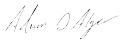
TR 3765 A

Equipment Under Test:	RM1262
Requirement(s):	FCC 15.247 DTS ISED RSS-247 DTS
Test Date(s):	12/13/2023 – 12/15/2023
Prepared for:	Laird Connectivity Attn: Jonathan Kaye W66 N220 Commerce Ct. Cedarburg, WI 53012

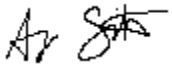
Report Issued by: Adam Alger, Laboratory Manager

Signature:  Date: 2/22/2024

Report Reviewed by: Adam Alger, Laboratory Manager

Signature:  Date: 1/8/2024

Report Constructed by: Anthony Smith, EMC Engineering Specialist

Signature:  Date: 12/18/2023

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Laird Connectivity Test Services in Review

The Laird Connectivity LLC laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025:2017 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein unless otherwise noted

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Federal Communications Commission (FCC) – USA

Accredited Test Firm Registration Number: 953492

Recognition of two 3 meter Semi-Anechoic Chambers

Government of Canada

Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

1 TEST REPORT SUMMARY

During **December 13th – December 15th, 2023** the Equipment Under Test (EUT), **RM 1262**, as provided by **Laird Connectivity** was tested to the following requirements for the purpose of a **Class 2 Permissive Change to add an antenna**:

Requirements	Description	Specification	Method	Result
FCC: 15.247 (a)(2) IC: RSS-247 5.2 (a)	Digital Modulation System 6 dB bandwidth	500 kHz	ANSI C63.10	Pass
FCC: 2.1049 IC: RSS-GEN 6.7	Occupied Bandwidth	Reported	ANSI C63.10	Pass
FCC: 15.247 (b)(3) IC: RSS-247 5.4 (d)	Maximum Conducted Output Power	30 dBm	ANSI C63.10	Pass
FCC: 15.247 (e) IC: RSS-247 5.2 (b)	Digital Modulation System Power Spectral Density	8 dBm / 3 kHz	ANSI C63.10	Pass
FCC: 15.247 (d) IC: RSS-247 5.5	RF Spurious Emissions at the Transmitter Antenna Terminal	30 dBc	ANSI C63.10	Pass
FCC: 15.247 (d) IC: RSS-GEN 8.10	Spurious Radiated Emissions in Restricted Bands	FCC 15.209 RSS-GEN 8.9	ANSI C63.10	Pass

Notice:

The results relate only to the item tested as configured and described in this report. Any additional configurations, modes of operation, or modifications made to the equipment under test after the specified test date(s) are at the decision of the client and may not apply to the data seen in this test report.

The decision rule for Pass / Fail assessment to the specification or standard listed in this test report has been agreed upon by the client and laboratory to be as follows:

Measurement Type	Rule
Emissions – Amplitude	1 dB below specified limit
Emissions – Frequency	1% less than the specification
Immunity	Tested at specified level

2 CLIENT INFORMATION

Company Name	Laird Connectivity
Contact Person	Jonathan Kaye
Address	W66N220 Commerce Court Cedarburg, WI, 53012

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	RM1262
Model Number	RM1262
Serial Number	00082
FCC ID	SQG-RM1262
IC ID	3147A-RM1262

2.2 Product Description

LoRaWAN module operating in the 903-914.2 MHz range.

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Additional Information

Programmed via USB cable utilizing UwTerminalX ver 1.17 (terminal emulator software).

Radio Test Firmware: RM1262_480-00219-R128.4.1.242.gbl.

Powered via USB.

2.6 Additional Information

Tested for a Class 2 Permissive Change to add a Laird FlexDIPOLE antenna with a peak gain of 2.4 dBi to the list of antennas usable by the RM1262. EUT tested via Cabinet Radiation method.

2.7 RF Information

Channel Frequency (MHz)	Channel List	Data Rate (bits/sec)	Spreading Factor	Channel Bandwidth (kHz)
903.0-914.2	8 Channels	12500	SF 8	500

2.8 Test Channels, Duty Cycle, and Power Index

Channel	Frequency (MHz)	Power Index	Modulation Mode	Duty Cycle	Duty Factor (dB)
64	903.0	22	LoRa	79.5	1.0
67	907.8	22	LoRa	79.5	1.0
71	914.2	22	LoRa	79.5	1.0

3 REFERENCES

Publication	Edition	Date	AMD 1
eCFR	-	2023	-
RSS-247	3	2024	-
RSS-GEN	5	2018	2019
ANSI C63.10	-	2013	-
KDB 178919 D01	6	2015	-

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k = 2.

References
CISPR 16-4-1
CISPR 16-4-2
CISPR 32
ANSI C63.23
A2LA P103
A2LA P103c
ETSI TR 100-028

Measurement Type	Configuration	Uncertainty ±
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

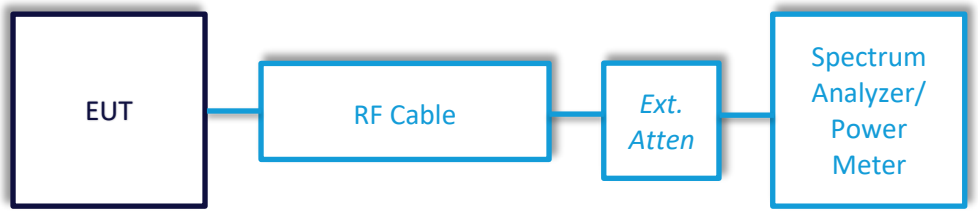
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter. The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.
Example Calculations	Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm) Margin (dB) = Limit (dBm) – Corrected Reading (dBm)

Block Diagram



Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960156	Filter - High Pass 900 MHz	KWM	HPF-L-14185	none	4/11/2023	4/11/2024	Active Calibration
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2023	6/12/2024	Active Verification
EE 960085	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	4/27/2023	4/27/2024	Active Calibration
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/11/2023	4/11/2024	Active Calibration
EE 960203	Analyzer - EMI Receiver	Keysight	N9038A	MY56400072	4/11/2023	4/11/2024	Active Calibration

5.1.1 Antenna Port Conducted Emissions – Output Power

Operator	Anthony Smith	**QA**	Dylan Rosenfeldt
Temperature	21.4, 21.9, 21.5°C	**R.H. %**	22.3, 29.2, 34.8%
Test Date	12/13/2023,12/14/2023, 12/15/2023	**Location**	Conducted RF Bench
Requirement	FCC 15.247 (b)(3) RSS-247	**Method**	ANSI C63.10 11.9.2.2.4

Limits: 1W

Test Parameters

Frequency	903.0-914.2 MHz	**Setup**	Conducted
RBW	10 kHz	**VBW**	30 kHz
Detector(s)	RMS – Trace Average	**Sweep Time**	Auto

EUT Parameters

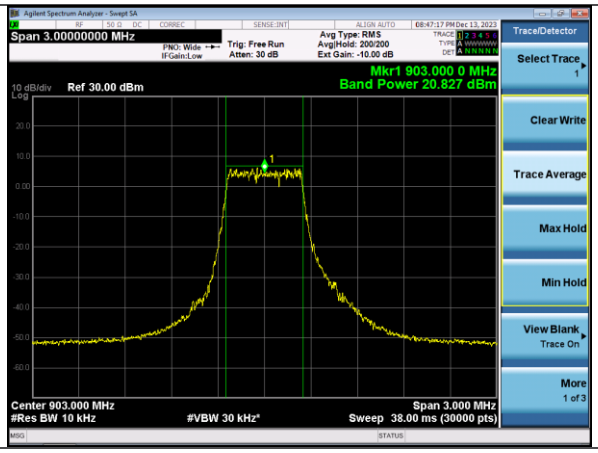
Input Power	USB	**Mode**	LoRa
Frequency	903.0, 907.8, 914.2 MHz	**Channel**	Low, Mid, High
Bandwidth	500 kHz	**Spreading Factor**	8
Notes	Duty Factor (dB) = 10*LOG(1/Duty Cycle)		

Data

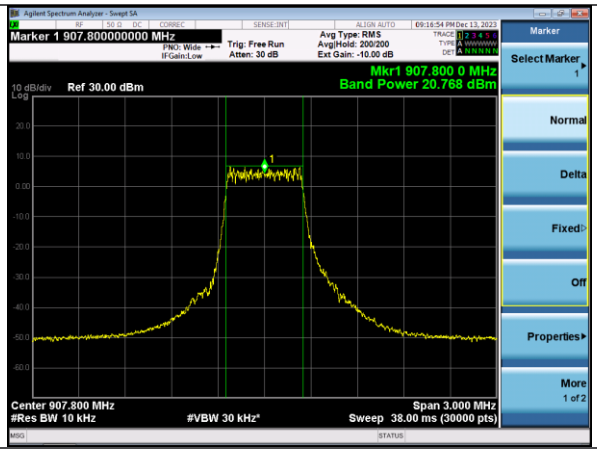
Table

Frequency (MHz)	Antenna Gain (dBi)	Measurement (dBm)	Duty Cycle Correction (dB)	Corrected Average Output Power (dBm)	Limit (dBm)	Margin (dB)
903.0	2.4	20.8	1.0	21.8	30.0	8.2
907.8	2.4	20.8	1.0	21.8	30.0	8.2
914.2	2.4	20.6	1.0	21.6	30.0	8.4

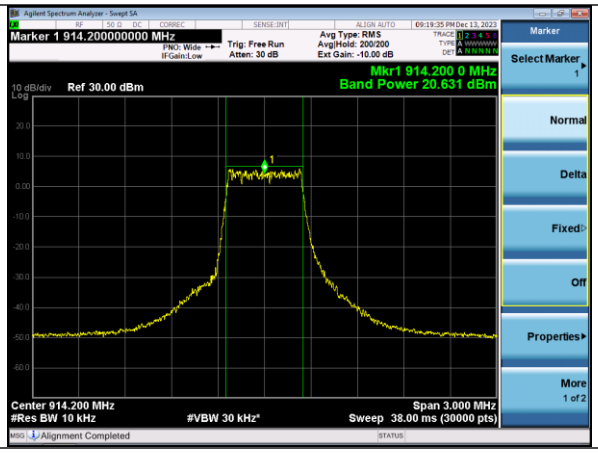
Plots



903.0 MHz



907.8 MHz



914.2 MHz

5.1.2 Antenna Port Conducted Emissions – 6dB and Occupied Bandwidth

Operator	Anthony Smith	**QA**	Dylan Rosenfeldt
Temperature	21.4, 21.9, 21.5°C	**R.H. %**	22.3, 29.2, 34.8%
Test Date	12/13/2023,12/14/2023, 12/15/2023	**Location**	Conducted RF Bench
Requirement	FCC 15.247 (a)(2) RSS-247 5.2 (a)	**Method**	ANSI C63.10 § 6.9.3 (OBW) § 11.8.2 (6dB)

Limits: ≥ 500 kHz (6dB Bandwidth)

Test Parameters

Frequency	2400-2483.5 MHz	**Setup**	Conducted
RBW	100 kHz (6dB) 10 kHz (OBW)	**VBW**	300 kHz (6dB) 30 kHz (OBW)
Detector(s)	Peak Max Hold	**Sweep Time**	Auto

EUT Parameters

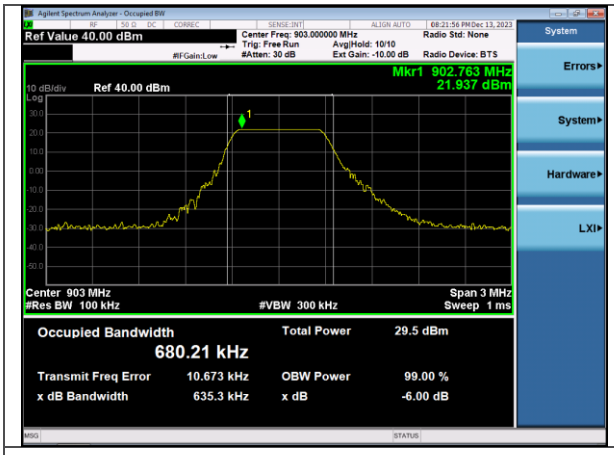
Input Power	USB	**Mode**	LoRa
Frequency	903.0, 907.8, 914.2 MHz	**Channel**	Low, Mid, High
Bandwidth	500 kHz	**Spreading Factor**	8

Data

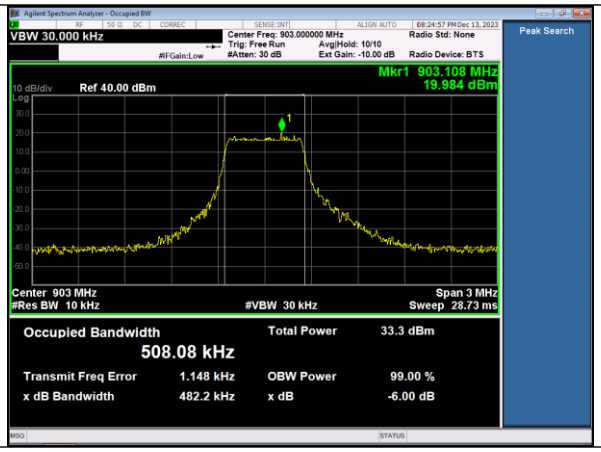
Table

Frequency (MHz)	6 dB BW (kHz)	99% OBW (kHz)	Limit (kHz)	Margin (kHz)
903.0	635.3	508.1	500.0	135.3
907.8	635.8	502.7	500.0	135.8
914.2	636.5	503.0	500.0	136.5

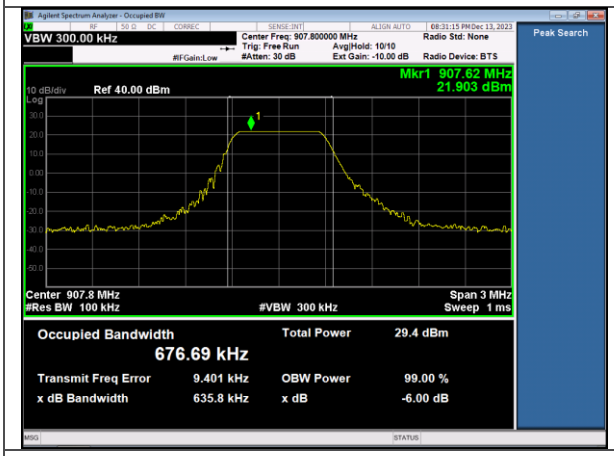
Plots



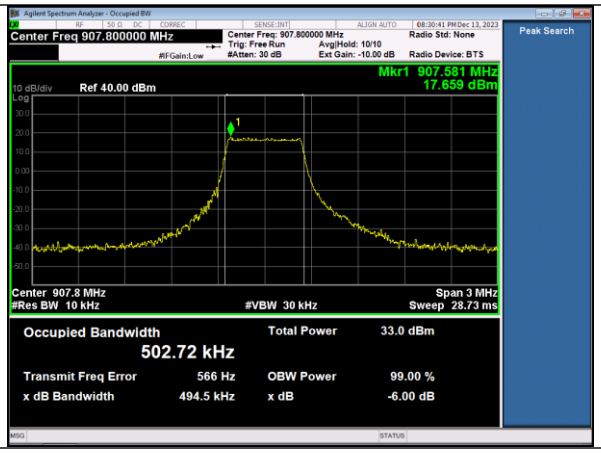
6 dB BW – Low



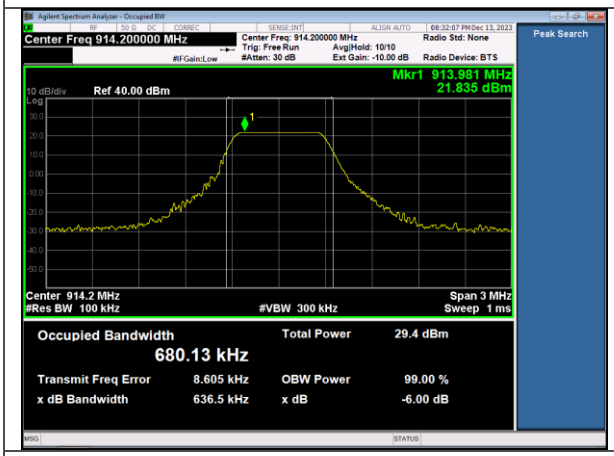
99% OBW – Low



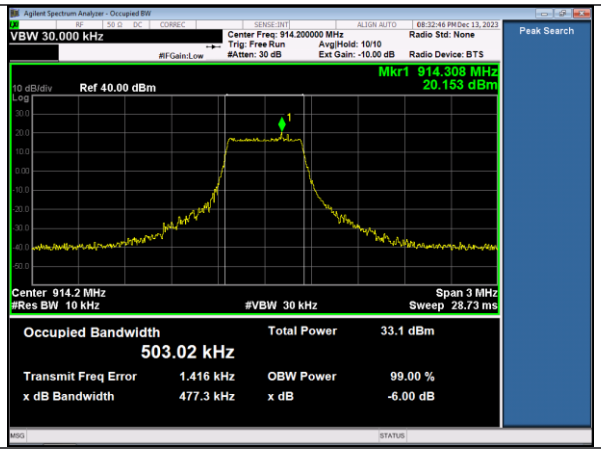
6 dB BW – Mid



99% OBW – Mid



6 dB BW – High



99% OBW - High

5.1.3 Antenna Port Conducted Emissions – Power Spectral Density

Operator	Anthony Smith	**QA**	Dylan Rosenfeldt
Temperature	21.4, 21.9, 21.5°C	**R.H. %**	22.3, 29.2, 34.8%
Test Date	12/13/2023,12/14/2023, 12/15/2023	**Location**	Conducted RF Bench
Requirement	FCC 15.247 (e) RSS-247 5.2 (b)	**Method**	ANSI C63.10 § 11.10.3

Limits: ≤ 8 dBm / 3 kHz

Test Parameters

Frequency	2400-2483.5 MHz	**Setup**	Conducted
RBW	3 kHz	**VBW**	10 kHz
Detector(s)	RMS Trace Average	**Sweep Time**	Auto
Notes	Average PSD Method		

EUT Parameters

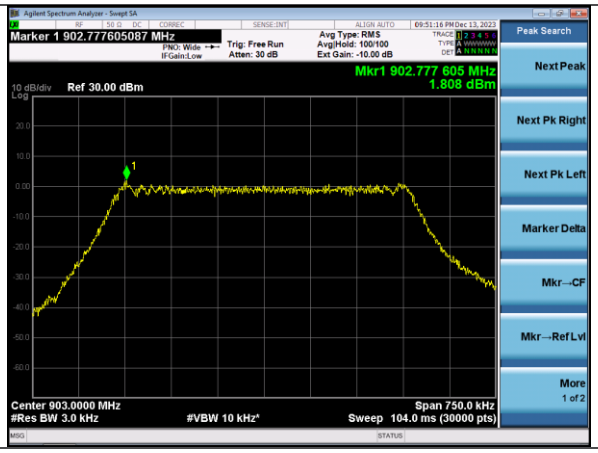
Input Power	USB	**Mode**	LoRa
Frequency	903.0, 907.8, 914.2 MHz	**Channel**	Low, Mid, High
Bandwidth	500 kHz	**Spreading Factor**	8

Data

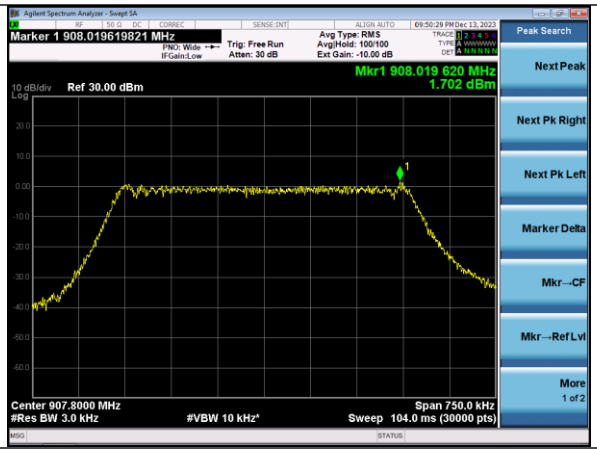
Table

Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
903.0	1.8	8.0	6.2
907.8	1.7	8.0	6.3
914.2	1.7	8.0	6.3

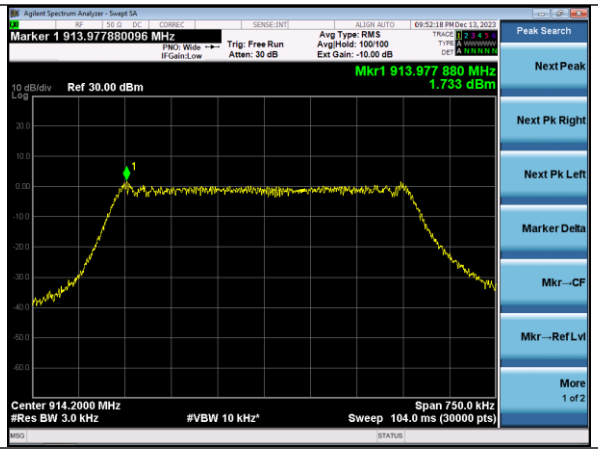
Plots



PSD Low



PSD Mid



PSD High

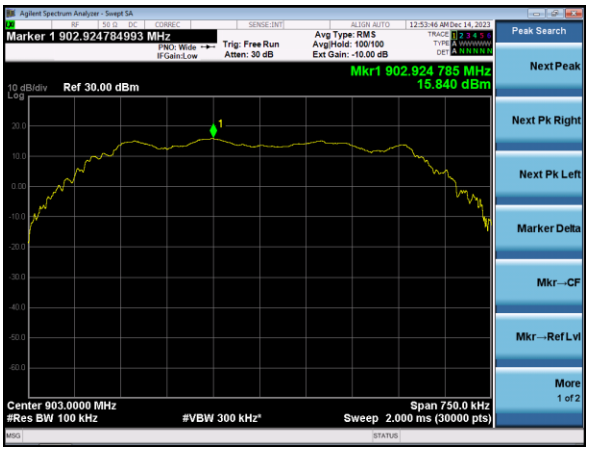
5.1.4 Antenna Port Conducted Emissions – Spurious Emissions in Non-Restricted Bands

Operator	Anthony Smith	**QA**	Dylan Rosenfeldt
Temperature	21.4, 21.9, 21.5°C	**R.H. %**	22.3, 29.2, 34.8%
Test Date	12/13/2023,12/14/2023, 12/15/2023	**Location**	Conducted RF Bench
Requirement	15.247 (d) RSS-247 5.5	**Method**	ANSI C63.10

Limits: ≤ 30 dBc

15.8 dBm – 30 dB = -14.2 dBm

Reference Plot:



Test Parameters

Frequency	30-10000 MHz	**Setup**	Conducted
RBW	100 kHz	**VBW**	300 kHz
Detector(s)	Peak Max Hold	**Sweep Time**	Auto
Example Calculations	Reference PSD (dBm/100kHz) – 30 dB = Limit (dBm/100kHz)		

EUT Parameters

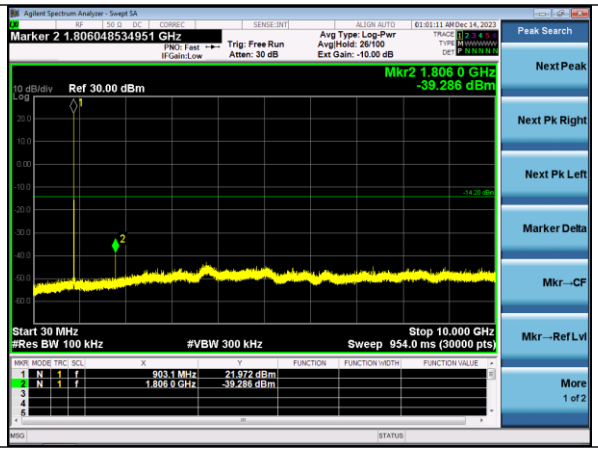
Input Power	USB	**Mode**	LoRa
Frequency	903.0, 907.8, 914.2 MHz	**Channel**	Low, Mid, High
Bandwidth	500 kHz	**Spreading Factor**	8

Data

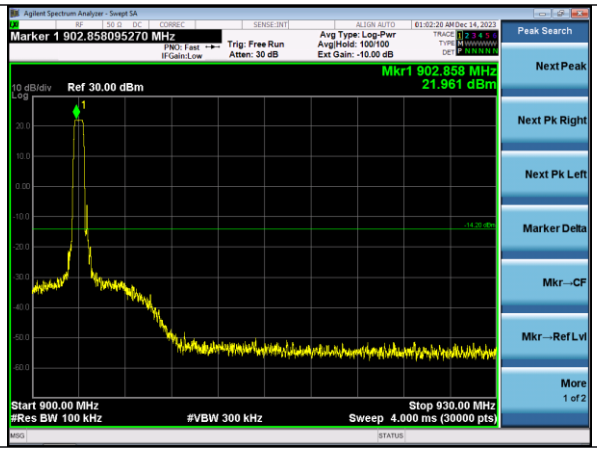
Table

Frequency (MHz)	Emission Measurement (dBm)	Limit (dBm)	Margin (dB)	Channel
1805.6	-30.1	-14.2	15.9	Low
1815.2	-30.6	-14.2	16.4	Mid
1828.0	-31.3	-14.2	17.1	High

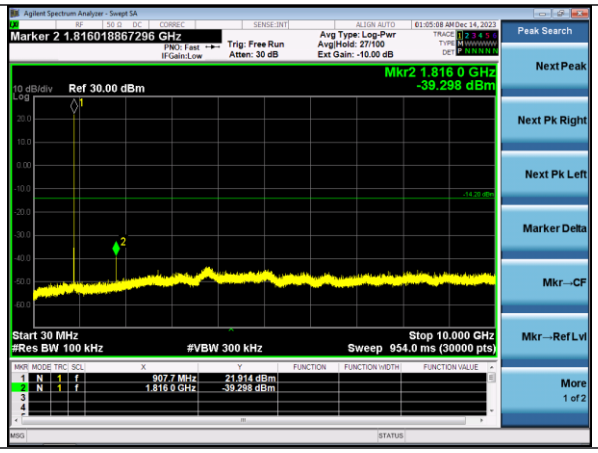
Plots



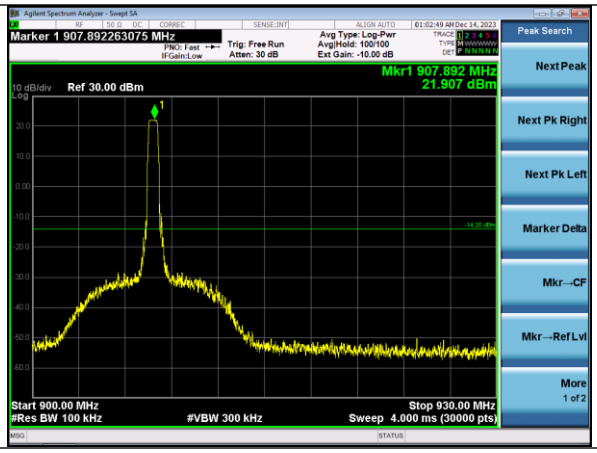
30-10000 MHz Tx Low



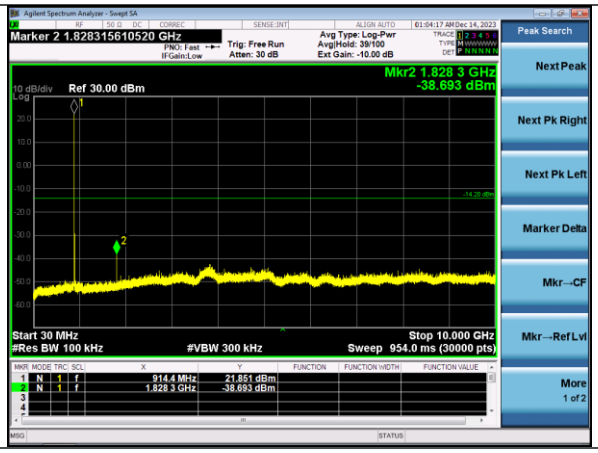
900-930 MHz Tx Low



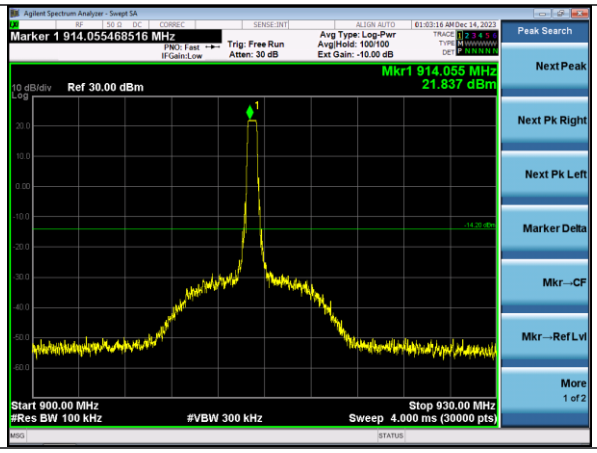
30-10000 MHz Tx Mid



900-930 MHz Tx Mid



30-10000 MHz Tx High



900-930 MHz Tx High

5.1.5 Antenna Port Conducted Emissions – Spurious Emissions in Restricted Bands

Operator	Anthony Smith	**QA**	Dylan Rosenfeldt
Temperature	21.4, 21.9, 21.5°C	**R.H. %**	22.3, 29.2, 34.8%
Test Date	12/13/2023,12/14/2023, 12/15/2023	**Location**	Conducted RF Bench
Requirement	15.247 (d) RSS-GEN 8.10	**Method**	ANSI C63.10 § 11.12.2

Limits:

Frequency (MHz)	Quasi Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Peak Limit (dBµV/m)
30-88	40.0	-	-
88-216	43.5	-	-
216-960	46.0	-	-
960-1000	54.0	-	-
1000-25000	-	54.0	74.0

Test Parameters

Frequency	30-10000 MHz	**Setup**	Conducted
RBW	120 kHz Below 1 GHz 1 MHz Above 1 GHz	**VBW**	1.2 MHz Below 1 GHz 3 MHz Above 1 GHz Peak 51 Hz Above 1 GHz Average
Detector(s)	Peak Max Hold	**Sweep Time**	Auto
Example Calculations	Average VBW = 1/On Time 54 dBµV/m – 95.2 = -41.2 dBm Conducted Average Limit 75 dBµV/m – 95.2 = -21.2 dBm Conducted Peak Limit		

EUT Parameters

Input Power	USB	**Mode**	LoRa
Frequency	903.0, 907.8, 914.2 MHz	**Channel**	Low, Mid, High
Bandwidth	500 kHz	**Spreading Factor**	8

Data

Table

Below 1 GHz

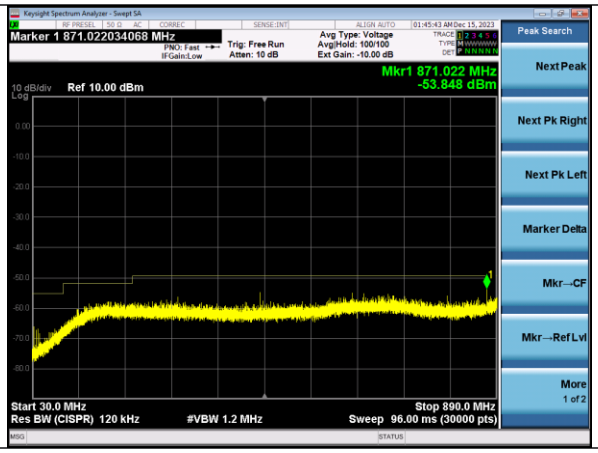
Channel	Frequency (MHz)	Emission Measurement (dBm)	Antenna Gain (dBi)	GRF (dB)	Corrected Measument (EIRP)	Limit (dBm)	Margin (dB)
Low	160.3	-62.9	2.4	4.7	-55.8	-51.7	4.1
Mid	193.3	-62.8	2.4	4.7	-55.7	-51.7	4.0
High	185.6	-65.4	2.4	4.7	-58.3	-51.7	6.6
Low	611.8	-61.7	2.4	4.7	-54.6	-49.2	5.4
Mid	612.9	-61.7	2.4	4.7	-54.6	-49.2	5.4
High	611.9	-61.8	2.4	4.7	-54.7	-49.2	5.5

Above 1 GHz

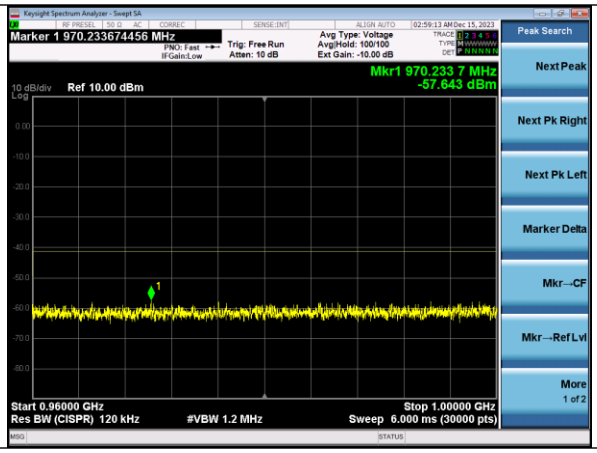
Channel	Frequency (MHz)	Emission Measurement (dBm)	Antenna Gain (dBi)	Corrected Measurement (EIRP)	Limit (dBm)	Margin (dB)
Low	2709.3	-48.7	2.4	-46.3	-21.2	25.1
Mid	2724.0	-49.1	2.4	-46.7	-21.2	25.5
High	2742.8	-48.8	2.4	-46.4	-21.2	25.2
Low	2709.0	-53.5	2.4	-51.1	-41.2	9.9
Mid	2723.5	-53.8	2.4	-51.4	-41.2	10.2
High	2742.7	-53.7	2.4	-51.3	-41.2	10.1

Plots

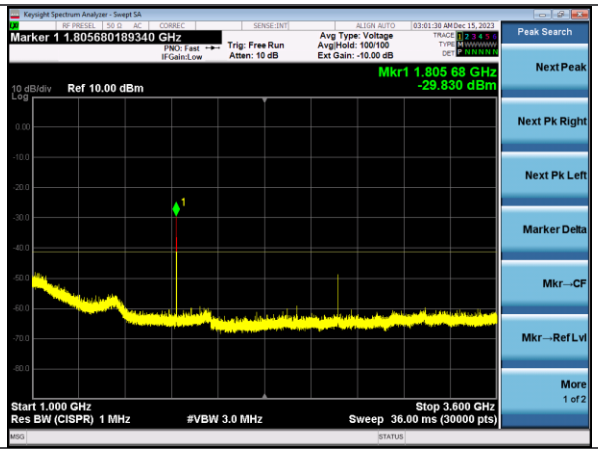
Tx Low



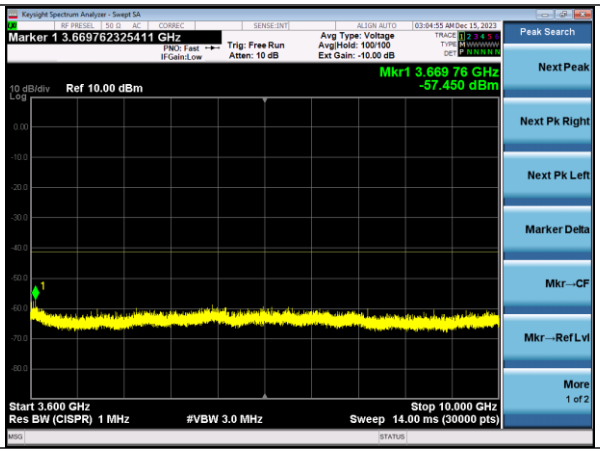
30-890 MHz



960-1000 MHz

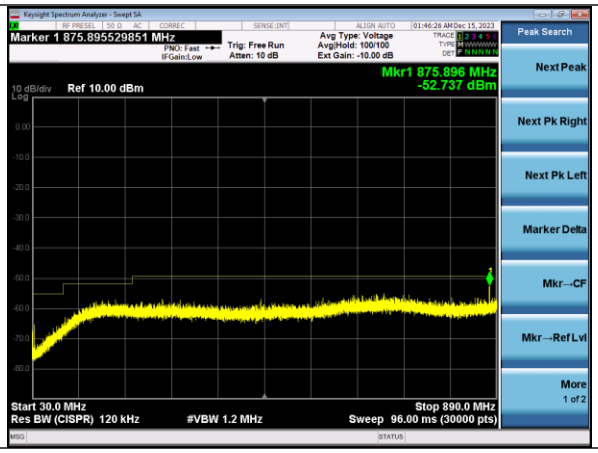


1-3.6 GHz

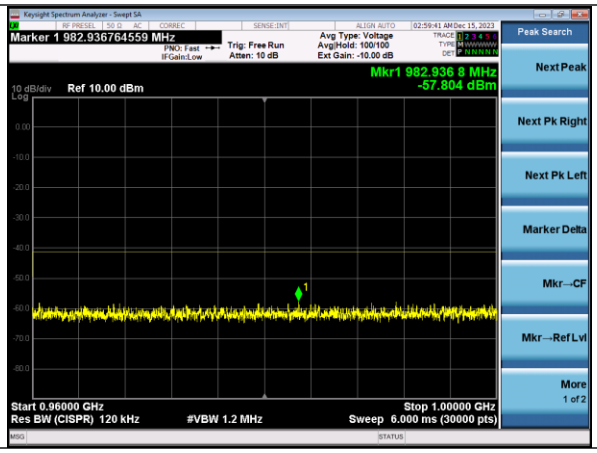


3.6-10 GHz

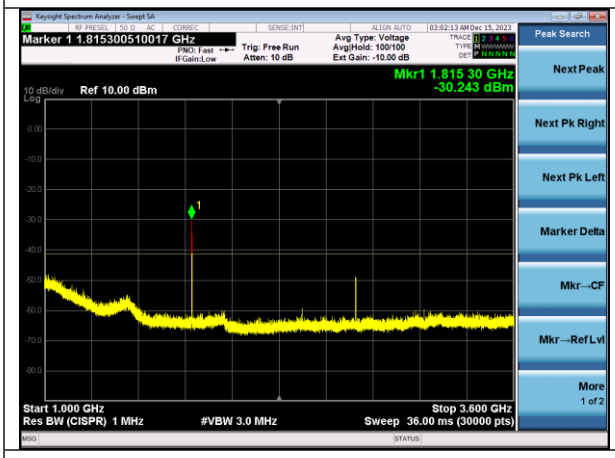
Tx Mid



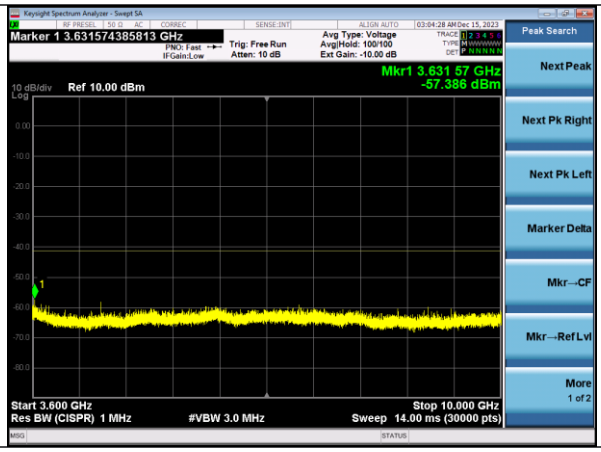
30-890 MHz



960-1000 MHz

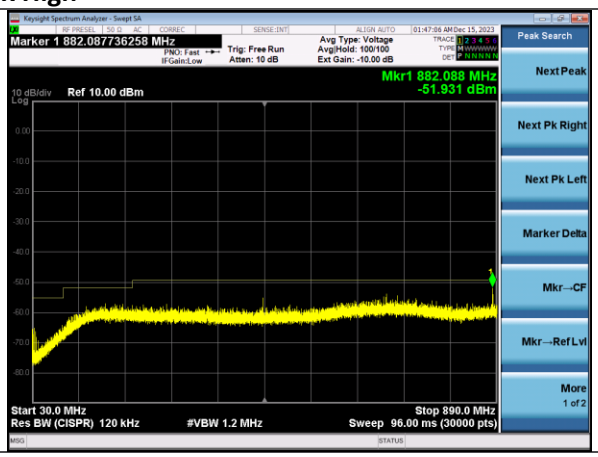


1-3.6 GHz

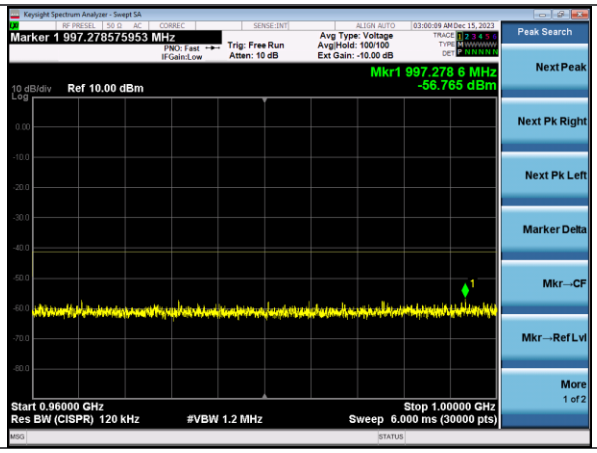


3.6-10 GHz

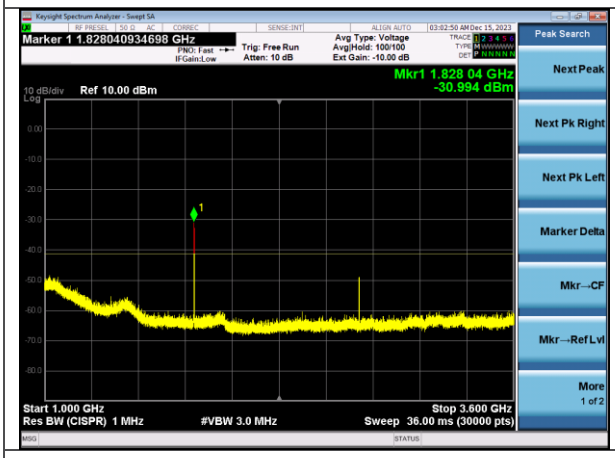
Tx High



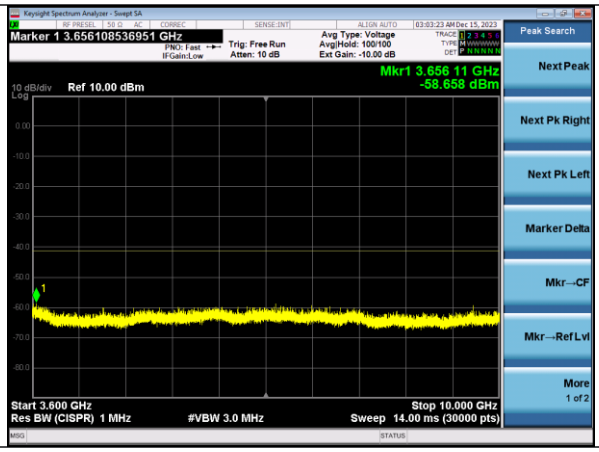
30-890 MHz



960-1000 MHz



1-3.6 GHz



3.6-10 GHz

6 REVISION HISTORY

Version	Date	Notes	Person
0	12/18/2023	Initial Draft	Anthony Smith
1	1/9/2024	Revised Draft – Comments Addressed	Anthony Smith
2	2/22/2024	RSS-247 Issue 3	Adam Alger

END OF REPORT