TEST REPORT

Applicant:	Sonoc Corp.
Address:	8F.-3, No.1071, Zhongzheng Rd., Taoyuan Dist., Taiwan
Equipment Type:	LoRaWAN Gateway
Model Name:	SL100 (refer section 2.4)
Brand Name:	SONoC
FCC ID:	2A7JX-SL100
ISED Number:	28690-SL100
Test Standard:	47 CFR Part 15 Subpart C RSS-Gen Issue 5 RSS-247 Issue 2 (refer section 3.1)
Test Date:	Jul. 05, 2022 - Jul. 13, 2022
Date of Issue:	Jul. 22, 2022

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Julie zhu **Checked by:** Ye Hongji **Approved by:** Liao Jianming (Technical Director)

Revision History

Version	Issue Date	Revisions
Rev. 01	Jul. 22, 2022	Initial Issue

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1 GENERAL INFORMATION

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China
Phone Number	+86 755 6685 0100

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A.
Description	All measurement facilities used to collect the measurement data are located at Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Sonoc Corp.
Address	8F.-3, No.1071, Zhongzheng Rd., Taoyuan Dist., Taiwan

2.2 Manufacturer Information

Manufacturer	Sonoc Corp.
Address	8F.-3, No.1071, Zhongzheng Rd., Taoyuan Dist., Taiwan

2.3 Factory Information

Factory	N/A
Address	N/A

2.4 General Description for Equipment under Test (EUT)

EUT Name	LoRaWAN Gateway
Model Name Under Test	SL100
Series Model Name	SL100-US915, SL100-AS923, SL100-AU915
Description of Model name differentiation	Software configuration is different (nothing to do with wireless)
Serial Number	112233445566A21
Hardware Version	v2.0
Software Version	1.0.0
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.5 Technical Information

Network and Wireless connectivity	Bluetooth (BLE) WIFI 802.11b, 802.11g, 802.11n(HT20/40) LoraWAN

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

Modulation Technology	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	8
Tested Channel	1 (923.3 MHz), 5 (925.7 MHz), 8 (927.5 MHz)
Antenna Type	Glue Stick Antenna
Antenna Gain	1.2 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:

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
1	**923.3**	**5**	**925.7**
2	923.9	6	926.3
3	924.5	7	926.9
4	925.1	**8**	**927.5**

2.6 Additional Instructions

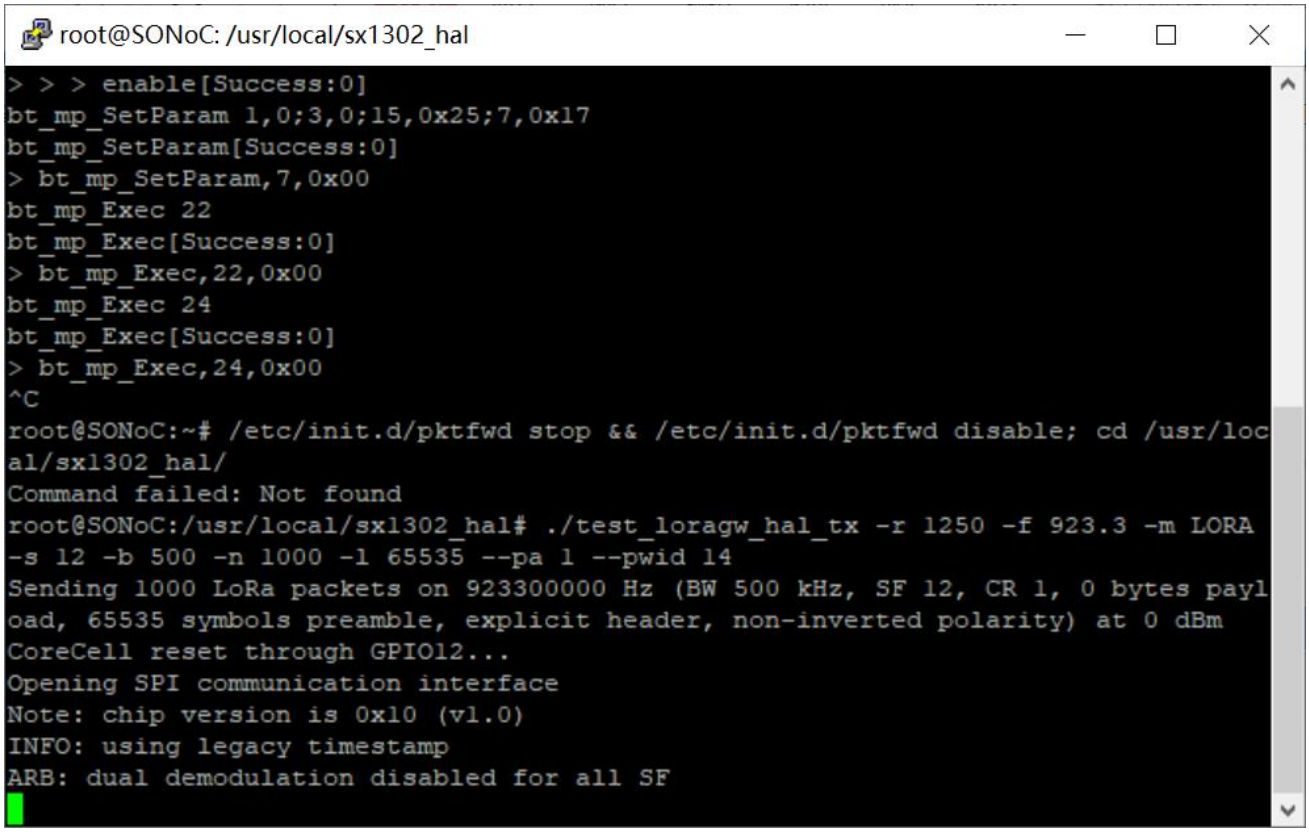
EUT Software Settings:

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	Putty		
Support Units (Software installation media)	Description	Manufacturer	Model
	Notebook	HP	N/A
Mode	Channel	Frequency (MHz)	Soft Set
LoRa	1	923.3	--pa 1 pwid 14
	5	925.7	--pa 1 pwid 14
	8	927.5	--pa 1 pwid 14

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	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	KDB Publication 662911 D01v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc)
4	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
5	RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems(FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
6	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

3.2 Test Verdict

No.	Description	FCC Part No.	ISED Part No.	Channel	Verdict
1	Antenna Requirement	15.203	RSS-247, 5.4 (6)	--	Pass[Note]
2	Output Power	15.247(b)	RSS-247, 5.4 (4)	ANNEX A.1	Pass
3	Occupied Bandwidth	15.247(a)	RSS-GEN, 6.6; RSS-247, 5.2 (1)	ANNEX A.2	Pass
4	Conducted Spurious Emission	15.247(d)	RSS-247, 5.5	ANNEX A.3	Pass
5	Band Edge(Authorized-band band-edge)	15.247(d)	RSS-GEN, 8.9; RSS-247, 5.5	ANNEX A.4	Pass
6	Conducted Emission	15.207	RSS-GEN, 8.8	ANNEX A.5	Pass
7	Radiated Spurious Emission	15.209 15.247(d)	RSS-247, 5.5	ANNEX A.6	Pass
8	Band Edge(Restricted-band band-edge)	15.209 15.247(d)	RSS-247, 5.5	ANNEX A.7	Pass
9	Power spectral density (PSD)	15.247(e)	RSS-247, 5.2 (2)	ANNEX A.8	Pass
Note: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.					

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)	12.0 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-40	101544	2022.01.04	2023.01.03
Spectrum Analyzer	KEYSIGHT	N9020A	MY50330200	2022.05.19	2023.05.18
Signaling Unit	ROHDE&SCHWARZ	CMW500	142028	2022.05.19	2023.05.18
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2021.09.13	2022.09.12
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2021.10.10	2022.10.09
LISN	SCHWARZBECK	NSLK 8127	8127-687	2022.06.01	2023.05.31
Test Antenna-Loop(9 kHz-30 MHz)	SCHWARZBECK	FMZB 1519	1519-037	2021.04.16	2024.04.15
Test Antenna-Bi-Log(30 MHz-3 GHz)	SCHWARZBECK	VULB 9163	9163-624	2021.08.20	2024.08.19
Test Antenna-Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	01917	2022.06.09	2025.06.08
Test Antenna-Horn (18-40 GHz)	A-INFO	LB-180400KF	J211060273	2021.07.02	2024.07.01
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2022.02.19	2024.09.03
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60*7.35m	N/A	2021.08.15	2024.08.14
Shielded Enclosure	ChangNing	CN-130701	130703	--	--

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.

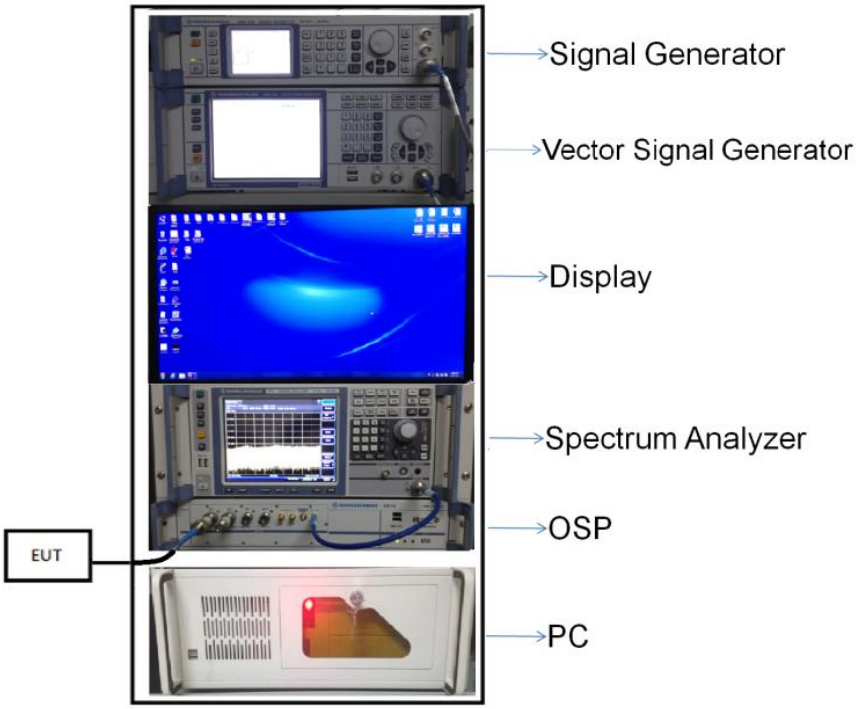
Parameters	Uncertainty
Occupied Channel Bandwidth	2.8%
RF output power, conducted	1.28 dB
Power Spectral Density, conducted	1.30 dB
Unwanted Emissions, conducted	1.84 dB
All emissions, radiated	5.36 dB
Temperature	0.82°C
Humidity	4.1%

4.4 Description of Test Setup

4.4.1 For Antenna Port Test

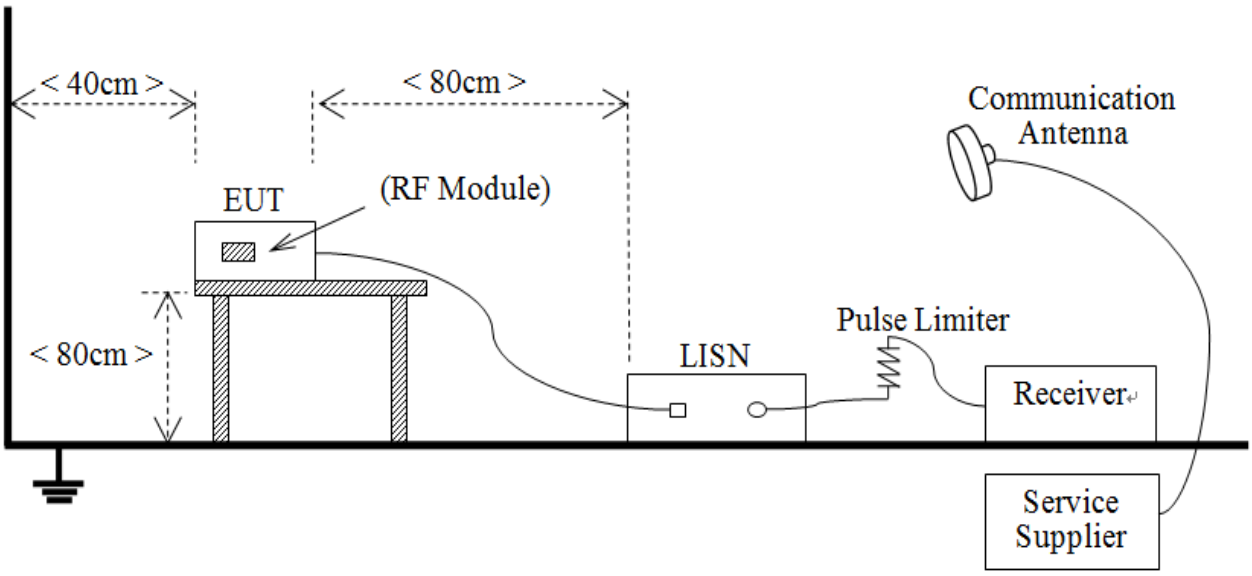
Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

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



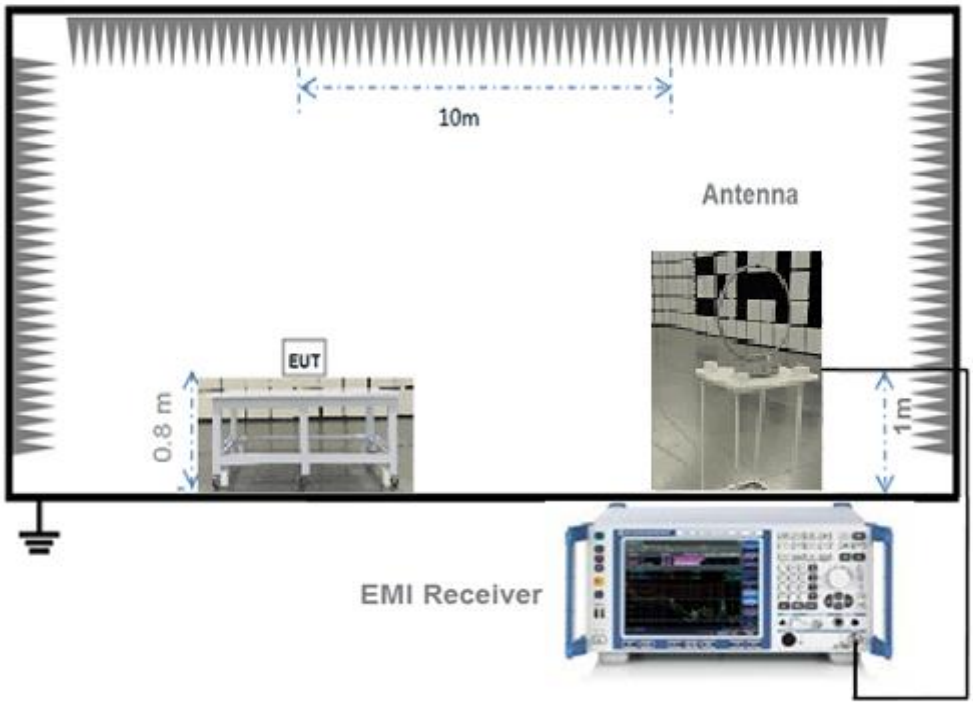
(Diagram 1)

4.4.2 For AC Power Supply Port Test



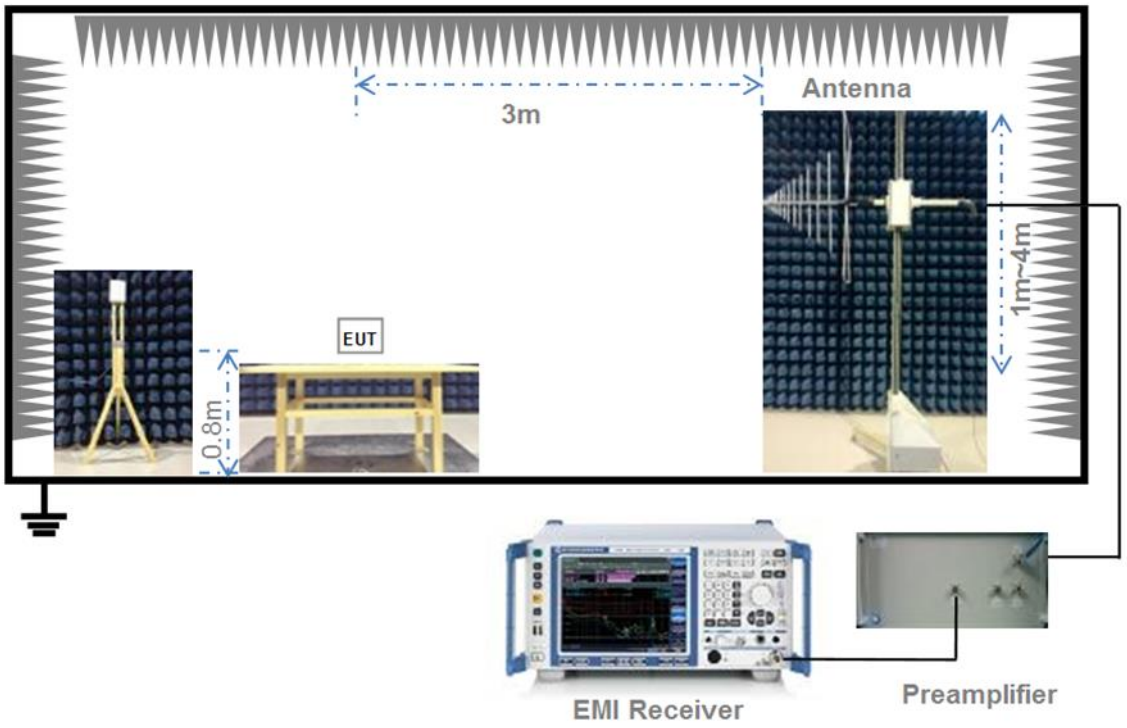
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



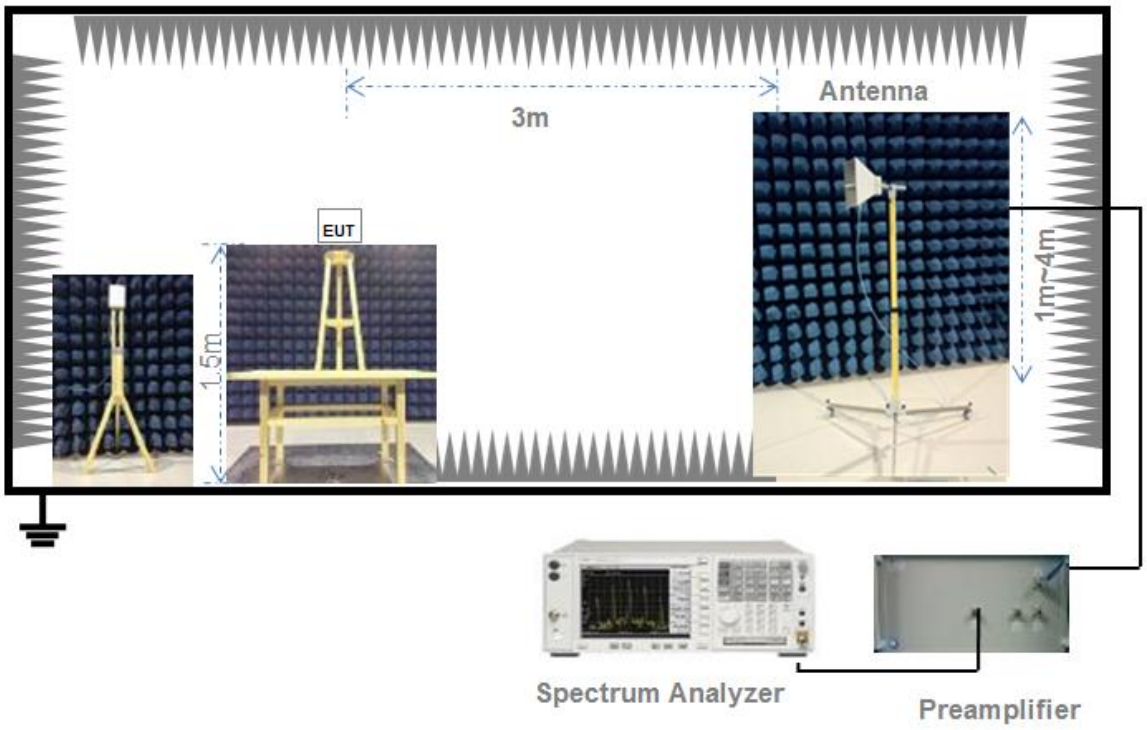
(Diagram 3)

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.

4.5.2 For radiated band edges and spurious emission test:

E = EIRP – 20log D + 104.8

where:

E = electric field strength in dBμV/m,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

EIRP= Measure Conducted output power Value (dBm) + Maximum transmit antenna gain (dBi) + the appropriate maximum ground reflection factor (dB)

5 TEST ITEMS

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.	An embedded-in antenna design is used.

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 Output Power

5.2.1 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.

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

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.)

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Occupied Bandwidth

5.3.1 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.

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:

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.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Conducted Spurious Emission

5.4.1 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.

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 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.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Band Edge (Authorized-band band-edge)

5.5.1 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.

5.5.2 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 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.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Conducted Emission

5.6.1 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

5.6.2 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.

5.6.3 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.

5.6.4 Test Result

Please refer to ANNEX A.5.

5.7 Radiated Spurious Emission

5.7.1 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).

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:

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).

5.7.2 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.

5.7.3 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.

5.7.4 Test Result

Please refer to ANNEX A.6.

5.8 Band Edge (Restricted-band band-edge)

5.8.1 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).

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.

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

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Power Spectral density (PSD)

5.9.1 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).

5.9.2 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.

5.9.3 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.

5.9.4 Test Result

Please refer to ANNEX A.8.

ANNEX A TEST RESULT

A.1 Output Power

Peak Power Test Data

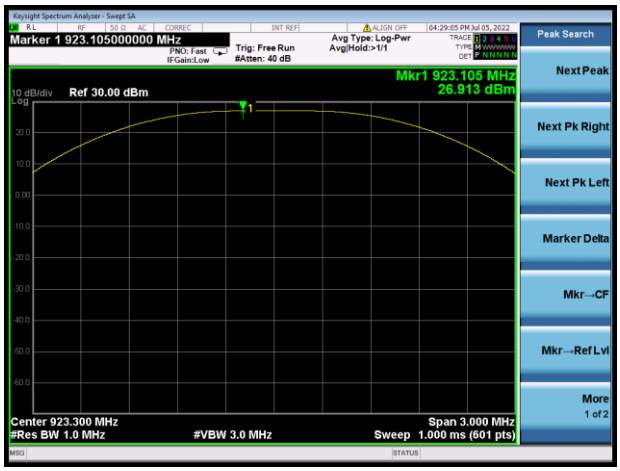
Channel	Measured Output Peak Power		Limit		Verdict
	LoRa		dBm	mW	
	dBm	mW			
Low	26.91	491.25	30	1000	Pass
Middle	26.98	498.43			Pass
High	26.93	493.06			Pass

E.I.R.P Test Data (For ISED)

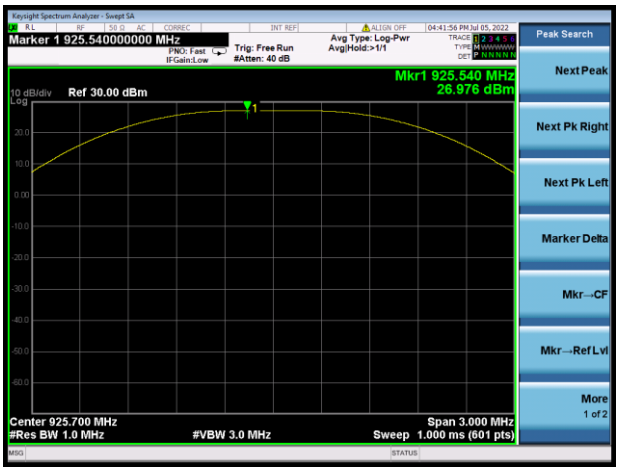
Channel	Measured Output Peak Power		Limit		Verdict
	LoRa		dBm	mW	
	dBm	mW			
Low	28.11	647.59	36	4000	Pass
Middle	28.18	657.05			Pass
High	28.13	649.98			Pass

Test Plots

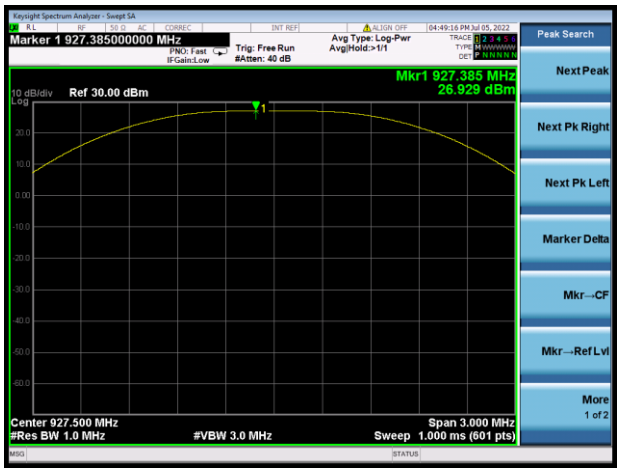
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



A.2 Occupied Bandwidth

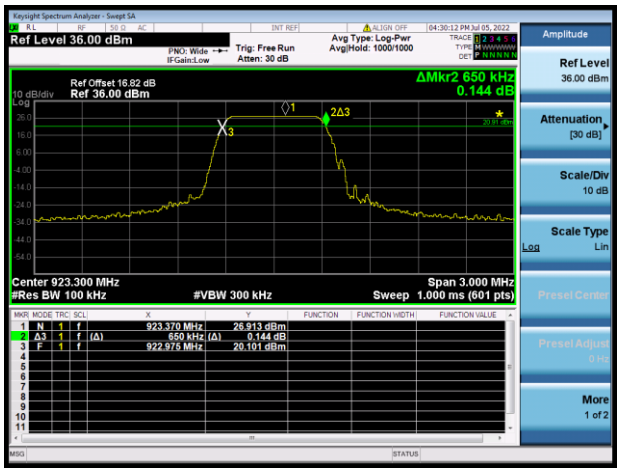
Test Data

Test Mode	LoRa		
Channel	6 dB Bandwidth (kHz)	99% Bandwidth (kHz)	6 dB Bandwidth Limits (kHz)
Low Channel	650.000000	504.410000	≥500
Middle Channel	650.000000	504.020000	≥500
High Channel	650.000000	503.620000	≥500

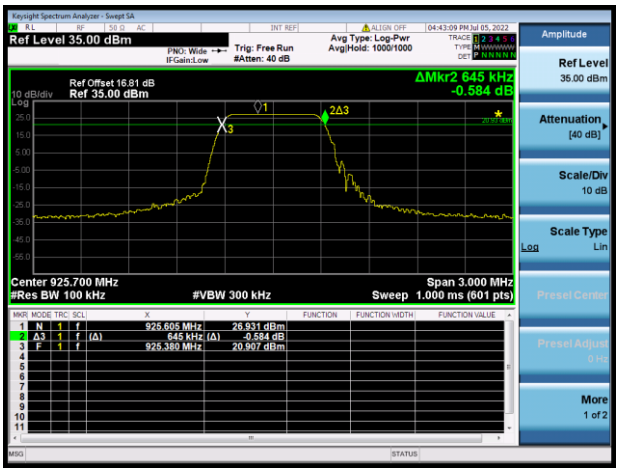
Test Plots

6 dB Bandwidth

LOW CHANNEL



MIDDLE CHANNEL



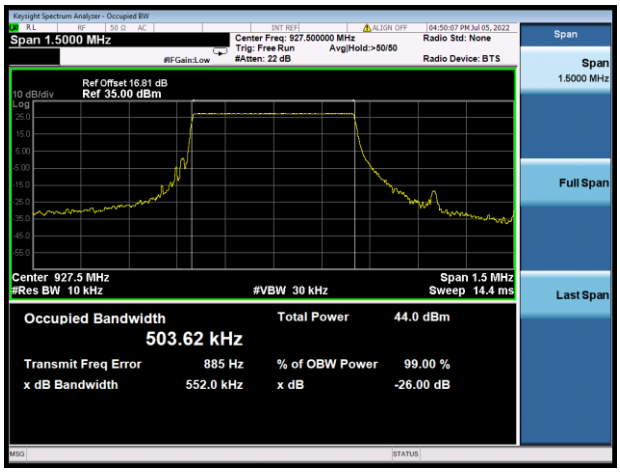
HIGH CHANNEL

99% Bandwidth

LOW CHANNEL

MIDDLE CHANNEL

HIGH CHANNEL



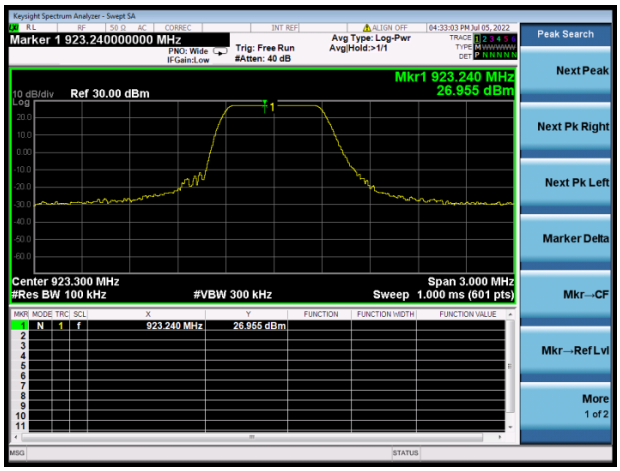
A.3 Conducted Spurious Emissions

Test Data

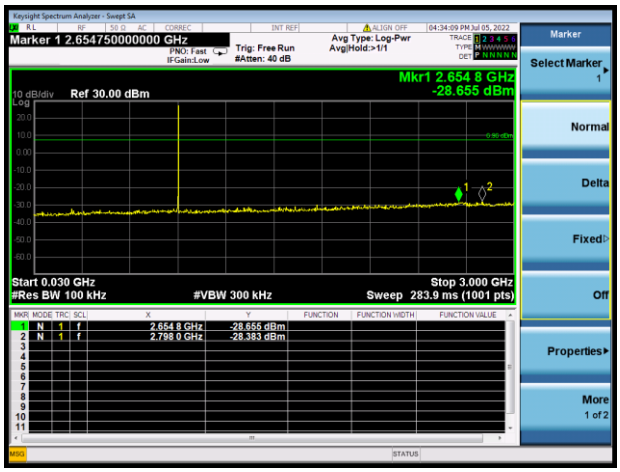
LoRa				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-17.02	26.96	6.96	Pass
Middle	-17.92	26.95	6.95	Pass
High	-17.35	26.95	6.95	Pass

Test Plots

LOW CHANNEL, CARRIER LEVEL

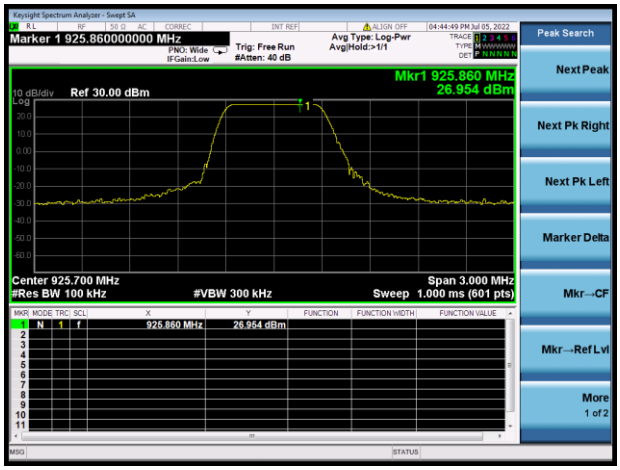


LOW CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

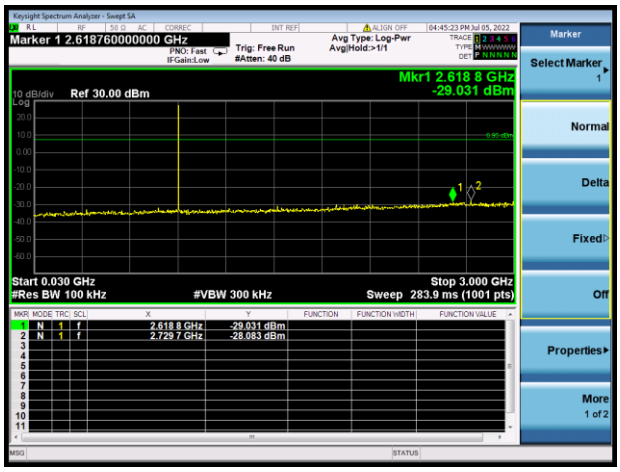


LOW CHANNEL, SPURIOUS 2 GHz ~ 25 GHz

MIDDLE CHANNEL, CARRIER LEVEL

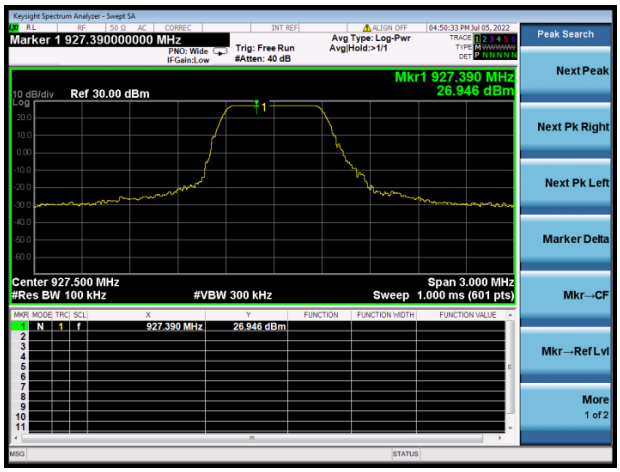


MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

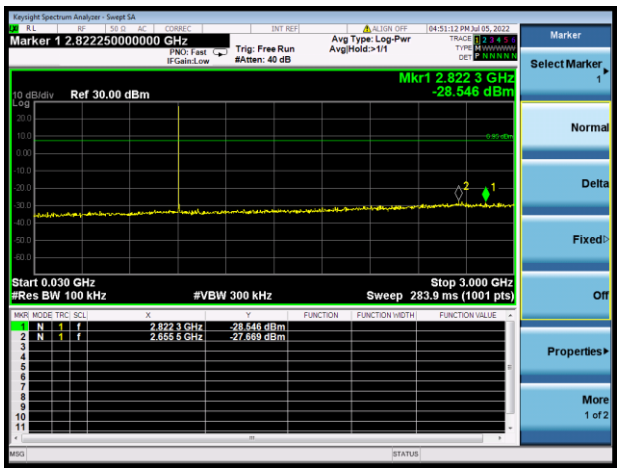


MIDDLE CHANNEL, SPURIOUS 2 GHz ~ 25 GHz

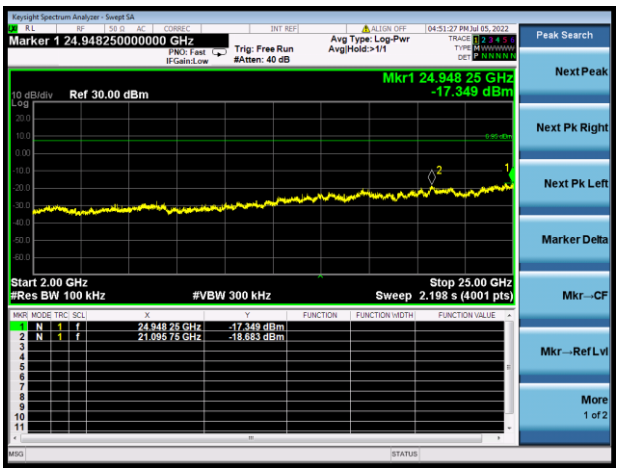
HIGH CHANNEL, CARRIER LEVEL



HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



HIGH CHANNEL, SPURIOUS 2 GHz ~ 25 GHz



A.4 Band Edge (Authorized-band band-edge)

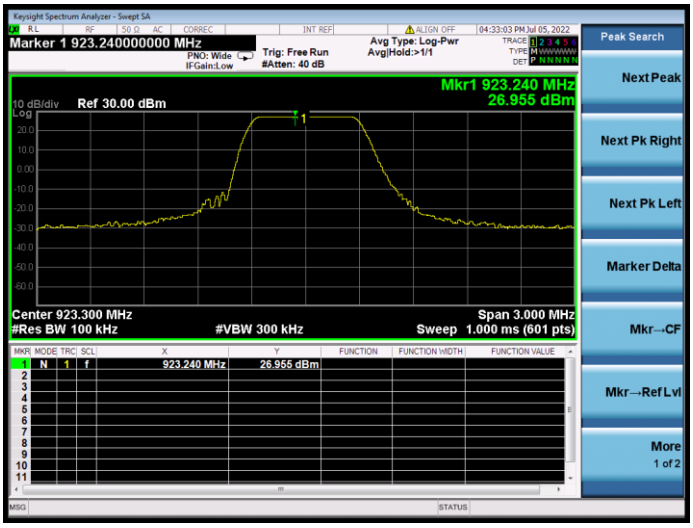
Note: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Test Data

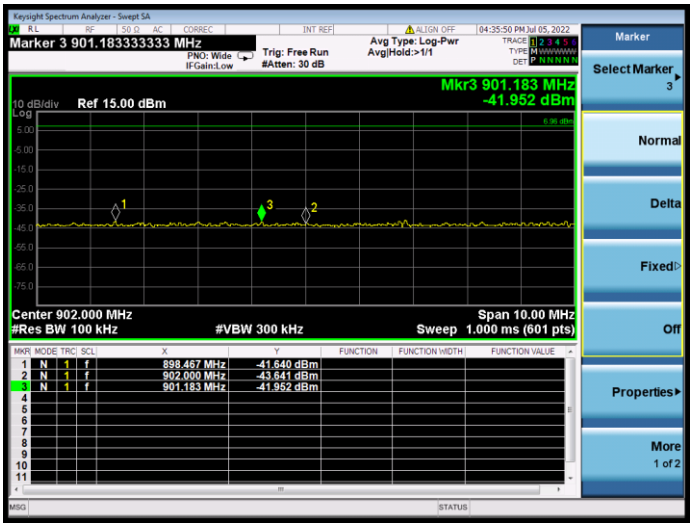
LoRa				
Channel	Measured Max. Band Edge Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-41.54	26.96	6.96	Pass
High Channel	-15.84	26.95	6.95	Pass

Test Plots

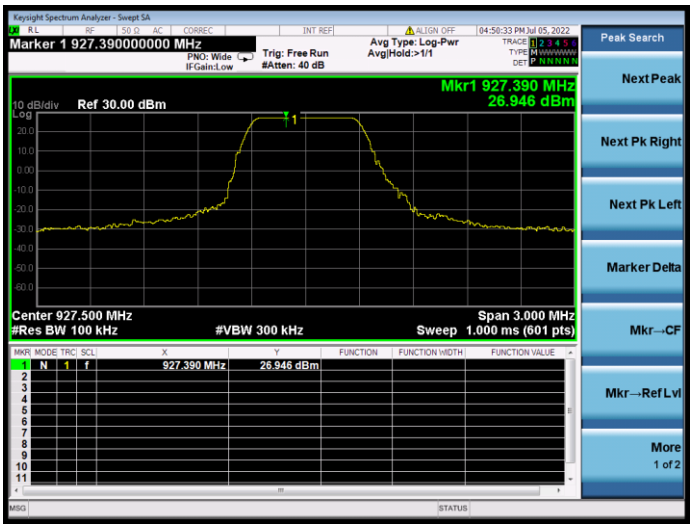
LOW CHANNEL, CARRIER LEVEL



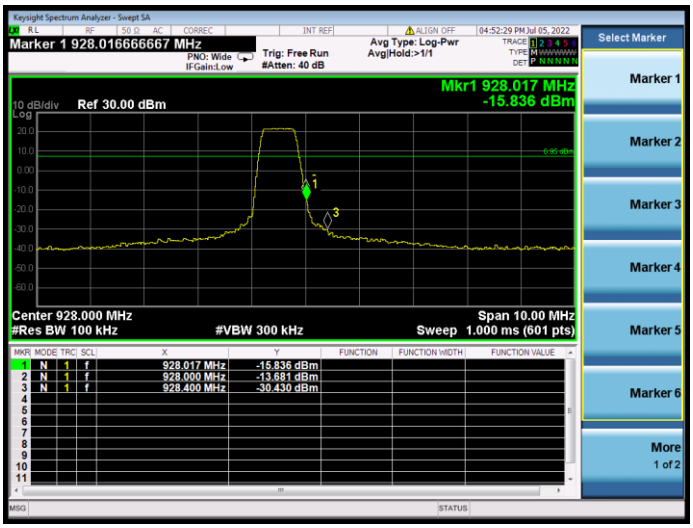
LOW CHANNEL, BAND EDGE



HIGH CHANNEL, CARRIER LEVEL



HIGH CHANNEL, BAND EDGE

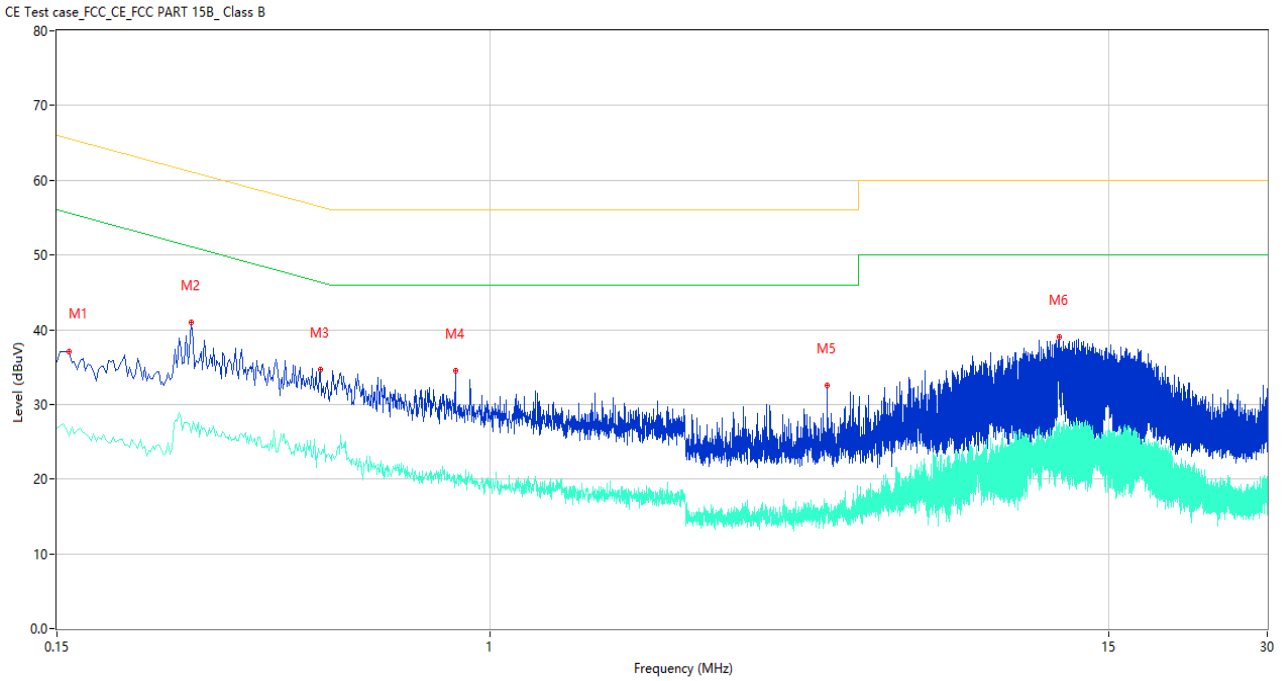


A.5 Conducted Emissions

Note [1]: The EUT is working in the Normal link mode.
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)

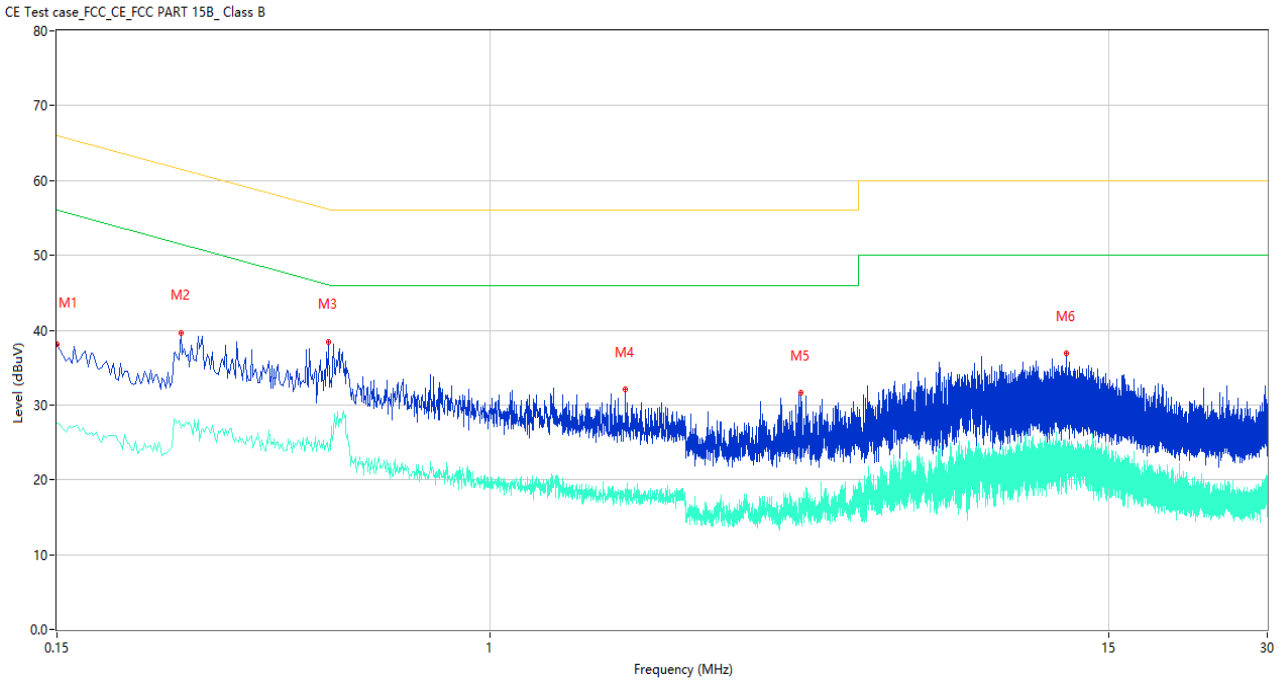
Test Data and Plots

PHASE L



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.158	37.13	10.18	65.57	-28.44	Peak	L	Pass
1**	0.158	25.81	10.18	55.57	-29.76	AV	L	Pass
2	0.270	40.99	10.08	61.12	-20.13	Peak	L	Pass
2**	0.270	26.20	10.08	51.12	-24.92	AV	L	Pass
3	0.476	34.64	10.11	56.41	-21.77	Peak	L	Pass
3**	0.476	23.37	10.11	46.41	-23.04	AV	L	Pass
4	0.858	34.46	10.05	56.00	-21.54	Peak	L	Pass
4**	0.858	19.80	10.05	46.00	-26.20	AV	L	Pass
5	4.372	32.55	10.03	56.00	-23.45	Peak	L	Pass
5**	4.372	16.17	10.03	46.00	-29.83	AV	L	Pass
6	12.062	39.05	10.12	60.00	-20.95	Peak	L	Pass
6**	12.062	27.57	10.12	50.00	-22.43	AV	L	Pass

PHASE N



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.150	38.18	10.19	66.00	-27.82	Peak	N	Pass
1**	0.150	27.62	10.19	56.00	-28.38	AV	N	Pass
2	0.258	39.67	10.08	61.50	-21.83	Peak	N	Pass
2**	0.258	26.96	10.08	51.50	-24.54	AV	N	Pass
3	0.492	38.49	10.11	56.13	-17.64	Peak	N	Pass
3**	0.492	23.80	10.11	46.13	-22.33	AV	N	Pass
4	1.806	32.02	9.89	56.00	-23.98	Peak	N	Pass
4**	1.806	18.87	9.89	46.00	-27.13	AV	N	Pass
5	3.890	31.61	10.09	56.00	-24.39	Peak	N	Pass
5**	3.890	16.81	10.09	46.00	-29.19	AV	N	Pass
6	12.450	36.91	10.11	60.00	-23.09	Peak	N	Pass
6**	12.450	23.07	10.11	50.00	-26.93	AV	N	Pass

A.6 Radiated Spurious Emission

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

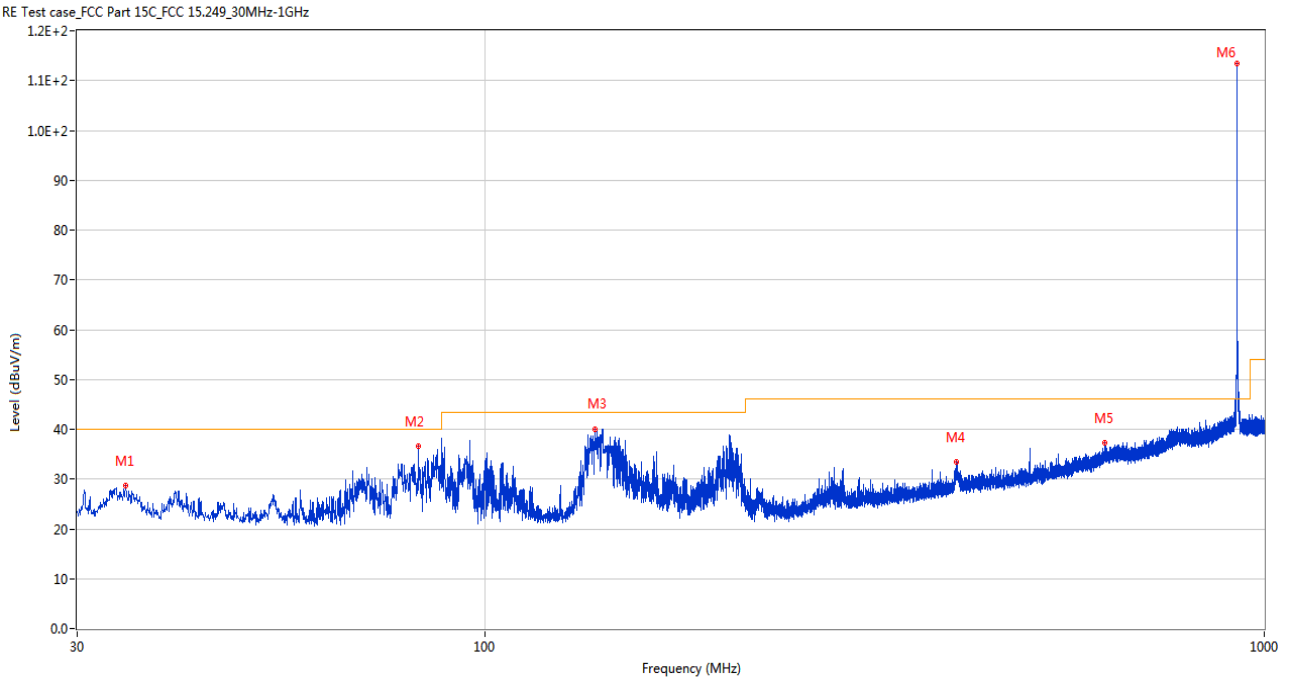
Note [2]: For the test data above 1 GHz, according the ANSI C63.4-2014, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

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 900 MHz with circle should be ignored because they are Fundamental signal.

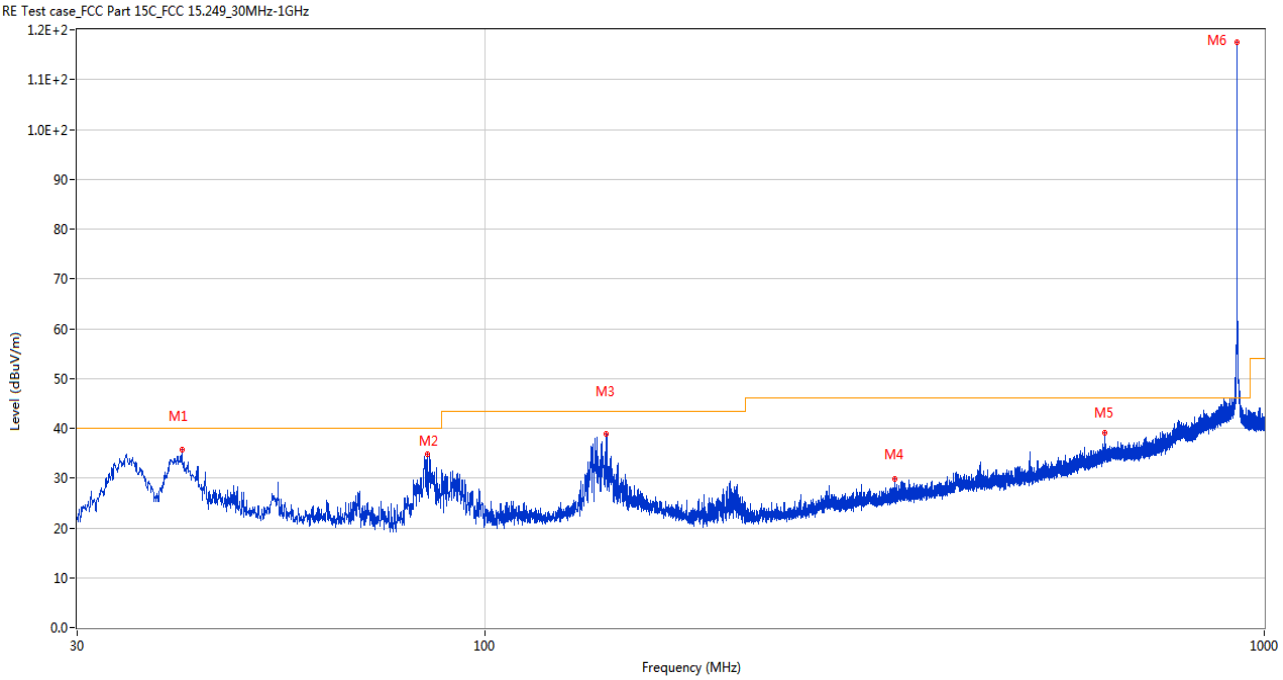
Test Data and Plots

LOW CHANNEL, 30 MHz to 1 GHz, ANT H



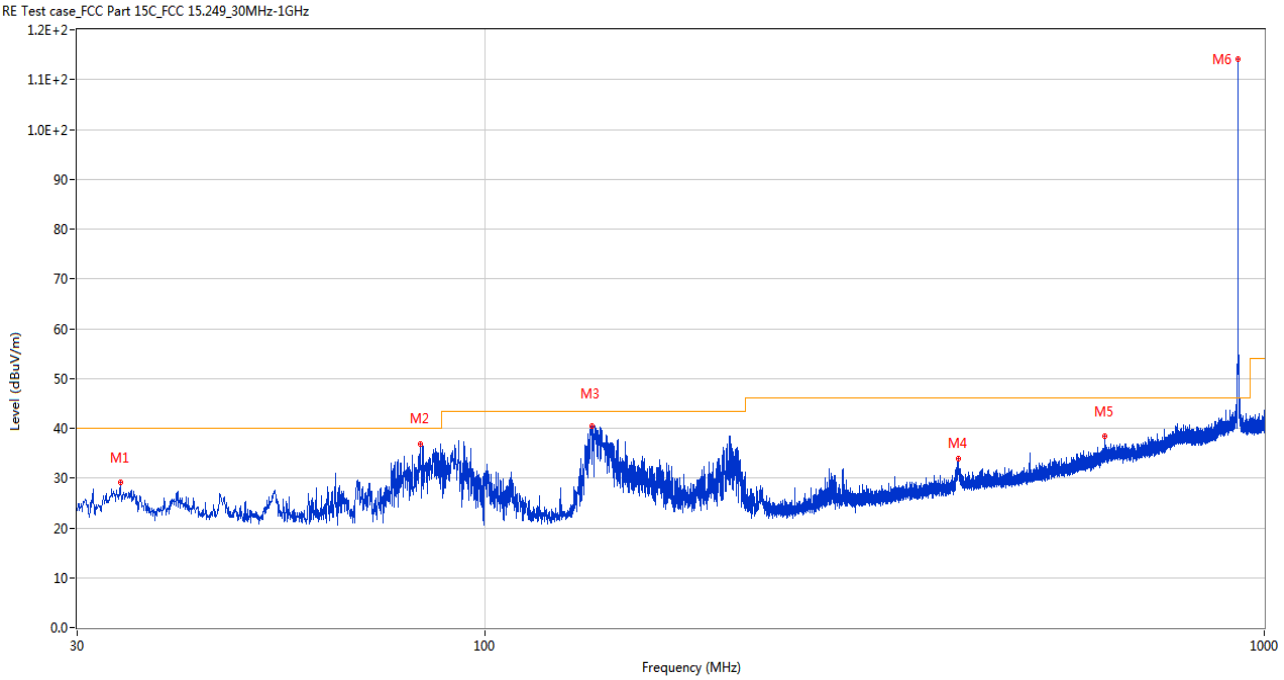
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	34.608	28.62	-14.62	40.0	-11.38	Peak	40.00	200	Horizontal	Pass
2	82.186	36.58	-17.82	40.0	-3.42	Peak	32.00	200	Horizontal	Pass
3	138.446	40.00	-13.13	43.5	-3.50	Peak	212.00	200	Horizontal	Pass
4	402.771	33.42	-8.94	46.0	-12.58	Peak	269.00	100	Horizontal	Pass
5	625.047	37.36	-1.53	46.0	-8.64	Peak	237.00	200	Horizontal	Pass
6	923.370	113.44	4.30	46.0	67.44	Peak	77.00	100	Horizontal	N/A

LOW CHANNEL, 30 MHz to 1 GHz, ANT V



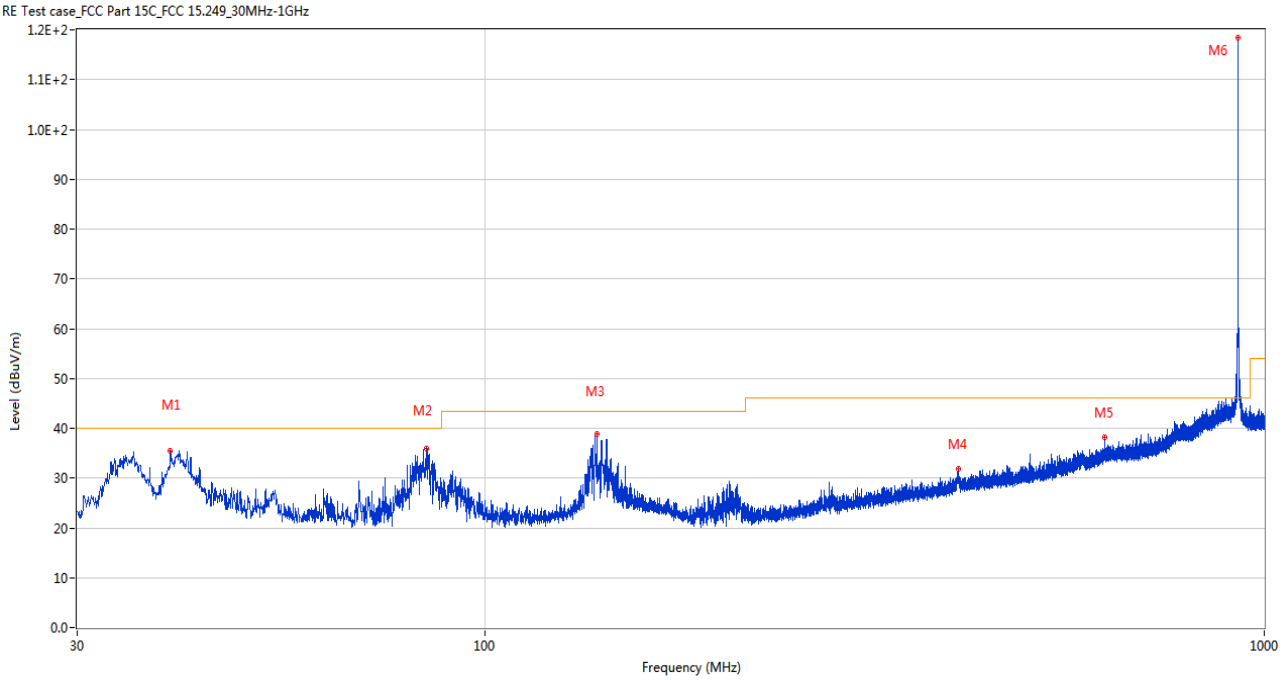
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	40.864	35.63	-13.79	40.0	-4.37	Peak	20.00	100	Vertical	Pass
2	84.417	34.70	-17.80	40.0	-5.30	Peak	131.00	200	Vertical	Pass
3	143.296	38.83	-12.70	43.5	-4.67	Peak	142.00	200	Vertical	Pass
4	336.035	29.86	-10.63	46.0	-16.14	Peak	136.00	100	Vertical	Pass
5	624.998	39.12	-1.53	46.0	-6.88	Peak	242.00	100	Vertical	Pass
6	923.079	117.41	4.30	46.0	71.41	Peak	291.00	100	Vertical	N/A

MIDDLE CHANNEL, 30 MHz to 1 GHz, ANT H



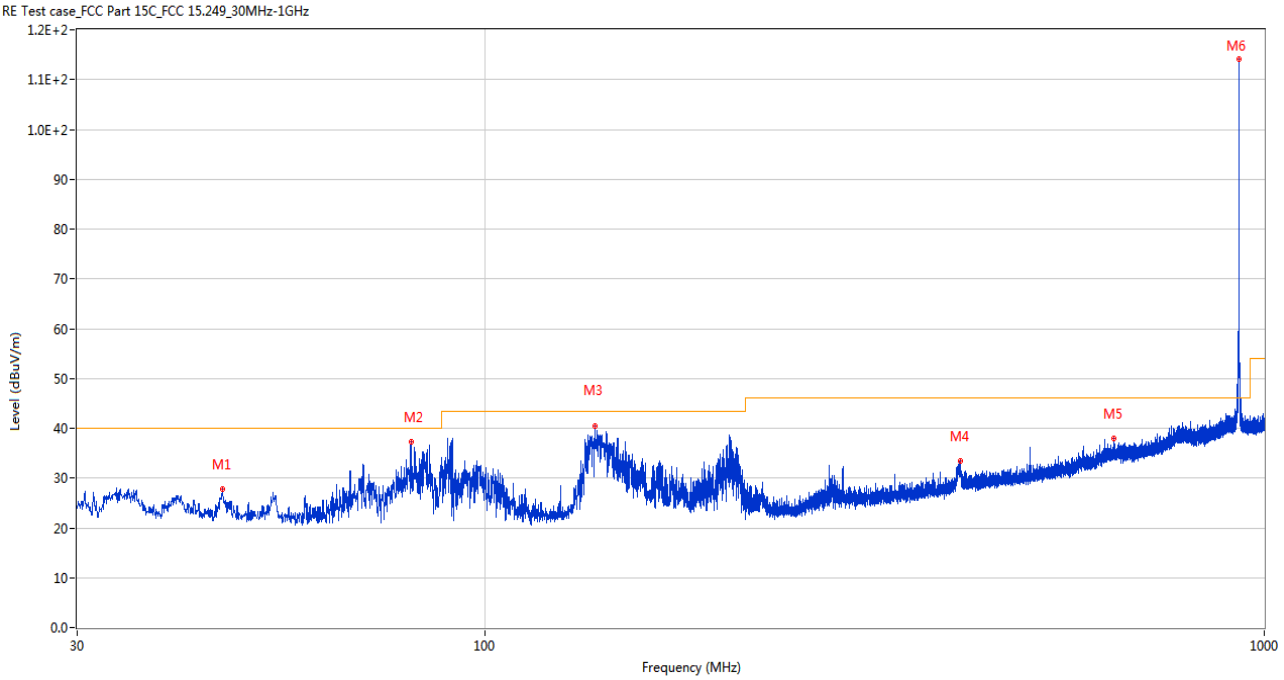
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	34.074	29.06	-14.65	40.0	-10.94	Peak	119.00	100	Horizontal	Pass
2	82.671	36.94	-17.80	40.0	-3.06	Peak	227.00	200	Horizontal	Pass
3	137.088	40.45	-13.30	43.5	-3.05	Peak	212.00	200	Horizontal	Pass
4	405.099	33.80	-8.90	46.0	-12.20	Peak	292.00	100	Horizontal	Pass
5	624.998	38.38	-1.53	46.0	-7.62	Peak	253.00	100	Horizontal	Pass
6	925.601	114.06	4.23	46.0	68.06	Peak	78.00	100	Horizontal	N/A

MIDDLE CHANNEL, 30 MHz to 1 GHz, ANT V



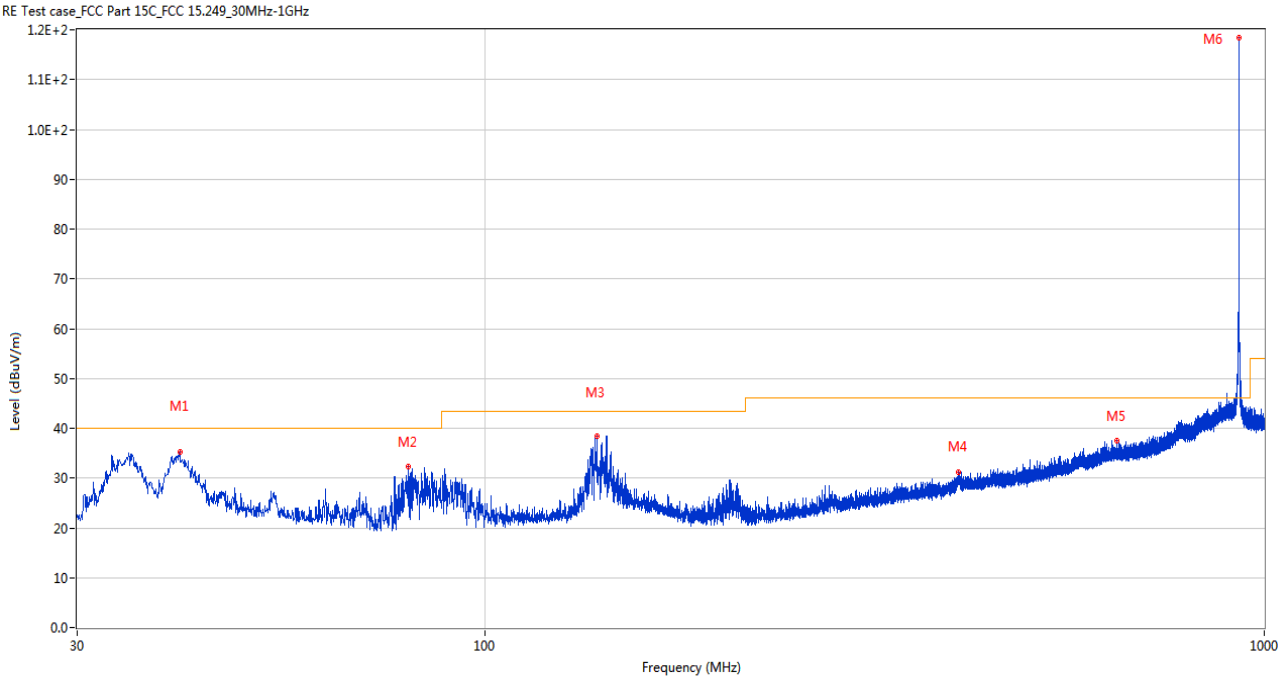
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	39.506	35.56	-13.82	40.0	-4.44	Peak	168.00	100	Vertical	Pass
2	84.271	35.83	-17.80	40.0	-4.17	Peak	137.00	200	Vertical	Pass
3	139.270	38.87	-13.06	43.5	-4.63	Peak	145.00	200	Vertical	Pass
4	405.050	31.76	-8.89	46.0	-14.24	Peak	188.00	100	Vertical	Pass
5	624.998	38.19	-1.53	46.0	-7.81	Peak	52.00	100	Vertical	Pass
6	925.504	118.33	4.24	46.0	72.33	Peak	247.00	100	Vertical	N/A

HIGH CHANNEL, 30 MHz to 1 GHz, ANT H



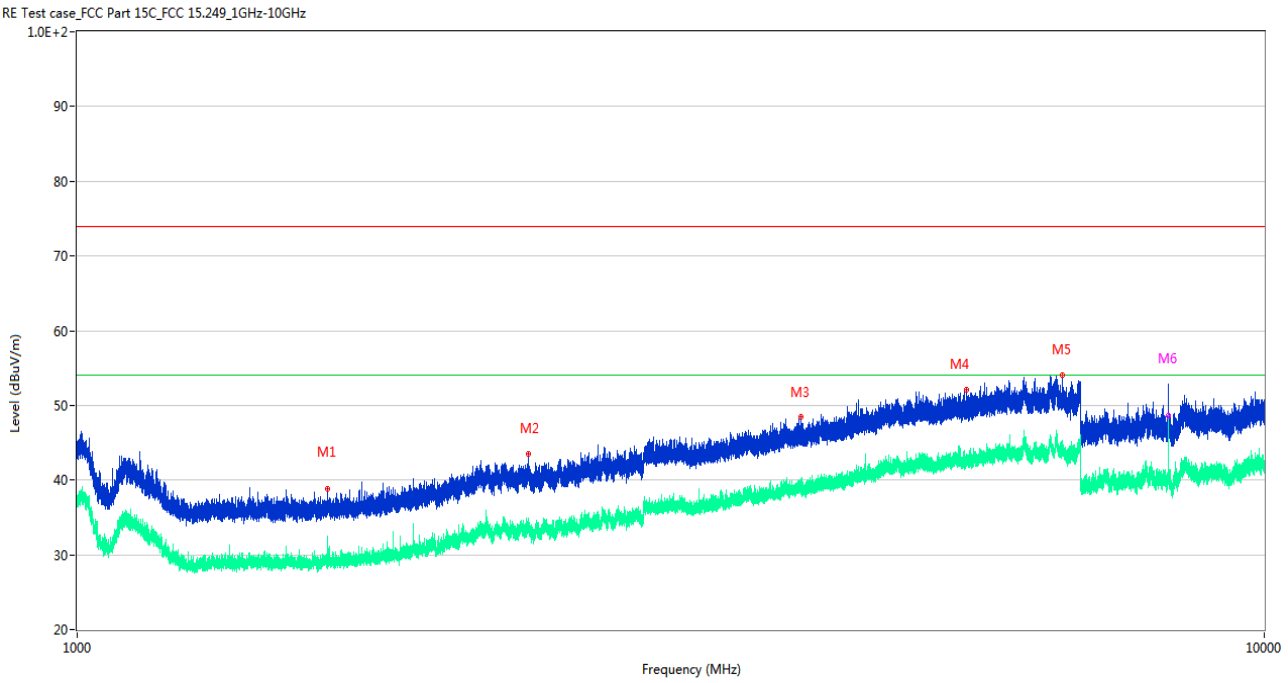
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	46.053	27.77	-14.06	40.0	-12.23	Peak	176.00	200	Horizontal	Pass
2	80.392	37.00	-17.85	40.0	-3.00	Peak	212.00	200	Horizontal	Pass
3	138.446	40.46	-13.13	43.5	-3.04	Peak	217.00	200	Horizontal	Pass
4	407.378	33.39	-8.89	46.0	-12.61	Peak	269.00	100	Horizontal	Pass
5	641.682	37.88	-1.37	46.0	-8.12	Peak	125.00	200	Horizontal	Pass
6	927.735	114.05	4.24	46.0	68.05	Peak	79.00	100	Horizontal	N/A

HIGH CHANNEL, 30 MHz to 1 GHz, ANT V



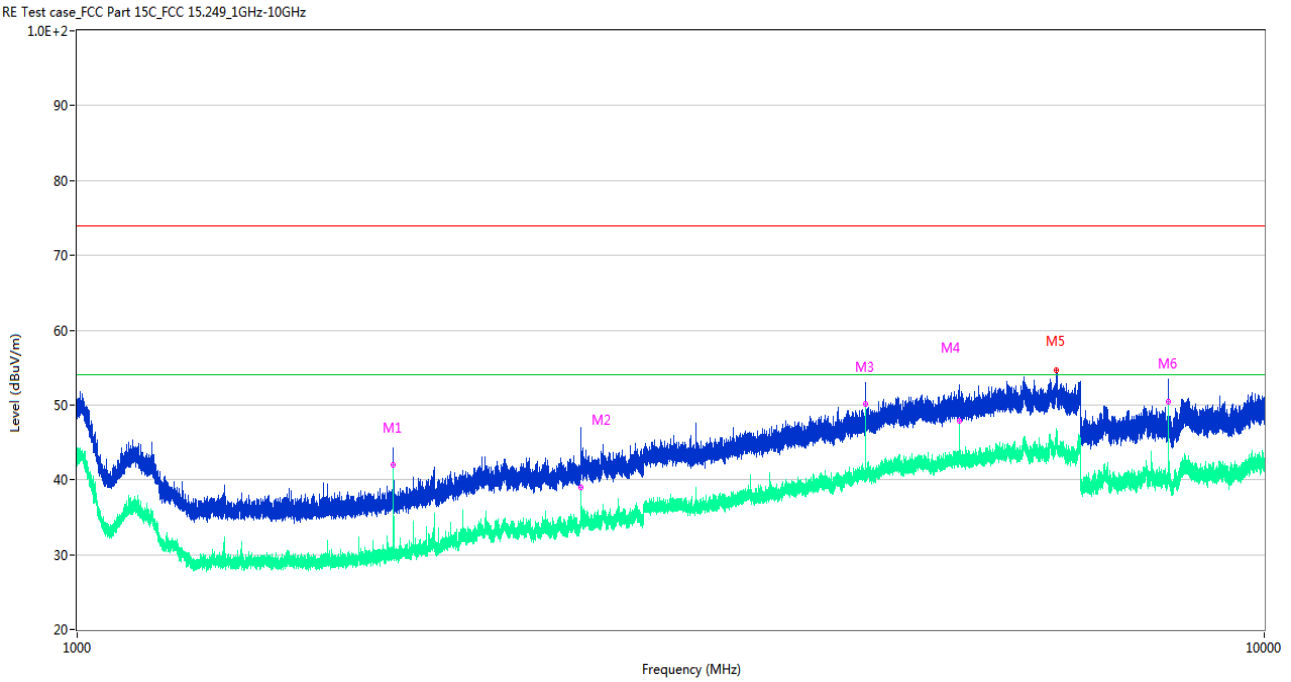
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	40.621	35.34	-13.78	40.0	-4.66	Peak	217.00	100	Vertical	Pass
2	79.810	32.29	-17.83	40.0	-7.71	Peak	119.00	100	Vertical	Pass
3	139.270	38.53	-13.06	43.5	-4.97	Peak	147.00	200	Vertical	Pass
4	405.584	31.29	-8.93	46.0	-14.71	Peak	51.00	200	Vertical	Pass
5	647.502	37.54	-1.45	46.0	-8.46	Peak	320.00	100	Vertical	Pass
6	927.638	118.32	4.23	46.0	72.32	Peak	246.00	100	Vertical	N/A

LOW CHANNEL 1 GHz to 12.75 GHz, ANT H



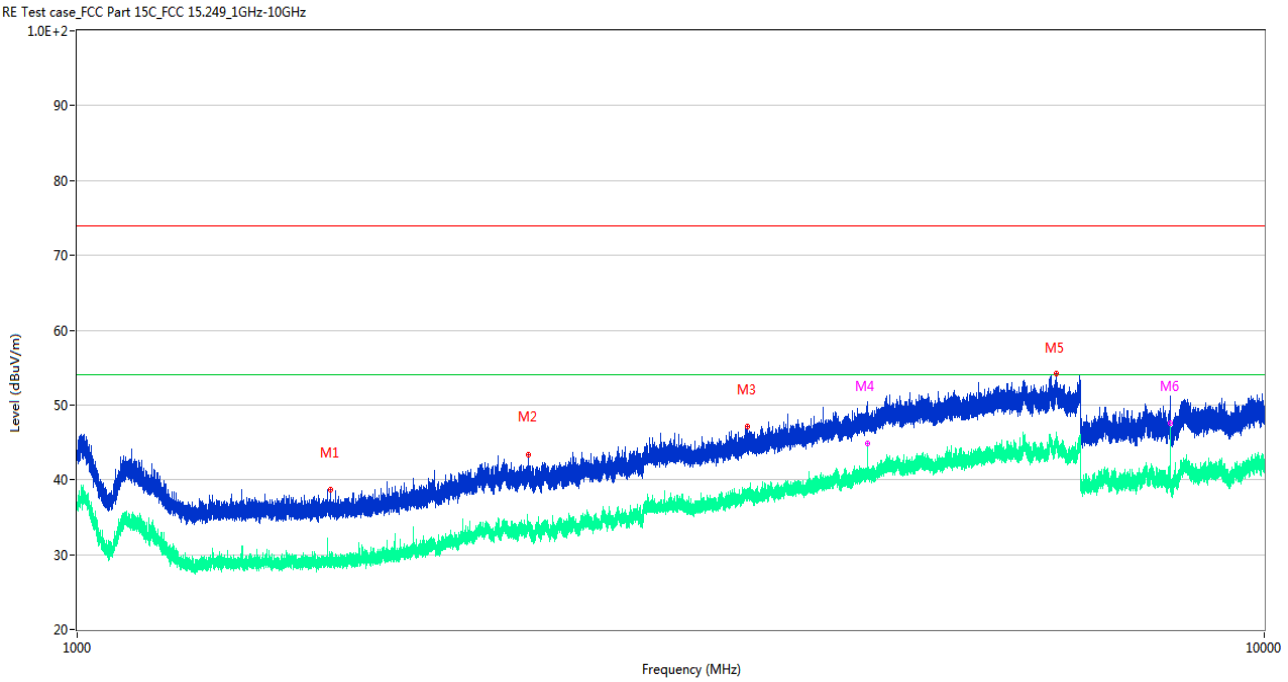
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1624.300	38.81	-17.72	74.0	-35.19	Peak	6.00	400	Horizontal	Pass
1**	1624.300	29.37	-17.72	54.0	-24.63	AV	6.00	400	Horizontal	Pass
2	2398.000	43.47	-12.31	74.0	-30.53	Peak	95.00	300	Horizontal	Pass
2**	2398.000	33.77	-12.31	54.0	-20.23	AV	95.00	300	Horizontal	Pass
3	4067.800	48.41	-5.49	74.0	-25.59	Peak	154.00	200	Horizontal	Pass
3**	4067.800	38.04	-5.49	54.0	-15.96	AV	154.00	200	Horizontal	Pass
4	5617.200	52.12	-2.62	74.0	-21.88	Peak	185.00	200	Horizontal	Pass
4**	5617.200	42.26	-2.62	54.0	-11.74	AV	185.00	200	Horizontal	Pass
5	6762.800	54.10	-1.19	74.0	-19.90	Peak	292.00	200	Horizontal	Pass
5**	6762.800	44.75	-1.19	54.0	-9.25	AV	292.00	200	Horizontal	Pass
6	8309.800	51.86	-1.63	74.0	-22.14	Peak	317.00	200	Horizontal	Pass
6**	8309.800	48.65	-1.63	54.0	-5.35	AV	317.00	200	Horizontal	Pass

LOW CHANNEL 1 GHz to 12.75 GHz, ANT V



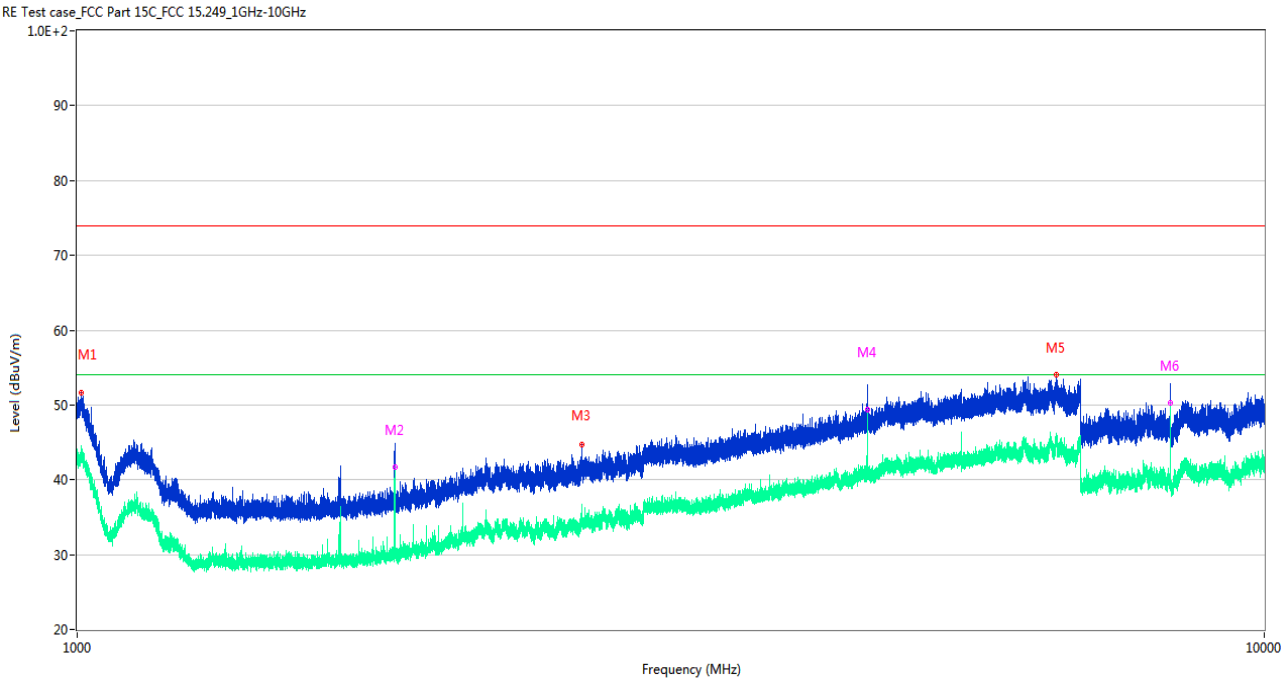
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1846.800	43.71	-16.78	74.0	-30.29	Peak	8.00	200	Vertical	Pass
1**	1846.800	42.02	-16.78	54.0	-11.98	AV	8.00	200	Vertical	Pass
2	2654.700	41.34	-11.43	74.0	-32.66	Peak	353.00	300	Vertical	Pass
2**	2654.700	39.05	-11.43	54.0	-14.95	AV	353.00	300	Vertical	Pass
3	4616.800	51.47	-4.14	74.0	-22.53	Peak	165.00	150	Vertical	Pass
3**	4616.800	50.07	-4.14	54.0	-3.93	AV	165.00	150	Vertical	Pass
4	5540.200	52.75	-2.01	74.0	-21.25	Peak	333.00	300	Vertical	Pass
4**	5540.200	47.88	-2.01	54.0	-6.12	AV	333.00	300	Vertical	Pass
5	6680.200	54.62	-0.53	74.0	-19.38	Peak	353.00	300	Vertical	Pass
5**	6680.200	45.16	-0.53	54.0	-8.84	AV	353.00	300	Vertical	Pass
6	8309.950	52.99	-1.60	74.0	-21.01	Peak	43.00	400	Vertical	Pass
6**	8309.950	50.49	-1.60	54.0	-3.51	AV	43.00	400	Vertical	Pass

MIDDLE CHANNEL 1 GHz to 12.75 GHz, ANT H



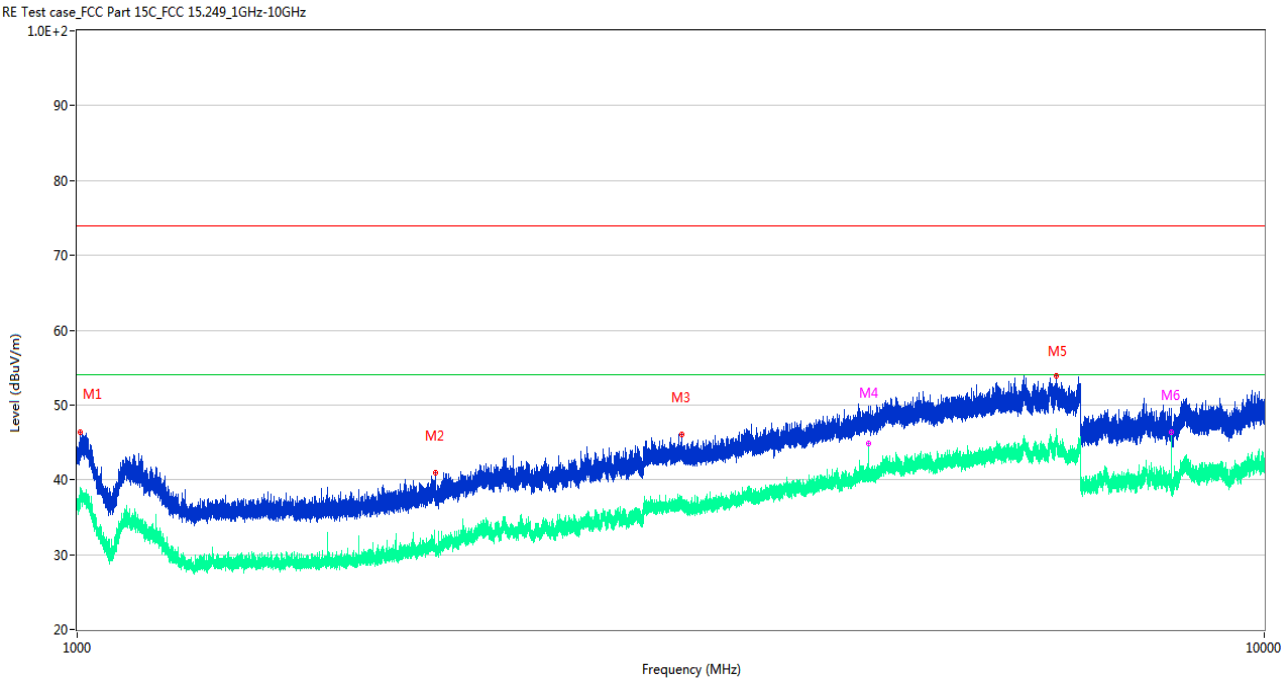
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1633.300	38.72	-17.48	74.0	-35.28	Peak	34.00	300	Horizontal	Pass
1**	1633.300	28.44	-17.48	54.0	-25.56	AV	34.00	300	Horizontal	Pass
2	2400.400	43.42	-12.39	74.0	-30.58	Peak	219.00	100	Horizontal	Pass
2**	2400.400	34.14	-12.39	54.0	-19.86	AV	219.00	100	Horizontal	Pass
3	3668.000	47.19	-6.85	74.0	-26.81	Peak	171.00	200	Horizontal	Pass
3**	3668.000	37.65	-6.85	54.0	-16.35	AV	171.00	200	Horizontal	Pass
4	4628.400	49.37	-3.68	74.0	-24.63	Peak	14.00	300	Horizontal	Pass
4**	4628.400	44.84	-3.68	54.0	-9.16	AV	14.00	300	Horizontal	Pass
5	6682.000	54.20	-0.47	74.0	-19.80	Peak	223.00	200	Horizontal	Pass
5**	6682.000	44.96	-0.47	54.0	-9.04	AV	223.00	200	Horizontal	Pass
6	8331.550	50.63	-2.14	74.0	-23.37	Peak	334.00	400	Horizontal	Pass
6**	8331.550	47.54	-2.14	54.0	-6.46	AV	334.00	400	Horizontal	Pass

MIDDLE CHANNEL 1 GHz to 12.75 GHz, ANT V



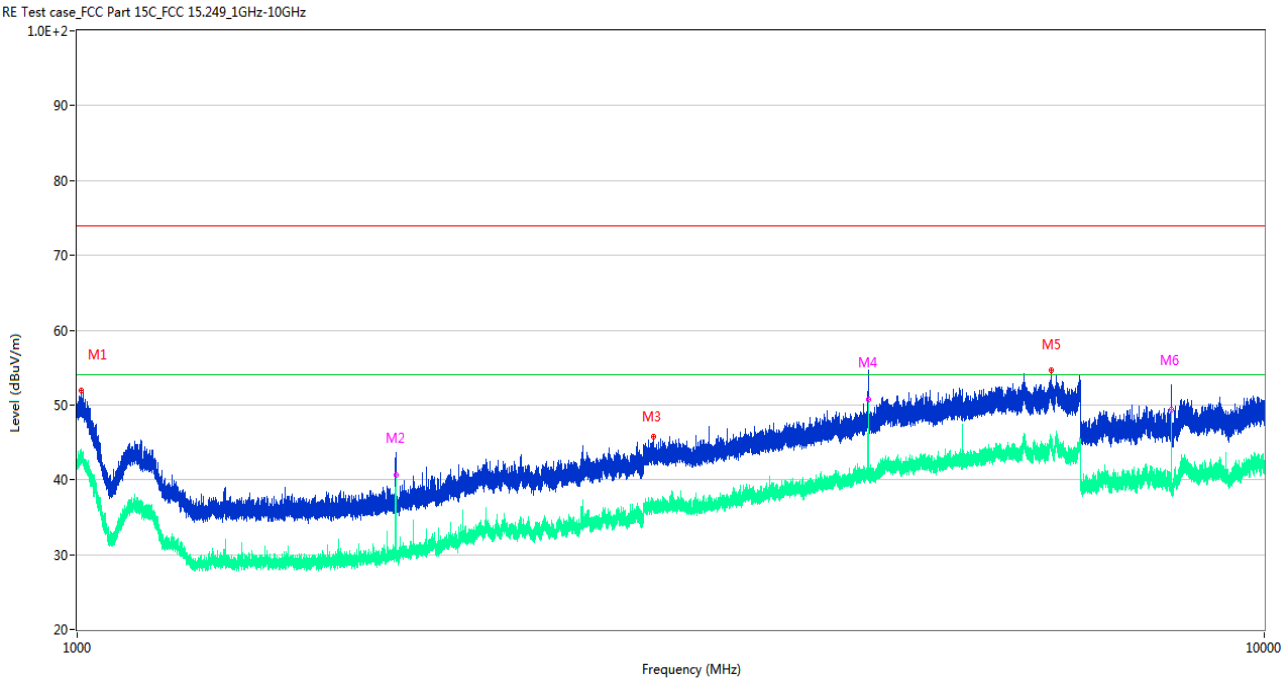
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1008.700	51.60	-17.97	74.0	-22.40	Peak	59.00	200	Vertical	Pass
1**	1008.700	43.52	-17.97	54.0	-10.48	AV	59.00	200	Vertical	Pass
2	1851.400	44.84	-16.40	74.0	-29.16	Peak	340.00	100	Vertical	Pass
2**	1851.400	41.67	-16.40	54.0	-12.33	AV	340.00	100	Vertical	Pass
3	2661.800	44.77	-11.18	74.0	-29.23	Peak	102.00	100	Vertical	Pass
3**	2661.800	35.32	-11.18	54.0	-18.68	AV	102.00	100	Vertical	Pass
4	4628.800	51.21	-3.67	74.0	-22.79	Peak	184.00	300	Vertical	Pass
4**	4628.800	49.33	-3.67	54.0	-4.67	AV	184.00	300	Vertical	Pass
5	6676.600	54.09	-0.59	74.0	-19.91	Peak	111.00	200	Vertical	Pass
5**	6676.600	45.70	-0.59	54.0	-8.30	AV	111.00	200	Vertical	Pass
6	8331.400	52.57	-2.14	74.0	-21.43	Peak	25.00	300	Vertical	Pass
6**	8331.400	50.24	-2.14	54.0	-3.76	AV	25.00	300	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	1006.700	46.43	-17.98	74.0	-27.57	Peak	187.00	300	Horizontal	Pass
1**	1006.700	36.92	-17.98	54.0	-17.08	AV	187.00	300	Horizontal	Pass
2	2005.400	40.94	-15.81	74.0	-33.06	Peak	17.00	100	Horizontal	Pass
2**	2005.400	30.94	-15.81	54.0	-23.06	AV	17.00	100	Horizontal	Pass
3	3229.600	46.07	-7.29	74.0	-27.93	Peak	0.00	150	Horizontal	Pass
3**	3229.600	36.98	-7.29	54.0	-17.02	AV	0.00	150	Horizontal	Pass
4	4637.800	49.29	-3.61	74.0	-24.71	Peak	16.00	200	Horizontal	Pass
4**	4637.800	44.79	-3.61	54.0	-9.21	AV	16.00	200	Horizontal	Pass
5	6686.400	53.88	-0.21	74.0	-20.12	Peak	94.00	200	Horizontal	Pass
5**	6686.400	45.19	-0.21	54.0	-8.81	AV	94.00	200	Horizontal	Pass
6	8347.599	49.15	-2.95	74.0	-24.85	Peak	317.00	300	Horizontal	Pass
6**	8347.599	46.39	-2.95	54.0	-7.61	AV	317.00	300	Horizontal	Pass

HIGH CHANNEL 1 GHz to 12.75 GHz, ANT V



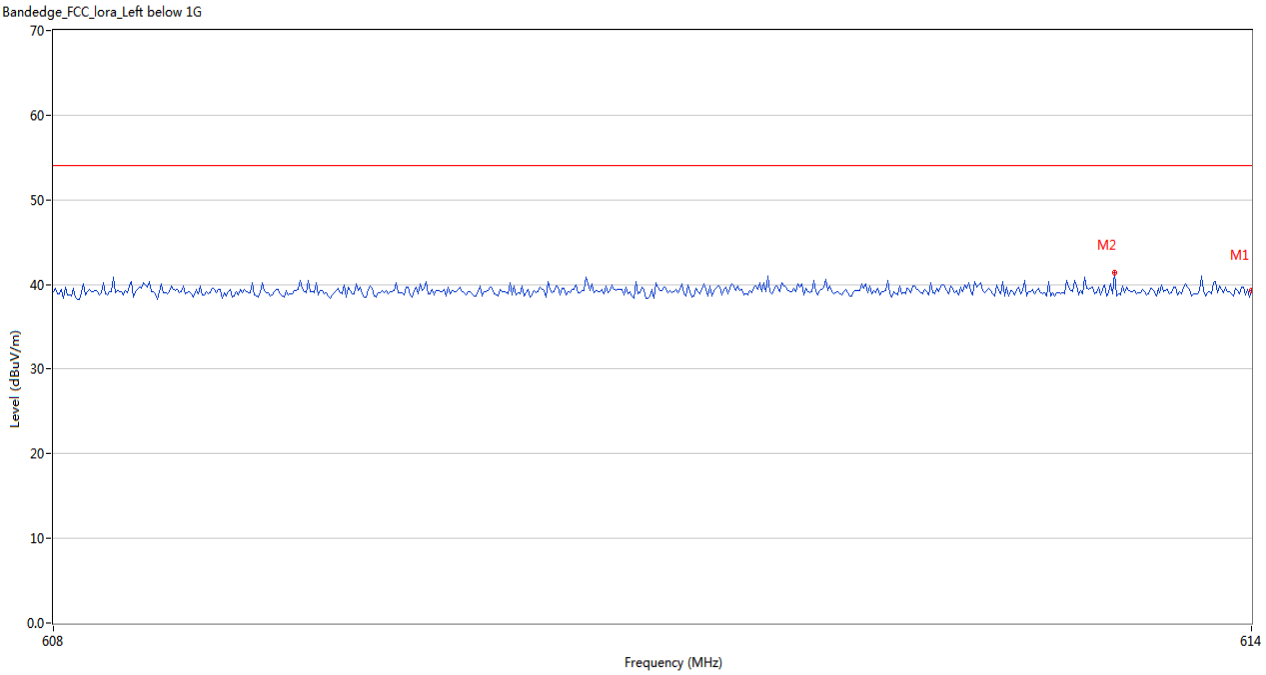
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1008.200	51.95	-17.95	74.0	-22.05	Peak	318.00	400	Vertical	Pass
1**	1008.200	42.59	-17.95	54.0	-11.41	AV	318.00	400	Vertical	Pass
2	1855.000	42.81	-16.70	74.0	-31.19	Peak	13.00	200	Vertical	Pass
2**	1855.000	40.63	-16.70	54.0	-13.37	AV	13.00	200	Vertical	Pass
3	3058.000	45.81	-7.69	74.0	-28.19	Peak	110.00	200	Vertical	Pass
3**	3058.000	36.49	-7.69	54.0	-17.51	AV	110.00	200	Vertical	Pass
4	4637.800	52.72	-3.61	74.0	-21.28	Peak	162.00	200	Vertical	Pass
4**	4637.800	50.67	-3.61	54.0	-3.33	AV	162.00	200	Vertical	Pass
5	6610.800	54.61	0.19	74.0	-19.39	Peak	110.00	300	Vertical	Pass
5**	6610.800	44.87	0.19	54.0	-9.13	AV	110.00	300	Vertical	Pass
6	8347.599	51.22	-2.95	74.0	-22.78	Peak	43.00	200	Vertical	Pass
6**	8347.599	49.32	-2.95	54.0	-4.68	AV	43.00	200	Vertical	Pass

A.7 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.

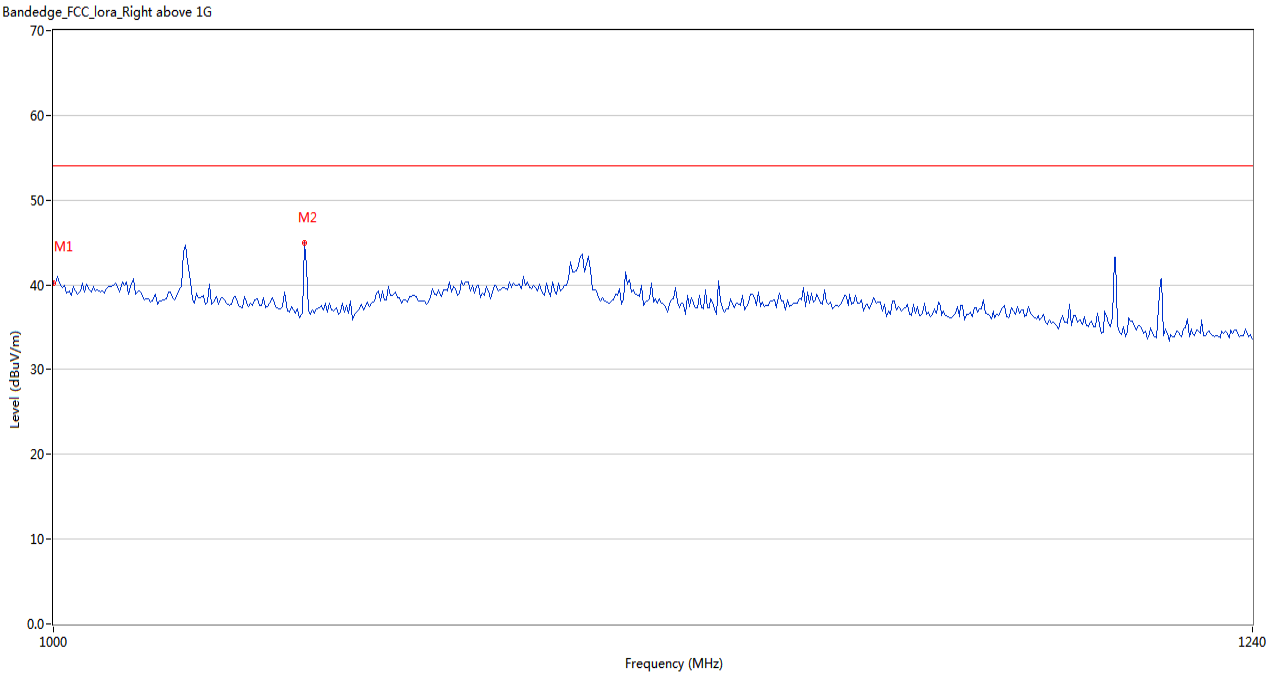
Test Data and Plots

LOW CHANNEL



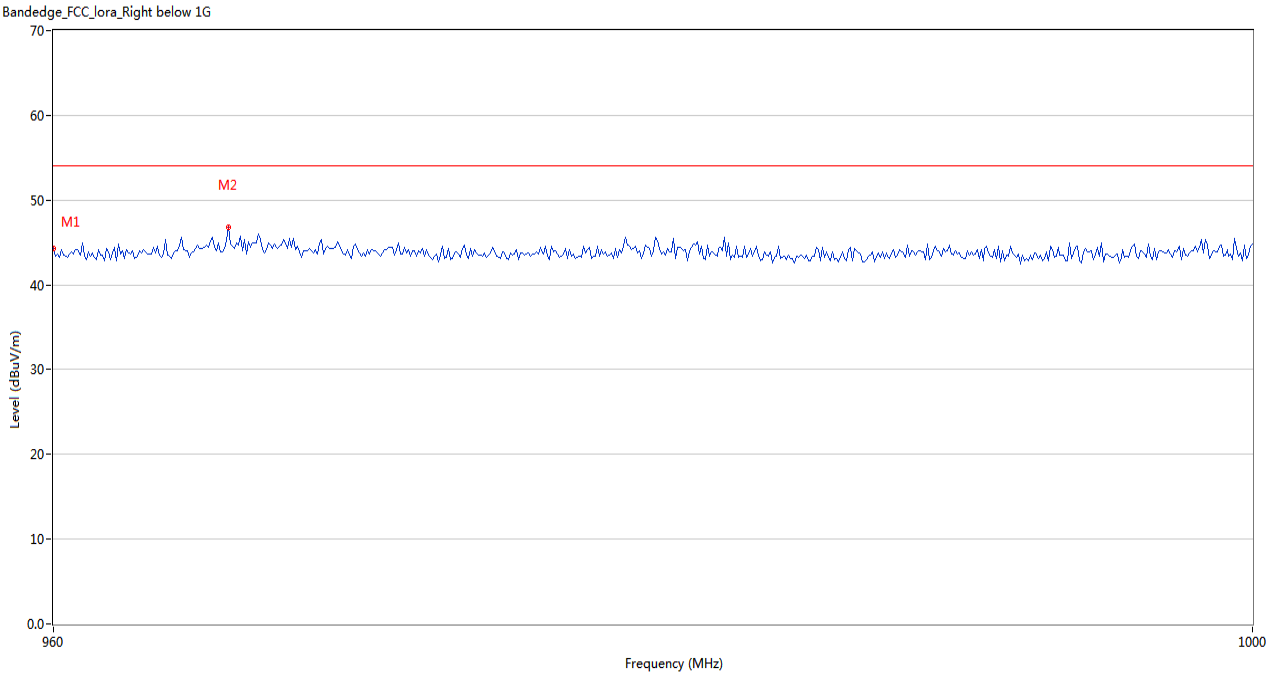
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	614.000	39.27	3.31	54.0	-14.73	Peak	222.00	200	Vertical	Pass
2	613.310	41.39	3.30	54.0	-12.61	Peak	225.00	200	Vertical	Pass

HIGH CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1000.000	40.25	-18.22	54.0	-13.75	Peak	5.00	100	Vertical	Pass
2	1046.000	44.92	-18.39	54.0	-9.08	Peak	96.00	100	Vertical	Pass

HIGH CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	960.000	44.24	-3.60	54.0	-9.76	Peak	216.00	200	Vertical	Pass
2	965.733	46.86	-3.27	54.0	-7.14	Peak	216.00	100	Vertical	Pass

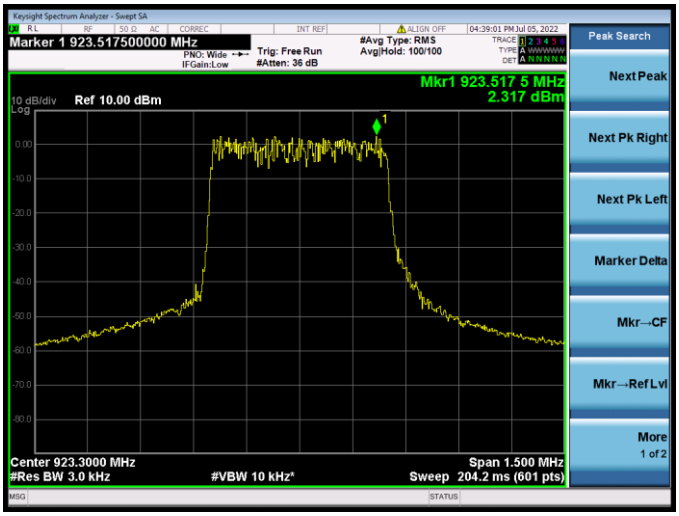
A.8 Power Spectral Density (PSD)

Test Data

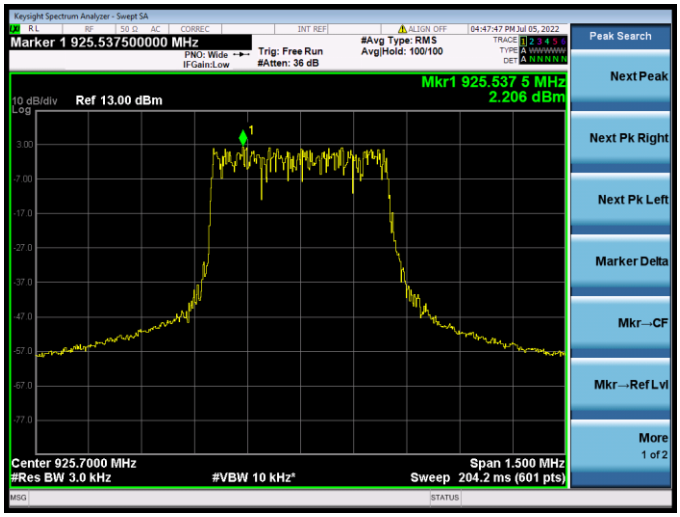
LoRa			
Channel	Spectral power density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	2.32	8	Pass
Middle Channel	2.21	8	Pass
High Channel	3.10	8	Pass

Test Plots

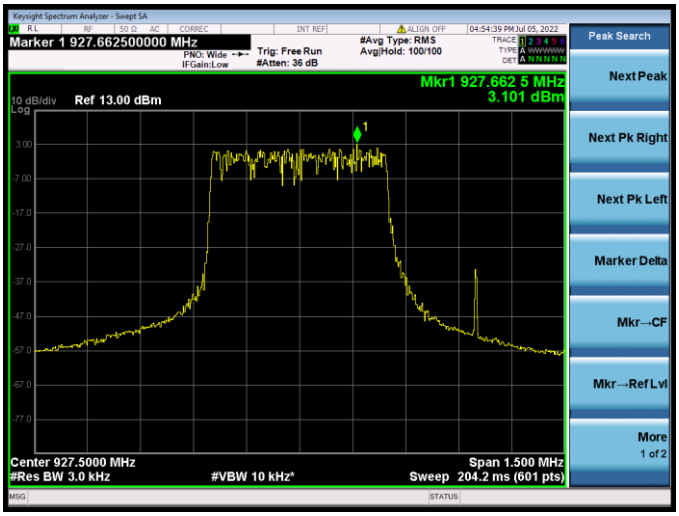
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ2260818-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ2260818-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ2260818-AI.PDF”.

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