F2 Labs
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Middlefield, Ohio 44062
United States of America
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CERTIFICATION TEST REPORT

Manufacturer:	**Trimble Inc.** **10368 Westmoor Drive** **Westminster, Colorado 80021 USA**
Applicant:	**Same as Above**
Product Name:	**SIMPAS_RE RFID R/W**
Product Description:	RFID Reader/Writer
Model:	**SMSE013**
FCC ID:	**JUP-SMSE013**
Testing Commenced:	2023-04-24
Testing Ended:	2023-04-26
Summary of Test Results:	**In Compliance** The EUT complies with the EMC requirements when manufactured identically as the unit tested in this report, including any required modifications and/or manufacturer's statement. Any changes to the design or build of this unit subsequent to this testing may deem it non-compliant.

Rules:

- **FCC Part 15 Subpart C, Section 15.247**
- **FCC Part 15.31(e)**
- **ANSI C63.10:2013**

Evaluation Conducted by:

Julius Chiller, Senior Wireless Project Engineer

Report Reviewed by:

Ken Littell, Vice President of Operations

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1 ADMINISTRATIVE INFORMATION

1.1 Measurement Location:

F2 Labs in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD**.**

1.2 Measurement Procedure:

All measurements were performed according to ANSI C63.10 and recommended FCC procedure of measurement under Section 15.247 and in KDB558074. A list of the measurement equipment can be found in Section 6.

1.3 Uncertainty Budget:

The uncertainty in EMC measurements arises from several factors which affect the results, some associated with environmental conditions in the measurement room, the test equipment being used, and the measurement techniques adopted.

The measurement uncertainty budgets detailed below are calculated from the test and calibration data and are expressed with a 95% confidence factor. Note: Only measurements listed below which relate to tests included in this Test Report are applicable to it.

Measurement Range	Expanded Uncertainty	Combined Uncertainly
Radiated Emissions <1 GHz @ 3m	±5.07dB	±2.54
Radiated Emissions <1 GHz @10m	±5.09dB	±2.55
Radiated Emissions 1 GHz to 2.7 GHz	±3.62dB	±1.81
Radiated Emissions 2.7 GHz to 18 GHz	±3.10dB	±1.55
AC Power Line Conducted Emissions, 150kHz to 30 MHz	±2.76dB	±1.38

This Uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.4 Document History

Document Number	Description	Issue Date	Approved By
F2P28883-C1-01E	First Issue	2023-05-01	K. Littell

2 SUMMARY OF TEST RESULTS/MODIFICATIONS

Test Name	Standard(s)	Results
Occupied Bandwidth	CFR 47 Part 15.247(a)(1)(i) / KDB558074	Complies
Conducted Output Power	CFR 47 Part 15.247(b)(2) / KDB558074	Complies
Voltage Variations	CFR 47 Part 15.31(e)	Complies
Conducted Spurious Emissions	CFR 47 Part 15.247(d) / Part 15.207 / KDB558074	Complies
Radiated Spurious Emissions	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies
Peak Power Spectral Density	CFR 47 Part 15.247(e) / KDB558074	Not Applicable*
Frequency Separation	ANSI 63.10 2013 (7.8.2)	Complies
Number of Hopping Frequencies	ANSI 63.10 2013 (7.8.3)	Complies
Dwell Time	ANSI 63.10 2013 (7.8.4)	Complies
Conducted Emissions	CFR 47 Part 15.207(a)	Not Applicable

**PSD not required for FHSS radios under 15.247(b)(2).*

Modifications Made to the Equipment
None

3 TABLE OF MEASURED RESULTS

Test		Low Channel 902.75 MHz	Mid Channel 915.25 MHz	High Channel 927.25 MHz
99% Occupied Bandwidth		67.0kHz	61.0kHz	62.0kHz
-20dB Occupied Bandwidth		69.6kHz	64.8kHz	67.3kHz
Limit		<500kHz	<500kHz	<500kHz
Conducted Output Power		58.34mW 17.66dBm	54.20mW 17.34dBm	49.55mW 16.95dBm
Limit		1W 30dBm	1W 30dBm	1W 30dBm
Voltage Variations	4.7VDC	53.83mW 17.31dBm	--	40.64mW 16.09dBm
	5.0VDC	54.70mW 17.38dBm	--	41.02mW 16.13dBm
	5.5VDC	55.98mW 17.48dBm	--	42.46mW 16.28dBm
Limit		1W 30dBm	1W 30dBm	1W 30dBm

To meet the requirements of 15.31, the voltage was varied from 4.7VDC to 5.5VDC according to USB power requirements. EUT ceased to function below 4.7VDC. All tests were then performed at the highest output power setting.

Note: Port 1 (far left port) was tested as representative port since all three are identical.

4 ENGINEERING STATEMENT

This report has been prepared on behalf of Trimble Inc. to provide documentation for the testing described herein. This equipment has been tested and found to comply with Part 15.247 of the FCC Rules using ANSI C63.10 and KDB558074 standards. The test results found in this test report relate only to the items tested.

5 EUT INFORMATION AND DATA

5.1 Equipment Under Test:

Product: SIMPAS_RE RFID R/W
Model: SMSE013
Serial No.: 3059790002C 16027
Firmware: 4.2.2.0
Hardware: 4.0
FCC ID: JUP-SMSE013

5.2 Trade Name:

Trimble Inc.

5.3 Power Supply:

USB 5VDC

5.4 Applicable Rules:

CFR 47, Part 15.247, subpart C

5.5 Equipment Category:

Radio Transmitter-FHSS

5.6 Antenna:

Dipole, Mueller Electronics 3059790003

5.7 Accessories:

Device	Manufacturer	Model Number	Serial Number
Laptop	Dell	Latitude E6530	None Specified
Power Supply*	BK Precision	1685B	346F17303

**Indicates F2 Labs-supplied equipment.*

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

EUT was set to transmit in the 902-928 MHz band. FHSS timing and low (902.75 MHz), mid (915.25 MHz) and high (927.25 MHz) channels were measured against FCC 15.247 requirements. Reader was tested with the Passive RFID tags.

6 LIST OF MEASUREMENT INSTRUMENTATION

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber	CL166-E	Albatross Projects	B83117-DF435-T261	US140023	2023-08-22
Receiver	CL151	Rohde & Schwarz	ESU40	100319	2024-04-10
Preamplifier	CL284	AH Systems, Inc.	PAM-1001	131	2024-04-12
Horn Antenna	CL098	Emco	3115	9809-5580	2024-01-19
Pre-Amplifier	CL153	Keysight Tech.	83006A	MY39500791	2023-12-16
Active 18” Loop Antenna	CL163-Loop	A.H. Systems, Inc.	EHA-52B	100	2023-10-23
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	2023-09-22
Software:	Tile Version 3.4.B.3			Software Verified: 2023-04-24	
Software:	EMC 32, Version 8.53.0			Software Verified: 2023-04-24	
Temp/Hum. Recorder	CL293	Thermpro	TP50	1	2023-05-31

7 FCC PART 15.247(a)(1)(i) – OCCUPIED BANDWIDTH

7.1 Requirements:

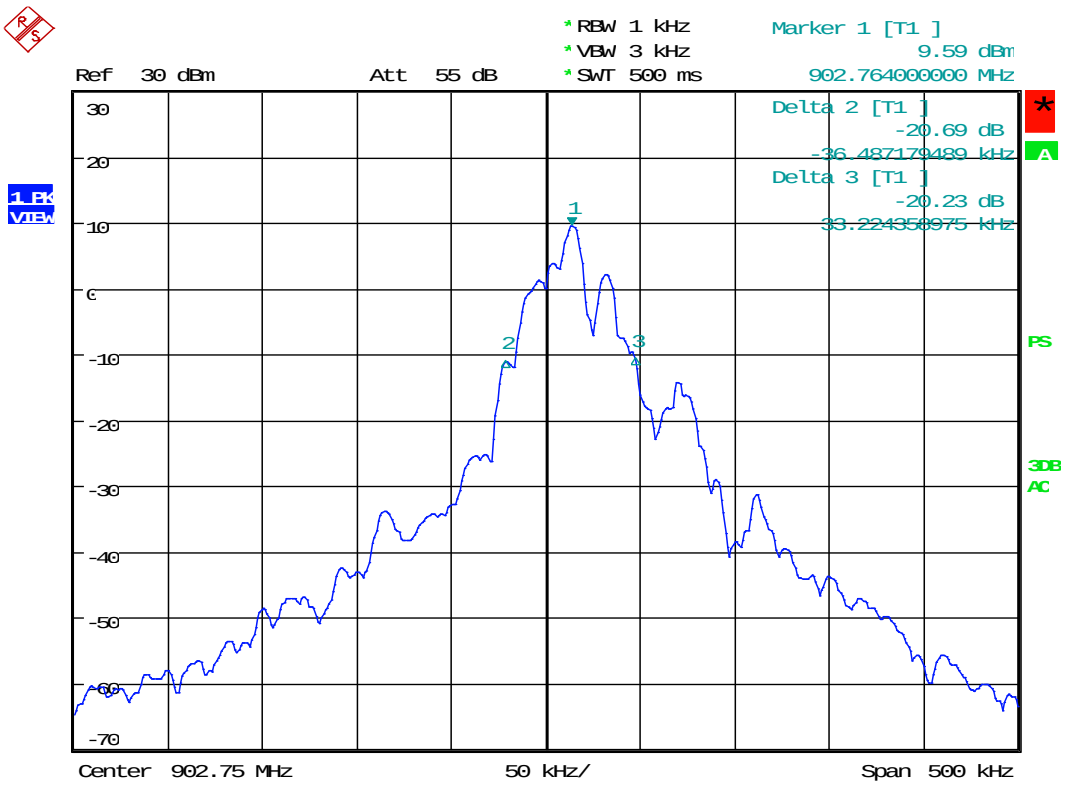
For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Bandwidth measurements were made at the low, mid and upper frequencies with the resolution bandwidth (RBW) set at 1 kHz (video bandwidth set at 3 kHz) while the span was set at 500kHz. The 20dB bandwidth was measured using the Marker delta method.

7.2 Occupied Bandwidth Test Data

Test Date:	2023-04-24	**Test Engineer:**	J. Chiller
Standards:	CFR 47 Part 15.247(a)(2); KDB558074	**Air Temperature:**	22.0ºC
		Relative Humidity:	38%

-20dB, Low Channel



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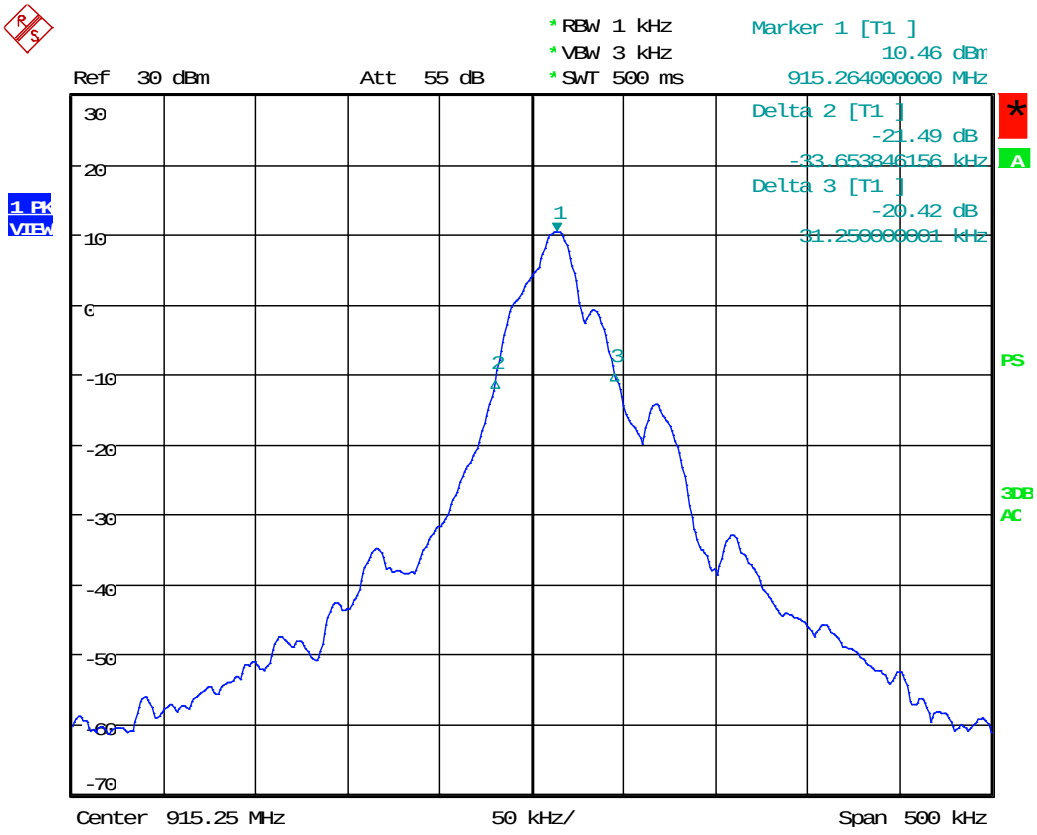
-20dB, Mid Channel



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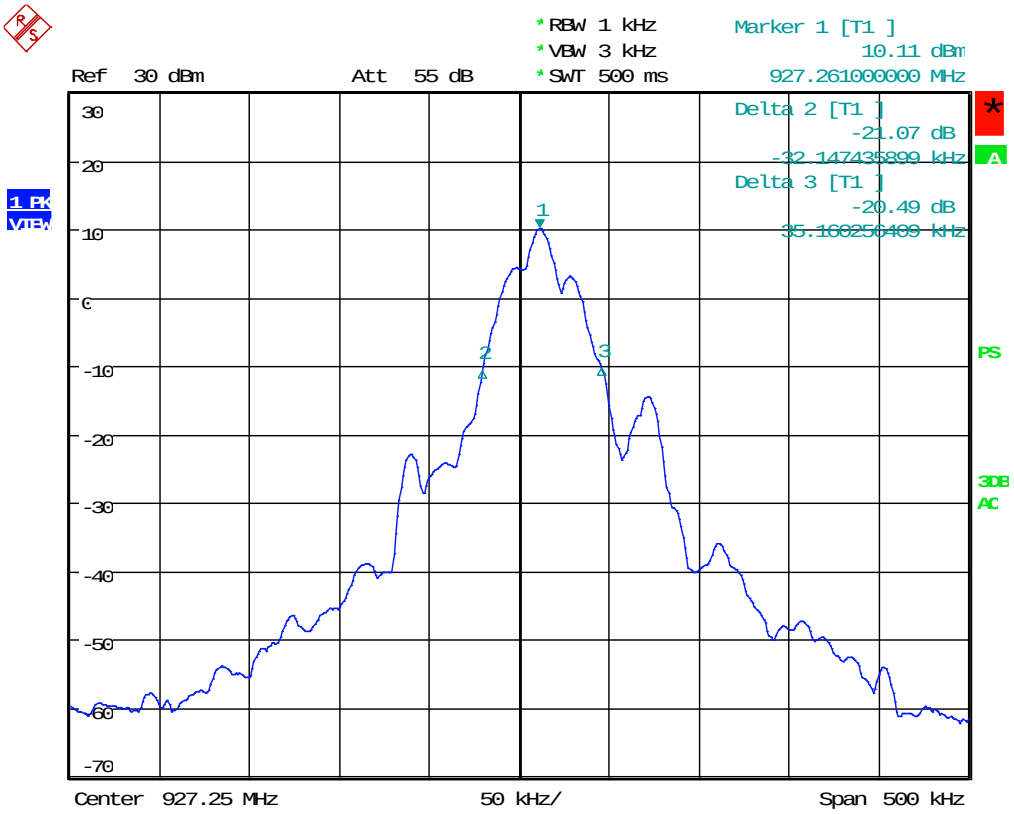
-20dB, High Channel



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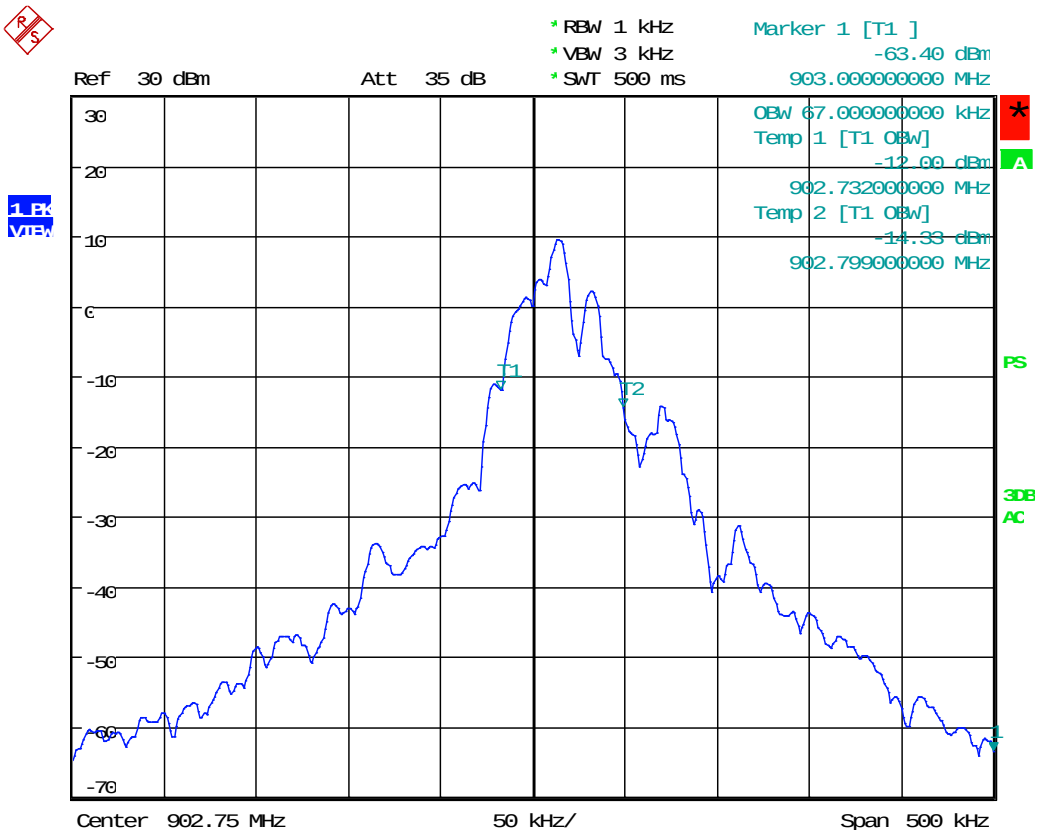
99%, Low Channel



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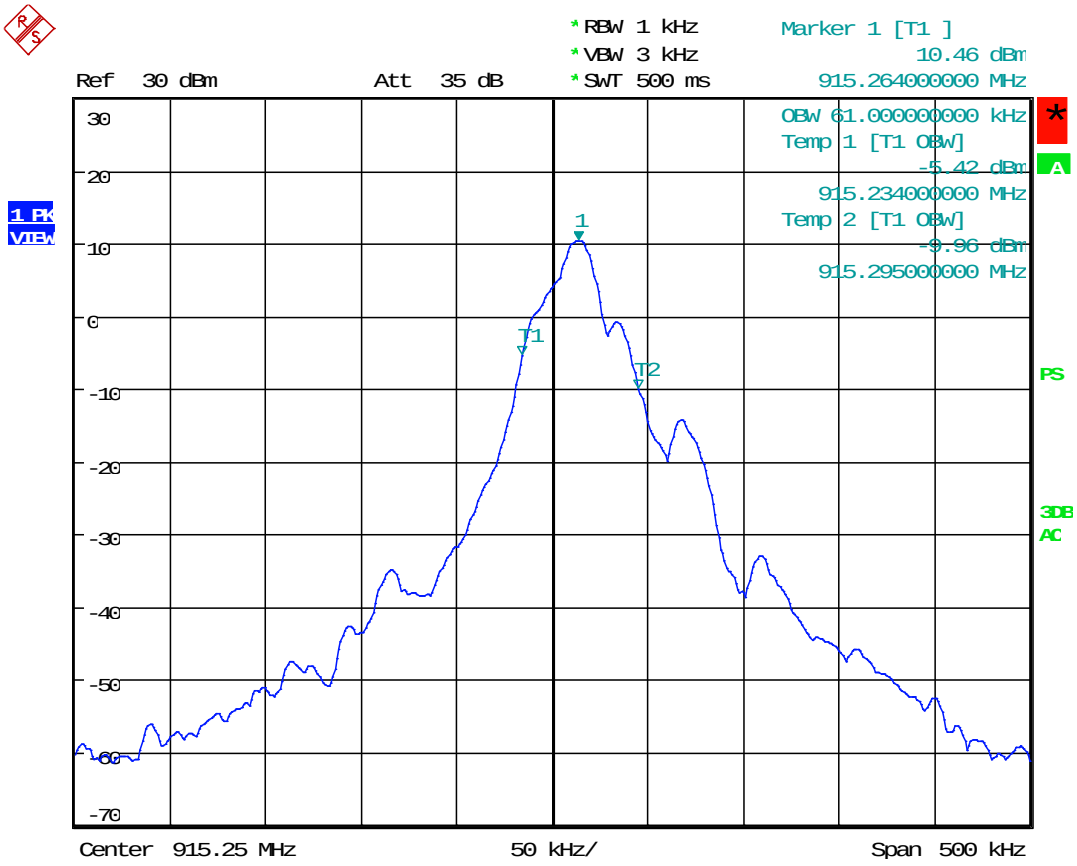
99%, Mid Channel



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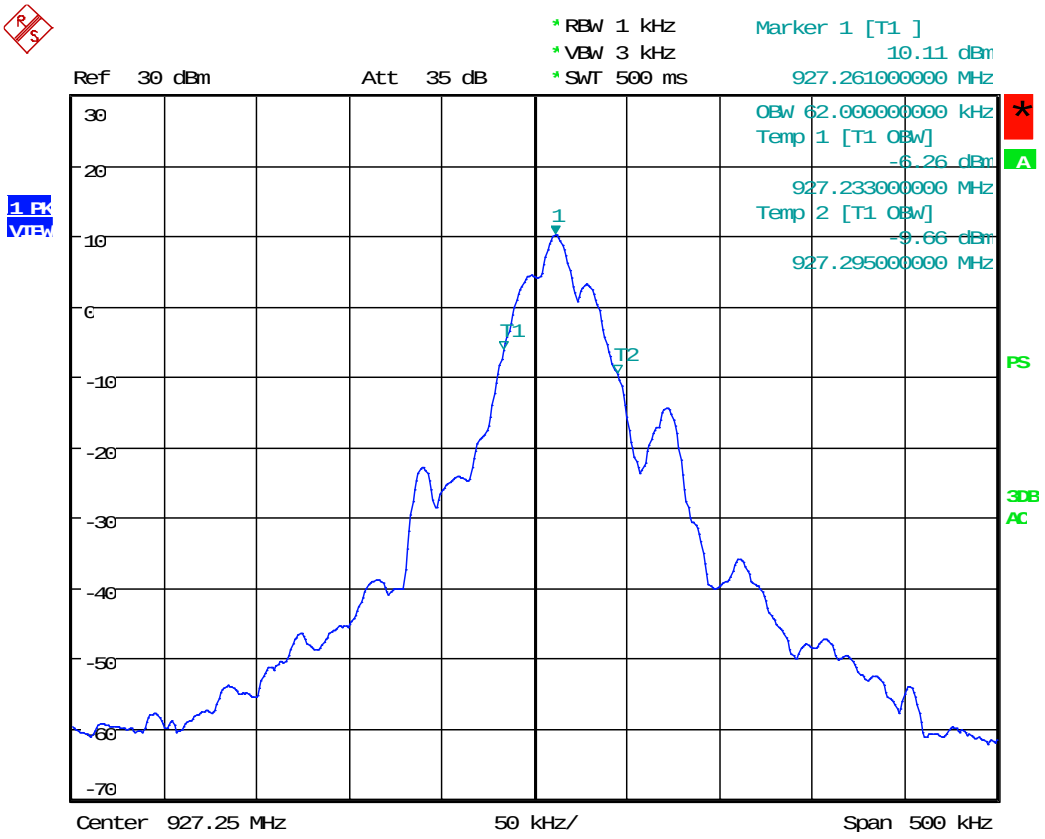
99%, High Channel



8 FCC PART 15.247(b)(2) – CONDUCTED OUTPUT POWER

The EUT antenna port was directly connected to the input of the receiver. The peak power output was measured.

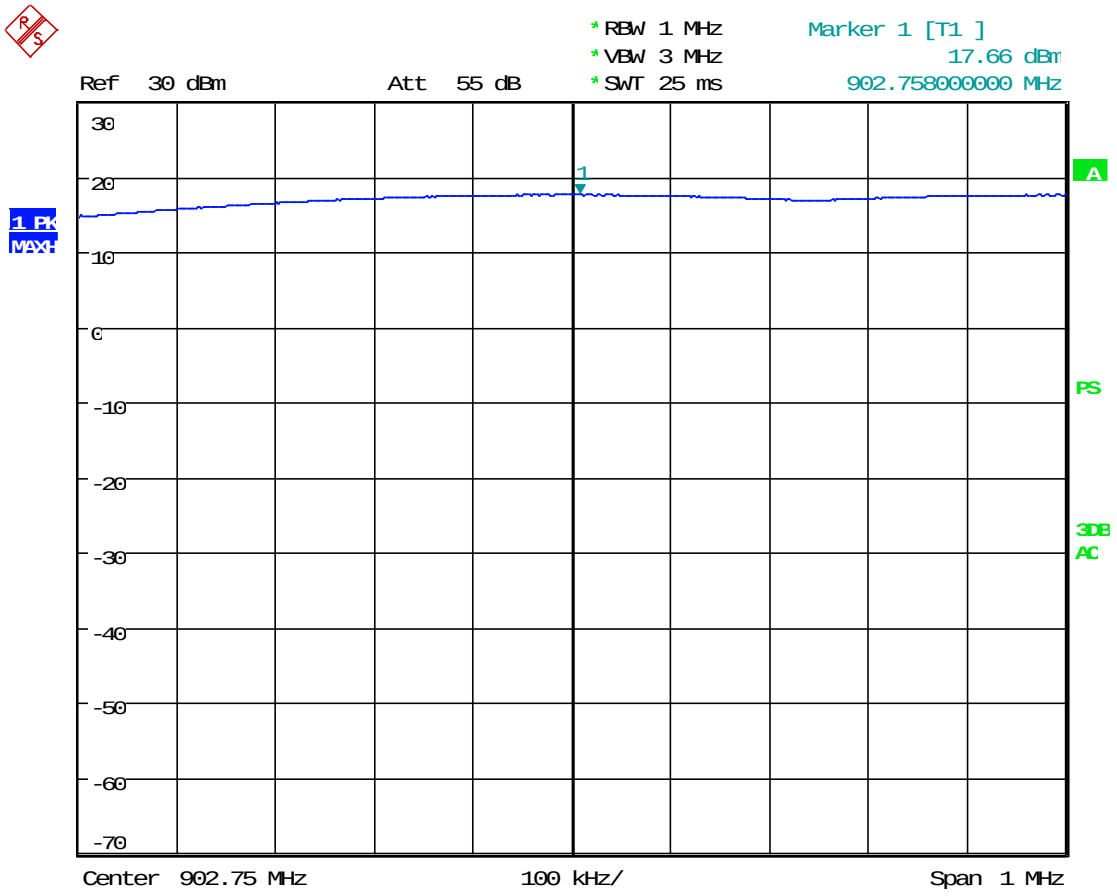
8.1 Requirements:

For frequency hopping systems operating in the 902–928 MHz band: 1 watt (30dBm) for systems employing at least 50 hopping channels; and 0.25 (24dBm) watts for systems employing less than 50 hopping channels.

8.2 Conducted Output Power Test Data

Test Date:	2023-04-24	**Test Engineer:**	J. Chiller
Standards:	CFR 47 Part 15.247(b)(3); KDB558074	**Air Temperature:**	22.2ºC
		Relative Humidity:	37%

Low Channel



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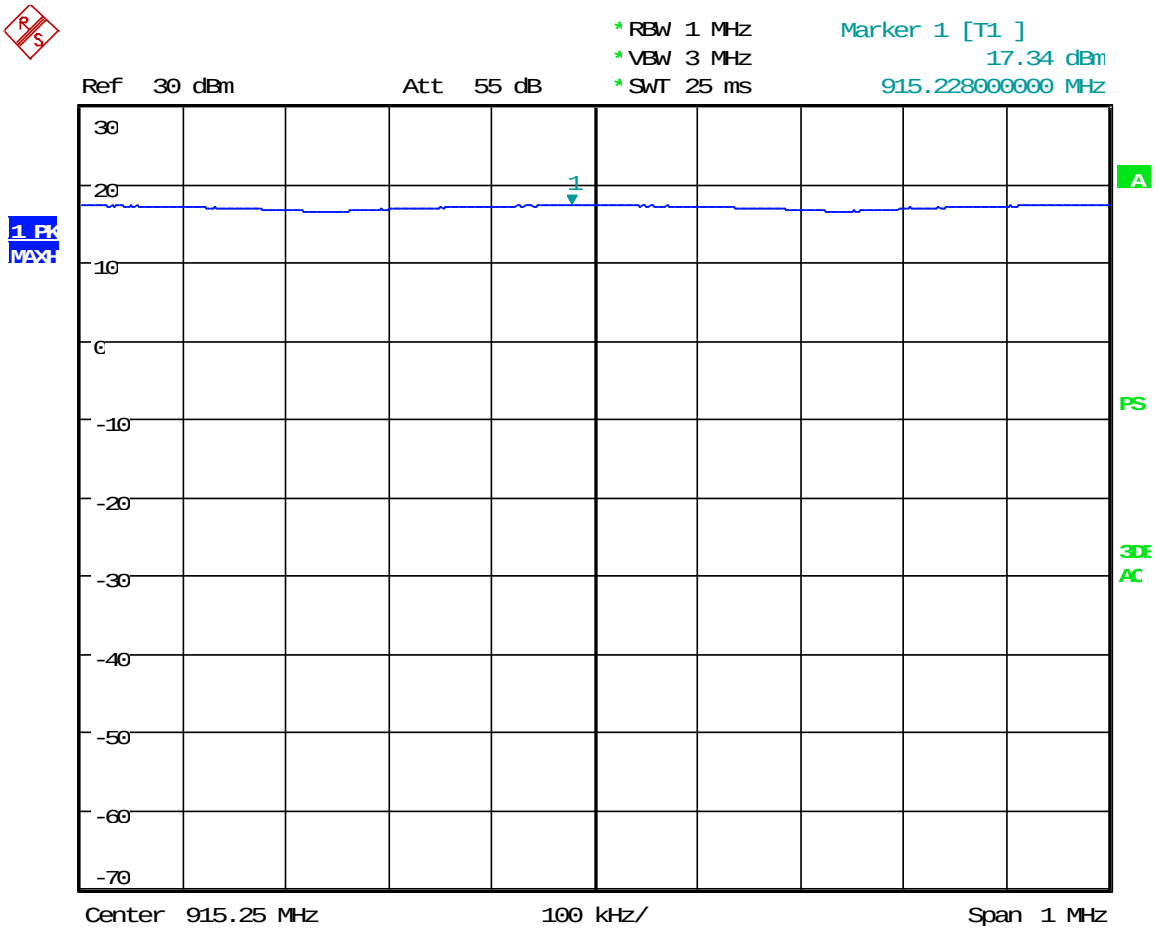
Mid Channel



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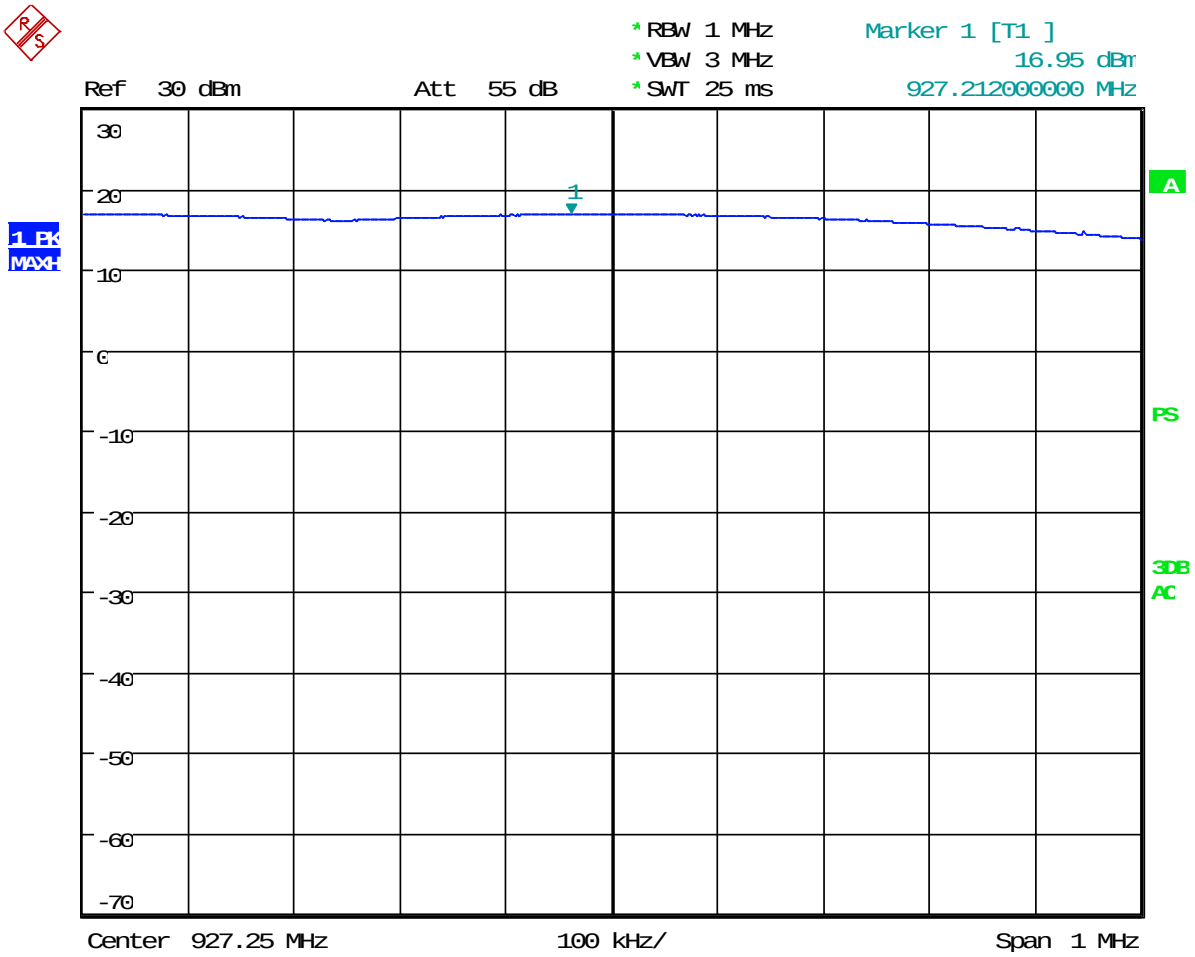
High Channel



Date: 24.APR.2023 11:43:15

9 FCC PART 15.31(e) – VOLTAGE VARIATIONS

9.1 Requirements

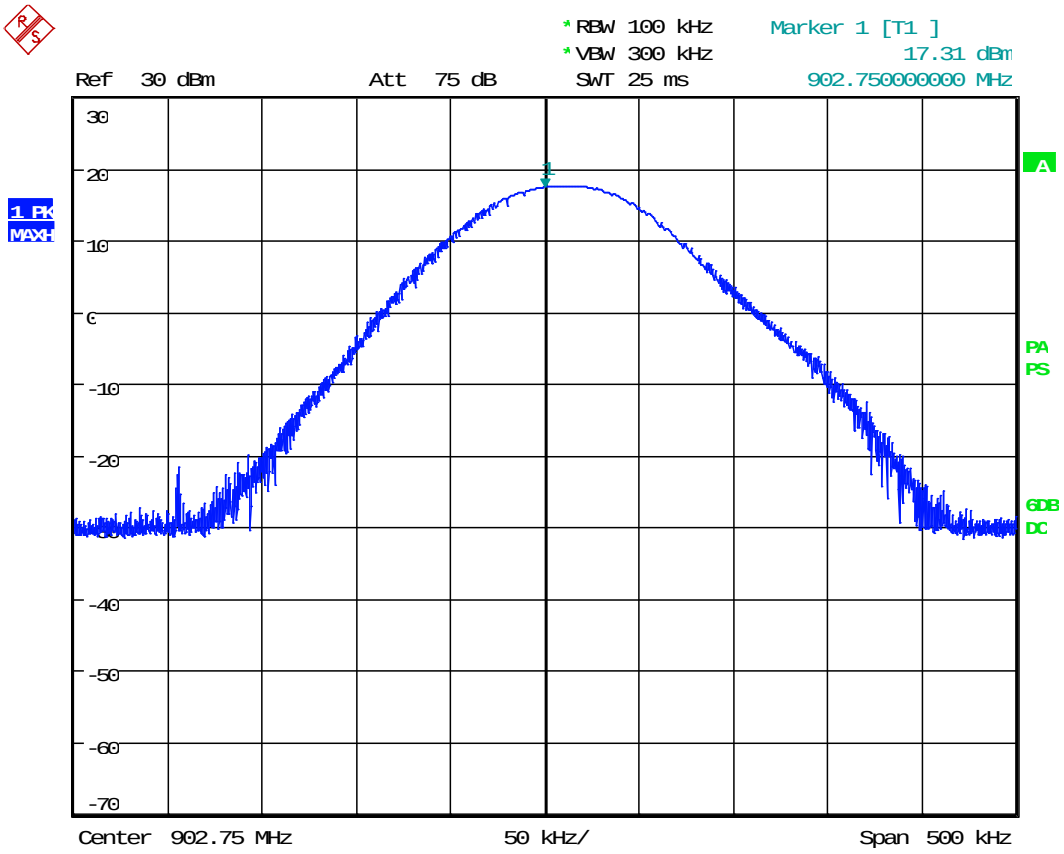
For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery-operated equipment, the equipment tests shall be performed using a new battery.

To meet the requirements of 15.31, the voltage was varied from 4.7VDC to 5.5VDC according to USB power requirements. EUT ceased to function below 4.7VDC.

9.2 Voltage Variations Test Data

Test Date(s):	2023-04-26	**Test Engineer:**	J. Chiller
Rule:	15.31(e)	**Air Temperature:**	22.1º C
Test Results:	Complies	**Relative Humidity:**	38%

Low Channel, 4.7VDC



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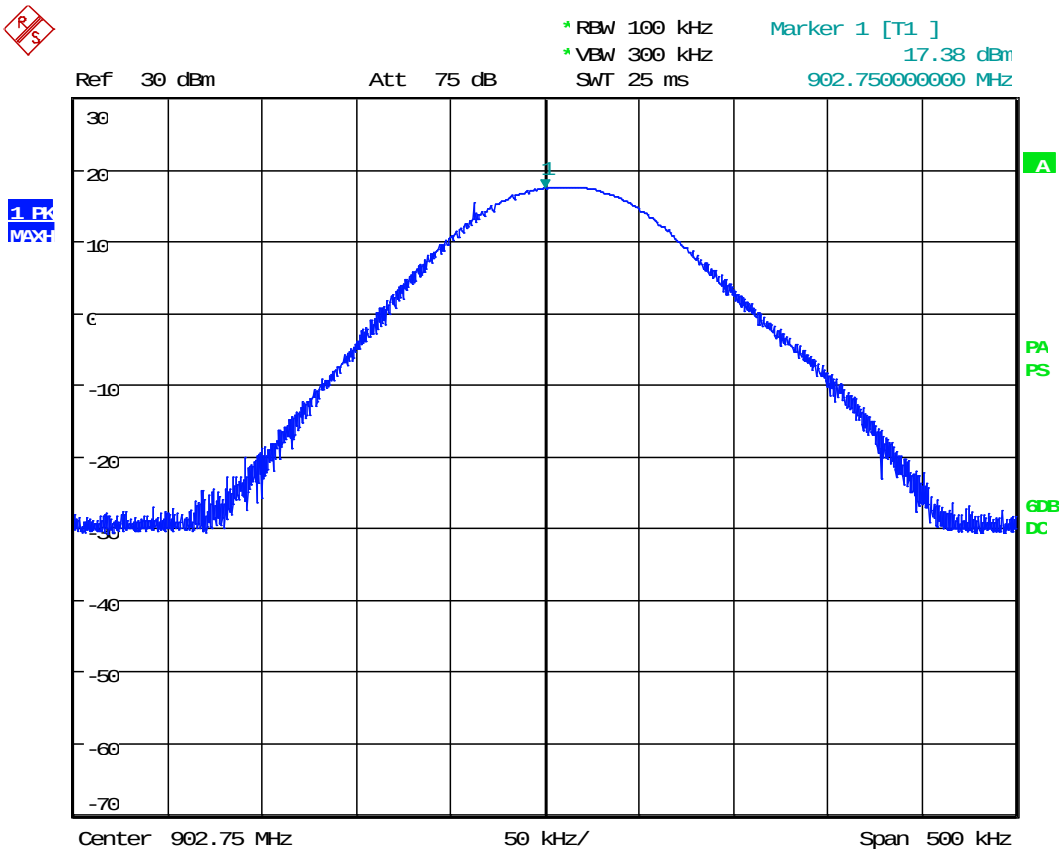
Low Channel, 5.0VDC



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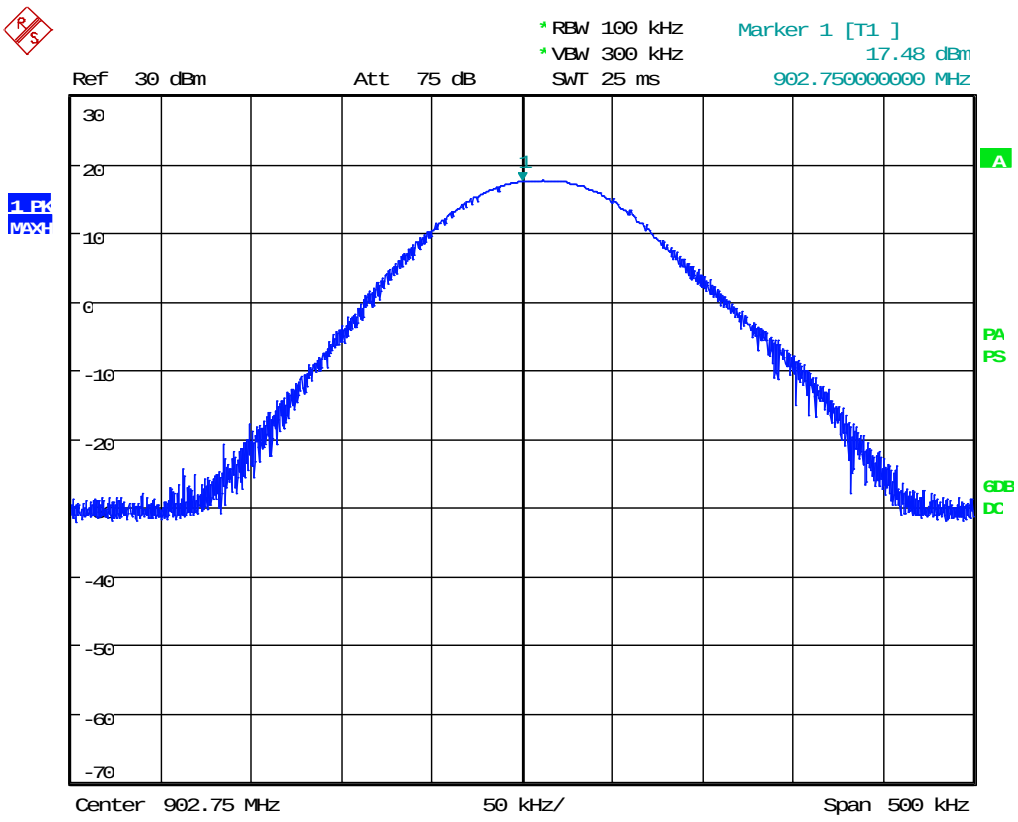
Low Channel, 5.5VDC



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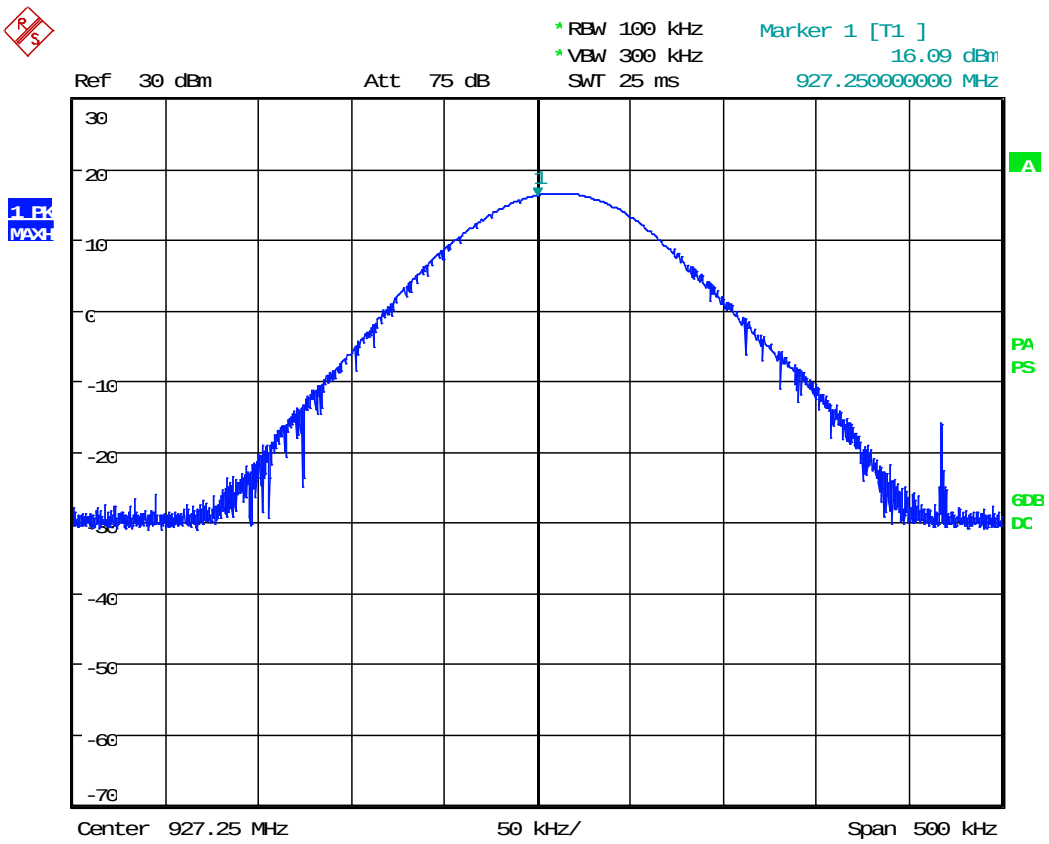
High Channel, 4.7VDC



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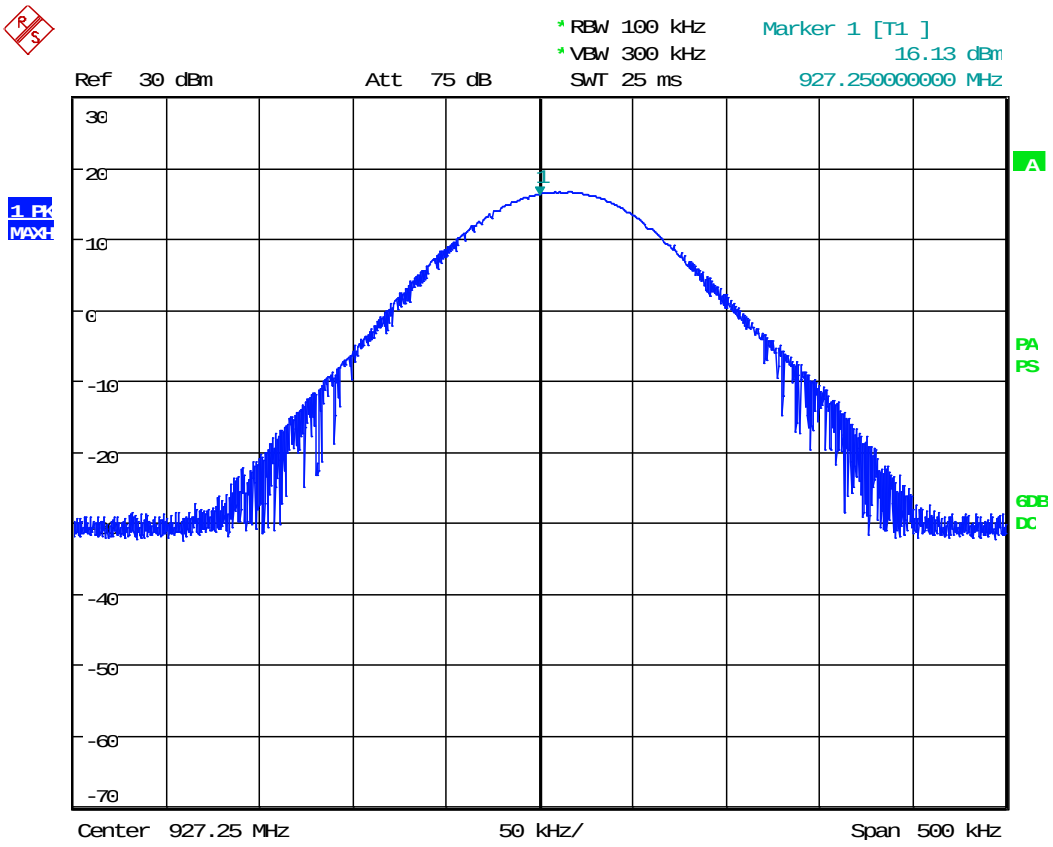
High Channel, 5.0VDC



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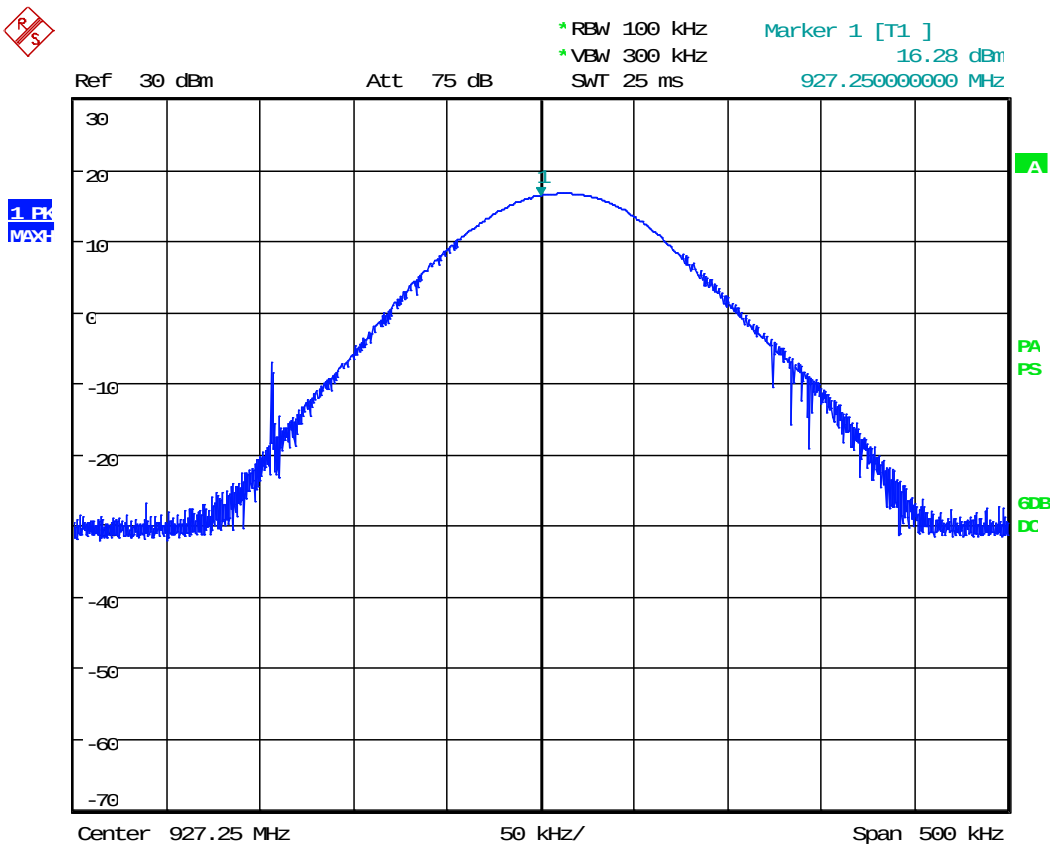
High Channel, 4.7VDC



Date: 26.APR.2023 10:31:39

10 FCC Part 15.247(d) – CONDUCTED SPURIOUS EMISSIONS

The following tests were performed to demonstrate compliance.

RF Conducted Test

The EUT antenna port was directly connected to the input of the spectrum analyzer. Low channel results are presented as worse case.

10.1 Requirements:

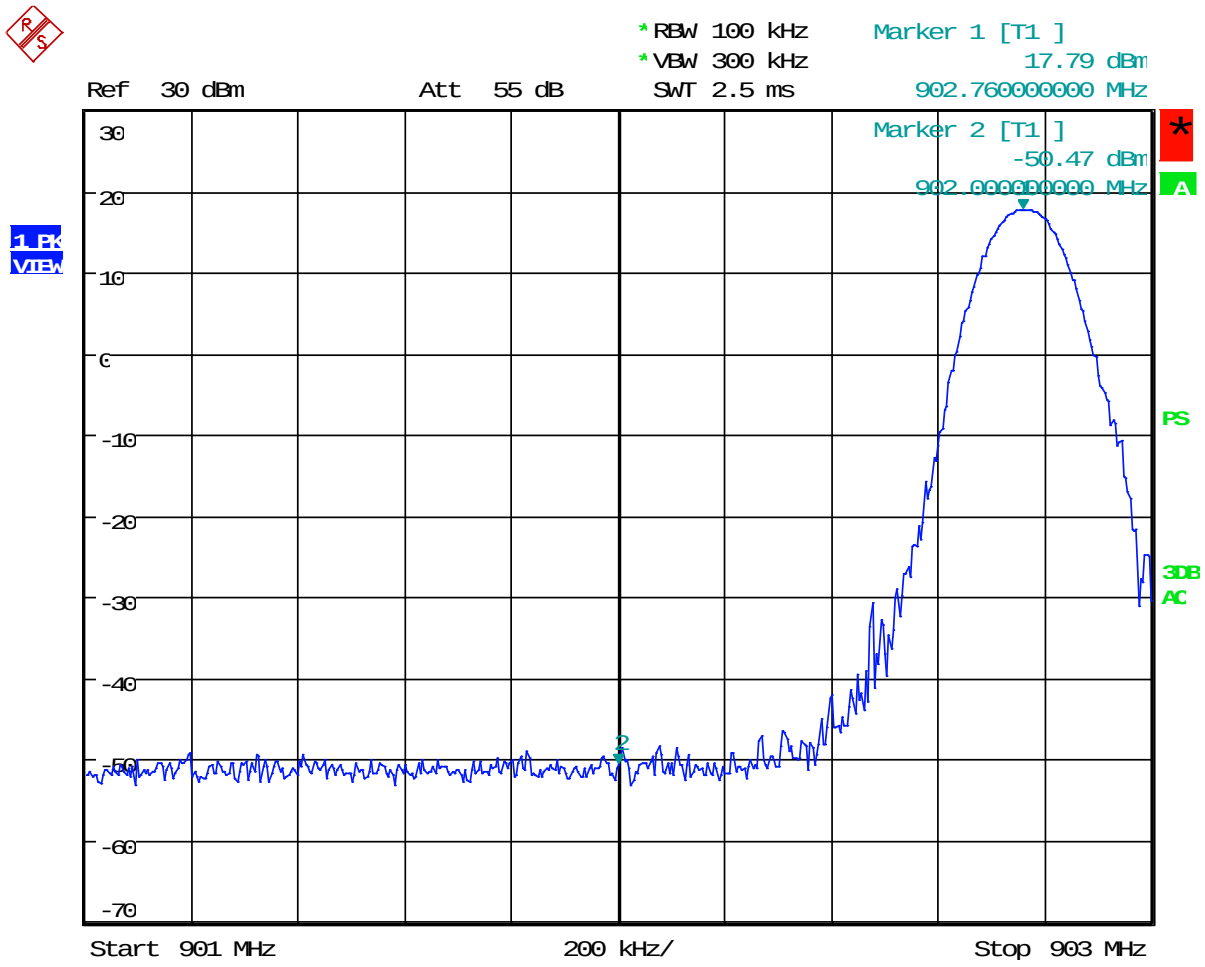
All Spurious Emissions must be at least 20dB down from the highest emission level measured within the authorized band up through the tenth harmonic. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Spurious emissions measurements were made at the low, mid, and upper channels with the appropriate spectrum analyzer impulse bandwidth. Additionally, 20dB down points were measured for the low and high channels to verify band edge compliance.

10.2 Conducted Spurious Emissions Test Data

Test Date:	2023-04-24	**Test Engineer:**	J. Chiller
Standards:	CFR 47 Part 15.247(d) / Part 15.207 KDB558074	**Air Temperature:**	21.7ºC
		Relative Humidity:	38%

Conducted Spurious Emissions: Lower Band Edge



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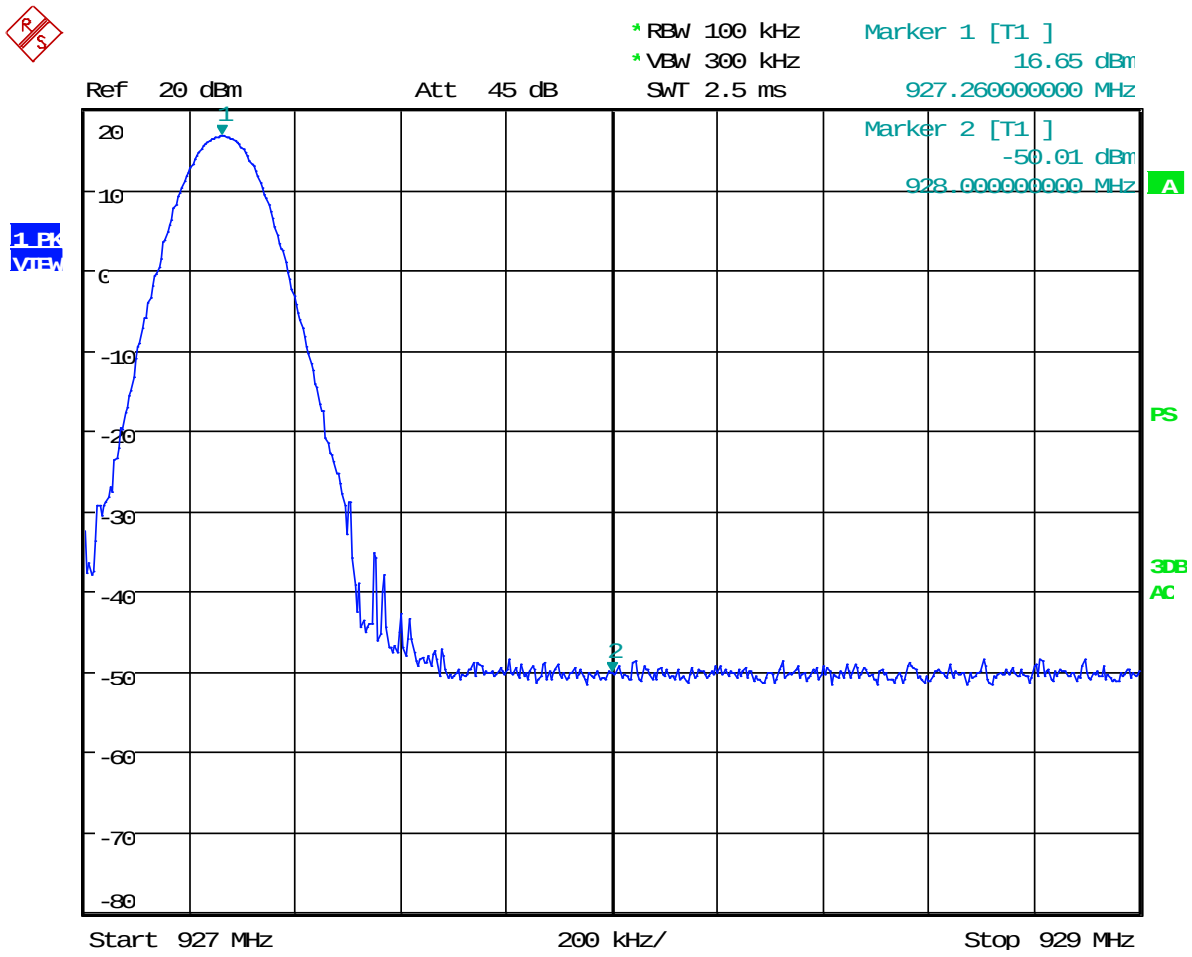
Conducted Spurious Emissions: Upper Band Edge



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Conducted Spurious Emissions: 0.009 MHz to 0.15 MHz

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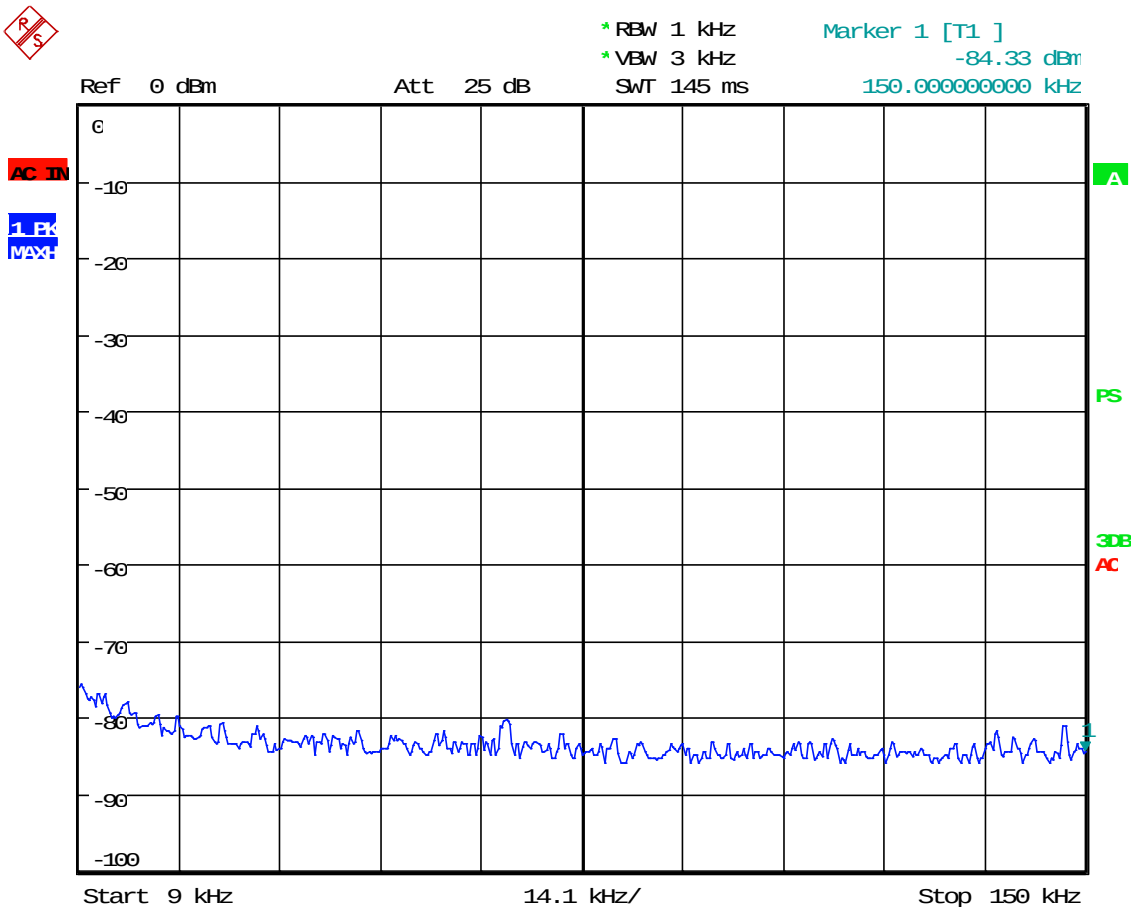

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Conducted Spurious Emissions: 0.15 MHz to 30.0 MHz

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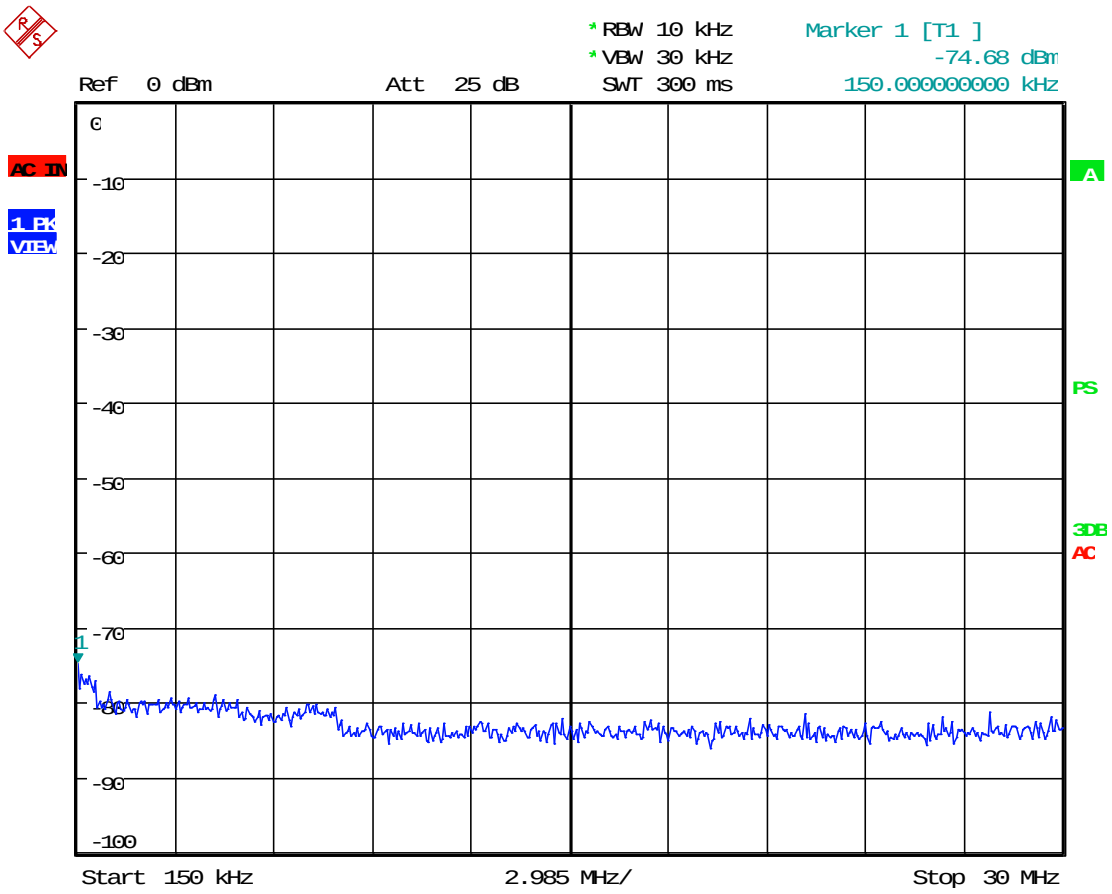

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Conducted Spurious Emissions: 30 MHz to 1000 MHz

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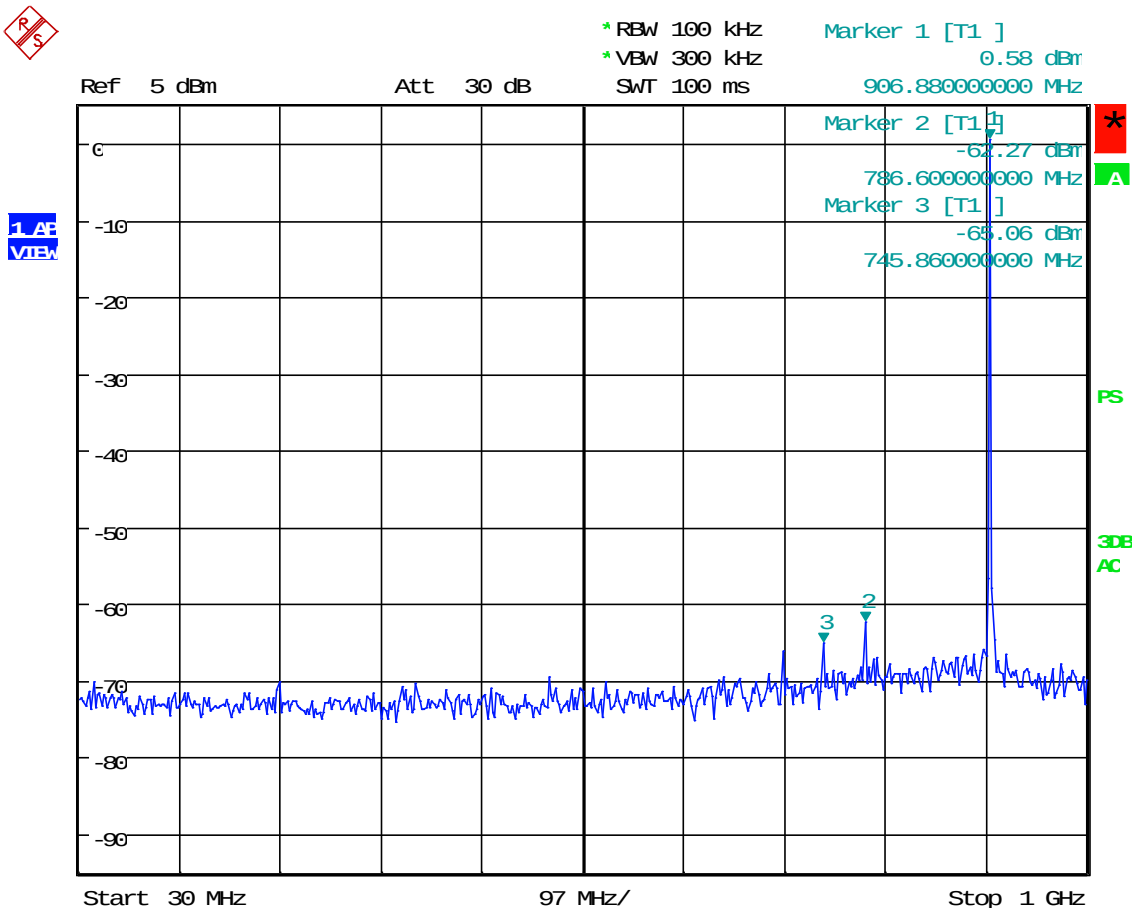

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Conducted Spurious Emissions: 1 GHz to 10 GHz

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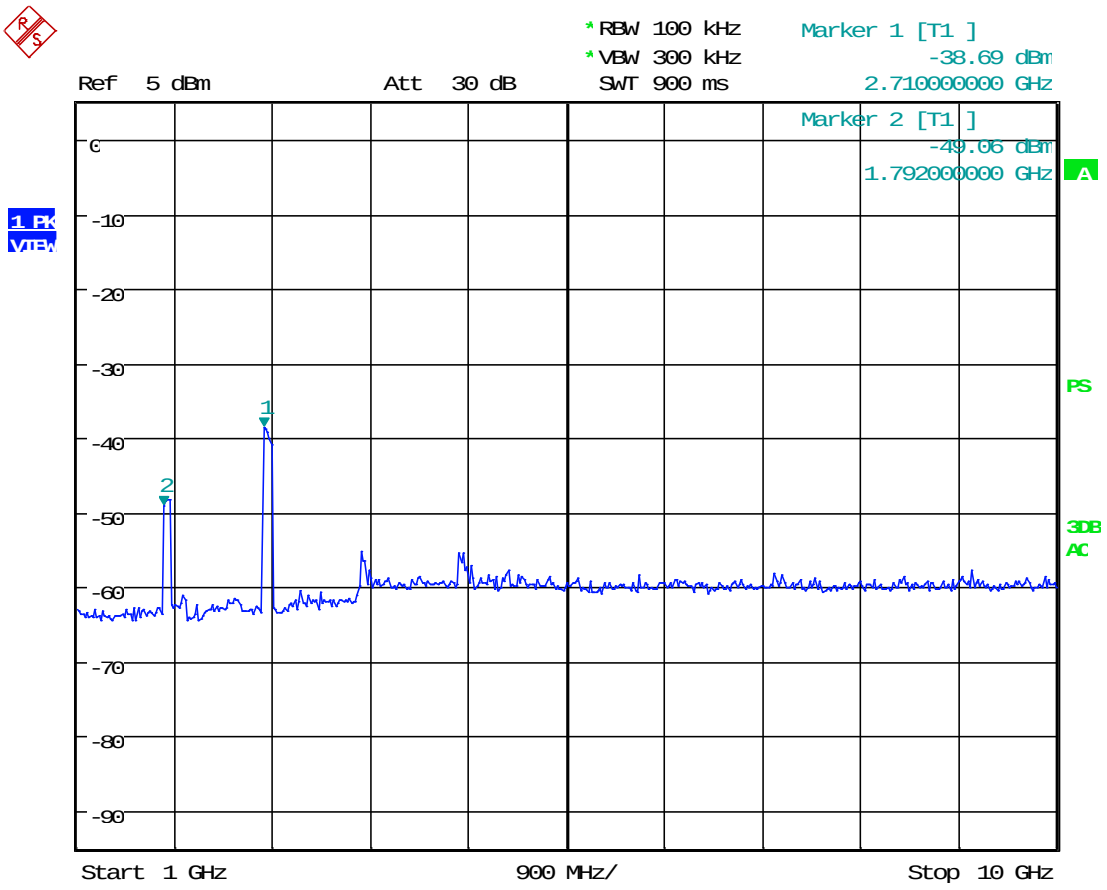

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11 RADIATED SPURIOUS EMISSIONS

The EUT antenna port was fitted with its external antenna. Radiated emissions were measured in a Semi-Anechoic Chamber. All emissions generated that fall in the restricted bands per FCC Part 15.205 were examined.

11.1 Requirements:

All emissions that fall in the restricted bands defined in FCC Part 15.205 shall not exceed the maximum field strength listed in FCC Part 15.209(a).

11.2 Radiated Spurious Emissions Test Data

Test Date(s):	2023-04-24	**Test Engineer:**	J. Chiller
Standards:	CFR 47 Part 15.247(d); Part 15.209 / KDB558074	**Air Temperature:**	22.2ºC
		Relative Humidity:	37%

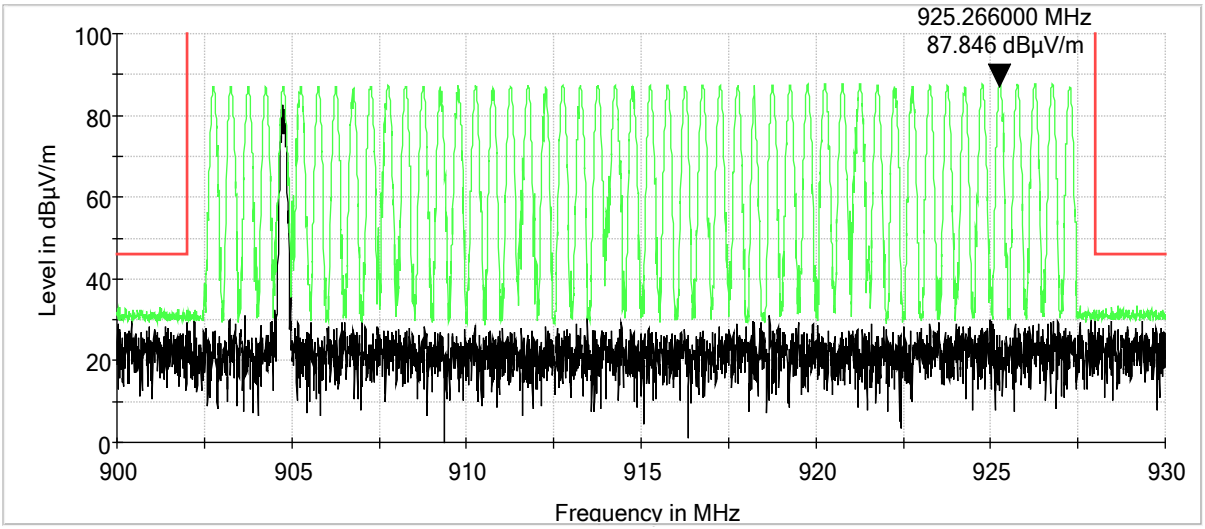
Notes: Plots are peak, max hold prescan data included only to determine what frequencies to investigate and measure. The EUT was initially placed in a semi-anechoic chamber, and rotated in all three orthogonal positions to maximize the emissions. Characterization measurements were then performed to determine at which frequencies significant emissions occurred. These graphs are shown below.

The equipment was fully exercised with all cabling attached to the EUT and was positioned for maximum emissions. While the equipment was energized, the receiving antenna was scanned from 1.0 meter to 4.0 meters in both vertical and horizontal polarities while the turntable was adjusted 360 degrees to determine the maximum field strength. The tables of measured results can be found below.

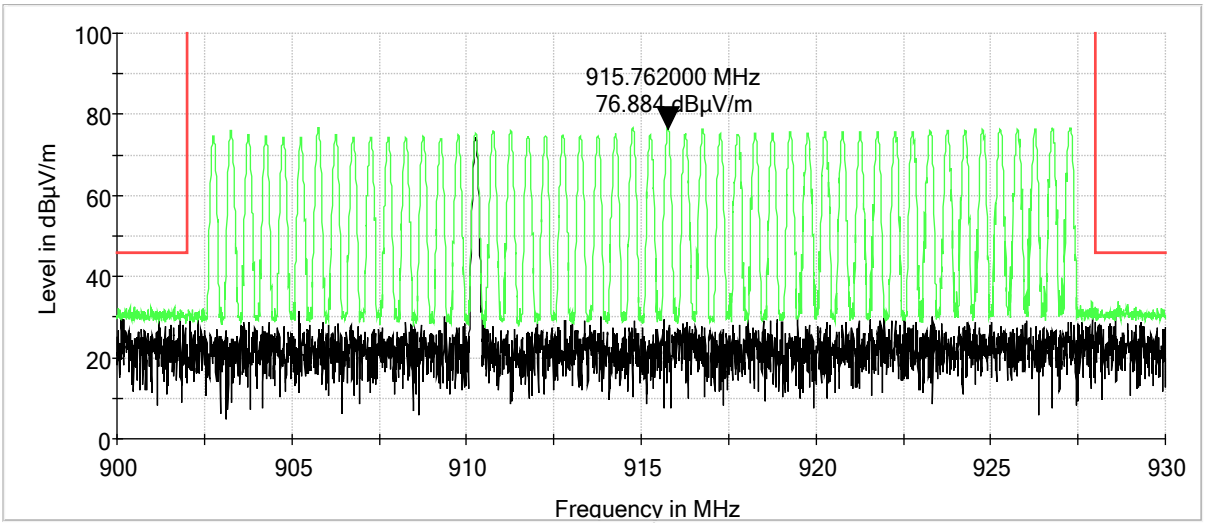
Some of the frequencies did not change with the EUT on or off. At those frequencies, the test distance was shortened to 1 meter and still no emissions from the EUT were visible or over the ambient or limit.

In the following plots, the black line indicates ambient noise and the red line indicates the measurement with the EUT on. Emissions to be found by the EUT were measured and listed in tables. The plots are for reference only and the limit lines are not actual limit lines but merely a guide.

Radiated Band Edges: Vertical

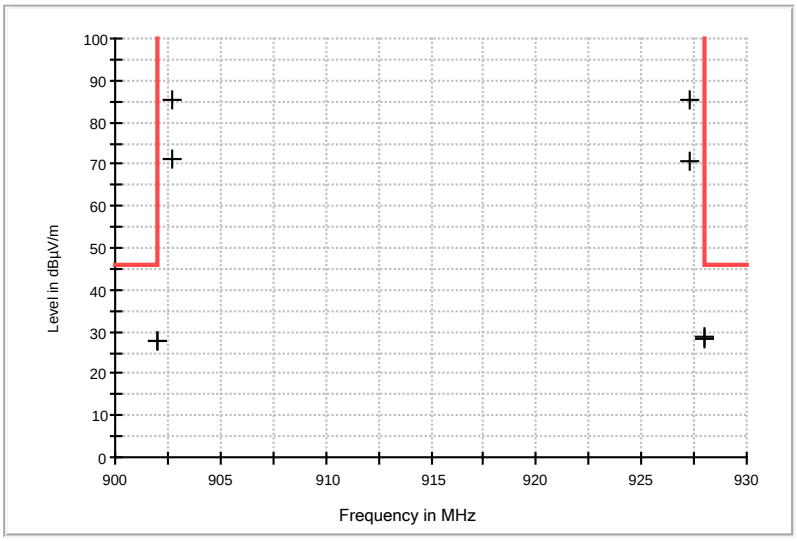


Radiated Band Edges: Horizontal

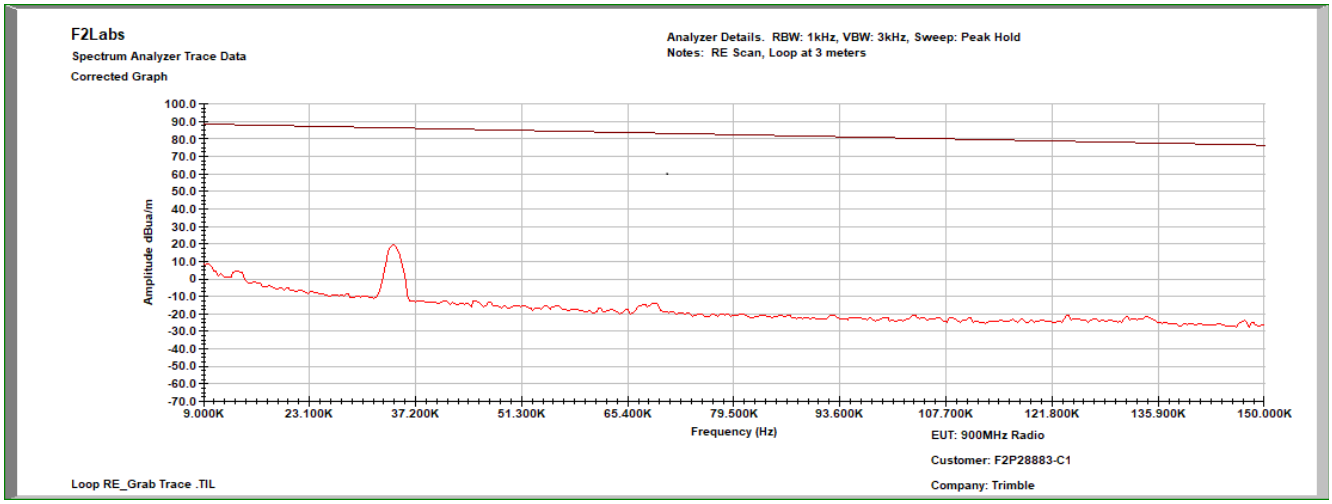


Radiated Band Edges: Measurements

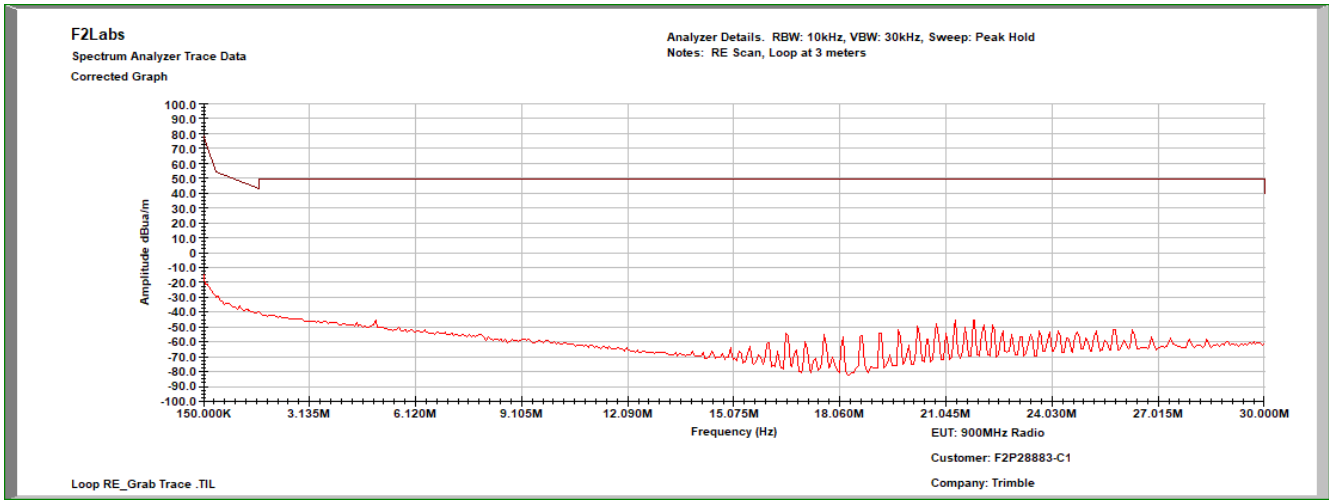
Frequency (MHz)	Antenna Polarization	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
902.000000	H	41.6	-13.9	27.70	46.0	-18.3
902.000000	V	41.9	-13.9	28.00	46.0	-18.0
902.750000	H	85.2	-13.9	71.30	--	--
902.750000	V	99.3	-13.9	85.40	--	--
927.250000	V	98.4	-13.2	85.20	--	--
927.250000	H	83.9	-13.2	70.70	--	--
928.000000	H	41.3	-13.2	28.10	46.0	-17.9
928.000000	V	42.2	-13.2	29.00	46.0	-17.0



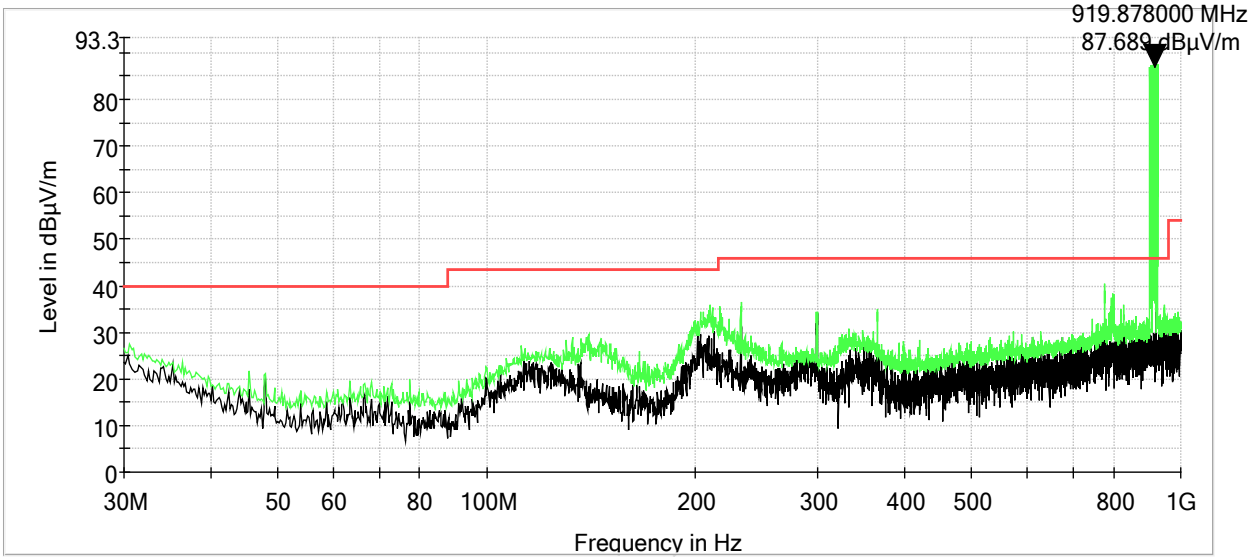
Radiated Spurious Emissions: 0.009 MHz to 0.15 MHz – Loop Antenna



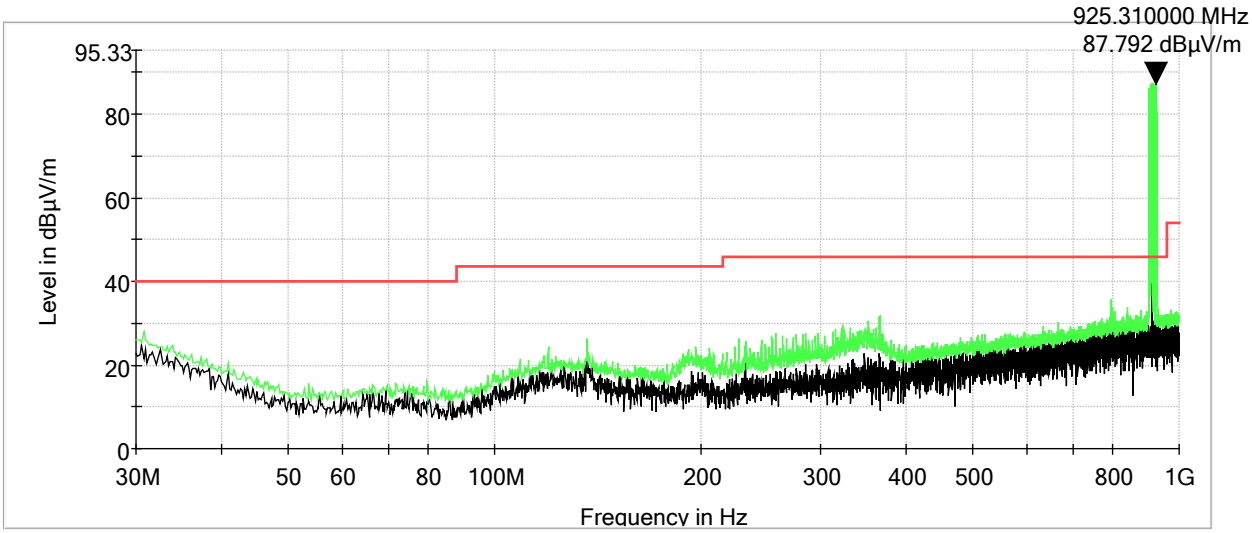
Radiated Spurious Emissions: 0.15 MHz to 30 MHz – Loop Antenna



Radiated Spurious Emissions: 30 MHz to 1000 MHz - Vertical



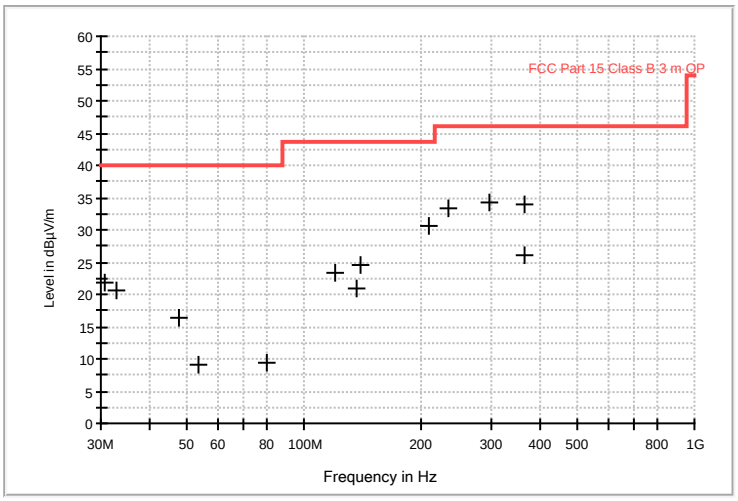
Radiated Spurious Emissions: 30 MHz to 1000 MHz – Horizontal



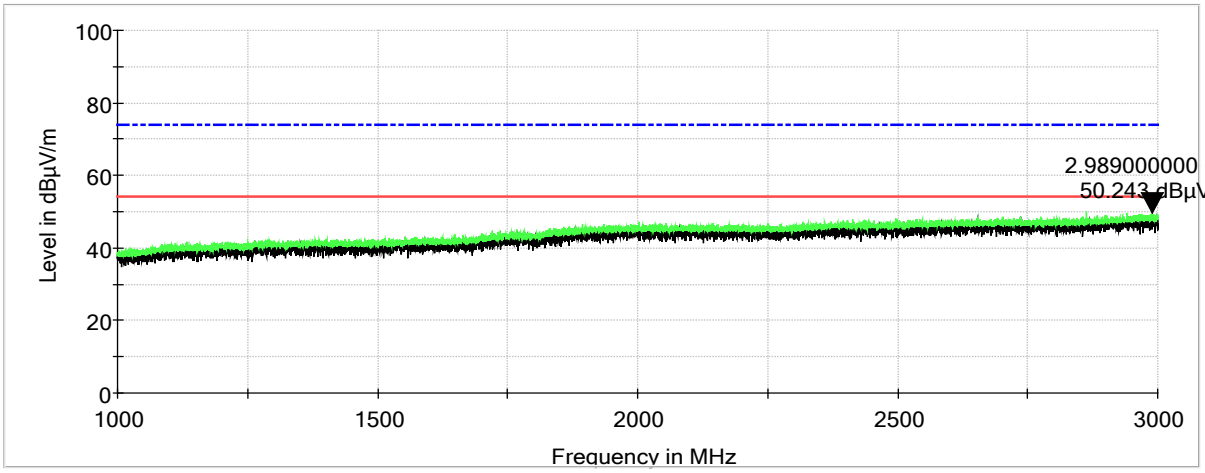
Measurements

Quasi-Peak, 30 MHz to 1000 MHz

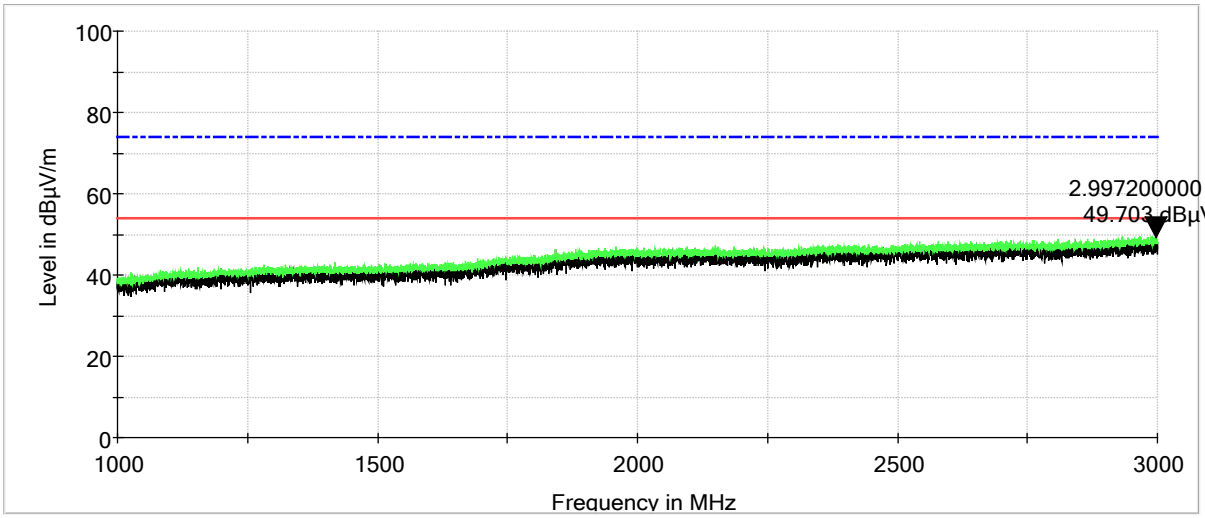
Frequency (MHz)	Ant. Pol.	Antenna Height (cm)	Azimuth (degrees)	Reading (dBµV)	Corr. Factors (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.760000	H	100.00	358.00	41.7	-19.8	21.90	40.0	-18.1
32.720000	V	100.00	358.00	41.9	-21.2	20.70	40.0	-19.3
47.840000	V	100.00	358.00	47.8	-31.5	16.30	40.0	-23.7
53.680000	H	100.00	358.00	42.0	-32.9	9.10	40.0	-30.9
79.840000	H	100.00	358.00	41.7	-32.3	9.40	40.0	-30.6
120.000000	H	100.00	47.00	49.4	-26.1	23.30	43.5	-20.2
136.520000	H	100.00	96.00	47.2	-26.3	20.90	43.5	-22.6
139.240000	V	100.00	217.00	50.9	-26.5	24.40	43.5	-19.1
209.440000	V	100.00	339.00	59.1	-28.6	30.50	43.5	-13.0
232.720000	V	100.00	144.00	60.9	-27.6	33.30	46.0	-12.7
299.280000	V	100.00	224.00	59.8	-25.5	34.30	46.0	-11.7
365.040000	H	100.00	111.00	49.8	-23.7	26.10	46.0	-19.9
365.800000	V	100.00	140.00	57.6	-23.7	33.90	46.0	-12.1



Radiated Spurious Emissions: 1 GHz to 3 GHz – Vertical



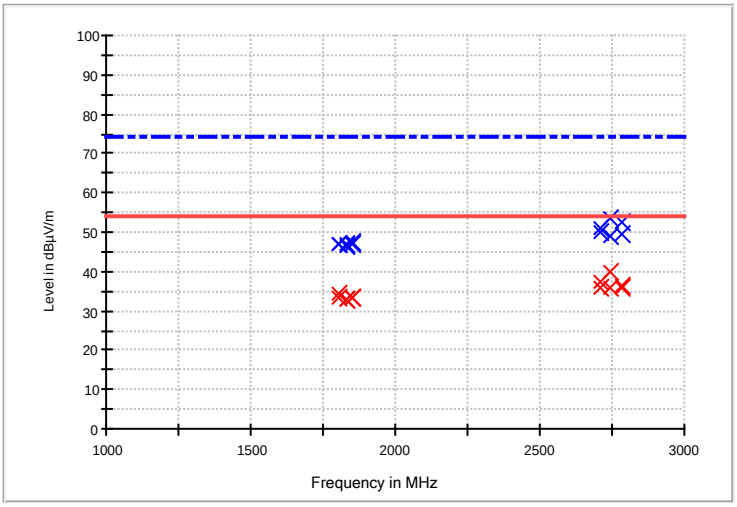
Radiated Spurious Emissions: 1 GHz to 3 GHz – Horizontal



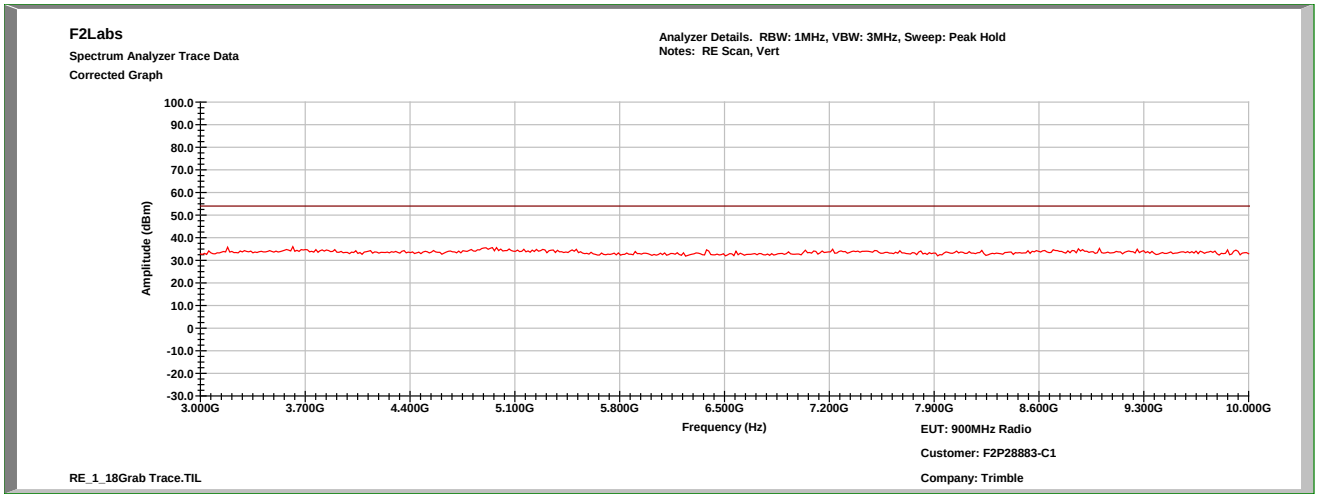
Radiated Spurious Emissions: 1 GHz to 3 GHz, with Harmonics

*Indicates emission is in a restricted band.

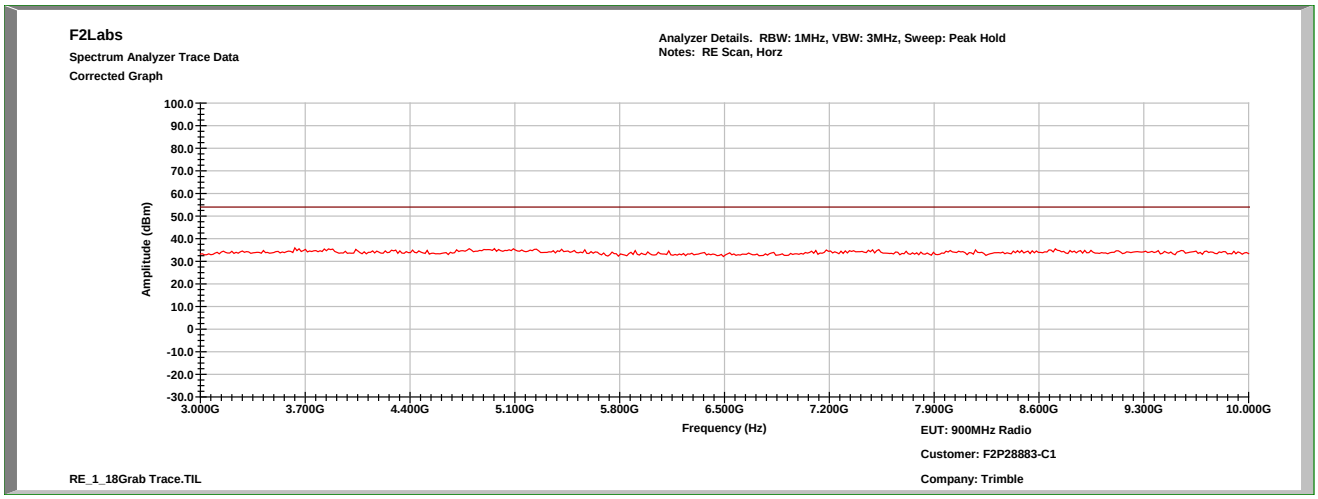
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Margin – MaxPeak (dB)	Limit – MaxPeak (dBµV/m)
1805.500000	47.0	34.4	1000.000	150.0	H	0.0	7.8	19.6	54.0	27.0	74.0
1805.500000	47.0	33.4	1000.000	150.0	V	5.0	7.8	20.6	54.0	27.0	74.0
1830.500000	46.7	32.8	1000.000	150.0	V	359.0	8.3	21.2	54.0	27.3	74.0
1830.500000	47.2	32.8	1000.000	150.0	H	0.0	8.3	21.2	54.0	26.8	74.0
1854.500000	47.1	33.4	1000.000	150.0	H	0.0	8.8	20.6	54.0	26.9	74.0
1854.500000	47.3	33.3	1000.000	150.0	V	7.0	8.8	20.7	54.0	26.7	74.0
*2708.25000	50.0	35.8	1000.000	150.0	V	357.0	11.4	18.2	54.0	24.0	74.0
*2708.25000	50.9	37.6	1000.000	150.0	H	0.0	11.4	16.4	54.0	23.1	74.0
*2745.75000	48.9	35.7	1000.000	150.0	H	0.0	11.4	18.3	54.0	25.1	74.0
*2745.75000	53.7	39.8	1000.000	150.0	V	15.0	11.4	14.2	54.0	20.3	74.0
*2781.75000	52.4	35.9	1000.000	150.0	H	355.0	11.4	18.1	54.0	21.6	74.0
*2781.75000	49.5	36.5	1000.000	150.0	V	358.0	11.4	17.5	54.0	24.5	74.0



Radiated Spurious Emissions: 3 GHz to 10 GHz – Vertical



Radiated Spurious Emissions: 3 GHz to 10 GHz – Horizontal



13 ANSI 63.10 7.8.2 - FREQUENCY SEPARATION

EUT was directly connected to the analyzer with the Hopping function on.

13.1 Requirements:

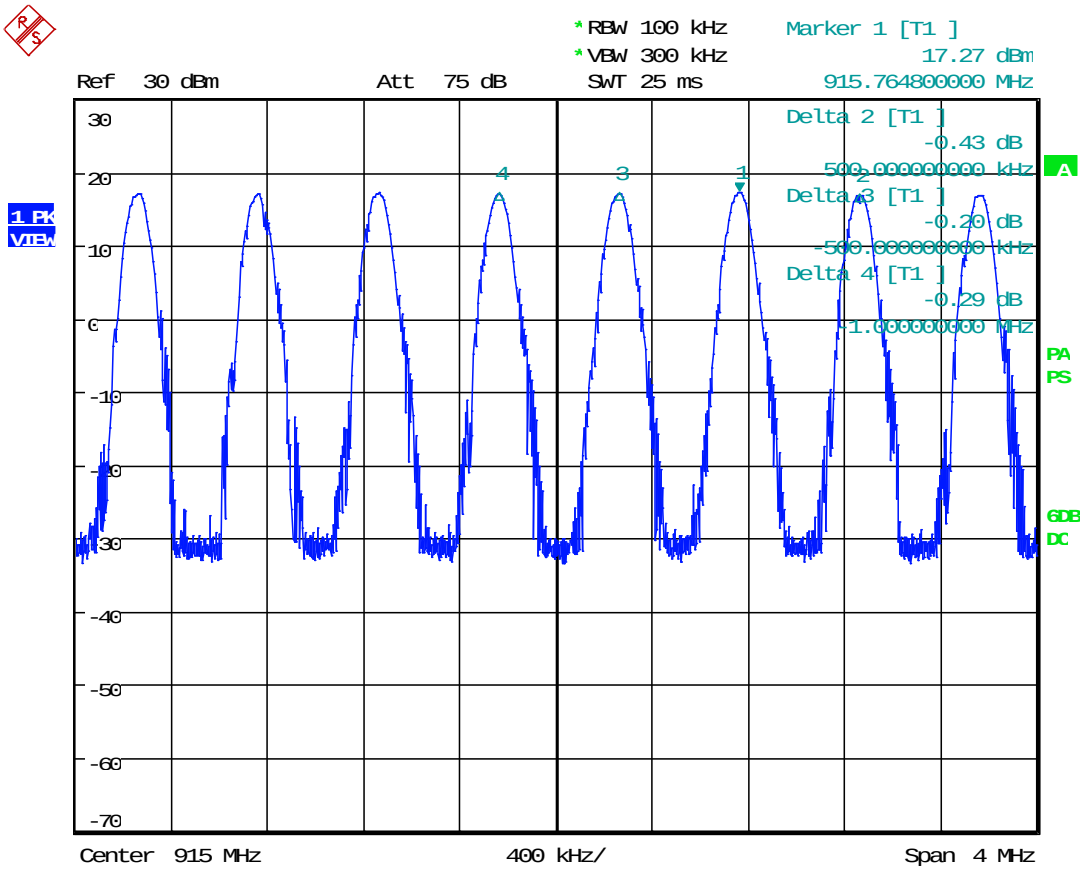
Frequency separation must be greater than 25kHz or 20dB bandwidth of the Hopping Channel, whichever is greater.

13.2 Frequency Separation Test Data

Test Date(s):	2023-04-24	Test Engineer:	J. Chiller
Standards:	ANSI 63.10 7.8.2	Air Temperature:	22.1ºC
		Relative Humidity:	38%

Minimum Separation Limit: 69.6kHz (Maximum OBW)

All channels have a frequency separation of 500kHz as claimed by the manufacturer.



14 ANSI 63.10 7.8.3 – NUMBER OF HOPPING FREQUENCIES

The EUT was directly connected to the measurement device through a SMA connector. With the hopping enabled, the EUT was checked to ensure all of the hopping channels were present.

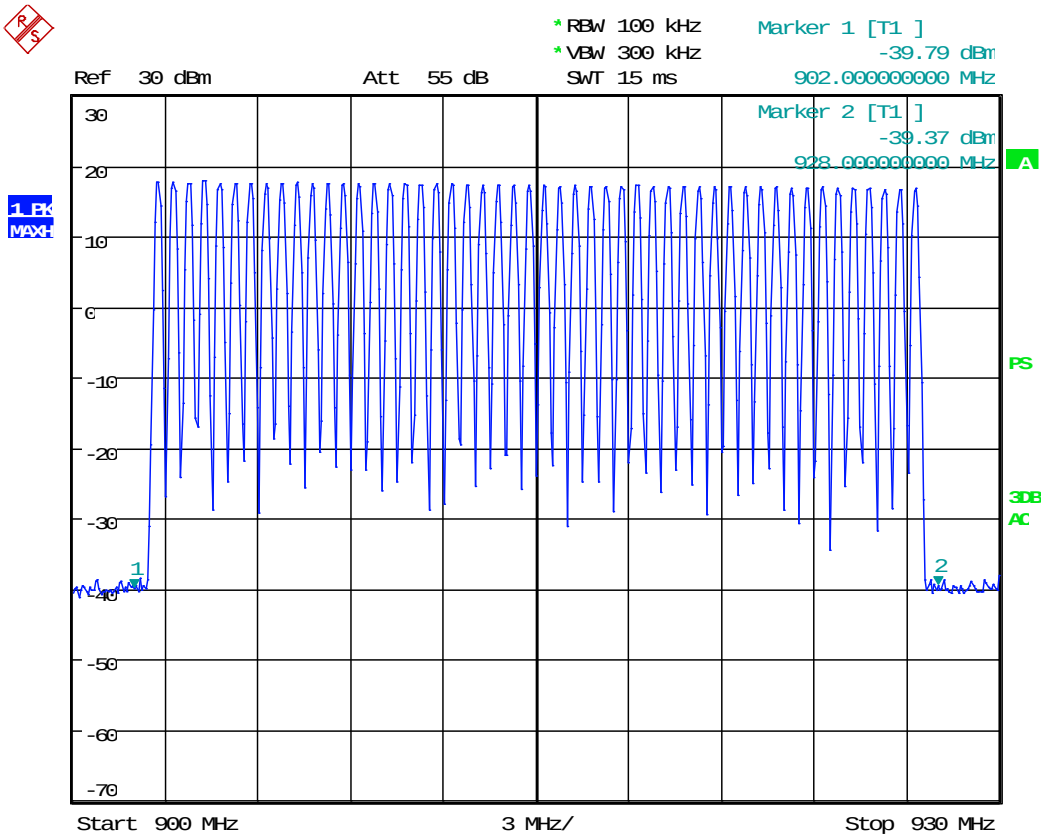
14.1 Requirements:

Verify that all channels are present.

14.2 Number of Hopping Frequencies Test Data

Test Date(s):	2023-04-26	Test Engineer:	J. Chiller
Standards:	ANSI 63.10 7.8.3	Air Temperature:	22.1ºC
		Relative Humidity:	38%

EUT showed 50 channels, confirming manufacturer's specifications.



Date: 24.APR.2023 10:12:16

15 ANSI 63.10 7.8.4 – DWELL TIME

Test was to verify the dwell time on any channel while Hopping was on. EUT was directly connected to analyzer. The plots on the following page show how long a transmission is, and the transmissions in twenty (20) seconds.

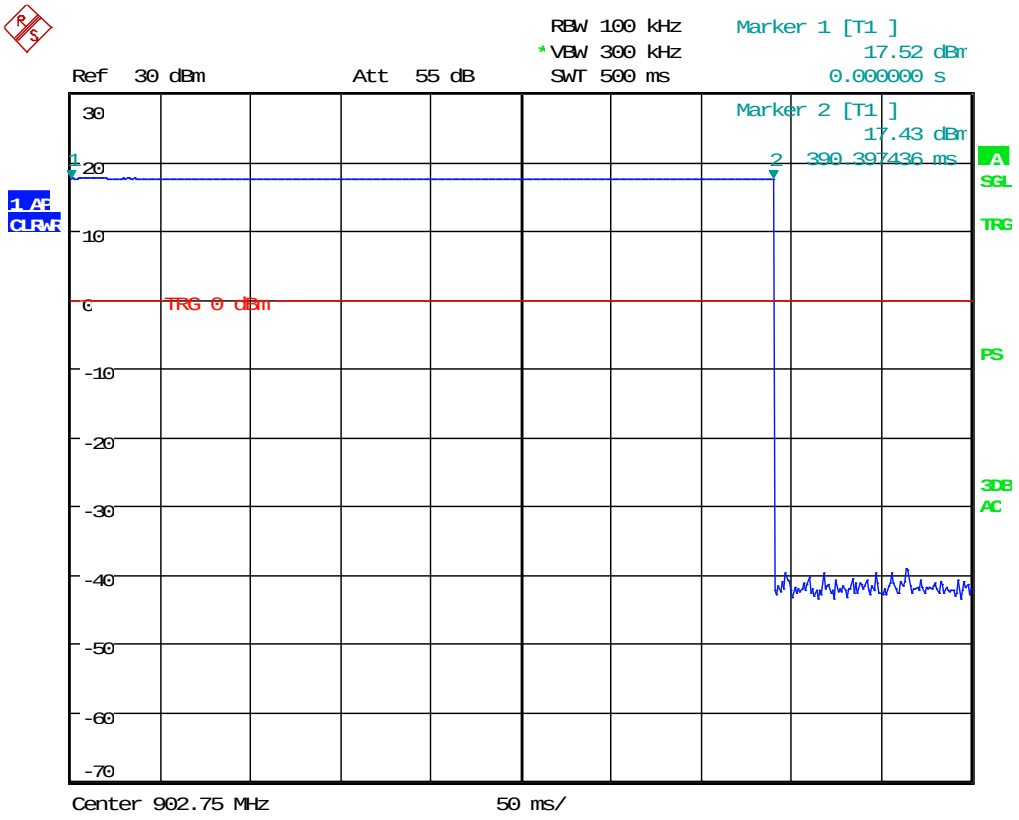
15.1 Requirements:

Limit of 400mS in a 20-second period.

15.2 Dwell Time Test Data

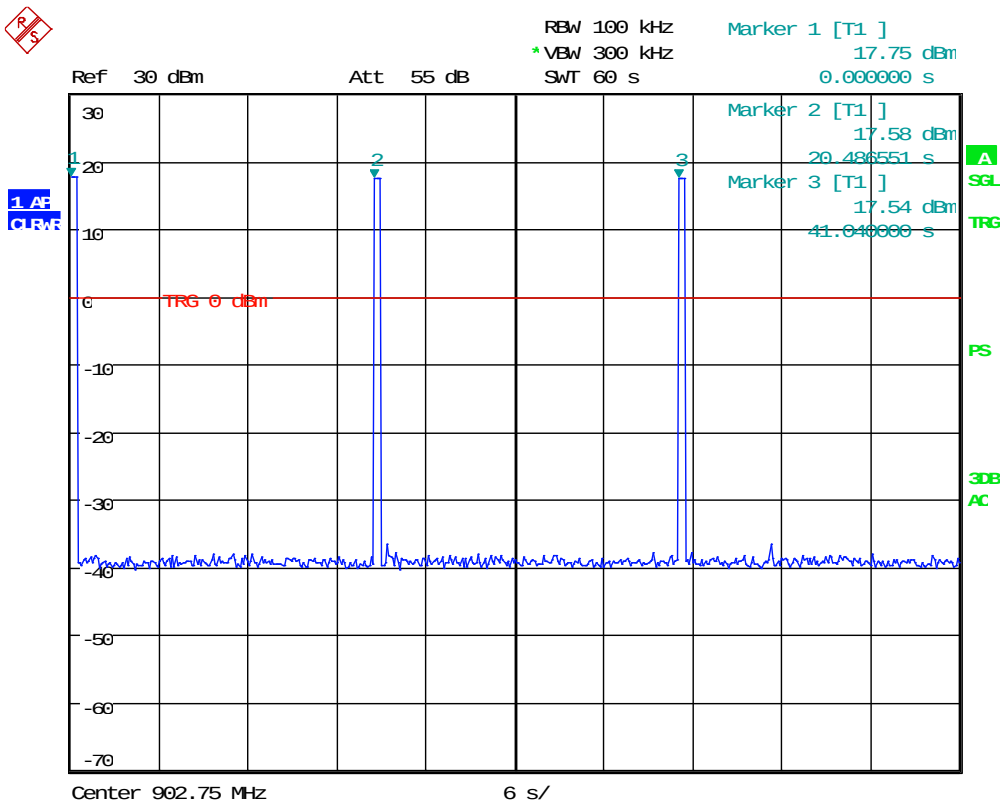
Test Date(s):	2023-04-24	Test Engineer:	J. Chiller
Standards:	ANSI 63.10 7.8.4	Air Temperature:	20.9ºC
		Relative Humidity:	39%

Length of Transmission



Transmission Duration = 390.39ms

Transmissions in 20 Seconds



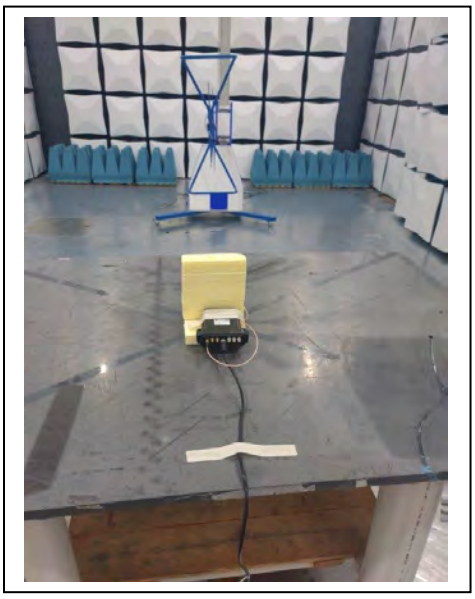
Date: 24.APR.2023 10:33:27

Time between Transmissions = 20.48 seconds
Dwell Limit: 400mS in 20-second period.
390.3mS transmission with 1 transmission in 20 seconds.
Total Dwell time /20 sec. = 390.3ms

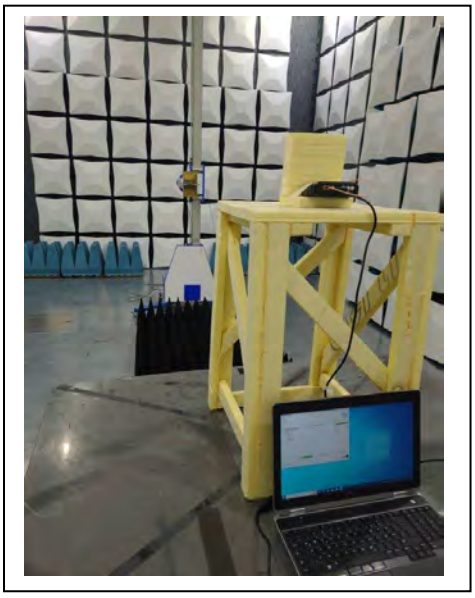
16 TEST SETUP PHOTOGRAPHS

Radiated Spurious Emissions: Loop Antenna

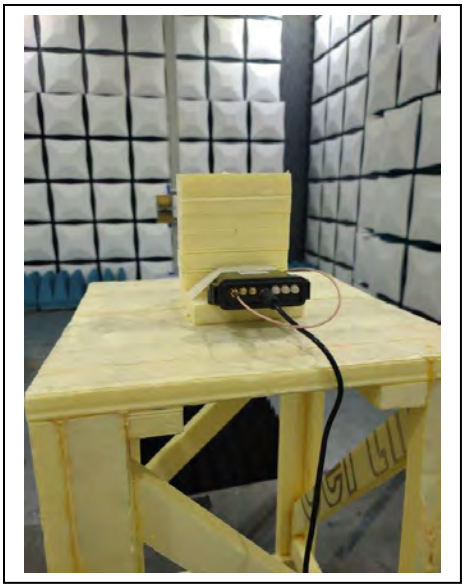
Radiated Spurious Emissions: Less Than 1 GHz



Radiated Spurious Emissions: Greater Than 1 GHz



Radiated Emissions Test Setup: Radio

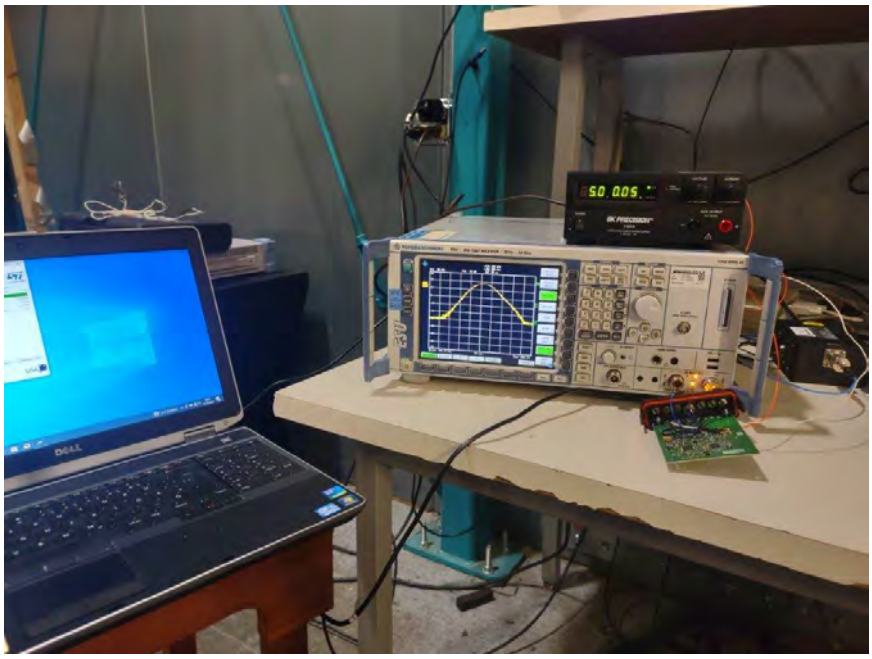


Radiated Emissions Test Setup: Antenna

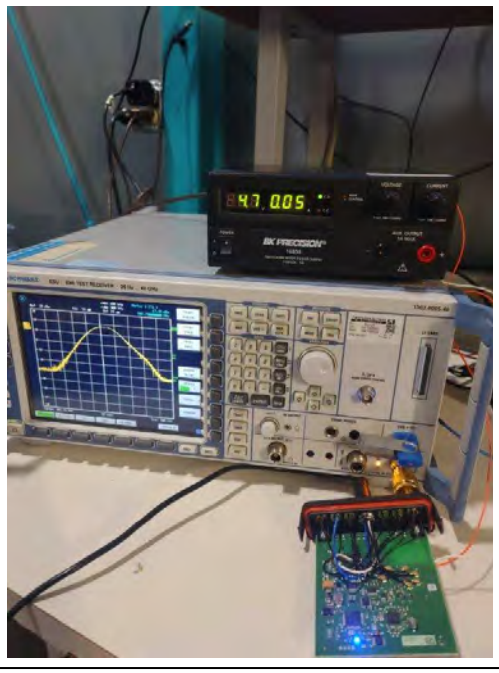
Conducted Test Setup: General

Conducted Test Setup: Radio

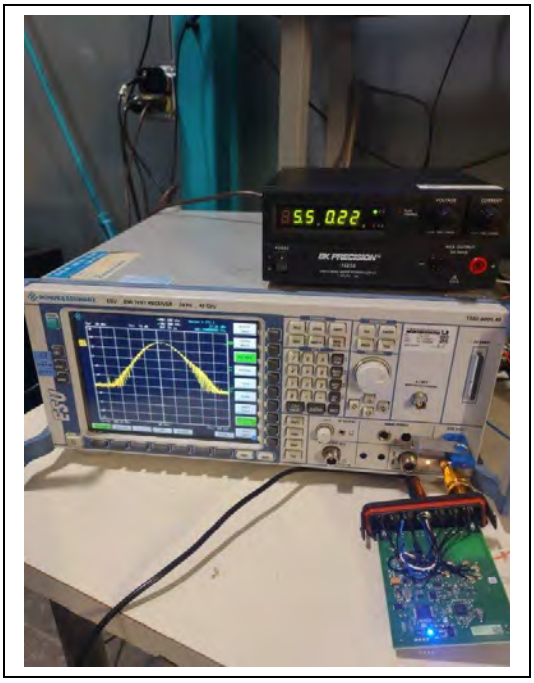
Voltage Variations Test Setup: General



Voltage Variations Test Setup: Low Voltage (4.7VDC)



Voltage Variations Test Setup: High Voltage (5.5VDC)



Voltage Variations Test Setup: Radio