

TEST REPORT

Applicant: Zhejiang Bove Intelligent Technology Co., Ltd.

Address: Level 5, Building 5, No. 36, Changsheng South

Road, Jiaxing, Zhejiang, China, 314000

Equipment Type: Ultrasonic Water Meter

Model Name: BECOY

Brand Name: BOVE TECHNOLOGY

FCC ID: 2BCZQBECOY

Test Standard: 47 CFR Part 15 Subpart C

(refer to section 3.1)

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ISSUED BY:

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In time

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1 GENERAL INFORMATION

1.1 Test Laboratory

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

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
	☑ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi
	Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Location	□ 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park,
	No. 1008, Songbai Road, Yangguang Community, Xili Sub-district,
	Nanshan District, Shenzhen, Guangdong Province, P. R. China
A core ditation Cortificate	The laboratory is a testing organization accredited by FCC as a
Accreditation Certificate	accredited testing laboratory. The designation number is CN1196.



2 PRODUCT INFORMATION

2.1 Applicant Information

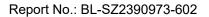
Applicant	Zhejiang Bove Intelligent Technology Co., Ltd.	
Address	Level 5, Building 5, No. 36, Changsheng South Road, Jiaxing,	
Address	Zhejiang, China, 314000	

2.2 Manufacturer Information

Manufacturer	Zhejiang Bove Intelligent Technology Co., Ltd.	
Address	Level 5, Building 5, No. 36, Changsheng South Road, Jiaxing,	
Address	Zhejiang, China, 314000	

2.3 General Description for Equipment under Test (EUT)

EUT Name	Ultrasonic Water Meter	
Model Name Under Test	BECOY	
Series Model Name	N/A	
Description of Model	NIA	
name differentiation	N/A	
Hardware Version	V1.2	
Software Version	V1.1.12	
Dimensions (Approx.)	N/A	
Weight (Approx.)	N/A	





2.4 Technical Information

Network and Wireless	LoRa
connectivity	LUNA

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

Modulation Technology	DTS	
Modulation Type	LoRa	
Product Type	☐ Portable	
	☐ Fix Location	
Frequency Range	The frequency range used is 915 MHz to 928 MHz.	
Number of Channel	8	
Tested Channel	1 (915.9 MHz), 4 (920.7 MHz), 8 (927.1 MHz)	
Antenna Type	FPC Antenna	
Antenna Gain	0.54 dBi	
Antenna System	NI/A	
(MIMO Smart Antenna)	N/A	

All channel was listed on the following table:

Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
1	915.9	5	922.3
2	917.5	6	923.9
3	919.1	7	925.5
4	920.7	8	927.1



3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title	
1	47 CFR Part 15, Subpart C	Intentional radiators of radio frequency equipment	
		GUIDANCE FOR COMPLIANCE MEASUREMENTS ON	
	KDB Publication 558074	DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING	
2	D01v05r02	SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES	
		OPERATING UNDER SECTION 15.247 OF THE FCC RULES	
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices	

3.2 Test Verdict

No.	Description	FCC Part No.	Channel	Verdict
1	Antenna Requirement	15.203		Pass ^{Note1}
2	Output Power	15.247(b)	ANNEX A.1	Pass
3	Occupied Bandwidth	15.247(a)	ANNEX A.2	Pass
4	Conducted Spurious Emission	15.247(d)	ANNEX A.3	Pass
5	Band Edge(Authorized-band band-edge)	15.247(d)	ANNEX A.4	Pass
6	Conducted Emission	15.207	ANNEX A.5	N/A ^{Note2}
7	Radiated Spurious Emission	15.209 15.247(d)	ANNEX A.6	Pass
8	Band Edge(Restricted-band band-edge)	15.209 15.247(d)	ANNEX A.7	Pass
9	Power spectral density (PSD)	15.247(e)	ANNEX A.8	Pass

Note 1: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.

Note 2: The EUT only powered by battery, so the Conducted Emission test is not applicable.



GENERAL TEST CONFIGURATIONS

4.1 Test Environments

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

Relative Humidity	36% to 56%				
Atmospheric Pressure	100 kPa to 102 kPa				
Temperature	NT (Normal Temperature)	+23.9°C to +25.6°C			
Working Voltage of the EUT	NV (Normal Voltage)	3.6 V			

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	KEYSIGHT	N9020A	MY46471071	2023.07.25	2024.07.24
Spectrum Analyzer	KEYSIGHT	N9020A	MY52510065	2023.09.05	2024.09.04
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9163	01415	2021.03.08	2024.03.07
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	01631	2022.02.03	2025.02.02
Test Antenna-Horn	A-INFO	LB- 180400KF	J211060273	2021.07.02	2024.07.01
Anechoic Chamber	RAINFORD	9m*6m*6m	144	2022.02.19	2024.09.03
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2023.09.05	2024.09.04
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9168	00883	2022.04.01	2025.03.31
Test Antenna-Loop	SCHWARZBECK	FMZB 1519	1519-037	2021.04.16	2024.04.15
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60 *7.35m	130	2021.08.15	2024.08.14

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	0.8°C	
Humidity	4%	

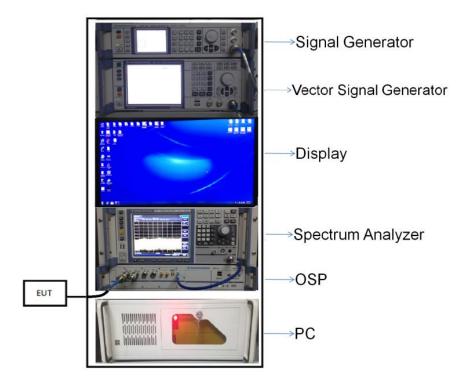


4.4 Description of Test Setup

4.4.1 For Antenna Port Test

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

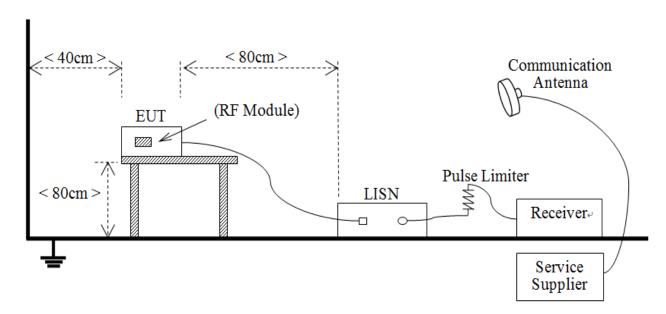
For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT: Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



(Diagram 1)

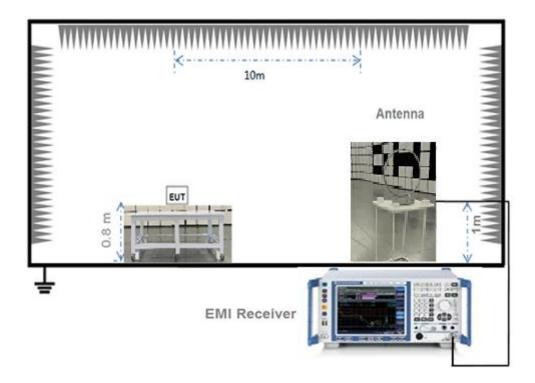


4.4.2For AC Power Supply Port Test



(Diagram 2)

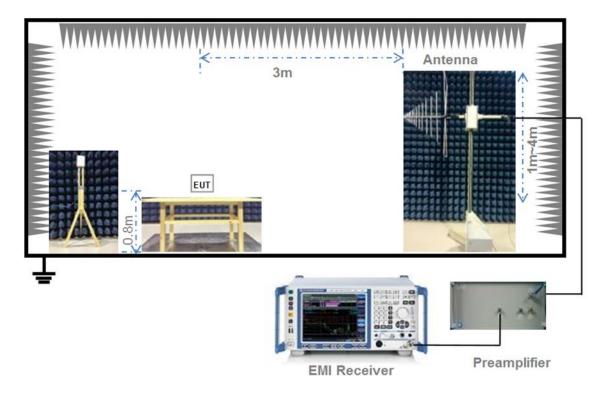
4.4.3 For Radiated Test (Below 30 MHz)



(Diagram 3)

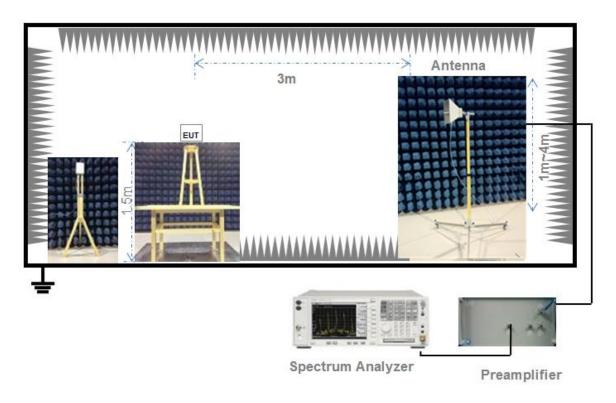


4.4.4For Radiated Test (30 MHz-1 GHz)



(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:

 $E = electric field strength in dB\mu V/m$,

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)

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.

5.1.2Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is embedded in the	An embedded-in antenna design is used.
product.	

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.

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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.

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 \leq 16.7 microseconds.)

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5.2.4Test Result

Please refer to ANNEX A.1.



5.3 Occupied Bandwidth

5.3.1 Limit

FCC §15.247(a)

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.

5.3.3Test 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.

5.3.4Test Result

Please refer to ANNEX A.2.

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5.4 Conducted Spurious Emission

5.4.1 Limit

FCC §15.247(d)

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.

5.4.2Test 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 \geq 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 \geq 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.

5.4.4Test Result

Please refer to ANNEX A.3.



5.5 Band Edge (Authorized-band band-edge)

5.5.1 Limit

FCC §15.247(d)

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.

5.5.2Test 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 \geq 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 \pm 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.

 $VBW \ge 3 \times RBW$.

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) \pm 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 \pm 0.5 MHz.



5.5.4Test Result

Please refer to ANNEX A.4.



5.6 Conducted Emission

5.6.1 Limit

FCC §15.207

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 $50\mu\text{H}/50\Omega$ line impedance stabilization network (LISN).

Frequency range	Conducted Limit (dBµV)				
(MHz)	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.

5.6.4Test Result

Please refer to ANNEX A.5.



5.7 Radiated Spurious Emission

5.7.1 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).

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 ($dB\mu V/m$) = 20*log[Field Strength ($\mu V/m$)].
- 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 $f \ge 1$ 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.

5.7.4Test 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)

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).

5.8.2Test 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 $f \ge 1$ 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.

5.8.4Test Result

Please refer to ANNEX A.7.



5.9 Power Spectral density (PSD)

5.9.1 Limit

FCC §15.247(e)

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: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.

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.

5.9.4Test Result

Please refer to ANNEX A.8.



ANNEX A TEST RESULT

A.1 Output Power

Peak Power Test Data

	Measured Output Peak Power		Lir			
Channel	LoRa		dBm	m\\/	Verdict	
d	dBm	mW	иын	mW		
Low	17.47	55.90			Pass	
Middle	17.40	54.95	30	1000	Pass	
High	17.37	54.63			Pass	

Test Plots

LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL





A.2 Occupied Bandwidth

Test Data

Test Mode	LoRa					
Channel	6 dB Bandwidth	99% Bandwidth	6 dB Bandwidth			
Channel	(MHz)	(MHz)	Limits (MHz)			
Low Channel	Low Channel 0.740000		≥0.5			
Middle Channel	0.770000	0.646570	≥0.5			
High Channel	0.735000	0.683560	≥0.5			

Test Plots

6 dB Bandwidth

LOW CHANNEL



MIDDLE CHANNEL



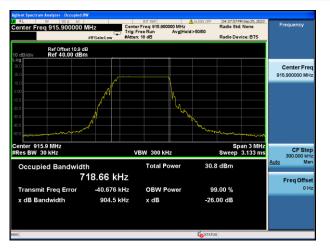
HIGH CHANNEL





99% Bandwidth

LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL





A.3 Conducted Spurious Emissions

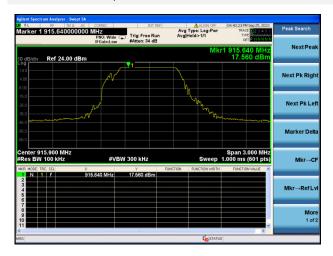
Test Data

<u> Bata</u>								
LoRa								
	Measured Max.	Limit (dBm)						
Channel	Out of Band	Carrier Lavel	Calculated	Verdict				
	Emission (dBm)	Carrier Level	20 dBc Limit					
Low	-31.32	17.56	-2.44	Pass				
Middle	-31.60	17.54	-2.46	Pass				
High	-28.69	17.49	-2.51	Pass				



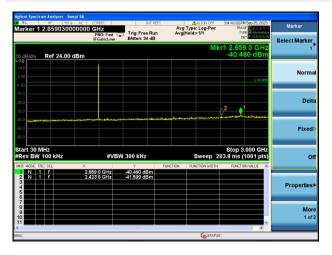
Test Plots

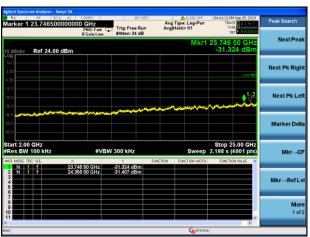
LOW CHANNEL, CARRIER LEVEL



LOW CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

LOW CHANNEL, SPURIOUS 2 GHz ~ 25 GHz





MIDDLE CHANNEL, CARRIER LEVEL

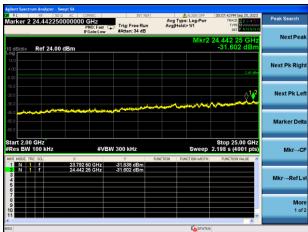




MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



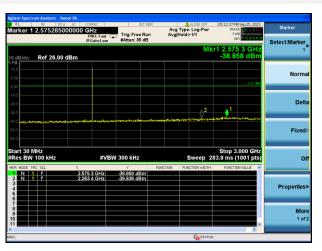
MIDDLE CHANNEL, SPURIOUS 2 GHz ~ 25 GHz



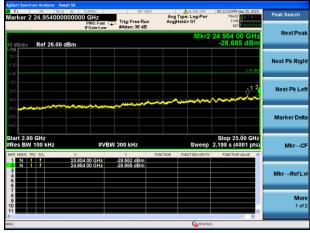
HIGH CHANNEL, CARRIER LEVEL



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

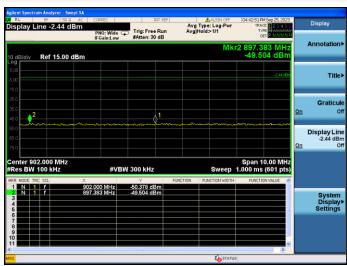
LoRa							
	Measured Max.	Limit (dBm)					
Channel	Band Edge		Calculated	Verdict			
	Emission (dBm)	Carrier Level	20 dBc Limit				
Low Channel	-49.50	17.56	-2.44	Pass			
High Channel	-36.55	17.49	-2.51	Pass			

Test Plots

LOW CHANNEL, CARRIER LEVEL



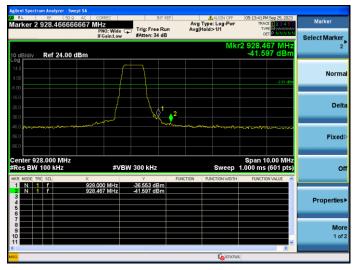
LOW CHANNEL, BAND EDGE



HIGH CHANNEL, CARRIER LEVEL



HIGH CHANNEL, BAND EDGE



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A.5 Conducted Emissions

Note: Not applicable.



A.6 Radiated Spurious Emission

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

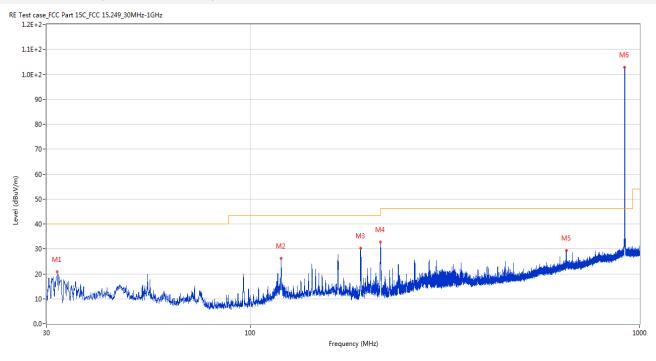
Note ²: For the test data above 1 GHz, according the ANSI C63.4-2014, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

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

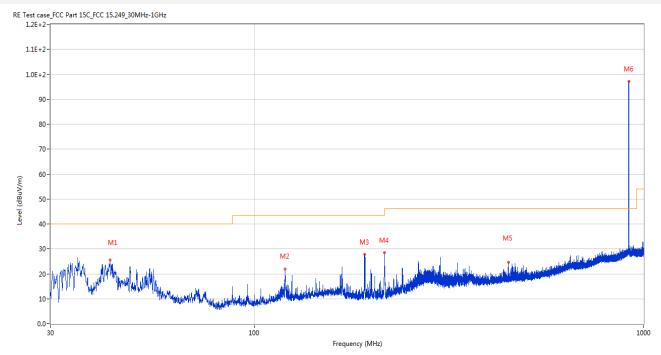
LOW CHANNEL, 30 MHz to 1 GHz, ANT H



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	31.940	20.73	-26.91	40.0	19.27	Peak	217.00	100	Horizontal	Pass
2	120.016	26.11	-26.47	43.5	17.39	Peak	103.00	150	Horizontal	Pass
3	192.136	30.35	-27.50	43.5	13.15	Peak	249.00	100	Horizontal	Pass
4	215.998	32.84	-27.12	43.5	10.66	Peak	83.00	100	Horizontal	Pass
5	648.036	29.35	-13.13	46.0	16.65	Peak	187.00	100	Horizontal	Pass
6	915.756	102.87	-7.85	46.0	-56.87	Peak	100.00	150	Horizontal	N/A



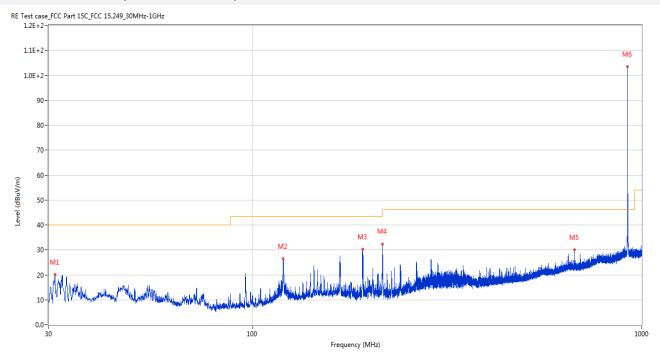
LOW CHANNEL, 30 MHz to 1 GHz, ANT V



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	42.658	25.44	-26.05	40.0	14.56	Peak	207.00	100	Vertical	Pass
2	120.016	22.03	-26.47	43.5	21.47	Peak	185.00	150	Vertical	Pass
3	192.038	27.73	-27.49	43.5	15.77	Peak	198.00	150	Vertical	Pass
4	215.900	28.51	-27.12	43.5	14.99	Peak	185.00	100	Vertical	Pass
5	450.058	24.64	-19.16	46.0	21.36	Peak	68.00	100	Vertical	Pass
6	916.143	97.20	-7.86	46.0	-51.20	Peak	82.00	150	Vertical	N/A



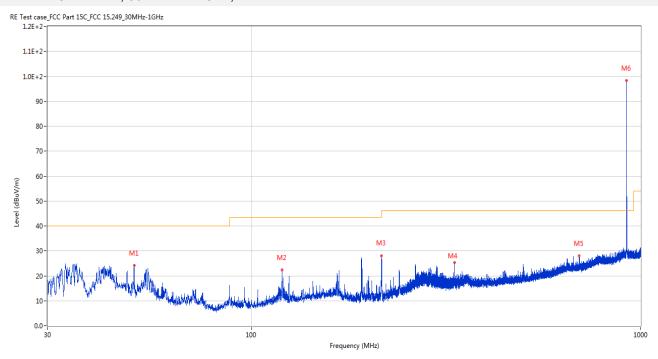
MIDDLE CHANNEL, 30 MHz to 1 GHz, ANT H



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	31.164	20.09	-26.93	40.0	19.91	Peak	184.00	150	Horizontal	Pass
2	120.016	26.35	-26.47	43.5	17.15	Peak	85.00	150	Horizontal	Pass
3	192.038	30.35	-27.49	43.5	13.15	Peak	240.00	100	Horizontal	Pass
4	216.046	32.41	-27.12	46.0	13.59	Peak	79.00	100	Horizontal	Pass
5	672.043	30.05	-13.45	46.0	15.95	Peak	173.00	100	Horizontal	Pass
6	920.557	103.39	-7.79	46.0	-57.39	Peak	99.00	150	Horizontal	N/A



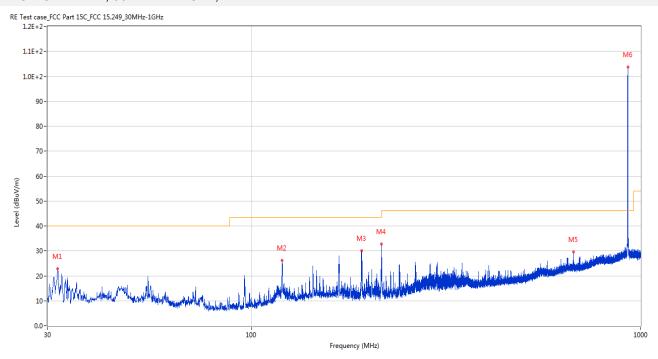
MIDDLE CHANNEL, 30 MHz to 1 GHz, ANT V



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	50.031	24.15	-26.14	40.0	15.85	Peak	338.00	100	Vertical	Pass
2	120.016	22.40	-26.47	43.5	21.10	Peak	174.00	150	Vertical	Pass
3	216.094	28.13	-27.12	46.0	17.87	Peak	178.00	100	Vertical	Pass
4	333.125	25.22	-22.78	46.0	20.78	Peak	136.00	100	Vertical	Pass
5	696.002	28.03	-13.25	46.0	17.97	Peak	163.00	100	Vertical	Pass
6	920.897	98.19	-7.80	46.0	-52.19	Peak	86.00	150	Vertical	N/A



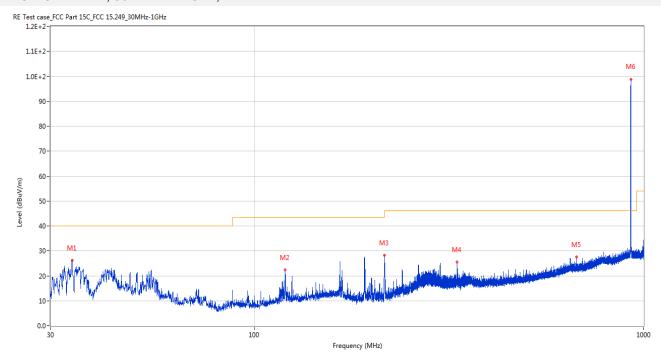
HIGH CHANNEL, 30 MHz to 1 GHz, ANT H



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	31.843	22.73	-26.91	40.0	17.27	Peak	202.00	150	Horizontal	Pass
2	120.016	26.11	-26.47	43.5	17.39	Peak	81.00	150	Horizontal	Pass
3	191.990	30.12	-27.49	43.5	13.38	Peak	245.00	100	Horizontal	Pass
4	215.998	32.69	-27.12	43.5	10.81	Peak	87.00	100	Horizontal	Pass
5	672.237	29.51	-13.45	46.0	16.49	Peak	179.00	100	Horizontal	Pass
6	927.250	103.78	-7.92	46.0	-57.78	Peak	99.00	150	Horizontal	N/A



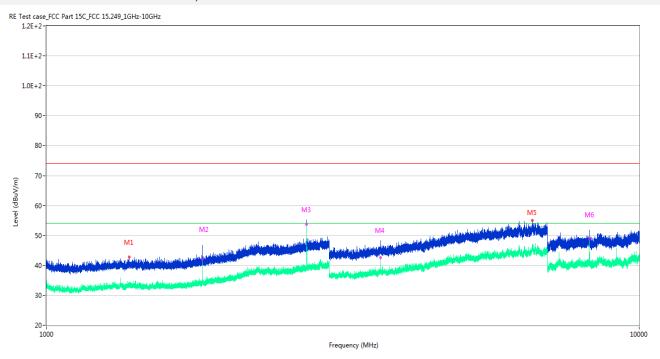
HIGH CHANNEL, 30 MHz to 1 GHz, ANT V



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	34.074	26.21	-26.78	40.0	13.79	Peak	213.00	100	Vertical	Pass
2	120.016	22.45	-26.47	43.5	21.05	Peak	161.00	150	Vertical	Pass
3	215.998	28.31	-27.12	43.5	15.19	Peak	186.00	100	Vertical	Pass
4	331.864	25.54	-22.85	46.0	20.46	Peak	360.00	100	Vertical	Pass
5	672.043	27.63	-13.45	46.0	18.37	Peak	186.00	150	Vertical	Pass
6	927.250	98.85	-7.92	46.0	-52.85	Peak	86.00	150	Vertical	N/A



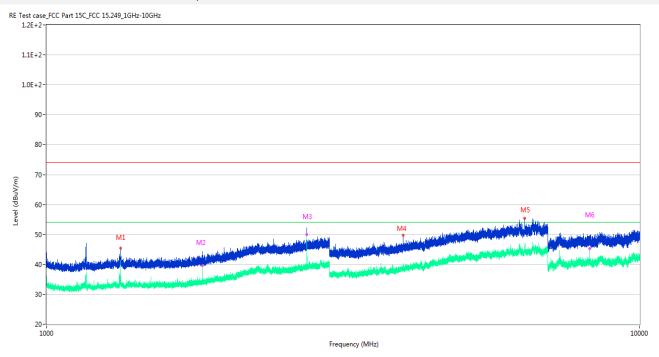
LOW CHANNEL 1 GHz to 10 GHz, ANT H



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	1379.200	42.77	-13.22	74.0	31.23	Peak	311.00	150	Horizontal	Pass
1**	1379.200	33.80	-13.22	54.0	20.20	AV	311.00	150	Horizontal	Pass
2	1832.000	46.41	-12.51	74.0	27.59	Peak	225.00	150	Horizontal	Pass
2**	1832.000	42.10	-12.51	54.0	11.90	AV	225.00	150	Horizontal	Pass
3	2747.800	54.85	-6.55	74.0	19.15	Peak	212.00	150	Horizontal	Pass
3**	2747.800	53.69	-6.55	54.0	0.31	AV	212.00	150	Horizontal	Pass
4	3664.600	46.15	-7.05	74.0	27.85	Peak	206.00	150	Horizontal	Pass
4**	3664.600	42.60	-7.05	54.0	11.40	AV	206.00	150	Horizontal	Pass
5	6597.000	54.98	-0.32	74.0	19.02	Peak	273.00	150	Horizontal	Pass
5**	6597.000	45.47	-0.32	54.0	8.53	AV	273.00	150	Horizontal	Pass
6	8245.450	50.73	-2.10	74.0	23.27	Peak	80.00	150	Horizontal	Pass
6**	8245.450	48.75	-2.10	54.0	5.25	AV	80.00	150	Horizontal	Pass



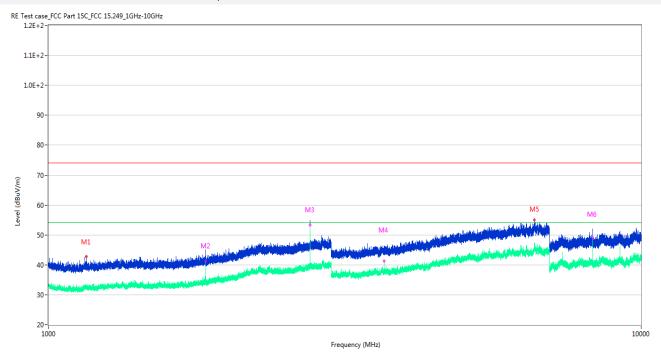
LOW CHANNEL 1 GHz to 10 GHz, ANT V



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	1332.800	45.48	-13.38	74.0	28.52	Peak	5.00	150	Vertical	Pass
1**	1332.800	35.74	-13.38	54.0	18.26	AV	5.00	150	Vertical	Pass
2	1831.700	43.47	-12.51	74.0	30.53	Peak	59.00	150	Vertical	Pass
2**	1831.700	39.67	-12.51	54.0	14.33	AV	59.00	150	Vertical	Pass
3	2747.000	51.40	-6.62	74.0	22.60	Peak	245.00	150	Vertical	Pass
3**	2747.000	49.92	-6.62	54.0	4.08	AV	245.00	150	Vertical	Pass
4	3993.800	49.66	-5.36	74.0	24.34	Peak	142.00	150	Vertical	Pass
4**	3993.800	40.32	-5.36	54.0	13.68	AV	142.00	150	Vertical	Pass
5	6402.800	55.33	0.05	74.0	18.67	Peak	131.00	150	Vertical	Pass
5**	6402.800	45.06	0.05	54.0	8.94	AV	131.00	150	Vertical	Pass
6	8244.550	47.95	-2.10	74.0	26.05	Peak	331.00	150	Vertical	Pass
6**	8244.550	45.18	-2.10	54.0	8.82	AV	331.00	150	Vertical	Pass



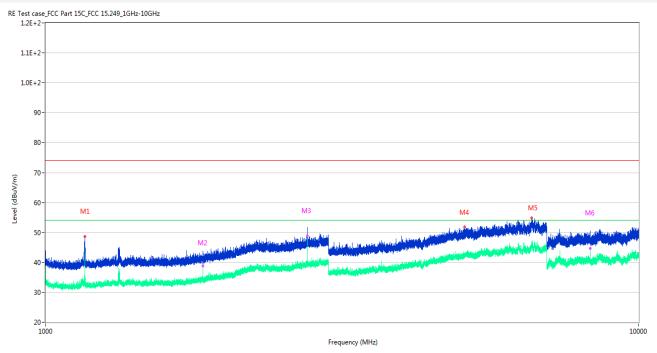
MIDDLE CHANNEL 1 GHz to 10 GHz, ANT H



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	1158.400	42.76	-13.79	74.0	31.24	Peak	360.00	150	Horizontal	Pass
1**	1158.400	32.30	-13.79	54.0	21.70	AV	360.00	150	Horizontal	Pass
2	1840.900	43.66	-12.67	74.0	30.34	Peak	224.00	150	Horizontal	Pass
2**	1840.900	41.32	-12.67	54.0	12.68	AV	224.00	150	Horizontal	Pass
3	2762.300	54.73	-6.25	74.0	19.27	Peak	206.00	150	Horizontal	Pass
3**	2762.300	53.35	-6.25	54.0	0.65	AV	206.00	150	Horizontal	Pass
4	3683.200	46.37	-6.50	74.0	27.63	Peak	71.00	150	Horizontal	Pass
4**	3683.200	41.20	-6.50	54.0	12.80	AV	71.00	150	Horizontal	Pass
5	6606.400	55.04	1.42	74.0	18.96	Peak	125.00	150	Horizontal	Pass
5**	6606.400	46.42	1.42	54.0	7.58	AV	125.00	150	Horizontal	Pass
6	8287.000	52.00	-1.95	74.0	22.00	Peak	65.00	150	Horizontal	Pass
6**	8287.000	49.07	-1.95	54.0	4.93	AV	65.00	150	Horizontal	Pass



MIDDLE CHANNEL 1 GHz to 10 GHz, ANT V



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	1165.800	48.60	-14.01	74.0	25.40	Peak	49.00	150	Vertical	Pass
1**	1165.800	33.00	-14.01	54.0	21.00	AV	49.00	150	Vertical	Pass
2	1841.300	43.37	-12.66	74.0	30.63	Peak	98.00	150	Vertical	Pass
2**	1841.300	38.89	-12.66	54.0	15.11	AV	98.00	150	Vertical	Pass
3	2762.200	50.28	-6.26	74.0	23.72	Peak	261.00	150	Vertical	Pass
3**	2762.200	48.78	-6.26	54.0	5.22	AV	261.00	150	Vertical	Pass
4	5085.000	51.76	-2.62	74.0	22.24	Peak	184.00	150	Vertical	Pass
4**	5085.000	41.90	-2.62	54.0	12.10	AV	184.00	150	Vertical	Pass
5	6600.600	54.81	0.41	74.0	19.19	Peak	229.00	150	Vertical	Pass
5**	6600.600	45.69	0.41	54.0	8.31	AV	229.00	150	Vertical	Pass
6	8284.750	48.74	-1.92	74.0	25.26	Peak	336.00	150	Vertical	Pass
6**	8284.750	44.73	-1.92	54.0	9.27	AV	336.00	150	Vertical	Pass



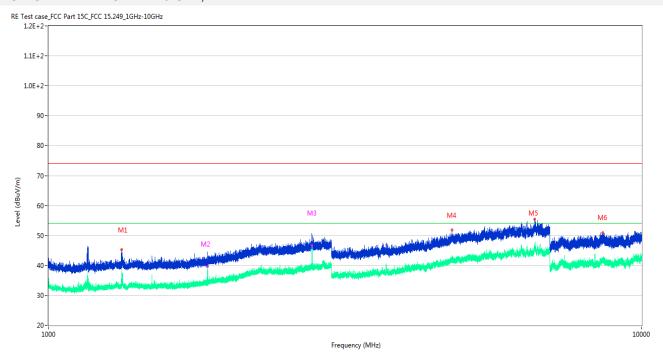
HIGH CHANNEL 1 GHz to 10 GHz, ANT H



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	1240.100	42.38	-13.93	74.0	31.62	Peak	39.00	150	Horizontal	Pass
1**	1240.100	32.82	-13.93	54.0	21.18	AV	39.00	150	Horizontal	Pass
2	1854.400	44.40	-12.84	74.0	29.60	Peak	255.00	150	Horizontal	Pass
2**	1854.400	40.98	-12.84	54.0	13.02	AV	255.00	150	Horizontal	Pass
3	2781.700	53.91	-6.16	74.0	20.09	Peak	212.00	150	Horizontal	Pass
3**	2781.700	52.87	-6.16	54.0	1.13	AV	212.00	150	Horizontal	Pass
4	4101.400	48.81	-5.38	74.0	25.19	Peak	128.00	150	Horizontal	Pass
4**	4101.400	38.70	-5.38	54.0	15.30	AV	128.00	150	Horizontal	Pass
5	6606.400	54.90	1.42	74.0	19.10	Peak	307.00	150	Horizontal	Pass
5**	6606.400	45.85	1.42	54.0	8.15	AV	307.00	150	Horizontal	Pass
6	8344.450	49.21	-2.12	74.0	24.79	Peak	81.00	150	Horizontal	Pass
6**	8344.450	48.77	-2.12	54.0	5.23	AV	81.00	150	Horizontal	Pass



HIGH CHANNEL 1 GHz to 10 GHz, ANT V



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	1327.500	45.25	-13.59	74.0	28.75	Peak	20.00	150	Vertical	Pass
1**	1327.500	33.45	-13.59	54.0	20.55	AV	20.00	150	Vertical	Pass
2	1854.700	41.78	-12.84	74.0	32.22	Peak	240.00	150	Vertical	Pass
2**	1854.700	39.58	-12.84	54.0	14.42	AV	240.00	150	Vertical	Pass
3	2780.700	49.23	-6.21	74.0	24.77	Peak	253.00	150	Vertical	Pass
3**	2780.700	46.75	-6.21	54.0	7.25	AV	253.00	150	Vertical	Pass
4	4786.600	51.78	-2.68	74.0	22.22	Peak	239.00	150	Vertical	Pass
4**	4786.600	42.31	-2.68	54.0	11.69	AV	239.00	150	Vertical	Pass
5	6609.200	55.45	1.58	74.0	18.55	Peak	34.00	150	Vertical	Pass
5**	6609.200	45.88	1.58	54.0	8.12	AV	34.00	150	Vertical	Pass
6	8601.550	50.91	-2.20	74.0	23.09	Peak	360.00	150	Vertical	Pass
6**	8601.550	41.61	-2.20	54.0	12.39	AV	360.00	150	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.

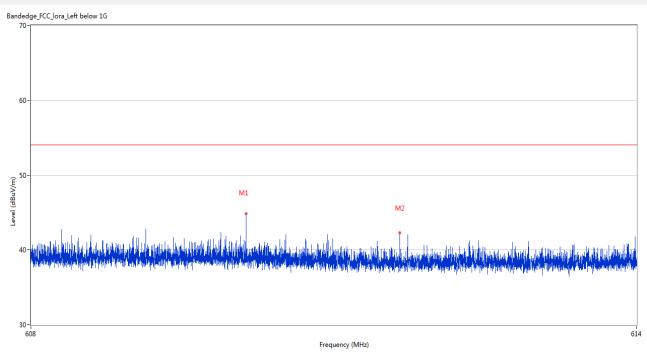
Note ²: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

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

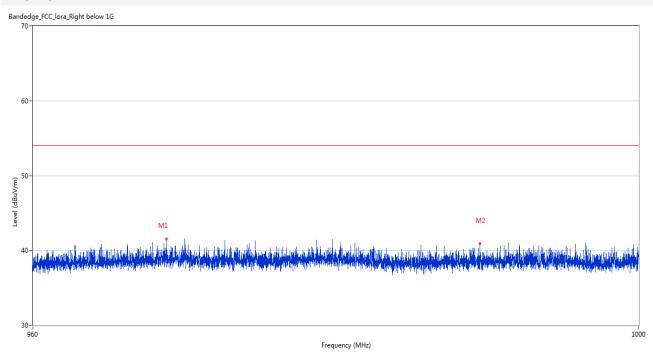
LOW CHANNEL



No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	610.124	44.86	3.09	54.0	9.14	Peak	187.00	150	Horizontal	Pass
2	611.648	42.29	3.09	54.0	11.71	Peak	133.00	150	Horizontal	Pass



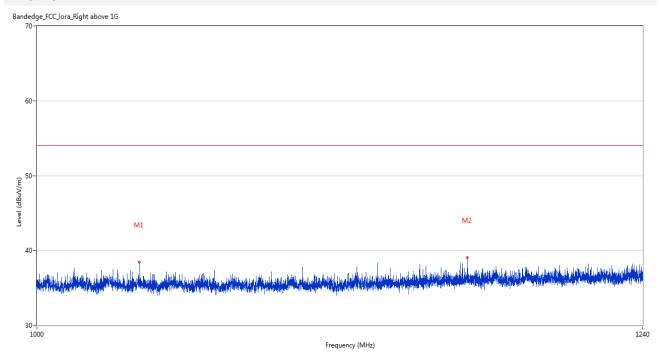




No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	968.667	41.55	-3.44	54.0	12.45	Peak	352.00	150	Horizontal	Pass
2	989.360	40.91	-3.83	54.0	13.09	Peak	152.00	150	Horizontal	Pass







No.	Frequency	Results	Factor	Limit	Margin	Detector	Table	Height	Antenna	Verdict
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dB)		(Degree)	(cm)		
1	1036.920	38.43	-18.09	54.0	15.57	Peak	305.00	150	Horizontal	Pass
2	1165.080	39.01	-18.01	54.0	14.99	Peak	39.00	150	Horizontal	Pass



Power Spectral Density (PSD) 8.A

Test Data

LoRa			
Channel	Spectral power density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	-5.37	8	Pass
Middle Channel	-5.56	8	Pass
High Channel	-5.82	8	Pass

Test Plots

LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



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ANNEX B TEST SETUP PHOTOS

Please refer the document "BL-SZ2390973-AR.PDF".

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document "BL-SZ2390973-AW.PDF".

ANNEX D EUT INTERNAL PHOTOS

Please refer the document "BL-SZ2390973-AI.PDF".

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