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Date: 29 September 2024

I.T.L. Product Testing Ltd.
FCC/ISED Radio Test Report
for
Roseman Engineering Ltd.

Equipment under test:

Nozzle Reader

Universal Nozzle Reader

FCC ID: JAKNR-G5

IC: 29097NR-G5

Tested by: _____

M. Zohar

Approved by: _____

Netanel Y.

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This report concerns: Original Grant

Equipment type: FCC: DSS Part 15 Spread Spectrum Transmitter
IC: Spread Spectrum Digital Device (2400-2483.5 MHz)

Limits used: 47CFR15 Section 15.247
RSS-247, Issue 2, February 2017, Section 5
RSS-Gen, Issue 5, April 2018

Measurement procedures: KDB 558074 D01 v05, ANSI C63.10: 2013, and
RSS-Gen, Issue 5, April 2018

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Table of Contents

1.	General Information-----	5
1.1	Administrative Information.....	5
1.2	List of Accreditations	5
1.3	Product Description	6
1.4	Test Methodology	6
1.5	Test Facility	6
1.6	Measurement Uncertainty	7
2.	System Test Configuration -----	8
2.1	Justification.....	8
2.2	EUT Exercise Software	8
2.3	Special Accessories	8
2.4	Equipment Modifications	8
2.5	Configuration of Tested System.....	9
3.	20dB Minimum Bandwidth-----	10
3.1	Test Specification	10
3.2	Test Procedure.....	10
3.3	Test Limit.....	10
3.4	Test Results	10
3.5	Test Equipment Used, 20 dB Minimum Bandwidth	12
4.	Occupied Bandwidth -----	13
4.1	Test Specification	13
4.2	Test Procedure.....	13
4.3	Test Limit.....	13
4.4	Test Results	13
4.5	Test Equipment Used, Occupied Bandwidth	15
5.	Number of Hopping Frequencies-----	16
5.1	Test Specification	16
5.2	Test Procedure.....	16
5.3	Test Limit.....	16
5.4	Test Results	16
5.5	Test Equipment Used, Number of Hopping Frequencies	17
6.	Channel Frequency Separation -----	18
6.1	Test Specification	18
6.2	Test Procedure.....	18
6.3	Test Limit.....	18
6.4	Test Results	18
6.5	Test Equipment Used, Channel Frequency Separation Test	19
7.	Peak Output Power-----	20
7.1	Test Specification	20
7.2	Test Procedure.....	20
7.3	Test Limit.....	20
7.4	Test Results	20
7.5	Test Equipment Used, Peak Output Power	22
8.	Dwell Time on Each Channel -----	23
8.1	Test Specification	23
8.2	Test Procedure.....	23
8.3	Test Limit.....	23
8.4	Test Results	23
8.5	Test Equipment Used, Dwell Time on Each Channel	25



9.	Band Edge -----	26
9.1	Test Specification	26
9.2	Test Procedure	26
9.3	Test Limit	26
9.4	Test Results	26
9.5	Test Equipment Used, Band Edge	29
10.	Emissions in non-Restricted Frequency Bands -----	30
10.1	Test Specification	30
10.2	Test Procedure	30
10.3	Test Limit	30
10.4	Test Results	30
10.5	Test Equipment Used, Emissions in Non-Restricted Frequency Bands	31
11.	Emissions in Restricted Frequency Bands-----	32
11.1	Test Specification	32
11.2	Test Procedure	32
11.3	FCC Test Limit	32
11.4	IC Test Limit	33
11.5	Test Results	33
11.6	Test Equipment Used, Emissions in Restricted Frequency Bands	35
12.	Setup Photographs -----	36
13.	Appendix A - Correction Factors -----	37
13.1	ITL #1911: OATS RF Cable	37
13.2	ITL #1840: Semi-Anechoic Chamber RF Cable	37
13.3	ITL # 1075: Active Loop Antenna	38
13.4	ITL #1356: Biconical Antenna	38
13.5	ITL # 1349: Log Periodic Antenna	38
13.6	ITL # 1352: 1-18 GHz Horn Antenna	39
13.7	ITL # 1353: 18-26.5 GHz Horn Antenna	39
13.8	ITL # 1777: 26.5-40 GHz Horn Antenna	40



1. General Information

1.1 Administrative Information

Manufacturer: Roseman Engineering Ltd.
Manufacturer's Address: Same as applicant
Tel: +972.3.5731801
Equipment Under Test (E.U.T): Nozzle Reader
PMN: Universal Nozzle Reader
HVIN: NRD-2000-05
Equipment Serial No.: N/A
Date of Receipt of E.U.T: January 16, 2022
Start of Test: January 16, 2022
End of Test: May 8, 2022
Test Laboratory Location: I.T.L Product Testing Ltd.
3 Ha'oreg Street, Modi'in 7177909, Israel
Test Specifications: 47CFR15 Section 15.247
RSS-247, Issue 2 (February 2017), Section 5
RSS-Gen, Issue 5, (April 2018), Amendment 2
(February 2021)

1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation No. IL1005.
3. Department of Innovation, Science and Economic Development (ISED) Canada, CAB identifier: IL1002

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.



1.3 Product Description

The UNR (Universal Nozzle Reader) is an active stand-alone device mounted on the nozzle. It is robust plastic structure enables to operate in harsh fuel environment

The UNR can read the Roseman vehicle identification devices including the USID (Universal Secured Identification Device).

Type of Equipment							
<input checked="" type="checkbox"/>	Stand Alone (Equipment with/without its own control provisions)						
<input type="checkbox"/>	Combined (Equipment where radio part is fully integrated with another type of equipment)						
<input type="checkbox"/>	Plug in card (Equipment intended for a variety of host systems)						
Intended Use				Condition of use			
<input type="checkbox"/>	Fixed			Always of distance >2m from the people			
<input type="checkbox"/>	Mobile			Always of distance >20cm from the people			
<input type="checkbox"/>	Portable			Always of distance <20cm to human body			
Assigned frequency band				2400.0-2483.5MHz			
Operational frequencies				2401.0-2478M.0Hz			
Maximum rated output power				At transmitter 50Ω RF output connector [dBm]		N/A	
				Effective Radiated Power (for equipment without RF connector)		~+1dBm	
Antenna Connection							
<input type="checkbox"/>	Unique Coupling	<input type="checkbox"/>	Standard Connection	<input checked="" type="checkbox"/>	Integral	<input checked="" type="checkbox"/>	With temporary RF connector
						<input type="checkbox"/>	Without temporary RF connector
Antenna Gain				+2dBi			
Operating channel bandwidth				296KHz			
Type of modulation				MSK			
Bit rate				250Kbs			
Maximum transmitter duty cycle				98%			
Transmitter power source							
<input type="checkbox"/>	AC			Nominal rated voltage			
<input type="checkbox"/>	DC			Nominal rated voltage			
<input checked="" type="checkbox"/>	Battery			Nominal rated voltage		3.6V	
FHSS/DTS equipment				16 channels FHSS			

1.4 Test Methodology

Radiated testing was performed according to the procedures in KDB 558074 D01 v05, ANSI C63.10: 2013 and RSS-Gen Issue 5 (2018). Radiated testing was performed at an antenna to EUT distance of three meters.

1.5 Test Facility

Emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.



1.6 Measurement Uncertainty

Conducted Emission

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)
0.15 – 30 MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 3.6 dB

Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for
open site:

30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 4.96 dB

1 GHz to 6 GHz

Expanded Uncertainty (95% Confidence, K=2):

± 5.19 dB

>6 GHz

Expanded Uncertainty (95% Confidence, K=2):

± 5.51 dB

2. System Test Configuration

2.1 Justification

1. The E.U.T is battery powered and contains 16 channels hopping transceiver.
2. The unit was evaluated while transmitting at the low channel (2401MHz), the mid channel (2442MHz), and the high channel (2478MHz).
3. Final radiated emission test was performed after exploratory emission testing that was performed in three orthogonal polarities, to determine the “worst case” radiation.
4. According to the below results the “worst case” was the Y axis

Orientation	Frequency	2 nd Harmonic	3 rd Harmonic	Band Edge
	(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)
X axis	2401.0	47.0	44.0 (N.L.)*	58.3
	2442.0	51.0	44.6	-
	2478.0	48.9	43.5 (N.L.)	55.7
Y axis	2401.0	54.1	44.9 (N.L.)	64.2
	2442.0	53.7	45.2 (N.L.)	-
	2478.0	50.9	44.7 (N.L.)	60.9
Z axis	2401.0	45.9 (N.L)	45.7 (N.L.)	60.3
	2442.0	44.8 (N.L)	45.6 (N.L.)	-
	2478.0	47.7	44.9 (N.L.)	61.0

*N.L.: noise level

Figure 1. Screening Results

5. Conducted emission tests were performed with the E.U.T. antenna terminal connected by an RF cable to the Spectrum Analyzer through a 30dB external attenuator.

2.2 EUT Exercise Software

No special exercise software was used.

2.3 Special Accessories

No special accessories were needed in order to achieve compliance.

2.4 Equipment Modifications

No modifications were needed in order to achieve compliance.



2.5 Configuration of Tested System

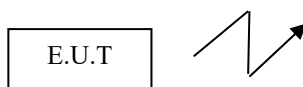


Figure 2. Configuration of Tested System – Radiated

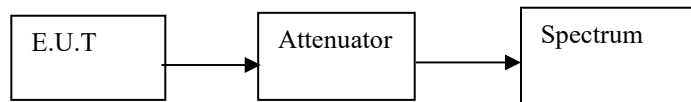


Figure 3. Configuration of Tested System - Conducted



3. 20dB Minimum Bandwidth

3.1 Test Specification

FCC, Part 15, Subpart C, Section 15.247(a)(1)
RSS-247, Issue 2, Section 5.1(b)

3.2 Test Procedure

(Temperature (19°C)/ Humidity (43%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable. The transmitter unit operated with normal modulation.

The spectrum analyzer was set to the following parameters:

Span = ~ 2 to 3 times the 20 dB bandwidth,

RBW \geq 1% of the 20 dB bandwidth

Detector Function: Peak, Trace: Maximum Hold.

3.3 Test Limit

N/A

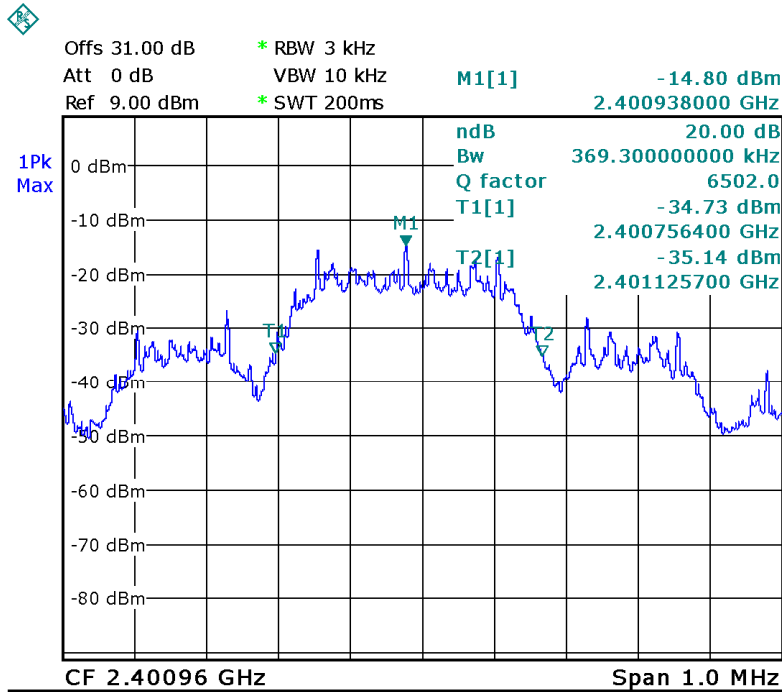
3.4 Test Results

Operation Frequency (MHz)	Bandwidth Reading (kHz)
2401.0	369.3
2442.0	375.2
2478.0	379.2

Figure 4 Test Results

JUDGEMENT: Pass

For additional information see *Figure 5* to *Figure 7*.



Date: 16.JAN.2022 09:47:03

Figure 5. 2401MHz

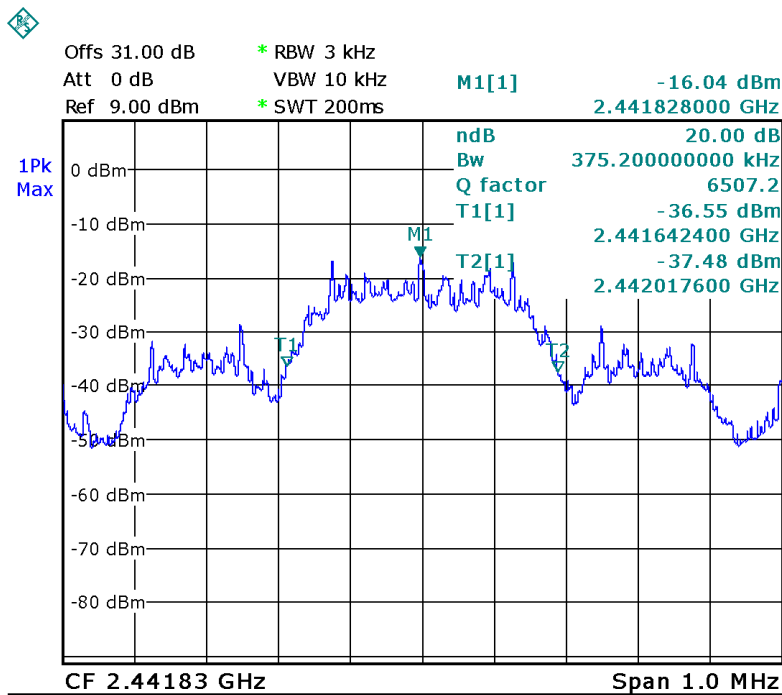


Figure 6. 2442MHz

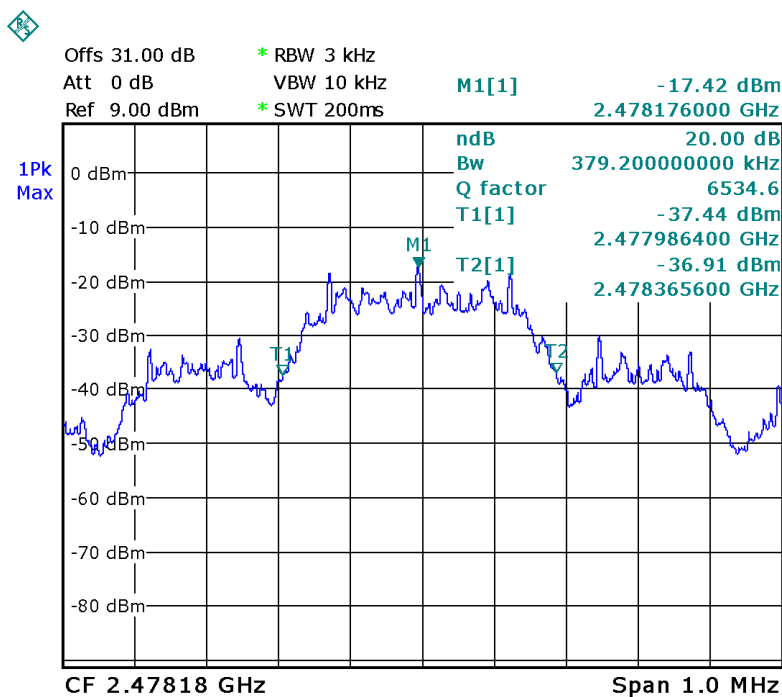


Figure 7. 2478MHz

3.5 Test Equipment Used, 20 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 20, 2022	February 20, 2023
30 dB attenuator	MCL	BW-S30W5	533	May 16, 2021	May 16, 2022
Low Loss cable	Huber Suhner	Sucofelex	28239/4PEA	May 23, 2021	May 23, 2022

Figure 8 Test Equipment Used



4. Occupied Bandwidth

4.1 Test Specification

FCC, Part 15, Subpart C, Section 2.1048

RSS-Gen, Issue 5: 2018, Section 6.6

4.2 Test Procedure

(Temperature (19°C)/ Humidity (43%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable .

The spectrum analyzer was set to the following parameters:

Span = ~ 1.5 to 5 times the OBW

RBW = 1% to 5% of the 20 dB bandwidth

Detector Function: Peak, Trace: Maximum Hold.

4.3 Test Limit

N/A

4.4 Test Results

Operation Frequency (MHz)	Bandwidth Reading (kHz)
2401.0	746.5
2442.0	754.5
2478.0	778.4

Figure 9 Test Results

JUDGEMENT: Pass

For additional information see *Figure 10* to *Figure 12*.

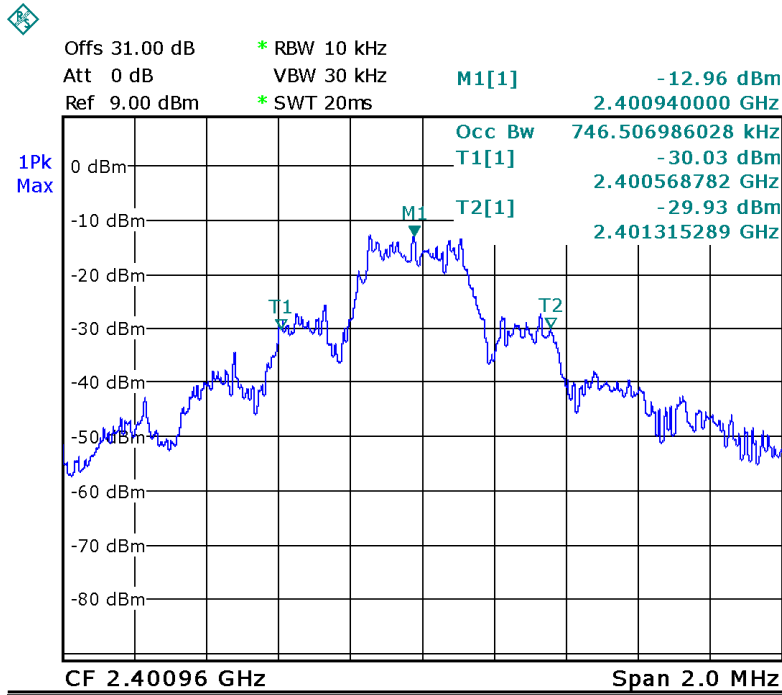


Figure 10. 2401MHz

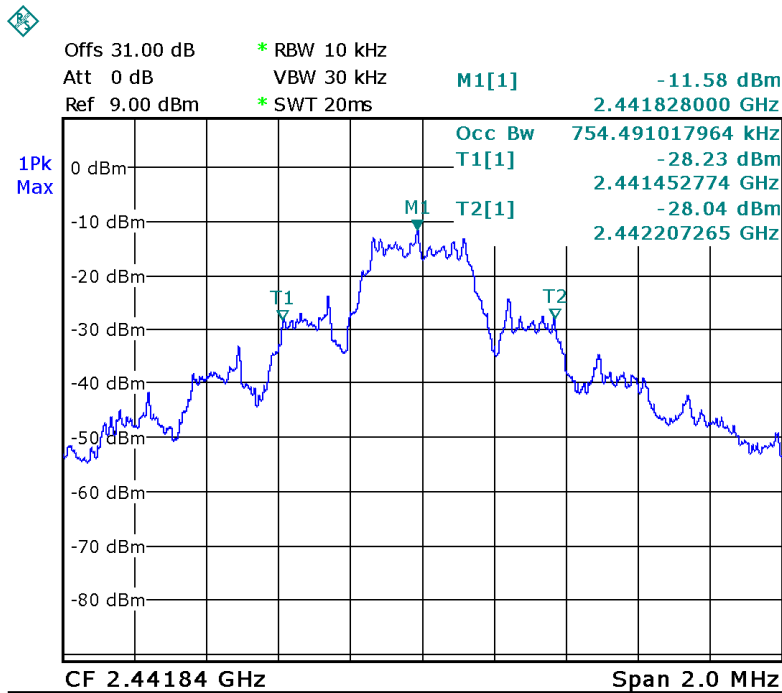


Figure 11. 2442MHz

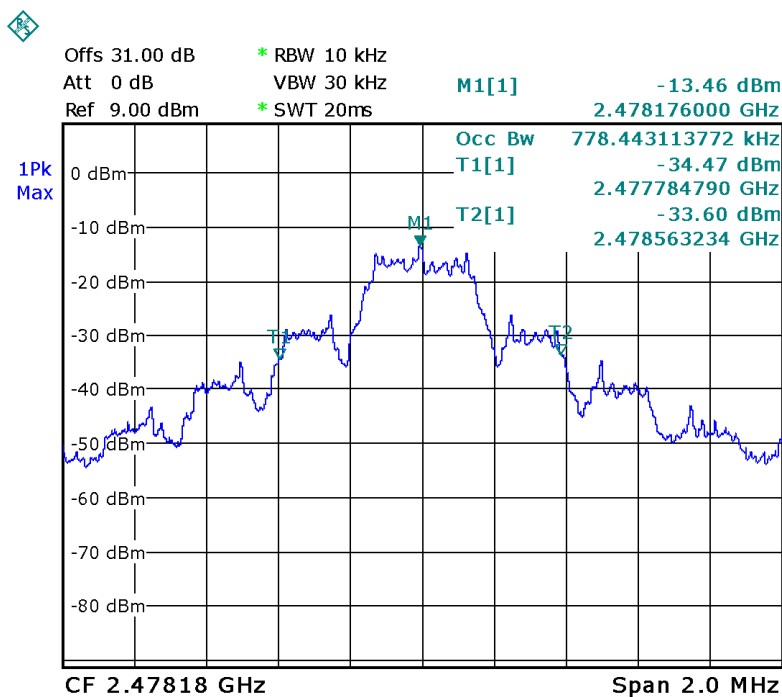


Figure 12. 2478MHz

4.5 Test Equipment Used, Occupied Bandwidth

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 20, 2022	February 20, 2023
30 dB attenuator	MCL	BW-S30W5	533	May 16, 2021	May 16, 2022
Low Loss cable	Huber Suhner	Sucofelex	28239/4PEA	May 23, 2021	May 23, 2022

Figure 13 Test Equipment Used



5. Number of Hopping Frequencies

5.1 Test Specification

FCC, Part 15, Subpart C Section 15.247(a)(1)(iii)

RSS, Issue 2, Section 5.1(d)

5.2 Test Procedure

(Temperature (19°C)/ Humidity (48%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable.

The E.U.T. was set to hopping mode.

The spectrum analyzer was set to the following parameters:

Band of Operation: 2400M-2483.5 MHz

RBW= VBW: 1MHz

Detector Function: Peak, Trace: Maximum Hold

5.3 Test Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15/75 Channels.

5.4 Test Results

Number of Hopping Frequencies	Limit
16	≥ 15

Figure 14 Test Results

JUDGEMENT: Pass

For additional information see *Figure 15*.

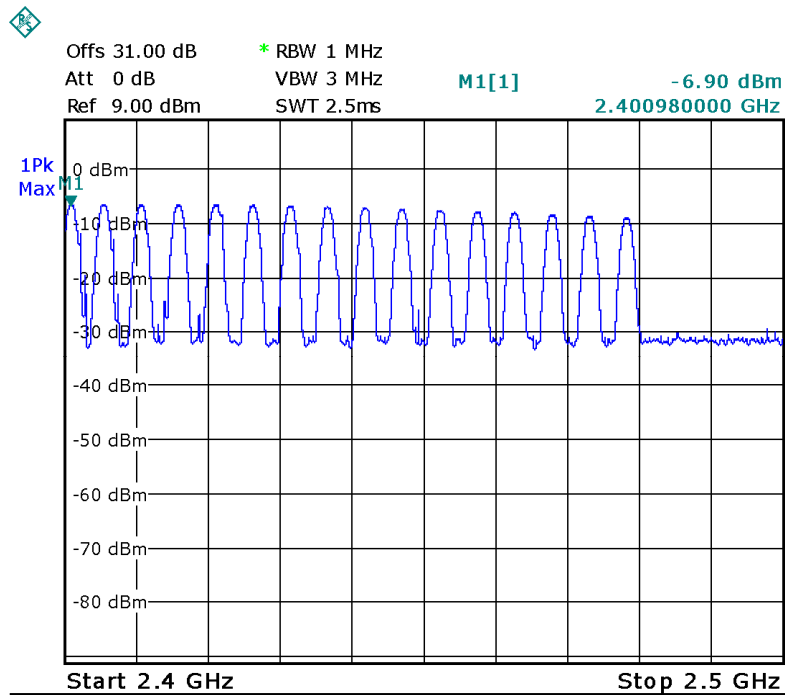


Figure 15. Number of Channels

5.5 Test Equipment Used, Number of Hopping Frequencies

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 20, 2022	February 20, 2023
30 dB attenuator	MCL	BW-S30W5	533	May 16, 2021	May 16, 2022
Low Loss cable	Huber Suhner	Sucofelex	28239/4PEA	May 23, 2021	May 23, 2022

Figure 16 Test Equipment Used

6. Channel Frequency Separation

6.1 Test Specification

FCC Part 15, Subpart C, 15.247(a) (1)

RSS, Issue 2, Section 5.1(b)

6.2 Test Procedure

(Temperature (19°C)/ Humidity (48%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable.

The E.U.T. was set to hopping mode.

The spectrum analyzer was set to the following parameters:

Span = wide enough to capture two adjacent channels, $RBW \geq 1\%$ of the span

Detector Function: Peak, Trace: Maximum Hold.

6.3 Test Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

6.4 Test Results

Channel Frequency Separation	Limit	Margin
(kHz)	(kHz)	(kHz)
4531.0	380.0	-4151.0

Figure 17 Test Results

JUDGEMENT: Pass

For additional information see *Figure 18*.

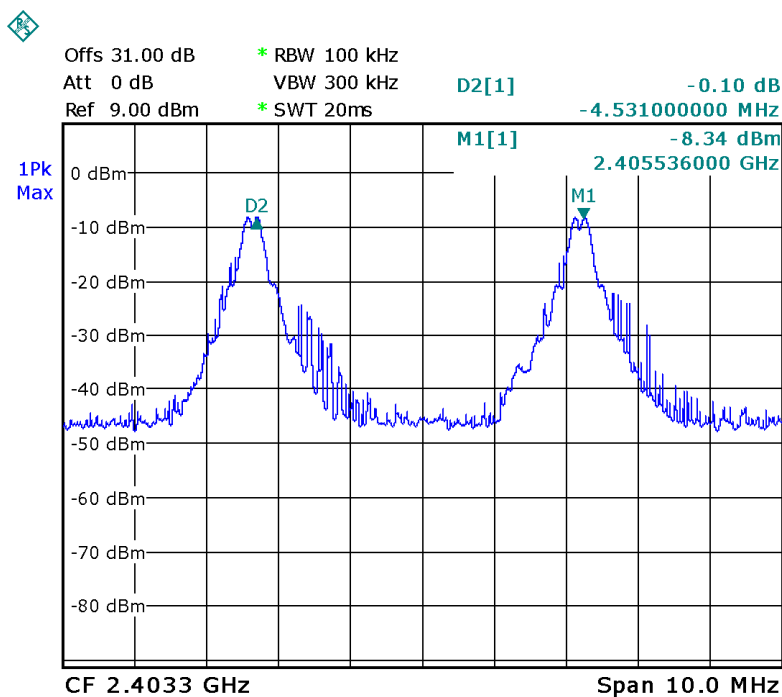


Figure 18. Channel Frequency Separation

6.5 Test Equipment Used, Channel Frequency Separation Test

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 20, 2022	February 20, 2023
30 dB attenuator	MCL	BW-S30W5	533	May 16, 2021	May 16, 2022
Low Loss cable	Huber Suhner	Sucofelex	28239/4PEA	May 23, 2021	May 23, 2022

Figure 19 Test Equipment Used



7. Peak Output Power

7.1 Test Specification

FCC Part 15, Subpart C, Section 15.247(b)(1)
RSS, Issue 2, Section 5.4(b)

7.2 Test Procedure

(Temperature (19°C)/ Humidity (48%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.
The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable.

7.3 Test Limit

The maximum peak conducted output power of the intentional radiator shall not exceed the following: For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt.
For all other frequency hopping systems in the 2400-2483.5 MHz band:
0.125 W (the limits above apply to antenna gain up to 6 dBi).

7.4 Test Results

Operation Frequency	Power	Power	Limit	Margin
(MHz)	(dBm)	(mW)	(mW)	(mW)
2401.0	0.7	1.17	125.0	-123.83
2442.0	-0.1	0.98	125.0	-124.02
2478.0	-0.9	0.81	125.0	-124.19

Figure 20 Peak Power Output Test Results

JUDGEMENT: Pass

For additional information see Figure 21 to Figure 23.

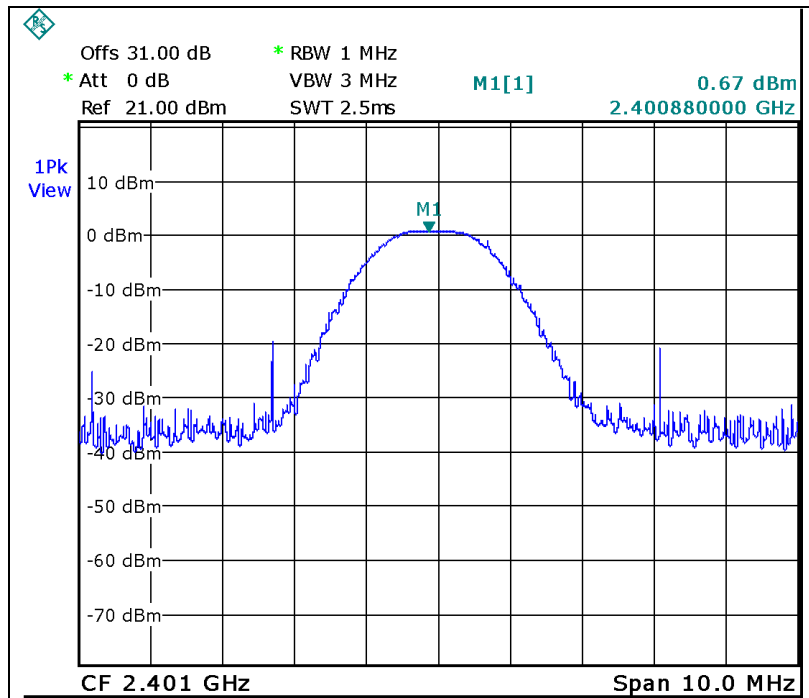


Figure 21 2401MH

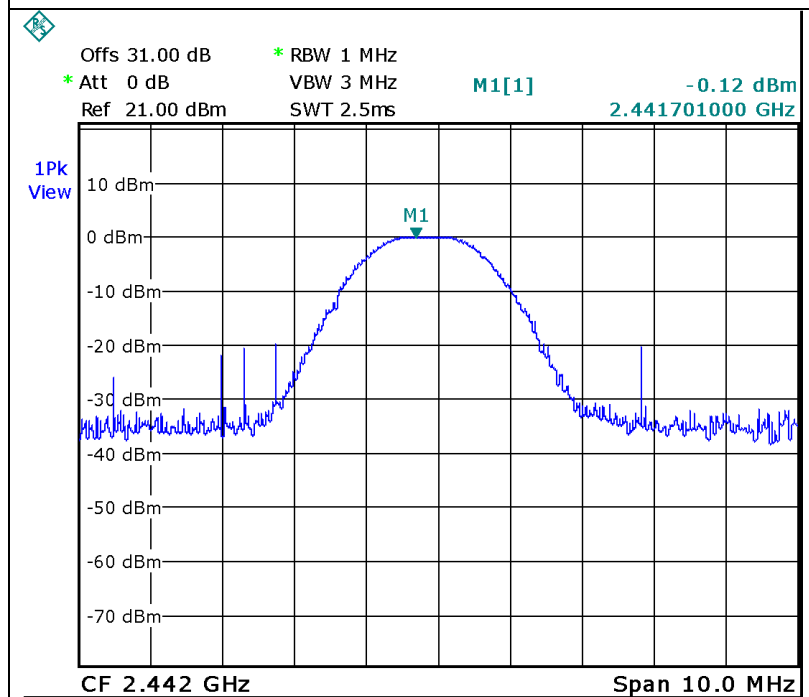
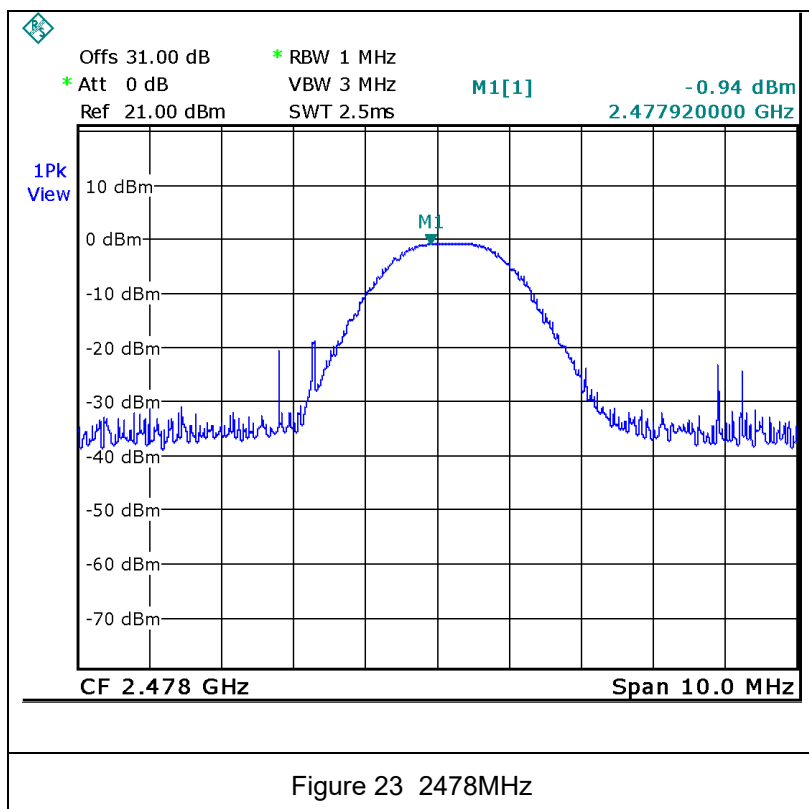


Figure 22 2442MHz



7.5 Test Equipment Used, Peak Output Power

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 20, 2022	February 20, 2023
30 dB attenuator	MCL	BW-S30W5	533	May 16, 2021	May 16, 2022
Low Loss cable	Huber Suhner	Sucofelex	28239/4PEA	May 23, 2021	May 23, 2022

Figure 24 Test Equipment Used



8. Dwell Time on Each Channel

8.1 Test Specification

FCC Part 15, Part C, Section 15.247(a)(1)(iii)

RSS, Issue 2, Section 5.1(d)

8.2 Test Procedure

(Temperature (19°C)/ Humidity (48%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable.

The spectrum analyzer was set to the following parameters:

Span = zero span, centered on a hopping channel, $RBW \geq 1\text{MHz}$

Detector Function: Peak, Trace: Maximum Hold

8.3 Test Limit

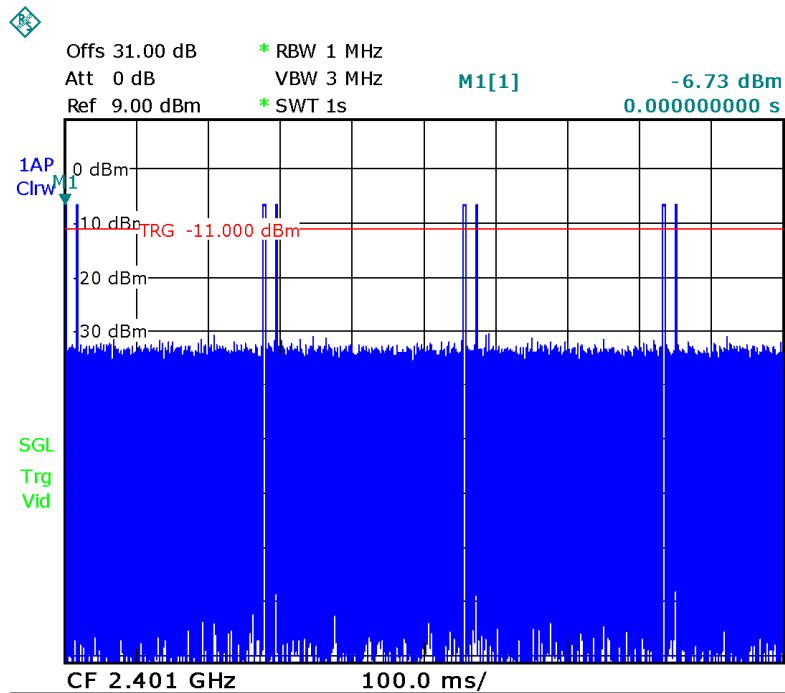
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed ($0.4 \times 16 = 6.4\text{ sec}$)

8.4 Test Results

JUDGEMENT: Pass

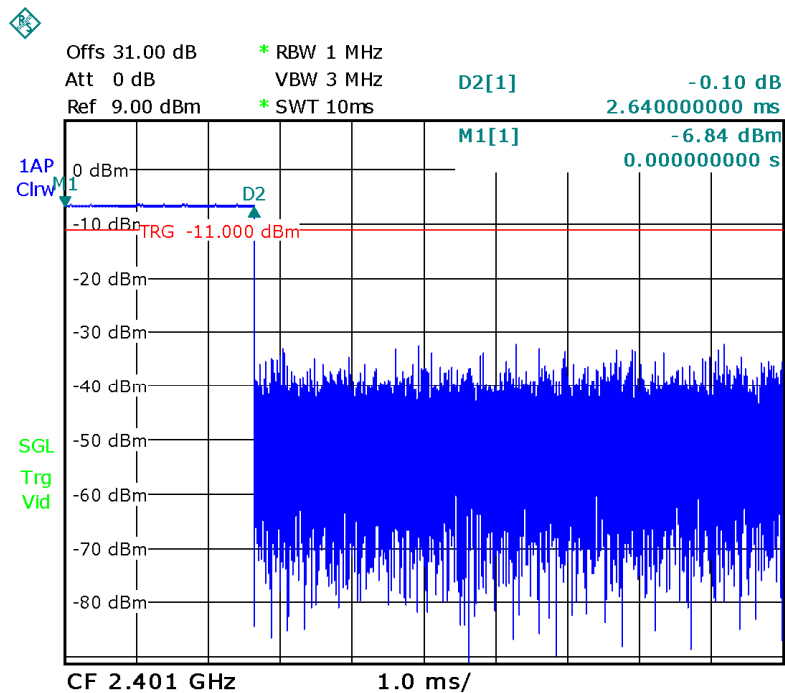
The E.U.T met the requirements of the FCC Part 15, Section 15.247(d) and RSS, Issue 2, Section 5.1(d)

Additional information of the results is given in *Figure 25* to *Figure 26*.



Date: 16.JAN.2022 07:35:05

Figure 25 Number of Bursts in 1 sec=8



Date: 16.JAN.2022 07:32:45

Figure 26 Channel Occupancy Duration =2.64msec

$$\text{Dwell Time} = (6.4 * 8) * 2.64\text{m} = 135.1\text{msec} < 400\text{msec}$$



8.5 Test Equipment Used, Dwell Time on Each Channel

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 20, 2022	February 20, 2023
30 dB attenuator	MCL	BW-S30W5	533	May 16, 2021	May 16, 2022
Low Loss cable	Huber Suhner	Sucofelex	28239/4PEA	May 23, 2021	May 23, 2022

Figure 27 Test Equipment Used

9. Band Edge

9.1 Test Specification

FCC Part 15, Section 15.247(d)

RSS-247, Issue 2, Section 5.5

9.2 Test Procedure

(Temperature (19°C)/ Humidity (48%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable.

The transmitter unit operated in 2 modes: hopping enabled and hopping disabled.

The RBW was set to 100 kHz.

9.3 Test Limit

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.

9.4 Test Results

Mode	Operation Frequency (MHz)	Band Edge Frequency (MHz)	Spectrum Level (dBm)	Limit (dBm)	Margin (dB)
Hopping	2402-2480	2400.0	-42.1	-28.2	-13.9
		2483.5	-45.1	-32.3	-12.8
non-Hopping	2402.0	2400.0	-41.0	-28.0	-13.0
	2480.0	2483.5	-45.9	-32.0	-13.9

Figure 28 Band Edge Test Results

JUDGEMENT: Pass

For additional information see *Figure 29* to *Figure 32*.

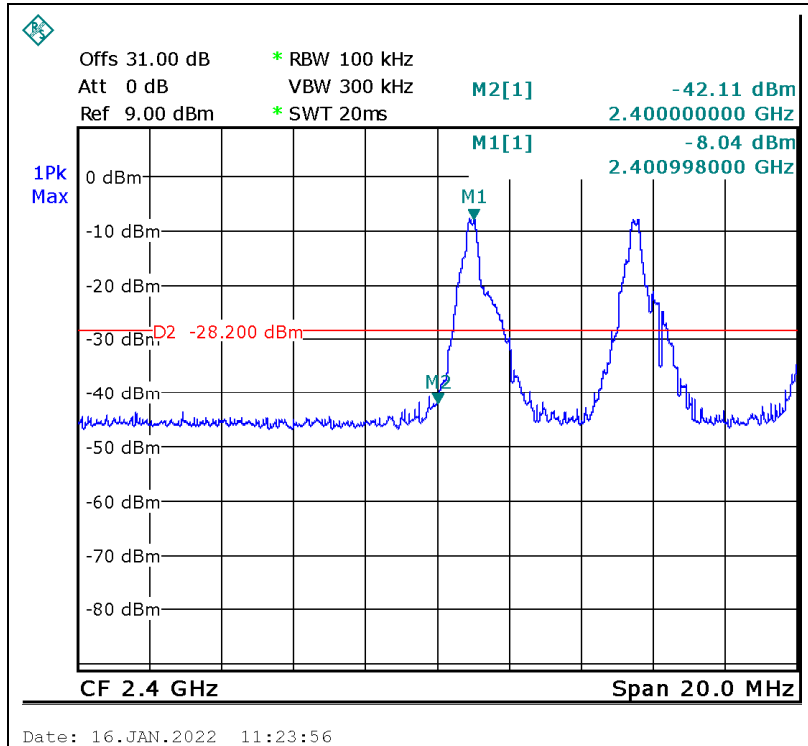


Figure 29 Hopping, Band Edge Low

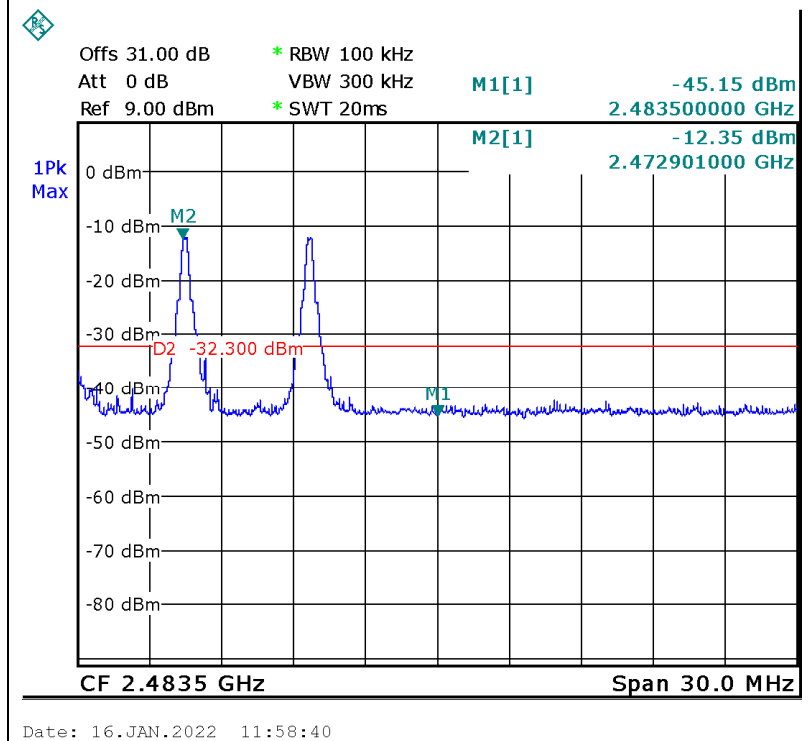


Figure 30 Hopping, Band Edge High

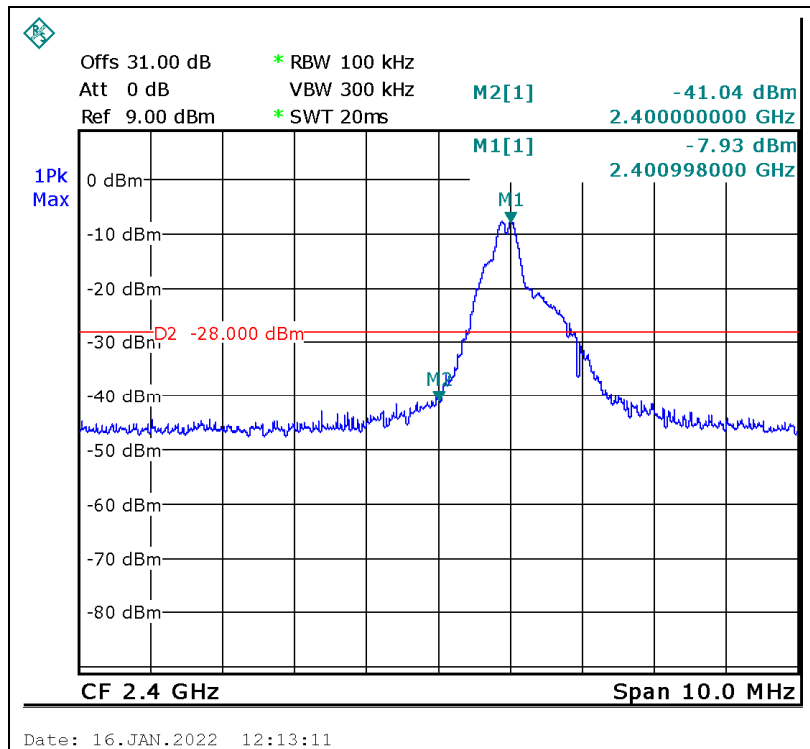


Figure 31 Non-Hopping, Band Edge Low

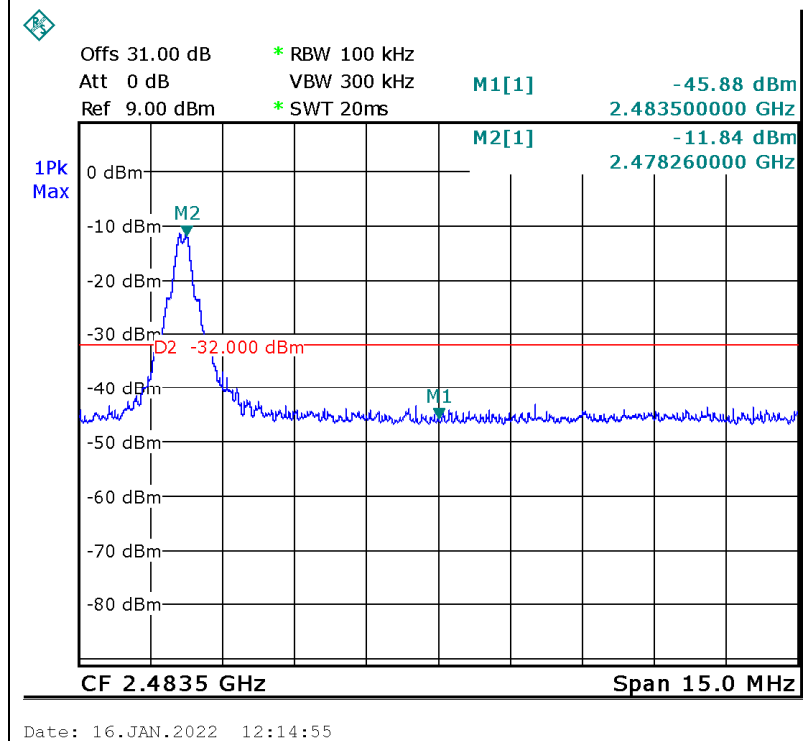


Figure 32 Non-Hopping, Band Edge High



9.5 Test Equipment Used, Band Edge

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 20, 2022	February 20, 2023
30 dB attenuator	MCL	BW-S30W5	533	May 16, 2021	May 16, 2022
Low Loss cable	Huber Suhner	Sucofelex	28239/4PEA	May 23, 2021	May 23, 2022

Figure 33 Test Equipment Used



10. Emissions in non-Restricted Frequency Bands

10.1 Test Specification

FCC, Part 15, Subpart C, Section 15.247(d)

RSS-247, Issue 2, Section 5.5

10.2 Test Procedure

(Temperature (20°C)/ Humidity (49%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable.

RBW was set to 100 kHz, detector was set to max. peak and the trace to “max hold”.

10.3 Test Limit

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.

10.4 Test Results

JUDGEMENT: Pass

For additional information see Figure 34 to Figure 36.

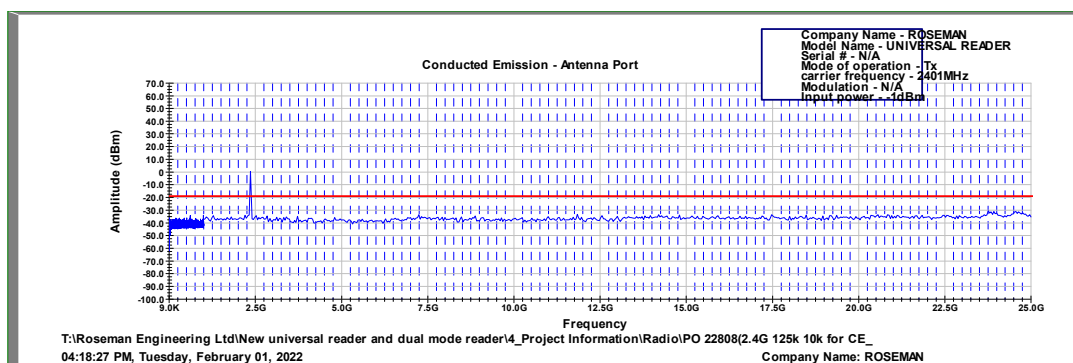


Figure 34 Conducted Spurious Emission, 2401MHz

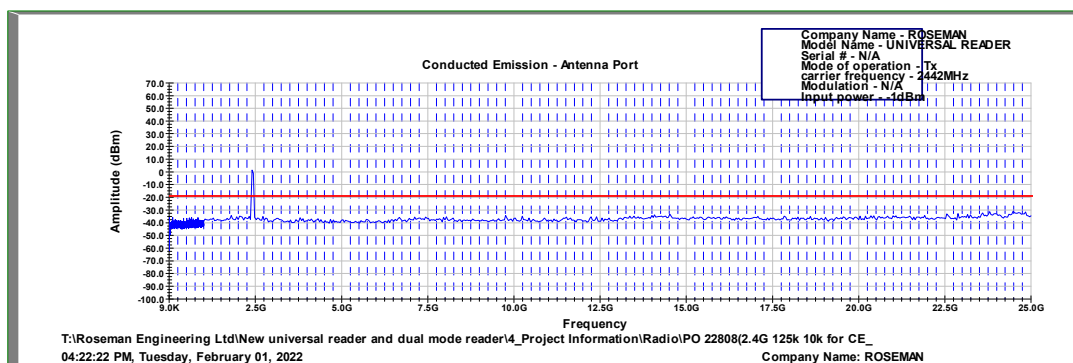


Figure 35 Conducted Spurious Emission, 2442MHz

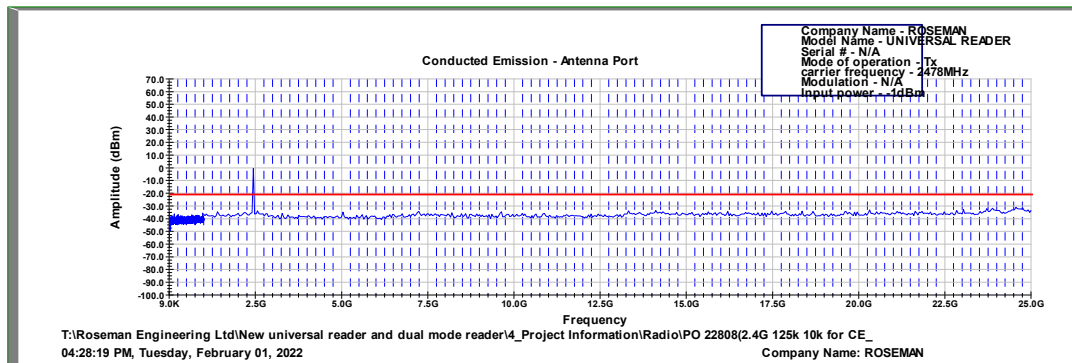


Figure 36 Conducted Spurious Emission, 2478MHz

10.5 Test Equipment Used, Emissions in Non-Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	HP	8564E	3442A00275	February 28, 2023	February 28, 2024
30 dB attenuator	MCL	BW-S30W5	533	May 16, 2021	May 16, 2022
Low Loss cable	Huber Suhner	Sucofelex	28239/4PEA	May 23, 2021	May 23, 2022

Figure 37 Test Equipment Used

11. Emissions in Restricted Frequency Bands

11.1 Test Specification

FCC, Part 15, Subpart C, Sections 247(d), 15.205, 15.209

RSS-247, Issue 2, Section 3.3

RSS-Gen, Issue 5, Section 8.10

11.2 Test Procedure

(Temperature (20°C)/ Humidity (53%RH))

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

For measurements between 0.009MHz-30MHz:

The E.U.T was tested inside the shielded room at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The frequency range 0.009MHz-30MHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of 3 meters.

For measurements between 30.0MHz-1.0GHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of 3 meters.

For measurements between 1.0GHz-25.0GHz:

The E.U.T was tested inside the shielded room at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 1.0GHz -25.0GHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of 3 meters.

11.3 FCC Test Limit

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency (MHz)	Field strength (microvolts/ meter)	Measurement distance (meters)	Field strength* (dBµV/m)	Field strength* (dBµV/m) @3m
0.009-0.490	2400/F(kHz)	300	48.5-13.8	128.5-73.8
0.490-1.705	24000/F(kHz)	30	33.8-23.0	73.8-63.0
1.705-30.0	30	30	29.5	69.5
30-88	100	3	40.0	40.0

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	Field strength* (dBμV/m)	Field strength* (dBμV/m) @3m
88-216	150	3	43.5	43.5
216-960	200	3	46.0	46.0
Above 960	500	3	54.0	54.0

*The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

Figure 38 FCC Table of Limits

11.4 IC Test Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Magnetic Field strength (microampere/meter)	Measurement distance (meters)	Magnetic Field strength (dBμA/m)	Magnetic Field strength* (dBμA/m) @3m
0.009-0.490	6.37/F(kHz)	300	-3.0-(-37.7)	77.0-42.2
0.490-1.705	63.7/F(kHz)	30	-17.7-(-28.5)	22.3-11.4
1.705-30.0	0.08	30	-21.9	18.0
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	Field strength (dBμV/m)	Field strength* (dBμV/m)@3m
30-88	100	3	40.0	40.0
88-216	150	3	43.5	43.5
216-960	200	3	46.0	46.0
Above 960	500	3	54.0	54.0

*The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

Figure 39 IC Table of Limits

11.5 Test Results

JUDGEMENT: Pass

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 209 specification.

For additional information see *Figure 40*.



E.U.T Description Nozzle Reader
Type Universal Nozzle Reader
Serial Number: N/A

Specification: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d);
RSS-Gen, Issue 5, Section 8.10

Antenna Polarization: Horizontal/Vertical Frequency Range: 9 kHz to 25.0 GHz
Detector: Peak, Average

Operation Frequency	Freq.	Pol.	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin*
(MHz)	(MHz)	(H/V)	(dBμV/m)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2401.0	2390.0	V	64.2	74.0	-9.8	45.6	54.0	-8.4
	2390.0	H	62.3	74.0	-11.7	44.3	54.0	-9.7
	4802.0	V	54.1	74.0	-19.9	43.1 (N.L) ¹	54.0	-10.9
	4802.0	H	51.6	74.0	-22.4	-	54.0	-
2442.0	4884.0	V	50.9	74.0	-23.1	-	54.0	-
	4884.0	H	51.2	74.0	-22.8	-	54.0	-
2478.0	4956.0	V	50.9	74.0	-23.1	-	54.0	-
	4956.0	H	50.2	74.0	-23.8	-	54.0	-
	2483.5	V	60.9	74.0	-13.1	41.9 (N.L)	54.0	-12.1
	2483.5	H	60.8	74.0	-13.2	42.5 (N.L)	54.0	-11.5

Figure 40. Radiated Emission Results - STD

*Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss - Low Noise Amplifier Gain

¹ Noise level



11.6 Test Equipment Used, Emissions in Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Active Loop Antenna	EMCO	6502	2950	July 5, 2021	July 5, 2022
EMI Receiver	HP (Agilent)	8542E	3906A00276	February 20, 2021	February 20, 2023
RF Filter	HP (Agilent)	85420E	3705A00248	February 20, 2021	February 20, 2023
Log-periodic Antenna	EMCO	3146	9505-4081	April 27, 2021	April 27, 2024
Biconical Antenna	EMCO	3110B	9912-3337	January 18, 2022	January 18, 2024
Multi device Controller	EMCO	2090	9908-1456	NCR	NCR
LOD Semi anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR
Pass Band Filter	Meuro	MFL040120 H50	902252	May 16, 2022	May 16, 2023
EMI Test Receiver	Rohde & Schwarz	ESCI7	100724	February 20, 2023	February 20, 2024
Wideband RF Amplifier 100K-26.5GHz	OSR	N.A.	N.A.	May 16, 2022	May 16, 2023
10 m RF cable	Commscope ORS (Serge)	0623 WBC-400	G020133	May 16, 2022	May 16, 2023
Antenna Mast	ETS	2070-2	9608-1497	NCR	NCR
Turntable	ETS	2087	-	NCR	NCR

Figure 41 Test Equipment Used



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12. Setup Photographs

See a separate file.



13. Appendix A - Correction Factors

13.1 ITL #1911: OATS RF Cable

Frequency (MHz)	Cable Loss (dB)		Frequency (MHz)	Cable Loss (dB)
1.00	0.50		450.00	5.83
10.00	1.00		500.00	6.33
20.00	1.34		550.00	6.67
30.00	1.50		600.00	6.83
50.00	1.83		650.00	7.17
100.00	2.67		700.00	7.66
150.00	3.17		750.00	7.83
200.00	3.83		800.00	8.16
250.00	4.17		850.00	8.50
300.00	4.50		900.00	8.83
350.00	5.17		950.00	8.84
400.00	5.50		1000.00	9.00

13.2 ITL #1840: Semi-Anechoic Chamber RF Cable

Frequency (MHz)	Cable Loss (dB)		Frequency (MHz)	Cable Loss (dB)
1,000.0	-1.40		10,000.0	-6.00
1,500.0	-1.70		10,500.0	-6.20
2,000.0	-2.00		11,000.0	-6.20
2,500.0	-2.30		11,500.0	-6.00
3,000.0	-2.60		12,000.0	-6.00
3,500.0	-2.80		12,500.0	-6.10
4,000.0	-3.10		13,000.0	-6.30
4,500.0	-3.30		13,500.0	-6.50
5,000.0	-3.60		14,000.0	-6.70
5,500.0	-3.70		14,500.0	-7.00
6,000.0	-4.00		15,000.0	-7.30
6,500.0	-4.40		15,500.0	-7.50
7,000.0	-4.7		16,000.0	-7.60
7,500.0	-4.80		16,500.0	-8.00
8,000.0	-5.00		17,000.0	-8.00
8,500.0	-5.10		17,500.0	-8.10
9,000.0	-5.60		18,000.0	-8.20
9,500.0	-5.80			

13.3 ITL # 1075: Active Loop Antenna

Frequency (MHz)	MAF (dBs/m)	AF (dB/m)	Frequency (MHz)	MAF (dBs/m)	AF (dB/m)
0.01	-33.10	18.40	3.00	-40.00	11.50
0.02	-37.20	14.30	4.00	-40.10	11.40
0.03	-38.20	13.30	5.00	-40.20	11.30
0.05	-39.80	11.70	6.00	-40.40	11.10
0.10	-40.10	11.40	7.00	-40.40	11.10
0.20	-40.30	11.20	8.00	-40.40	11.10
0.30	-40.30	11.20	9.00	-40.50	11.00
0.50	-40.30	11.20	10.00	-40.50	11.00
0.70	-40.30	11.20	20.00	-41.50	10.00
1.00	-40.10	11.40	30.00	-43.50	8.00
2.00	-40.00	11.50			

13.4 ITL #1356: Biconical Antenna

Frequency (MHz)	AF (dB/m)	Frequency (MHz)	AF (dB/m)
30.00	13.00	90.00	8.23
35.00	10.89	100.00	11.12
40.00	10.59	120.00	13.16
45.00	10.63	140.00	13.07
50.00	10.12	160.00	14.80
60.00	9.26	180.00	16.95
70.00	7.74	200.00	17.17
80.00	6.63		

13.5 ITL # 1349: Log Periodic Antenna

Frequency (MHz)	AF (dB/m)
200.00	11.58
250.00	12.04
300.00	14.76
400.00	15.55
500.00	17.85
600.00	18.66
700.00	20.87
800.00	21.15
900.00	22.32
1000.00	24.22



13.6 ITL # 1352: 1-18 GHz Horn Antenna

Frequency (GHz)	AF (dB/m)		Frequency (GHz)	AF (dB/m)
0.75	25.00		9.50	38.00
1.00	23.50		10.00	38.50
1.50	26.00		10.50	38.50
2.00	29.00		11.00	38.50
2.50	27.50		11.50	38.50
3.00	30.00		12.00	38.00
3.50	31.50		12.50	38.50
4.00	32.50		13.00	40.00
4.50	32.50		13.50	41.00
5.00	33.00		14.00	40.00
5.50	35.00		14.50	39.00
6.00	36.50		15.00	38.00
6.50	36.50		15.50	37.50
7.00	37.50		16.00	37.50
7.50	37.50		16.50	39.00
8.00	37.50		17.00	40.00
8.50	38.00		17.50	42.00
9.00	37.50		18.00	42.50

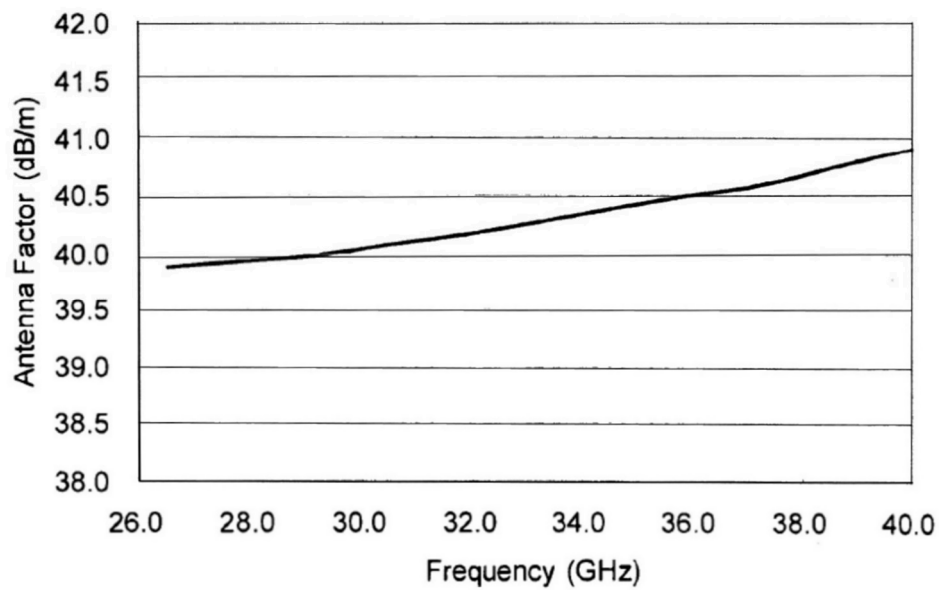
13.7 ITL # 1353: 18-26.5 GHz Horn Antenna

Frequency (MHz)	Measured antenna factor (dB/m) ²		Frequency (MHz)	Measured antenna factor (dB/m)
18,000.00	32.40		22,500.00	33.00
18,500.00	32.00		23,000.00	33.10
19,000.00	32.30		23,500.00	33.80
19,500.00	32.40		24,000.00	33.50
20,000.00	32.30		24,500.00	33.50
20,500.00	32.80		25,000.00	33.80
21,000.00	32.80		25,500.00	33.90
21,500.00	32.70		26,000.00	34.20
22,000.00	33.10		26,500.00	34.70

² The antenna factor shall be added to the receiver's reading in dBμV, to obtain field strength in dBμ V/m



13.8 ITL # 1777: 26.5-40 GHz Horn Antenna



End of Test Report