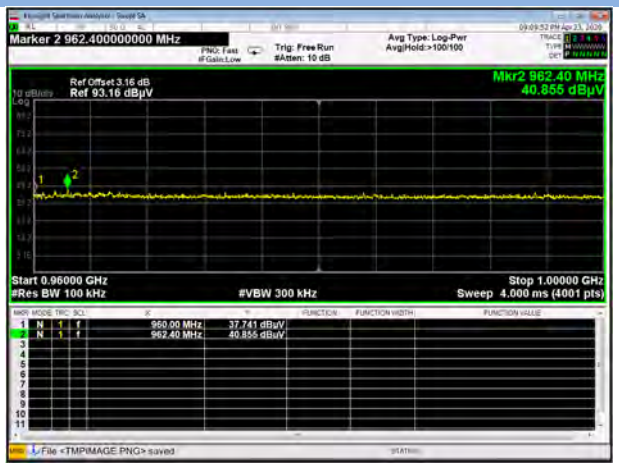


250KHz

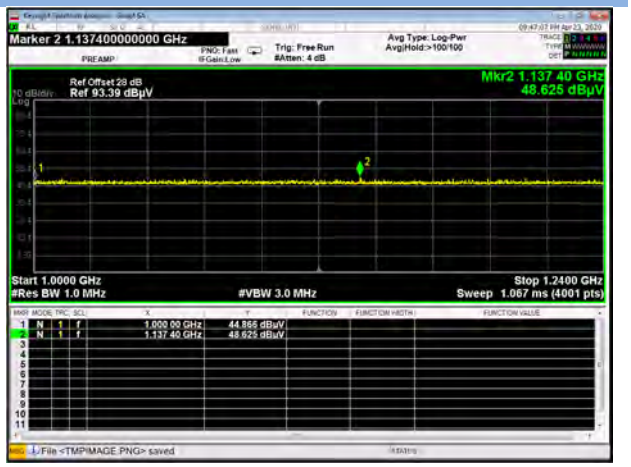
LOW CHANNEL, PEAK



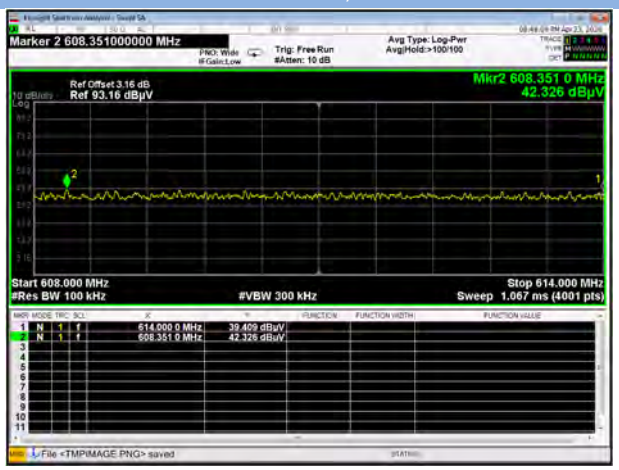
HIGH CHANNEL, PEAK



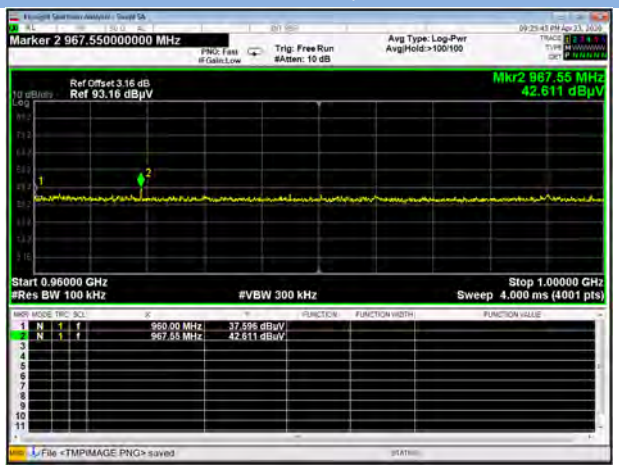
HIGH CHANNEL, AV



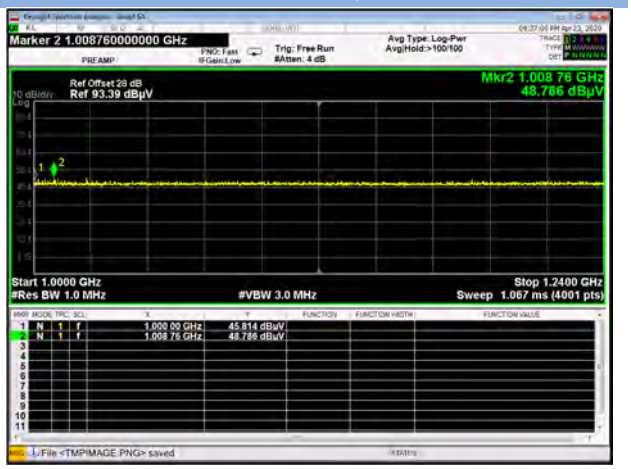
HOPPING LOW CHANNEL, PEAK



HOPPING HIGH CHANNEL, PEAK

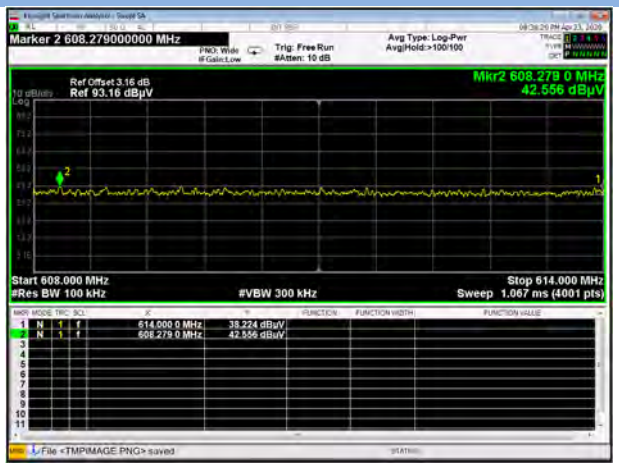


HOPPING HIGH CHANNEL, AV

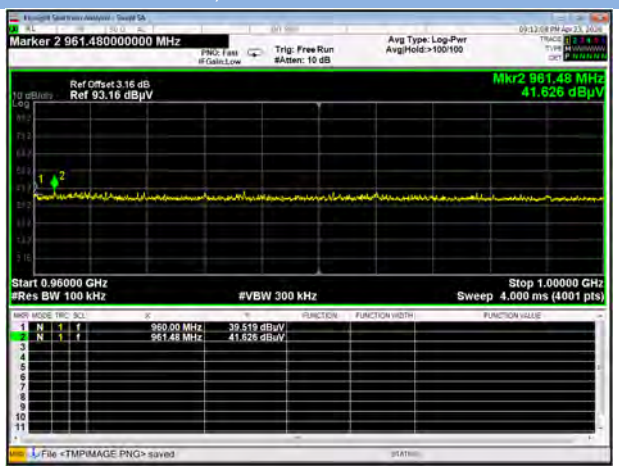


500KHz

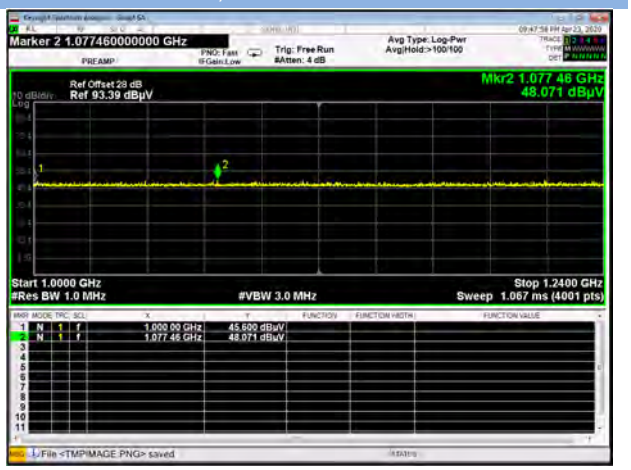
LOW CHANNEL, PEAK



HIGH CHANNEL, PEAK



HIGH CHANNEL, AV



A.9 Power Spectral Density (PSD)

Test Data

500KHz

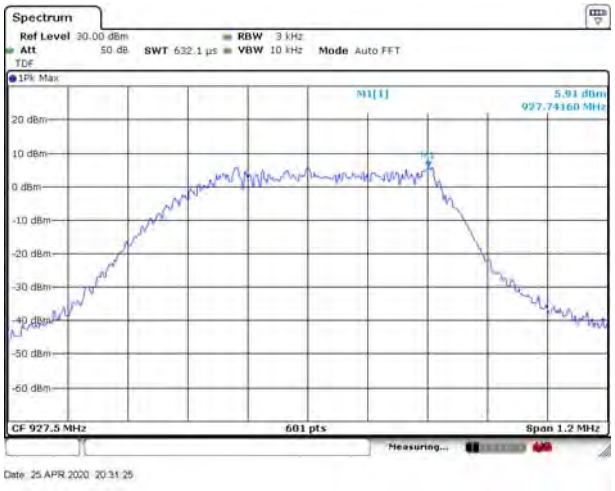
Channel	Spectral power density (dBm/3KHz)	Limit (dBm/3KHz)	Verdict
Low	6.69	8	Pass
Middle	6.64	8	Pass
High	5.91	8	Pass

Test plots

LOW CHANNEL

MIDDLE CHANNEL

HIGH CHANNEL



ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ2030163-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ2030163-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ2030163-AI.PDF”.

--END OF REPORT--