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TEST REPORT

FCC LoRa Test for IML-C6400W

APPLICANT
Infomark Co.,Ltd.

REPORT NO.
HCT-RF-2301-FC087

DATE OF ISSUE
January 31, 2023

Tested by
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Additional Model
-

Applicant	**Infomark Co.,Ltd.** 8F, 321, Hwangsaeul-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, 13590, KOREA
Eut Type Model Name	LTE Mobile WiFi IML-C6400W
FCC ID	YCO-IML-C6400W
RF Peak Output Power	20.572 dBm (114.08 mW)
FCC Classification	FCC Part 15 Spread Spectrum Transmitter
FCC Rule Part(s)	Part 15 subpart C 15.247

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test results were applied only to the test methods required by the standard.

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	January 31, 2023	Initial Release

Engineering Statement:
The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

If this report is required to confirmation of authenticity, please contact to www.hct.co.kr

CONTENTS

1. EUT DESCRIPTION

Model	IML-C6400W
EUT Type	LTE Mobile WiFi
Battery Capacity	3,300 mAh
Limited Charging(V)	4.35 V
Rated Voltage (V)	3.80 V
Discharging Cut-off (V)	3.00 V
Charging	DC 5V / 2A with Type-C USB Connector
Frequency Range	US: 902 MHz – 928 MHz (TX 125 kHz : 902.3 ~ 914.9) AU: 915 MHz – 928 MHz (TX 125 kHz : 915.2 ~927.8)
Max. RF Output Power	20.572 dBm (114.08 mW)
Modulation Type	CSS
Number of Channels (125 kHz)	64 Channels uplink 8 Channels downlink
Antenna Specification	Antenna type: LPS antenna Peak Gain : -0.08 dBi
Date(s) of Tests	December 13, 2022 ~ January 31, 2023
EUT serial numbers	Conducted : 980091 Radiated : 980087

2. Requirements for Frequency Hopping Device(FHSS) transmitter(15.247)

This LoRa module has been tested by a LoRa Qualification Lab, and we confirm the following:

1) This system is hopping pseudo-randomly.
2) Each frequency is used equally on the average by each transmitter.
3) The receiver input bandwidths that match the hopping channel bandwidths of their corresponding transmitters
4) The receiver shifts frequencies in synchronization with the transmitted signals.

▪ 15.247(g): The system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this Section 15.247 should the transmitter be presented with a continuous data (or information) stream.

▪ 15.247(h): The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

▪ RSS-247 5.1 (a): The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

3. TEST METHODOLOGY

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Device (ANSI C63.10-2013, KDB 558074) is used in the measurement of the test device.

EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1 GHz. Above 1 GHz with 1.5 m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 6.6.5 of ANSI C63.10. (Version: 2013). To record the final measurements, the analyzer detector function was set to CISPR quasi-peak mode and the bandwidth of the spectrum analyzer was set to 120 kHz for frequencies below 1 GHz or 1 MHz for frequencies above 1 GHz. For average measurements above 1 GHz, the analyzer was set to peak detector with a reduced VBW setting(RBW = 1 MHz, VBW = 1/T Hz, where T = Pulse width).

DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards.
Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

5. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.
Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR § 15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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."

(1) The antennas of this E.U.T are permanently attached.

(2) The E.U.T Complies with the requirement of § 15.203

7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of
ANSI C63.10-2013.
All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	2.00 (Confidence level about 95 %, k=2)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.40 (Confidence level about 95 %, k=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.74 (Confidence level about 95 %, k=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.51 (Confidence level about 95 %, k=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.92 (Confidence level about 95 %, k=2)
Radiated Disturbance (Above 40 GHz)	5.48 (Confidence level about 95 %, k=2)

8. DESCRIPTION OF TESTS

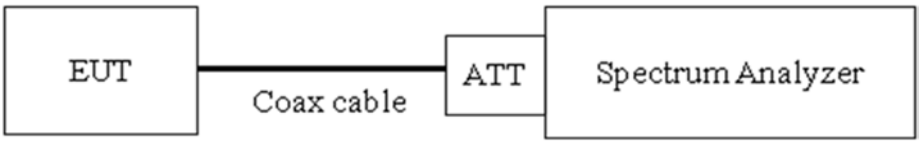
8.1. Conducted Maximum Peak Output Power

Limit

The maximum peak output power of the intentional radiator shall not exceed the following:

1. For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels
2. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer. The Spectrum Analyzer is set to the peak detector mode. This test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.5 in ANSI 63.10-2013 & Procedure 10(b)(6)(i) in KDB 558074 v05r02)

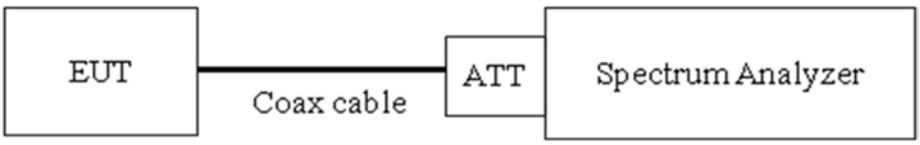
1) Span: approximately 5 times the 20 dB bandwidth, centered on a hopping channel
2) RBW > the 20 dB bandwidth of the emission being measured
3) VBW ≥ RBW
4) Sweep = Auto
5) Detector = Peak
6) Trace = Max hold

8.2. Conducted Band Edge(Out of Band Emissions)

Limit

According to § 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, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Configuration



Test Procedure

This test is performed with hopping off and hopping on.

The Spectrum Analyzer is set to (6.10.4 in ANSI 63.10-2013 & Procedure 8.5 and 8.6 in KDB 558074 v05r02)

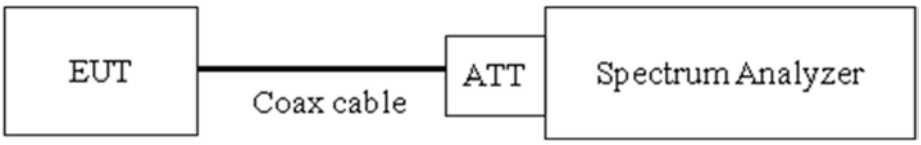
1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
3) Attenuation: Auto (at least 10 dB preferred).
4) Sweep time: Coupled.
5) RBW: 100 kHz
6) VBW: 300 kHz
7) Detector: Peak
8) Trace: Max hold

8.3. Frequency Separation & 20 dB Bandwidth

Limit

According to § 15.247(a)(1), **Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.**

Test Configuration



Test Procedure(Frequency Separation)

The Channel Separation test is performed with hopping on.
And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.2 in ANSI 63.10-2013 & Procedure 10(b)(6)(iii) in KDB 558074 v05r02)

1) Span: Wide enough to capture the peaks of two adjacent channels
2) RBW: Start with the RBW set to approximately 30 % of the channel spacing; adjust as necessary to best identify the center of each individual channel.
3) VBW ≥ RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) All the trace to stabilize.
8) Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

Test Procedure (20 dB Bandwidth)

And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (6.9.2 in ANSI 63.10-2013)

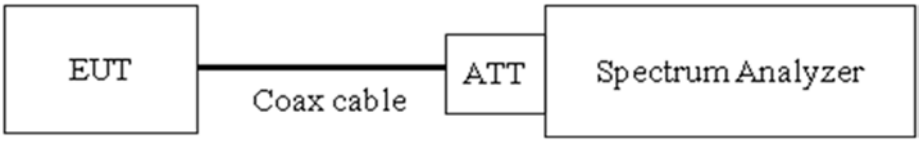
1) Span: Set between two times and five times the OBW
2) RBW: 1 % to 5 % of the OBW.
3) VBW ≥ 3 x RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) All the trace to stabilize.

8.4. Number of Hopping Frequencies

Limit

According to § 15.247(a)(1)(i), **For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies**

Test Configuration



Test Procedure

The Bluetooth frequency hopping function of the EUT was enabled.

The Spectrum Analyzer is set to (7.8.3 in ANSI 63.10-2013 & Procedure 10(b)(4) in KDB 558074 v05r02)

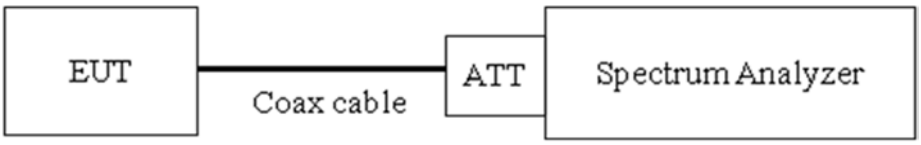
1) Span: the frequency band of operation
2) RBW: To identify clearly the individual channels, set the RBW to less than 30 % of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3) VBW ≥ RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) Allow the trace to stabilize.

8.5. Time of Occupancy

Limit

According to § 15.247(a)(1)(i), **For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period**

Test Configuration



Test Procedure

This test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.4 in ANSI 63.10-2013 & Procedure 10(b)(6)(iv) in KDB 558074 v05r02)

1) Span: Zero span, centered on a hopping channel
2) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
3) Sweep = as necessary to capture the entire dwell time per hopping channel
4) Detector: Peak
5) Trace: Max hold

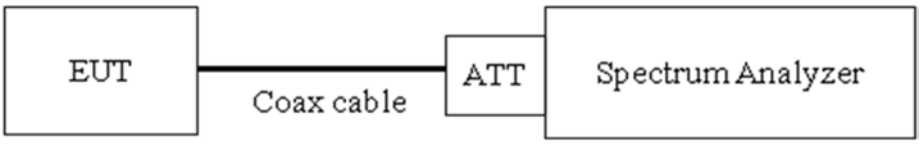
The marker-delta function was used to determine the dwell time.

8.6. Conducted Spurious Emissions

Limit

Conducted > 20 dBc

Test Configuration



Test Procedure

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer.
The Spectrum Analyzer is set to (7.8.8 in ANSI 63.10-2013 & Procedure 8.5 and 8.6 in KDB 558074 v05r02)

1) Span: 30 MHz to 10 times the operating frequency in GHz.
2) RBW: 100 kHz
3) VBW: 300 kHz
4) Sweep: Coupled
5) Detector: Peak

Measurements are made over the 30 MHz to 10 GHz range with the transmitter set to the lowest, middle, and highest channels.
This test is performed with hopping off.

Factors for frequency

Freq(MHz)	Factor(dB)
30	20.04
100	20.07
200	20.12
300	20.17
400	20.20
500	20.21
600	20.21
700	20.23
800	20.30
902	20.35
928	20.35
1 000	20.37
2 000	20.51
2 400	20.53
2 500	20.65
3 000	20.72
4 000	20.80
5 000	20.81
6 000	20.93
7 000	21.20
8 000	21.35
9 000	21.51
10 000	21.97
11 000	22.02
12 000	22.10
13 000	22.19
14 000	22.46
15 000	22.51
16 000	22.52
17 000	22.25
18 000	22.30
19 000	22.32
20 000	22.36
21 000	22.48
22 000	22.55
23 000	22.55
24 000	22.69
25 000	23.08
26 000	23.27

Note :
1. 902 ~ 928 MHz is fundamental frequency range.
2. Factor = Cable loss + Attenuator

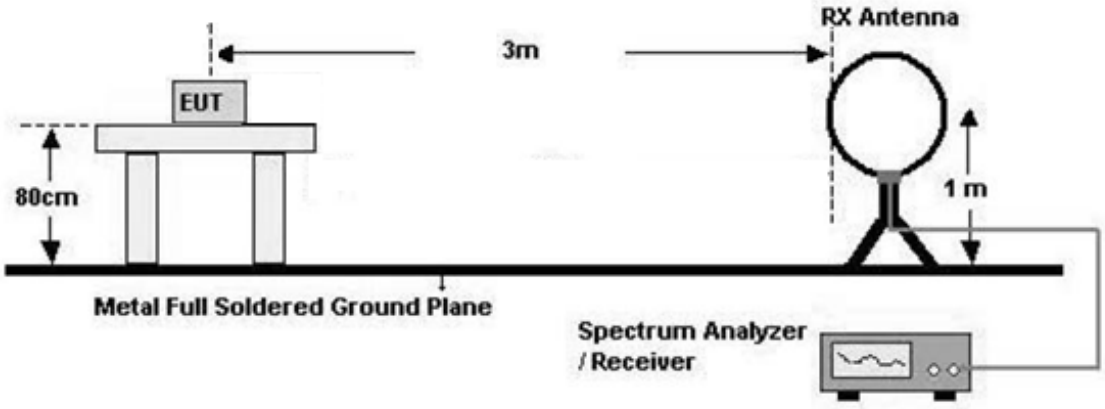
8.7. Radiated Test

Limit

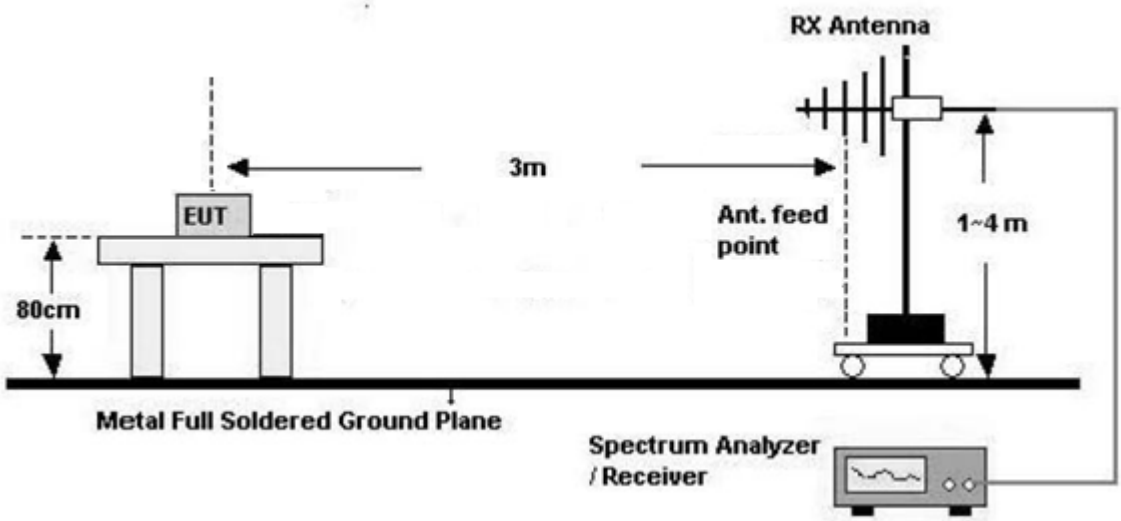
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

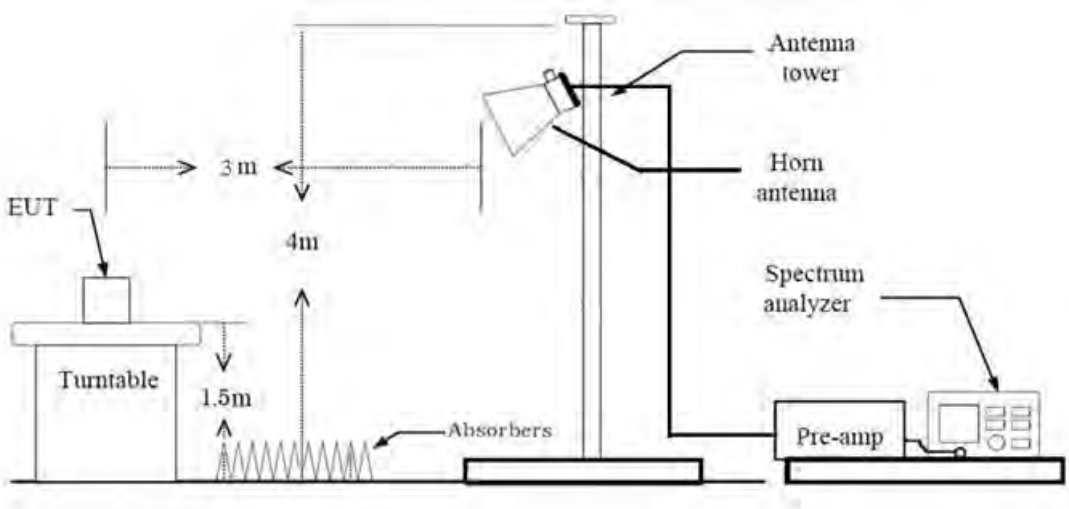
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions(Below 30 MHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3 m from the EUT
3. The EUT is placed on a turntable, which is 0.8 m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor(0.009 MHz – 0.490 MHz) = 40log(3 m/300 m) = - 80 dB
   Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = 40log(3 m/30 m) = - 40 dB
   Measurement Distance : 3 m
8. Spectrum Setting
   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 9 kHz
   - VBW ≥ 3 x RBW
9. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific

emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

KDB 414788 OFS and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

Test Procedure of Radiated spurious emissions(Below 1 GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8 m above ground plane.
3. The Hybrid antenna was placed at a location 3 m from the EUT, which is varied from 1 m to 4 m to find out the highest emissions.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 100 kHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Quasi-peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Quasi-Peak
      - RBW = 120 kHz

   ※In general, (1) is used mainly
7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)
8. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. Radiated test is performed with hopping off.
2. The EUT is placed on a turntable, which is 1.5 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range 1 GHz – 10^{th} Harmonics
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Average):
      - We performed using a reduced video BW method was done with the analyzer in linear mode
      - Measured Frequency Range : 1 GHz – 10^{th} Harmonics
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 1/τ Hz, where τ = pulse width in seconds
        The actual setting value of VBW = 1 kHz

9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
11. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

Test Procedure of Radiated Restricted Band Edge

1. Radiated test is performed with hopping off.
2. The EUT is placed on a turntable, which is 1.5 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 1 GHz – 10th Harmonics
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Average):
      - We performed using a reduced video BW method was done with the analyzer in linear mode
      - Measured Frequency Range : 1 GHz – 10th Harmonics
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 1/τ Hz, where τ = pulse width in seconds
      The actual setting value of VBW = 1 kHz

8. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
9. Total(Measurement Type : Peak, Average)
   = Measured Level + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F) – Amp Gain(A.G)
10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

8.8. AC Power line Conducted Emissions

Limit

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 or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56[a]	56 to 46[a]
0.50 to 5	56	46
5 to 30	60	50

[a]Decreases with the logarithm of the frequency.

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Annex A for the actual connections between EUT and support equipment.

Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors : Quasi Peak and Average Detector.
5. The EUT is the device operating below 30 MHz.
   - For unterminated the Antenna, the AC line conducted tests are performed with the antenna connected
   - For terminated the Antenna, the AC line conducted tests are performed with a dummy load connected to the EUT antenna output terminal.

Sample Calculation

Quasi-peak(Final Result) = Measured Value + Correction Factor

8.8. Worst case configuration and mode

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone
2. EUT Axis
   - Radiated Spurious Emissions : Y
   - Radiated Restricted Band Edge : Y
3. All data rate of operation were investigated and the test results are worst case of each mode.
   - 125 kHz (SF 7, 8, 9, 10)
   - Worst case : 125 kHz SF 10
4. All position of loop antenna were investigated and the test result is a no critical peak found at all positions.
   - Position : Horizontal, Vertical, Parallel to the ground plane

AC Power line Conducted Emissions

1. All modes of operation were investigated and the worst case configuration results are reported.

Conducted test

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : 125kHz (SF 7, 8, 9, 10)
   - Worst case : 125 kHz SF7, 10

9. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	§ 15.247(a)(1)(i)	< 250 kHz	Conducted	PASS
Occupied Bandwidth	N/A	N/A		N/A
Conducted Maximum Peak Output Power	§ 15.247(b)(2)	< 1 W		PASS
Carrier Frequency Separation	§ 15.247(a)(1)	> 25 kHz or > 20 dB BW of hopping channel, whichever is greater.		PASS
Number of Hopping Frequencies	§ 15.247(a)(1)(i)	≥ 50		PASS
Time of Occupancy	§ 15.247(a)(1)(i)	< 400 ms (20s)		PASS
Conducted Spurious Emissions	§ 15.247(d)	> 20 dB for all out-of band emissions		PASS
Band Edge (Out of Band Emissions)	§ 15.247(d)	> 20 dB for all out-of band emissions		PASS
AC Power line Conducted Emissions	§ 15.207(a)	cf. Section 8.8		PASS
Radiated Spurious Emissions	§ 15.247(d), 15.205, 15.209	cf. Section 8.7	Radiated	PASS
Radiated Restricted Band Edge	§ 15.247(d), 15.205, 15.209	cf. Section 8.7		PASS
Receiver Spurious Emissions	N/A	cf. Section 8.9		PASS

10. TEST RESULT

10.1 PEAK POWER

Test Data (LoRa 125k FCC)

Channel	Frequency (MHz)	Output Power (SF7)		Limit (mW)	Result
		(dBm)	(mW)		
Low	902.3	20.572	114.08	250	PASS
Mid	908.5	20.381	109.17		PASS
High	914.9	20.500	112.20		PASS

Channel	Frequency (MHz)	Output Power (SF10)		Limit (mW)	Result
		(dBm)	(mW)		
Low	902.3	20.334	107.99	250	PASS
Mid	908.5	20.397	109.57		PASS
High	914.9	20.523	112.80		PASS

Test Data (LoRa 125k AU)

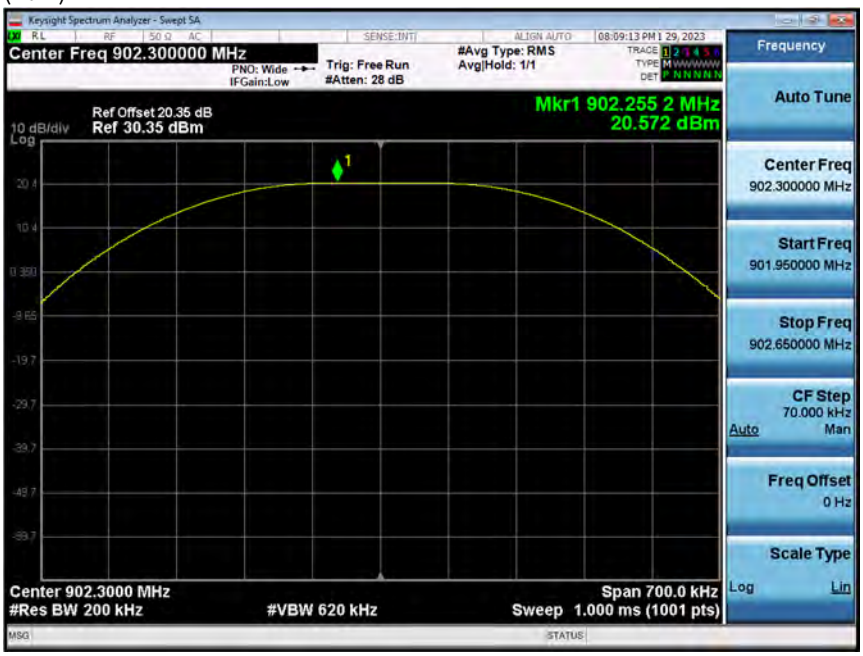
Channel	Frequency (MHz)	Output Power (SF7)		Limit (mW)	Result
		(dBm)	(mW)		
Low	915.2	20.477	111.61	250	PASS
Mid	921.4	20.505	112.33		PASS
High	927.8	20.389	109.37		PASS

Channel	Frequency (MHz)	Output Power (SF10)		Limit (mW)	Result
		(dBm)	(mW)		
Low	915.2	20.485	111.81	250	PASS
Mid	921.4	20.504	112.31		PASS
High	927.8	20.403	109.72		PASS

-LoRa 125k FCC-

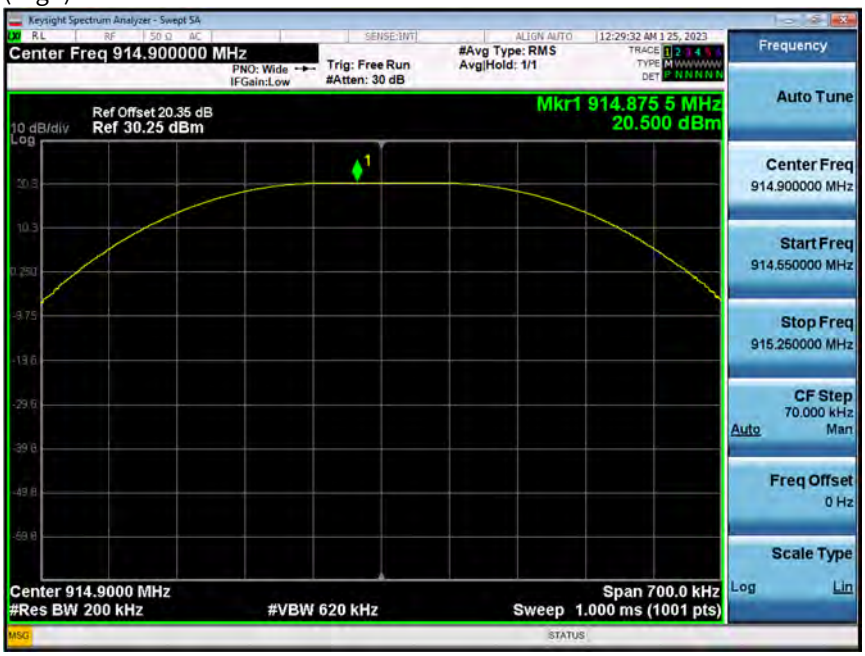
Test Plots (SF7)

Peak Power (Low)



Peak Power (Mid)

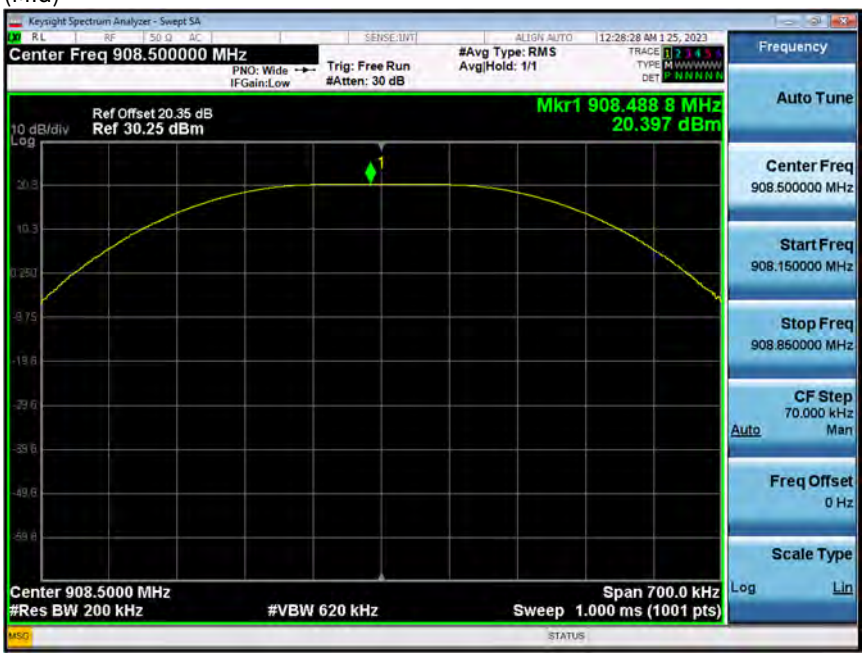
Peak Power (High)



Test Plots (SF10)

Peak Power (Low)

Peak Power (Mid)

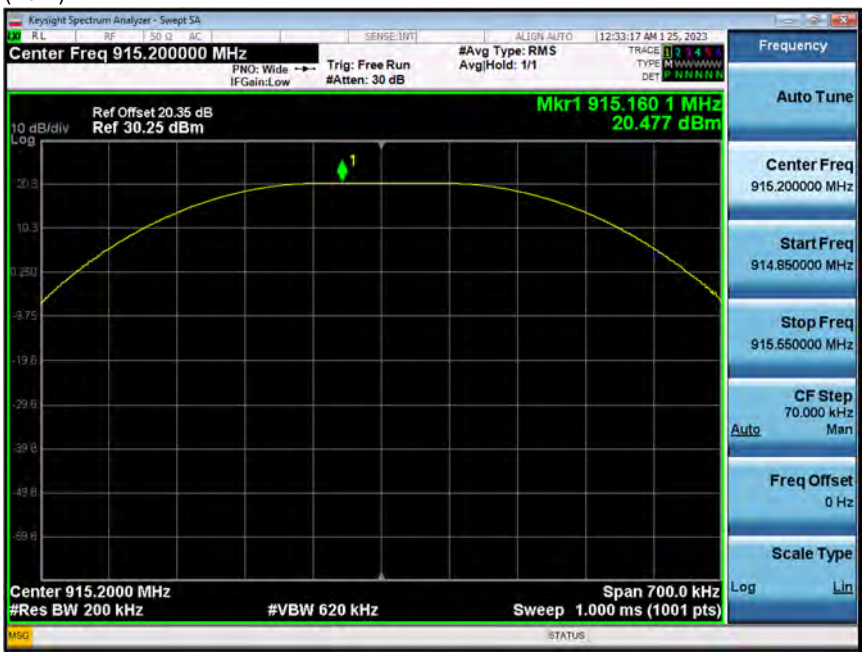


Peak Power (High)

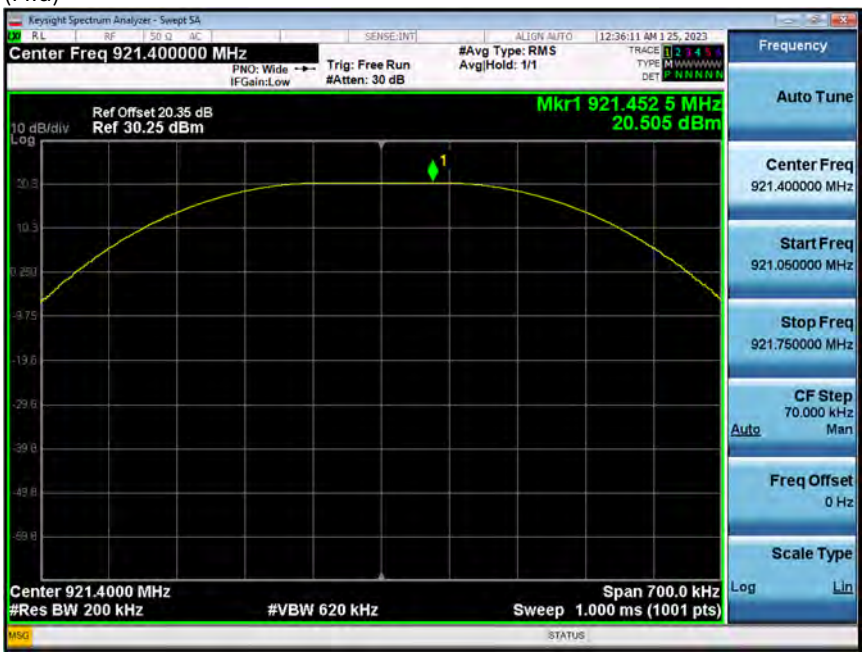
-LoRa 125k AU-

Test Plots (SF7)

Peak Power (Low)



Peak Power (Mid)

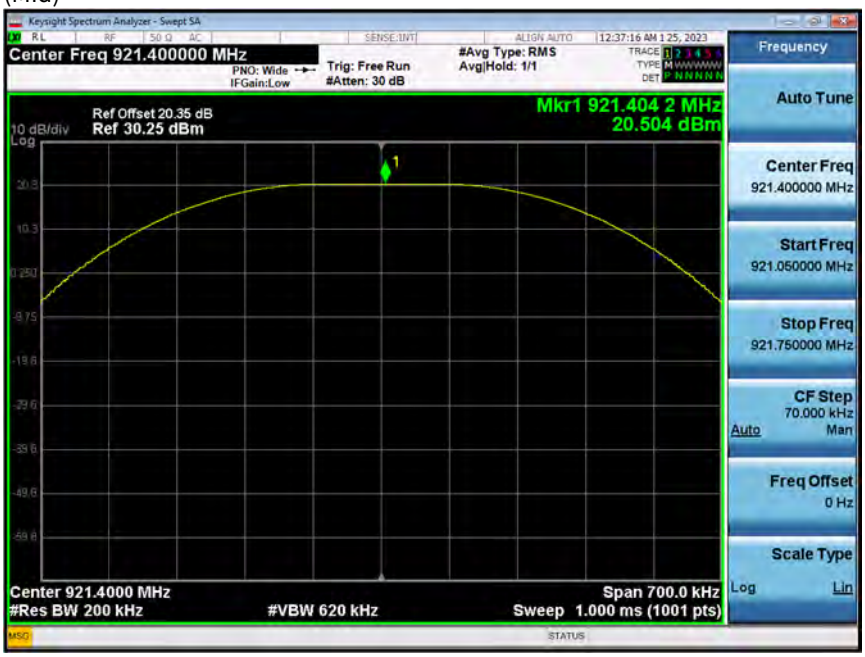


Peak Power (High)

Test Plots (SF10)

Peak Power (Low)

Peak Power (Mid)



Peak Power (High)

10.2 BAND EDGES

Test Data (LoRa 125k FCC)

- Without hopping

Frequency (MHz)	Channel	Position	SF7 (dB)	Limit (dBc)	Margin (dBc)	Result
902.3	Low	Lower	46.791	20	26.791	Pass
914.9	High	Upper	70.795		50.795	Pass

Frequency (MHz)	Channel	Position	SF10 (dB)	Limit (dBc)	Margin (dBc)	Result
902.3	Low	Lower	47.248	20	27.248	Pass
914.9	High	Upper	69.544		49.544	Pass

- With hopping

Frequency (MHz)	Channel	Position	SF7 (dB)	Limit (dBc)	Margin (dBc)	Result
902.3	Low	Lower	49.779	20	29.779	Pass
914.9	High	Upper	69.636		49.636	Pass

Frequency (MHz)	Channel	Position	SF10 (dB)	Limit (dBc)	Margin (dBc)	Result
902.3	Low	Lower	49.810	20	29.810	Pass
914.9	High	Upper	69.612		49.612	Pass

Test Data (LoRa 125k AU)

- Without hopping

Frequency (MHz)	Channel	Position	SF7 (dB)	Limit (dBc)	Margin (dBc)	Result
915.2	Low	Lower	70.400	20	50.400	Pass
927.8	High	Upper	21.669		1.669	Pass

Frequency (MHz)	Channel	Position	SF10 (dB)	Limit (dBc)	Margin (dBc)	Result
915.2	Low	Lower	69.949	20	49.949	Pass
927.8	High	Upper	21.081		1.081	Pass

- With hopping

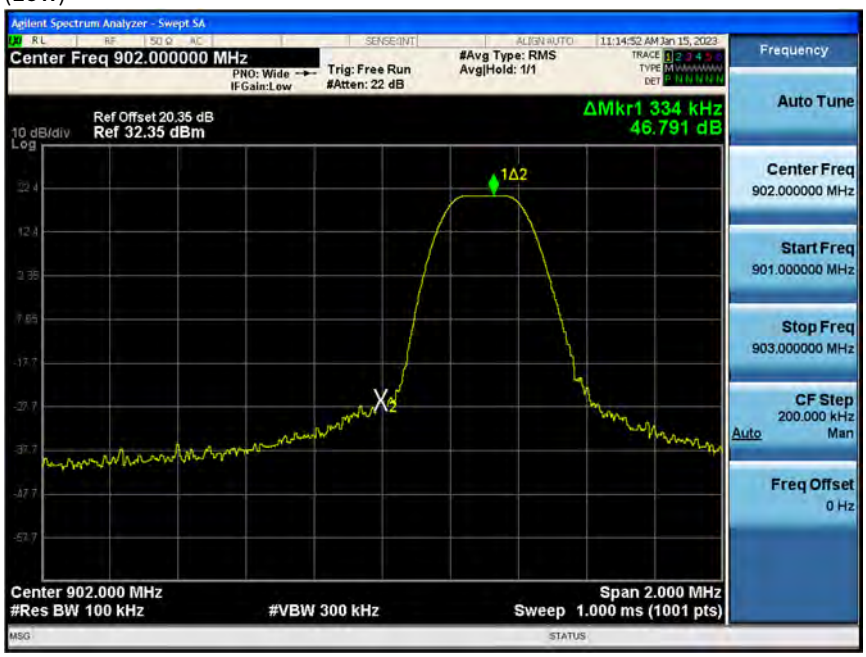
Frequency (MHz)	Channel	Position	SF7 (dB)	Limit (dBc)	Margin (dBc)	Result
915.2	Low	Lower	71.155	20	51.155	Pass
927.8	High	Upper	25.551		5.551	Pass

Frequency (MHz)	Channel	Position	SF10 (dB)	Limit (dBc)	Margin (dBc)	Result
915.2	Low	Lower	70.946	20	50.946	Pass
927.8	High	Upper	22.185		2.185	Pass

- LoRa 125k FCC-

Test Plots without hopping (SF7)

Band Edges (Low)



Band Edges (High)

Test Plots with hopping (SF7)

Band Edges (Low)

Band Edges (High)

Test Plots without hopping (SF10)

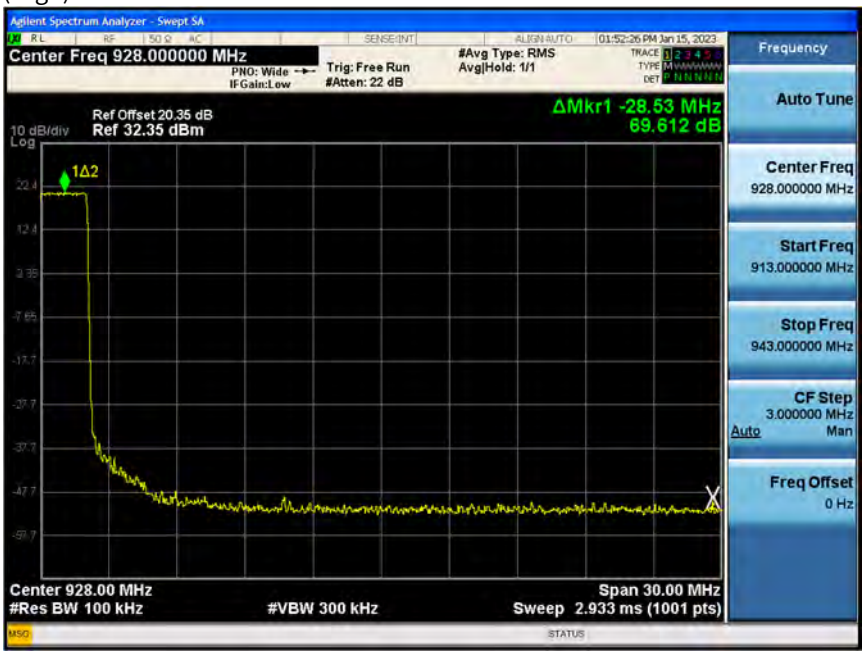
Band Edges (Low)

Band Edges (High)

Test Plots with hopping (SF10)

Band Edges (Low)

Band Edges (High)



- LoRa 125k AU-

Test Plots without hopping (SF7)

Band Edges (Low)

Band Edges (High)

Test Plots with hopping (SF7)

Band Edges (Low)

Band Edges (High)

Test Plots without hopping (SF10)

Band Edges (Low)

Band Edges (High)

Test Plots with hopping (SF10)

Band Edges (Low)

Band Edges (High)

10.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99 % BW)

Test Data (LoRa 125k FCC)

Channel Separation (kHz)		20 dB Bandwidth (kHz)					Limit (kHz)	Result
SF7	SF10	Channel	SF 7	Limit (kHz)	SF 10	Limit (kHz)		
200.4	201.0	Low	143.5	144.1	143.6	143.9	>25 or > 20 dB BW of hopping channel, Whichever is greater	Pass
		Mid	144.1		143.9			
		High	143.1		143.3			

Occupied Bandwidth (99 % BW)

	99 % BW (kHz)			
Channel	SF	Low-ch	Mid-ch	High-ch
	SF7	125.62	125.91	125.55
	SF10	125.64	125.95	125.58

Test Data (LoRa 125k AU)

Channel Separation (kHz)		20 dB Bandwidth (kHz)					Limit (kHz)	Result
SF7	SF10	Channel	SF 7	Limit (kHz)	SF 10	Limit (kHz)		
200.4	201.0	Low	144.2	144.5	143.9	143.9	25 or > 20 dB BW of hopping channel Whichever is greater	Pass
		Mid	144.5		143.1			
		High	142.9		142.9			

Occupied Bandwidth (99 % BW)

	99 % BW (kHz)			
Channel	SF	Low-ch	Mid-ch	High-ch
	SF7	126.00	126.12	125.36
	SF10	125.91	125.43	125.37

-LoRa 125k FCC-

Test Plots (SF7)

Channel Separation

Test Plots (SF10)

Channel Separation

Test Plots (SF7)

20 dB Bandwidth & Occupied Bandwidth (Low)

Test Plots (SF7)

20 dB Bandwidth & Occupied Bandwidth (Mid)

Test Plots (SF7)

20 dB Bandwidth & Occupied Bandwidth (High)

Test Plots (SF10)

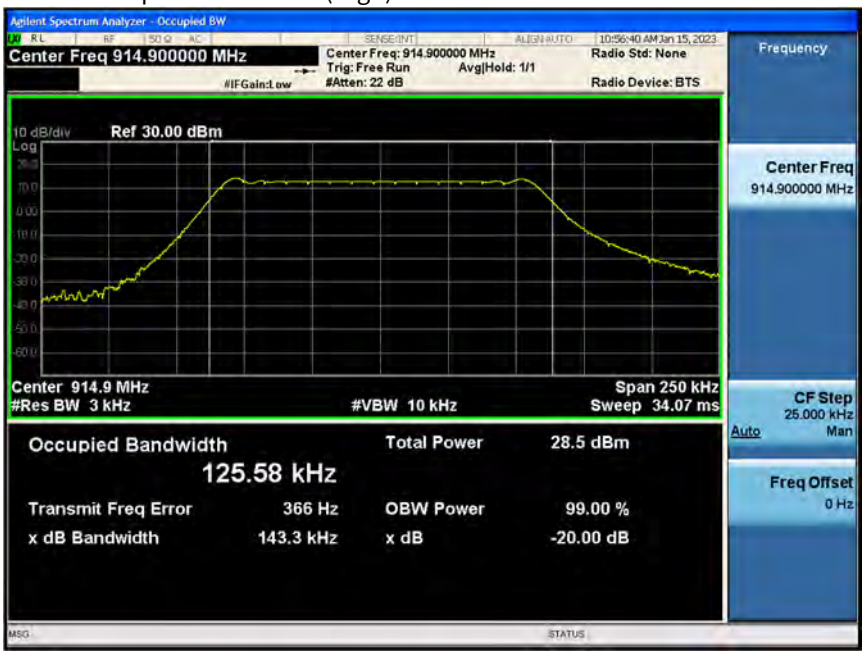
20 dB Bandwidth & Occupied Bandwidth (Low)

Test Plots (SF10)

20 dB Bandwidth & Occupied Bandwidth (Mid)

Test Plots (SF10)

20 dB Bandwidth & Occupied Bandwidth (High)



-LoRa 125k AU-

Test Plots (SF7)

Channel Separation

Test Plots (SF10)

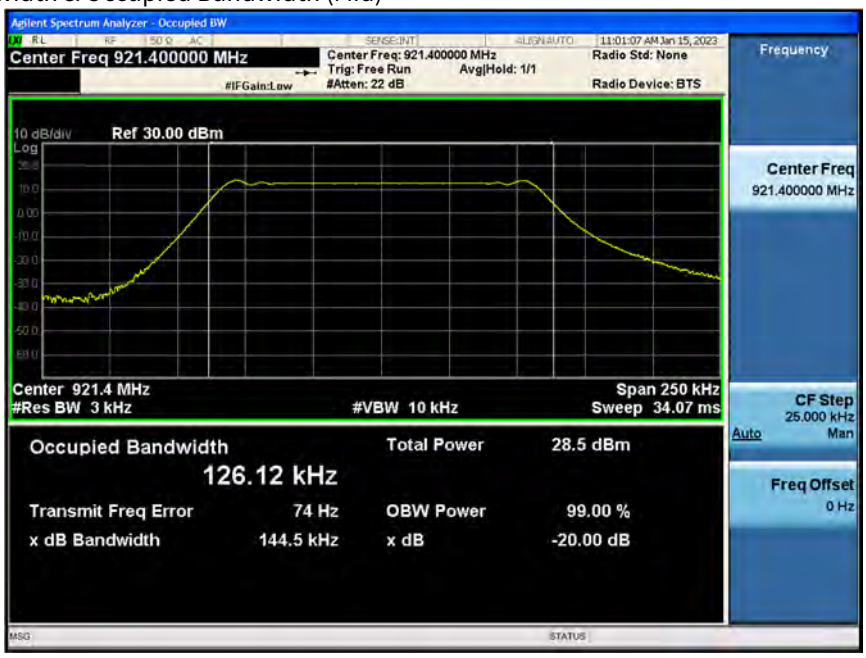
Channel Separation

Test Plots (SF7)

20 dB Bandwidth & Occupied Bandwidth (Low)

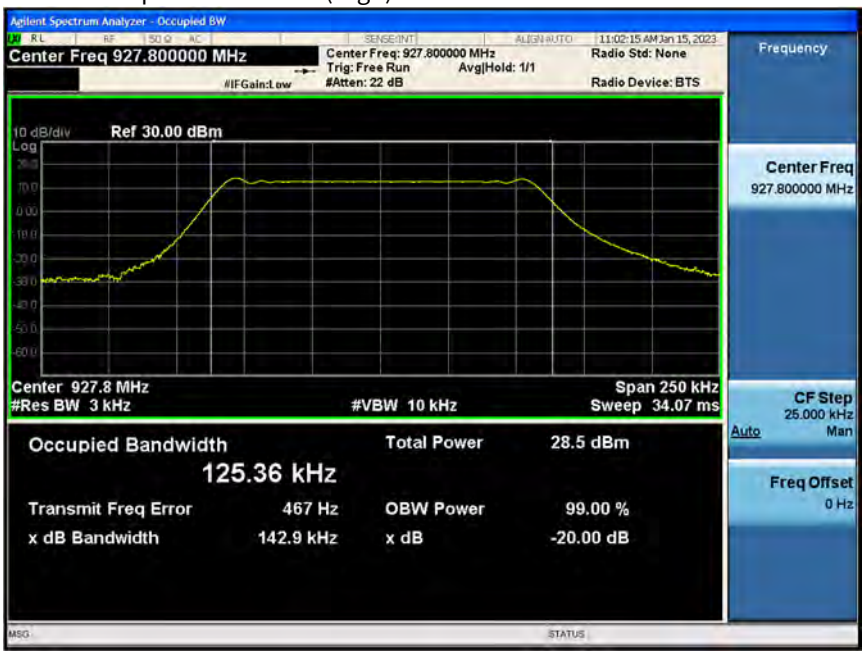
Test Plots (SF7)

20 dB Bandwidth & Occupied Bandwidth (Mid)



Test Plots (SF7)

20 dB Bandwidth & Occupied Bandwidth (High)



Test Plots (SF10)

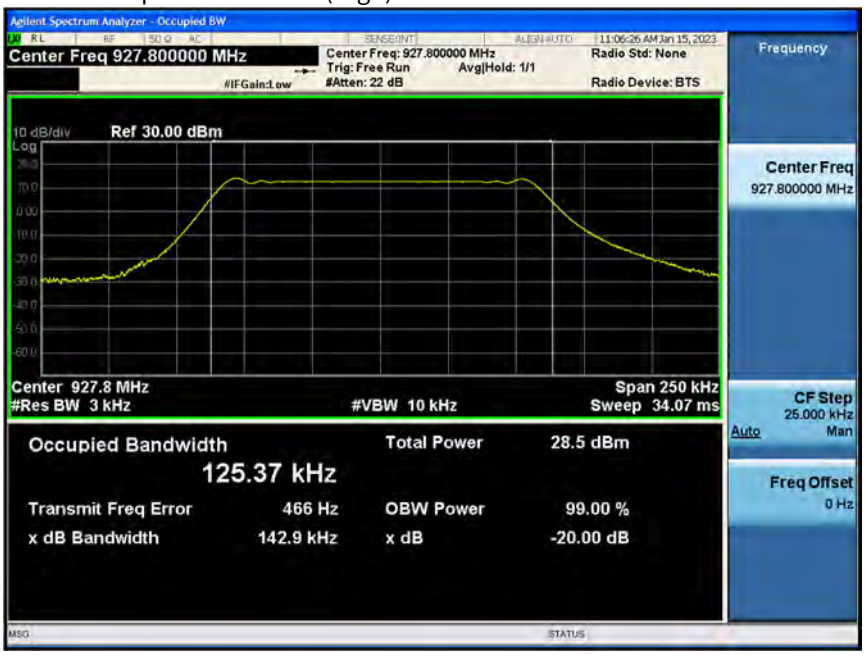
20 dB Bandwidth & Occupied Bandwidth (Low)

Test Plots (SF10)

20 dB Bandwidth & Occupied Bandwidth (Mid)

Test Plots (SF10)

20 dB Bandwidth & Occupied Bandwidth (High)



10.4 NUMBER OF HOPPING FREQUENCY

Result (No. of CH)		Limit
SF7	SF10	
64	64	> 50

- LoRa 125k FCC-

Test Plots

Number of Channels (SF7)

Test Plots

Number of Channels (SF10)

-LoRa 125k AU-

Test Plots

Number of Channels (SF7)

Test Plots

Number of Channels (SF10)

10.5 TIME OF OCCUPANCY (DWELL TIME)

TEST RESULTS (LoRa 125k FCC)

See the table.

	Channel	SF7	SF10	Limit (ms)	Result
Dwell Time (ms)	Low	348.5	289.0	400	Pass
	Mid	348.5	289.0		Pass
	High	348.4	289.0		Pass

TEST RESULTS (LoRa 125k AU)

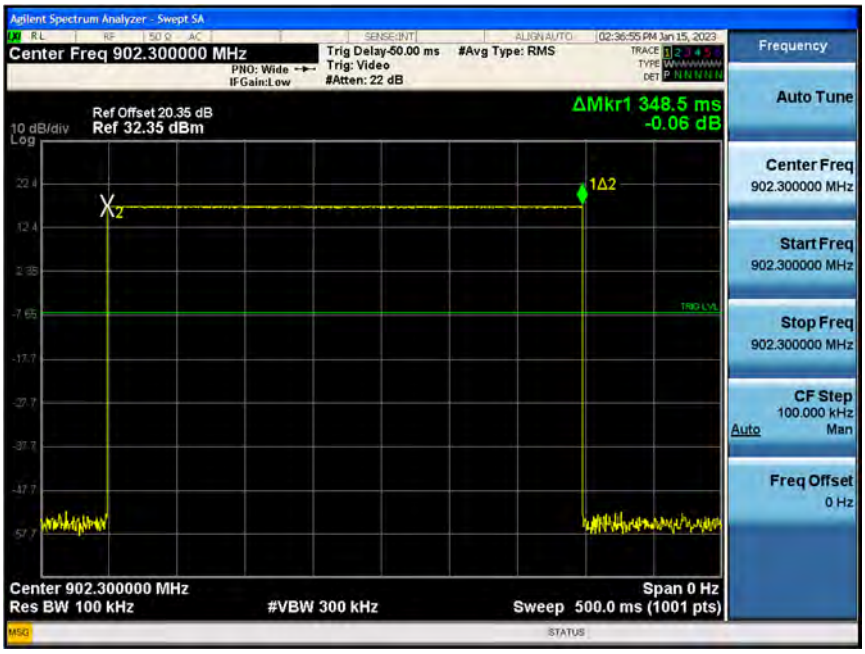
See the table.

	Channel	SF7	SF10	Limit (ms)	Result
Dwell Time (ms)	Low	348.5	289.0	400	Pass
	Mid	348.5	288.5		Pass
	High	348.5	288.5		Pass

- LoRa 125k FCC-

Test Plots (Channel Low_SF7)

Dwell time = 348.5 ms

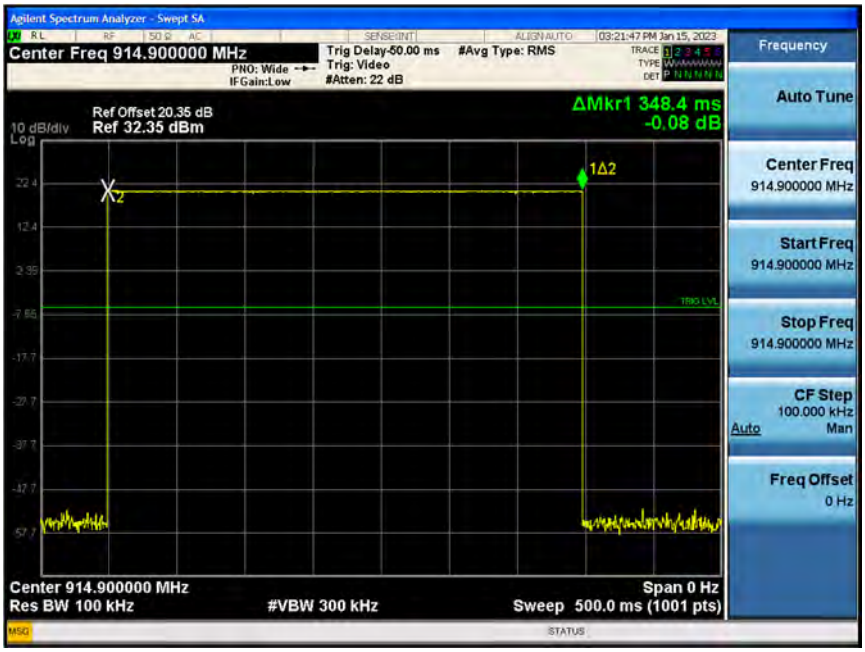


Test Plots (Channel Mid_SF7)

Dwell time = 348.5 ms

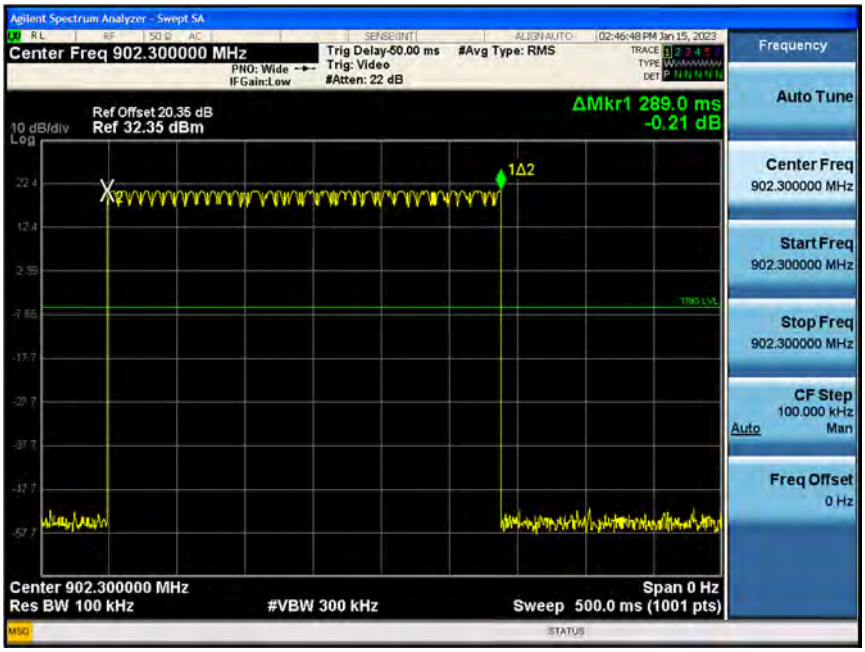
Test Plots (Channel High_SF7)

Dwell time = 348.4 ms



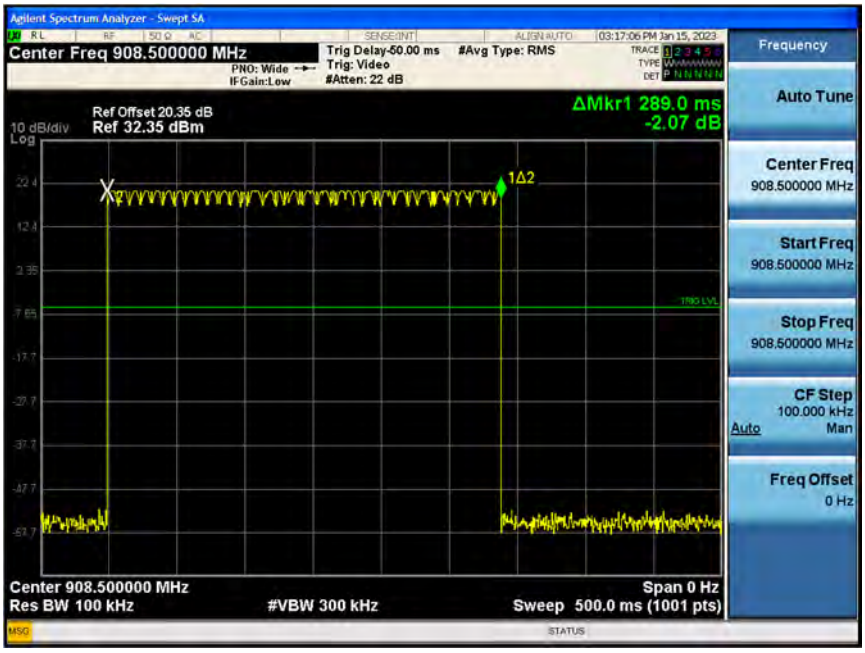
Test Plots (Channel Low_SF10)

Dwell time = 289.0 ms



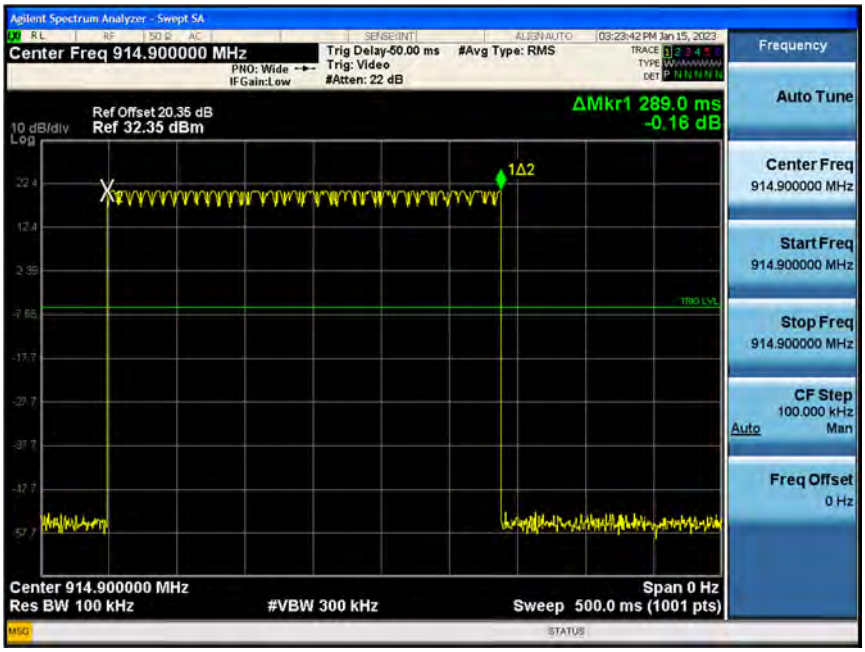
Test Plots (Channel Mid_SF10)

Dwell time = 289.0 ms



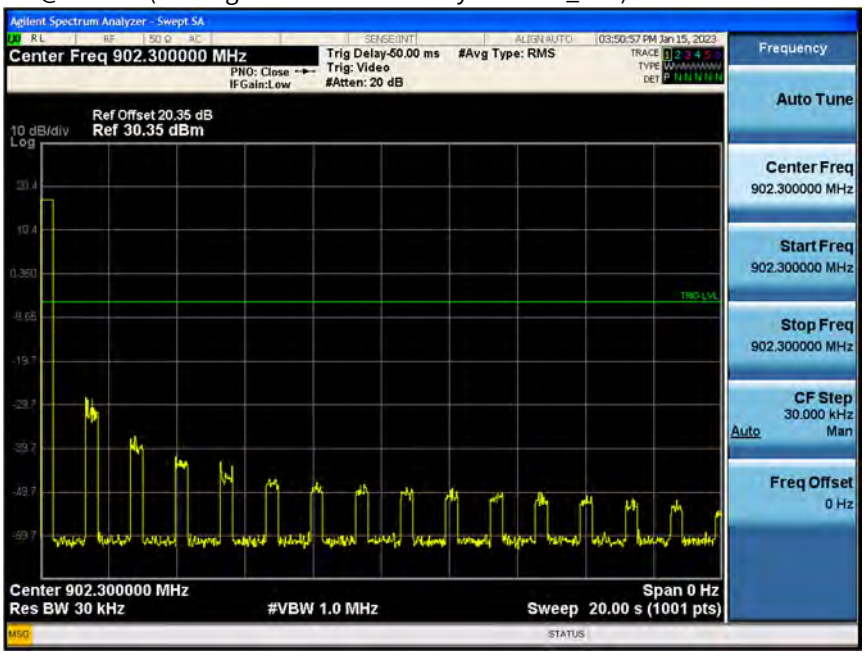
Test Plots (Channel High_SF10)

Dwell time = 289.0 ms



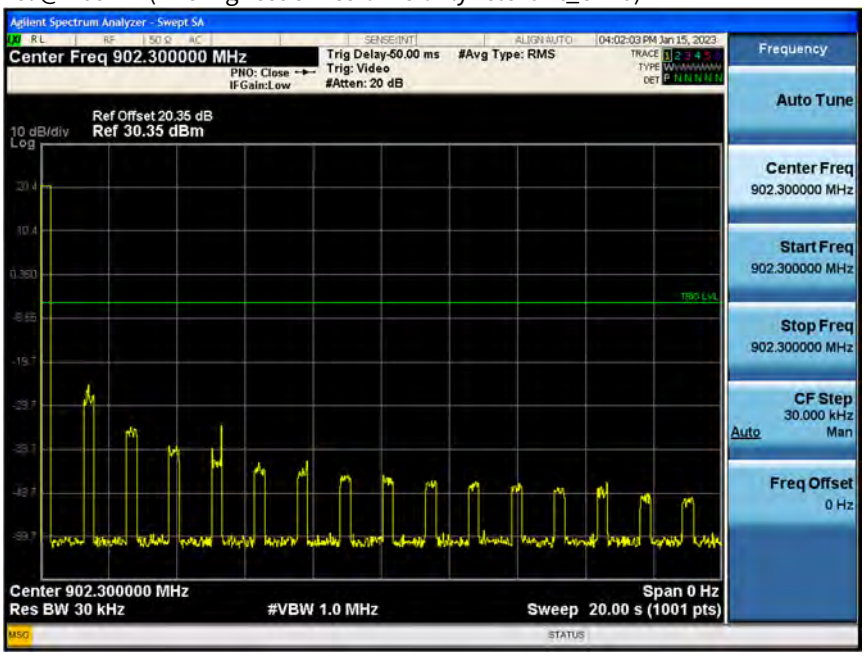
Test Plots

Hops / channel @ 20s = 1 (The highest emission is only relevant_SF7)



Test Plots

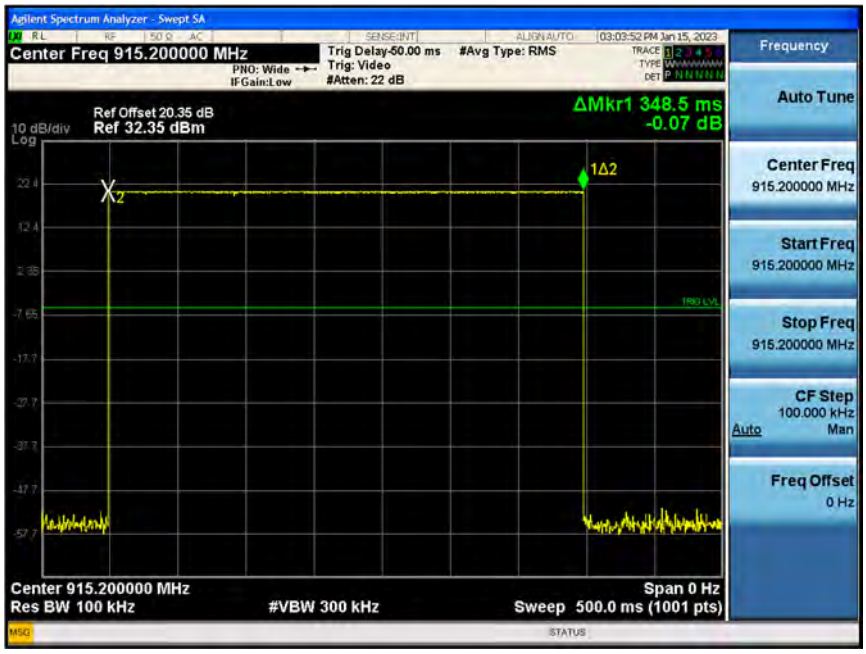
Hops / channel @ 20s = 1 (The highest emission is only relevant_SF10)



- LoRa 125k AU-

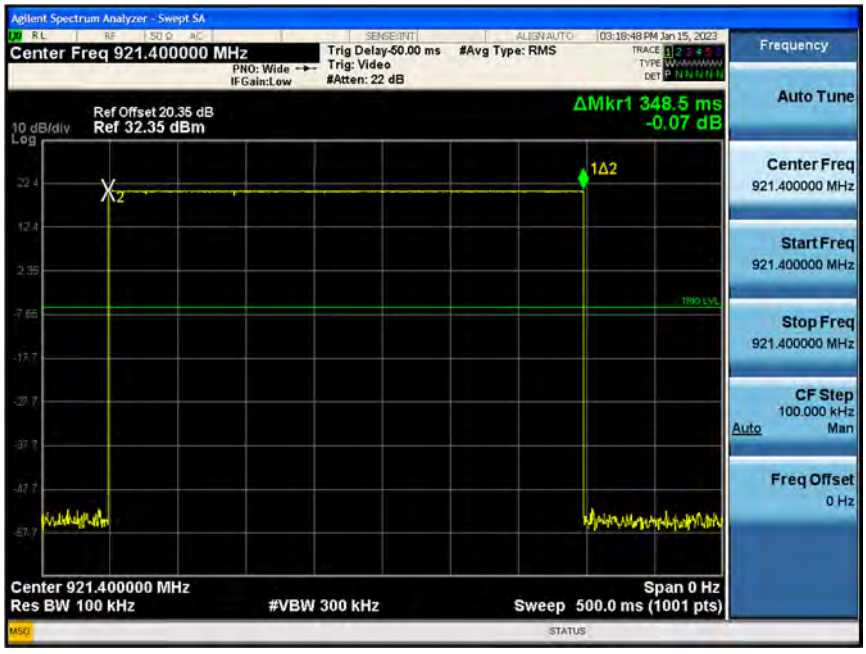
Test Plots (Channel Low_SF7)

Dwell time = 348.5 ms



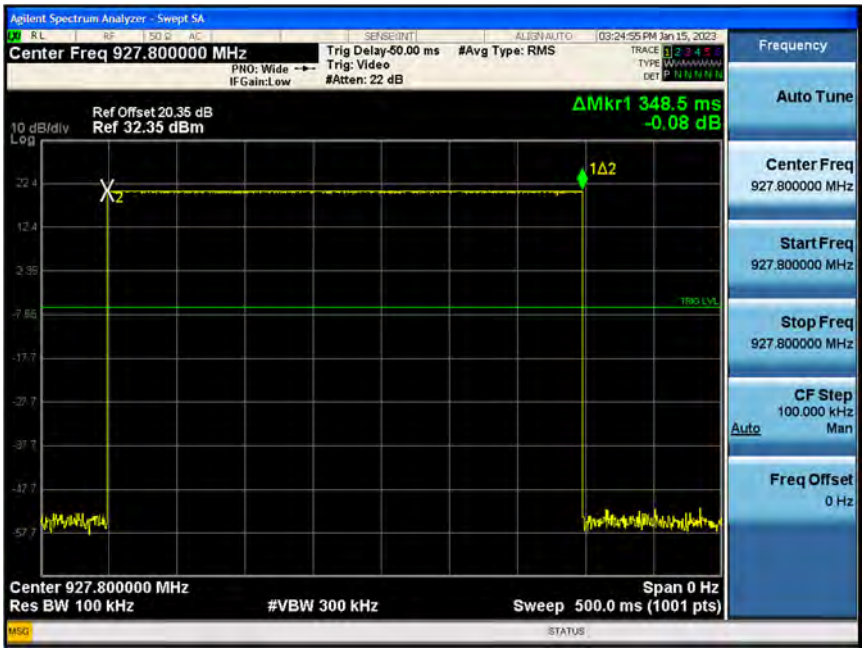
Test Plots (Channel Mid_SF7)

Dwell time = 348.5 ms



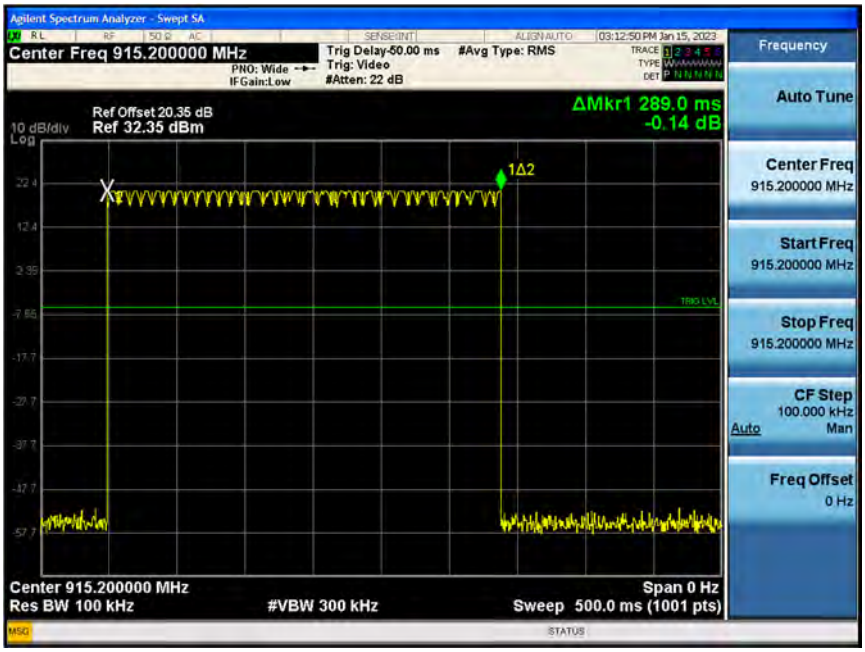
Test Plots (Channel High_SF7)

Dwell time = 348.5 ms



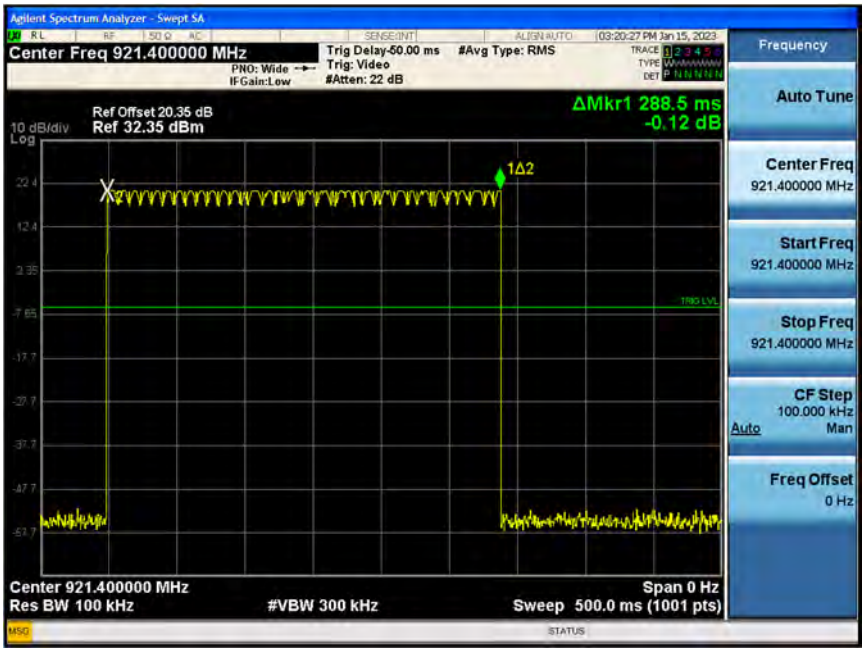
Test Plots (Channel Low_SF10)

Dwell time = 289.0 ms



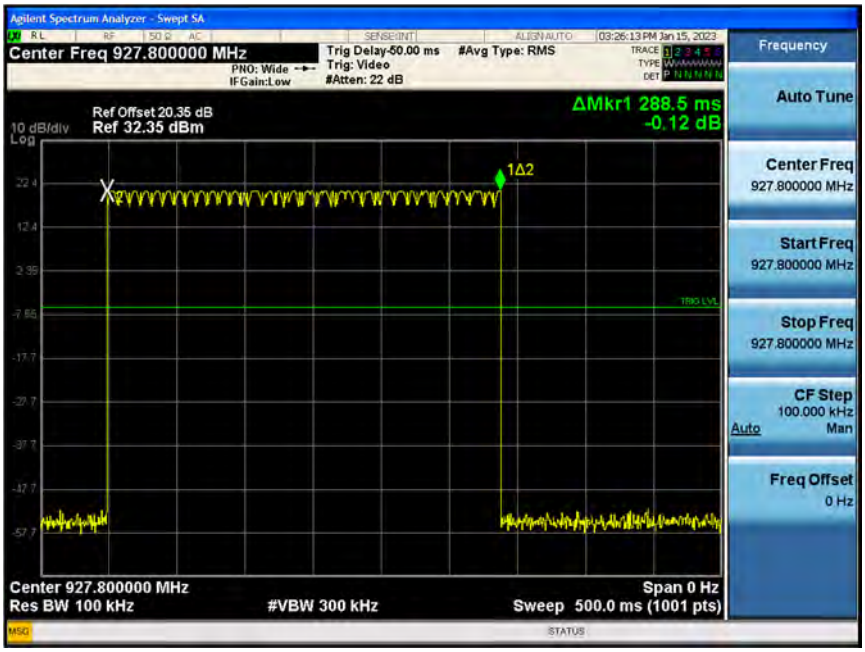
Test Plots (Channel Mid_SF10)

Dwell time = 288.5 ms



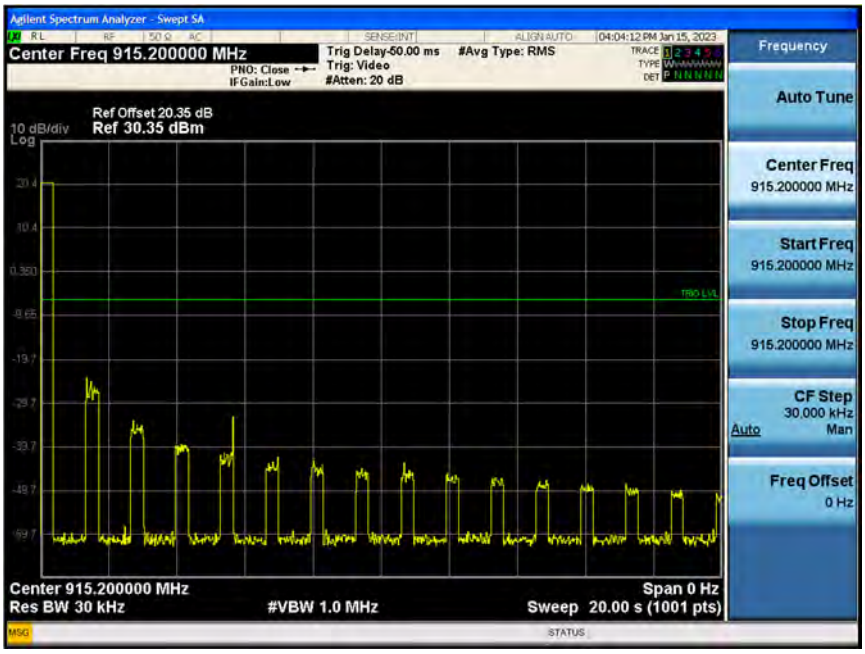
Test Plots (Channel High_SF10)

Dwell time = 288.5 ms



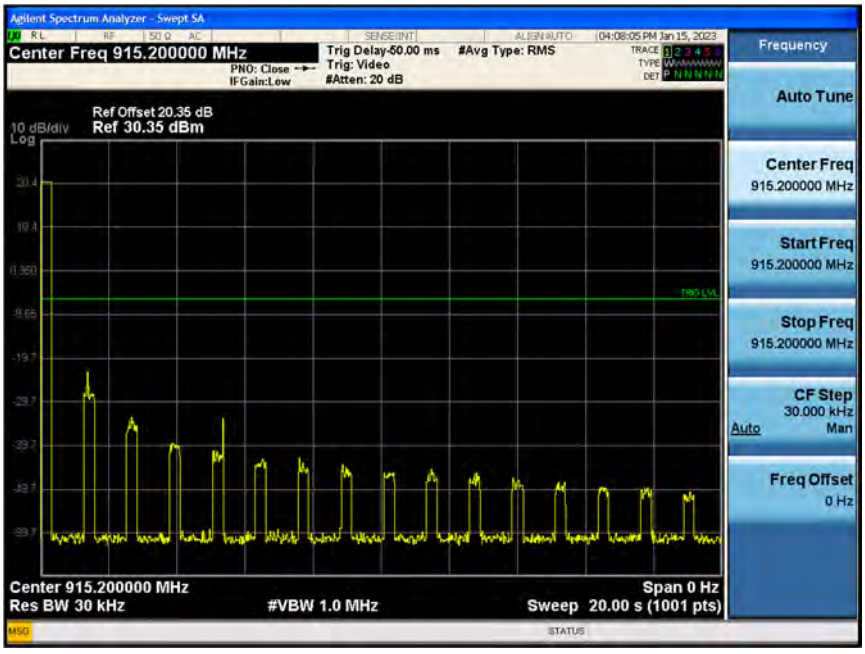
Test Plots

Hops / channel @ 20s = 1 (The highest emission is only relevant_SF7)



Test Plots

Hops / channel @ 20s = 1 (The highest emission is only relevant_SF10)



10.6 SPURIOUS EMISSIONS

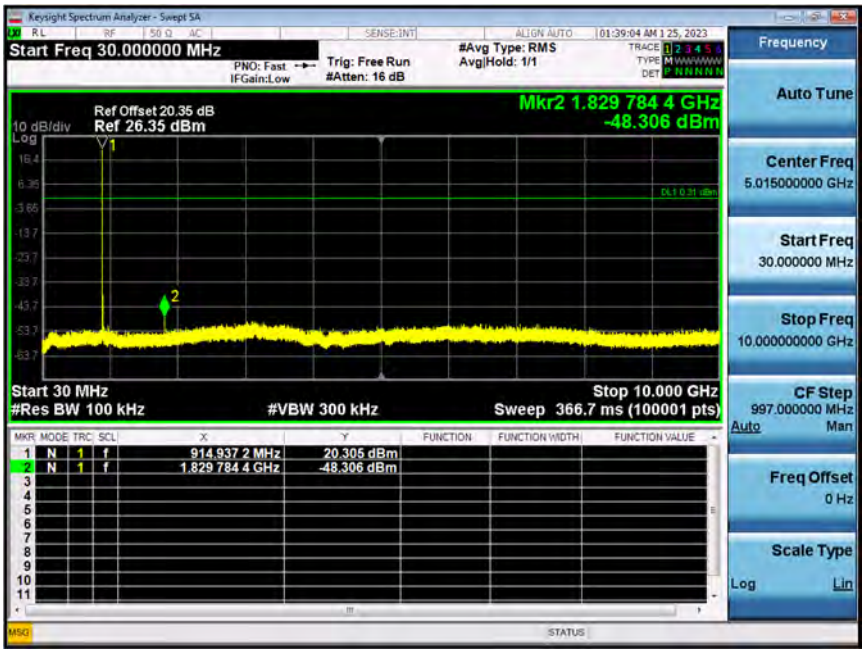
10.6.1 CONDUCTED SPURIOUS EMISSIONS

Test Result : please refer to the plot below.
In order to simplify the report, attached plots were only the worst case channel and data rate.

- LoRa 125k FCC -

Test Plots (SF7)

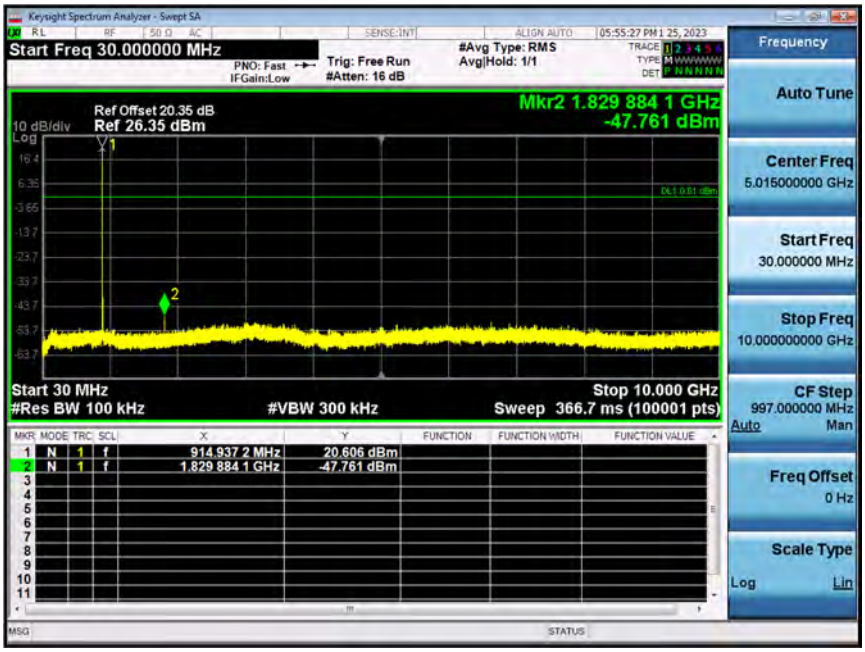
Spurious Emission (High)



- Limit : 0.31 dBm

Test Plots (SF10)

Spurious Emission (High)



- Limit : 0.61 dBm

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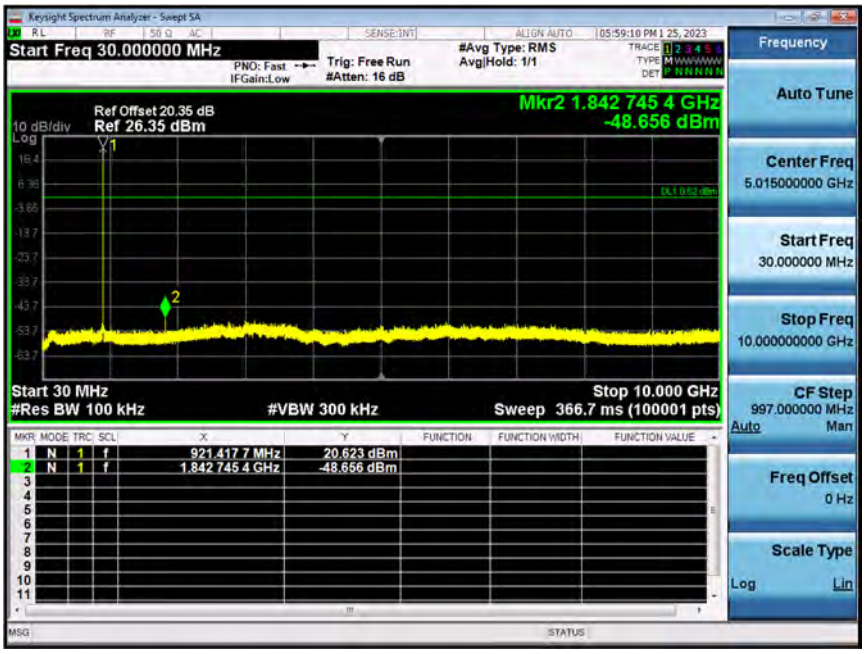
Test Plots (SF7)

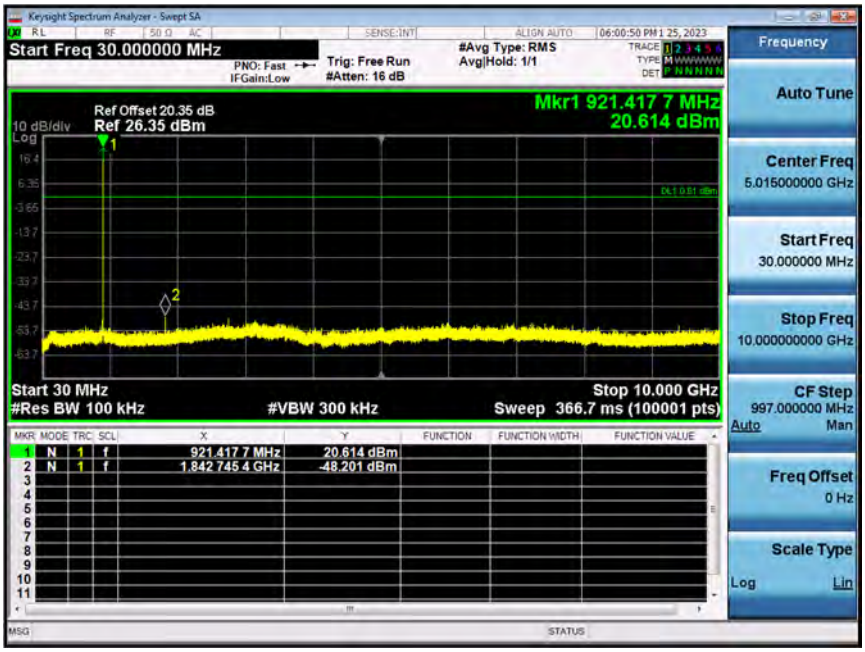
Spurious Emission (Mid)



- Limit : 0.62 dBm

Test Plots (SF10)

Spurious Emission (Mid)



- Limit : 0.61 dBm

10.6.2 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

Frequency	Measured Value	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμV/m	dBm/m	dB	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

Note:

1. The Measured of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
2. Distance extrapolation factor = 40log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBμV) + Distance extrapolation factor
4. Radiated test is performed with hopping off.

Frequency Range : Below 1 GHz

Frequency	Measured Value	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμV/m	dBm/m	dB	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
2. Radiated test is performed with hopping off.

Frequency Range : Above 1 GHz

Channel : SF10_Low (LoRa 125k FCC)

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
1 804.60	-	-2.74	H	-2.74	Non restricted Band		PK
1 804.60	-	-2.74	H	-2.74	Non restricted Band		AV
2 706.90	48.95	2.38	H	51.33	73.98	22.65	PK
2 706.90	38.19	2.38	H	40.57	53.98	13.41	AV
3 609.20	45.04	6.23	H	51.27	73.98	22.71	PK
3 609.20	31.03	6.23	H	37.26	53.98	16.72	AV
4 511.50	44.51	9.87	H	54.38	73.98	19.60	PK
4 511.50	30.26	9.87	H	40.13	53.98	13.85	AV
5 413.80	43.21	12.58	H	55.79	73.98	18.19	PK
5 413.80	30.18	12.58	H	42.76	53.98	11.22	AV
6 316.10	-	14.64	H	14.64	Non restricted Band		PK
6 316.10	-	14.64	H	14.64	Non restricted Band		AV
7 218.40	-	-4.34	H	-4.34	Non restricted Band		PK
7 218.40	-	-4.34	H	-4.34	Non restricted Band		AV
8 120.70	51.95	-2.33	H	49.62	73.98	24.36	PK
8 120.70	38.02	-2.33	H	35.69	53.98	18.29	AV
9 023.00	50.31	1.34	H	51.65	73.98	22.33	PK
9 023.00	37.00	1.34	H	38.34	53.98	15.64	AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
1 804.60	-	-2.74	V	-2.74	Non restricted Band		PK
1 804.60	-	-2.74	V	-2.74	Non restricted Band		AV
2 706.90	48.53	2.38	V	50.91	73.98	23.07	PK
2 706.90	36.89	2.38	V	39.27	53.98	14.71	AV
3 609.20	44.95	6.23	V	51.18	73.98	22.80	PK
3 609.20	30.97	6.23	V	37.20	53.98	16.78	AV
4 511.50	44.28	9.87	V	54.15	73.98	19.83	PK
4 511.50	30.12	9.87	V	39.99	53.98	13.99	AV
5 413.80	43.27	12.58	V	55.85	73.98	18.13	PK
5 413.80	30.20	12.58	V	42.78	53.98	11.20	AV
6 316.10	-	14.64	V	14.64	Non restricted Band		PK
6 316.10	-	14.64	V	14.64	Non restricted Band		AV
7 218.40	-	-4.34	V	-4.34	Non restricted Band		PK
7 218.40	-	-4.34	V	-4.34	Non restricted Band		AV
8 120.70	52.06	-2.33	V	49.73	73.98	24.25	PK
8 120.70	38.07	-2.33	V	35.74	53.98	18.24	AV
9 023.00	50.41	1.34	V	51.75	73.98	22.23	PK
9 023.00	37.02	1.34	V	38.36	53.98	15.62	AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Channel : SF10_Mid (LoRa 125k FCC)

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
1 817.00	-	-2.67	H	-2.67	Non restricted Band		PK
1 817.00	-	-2.67	H	-2.67	Non restricted Band		AV
2 725.50	48.42	2.56	H	50.98	73.98	23.00	PK
2 725.50	36.62	2.56	H	39.18	53.98	14.80	AV
3 634.00	44.98	6.25	H	51.23	73.98	22.75	PK
3 634.00	31.33	6.25	H	37.58	53.98	16.40	AV
4 542.50	44.04	9.87	H	53.91	73.98	20.07	PK
4 542.50	30.22	9.87	H	40.09	53.98	13.89	AV
5 451.00	42.82	13.15	H	55.97	73.98	18.01	PK
5 451.00	29.36	13.15	H	42.51	53.98	11.47	AV
6 359.50	-	14.86	H	14.86	Non restricted Band		PK
6 359.50	-	14.86	H	14.86	Non restricted Band		AV
7 268.00	53.67	-4.55	H	49.12	73.98	24.86	PK
7 268.00	40.24	-4.55	H	35.69	53.98	18.29	AV
8 176.50	51.45	-1.35	H	50.10	73.98	23.88	PK
8 176.50	38.02	-1.35	H	36.67	53.98	17.31	AV
9 085.00	49.76	1.38	H	51.14	73.98	22.84	PK
9 085.00	35.69	1.38	H	37.07	53.98	16.91	AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
1 817.00	-	-2.67	V	-2.67	Non restricted Band		PK
1 817.00	-	-2.67	V	-2.67	Non restricted Band		AV
2 725.50	48.31	2.56	V	50.87	73.98	23.11	PK
2 725.50	36.59	2.56	V	39.15	53.98	14.83	AV
3 634.00	44.72	6.25	V	50.97	73.98	23.01	PK
3 634.00	31.29	6.25	V	37.54	53.98	16.44	AV
4 542.50	43.87	9.87	V	53.74	73.98	20.24	PK
4 542.50	30.18	9.87	V	40.05	53.98	13.93	AV
5 451.00	42.62	13.15	V	55.77	73.98	18.21	PK
5 451.00	29.57	13.15	V	42.72	53.98	11.26	AV
6 359.50	-	14.86	V	14.86	Non restricted Band		PK
6 359.50	-	14.86	V	14.86	Non restricted Band		AV
7 268.00	54.05	-4.55	V	49.50	73.98	24.48	PK
7 268.00	40.14	-4.55	V	35.59	53.98	18.39	AV
8 176.50	51.83	-1.35	V	50.48	73.98	23.50	PK
8 176.50	38.19	-1.35	V	36.84	53.98	17.14	AV
9 085.00	50.18	1.38	V	51.56	73.98	22.42	PK
9 085.00	35.97	1.38	V	37.35	53.98	16.63	AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Channel : SF10_High (LoRa 125k FCC)

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
1 829.80	-	-2.58	H	-2.58	Non restricted Band		PK
1 829.80	-	-2.58	H	-2.58	Non restricted Band		AV
2 744.70	48.22	2.54	H	50.76	73.98	23.22	PK
2 744.70	36.16	2.54	H	38.70	53.98	15.28	AV
3 659.60	44.88	6.49	H	51.37	73.98	22.61	PK
3 659.60	31.25	6.49	H	37.74	53.98	16.24	AV
4 574.50	43.78	9.92	H	53.70	73.98	20.28	PK
4 574.50	30.16	9.92	H	40.08	53.98	13.90	AV
5 489.40	-	12.87	H	12.87	Non restricted Band		PK
5 489.40	-	12.87	H	12.87	Non restricted Band		AV
6 404.30	-	15.11	H	15.11	Non restricted Band		PK
6 404.30	-	15.11	H	15.11	Non restricted Band		AV
7 319.20	53.68	-3.71	H	49.97	73.98	24.01	PK
7 319.20	39.91	-3.71	H	36.20	53.98	17.78	AV
8 234.10	52.17	-1.82	H	50.35	73.98	23.63	PK
8 234.10	38.15	-1.82	H	36.33	53.98	17.65	AV
9 149.00	49.93	1.35	H	51.28	73.98	22.70	PK
9 149.00	36.02	1.35	H	37.37	53.98	16.61	AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
1 829.80	-	-2.58	V	-2.58	Non restricted Band		PK
1 829.80	-	-2.58	V	-2.58	Non restricted Band		AV
2 744.70	47.13	2.54	V	49.67	73.98	24.31	PK
2 744.70	35.07	2.54	V	37.61	53.98	16.37	AV
3 659.60	44.68	6.49	V	51.17	73.98	22.81	PK
3 659.60	31.08	6.49	V	37.57	53.98	16.41	AV
4 574.50	44.71	9.92	V	54.63	73.98	19.35	PK
4 574.50	30.31	9.92	V	40.23	53.98	13.75	AV
5 489.40	-	12.87	V	12.87	Non restricted Band		PK
5 489.40	-	12.87	V	12.87	Non restricted Band		AV
6 404.30	-	15.11	V	15.11	Non restricted Band		PK
6 404.30	-	15.11	V	15.11	Non restricted Band		AV
7 319.20	53.81	-3.71	V	50.10	73.98	23.88	PK
7 319.20	40.39	-3.71	V	36.68	53.98	17.30	AV
8 234.10	52.07	-1.82	V	50.25	73.98	23.73	PK
8 234.10	38.04	-1.82	V	36.22	53.98	17.76	AV
9 149.00	50.26	1.35	V	51.61	73.98	22.37	PK
9 149.00	36.12	1.35	V	37.47	53.98	16.51	AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Channel : SF10_Low (LoRa 125k AU)

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
1 830.40	-	-2.74	H	-2.74	Non restricted Band		PK
1 830.40	-	-2.74	H	-2.74	Non restricted Band		AV
2 745.60	48.54	2.38	H	50.92	73.98	23.06	PK
2 745.60	36.62	2.38	H	39.00	53.98	14.98	AV
3 660.80	45.53	6.23	H	51.76	73.98	22.22	PK
3 660.80	31.68	6.23	H	37.91	53.98	16.07	AV
4 576.00	44.61	9.87	H	54.48	73.98	19.50	PK
4 576.00	30.92	9.87	H	40.79	53.98	13.19	AV
5 491.20	-	12.58	H	12.58	Non restricted Band		PK
5 491.20	-	12.58	H	12.58	Non restricted Band		AV
6 406.40	-	14.64	H	14.64	Non restricted Band		PK
6 406.40	-	14.64	H	14.64	Non restricted Band		AV
7 321.60	53.55	-4.34	H	49.21	73.98	24.77	PK
7 321.60	40.01	-4.34	H	35.67	53.98	18.31	AV
8 236.80	53.05	-2.33	H	50.72	73.98	23.26	PK
8 236.80	39.06	-2.33	H	36.73	53.98	17.25	AV
9 152.00	49.37	1.34	H	50.71	73.98	23.27	PK
9 152.00	36.52	1.34	H	37.86	53.98	16.12	AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
1 830.40	-	-2.74	V	-2.74	Non restricted Band		PK
1 830.40	-	-2.74	V	-2.74	Non restricted Band		AV
2 745.60	47.81	2.38	V	50.19	73.98	23.79	PK
2 745.60	35.16	2.38	V	37.54	53.98	16.44	AV
3 660.80	45.28	6.23	V	51.51	73.98	22.47	PK
3 660.80	31.54	6.23	V	37.77	53.98	16.21	AV
4 576.00	44.29	9.87	V	54.16	73.98	19.82	PK
4 576.00	30.62	9.87	V	40.49	53.98	13.49	AV
5 491.20	-	12.58	V	12.58	Non restricted Band		PK
5 491.20	-	12.58	V	12.58	Non restricted Band		AV
6 406.40	-	14.64	V	14.64	Non restricted Band		PK
6 406.40	-	14.64	V	14.64	Non restricted Band		AV
7 321.60	54.54	-4.34	V	50.20	73.98	23.78	PK
7 321.60	40.45	-4.34	V	36.11	53.98	17.87	AV
8 236.80	54.06	-2.33	V	51.73	73.98	22.25	PK
8 236.80	39.31	-2.33	V	36.98	53.98	17.00	AV
9 152.00	50.08	1.34	V	51.42	73.98	22.56	PK
9 152.00	36.60	1.34	V	37.94	53.98	16.04	AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Channel : SF10_Mid (LoRa 125k AU)

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
1 842.80	-	-2.67	H	-2.67	Non restricted Band		PK
1 842.80	-	-2.67	H	-2.67	Non restricted Band		AV
2 764.20	49.04	2.56	H	51.60	73.98	22.38	PK
2 764.20	37.79	2.56	H	40.35	53.98	13.63	AV
3 685.60	45.72	6.25	H	51.97	73.98	22.01	PK
3 685.60	31.68	6.25	H	37.93	53.98	16.05	AV
4 607.00	43.88	9.87	H	53.75	73.98	20.23	PK
4 607.00	30.23	9.87	H	40.10	53.98	13.88	AV
5 528.40	-	13.15	H	13.15	Non restricted Band		PK
5 528.40	-	13.15	H	13.15	Non restricted Band		AV
6 449.80	-	14.86	H	14.86	Non restricted Band		PK
6 449.80	-	14.86	H	14.86	Non restricted Band		AV
7 371.20	52.97	-4.55	H	48.42	73.98	25.56	PK
7 371.20	39.05	-4.55	H	34.50	53.98	19.48	AV
8 292.60	49.94	-1.35	H	48.59	73.98	25.39	PK
8 292.60	36.15	-1.35	H	34.80	53.98	19.18	AV
9 214.00	-	1.38	H	1.38	Non restricted Band		PK
9 214.00	-	1.38	H	1.38	Non restricted Band		AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
1 842.80	-	-2.67	V	-2.67	Non restricted Band		PK
1 842.80	-	-2.67	V	-2.67	Non restricted Band		AV
2 764.20	48.75	2.56	V	51.31	73.98	22.67	PK
2 764.20	37.61	2.56	V	40.17	53.98	13.81	AV
3 685.60	45.24	6.25	V	51.49	73.98	22.49	PK
3 685.60	31.54	6.25	V	37.79	53.98	16.19	AV
4 607.00	44.67	9.87	V	54.54	73.98	19.44	PK
4 607.00	30.18	9.87	V	40.05	53.98	13.93	AV
5 528.40	-	13.15	V	13.15	Non restricted Band		PK
5 528.40	-	13.15	V	13.15	Non restricted Band		AV
6 449.80	-	14.86	V	14.86	Non restricted Band		PK
6 449.80	-	14.86	V	14.86	Non restricted Band		AV
7 371.20	53.78	-4.55	V	49.23	73.98	24.75	PK
7 371.20	39.25	-4.55	V	34.70	53.98	19.28	AV
8 292.60	50.29	-1.35	V	48.94	73.98	25.04	PK
8 292.60	36.65	-1.35	V	35.30	53.98	18.68	AV
9 214.00	-	1.38	V	1.38	Non restricted Band		PK
9 214.00	-	1.38	V	1.38	Non restricted Band		AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Channel : SF10_High (LoRa 125k AU)

Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
1 855.60	-	-2.58	H	-2.58	Non restricted Band		PK
1 855.60	-	-2.58	H	-2.58	Non restricted Band		AV
2 783.40	49.09	2.54	H	51.63	73.98	22.35	PK
2 783.40	38.67	2.54	H	41.21	53.98	12.77	AV
3 711.20	44.90	6.49	H	51.39	73.98	22.59	PK
3 711.20	31.49	6.49	H	37.98	53.98	16.00	AV
4 639.00	44.31	9.92	H	54.23	73.98	19.75	PK
4 639.00	30.16	9.92	H	40.08	53.98	13.90	AV
5 566.80	-	12.87	H	12.87	Non restricted Band		PK
5 566.80	-	12.87	H	12.87	Non restricted Band		AV
6 494.60	-	15.11	H	15.11	Non restricted Band		PK
6 494.60	-	15.11	H	15.11	Non restricted Band		AV
7 422.40	52.78	-3.71	H	49.07	73.98	24.91	PK
7 422.40	39.33	-3.71	H	35.62	53.98	18.36	AV
8 350.20	52.19	-1.82	H	50.37	73.98	23.61	PK
8 350.20	38.08	-1.82	H	36.26	53.98	17.72	AV
9 278.00	-	1.35	H	1.35	Non restricted Band		PK
9 278.00	-	1.35	H	1.35	Non restricted Band		AV

#Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

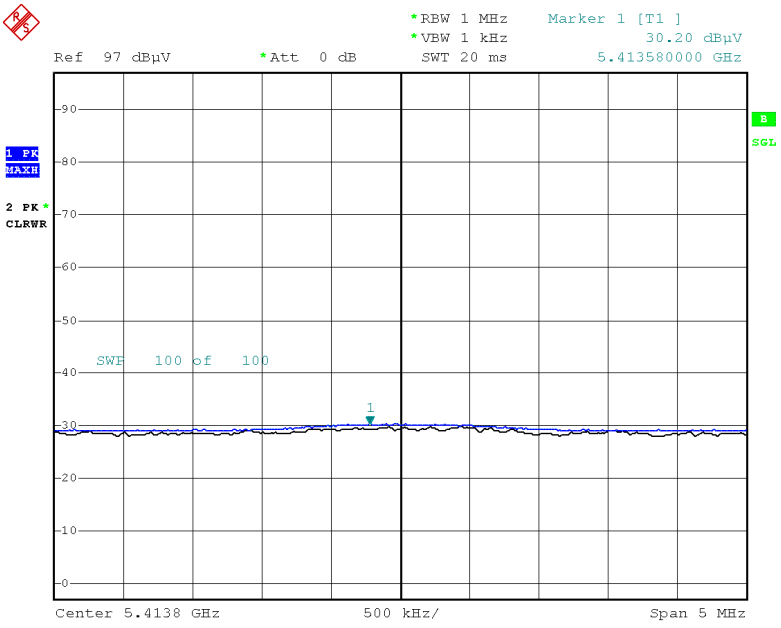
Frequency	Measured Level	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
1 855.60	-	-2.58	V	-2.58	Non restricted Band		PK
1 855.60	-	-2.58	V	-2.58	Non restricted Band		AV
2 783.40	49.02	2.54	V	51.56	73.98	22.42	PK
2 783.40	38.52	2.54	V	41.06	53.98	12.92	AV
3 711.20	44.64	6.49	V	51.13	73.98	22.85	PK
3 711.20	31.23	6.49	V	37.72	53.98	16.26	AV
4 639.00	43.73	9.92	V	53.65	73.98	20.33	PK
4 639.00	30.26	9.92	V	40.18	53.98	13.80	AV
5 566.80	-	12.87	V	12.87	Non restricted Band		PK
5 566.80	-	12.87	V	12.87	Non restricted Band		AV
6 494.60	-	15.11	V	15.11	Non restricted Band		PK
6 494.60	-	15.11	V	15.11	Non restricted Band		AV
7 422.40	52.89	-3.71	V	49.18	73.98	24.80	PK
7 422.40	39.00	-3.71	V	35.29	53.98	18.69	AV
8 350.20	51.81	-1.82	V	49.99	73.98	23.99	PK
8 350.20	38.06	-1.82	V	36.24	53.98	17.74	AV
9 278.00	-	1.35	V	1.35	Non restricted Band		PK
9 278.00	-	1.35	V	1.35	Non restricted Band		AV

#Note :

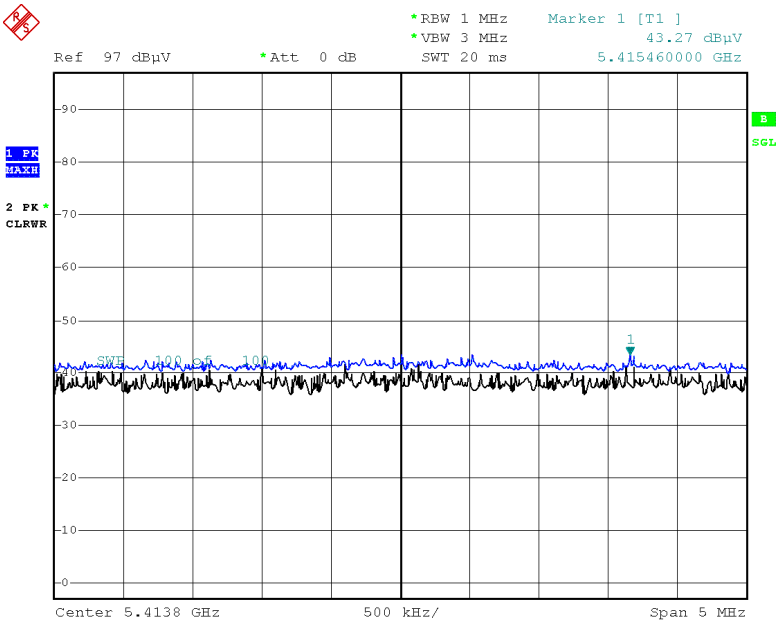
1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

RESULT PLOTS

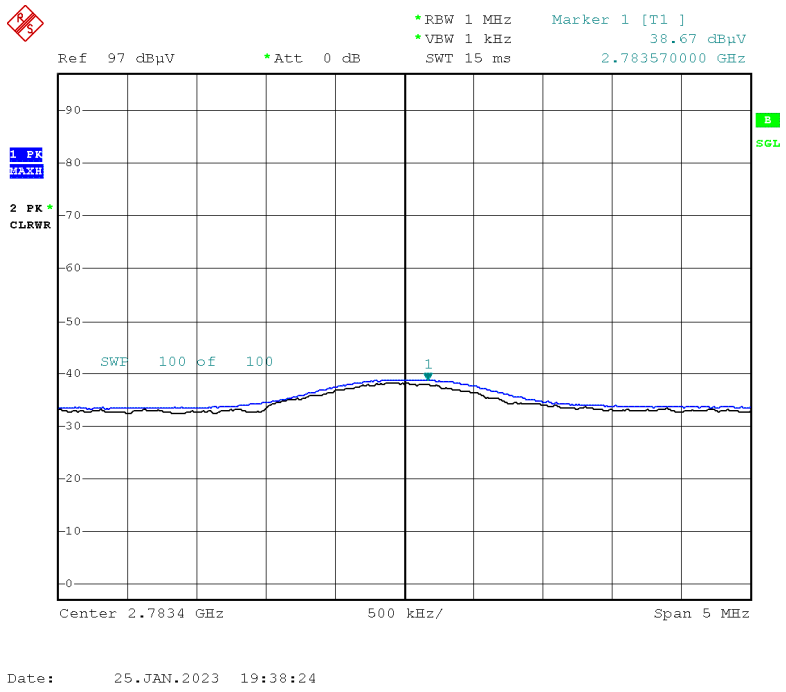
Radiated Spurious Emissions plot – Average Result (SF10 6th Harmonic_FCC)



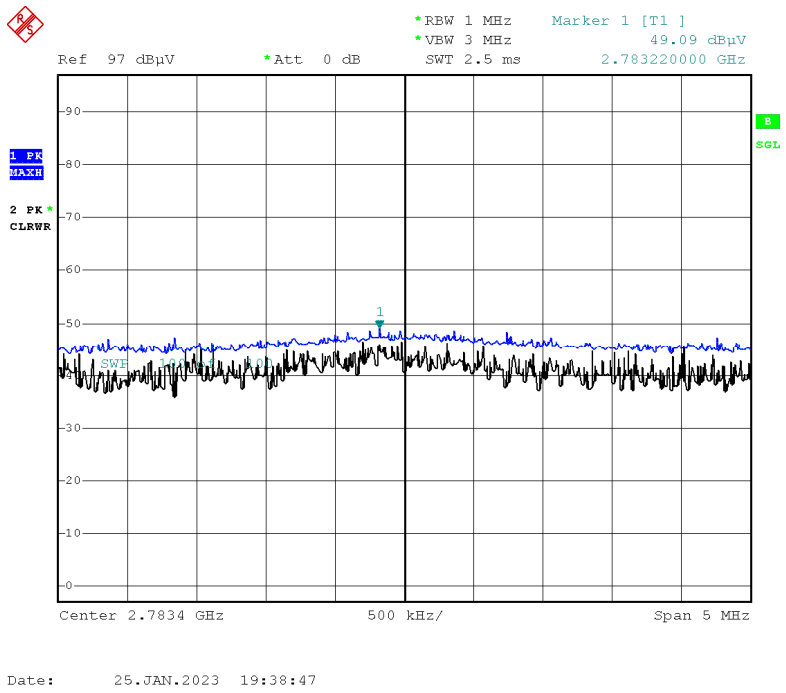
Radiated Spurious Emissions plot – Peak Result (SF10 6th Harmonic_FCC)



Radiated Spurious Emissions plot – Average Result (SF10 3th Harmonic_AU)



Radiated Spurious Emissions plot – Peak Result (SF10 3th Harmonic_AU)



Note : Only the worst case plots for Radiated Spurious Emissions.

10.7 POWERLINE CONDUCTED EMISSIONS

Conducted Emissions

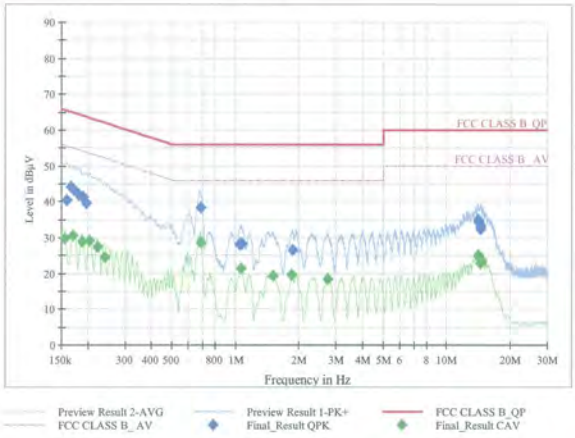
Test 1 / 2

Test Report

Common Information

EUT : IML-C6400W
Operating Conditions : LoRa 125k Mode
Comment :

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1590	40.34	65.52	25.18	1000.0	9.000	L1	OFF	9.6
0.1658	44.06	65.17	21.11	1000.0	9.000	N	OFF	9.5
0.1725	43.28	64.84	21.56	1000.0	9.000	N	OFF	9.6
0.1815	41.76	64.42	22.66	1000.0	9.000	L1	OFF	9.6
0.1905	41.37	64.02	22.64	1000.0	9.000	L1	OFF	9.6
0.1973	39.45	63.73	24.27	1000.0	9.000	N	OFF	9.6
0.6823	38.36	56.00	17.64	1000.0	9.000	L1	OFF	9.6
1.0468	28.12	56.00	27.88	1000.0	9.000	L1	OFF	9.6
1.0513	28.13	56.00	27.87	1000.0	9.000	L1	OFF	9.6
1.0603	28.13	56.00	27.87	1000.0	9.000	L1	OFF	9.6
1.0693	28.38	56.00	27.62	1000.0	9.000	L1	OFF	9.6
1.8658	26.49	56.00	29.51	1000.0	9.000	L1	OFF	9.7
14.1035	34.83	60.00	25.17	1000.0	9.000	L1	OFF	9.9
14.1373	34.34	60.00	25.66	1000.0	9.000	L1	OFF	9.9
14.4388	32.23	60.00	27.77	1000.0	9.000	L1	OFF	9.9
14.4455	32.59	60.00	27.41	1000.0	9.000	L1	OFF	9.9
14.4680	32.66	60.00	27.34	1000.0	9.000	L1	OFF	9.9
14.5063	33.41	60.00	26.59	1000.0	9.000	L1	OFF	9.9

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Test 2 / 2

Final_Result_CAV

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	29.65	55.75	26.10	1000.0	9.000	L1	OFF	9.6
0.1703	30.44	54.95	24.51	1000.0	9.000	L1	OFF	9.6
0.1883	28.80	54.11	25.31	1000.0	9.000	L1	OFF	9.6
0.2040	29.25	53.45	24.20	1000.0	9.000	L1	OFF	9.6
0.2220	27.28	52.74	25.47	1000.0	9.000	L1	OFF	9.6
0.2400	24.56	52.10	27.54	1000.0	9.000	L1	OFF	9.6
0.6823	28.62	46.00	17.38	1000.0	9.000	L1	OFF	9.6
1.0580	21.25	46.00	24.75	1000.0	9.000	L1	OFF	9.6
1.4990	19.45	46.00	26.55	1000.0	9.000	L1	OFF	9.7
1.8523	19.71	46.00	26.29	1000.0	9.000	L1	OFF	9.7
2.7298	18.60	46.00	27.40	1000.0	9.000	L1	OFF	9.7
2.7343	18.58	46.00	27.42	1000.0	9.000	L1	OFF	9.7
14.1080	24.97	50.00	25.03	1000.0	9.000	L1	OFF	9.9
14.1238	24.94	50.00	25.06	1000.0	9.000	L1	OFF	9.9
14.1350	25.15	50.00	24.85	1000.0	9.000	L1	OFF	9.9
14.1440	25.01	50.00	24.99	1000.0	9.000	L1	OFF	9.9
14.4208	22.92	50.00	27.08	1000.0	9.000	L1	OFF	9.9
14.5715	23.77	50.00	26.23	1000.0	9.000	L1	OFF	9.9

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11. LIST OF TEST EQUIPMENT

Conducted Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
LISN	ENV216	Rohde & Schwarz	102245	08/22/2023	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	06/07/2023	Annual
Temperature Chamber	SU-642	ESPEC	0093008124	03/04/2023	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	09/06/2023	Annual
Power Meter	N1911A	Agilent	MY45100523	03/24/2023	Annual
Power Sensor	N1921A	Agilent	MY57820067	03/24/2023	Annual
Directional Coupler	87300B	Agilent	3116A03621	11/02/2023	Annual
DC Power Supply	E3632A	Hewlett Packard	KR75305528	01/03/2024	Annual
Attenuator(10 dB)(DC-26.5 GHz)	8493C-010	Agilent	08285	06/21/2023	Annual
Attenuator(20 dB)	18N-20dB	Rohde & Schwarz	8	03/07/2023	Annual
Software	EMC32	Rohde & Schwarz	N/A	N/A	N/A
FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	HCT CO., LTD.	N/A	N/A	N/A

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

Radiated Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Controller(Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	N/A	N/A	N/A
Controller	EM2090	Emco	060520	N/A	N/A
Turn Table	N/A	Ets	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/17/2024	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	08/16/2024	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1191	11/18/2023	Biennial
Horn Antenna(15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170124	04/12/2023	Biennial
Amp & Filter Bank Switch Controller	FBSM-01A	TNM system	0	N/A	N/A
ATT(3 dB) + LNA2(6~18 GHz)	18B-03, CBL06185030	WEINSCHEL CERNEX	N/A	12/05/2023	Annual
ATT(10 dB) + LNA1(0.1~18 GHz)	56-10, CBLU1183540B-01	Api tech, CERNEX	N/A	12/05/2023	Annual
High Pass Filter	WHKX10-2700-3000-18000-40SS	Wainwright Instruments	N/A	12/05/2023	Annual
High Pass Filter	WHKX8-6090-7000-18000-40SS	Wainwright Instruments	N/A	12/05/2023	Annual
Thru	COAXIAL ATTENUATOR	T&M SYSTEM	N/A	12/05/2023	Annual
Power Amplifier	CBL18265035	CERNEX	22966	12/01/2023	Annual
Power Amplifier	CBL26405040	CERNEX	25956	03/11/2023	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000175	04/05/2023	Annual
Spectrum Analyzer	FSP(9 kHz ~ 30 GHz)	Rohde & Schwarz	836650/016	09/06/2023	Annual
Spectrum Analyzer	FSV40-N(9 kHz ~ 30 GHz)	Rohde & Schwarz	101068-SZ	09/07/2023	Annual

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
3. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5(Version : 2017).

12. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2301-FC087-P