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3/21/2024

HID Global Corporation (US)
6533 Flying Cloud Drive, Ste. 1000
Eden Prairie, MN 55344
USA

Dear Chris Armstrong,

Enclosed is the EMC test report for compliance testing of HID Global Corporation (US), Signo Tactile, tested to the requirements of:

- Title 47 of the CFR, Part 15.225, Subpart C for Certification as an Intentional Radiator.
- RSS-210: Issue 10, License-Exempt Radio Apparatus: Category 1 Equipment

Thank you for using the services of Eurofins E&E North America. If you have any questions regarding these results or if we can be of further service to you, please feel free to contact me.

Sincerely,

Nancy LaBrecque
Documentation Department
Eurofins Electrical and Electronic Testing NA, Inc.

Reference: WIRA129255 – FCC-IC-RFID-HF_R1

13.56MHz RFID
Test Report

for the

HID Global Corporation (US)
Signo Tactile (Model: 40T)

Tested under
the FCC Certification Rules
contained in
15.225 Subpart C and
RSS-210: Issue 10
for Intentional Radiators

Bryan Taylor, Wireless Team Lead
Electromagnetic Compatibility Lab

Nancy LaBrecque
Documentation Department

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.

Matthew Hinojosa
EMC Manager, Austin Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	1/23/2024	Initial Issue.
1	3/21/2024	Changes requested by HID

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Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the HID Global Corporation (US) Signo Tactile, with the requirements of Part 15, §15.225 and RSS-210 Issue10, Annex B, B.6. All references are to the most current version of Title 47 of the Code of Federal Regulations and RSS-210 in effect. The following data is presented in support of the Certification of the Signo Tactile. HID Global Corporation (US) should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Signo Tactile, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.225 and RSS-210, in accordance with HID Global Corporation (US), under purchase order number HID019245. All tests were conducted using measurement procedures ANSI C63.4-2014 and C63.10-2013.

FCC Reference	ISED Reference	Description	Compliance
Part 15 §15.203	---	Antenna Requirement	**Compliant**
Part 15 §15.207(a)	RSS-Gen (8.8)	Conducted Emission Limits	**Compliant**
Part 15 §15.215	---	20dB Occupied Bandwidth	**Compliant**
---	RSS-Gen (6.7)	99% Occupied Bandwidth	**Compliant**
Part 15 §15.225(a)	RSS-210 (B.6.a.i)	Field Strength emissions within the band 13.553 – 13.567 MHz	**Compliant**
Part 15 §15.225(b)	RSS-210 (B.6.a.ii)	Field Strength emissions within the band 13.410 – 13.553 MHz and 13.567 – 13.710 MHz	**Compliant**
Part 15 §15.225(c)	RSS-210 (B.6.a.iii)	Field Strength emissions within the band 13.110 – 13.410 MHz and 13.710 – 14.010 MHz	**Compliant**
Part 15 §15.225(d)	RSS-210 (B.6.a.iv)	Outside-Band Field Strength emissions per 15.209 - 13.110 – 14.010 MHz	**Compliant**
Part 15 §15.225(e)	RSS-210 (B.6.b)	Frequency Tolerance of the Carrier	**Compliant**

Table 1. Executive Summary

Equipment Configuration

A. Overview

Eurofins E&E North America was contracted by HID Global Corporation (US) to perform testing on the Signo Tactile.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the HID Global Corporation (US) Signo Tactile.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	40T (Pigtail and Terminal)	
Model(s) Covered:	40T (Pigtail and Terminal)	
EUT Specifications:	Primary Power: 12VDC	
	Type of Modulation(s):	ASK
	Equipment Code:	DXX
	Maximum field Strength:	83.76dBuV/m
	Antenna Type:	loop
	EUT Frequency Ranges:	13.56MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35° C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Bryan Taylor and Sergio Gutierrez	
Test Date(s):	10/24/2023 to 12/20/2023	

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
RSS-210 Issue 10	Licence-Exempt Radio Apparatus: Category I Equipment
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

C. Test Site

Eurofins MET Laboratories Inc. (Eurofins E&E North America) is part of the Eurofins Electrical & Electronics (E&E) global compliance network.

All testing was performed at Eurofins E&E North America, 13501 McCallen Pass, Austin, TX 78753. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

Correlation between semi-anechoic chamber and OATS:

Two calibrated Loop antennas were used on an OATS. One antenna was driven by a signal generator with a known power. The receive antenna was initially placed 1m away from the transmit antenna. The two antennas were placed parallel to each other. The receive antenna was in turn connected to a calibrated spectrum analyzer. The emissions were swept from 9 kHz to 30 MHz. The receive antenna was then rotated 90 degrees and measurements re-taken. Additional measurements were taken when the receive antenna was placed at 3meters.
This same setup was taken to inside the semi-anechoic chamber and the measurements repeated.

The data was used to correlate the semi-anechoic chamber and OATS.

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.97 dB	2	95%
RF Power Radiated Emissions	±2.95 dB	2	95%
Radiated Emissions, (30 MHz – 1 GHz)	±2.95	2	95%
Radiated Emissions, (1 GHz – 18 GHz)	±3.54	2	95%
Conducted Emission Voltage	±2.97	2	95%

Table 4. Uncertainty Calculations Summary

E. Description of Test Sample

The Signo Tactile (Model: 40T) is a smartcard reader typically installed near doorway as part of physical access system, to control access to that door. A user will approach the door and present a BLE or RFID credentials to the reader with intention of entering the door. The reader will read the credential and send its data to a connected access control panel, which determine whether or not grant the user access to the door. Optionally, a personal identification number (PIN) may also be required, in which case the user will enter the PIN on the reader's keypad.

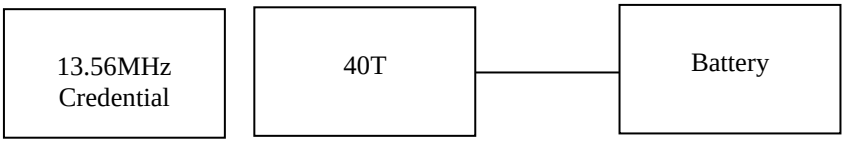


Figure 1. Block Diagram of Test Configuration

F. Equipment Configuration

The EUT was set up as outlined in Figure 1 above. The 13.56MHz Credential was placed in front of the Signo Tactile to force a continuous reading operation. Tests were performed with a sample configured with both a pluggable pigtail as well as a screw terminal wiring harness.

G. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	Customer Supplied Calibration Data
None	Laptop Computer	Lenovo	ThinkPad	None
None	Laptop Computer	Dell	NA	NA
None	12V Battery	Duracell	DURA12-8F2	None
None	13.56MHz RFID Credential	HID	13.56MHz HID Proximity Card	None
None	12V AC/DC Power Supply	Unknown	Unknown	None

Table 5. Support Equipment

H. Ports and Cabling Information

Port Name on EUT	Qty	Length as tested (m)	Shielded? (Y/N)	Termination Box ID & Port Name
DC Power Cable	1	2m	N	12V Battery
Wiring Harness	1	2m	Y	Laptop

Table 6. Ports and Cabling Information

I. Mode of Operation

The RF Credential was placed in front of the Signo Tactile in order to force continuous reading operations.

Transmit Band	Modulation	Channel Frequencies Tested	Exercising Method
13.56MHz	ASK	13.56MHz	13.56MHz RFID Credential

Table 7. Test Channels Utilized

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to HID Global Corporation (US) upon completion of testing.

Antenna Requirements

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The Signo Tactile as evaluated, was compliant as the antenna was permanently attached.

Test Engineer(s): Bryan Taylor

Test Date(s): 10/24/2023

Conducted Emissions

§ 15.207(a) Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** 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 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dBμV)	
	Quasi-Peak	Average
* 0.15 - 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

Table 8. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Note: *Decreases with the logarithm of the frequency.

RSS-GEN (8.8) AC Power-Line Conducted Emissions Limits

Test Requirement(s): **RSS-GEN (8.8):** Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in the below figure, as measured using a 50 µH / 50 Ω line impedance stabilization network (LISN). This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in the below figure shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Frequency (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
* 0.15-0.5	66 to 56	56 to 46[1]
0.5-5	56	46
5-30	60	50

Table 9. AC Power Line Conducted Emissions Limits

Note: *Decreases with the logarithm of the frequency.

Test Procedure: The EUT was placed on a 0.8 m-high non-conducting table above a ground plane. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 µH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10-2013 "Procedures for Compliance Testing of Unlicensed Wireless Devices"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 µH LISN as the input transducer to an EMI receiver.

Test Results: The Signo Tactile was compliant with this requirement. Testing was performed on the AC input to an AC to DC power supply that was feeding the 12VDC to the Signo Tactile.

Test Engineer(s): Michael Ermer

Test Date(s): 10/24/2023

Conducted Emissions Voltage Test Setup

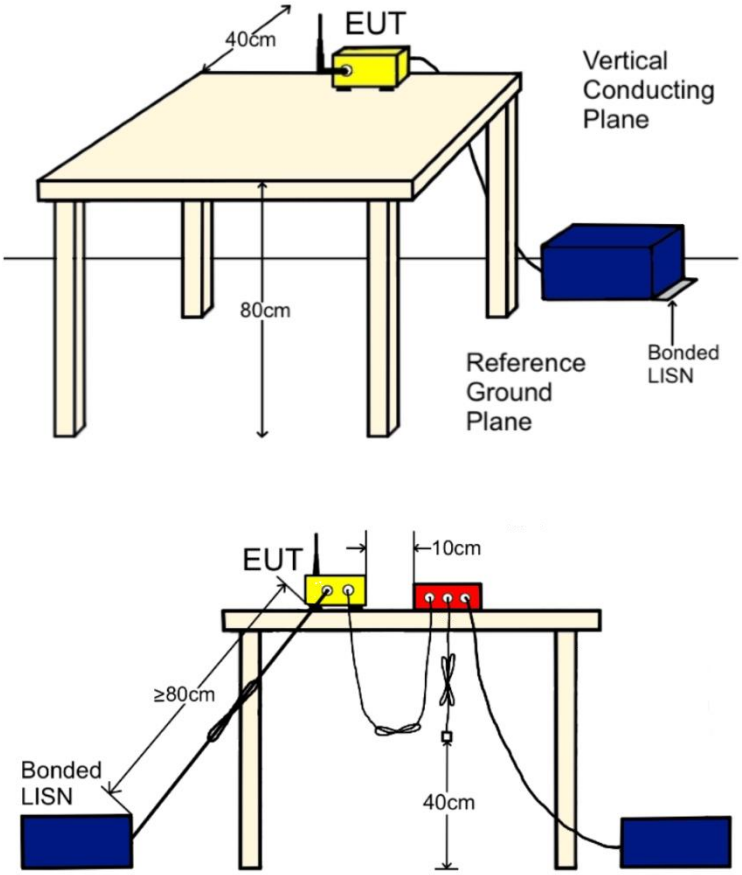
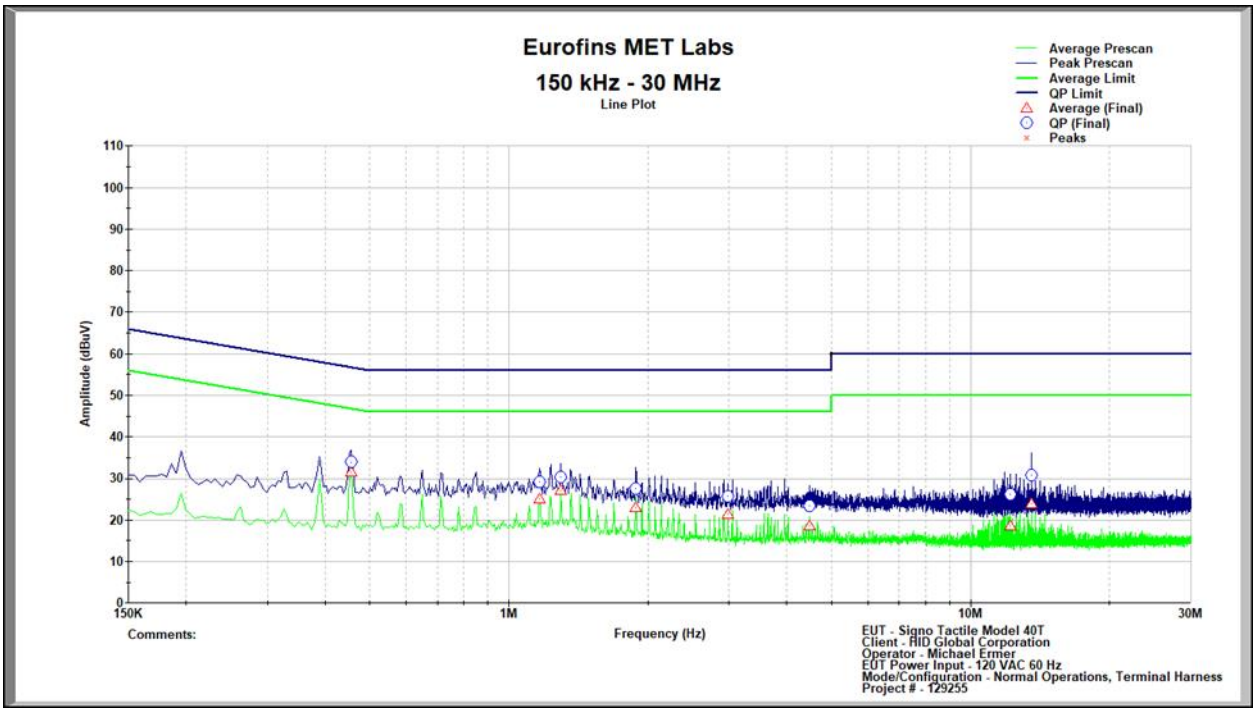


Figure 2. CEV Test Setup

15.207(a) Conducted Emissions Test Results

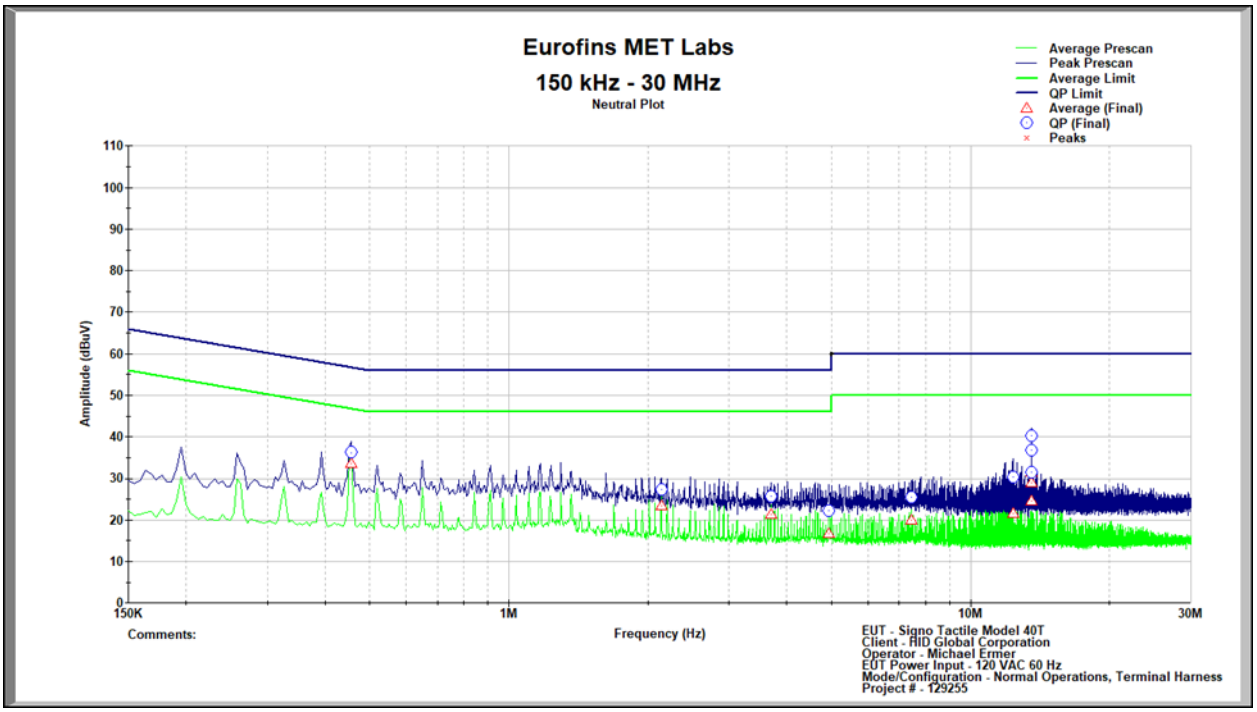


Conducted Emissions, 15.207(a), Phase

Frequency (MHz)	Quasi-Peak (dBµV)	Quasi-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.456	33.920	57.257	23.337	31.491	47.257	15.766
1.167	29.102	56.000	26.898	24.962	46.000	21.038
1.298	30.410	56.000	25.590	27.060	46.000	18.940
1.883	27.475	56.000	28.525	22.837	46.000	23.163
2.981	25.611	56.000	30.389	21.285	46.000	24.715
4.471	23.415	56.000	32.585	18.628	46.000	27.372
12.211	26.248	60.000	33.752	18.458	50.000	31.542
13.566	30.723	60.000	29.277	23.775	50.000	26.225

Table 10. Conducted Emissions, 15.207(a), Phase, Test Results

15.207(a) Conducted Emissions Test Results



Conducted Emissions, 15.207(a), Neutral

Frequency (MHz)	Quasi-Peak (dBµV)	Quasi-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.456	36.234	57.257	21.023	33.524	47.257	13.733
2.139	27.426	56.000	28.574	23.377	46.000	22.623
3.693	25.657	56.000	30.343	21.244	46.000	24.756
4.939	22.227	56.000	33.773	16.606	46.000	29.394
7.452	25.463	60.000	34.537	19.901	50.000	30.099
12.342	30.426	60.000	29.574	21.472	50.000	28.528
13.557	36.905	60.000	23.095	28.850	50.000	21.150
13.562	40.181	60.000	19.819	31.488	50.000	18.512
13.566	31.434	60.000	28.566	24.593	50.000	25.407

Table 11. Conducted Emissions, 15.207(a), Neutral, Test Results

Occupied Bandwidth Measurements

§ 15.215(c) 20 dB Occupied Bandwidth

Test Requirement(s): **§ 15.215 (c)** Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer. Per ANSI C63.10: 2020 the RBW should be between 1% and 5% of the occupied bandwidth. Due to the nature of the fundamental transmission being very "CW like" it was not possible to meet the RBW requirement. During the measurement the RBW was therefore set as narrow as possible. The 20 dB Bandwidth was measured and recorded.

Test Results: The Signo Tactile was compliant with this requirement. The 20dB Bandwidth is shown on the plots on the following pages.

Test Engineer(s): Bryan Taylor

Test Date(s): 10/23/2023 – 10/24/2023

RSS-GEN (6.7) 99% Occupied Bandwidth

Test Requirements: The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

Test Procedure: The EUT was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer. Per ANSI C63.10: 2020 the RBW should be between 1% and 5% of the occupied bandwidth. Due to the nature of the fundamental transmission being very "CW like" it was not possible to meet the RBW requirement. During the measurement the RBW was therefore set as narrow as possible. The 99% Bandwidth was measured and recorded.

Test Results The Signo Tactile was compliant with this requirement. The 99% Bandwidth is shown on the plots on the following pages.

Test Engineer(s): Bryan Taylor

Test Date(s): 10/23/2023 – 10/24/2023

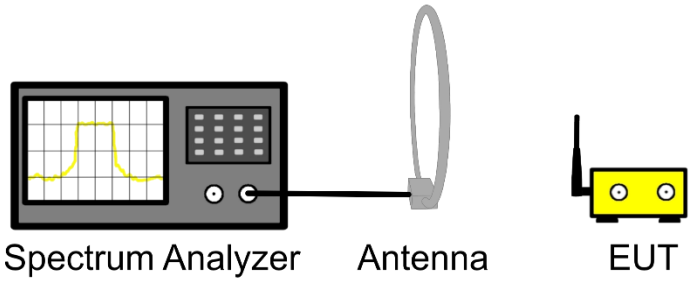
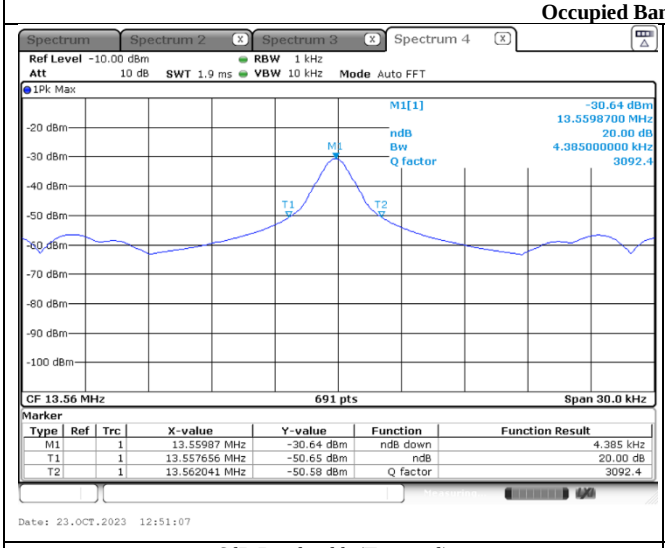


Figure 3. 20 dB Bandwidth and 99% Bandwidth Test Setup

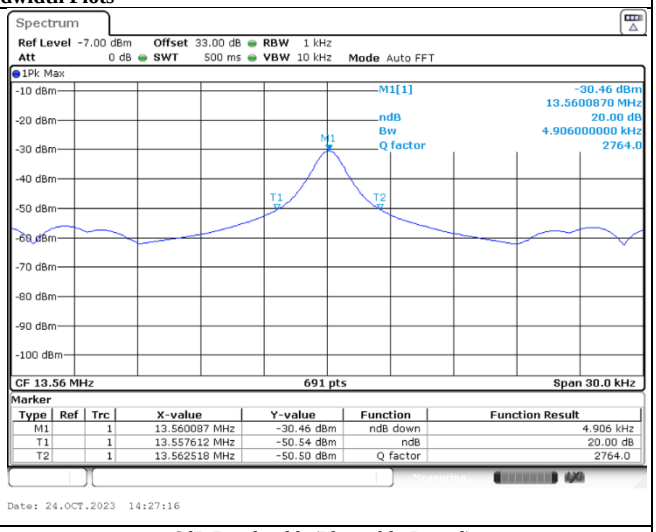
Wiring Harness Type Tested	Center Frequency (MHz)	6dB Bandwidth	20 dB Bandwidth	99% Bandwidth
Terminal	13.56MHz	1.476kHz	4.385kHz	6.555kHz
Pluggable Pigtail	13.56MHz	1.520kHz	4.906kHz	7.998kHz

Table 12. Occupied Bandwidth Test Results

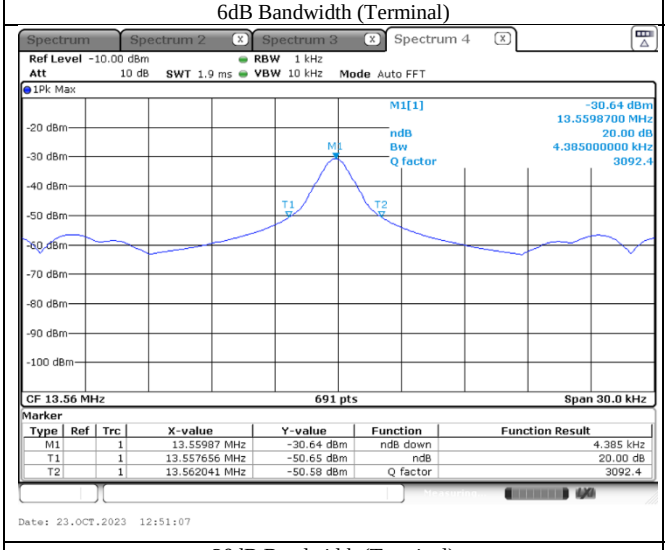
Occupied Bandwidth Plots



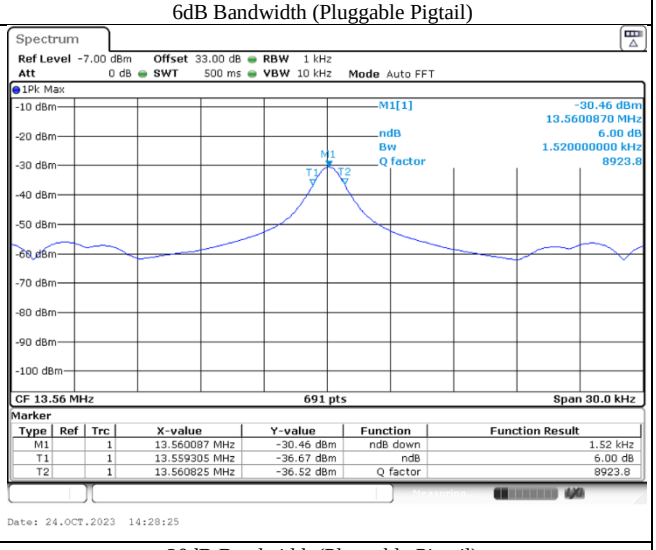
6dB Bandwidth (Terminal)



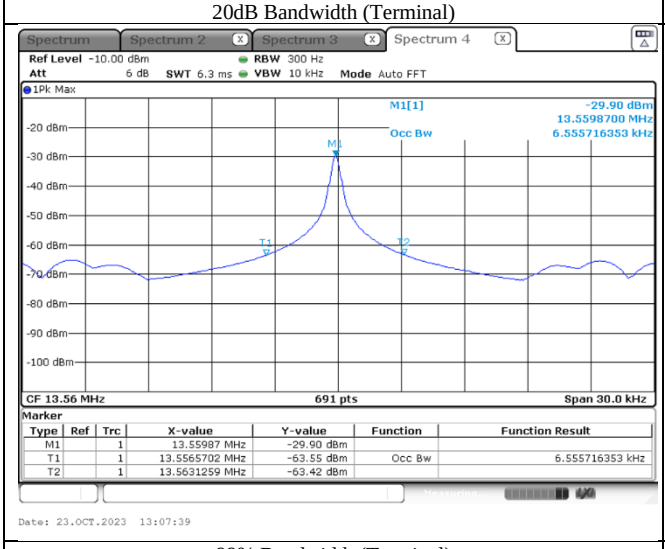
6dB Bandwidth (Pluggable Pigtail)



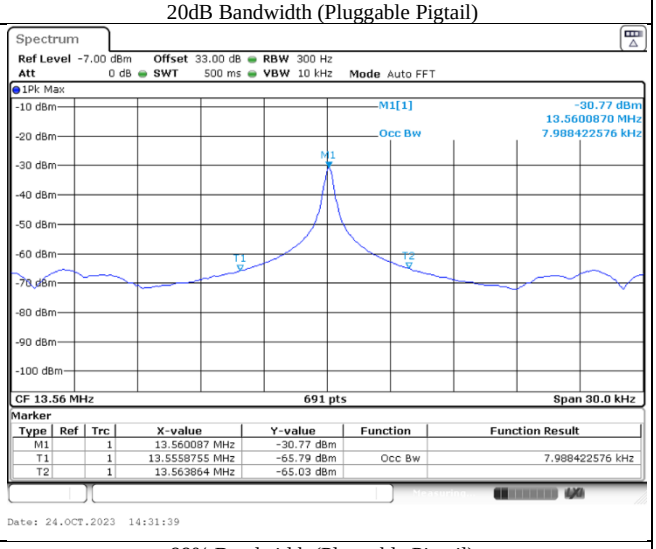
20dB Bandwidth (Terminal)



20dB Bandwidth (Pluggable Pigtail)



99% Bandwidth (Terminal)



99% Bandwidth (Pluggable Pigtail)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.225(a-d) Field Strength of Radiated Emissions

Test Requirement(s):

15.225 (a) The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

15.225 (b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

15.225 (c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

15.225 (d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

RSS-210 (B.6.a(ii - iv)) Field Strength of Radiated Emissions

Test Requirement(s):

RSS-210 (B.6.a(i)) The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15.848 mV/m (84 dBµV/m) at 30 meters.

RSS-210 (B.6.a(ii)) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 µV/m (50.5 dBµV/m) at 30 meters.

RSS-210 (B.6.a(iii)) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 µV/m (40.5 dBµV/m) at 30 meters.

RSS-210 (B.6.a(iv)) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in RSS-GEN Section 8.9.

Test Procedure:

The EUT was set to transmit and placed on a 0.8 m-high wooden stand inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.10: 2013 were used. For measurements below 30 MHz a loop antenna placed 3m away from the unit was used. For measurements above 30 MHz a biconalog antenna placed 10 m away from the unit was used. Measurements below 30 MHz were conducted with the loop antenna at coaxial (parallel) and planar (perpendicular) orientations. Measurements above 30 MHz were conducted with the biconalog antenna in the vertical and horizontal polarizations. A peak detector was used to perform a pre-scan from 9 kHz to 10 times the fundamental frequency. Spurious emissions within 20 dB of the applicable limit were measured using a quasi-peak detector and recorded in the subsequent section. Peak emissions that were observed over the appliable limit were determined to be digital emissions subject to the requirements of FCC Part 15 Subpart B and ICES-003 subsection 6.2 for Class A devices.

The measurements were made at 3 m with the loop antenna (below 30MHz). They were then extrapolated to 30m or 300 m using the following correction factors which were applied to the limit.

40log (30/3) = 40 dB
40log (300/3) = 80 dB

The measurements made at 10 m with the biconilog antenna (above 30MHz) were then extrapolated to the 3m using the following correction factor.

20log (10/3) = +10.46 dB

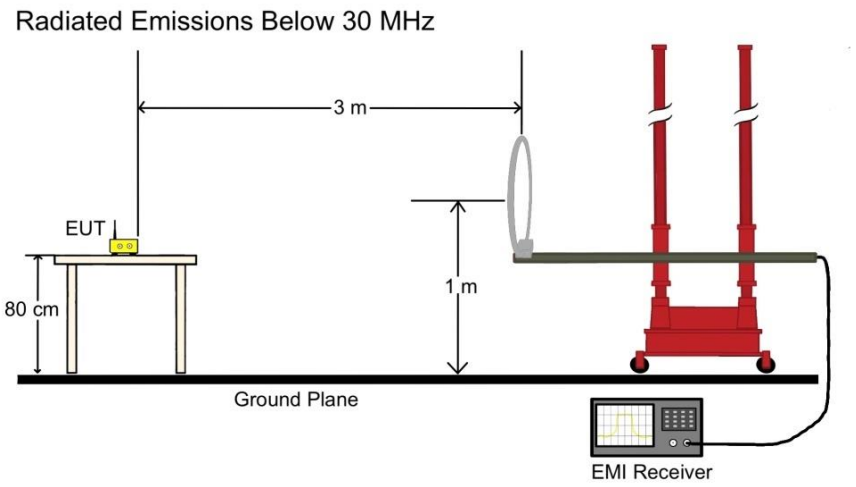


Figure 4: Radiated Emissions (Below 30MHz), Test Setup

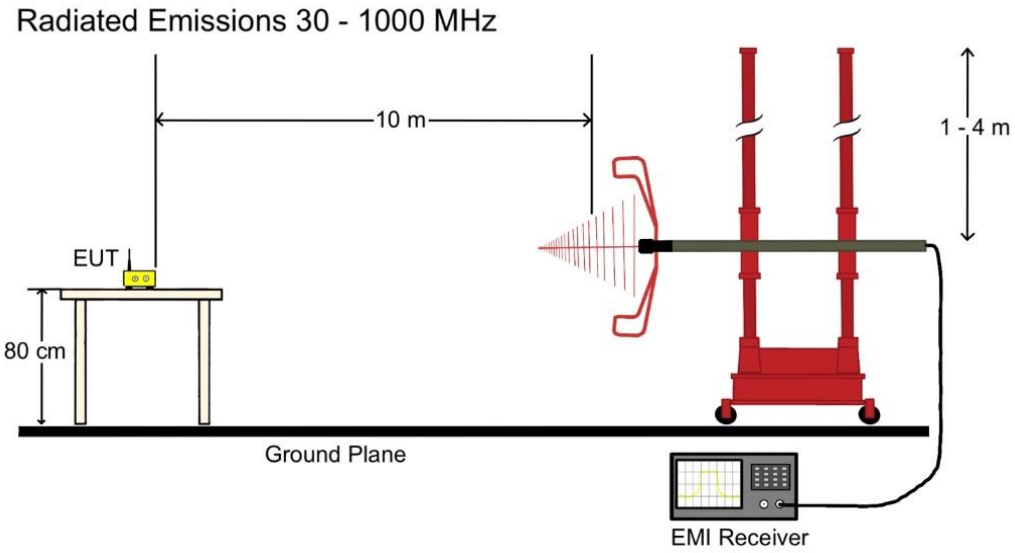


Figure 5. Radiated Emissions (Above 30MHz), Test Setup

Test Results: The Signo Tactile was compliant with the requirements of **§15.225(a - d)** and **RSS-210 RSS-210 (B.6.a(i, ii, iii, and iv))**.

Test Engineer(s): Sergio Gutierrez and Michael Ermer

Test Date(s): 10/25/2023 - 10/27/2023

Radiated Field Strength Test Results

Frequency [MHz]	Peak Level [dBµV/m] [1]	Limit [dBµV/m]	Margin [dB]	Correction [dB] [2]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
13.349	58.49	80.50	22.01	10.62	H	261	1	9.000	Pass
13.349	61.19	80.50	19.31	10.62	V	315.3	1	9.000	Pass
13.508	60.71	90.50	29.79	10.61	H	253.6	1	9.000	Pass
13.535	68.25	90.50	22.25	10.61	V	344.5	1	9.000	Pass
13.560	83.76	124.00	40.24	10.61	H	184.3	1	9.000	Pass
13.560	73.55	124.00	50.45	10.61	V	285.3	1	9.000	Pass
13.583	68.13	90.50	22.37	10.61	V	345.3	1	9.000	Pass
13.585	63.10	90.50	27.4	10.61	H	265.6	1	9.000	Pass
13.772	54.46	80.50	26.04	10.60	H	250.9	1	9.000	Pass
13.772	58.01	80.50	22.49	10.60	V	225	1	9.000	Pass

Figure 6. Worst Case In-Band Field Strength (Terminal)

Frequency [MHz]	Peak Level [dBµV/m][1]	Limit [dBµV/m]	Margin [dB]	Correction [dB][2]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
0.025	57.60	119.63	62.03	14.10	V	48.5	1	0.200	Pass
0.025	58.91	119.61	60.71	14.10	H	288.6	1	0.200	Pass
0.113	39.62	106.56	66.95	11.36	H	250.6	1	0.200	Pass
0.126	39.04	105.62	66.58	11.31	H	76.5	1	0.200	Pass
0.126	37.53	105.62	68.09	11.31	V	326.7	1	0.200	Pass
0.138	36.17	104.77	68.61	11.41	H	276.6	1	0.200	Pass

Figure 7. Worst Case Field Strength Below 30MHz (Terminal)

Frequency [MHz]	QPK Level [dBµV/m] [1]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB] [2]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
122.04	22.12	33.07	10.95	-7.56	V	31.9	2.19	120.000	Pass
189.84	24.81	33.07	8.26	-10.16	V	79.6	1.09	120.000	Pass
189.84	18.71	33.07	14.36	-10.16	H	272.6	3.98	120.000	Pass

Figure 8. Worst Case Field Strength Above 30MHz (Terminal)

[1] This corrected level includes the factor shown in the "correction" column. The corrected level = Raw Reading + Correction Factor. The raw reading is not shown in the table above.
[2] This correction factor includes cable loss in dB, preamplifier gain in dB, and an electric field antenna factor in (dB/m).

Frequency [MHz]	Peak Level [dBµV/m] [3]	Limit [dBµV/m]	Margin [dB]	Correction [dB] [4]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
13.349	57.54	80.50	22.96	10.62	H	225	1	V	Pass
13.546	60.60	80.5	19.9	10.62	V	272	1	H	Pass
13.508	62.33	90.50	28.17	10.61	V	275	1	V	Pass
13.535	65.65	90.50	24.85	10.61	H	315	1	H	Pass
13.560	81.07	124.00	42.93	10.61	H	315	1	H	Pass
13.560	66.54	124.00	57.46	10.61	V	196	1	V	Pass
13.585	65.34	90.50	25.16	10.61	H	315	1	H	Pass
13.585	62.50	90.50	28.00	10.61	V	268	1	V	Pass
13.772	59.79	80.50	20.71	10.60	H	343	1	H	Pass
13.772	50.89	80.50	29.61	10.60	V	225	1	V	Pass

Figure 9. Worst Case In-Band Field Strength (Pluggable Pigtail)

Frequency [MHz]	Peak Level [dBµV/m][3]	Limit [dBµV/m]	Margin [dB]	Correction [dB][4]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
0.025	56.30	119.61	63.31	14.10	V	66	1	0.200	Pass
0.110	45.27	106.76	61.49	11.38	H	285.5	1	0.200	Pass
0.113	36.39	106.56	70.17	11.36	V	21.8	1	0.200	Pass
0.126	40.47	105.62	65.15	11.31	H	137.1	1	0.200	Pass
0.126	38.19	105.62	67.43	11.31	V	339.4	1	0.200	Pass

Figure 10. Worst Case Field Strength Below 30MHz (Pluggable Pigtail)

Frequency [MHz]	QPK Level [dBµV/m] [3]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB] [4]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
162.720	20.35	33.07	12.72	-9.47	H	95.5	3.85	120.000	Pass
176.280	25.14	33.07	7.93	-9.93	V	224.9	2.61	120.000	Pass
181.320	16.29	33.07	16.78	-10.09	V	241.2	2.43	120.000	Pass
189.840	19.56	33.07	13.51	-10.16	V	181	3.69	120.000	Pass

Figure 11. Worst Case Field Strength Above 30MHz (Pluggable Pigtail)

[3] This corrected level includes the factor shown in the "correction" column. The corrected level = Raw Reading + Correction Factor. The raw reading is not shown in the table above.
[4] This correction factor includes cable loss in dB, preamplifier gain in dB, and an electric field antenna factor in (dB/m).

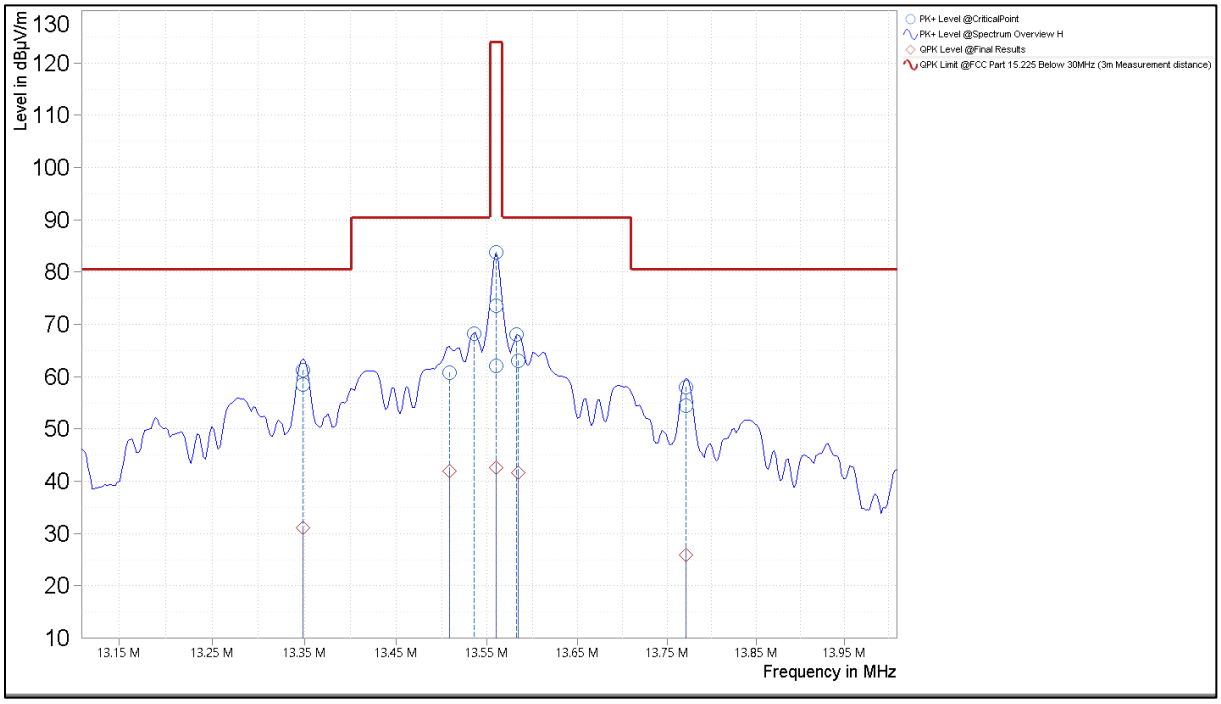


Figure 12. In-Band Emission Mask (Coplanar Loop, Terminal)

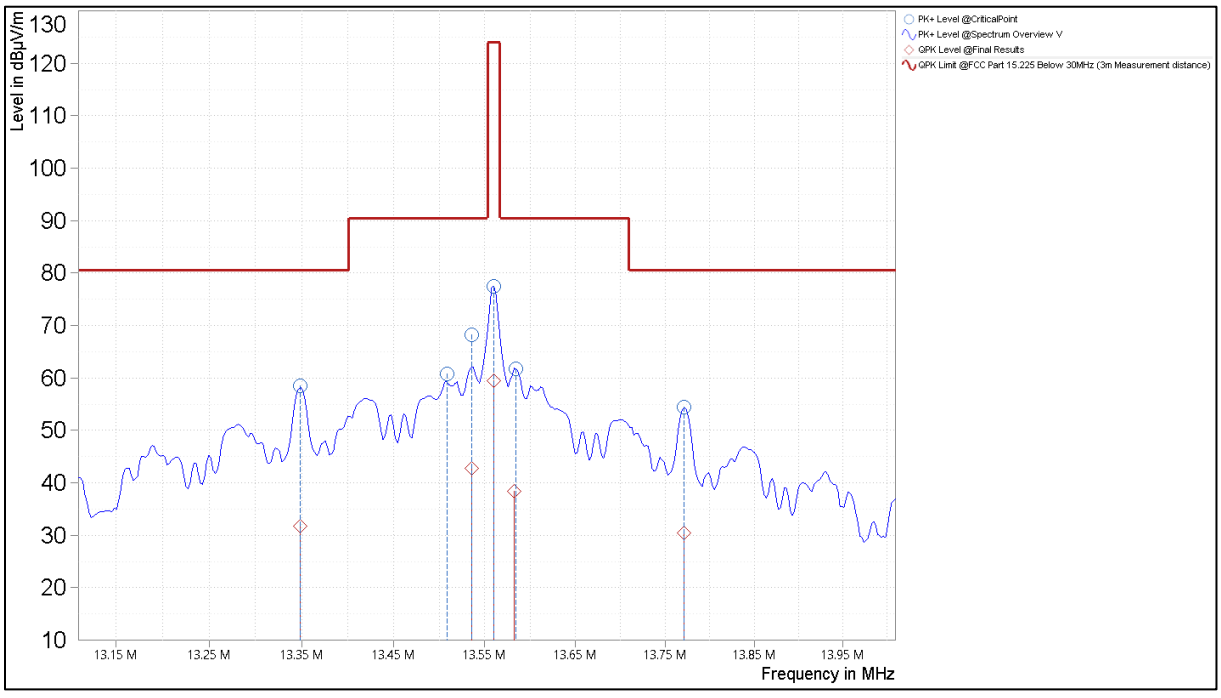


Figure 13. In-Band Emission Mask (Coaxial Loop, Terminal)

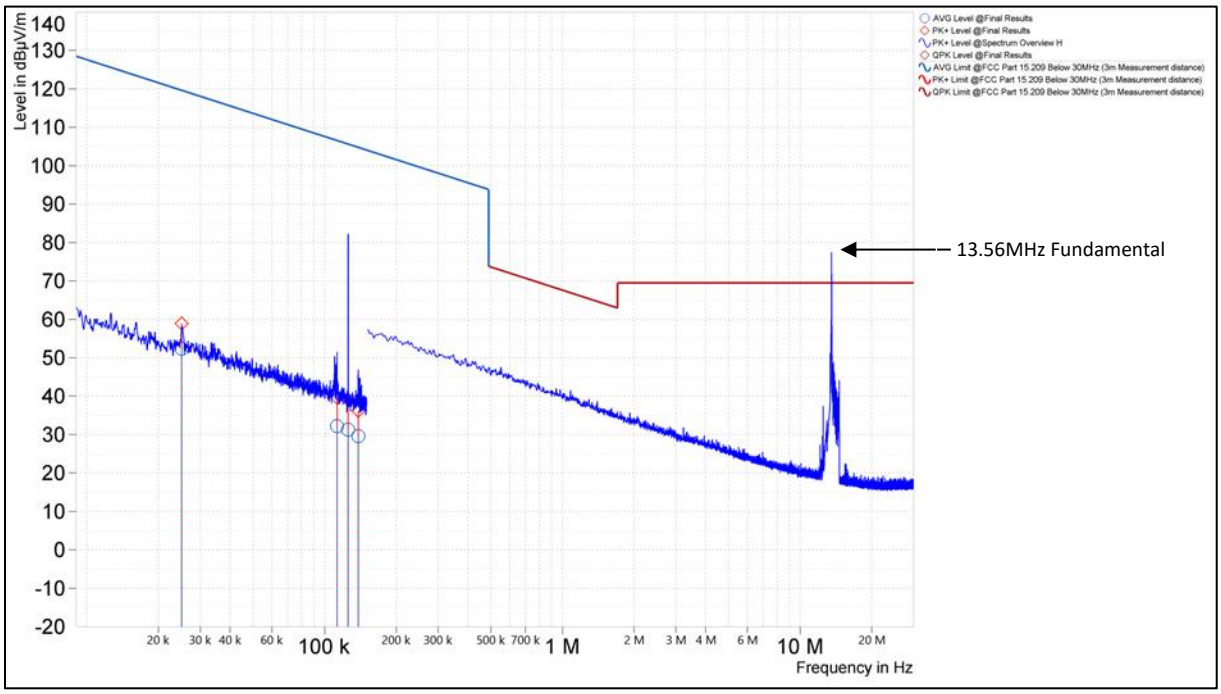


Figure 14. Out of Band Emissions Below 30MHz (Coplanar Loop, Terminal)

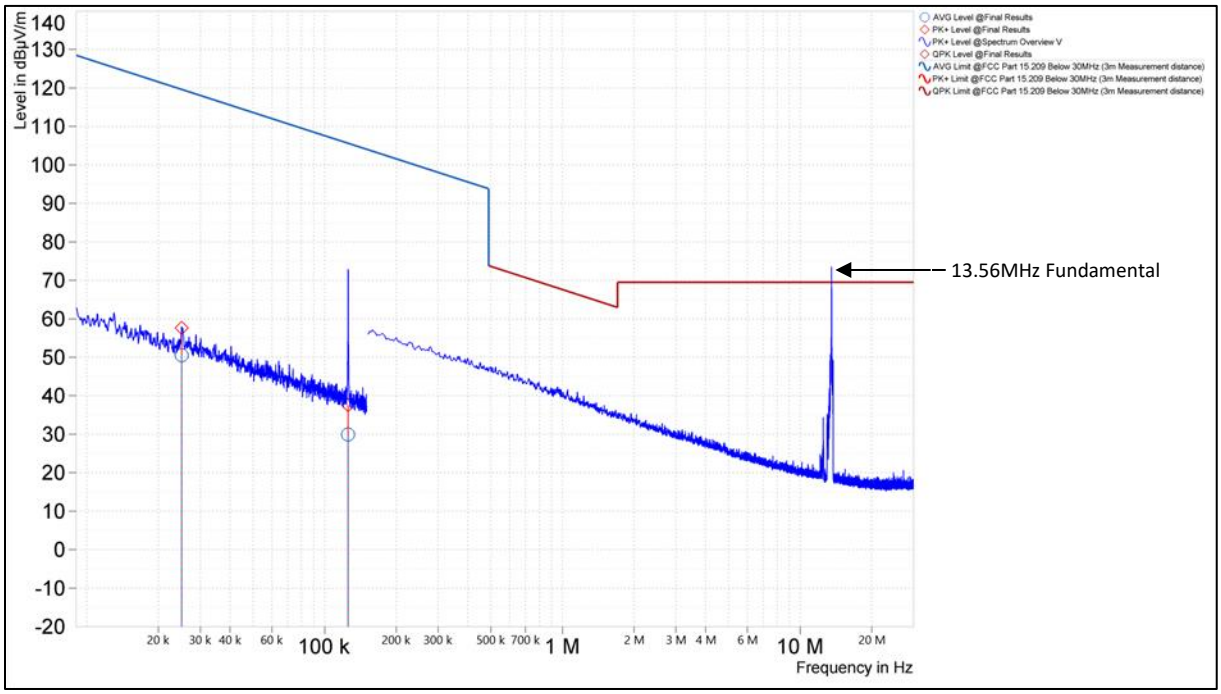


Figure 15. Out of Band Emissions Below 30MHz (Coaxial Loop, Terminal)

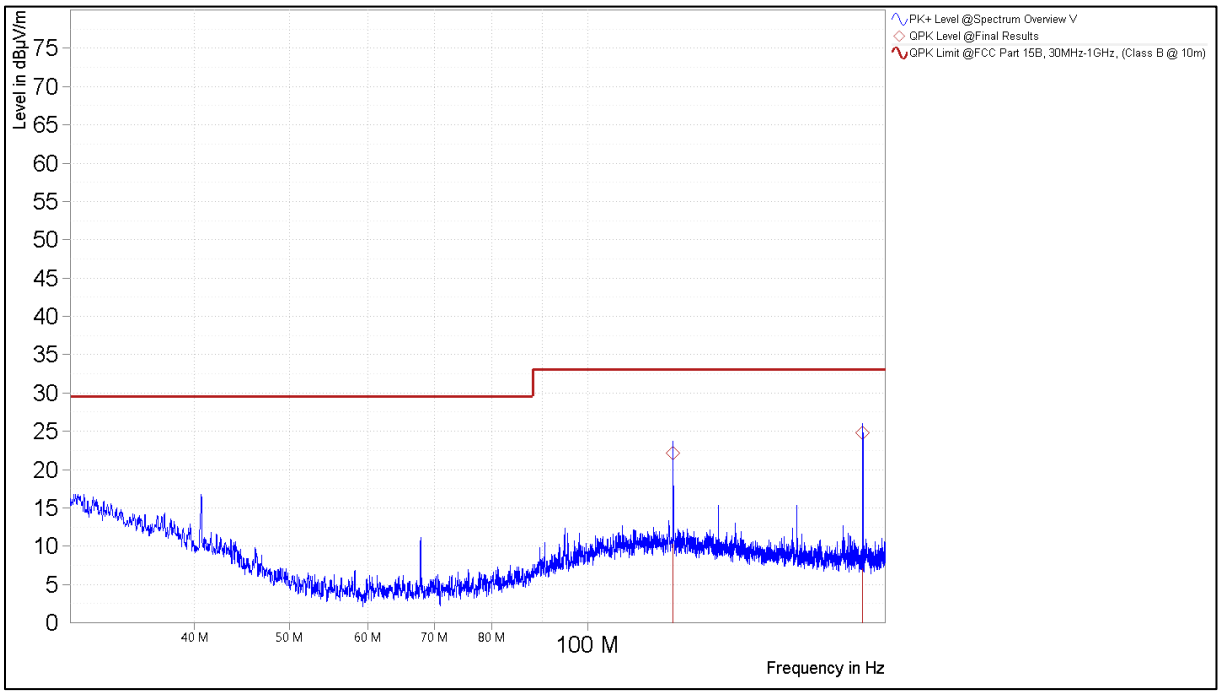


Figure 16. Out of Band Emissions Above 30MHz (Vertical Polarity, Terminal)

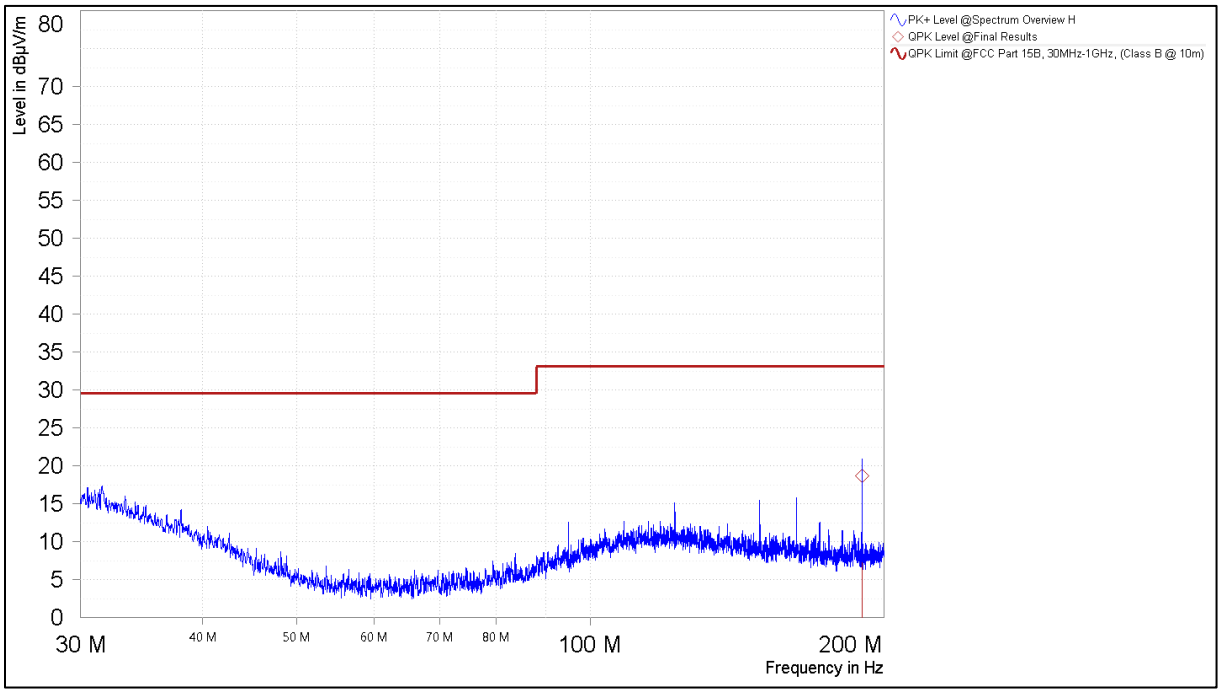


Figure 17. Out of Band Emissions Above 30MHz (Horizontal Polarity, Terminal)

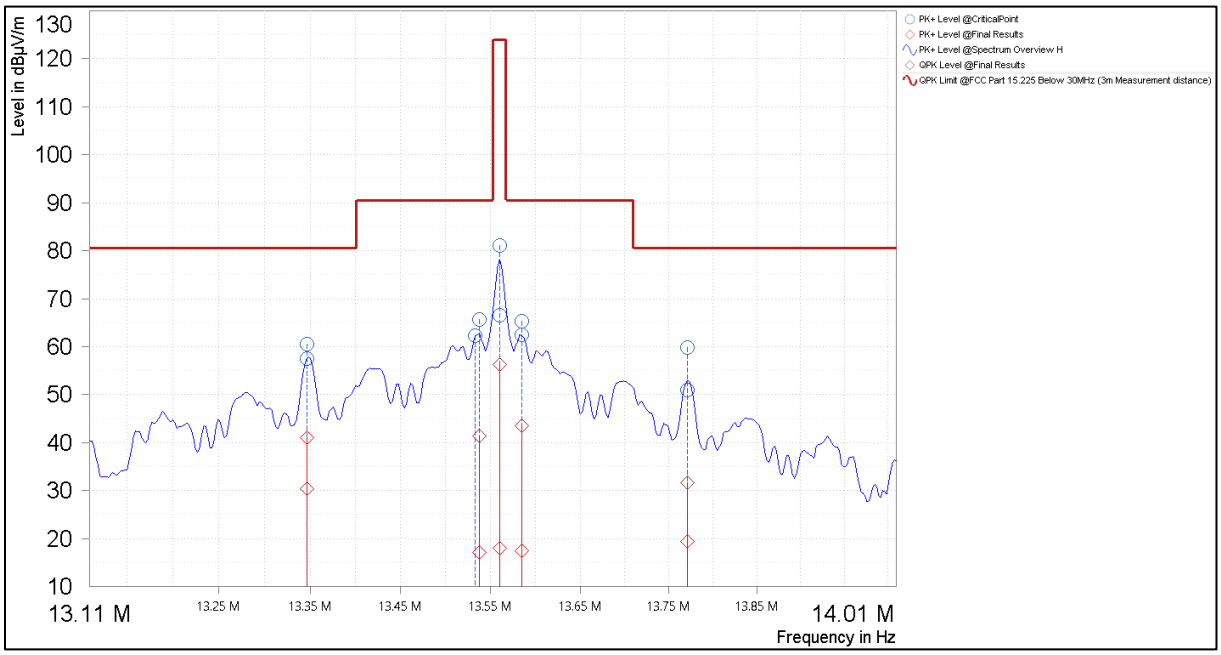


Figure 18. In-Band Emission Mask (Coplanar Loop, Pluggable Pigtail)

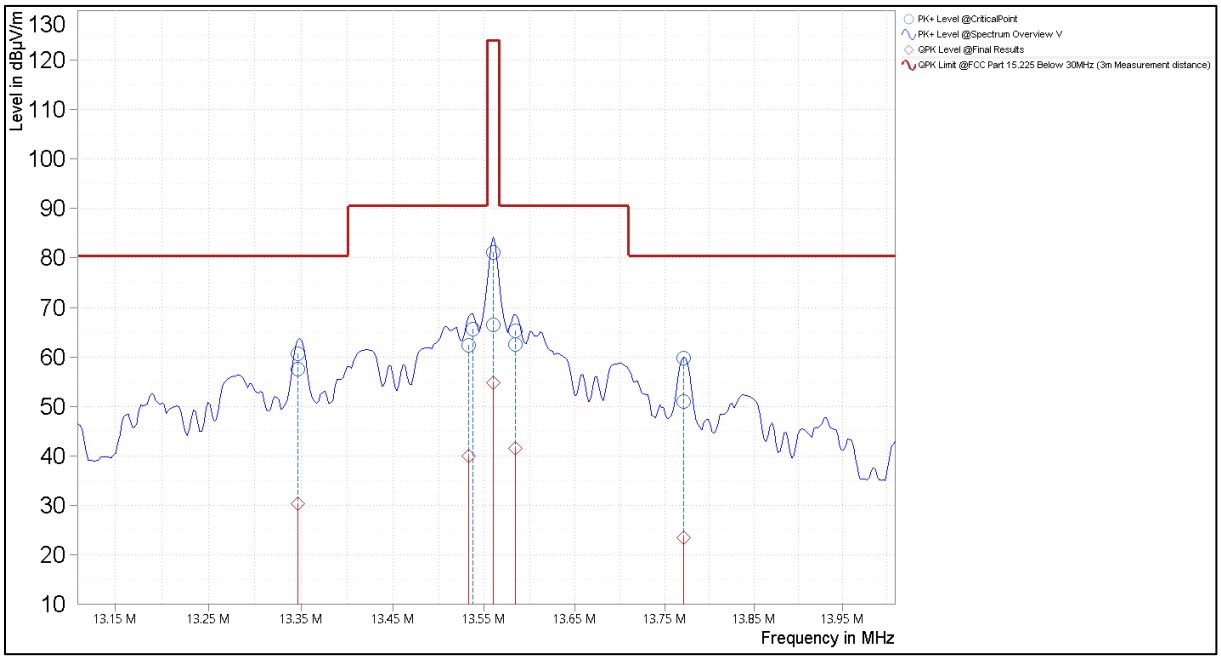


Figure 19. In-Band Emission Mask (Coaxial Loop, Pluggable Pigtail)

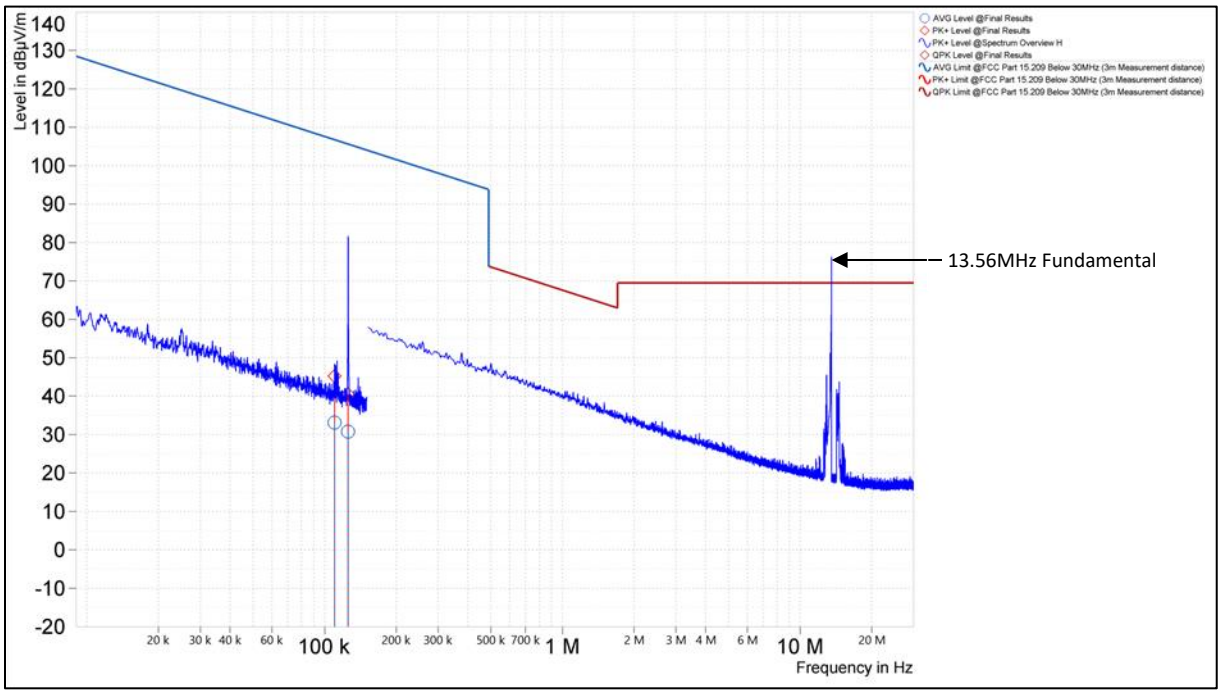


Figure 20. Out of Band Emissions Below 30MHz (Coplanar Loop, Pluggable Pigtail)

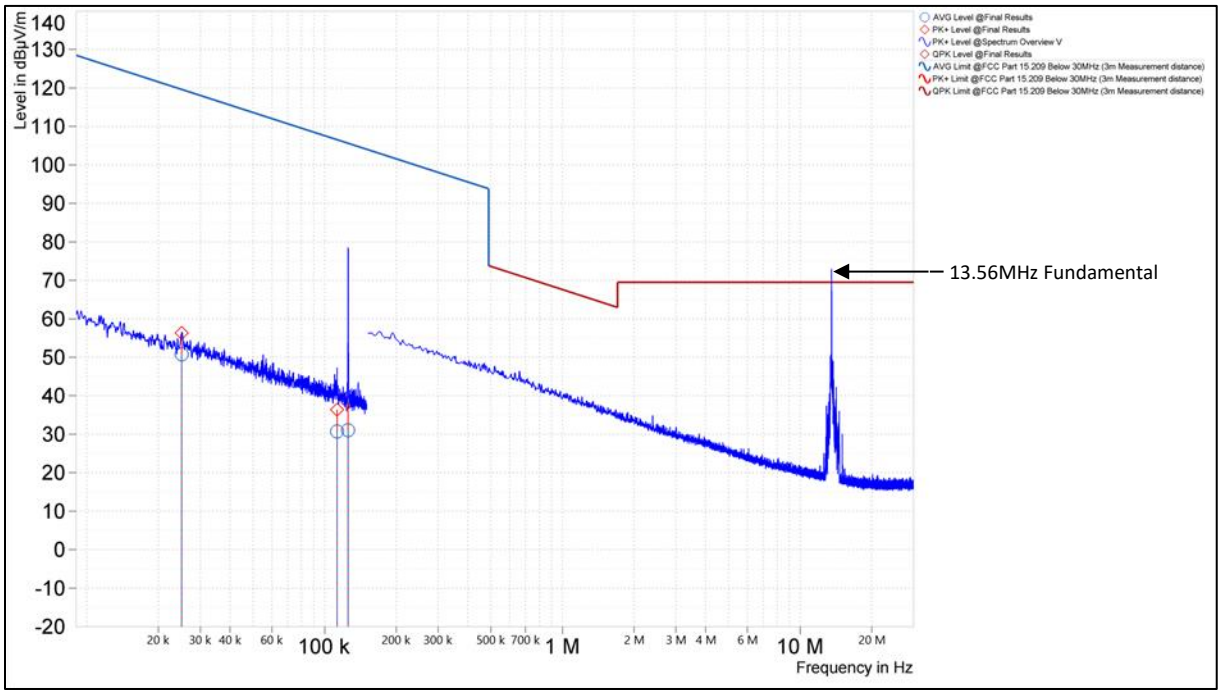


Figure 21. Out of Band Emissions Below 30MHz (Coaxial Loop, Pluggable Pigtail)

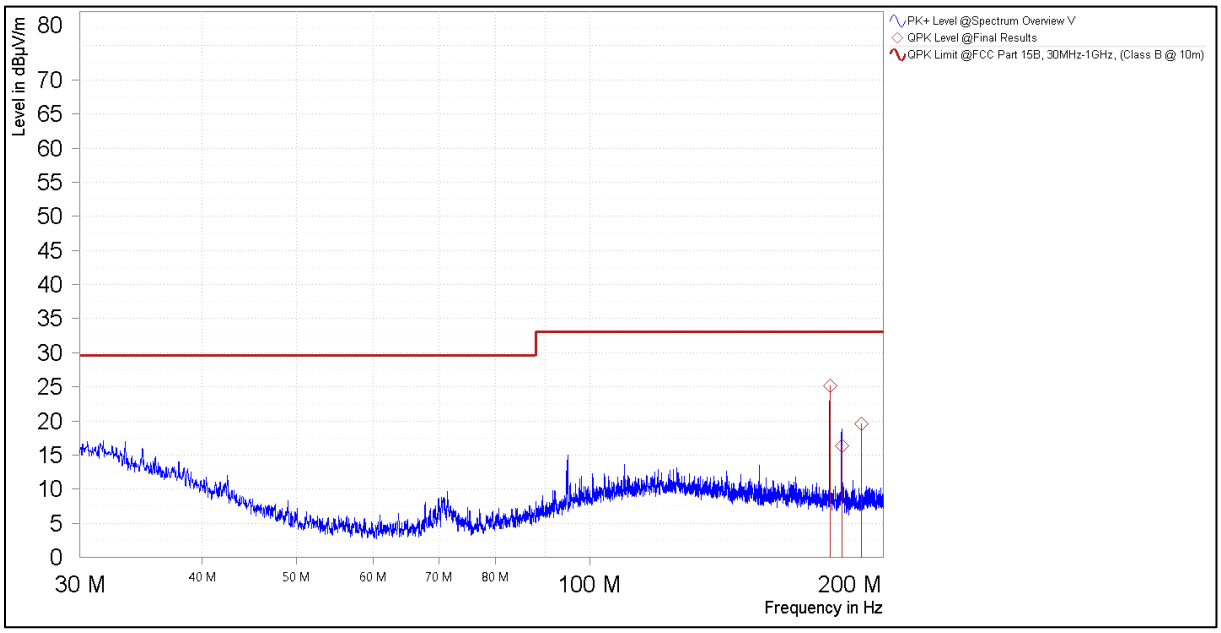


Figure 22. Out of Band Emissions Above 30MHz (Vertical Polarity, Pluggable Pigtail)

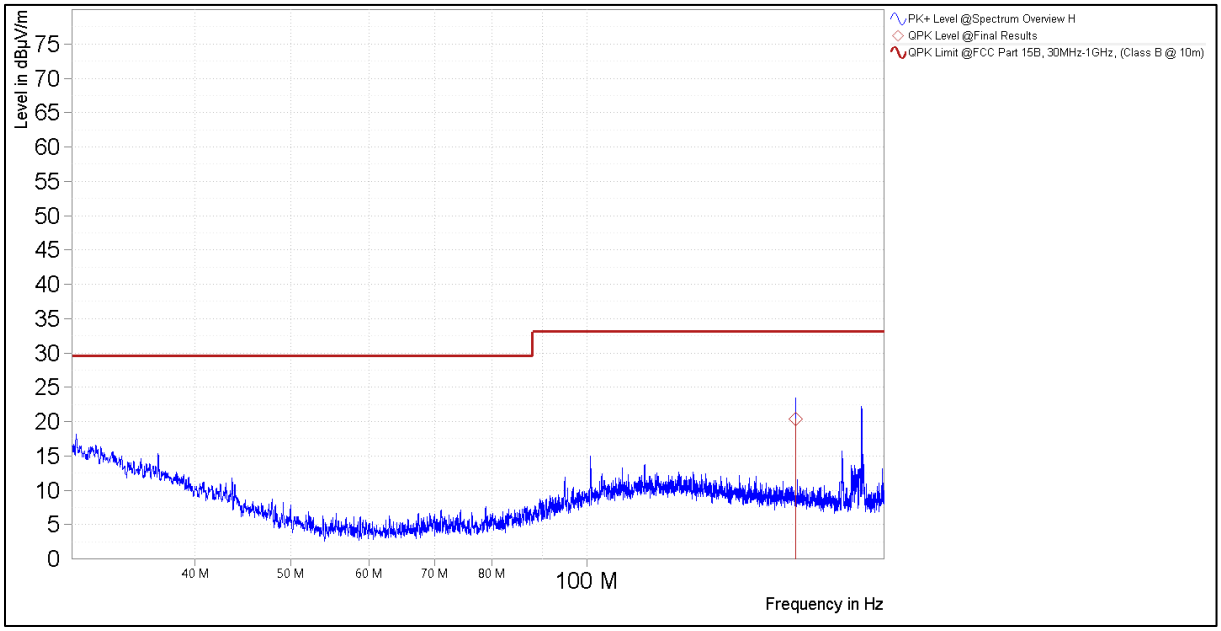


Figure 23. Out of Band Emissions Above 30MHz (Horizontal Polarity, Pluggable Pigtail)

Electromagnetic Compatibility Criteria for Intentional Radiators

Frequency Stability

Test Requirement(s): **15.225(e)** The frequency tolerance of the carrier signal shall be maintained within +/-0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

RSS-210 (B.6.b) The frequency tolerance of the carrier signal shall be maintained within +/-0.01% (± 100 ppm) of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Test Procedure: Measurements are in accordance with section 6.8 of ANSI C63.10. The EUT was placed in the Environmental Chamber and allowed to reach desired temperature. A spectrum analyzer was connected to a magnetic field loop antenna and used to measure the frequency drift via a radiated path measurement. The EUT was set to transmit in the operating frequency range. Frequency drift was investigated for the extreme temperatures and nominal temperature, until the unit is stabilized then recorded the reading in tabular format with the temperature range of -20º to 50ºC. The frequency stability tests were performed with the use of a DC power supply powering the product.

Test Results: The Signo Tactile was compliant with Part 15.225 (e) and RSS-210 (B.6.b) requirement(s) of this section.

Test Engineer(s): Bryan Taylor

Test Date(s): 10/24/2023 – 10/25/2024

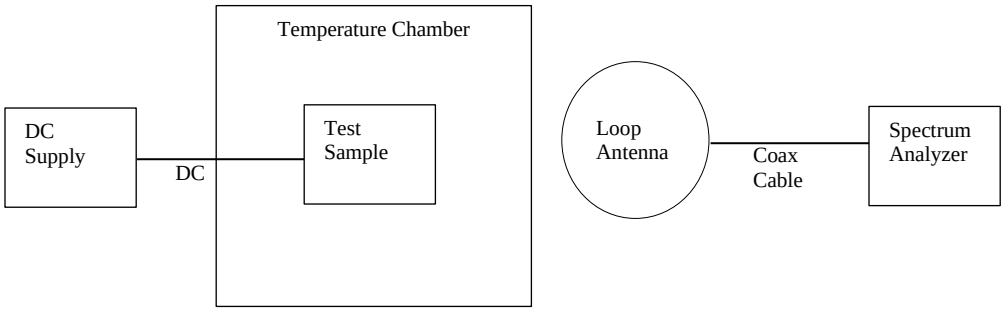


Figure 24. Temperature Stability Test Setup

Operating Freqeuncy:	13,560,000	Hz
Reference Voltage:	12	VDC
Deviation Limit:	0.01	%

Voltage %	Voltage (VDC)	Temp (°C)	Measured Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	Limit (%)
100%	12	-30	13,560,102	102	0.0008	0.01
100%	12	-20	13,560,099	99	0.0007	0.01
100%	12	-10	13,560,094	94	0.0007	0.01
100%	12	0	13,560,047	47	0.0003	0.01
100%	12	10	13,559,988	-12	-0.0001	0.01
100%	12	20	13,559,927	-73	-0.0005	0.01
100%	12	30	13,559,903	-97	-0.0007	0.01
100%	12	40	13,559,848	-152	-0.0011	0.01
100%	12	50	13,559,831	-169	-0.0012	1.01
100%	12	55	13,559,829	-171	-0.0013	0.01
115%	13.8	20	13,559,931	-69	-0.0005	0.01
85%	10.2	20	13,559,922	-78	-0.0006	0.01

Figure 25. Frequency Stability Test Results (Terminal)

Operating Freqeuncy:	13,560,000	Hz
Reference Voltage:	12	VDC
Deviation Limit:	0.01	%

Voltage %	Voltage (VDC)	Temp (°C)	Measured Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	Limit (%)
100%	12	-30	13,560,083	83	0.0006	0.01
100%	12	-20	13,560,098	98	0.0007	0.01
100%	12	-10	13,560,089	89	0.0007	0.01
100%	12	0	13,560,069	69	0.0005	0.01
100%	12	10	13,560,024	24	0.0002	0.01
100%	12	20	13,559,975	-25	-0.0002	0.01
100%	12	30	13,559,916	-84	-0.0006	0.01
100%	12	40	13,559,852	-148	-0.0011	0.01
100%	12	50	13,559,830	-170	-0.0013	1.01
100%	12	55	13,559,824	-176	-0.0013	0.01
115%	13.8	20	13,559,963	-37	-0.0003	0.01
85%	10.2	20	13,559,953	-47	-0.0003	0.01

Figure 26. Frequency Stability Test Results (Pluggable Pigtail)

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

MET Asset #	Description	Manufacturer	Model	Last Cal Date	Cal Due Date
MY46180897	Spectrum Analyzer	Keysight	E4448A	7/27/2023	7/27/2024
1A1234	FSV Signal Analyzer	Rohde & Schwarz	FSV 40	1/23/2023	1/23/2024
1A1250[5]	EMI Test Receiver	Rohde & Schwarz	ESW44	05/26/2023	05/26/2024
1A1083[6]	EMI Test Receiver	Rohde & Schwarz	ESU40	11/20/2023	11/20/2024
1A1176	Active Loop Antenna (9KHz-30MHz)	ETS-Lindgren	6502	7/13/2023	7/13/2024
1A1050	Bilog Antenna (30MHz – 1GHz)	Schaffner	CBL 6112D	1/24/2023	1/24/2024
1A1183	Horn Antenna (1GHz – 18GHz)	ETS Lindgren	3117	1/4/2023	1/4/2024
1A1161	Horn Antenna (18GHz – 40GHz)	ETS Lindgren	3116C	7/11/2023	7/11/2024
1A1065	EMI Receiver	Rohde & Schwarz	ESCI	8/4/2023	8/4/2024
1A1087	Pulse Limiter	Rohde & Schwarz	ESH3Z2	12/21/2022	12/21/2023
1A1122	LISN	Teseq	NNB 51	9/19/2023	9/19/2024
1A1149	DC Milliohm Meter	GW Instek	GOM-802	9/20/2023	9/20/2024
1A1164[5]	Digital Multimeter	Fluke	117	10/28/2022	10/28/2023
1A1117[6]	Digital Multimeter	Fluke	87 III	11/6/2023	11/6/2024
1A1225	Environmental Chamber	Espec	EXP-2H/New	5/16/2023	5/16/2024
1A1099	Generator	Com-Power	CGO-51000	See Note	
1A1088	Preamplifier	Rohde & Schwarz	TS-PR1	See Note	
1A1044	Generator	Com-Power	CG-520	See Note	
1A1073	Multi Device Controller	ETS	2090	See Note	
1A1074	System Controller	Panasonic	WV-CU101	See Note	
1A1080	Multi-Device	ETS	2090	See Note	
1A1180	Preamplifier	Miteq	AMF-7D-01001800-22-10P	See Note	
3A3219	DC Power Supply	Topward	6303A	See Note	

Table 13. Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

[5] This item was used for test dates in October of 2023
[6] This item was used for test dates in December of 2023

End of Report