

TEST REPORT

FCC/ISED Sigfox Test for LSM110A
Certification

APPLICANT
SJI CO.,LTD

REPORT NO.
HCT-RF-2205-FI003

DATE OF ISSUE
May 27, 2022

Tested by
Jeong Ho Kim



Technical Manager
Jong Seok Lee



HCT CO., LTD.
BongJai Huh
BongJai Huh / CEO

HCT CO., LTD.

74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si,
Gyeonggi-do, 17383 KOREA
Tel. +82 31 634 6300 Fax. +82 31 645 6401

F-TP22-03(Rev.04)

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**HCT Co., Ltd.**

74, Seocheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
Tel. +82 31 634 6300 Fax. +82 31 645 6401

TEST REPORT FCC/ISED Sigfox Test for LSM110A	REPORT NO. HCT-RF-2205-FI003
	DATE OF ISSUE May 27, 2022
	Additional Model -

Applicant	SJI CO.,LTD 54-33, Dongtanhana 1-gil, Hwaseong-si, Gyeonggi-do, Republic of Korea
Eut Type	LoRa Sigfox Module
Model Name	LSM110A
FCC ID	2AS8LLSM110A
IC	25119-LSM110A
RF Peak Output Power	20.661 dBm (116.44 mW)
FCC Classification	FCC Part 15 Spread Spectrum Transmitter
FCC Rule Part(s)	Part 15 subpart C 15.247
ISED Rule Part(s)	RSS-247 Issue 2 (February 2017) RSS-Gen Issue 5_Amendment 2 (February 2021)

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	May 27, 2022	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 / ISED Rules under normal use and maintenance.

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

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1. EUT DESCRIPTION

Model	LSM110A
EUT Type	LoRa Sigfox Module
Power Supply	DC 3.3 V
Frequency Range	RC2: 902.1375 MHz – 904.6625 MHz RC4: 920.1375 MHz – 922.6625 MHz
Max. RF Output Power	20.661 dBm (116.44 mW)
Modulation Type	TX : DBPSK RX : 2GFSK
Number of Channels	RC2: 54 Channels (9 Macro channels x 6 Micro channels) RC4: 54 Channels (9 Macro channels x 6 Micro channels)
Antenna Specification	Antenna type: PCB pattern antenna Peak Gain : 1.90 dBi
Date(s) of Tests	May 02, 2022 ~ May 25, 2022
PMN (Product Marketing Number)	LSM110A
HVIN (Hardware Version Identification Number)	LSM110A
FVIN (Firmware Version Identification Number)	v1.0.0
HMN (Host Marketing Name)	N/A
EUT serial numbers	Radiated : 110AXH3UR03000096G Conducted : 110AXH3UR03000086G

Frequency hopping channel list

[RC2] Frequency Band : 902.1375 ~ 904.6625 MHz

-	Micro Channel 1 (MHz)	Micro Channel 2 (MHz)	Micro Channel 3 (MHz)	Micro Channel 4 (MHz)	Micro Channel 5 (MHz)	Micro Channel 6 (MHz)
1 Macro Channel	902.1375	902.1625	902.1875	902.2125	902.2375	902.2625
2 Macro Channel	902.4375	902.4625	902.4875	902.5125	902.5375	902.5625
3 Macro Channel	902.7375	902.7625	902.7875	902.8125	902.8375	902.8625
4 Macro Channel	903.0375	903.0625	903.0875	903.1125	903.1375	903.1625
5 Macro Channel	903.3375	903.3625	903.3875	903.4125	903.4375	903.4625
6 Macro Channel	903.6375	903.6625	903.6875	903.7125	903.7375	903.7625
7 Macro Channel	903.9375	903.9625	903.9875	904.0125	904.0375	904.0625
8 Macro Channel	904.9375	904.2625	904.2875	904.3125	904.3375	904.3625
9 Macro Channel	904.5375	904.5625	904.5875	904.6125	904.6375	904.6625

[RC2]

Low ch : 902.1375 MHz

Mid ch : 903.4125 MHz

High ch : 904.6625 MHz

[RC4] Frequency Band : 920.1375 ~ 922.6625 MHz

-	Micro Channel 1 (MHz)	Micro Channel 2 (MHz)	Micro Channel 3 (MHz)	Micro Channel 4 (MHz)	Micro Channel 5 (MHz)	Micro Channel 6 (MHz)
1 Macro Channel	920.1375	920.1625	920.1875	920.2121	920.2375	920.2625
2 Macro Channel	920.4375	920.4625	920.4875	920.5125	920.5375	920.5625
3 Macro Channel	920.7375	920.7625	920.7875	920.8125	920.8375	920.8625
4 Macro Channel	921.0375	921.0625	921.0875	921.1125	921.1375	921.1625
5 Macro Channel	921.3375	921.3625	921.3875	921.4125	921.4375	921.4625
6 Macro Channel	921.6375	921.6625	921.6875	921.7125	921.7375	921.7625
7 Macro Channel	921.9375	921.9625	921.9875	922.0125	922.0375	922.0625
8 Macro Channel	922.2375	922.2625	922.2875	922.3125	922.3375	922.3625
9 Macro Channel	922.5375	922.5625	922.5875	922.6125	922.6375	922.6625

[RC4]

Low ch : 920.1375 MHz

Mid ch : 921.4125 MHz

High ch : 922.6625 MHz

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

This Sigfox module has been tested by a Sigfox 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.

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 RSS-GEN issue 5, RSS-247 issue 2.

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 A NSI 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).

For ISED, test facility was accepted dated January 26, 2021 (CAB identifier: 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

According to RSS-GEN(Issue 5) Section 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device’s antenna shall be stated, based on a measurement or on data from the antenna’s manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

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 (\pm 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

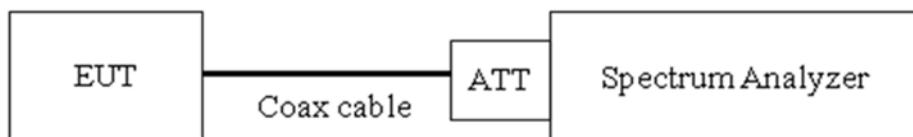
8.1. Conducted Maximum Peak Output Power

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 \geq RBW
- 4) Sweep = Auto
- 5) Detector = Peak
- 6) Trace = Max hold

Sample Calculation

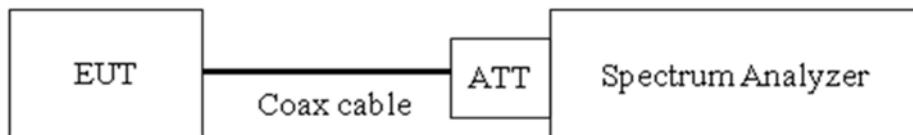
$$\begin{aligned} \text{Output Power} &= \text{Spectrum Measured Power} + \text{Power Splitter loss} + \text{Cable loss(2 ea)} \\ &= 10 \text{ dBm} + 6 \text{ dB} + 1.5 \text{ dB} = 17.5 \text{ dBm} \end{aligned}$$

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)

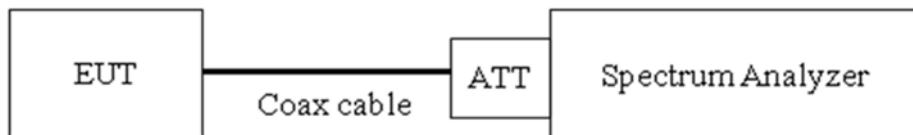
- 1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
- 2) Reference level: As required to keep the signal from exceeding the maximum instrument input 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 & 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(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 \geq 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)

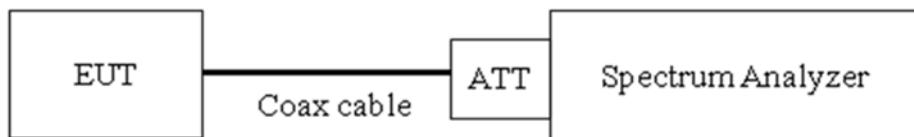
- 1) Span: Set between two times and five times the OBW
- 2) RBW: 1 % to 5 % of the OBW.
- 3) VBW \geq 3 x RBW
- 4) Sweep: Auto
- 5) Detector: Peak
- 6) Trace: Max hold
- 7) All the trace to stabilize.

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)

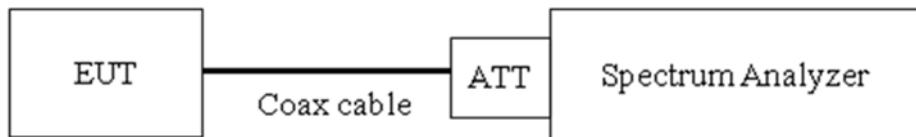
- 1) Span: the frequency band of operation
- 2) RBW: To identify clearly the individual channels, set the RBW to less than 30 % of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- 3) VBW \geq RBW
- 4) Sweep: Auto
- 5) Detector: Peak
- 6) Trace: Max hold
- 7) Allow the trace to stabilize.

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 \leq channel spacing and where possible RBW should be set $\gg 1 / T$, 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

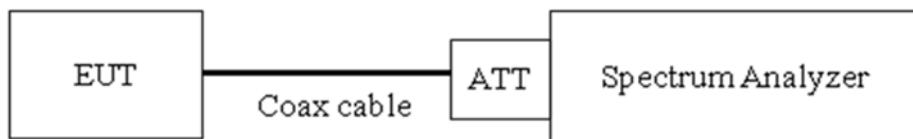
The marker-delta function was used to determine the dwell time.

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 25 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	10.04
100	10.07
200	10.12
300	10.17
400	10.20
500	10.21
600	10.21
700	10.23
800	10.24
902	10.26
928	10.30
1 000	10.31
2 000	10.41
2 400	10.43
2 500	10.45
3 000	10.52
4 000	10.60
5 000	10.71
6 000	10.73
7 000	10.80
8 000	10.85
9 000	10.91
10 000	10.97
11 000	11.02
12 000	11.10
13 000	11.19
14 000	11.16
15 000	11.21
16 000	11.22
17 000	11.25
18 000	11.30
19 000	11.32
20 000	11.36
21 000	11.48
22 000	11.55
23 000	11.55
24 000	11.59
25 000	11.68
26 000	11.27

Note :

1. 902 ~ 928 MHz is fundamental frequency range.
2. Factor = Cable loss(1 EA) + ATT(10 dB)

8.7. Radiated TestLimitFCC

Frequency (MHz)	Field Strength (μ V/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

ISED

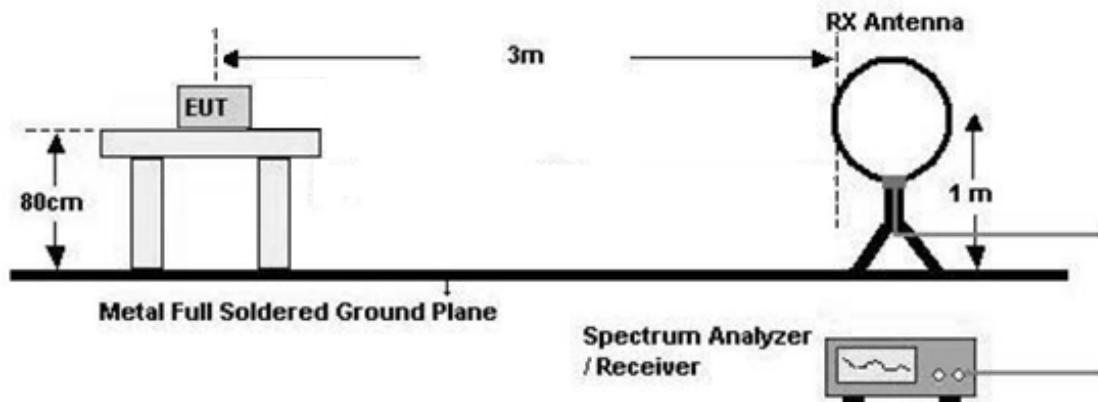
Frequency (MHz)	Field Strength (μ A/m)	Measurement Distance (m)
0.009 – 0.490	6.37/F(kHz)	300
0.490 – 1.705	63.7/F(kHz)	30
1.705 – 30	0.08	30

FCC&ISED

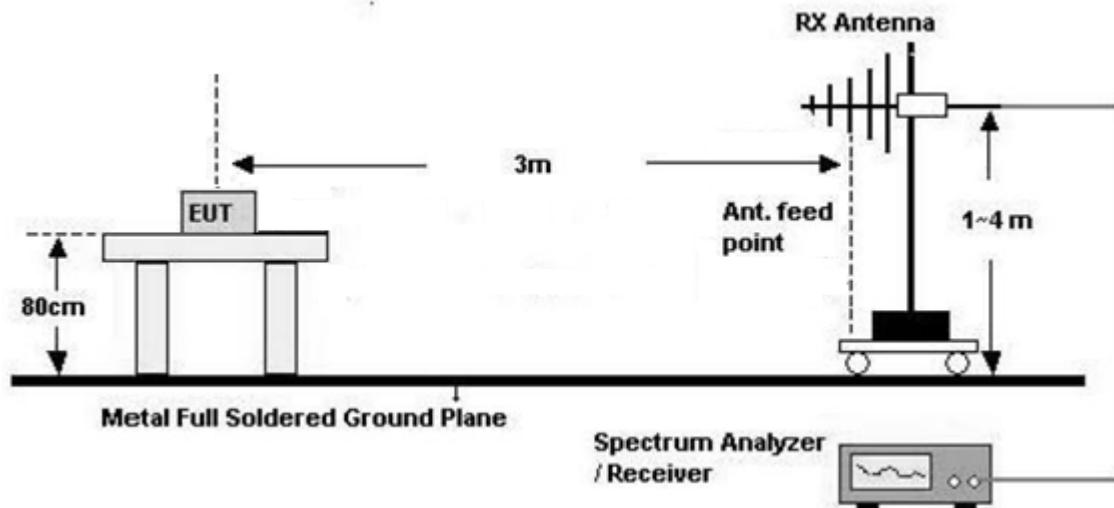
Frequency (MHz)	Field Strength (μ V/m)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

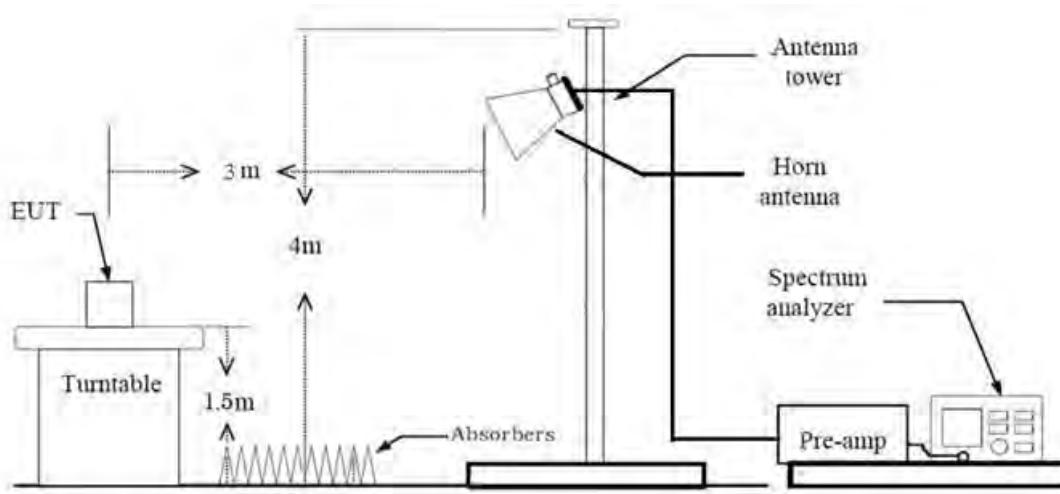
Below 30 MHz



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($0.009 \text{ MHz} - 0.490 \text{ MHz}$) = $40\log(3 \text{ m}/300 \text{ m}) = -80 \text{ dB}$
Measurement Distance : 3 m
7. Distance Correction Factor($0.490 \text{ MHz} - 30 \text{ MHz}$) = $40\log(3 \text{ m}/30 \text{ m}) = -40 \text{ dB}$
Measurement Distance : 3 m
8. Spectrum Setting
 - Frequency Range = 9 kHz ~ 30 MHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 9 kHz
 - VBW $\geq 3 \times \text{RBW}$
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 \geq 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 – 10th Harmonics
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 1 MHz
 - VBW \geq 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 \geq 1/ τ Hz, where τ = pulse width in seconds

The actual setting value of VBW = 10 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 = $20\log(\text{test distance} / \text{specific distance})$ (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 \geq 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 \geq 1/ τ Hz, where τ = pulse width in seconds

The actual setting value of VBW = 10 kHz
8. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
9. Total(Measurement Type : Peak, Average)
= Measured Value + 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 μ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dB μ V)	
	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

8.9. Receiver Spurious Emissions

Limit

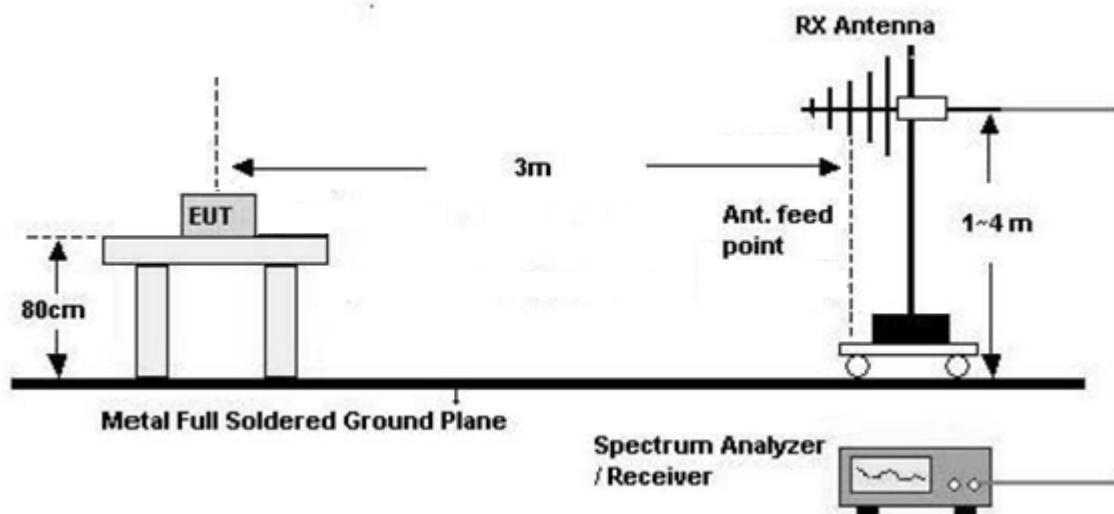
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

Measurements for compliance with the limits in table may be performed at distances other than 3 metres.

Test Configuration

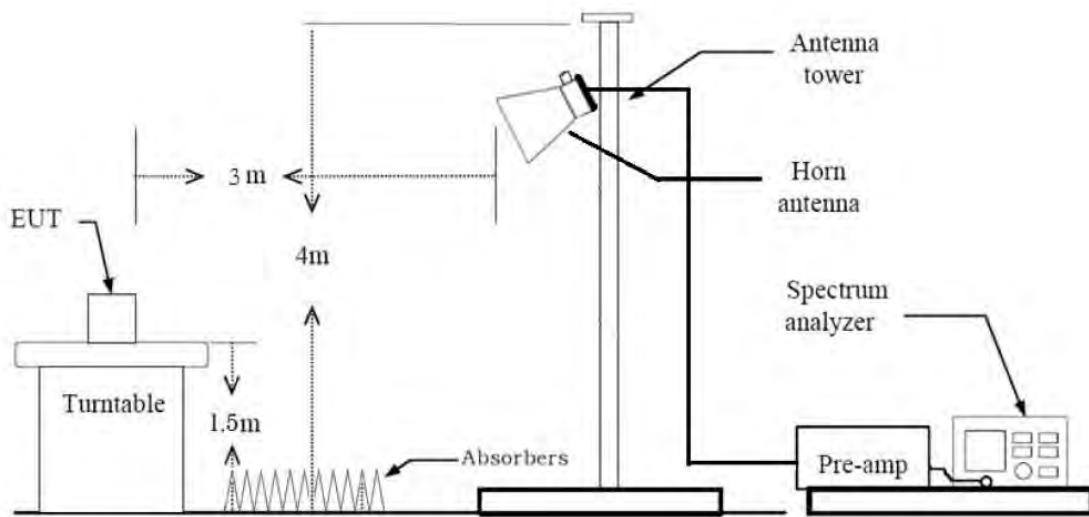
30 MHz - 1 GHz



Test Procedure of Receiver Spurious Emissions (Below 1GHz)

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 \geq 3 x RBW
 - (2) Measurement Type(Quasi-peak):
 - Measured Frequency Range : 30 MHz – 1 GHz
 - Detector = Quasi-Peak
 - RBW = 120 kHz
7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)

Above 1 GHz



Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
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 $\geq 3 \times$ 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
- $VBW \geq 1/\tau$ Hz, where τ = pulse width in seconds

The actual setting value of VBW = 10 kHz

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.
9. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

8.9. 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 in highest datarate of each mode. <biterate 100 or 600>
 - RC2 : bitrate 600 bps
 - RC4 : bitrate 600 bps
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.
 - Mode : Stand alone

Conducted test

1. The EUT was configured with data rate of highest power. <biterate 100 or 600>
 - RC2 : bitrate 600 bps
 - RC4 : bitrate 600 bps

9. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	ISED Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	§ 15.247(a)(1)(i)	RSS-247, 5.1 c)	< 250 kHz	Conducted	PASS
Occupied Bandwidth	N/A	RSS-GEN, 6.7	N/A		N/A
Conducted Maximum Peak Output Power	§ 15.247(b)(2)	RSS-247, 5.4 a)	< 1 W		PASS
Carrier Frequency Separation	§ 15.247(a)(1)	RSS-247, 5.1 b)	> 25 kHz or > 20 dB BW of hopping channel		PASS
Number of Hopping Frequencies	§ 15.247(a)(1)(i)	RSS-247, 5.1 c)	≥ 50		PASS
Time of Occupancy	§ 15.247(a)(1)(i)	RSS-247, 5.1 c)	< 400 ms (20s)		PASS
Conducted Spurious Emissions	§ 15.247(d)	RSS-247, 5.5	> 20 dB for all out-of band emissions		PASS
Band Edge (Out of Band Emissions)	§ 15.247(d)	RSS-247, 5.5	> 20 dB for all out-of band emissions		PASS
AC Power line Conducted Emissions	§ 15.207(a)	RSS-GEN, 8.8	cf. Section 8.8		PASS
Radiated Spurious Emissions	§ 15.247(d), 15.205, 15.209	RSS-GEN, 8.9	cf. Section 8.7	Radiated	PASS
Radiated Restricted Band Edge	§ 15.247(d), 15.205, 15.209	RSS-GEN, 8.9 RSS-GEN, 8.10	cf. Section 8.7		PASS
Receiver Spurious Emissions	N/A	RSS-GEN, 7	cf. Section 8.9		PASS

10. TEST RESULT

10.1 PEAK POWER

Test Data

Channel	Frequency (MHz)	Output Power (RC2)		Limit (mW)	Result
		(dBm)	(mW)		
Low	902.1375	20.661	116.44	1000	PASS
Mid	903.4125	20.658	116.36		PASS
High	904.6625	20.648	116.09		PASS

Channel	Frequency (MHz)	Output Power (RC4)		Limit (mW)	Result
		(dBm)	(mW)		
Low	920.1375	20.531	113.01	1000	PASS
Mid	921.4125	20.506	112.36		PASS
High	922.6625	20.490	111.94		PASS

Test Plots (RC2)

Peak Power (Low)



Test Plots (RC2)

Peak Power (Mid)



Test Plots (RC2)

Peak Power (High)



Test Plots (RC4)

Peak Power (Low)



Test Plots (RC4)

Peak Power (Mid)



Test Plots (RC4)

Peak Power (High)



10.2 BAND EDGES

Test Data

- Without hopping

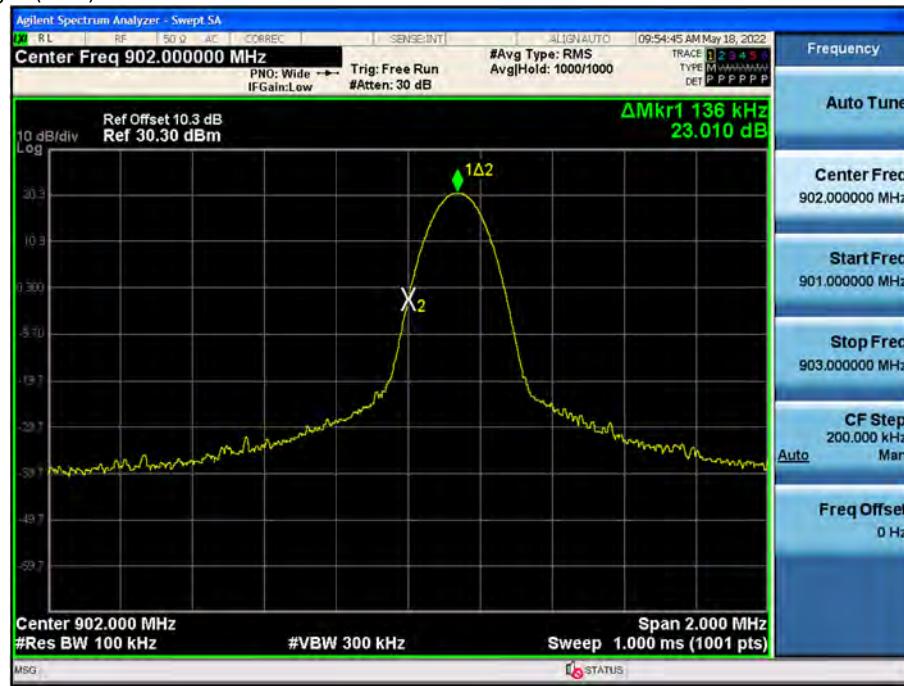
Frequency (MHz)	Channel	Position	sigfox (dB)	Limit	Margin	Result
				(dBc)	GFSK (dBc)	
902.1375	F1	Lower	23.010	20	3.010	Pass
922.6625	F3	Upper	68.386		48.386	Pass

- With hopping

Frequency (MHz)	Channel	Position	sigfox (dB)	Limit	Margin	Result
				(dBc)	GFSK (dBc)	
902.1375	F1	Lower	23.796	20	3.796	Pass
922.6625	F3	Upper	69.294		49.294	Pass

Test Plots without hopping (RC2)

Band Edges (Low)



Test Plots without hopping (RC4)

Band Edges (High)



Test Plots with hopping (RC2)

Band Edges (Low)



Test Plots with hopping (RC4)

Band Edges (High)



10.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99 % BW)**Test Data**

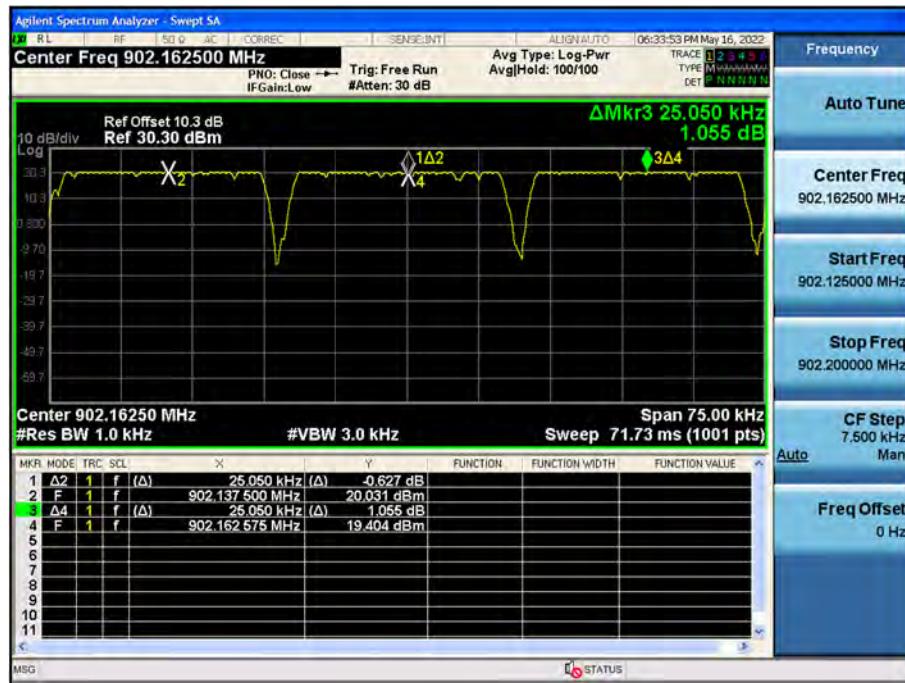
Channel Separation (kHz)		20 dB Bandwidth (kHz)			Limit (kHz)	Result
RC2	RC4	Channel	RC2	RC4		
25.05	25.05	Low	21.100	21.800	>25 or >20 dB BW of hopping channel	Pass
		Mid	21.650	21.830		
		High	21.750	21.800		

Occupied Bandwidth (99 % BW)

Channel	99 % BW (kHz)			
	RC	Low-ch	Mid-ch	High-ch
	RC2	25.406	25.409	25.416
RC4	25.324	25.350	25.310	

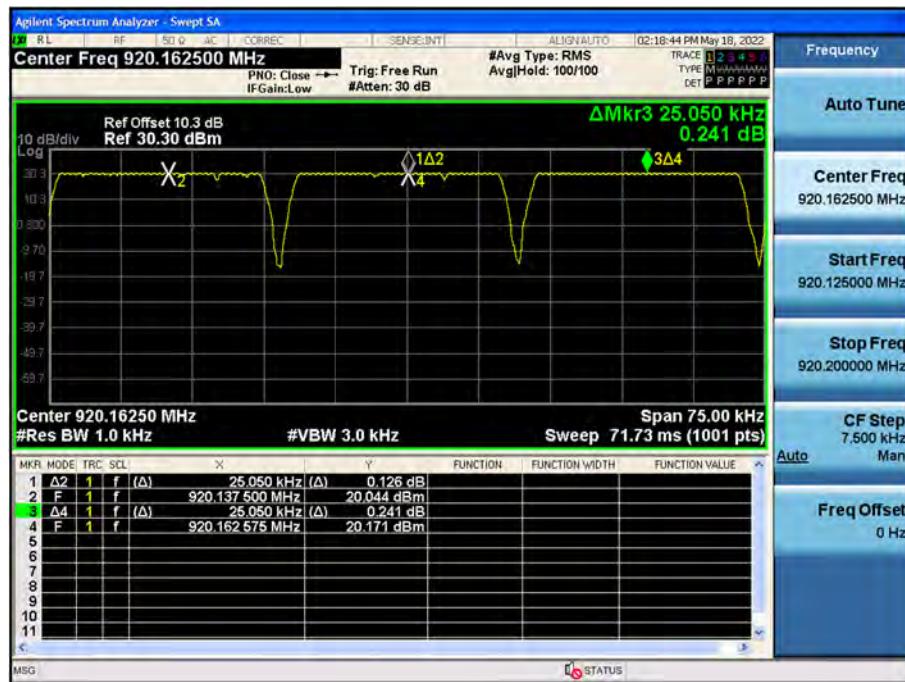
Test Plots (RC2)

Channel Separation



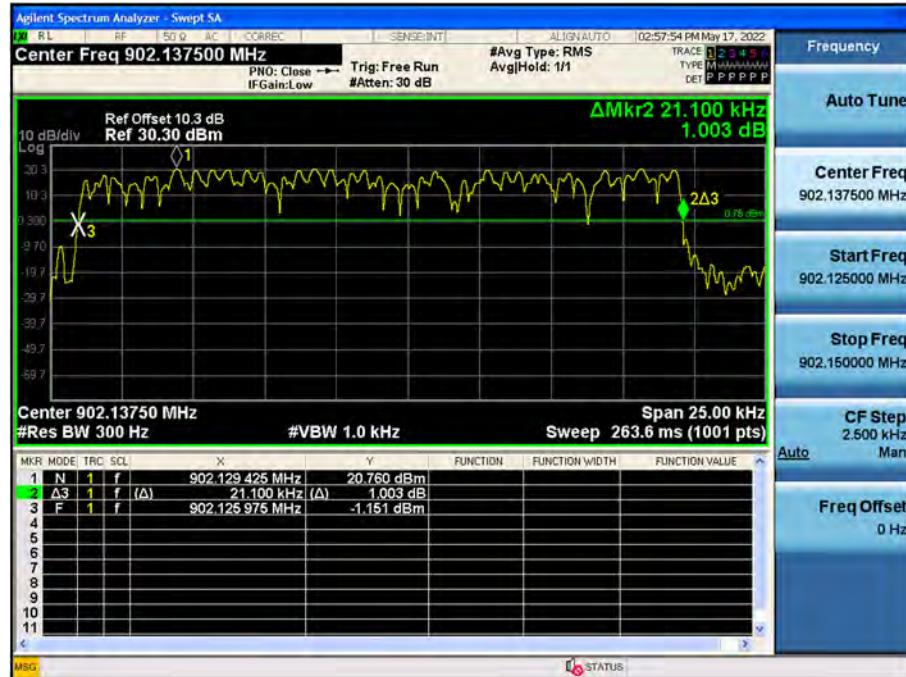
Test Plots (RC4)

Channel Separation



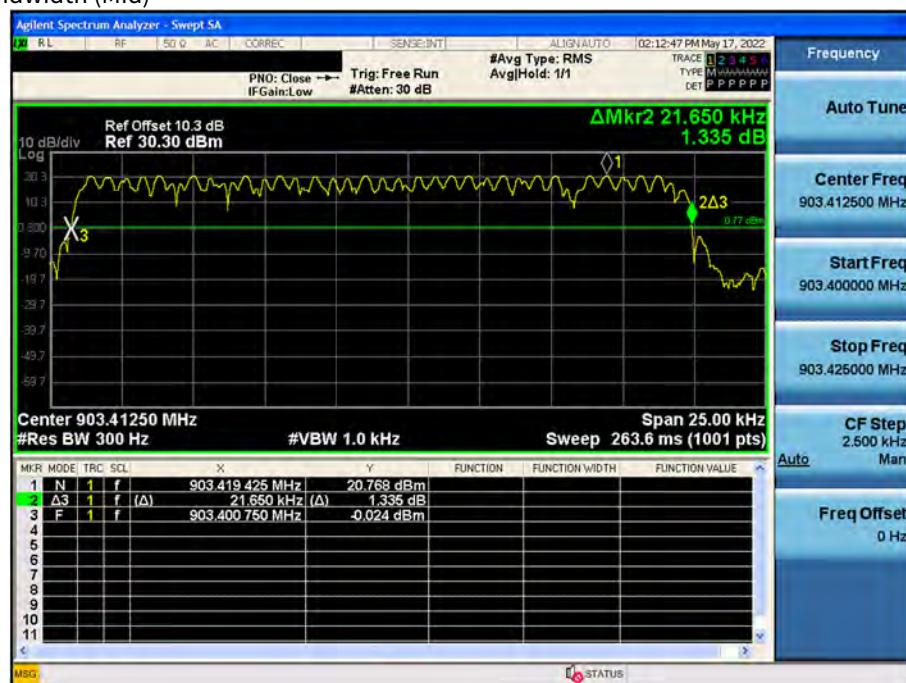
Test Plots (RC2)

20 dB Bandwidth (Low)



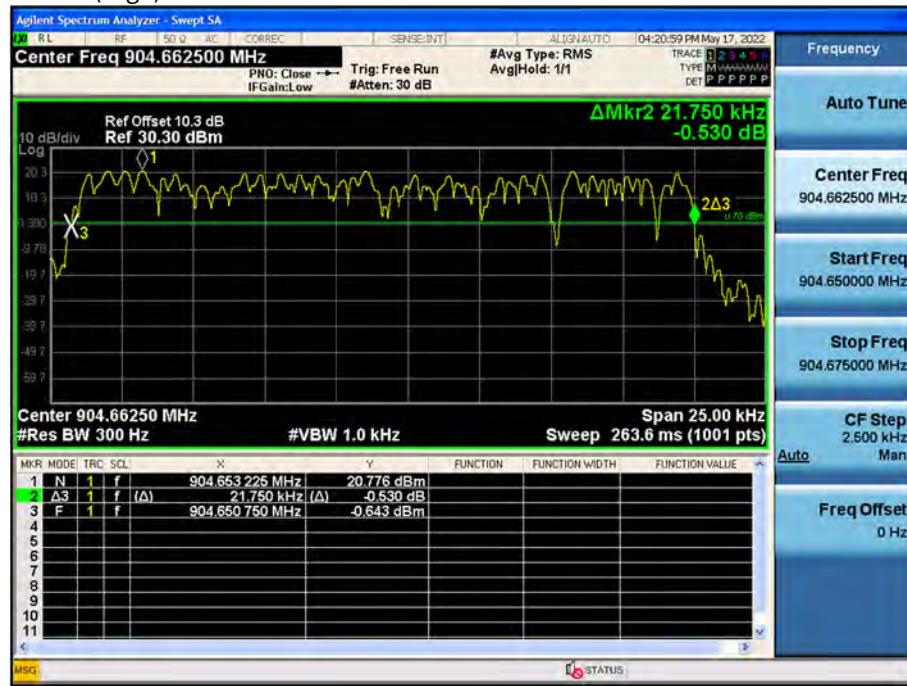
Test Plots (RC2)

20 dB Bandwidth (Mid)



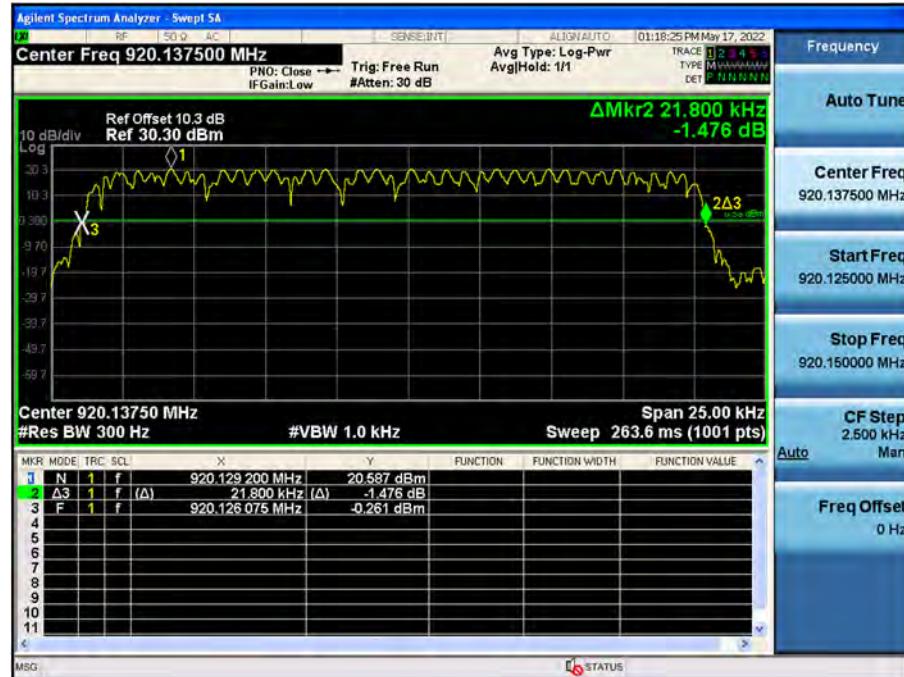
Test Plots (RC2)

20 dB Bandwidth (High)



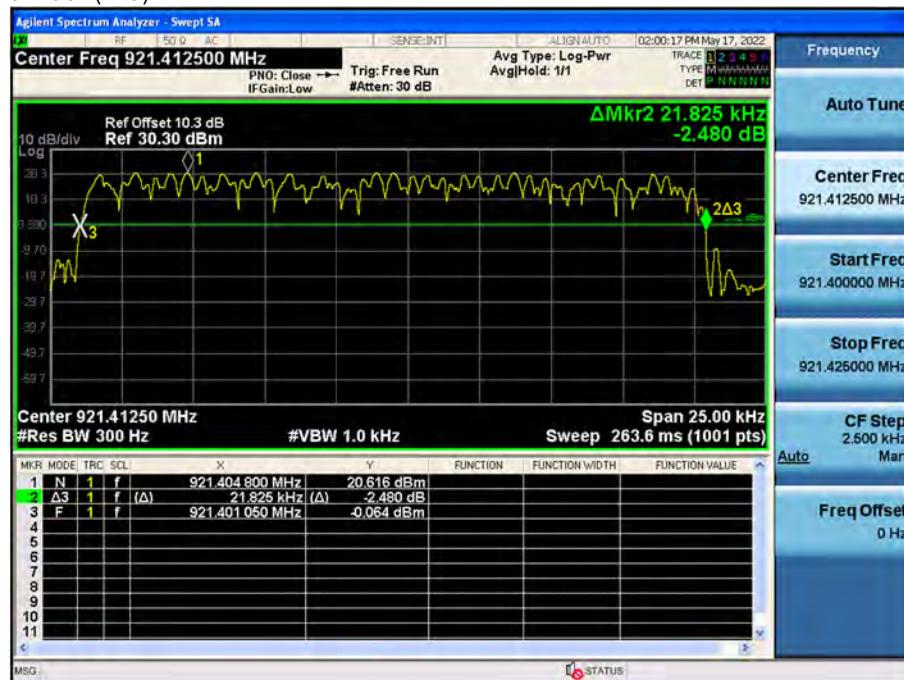
Test Plots (RC4)

20 dB Bandwidth (Low)



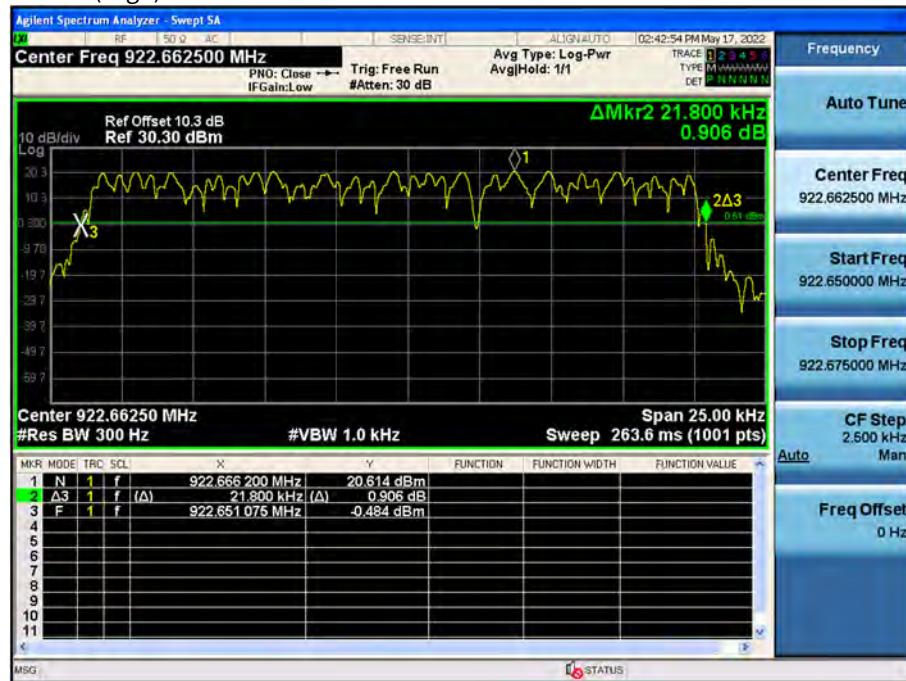
Test Plots (RC4)

20 dB Bandwidth (Mid)



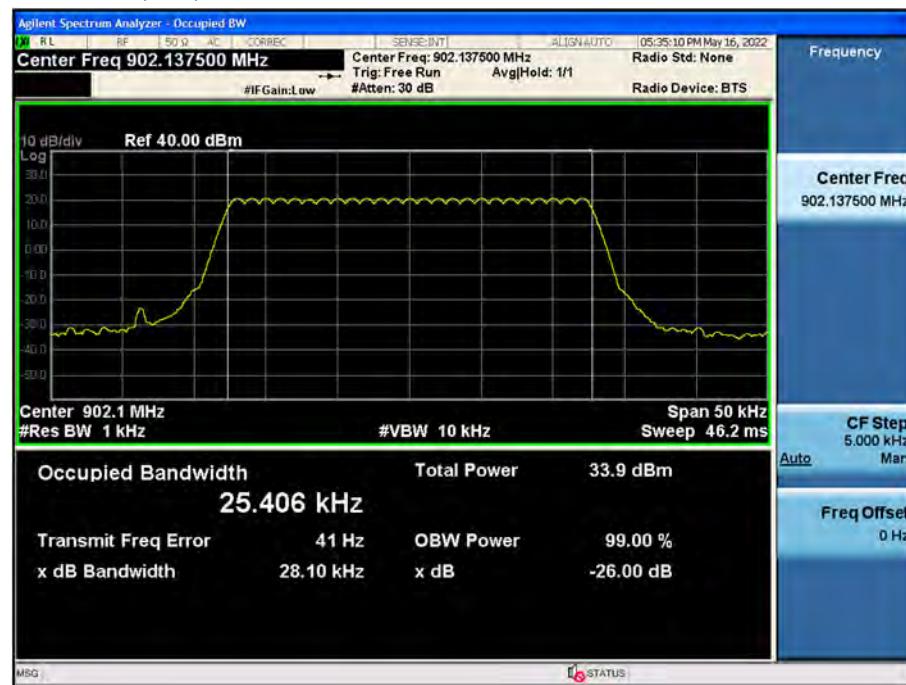
Test Plots (RC4)

20 dB Bandwidth (High)



Test Plots (RC2)

Occupied Bandwidth (Low)



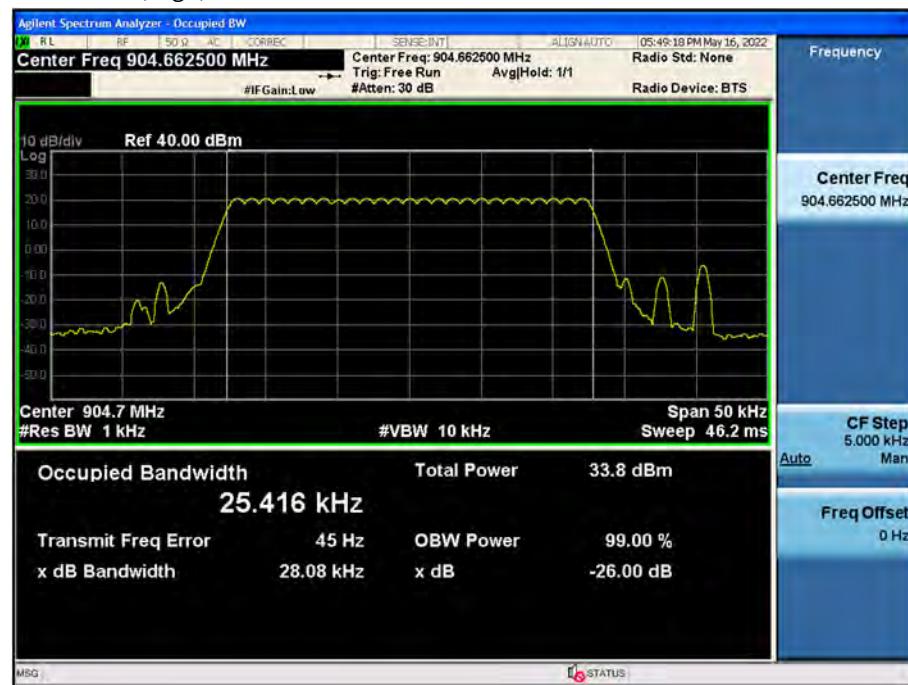
Test Plots (RC2)

Occupied Bandwidth (Mid)



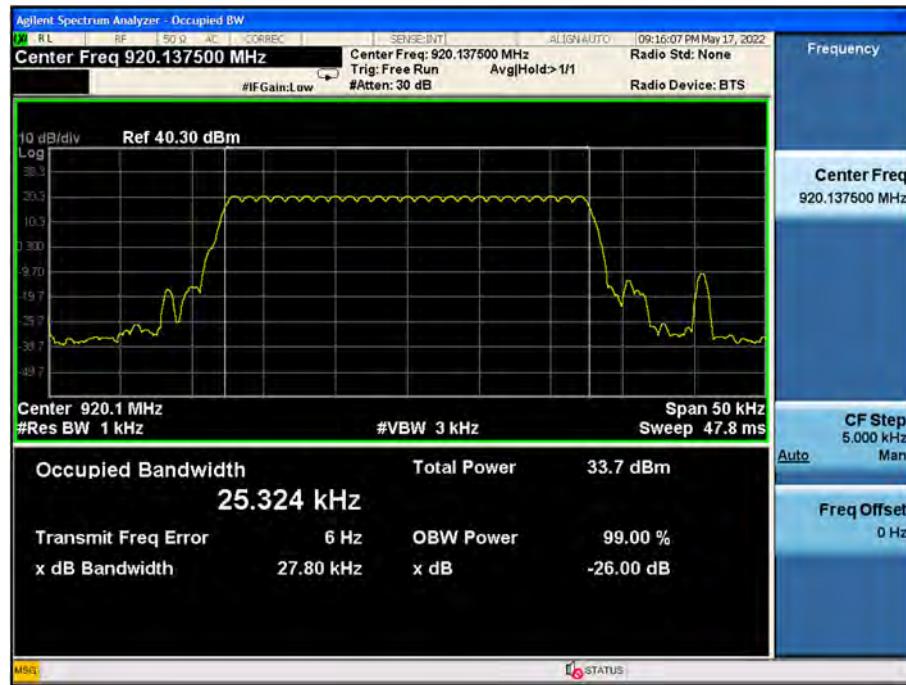
Test Plots (RC2)

Occupied Bandwidth (High)



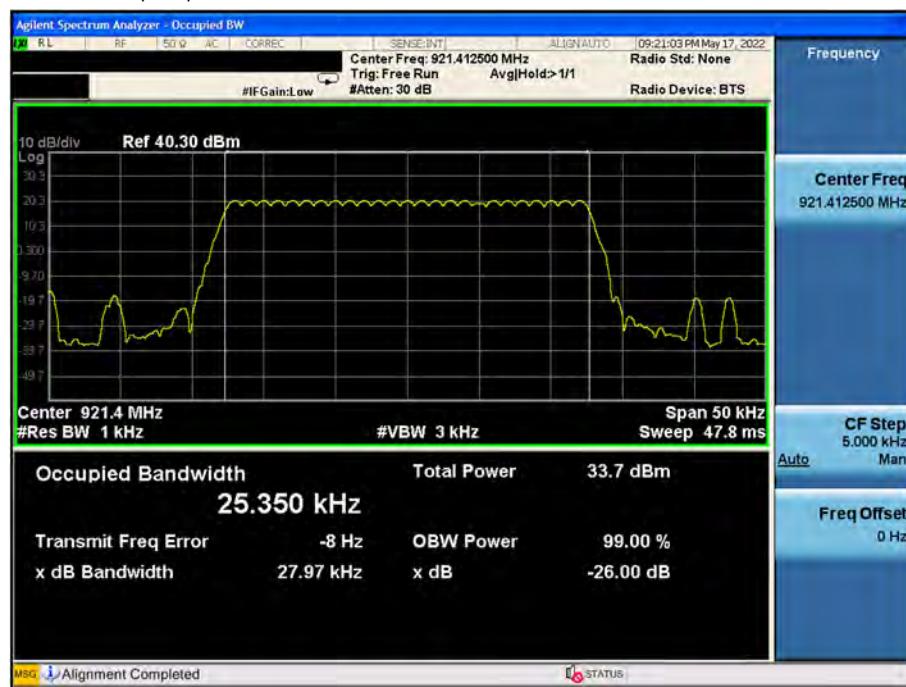
Test Plots (RC4)

Occupied Bandwidth (Low)



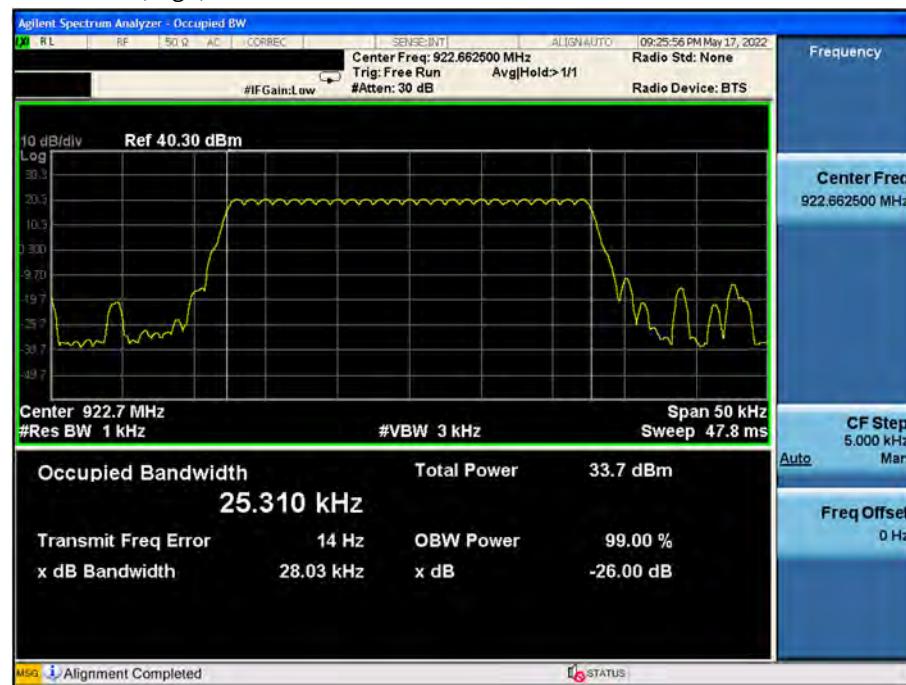
Test Plots (RC4)

Occupied Bandwidth (Mid)



Test Plots (RC4)

Occupied Bandwidth (High)

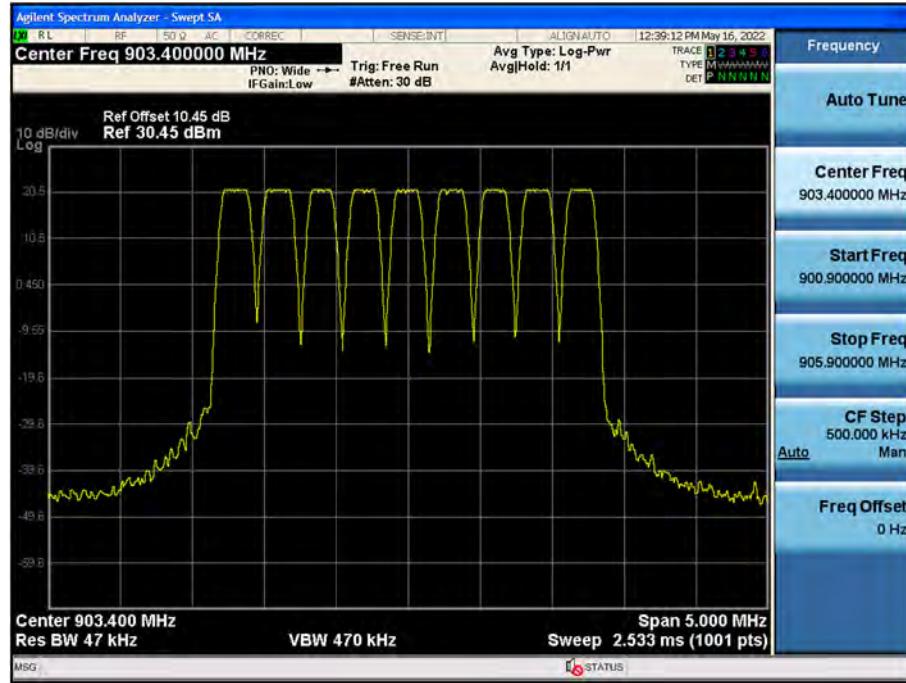


10.4 NUMBER OF HOPPING FREQUENCY**Test Data (Number of Hopping Frequencies : 9 x 6 = 54)**

No. of Macro CH		No. of Micro CH		Result (No. of CH)	
RC2	RC4	RC2	RC4	RC2	RC4
9	9	6	6	54	54

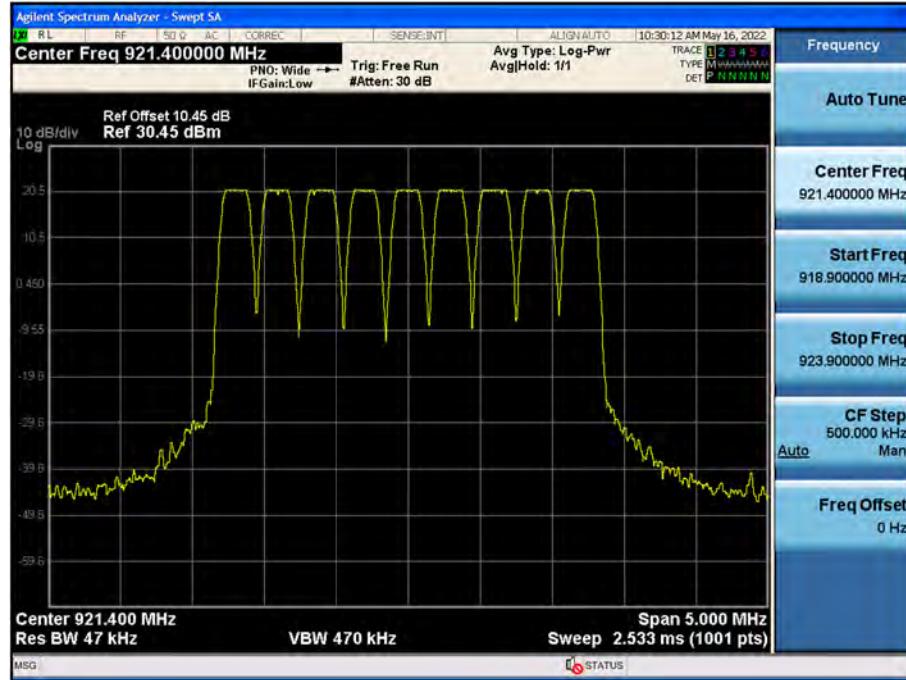
Test Plots

Number of macro channels(RC2)



Test Plots

Number of macro channels(RC4)



Test Plots

Number of micro channels in one single macro channel(RC2)



Test Plots

Number of micro channels in one single macro channel(RC4)



10.5 TIME OF OCCUPANCY (DWELL TIME)

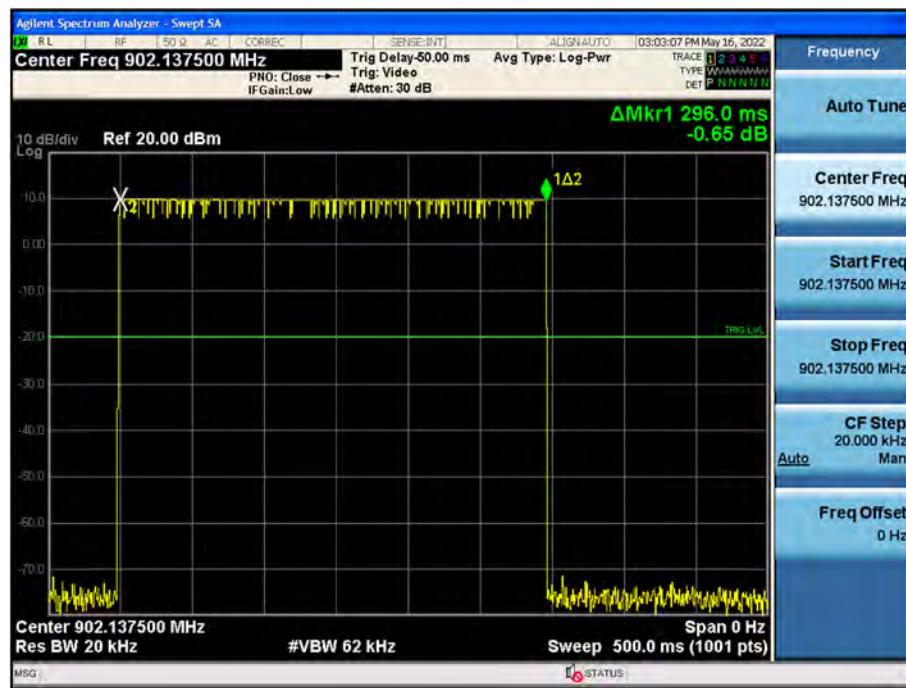
TEST RESULTS

See the table.

	Channel	RC2	RC4	Limit (ms)	Result
Dwell Time (ms)	Low	296.0	296.0	400	Pass
	Mid	296.0	296.0		Pass
	High	296.0	296.0		Pass

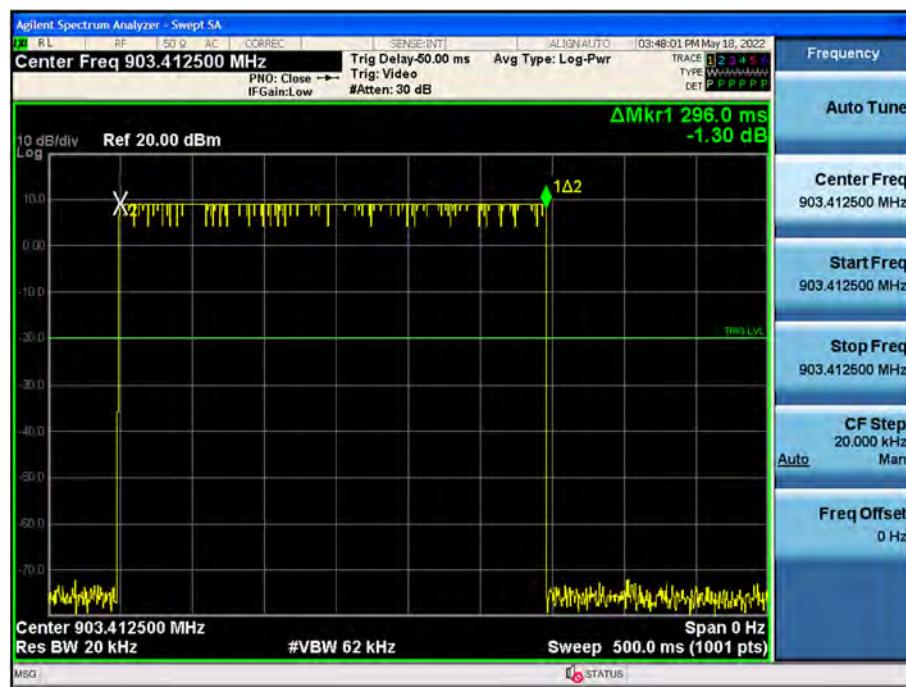
Test Plots (Channel Low_RC2)

Dwell time = 296.0 ms



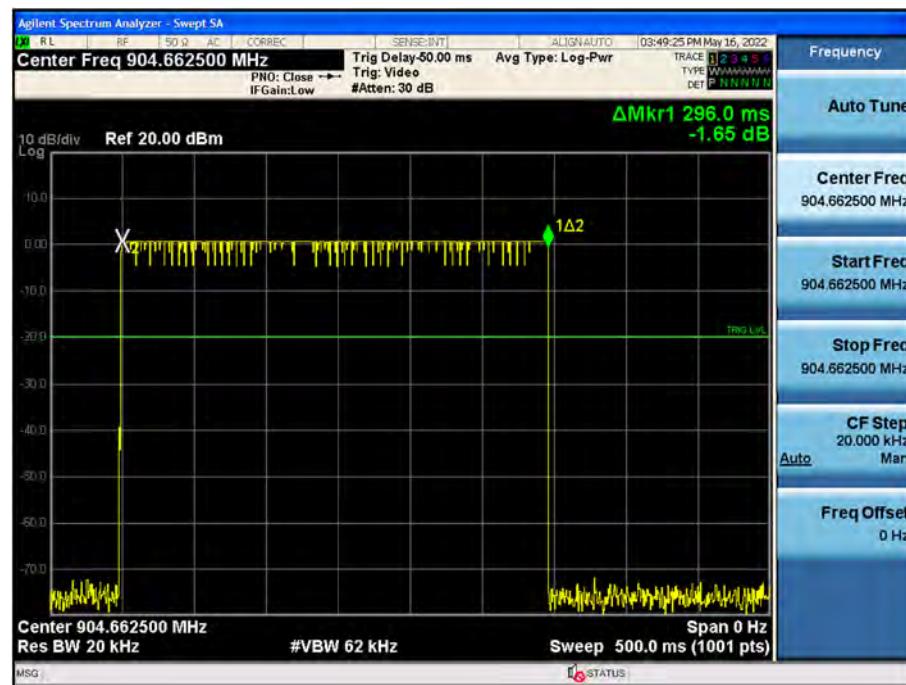
Test Plots (Channel Mid_RC2)

Dwell time = 296.0 ms



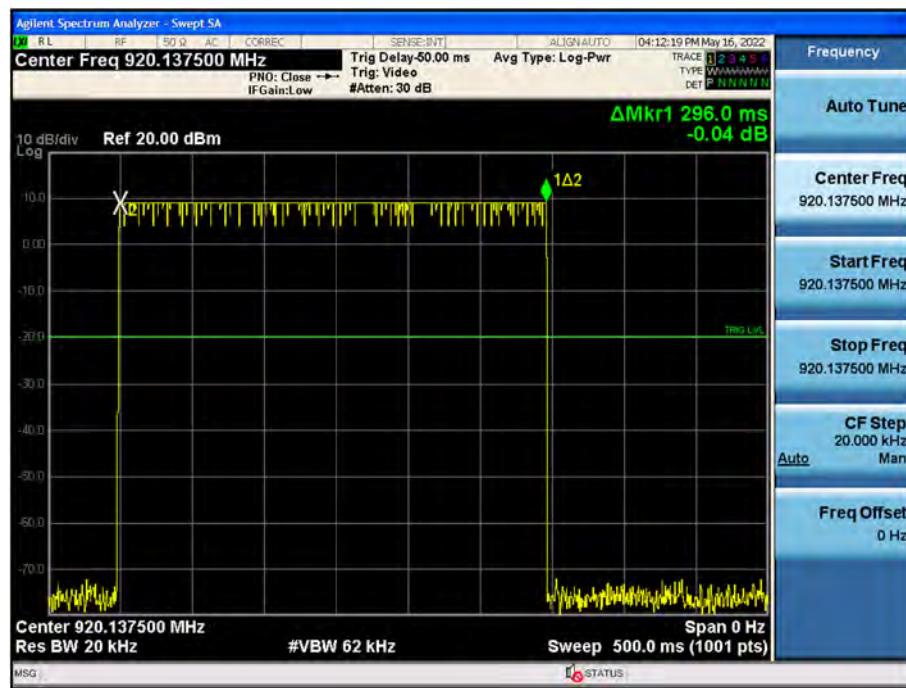
Test Plots (Channel High_RC2)

Dwell time = 296.0 ms



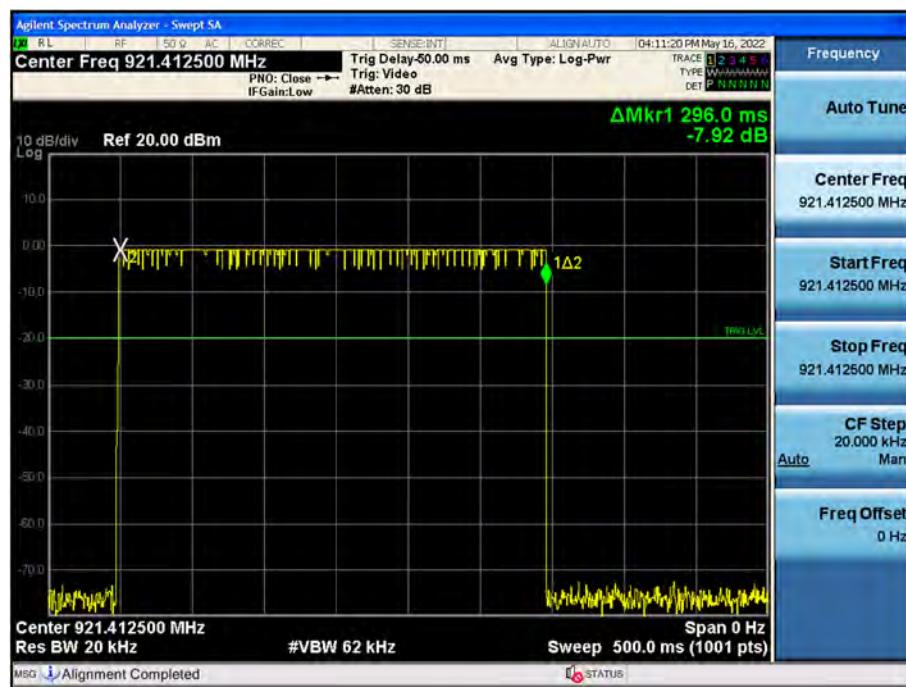
Test Plots (Channel Low_RC4)

Dwell time = 296.0 ms



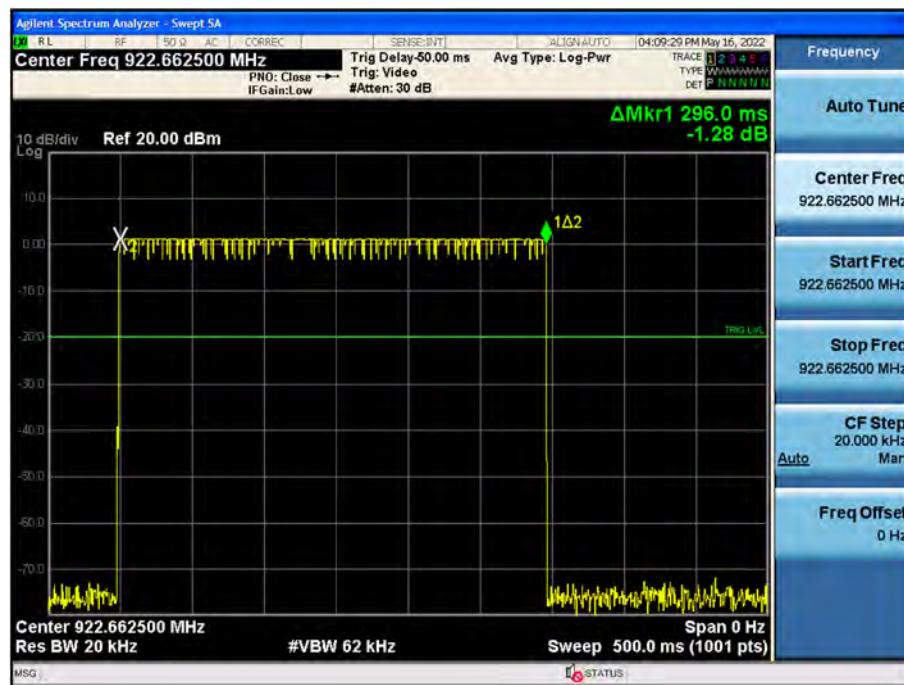
Test Plots (Channel Mid_RC4)

Dwell time = 296.0 ms



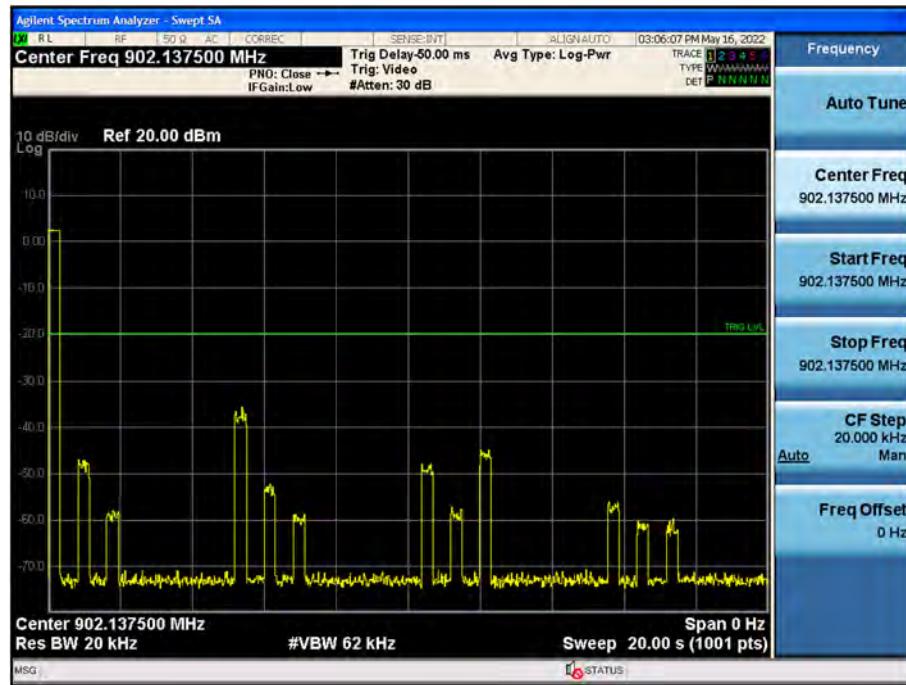
Test Plots (Channel High_RC4)

Dwell time = 296.0 ms

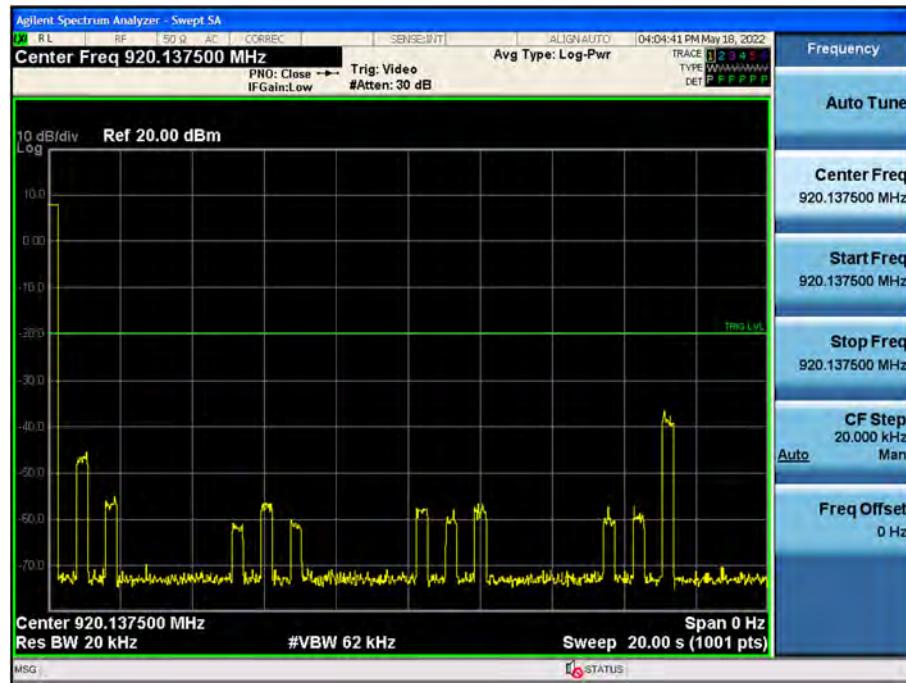


Test Plots

Hops / channel @ 20s = 1 (The highest emission is only relevant_RC2)



Hops / channel @ 20s = 1 (The highest emission is only relevant_RC4)



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.

Test Plots (RC2)

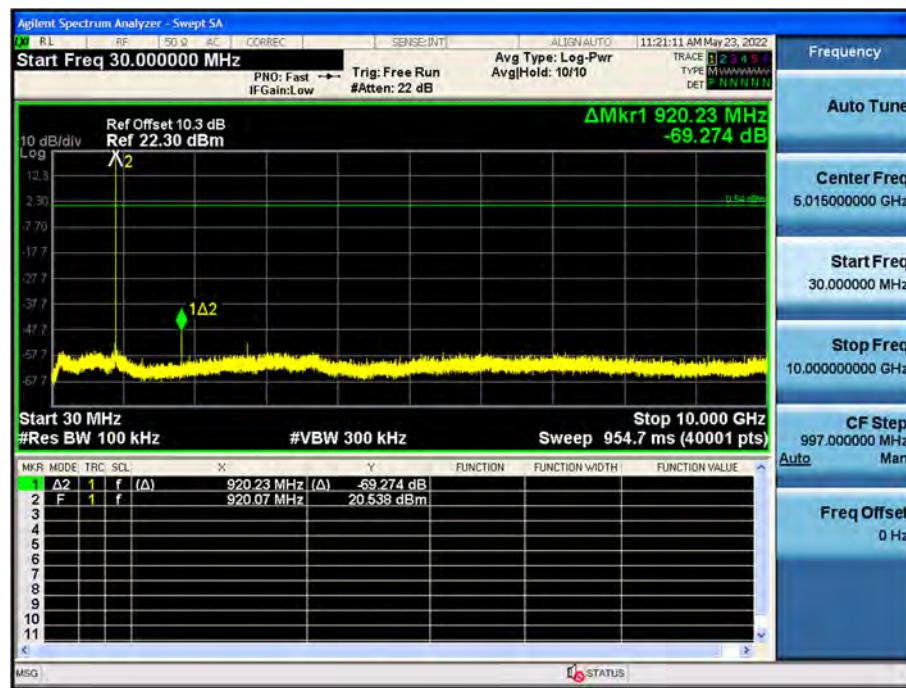
Spurious Emission



- Limit : 0.67 dBm

Test Plots (RC4)

Spurious Emission



- Limit : 0.54 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	dB μ V/m	dBm/m	dB	(H/V)	dB μ V/m	dB μ V/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 = $40\log(\text{specific distance} / \text{test distance})$ (dB)
3. Limit line = specific Limits (dB μ V) + 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	dB μ V/m	dBm/m	dB	(H/V)	dB μ V/m	dB μ V/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 : RC2_Low

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB V]	[dB]	[H/V]	[dB V/m]	[dB V/m]	[dB]	
1804.2750	64.61	-9.41	V	55.20	Non restricted Band	PK	
1804.2750	62.82	-9.41	V	53.41	Non restricted Band	AV	
<u>2706.4125</u>	45.68	-5.86	V	39.82	73.98	34.16	PK
<u>2706.4125</u>	39.46	-5.86	V	33.60	53.98	20.38	AV
<u>3608.5500</u>	44.17	-3.20	V	40.97	73.98	33.01	PK
<u>3608.5500</u>	34.21	-3.20	V	31.01	53.98	22.97	AV
<u>4510.6875</u>	41.15	1.14	V	42.29	73.98	31.69	PK
<u>4510.6875</u>	30.38	1.14	V	31.52	53.98	22.46	AV
<u>5412.8250</u>	39.65	4.56	V	44.21	73.98	29.77	PK
<u>5412.8250</u>	30.03	4.56	V	34.59	53.98	19.39	AV
6314.9625	36.84	9.56	V	46.40	Non restricted Band	PK	
6314.9625	26.63	9.56	V	36.19	Non restricted Band	AV	
7217.1000	37.40	11.71	V	49.11	Non restricted Band	PK	
7217.1000	27.06	11.71	V	38.77	Non restricted Band	AV	
<u>8119.2375</u>	37.78	11.38	V	49.16	73.98	24.82	PK
<u>8119.2375</u>	27.51	11.38	V	38.89	53.98	15.09	AV
<u>9021.3750</u>	39.22	13.93	V	53.15	73.98	20.83	PK
<u>9021.3750</u>	27.31	13.93	V	41.24	53.98	12.74	AV

#Note :

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

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB V]	[dB]	[H/V]	[dB V/m]	[dB V/m]	[dB]	
1804.2750	62.24	-9.41	H	52.83	Non restricted Band	PK	
1804.2750	57.60	-9.41	H	48.19	Non restricted Band	AV	
<u>2706.4125</u>	44.93	-5.86	H	39.07	73.98	34.91	PK
<u>2706.4125</u>	38.35	-5.86	H	32.49	53.98	21.49	AV
<u>3608.5500</u>	43.88	-3.20	H	40.68	73.98	33.30	PK
<u>3608.5500</u>	32.59	-3.20	H	29.39	53.98	24.59	AV
<u>4510.6875</u>	40.72	1.14	H	41.86	73.98	32.12	PK
<u>4510.6875</u>	30.15	1.14	H	31.29	53.98	22.69	AV
<u>5412.8250</u>	39.20	4.56	H	43.76	73.98	30.22	PK
<u>5412.8250</u>	28.79	4.56	H	33.35	53.98	20.63	AV
6314.9625	35.65	9.56	H	45.21	Non restricted Band	PK	
6314.9625	26.14	9.56	H	35.70	Non restricted Band	AV	
7217.1000	36.46	11.71	H	48.17	Non restricted Band	PK	
7217.1000	27.02	11.71	H	38.73	Non restricted Band	AV	
<u>8119.2375</u>	36.88	11.38	H	48.26	73.98	25.72	PK
<u>8119.2375</u>	27.19	11.38	H	38.57	53.98	15.41	AV
<u>9021.3750</u>	37.50	13.93	H	51.43	73.98	22.55	PK
<u>9021.3750</u>	26.21	13.93	H	40.14	53.98	13.84	AV

#Note :

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

Channel : RC4_Low

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB V]	[dB]	[H/V]	[dB V/m]	[dB V/m]	[dB]	
1840.2750	66.80	-8.70	V	58.10	Non restricted Band	PK	
1840.2750	63.19	-8.70	V	54.49	Non restricted Band	AV	
<u>2760.4125</u>	46.69	-5.77	V	40.92	73.98	33.06	PK
<u>2760.4125</u>	40.53	-5.77	V	34.76	53.98	19.22	AV
<u>3680.5500</u>	43.58	-2.79	V	40.79	73.98	33.19	PK
<u>3680.5500</u>	33.28	-2.79	V	30.49	53.98	23.49	AV
<u>4600.6875</u>	41.92	1.51	V	43.43	73.98	30.55	PK
<u>4600.6875</u>	31.21	1.51	V	32.72	53.98	21.26	AV
5520.8250	39.38	5.59	V	44.97	Non restricted Band	PK	
5520.8250	28.10	5.59	V	33.69	Non restricted Band	AV	
6440.9625	36.28	10.43	V	46.71	Non restricted Band	PK	
6440.9625	25.31	10.43	V	35.74	Non restricted Band	AV	
<u>7361.1000</u>	37.69	10.66	V	48.35	73.98	25.63	PK
<u>7361.1000</u>	27.22	10.66	V	37.88	53.98	16.10	AV
<u>8281.2375</u>	37.47	11.94	V	49.41	73.98	24.57	PK
<u>8281.2375</u>	27.33	11.94	V	39.27	53.98	14.71	AV
9201.3750	35.63	14.16	V	49.79	Non restricted Band	PK	
9201.3750	25.07	14.16	V	39.23	Non restricted Band	AV	

#Note :

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

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB μ V]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
1840.2750	66.48	-8.70	H	57.78	Non restricted Band	PK	
1840.2750	59.13	-8.70	H	50.43	Non restricted Band	AV	
<u>2760.4125</u>	45.23	-5.77	H	39.46	73.98	34.52	PK
<u>2760.4125</u>	39.36	-5.77	H	33.59	53.98	20.39	AV
<u>3680.5500</u>	42.55	-2.79	H	39.76	73.98	34.22	PK
<u>3680.5500</u>	33.16	-2.79	H	30.37	53.98	23.61	AV
<u>4600.6875</u>	40.82	1.51	H	42.33	73.98	31.65	PK
<u>4600.6875</u>	31.12	1.51	H	32.63	53.98	21.35	AV
5520.8250	39.10	5.59	H	44.69	Non restricted Band	PK	
5520.8250	28.07	5.59	H	33.66	Non restricted Band	AV	
6440.9625	35.79	10.43	H	46.22	Non restricted Band	PK	
6440.9625	25.28	10.43	H	35.71	Non restricted Band	AV	
<u>7361.1000</u>	36.00	10.66	H	46.66	73.98	27.32	PK
<u>7361.1000</u>	27.19	10.66	H	37.85	53.98	16.13	AV
<u>8281.2375</u>	37.42	11.94	H	49.36	73.98	24.62	PK
<u>8281.2375</u>	27.26	11.94	H	39.20	53.98	14.78	AV
9201.3750	35.09	14.16	H	49.25	Non restricted Band	PK	
9201.3750	25.04	14.16	H	39.20	Non restricted Band	AV	

#Note :

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

Channel : RC2_Mid

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB μ V]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
1806.8250	64.46	-9.41	V	55.05	Non restricted Band	PK	
1806.8250	62.63	-9.41	V	53.22	Non restricted Band	AV	
2710.2375	46.40	-5.72	V	40.68	73.98	33.30	PK
<u>2710.2375</u>	39.63	-5.72	V	33.91	53.98	20.07	AV
<u>3613.6500</u>	42.07	-3.18	V	38.89	73.98	35.09	PK
<u>3613.6500</u>	33.33	-3.18	V	30.15	53.98	23.83	AV
<u>4517.0625</u>	42.05	1.16	V	43.21	73.98	30.77	PK
<u>4517.0625</u>	30.87	1.16	V	32.03	53.98	21.95	AV
<u>5420.4750</u>	39.58	4.44	V	44.02	73.98	29.96	PK
<u>5420.4750</u>	30.66	4.44	V	35.10	53.98	18.88	AV
6323.8875	35.87	9.56	V	45.43	Non restricted Band	PK	
6323.8875	25.92	9.56	V	35.48	Non restricted Band	AV	
7227.3000	36.14	11.56	V	47.70	Non restricted Band	PK	
7227.3000	27.10	11.56	V	38.66	Non restricted Band	AV	
<u>8130.7125</u>	37.60	11.48	V	49.08	73.98	24.90	PK
<u>8130.7125</u>	27.58	11.48	V	39.06	53.98	14.92	AV
<u>9034.1250</u>	37.45	13.71	V	51.16	73.98	22.82	PK
<u>9034.1250</u>	26.43	13.71	V	40.14	53.98	13.84	AV

#Note :

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

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB μ V]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
1806.8250	63.45	-9.41	H	54.04	Non restricted Band	PK	
1806.8250	61.52	-9.41	H	52.11	Non restricted Band	AV	
2710.2375	45.89	-5.72	H	40.17	73.98	33.81	PK
<u>2710.2375</u>	38.56	-5.72	H	32.84	53.98	21.14	AV
<u>3613.6500</u>	42.24	-3.18	H	39.06	73.98	34.92	PK
<u>3613.6500</u>	33.28	-3.18	H	30.10	53.98	23.88	AV
<u>4517.0625</u>	41.32	1.16	H	42.48	73.98	31.50	PK
<u>4517.0625</u>	30.78	1.16	H	31.94	53.98	22.04	AV
<u>5420.4750</u>	38.67	4.44	H	43.11	73.98	30.87	PK
<u>5420.4750</u>	30.63	4.44	H	35.07	53.98	18.91	AV
6323.8875	36.46	9.56	H	46.02	Non restricted Band	PK	
6323.8875	25.91	9.56	H	35.47	Non restricted Band	AV	
7227.3000	36.61	11.56	H	48.17	Non restricted Band	PK	
7227.3000	26.97	11.56	H	38.53	Non restricted Band	AV	
<u>8130.7125</u>	36.89	11.48	H	48.37	73.98	25.61	PK
<u>8130.7125</u>	24.47	11.48	H	35.95	53.98	18.03	AV
<u>9034.1250</u>	36.04	13.71	H	49.75	73.98	24.23	PK
<u>9034.1250</u>	26.51	13.71	H	40.22	53.98	13.76	AV

#Note :

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

Channel : RC4_Mid

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB μ V]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
1842.8250	66.83	-8.77	V	58.06	Non restricted Band	PK	
1842.8250	63.23	-8.77	V	54.46	Non restricted Band	AV	
<u>2764.2375</u>	47.47	-5.93	V	41.54	73.98	32.44	PK
<u>2764.2375</u>	41.17	-5.93	V	35.24	53.98	18.74	AV
<u>3685.6500</u>	43.99	-2.75	V	41.24	73.98	32.74	PK
<u>3685.6500</u>	35.51	-2.75	V	32.76	53.98	21.22	AV
<u>4607.0625</u>	41.20	1.57	V	42.77	73.98	31.21	PK
<u>4607.0625</u>	31.53	1.57	V	33.10	53.98	20.88	AV
5528.4750	39.42	5.58	V	45.00	Non restricted Band	PK	
5528.4750	30.55	5.58	V	36.13	Non restricted Band	AV	
6449.8875	35.19	10.65	V	45.84	Non restricted Band	PK	
6449.8875	26.15	10.65	V	36.80	Non restricted Band	AV	
<u>7371.3000</u>	38.18	10.73	V	48.91	73.98	25.07	PK
<u>7371.3000</u>	27.82	10.73	V	38.55	53.98	15.43	AV
<u>8292.7125</u>	37.32	12.05	V	49.37	73.98	24.61	PK
<u>8292.7125</u>	27.41	12.05	V	39.46	53.98	14.52	AV
9214.1250	35.05	14.26	V	49.31	Non restricted Band	PK	
9214.1250	25.94	14.26	V	40.20	Non restricted Band	AV	

#Note :

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

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB μ V]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
1842.8250	64.75	-8.77	H	55.98	Non restricted Band	PK	
1842.8250	62.26	-8.77	H	53.49	Non restricted Band	AV	
<u>2764.2375</u>	46.98	-5.93	H	41.05	73.98	32.93	PK
<u>2764.2375</u>	39.08	-5.93	H	33.15	53.98	20.83	AV
<u>3685.6500</u>	43.61	-2.75	H	40.86	73.98	33.12	PK
<u>3685.6500</u>	35.45	-2.75	H	32.70	53.98	21.28	AV
<u>4607.0625</u>	40.40	1.57	H	41.97	73.98	32.01	PK
<u>4607.0625</u>	31.47	1.57	H	33.04	53.98	20.94	AV
5528.4750	38.54	5.58	H	44.12	Non restricted Band	PK	
5528.4750	30.54	5.58	H	36.12	Non restricted Band	AV	
6449.8875	35.09	10.65	H	45.74	Non restricted Band	PK	
6449.8875	26.12	10.65	H	36.77	Non restricted Band	AV	
<u>7371.3000</u>	37.38	10.73	H	48.11	73.98	25.87	PK
<u>7371.3000</u>	27.77	10.73	H	38.50	53.98	15.48	AV
<u>8292.7125</u>	36.25	12.05	H	48.30	73.98	25.68	PK
<u>8292.7125</u>	27.30	12.05	H	39.35	53.98	14.63	AV
9214.1250	35.01	14.26	H	49.27	Non restricted Band	PK	
9214.1250	25.81	14.26	H	40.07	Non restricted Band	AV	

#Note :

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

Channel : RC2_High

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB μ V]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
1809.3250	64.19	-9.31	V	54.88	Non restricted Band	PK	
1809.3250	62.37	-9.31	V	53.06	Non restricted Band	AV	
2713.9875	46.49	-5.88	V	40.61	73.98	33.37	PK
<u>2713.9875</u>	38.66	-5.88	V	32.78	53.98	21.20	AV
<u>3618.6500</u>	41.81	-3.18	V	38.63	73.98	35.35	PK
<u>3618.6500</u>	33.66	-3.18	V	30.48	53.98	23.50	AV
<u>4523.3125</u>	41.28	1.27	V	42.55	73.98	31.43	PK
<u>4523.3125</u>	31.32	1.27	V	32.59	53.98	21.39	AV
<u>5427.9750</u>	39.88	4.46	V	44.34	73.98	29.64	PK
<u>5427.9750</u>	30.90	4.46	V	35.36	53.98	18.62	AV
6332.6375	37.26	9.64	V	46.90	Non restricted Band	PK	
6332.6375	26.56	9.64	V	36.20	Non restricted Band	AV	
7237.3000	36.76	11.55	V	48.31	Non restricted Band	PK	
7237.3000	26.66	11.55	V	38.21	Non restricted Band	AV	
<u>8141.9625</u>	36.87	11.78	V	48.65	73.98	25.33	PK
<u>8141.9625</u>	26.72	11.78	V	38.50	53.98	15.48	AV
<u>9046.6250</u>	36.49	13.64	V	50.13	73.98	23.85	PK
<u>9046.6250</u>	26.48	13.64	V	40.12	53.98	13.86	AV

#Note :

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

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB μ V]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
1809.3250	63.29	-9.31	H	53.98	Non restricted Band	PK	
1809.3250	61.18	-9.31	H	51.87	Non restricted Band	AV	
2713.9875	45.82	-5.88	H	39.94	73.98	34.04	PK
<u>2713.9875</u>	38.21	-5.88	H	32.33	53.98	21.65	AV
<u>3618.6500</u>	42.90	-3.18	H	39.72	73.98	34.26	PK
<u>3618.6500</u>	33.52	-3.18	H	30.34	53.98	23.64	AV
<u>4523.3125</u>	40.92	1.27	H	42.19	73.98	31.79	PK
<u>4523.3125</u>	31.40	1.27	H	32.67	53.98	21.31	AV
<u>5427.9750</u>	39.96	4.46	H	44.42	73.98	29.56	PK
<u>5427.9750</u>	30.78	4.46	H	35.24	53.98	18.74	AV
6332.6375	36.25	9.64	H	45.89	Non restricted Band	PK	
6332.6375	26.62	9.64	H	36.26	Non restricted Band	AV	
7237.3000	37.36	11.55	H	48.91	Non restricted Band	PK	
7237.3000	26.65	11.55	H	38.20	Non restricted Band	AV	
<u>8141.9625</u>	35.82	11.78	H	47.60	73.98	26.38	PK
<u>8141.9625</u>	26.63	11.78	H	38.41	53.98	15.57	AV
<u>9046.6250</u>	36.73	13.64	H	50.37	73.98	23.61	PK
<u>9046.6250</u>	26.38	13.64	H	40.02	53.98	13.96	AV

#Note :

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

Channel : RC4_High

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB μ V]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
1845.3250	66.75	-8.87	V	57.88	Non restricted Band	PK	
1845.3250	63.26	-8.87	V	54.39	Non restricted Band	AV	
<u>2767.9875</u>	45.82	-5.99	V	39.83	73.98	34.15	PK
<u>2767.9875</u>	40.42	-5.99	V	34.43	53.98	19.55	AV
<u>3690.6500</u>	44.10	-2.41	V	41.69	73.98	32.29	PK
<u>3690.6500</u>	35.94	-2.41	V	33.53	53.98	20.45	AV
<u>4613.3125</u>	40.67	1.60	V	42.27	73.98	31.71	PK
<u>4613.3125</u>	32.14	1.60	V	33.74	53.98	20.24	AV
5535.9750	39.35	5.51	V	44.86	Non restricted Band	PK	
5535.9750	30.86	5.51	V	36.37	Non restricted Band	AV	
6458.6375	37.22	10.63	V	47.85	Non restricted Band	PK	
6458.6375	26.22	10.63	V	36.85	Non restricted Band	AV	
<u>7381.3000</u>	38.99	10.69	V	49.68	73.98	24.30	PK
<u>7381.3000</u>	27.91	10.69	V	38.60	53.98	15.38	AV
<u>8303.9625</u>	38.48	12.39	V	50.87	73.98	23.11	PK
<u>8303.9625</u>	27.42	12.39	V	39.81	53.98	14.17	AV
9226.6250	37.21	14.20	V	51.41	Non restricted Band	PK	
9226.6250	25.77	14.20	V	39.97	Non restricted Band	AV	

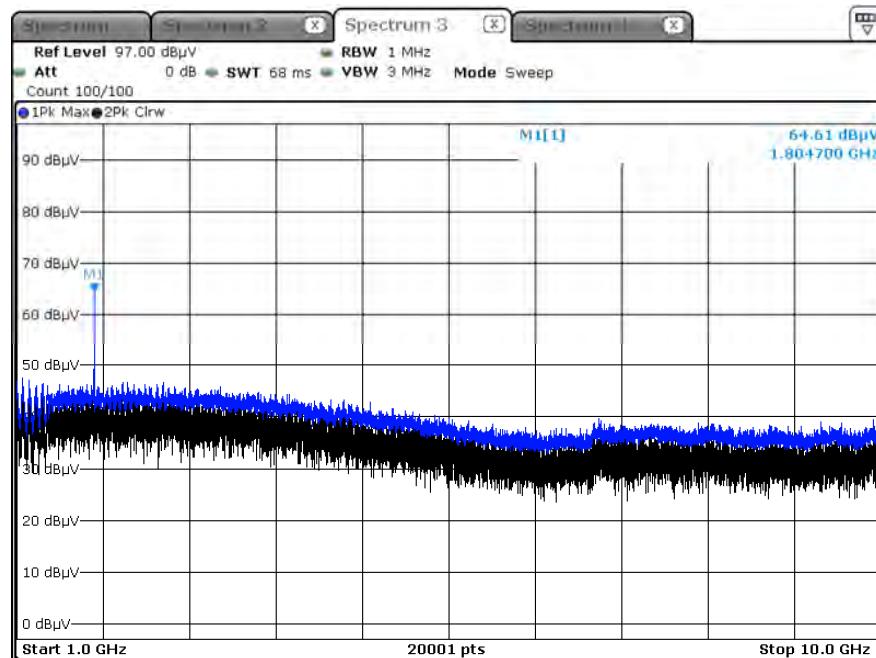
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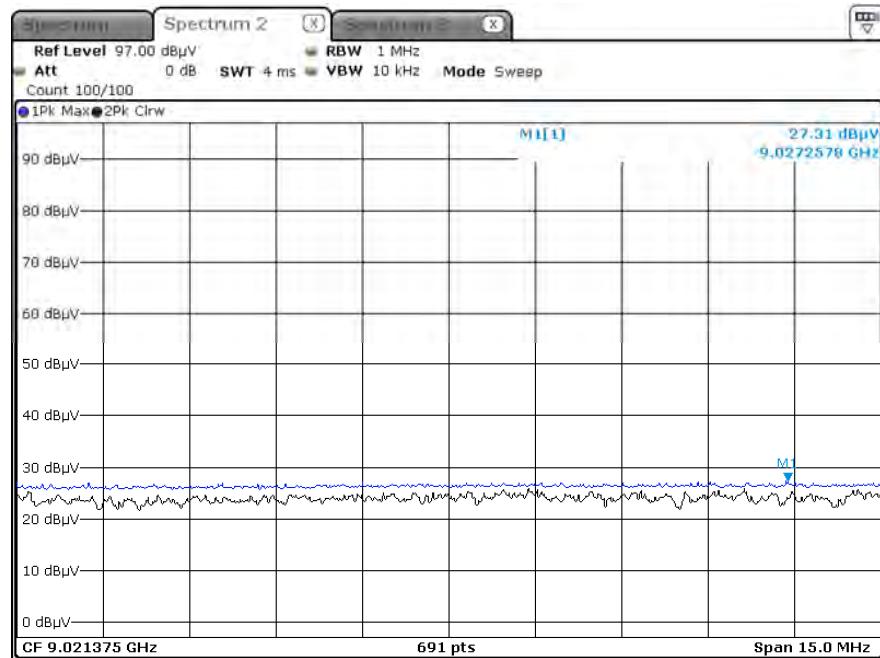
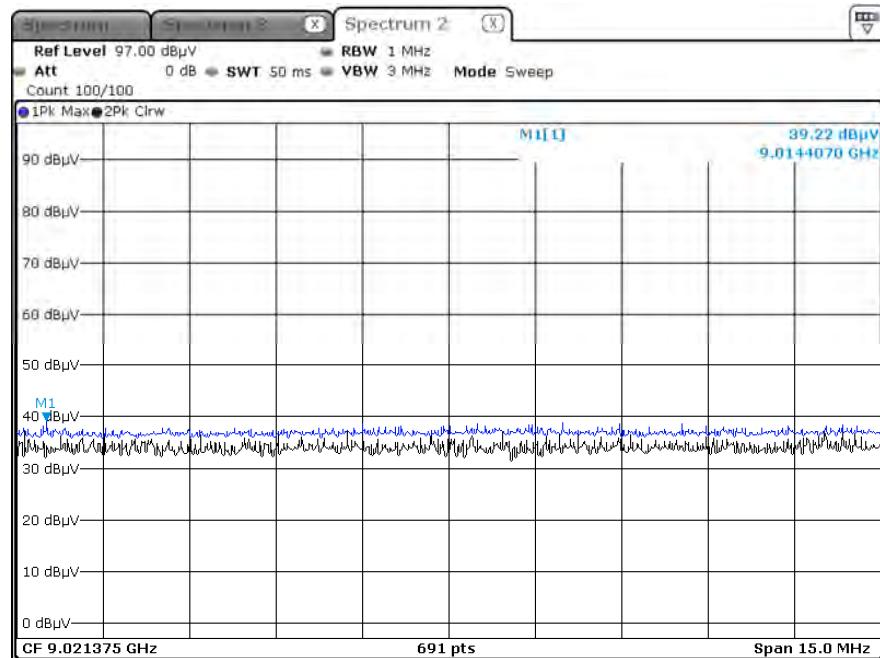
1. Non Restricted Band refer to Conducted Spurious emission test result (20dBc)
2. _ : Restricted band

Frequency	Measured Value	A.F+C.L-A.G+D.F	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dB μ V]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
1845.3250	65.51	-8.87	H	56.64	Non restricted Band	PK	
1845.3250	62.22	-8.87	H	53.35	Non restricted Band	AV	
<u>2767.9875</u>	45.64	-5.99	H	39.65	73.98	34.33	PK
<u>2767.9875</u>	39.65	-5.99	H	33.66	53.98	20.32	AV
<u>3690.6500</u>	43.54	-2.41	H	41.13	73.98	32.85	PK
<u>3690.6500</u>	35.78	-2.41	H	33.37	53.98	20.61	AV
<u>4613.3125</u>	40.57	1.60	H	42.17	73.98	31.81	PK
<u>4613.3125</u>	32.06	1.60	H	33.66	53.98	20.32	AV
5535.9750	39.32	5.51	H	44.83	Non restricted Band	PK	
5535.9750	30.96	5.51	H	36.47	Non restricted Band	AV	
6458.6375	37.08	10.63	H	47.71	Non restricted Band	PK	
6458.6375	26.17	10.63	H	36.80	Non restricted Band	AV	
<u>7381.3000</u>	39.35	10.69	H	50.04	73.98	23.94	PK
<u>7381.3000</u>	27.86	10.69	H	38.55	53.98	15.43	AV
<u>8303.9625</u>	38.08	12.39	H	50.47	73.98	23.51	PK
<u>8303.9625</u>	27.32	12.39	H	39.71	53.98	14.27	AV
9226.6250	37.18	14.20	H	51.38	Non restricted Band	PK	
9226.6250	25.67	14.20	H	39.87	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 –**[TX Pre-scan]macro ch.1 RC2 biterate600 1GHz~10GHz no peak & 2nd Harmonic(Non-Restricted Band)

Radiated Spurious Emissions plot – Average Result (RC2 10th Harmonic)Radiated Spurious Emissions plot – Peak Result (RC2 10th Harmonic)

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

10.7 RECEIVER SPURIOUS

EMISSIONS Frequency Range : Below 1

Frequency GHz MHz	Measured Value dB μ V/m	Ant. factor dBm/m	Cable loss dBm	Ant. POL (H/V)	Total dB μ V/m	Limit dB μ V/m	Margin dB
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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.

Frequency Range : Above 1 GHz

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

10.8 POWERLINE CONDUCTED EMISSIONS

Conducted Emissions (Line 1)

Test

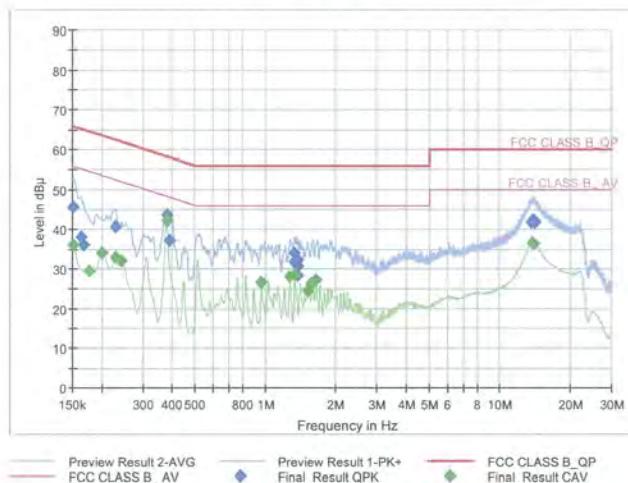
1 / 2

Test Report

Common Information

EUT : LSM110A
Manufacturer : SEONG JI
Test Site: SHIELD ROOM
Operating Conditions : Sigfox L1

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1523	45.59	65.88	20.28	9.000	L1	OFF	9.6
0.1635	38.13	65.28	27.15	9.000	L1	OFF	9.6
0.1680	36.10	65.06	28.96	9.000	L1	OFF	9.6
0.2310	40.63	62.41	21.78	9.000	L1	OFF	9.6
0.3795	43.60	58.29	14.70	9.000	L1	OFF	9.6
0.3908	37.16	58.05	20.89	9.000	L1	OFF	9.6
1.3258	31.77	56.00	24.23	9.000	L1	OFF	9.6
1.3370	34.01	56.00	21.99	9.000	L1	OFF	9.6
1.3595	31.81	56.00	24.19	9.000	L1	OFF	9.6
1.3685	32.22	56.00	23.78	9.000	L1	OFF	9.6
1.3730	30.64	56.00	25.36	9.000	L1	OFF	9.6
1.3775	28.30	56.00	27.70	9.000	L1	OFF	9.6
13.6918	41.71	60.00	18.29	9.000	L1	OFF	9.8
13.7953	42.00	60.00	18.00	9.000	L1	OFF	9.8
13.8380	42.00	60.00	18.00	9.000	L1	OFF	9.8
13.8493	42.07	60.00	17.93	9.000	L1	OFF	9.8
13.9258	41.99	60.00	18.01	9.000	L1	OFF	9.8
14.0585	41.87	60.00	18.13	9.000	L1	OFF	9.8

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Test

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Final Result CAV

Frequency (MHz)	CAverage (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1523	36.16	55.88	19.72	9.000	L1	OFF	9.6
0.1770	29.30	54.63	25.33	9.000	L1	OFF	9.6
0.2018	34.03	53.54	19.51	9.000	L1	OFF	9.6
0.2288	32.95	52.50	19.55	9.000	L1	OFF	9.6
0.2445	32.01	51.94	19.93	9.000	L1	OFF	9.6
0.3795	42.14	48.29	6.15	9.000	L1	OFF	9.6
0.9613	26.68	46.00	19.32	9.000	L1	OFF	9.6
1.2718	28.12	46.00	17.88	9.000	L1	OFF	9.6
1.3393	28.70	46.00	17.30	9.000	L1	OFF	9.6
1.5148	24.48	46.00	21.52	9.000	L1	OFF	9.6
1.5823	26.12	46.00	19.88	9.000	L1	OFF	9.6
1.6498	27.11	46.00	18.89	9.000	L1	OFF	9.6
13.7728	36.49	50.00	13.51	9.000	L1	OFF	9.8
13.7975	36.64	50.00	13.36	9.000	L1	OFF	9.8
13.8290	36.54	50.00	13.46	9.000	L1	OFF	9.8
13.8515	36.69	50.00	13.31	9.000	L1	OFF	9.8
13.9595	36.40	50.00	13.60	9.000	L1	OFF	9.8
13.9910	36.42	50.00	13.59	9.000	L1	OFF	9.8

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Conducted Emissions (Line 2)

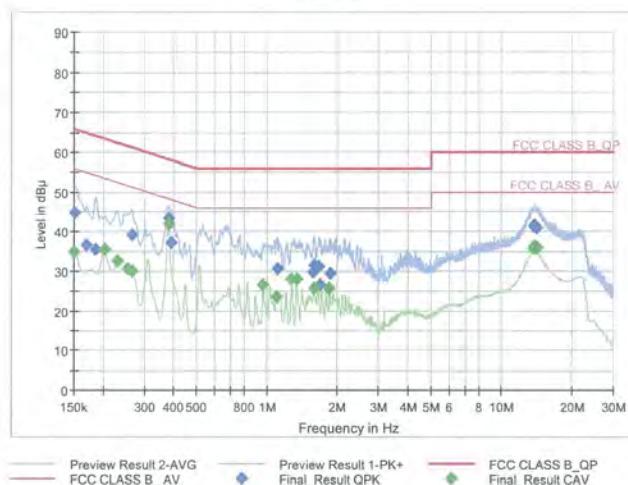
Test

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Test Report**Common Information**

EUT : LSM110A
Manufacturer : SEOONG JI
Test Site: SHIELD ROOM
Operating Conditions : Sigfox N

Full Spectrum

**Final Result QPK**

Frequency (MHz)	QuasiPeak (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1523	44.57	65.88	21.31	9.000	N	OFF	9.6
0.1703	36.50	64.95	28.45	9.000	N	OFF	9.6
0.1860	35.59	64.21	28.62	9.000	N	OFF	9.6
0.2648	39.16	61.28	22.12	9.000	N	OFF	9.6
0.3795	43.33	58.29	14.96	9.000	N	OFF	9.6
0.3908	37.19	58.05	20.86	9.000	N	OFF	9.6
1.1075	30.55	56.00	25.45	9.000	N	OFF	9.6
1.5710	29.79	56.00	26.21	9.000	N	OFF	9.6
1.5913	31.54	56.00	24.46	9.000	N	OFF	9.6
1.6655	31.05	56.00	24.95	9.000	N	OFF	9.6
1.6858	26.43	56.00	29.57	9.000	N	OFF	9.6
1.8725	29.42	56.00	26.58	9.000	N	OFF	9.6
13.7570	41.23	60.00	18.77	9.000	N	OFF	9.8
13.8178	41.17	60.00	18.83	9.000	N	OFF	9.8
13.8403	41.26	60.00	18.74	9.000	N	OFF	9.8
13.8470	41.42	60.00	18.58	9.000	N	OFF	9.8
13.8515	41.30	60.00	18.70	9.000	N	OFF	9.8
14.1868	40.99	60.00	19.01	9.000	N	OFF	9.8

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Test

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Final_Result_CAV

Frequency (MHz)	CAverage (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	34.92	56.00	21.08	9.000	N	OFF	9.6
0.2040	35.54	53.45	17.91	9.000	N	OFF	9.6
0.2288	32.59	52.50	19.90	9.000	N	OFF	9.6
0.2535	30.52	51.64	21.12	9.000	N	OFF	9.6
0.2670	29.98	51.21	21.24	9.000	N	OFF	9.6
0.3795	41.92	48.29	6.37	9.000	N	OFF	9.6
0.9613	26.41	46.00	19.59	9.000	N	OFF	9.6
1.0963	23.58	46.00	22.42	9.000	N	OFF	9.6
1.2718	27.88	46.00	18.12	9.000	N	OFF	9.6
1.3393	27.98	46.00	18.02	9.000	N	OFF	9.6
1.5845	25.80	46.00	20.20	9.000	N	OFF	9.6
1.8523	25.72	46.00	20.28	9.000	N	OFF	9.6
13.6378	35.87	50.00	14.13	9.000	N	OFF	9.8
13.7660	36.11	50.00	13.89	9.000	N	OFF	9.8
13.8178	36.27	50.00	13.73	9.000	N	OFF	9.8
13.8695	36.36	50.00	13.64	9.000	N	OFF	9.8
14.1193	36.11	50.00	13.89	9.000	N	OFF	9.8
14.1890	35.89	50.00	14.11	9.000	N	OFF	9.8

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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	08/23/2022	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	06/17/2022	Annual
Temperature Chamber	SU-642	ESPAC	0093008124	03/04/2023	Annual
Signal Analyzer	N9030A	Agilent	MY49431210	01/11/2023	Annual
Power Measurement Set	OSP 120	Rohde & Schwarz	101231	07/02/2022	Annual
Power Meter	N1911A	Agilent	MY45100523	03/24/2023	Annual
Power Sensor	N1921A	Keysight	MY57820067	03/24/2023	Annual
Directional Coupler	87300B	Agilent	3116A03621	11/02/2022	Annual
Power Splitter	11667B	Hewlett Packard	05001	05/18/2023	Annual
DC Power Supply	E3632A	Hewlett Packard	KR75306225	01/03/2023	Annual
Attenuator(10 dB)	8493C	Hewlett Packard	07560	06/18/2022	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	EM1000	Audix	060520	N/A	N/A
Turn Table	N/A	Audix	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/17/2024	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	760	02/22/2023	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	02299	03/24/2024	Biennial
Horn Antenna (15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170541	11/16/2023	Biennial
Spectrum Analyzer	FSV40-N	Rohde & Schwarz	102168	07/05/2022	Annual
Signal Analyzer	N9030A	Agilent	MY49431210	01/11/2023	Annual
High Pass Filter	WHK1.2/15G-10EF	Wainwright Instruments	2	07/27/2022	Annual
Attenuator (3 dB)	18B-03	Api tech.	1	01/21/2023	Annual
Attenuator(10 dB)	8493C-10	Agilent	08285	01/21/2023	Annual
Power Amplifier	CBLU1183540	CERNEX	22964	01/21/2023	Annual
Power Amplifier	CBL06185030	CERNEX	22965	01/21/2023	Annual
Power Amplifier	CBL18265035	CERNEX	22966	12/02/2022	Annual
Power Amplifier	CBL26405040	CERNEX	25956	03/11/2023	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-2205-FI003-P