HEADQUARTERS: 914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230 • PHONE (410) 354-3300 • FAX (410) 354-3313

March 2, 2022

HID Global Corporation
611 Center Ridge Drive
Austin, Texas 78753

Dear Robert Cresswell,

Enclosed is the EMC test report for compliance testing of the HID Global Corporation, DTCii Plus, 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: WIRA117660-FCC225-RSS210

Electromagnetic Compatibility Criteria
Test Report

for the

HID Global Corporation
X001800-2 / DTCii Plus

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

Report: WIRA117660-FCC225-RSS210

March 2, 2022

Prepared For:

HID Global Corporation
611 Center Ridge Drive
Austin, Texas 78753

Prepared By:
Eurofins E&E North America
13501 McCallen Pass,
Austin, TX 78753

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RSS-210: Issue 10
for Intentional Radiators

Bryan Taylor,
Wireless Team Lead

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Part 15.225 and RSS-210 Issue 10 under normal use and maintenance.

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	March 2, 2022	Initial Issue.

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Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the HID Global Corporation X001800-2 / DTCii Plus, 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 X001800-2 / DTCii Plus. HID Global Corporation should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the X001800-2 / DTCii Plus, 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, under purchase order number HID011899. 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 to perform testing on the X001800-2 / DTCii Plus.

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, X001800-2 / DTCii Plus.

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

Model(s) Tested:	X001800-2 / DTCii Plus	
Model(s) Covered:	X001800-2 / DTCii Plus; FCC ID: JQ6-X001800E; IC ID:2236B-X001800E	
EUT Specifications:	Primary Power: 24 VDC (via AC power adapter)	
	Type of Modulation(s):	ASK
	Equipment Code:	DXX
	Maximum field Strength (RFID Contactless Card Encoder):	39.686 dBµV/m
	Maximum field Strength (Print Ribbon RFID Reader):	32.484 dBµV/m
	Antenna Type:	Inductive Loop
	Peak Antenna Gain:	1 dBi
	Firmware Version:	N/A
	EUT Frequency Ranges:	13.56 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Bryan Taylor	
Report Date(s):	March 1, 2022	

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
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

Name of EUT/Model:	X001800-2 / DTCii Plus
Description of EUT and its intended use:	The DTCii is a card printer with a ribbon print only. Intend to print an image on a card. The EUT consists of two HF RFID radios operating at 13.56 MHz. The encoder radio assigns an ID string to an RFID credential. The ribbon radio detects the RFID credential during the printing process.
Selected Operation Mode(s):	The normal operation of the printer is simply by printing an image on a credential. To exercise both the Encoder and Ribbon radios, respectively, proprietary software was used to generate a constant modulated carrier at 13.56 MHz. The factory default power shall be used for both Radios.
Rationale for the selection of the Operation Mode(s):	The constant modulated carrier shall produce the worst-case emission profile for in band and out of band emissions.
Monitoring Method(s):	Verify proper connection to RFID radio controllers via Reader Utility and TestLab Spooler
Emissions Class Declaration:	**Class A ITE** where the device is intended primarily for use in an environment where the use of broadcast radio and television receivers may be expected within a distance of 10 m. A warning will be included in the user manual.
Configuration(s):	The EUT is a stand-alone unit and controlled by a laptop connected via ethernet cable.
EUT Power Requirement:	Voltage: 24 V AC or DC: DC Frequency: N/A Number of phases: N/A Amperage: 5 A Uses an external AC/DC adapter: Yes Additional comments: none
Physical Description	EUT Arrangement (tabletop, floor standing or both): Tabletop System w/Multiple Chassis? (Yes/No): No Size: (HxWxD): 19.4x10.4x10.3 inches Weight: 13 lbs
Other Info:	Highest frequency used in device: 2.4GHz (LPDDR4 Memory) EUT Software (internal to EUT): N/A Support Software (used by support PC to exercise EUT): Encoder Software Control: OMNIKEY Reader Utility Version 5.0.0.4 Ribbon Software Control: TestLab Spooler

Table 5. Equipment Overview and Test Configuration Information

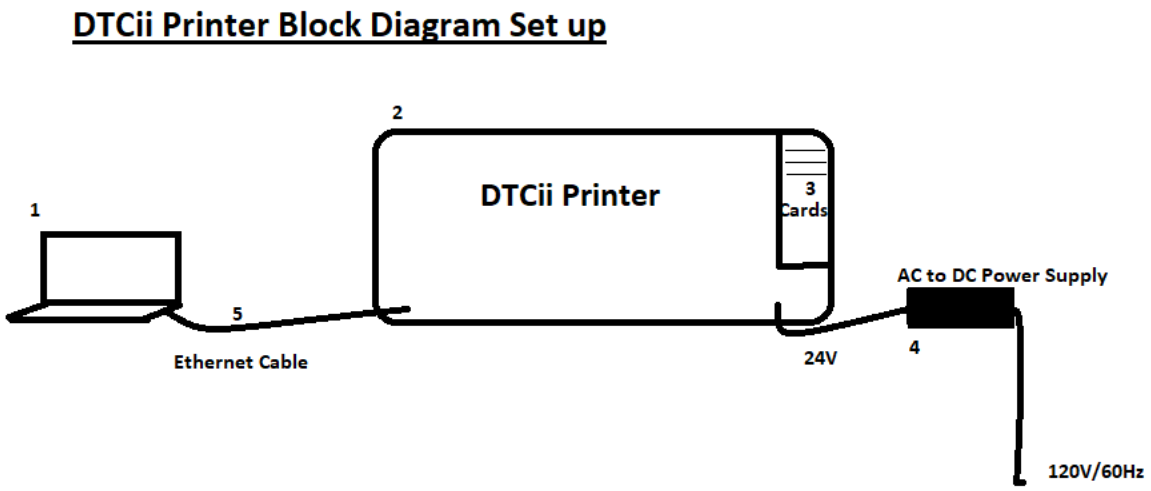


Figure 1. Block Diagram of Test Configuration

F. Equipment Configuration

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
1	--	Printer	DTCii	--	--	--

Table 6. Equipment Configuration

G. Support Equipment

Ref. ID	Name / Description	Manufacturer	Model Number
A	Laptop	Dell	--
B	AC to DC Power supply	LHV Power	STD-24050
C	Ethernet cable	RJ45	--

Table 7. Support Equipment

H. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded? (Y/N)	Termination Box ID & Port Name
1	AC Voltage	3 conductors	1	3	3	N	--
2	DC Voltage	2 conductors	1	3	3	N	--
3	Ethernet	Cat 5e cable	1	2	2	N	--
4	USB Type A to B	A to B type	1	1.5	1.5	Y	--

Table 8. Ports and Cabling Information

I. 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.

J. 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 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: Both the Encoder and Ribbon reader, as evaluated, were compliant as both had permanently attached antennas.

Test Engineer(s): Bryan Taylor

Test Date(s): 02/22/2022

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 9. 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 10. 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 Encoder and Ribbon reader were compliant with this requirement.

Test Engineer(s):

Bryan Taylor

Test Date(s):

02/23/2022

Conducted Emissions Voltage Test Setup

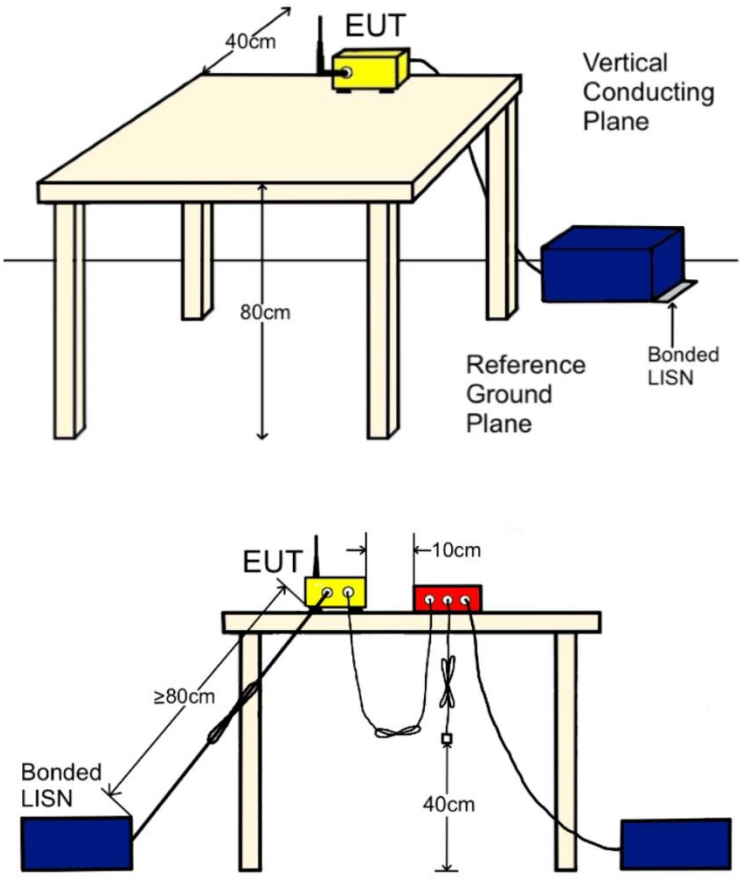
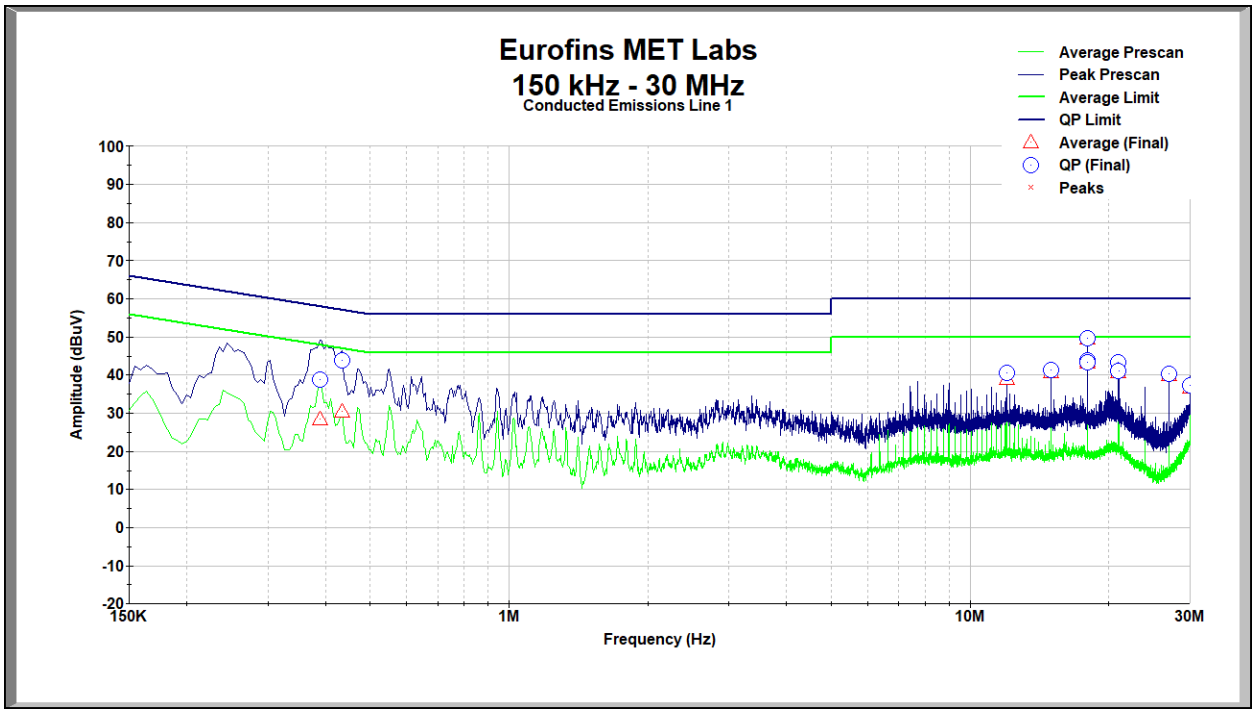


Figure 2. CEV Test Setup

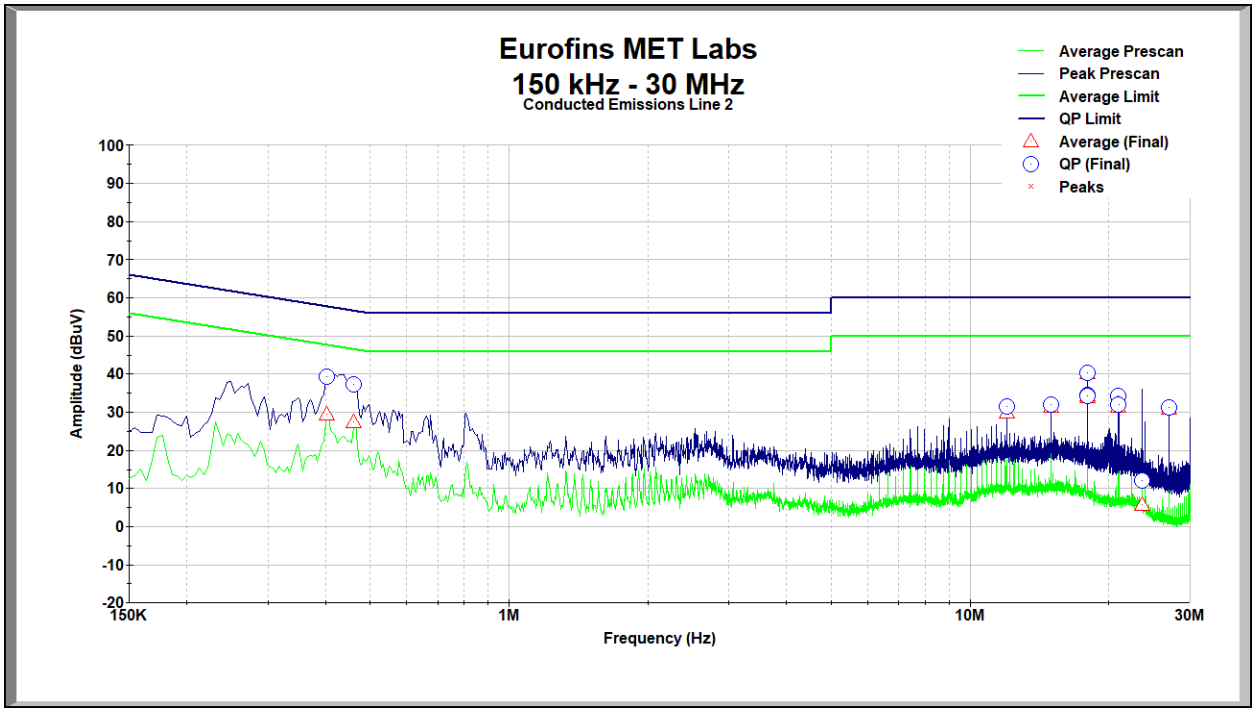
Measurement Location	Measurement	Limit	Pass/Fail
Bonding measurement from LISN ground to ground plane	0.48 mΩ	< 2.5 mΩ	Pass



Plot 1. Conducted Emissions, Phase, Encoder

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.3885	38.932	59.186	20.254	28.498	49.186	20.688
0.4335	43.932	57.900	13.968	30.383	47.900	17.517
11.9985	40.550	60.000	19.450	39.073	50.000	10.927
15.0015	41.226	60.000	18.774	40.772	50.000	9.228
17.9955	43.913	60.000	16.087	43.751	50.000	6.249
18.000	49.736	60.000	10.264	49.601	50.000	0.399
18.0045	43.417	60.000	16.583	43.247	50.000	6.753
20.9985	43.465	60.000	16.535	43.134	50.000	6.866
21.003	41.144	60.000	18.856	40.944	50.000	9.056
27.000	40.315	60.000	19.685	40.154	50.000	9.846
30.000	37.177	60.000	22.823	36.835	50.000	13.165

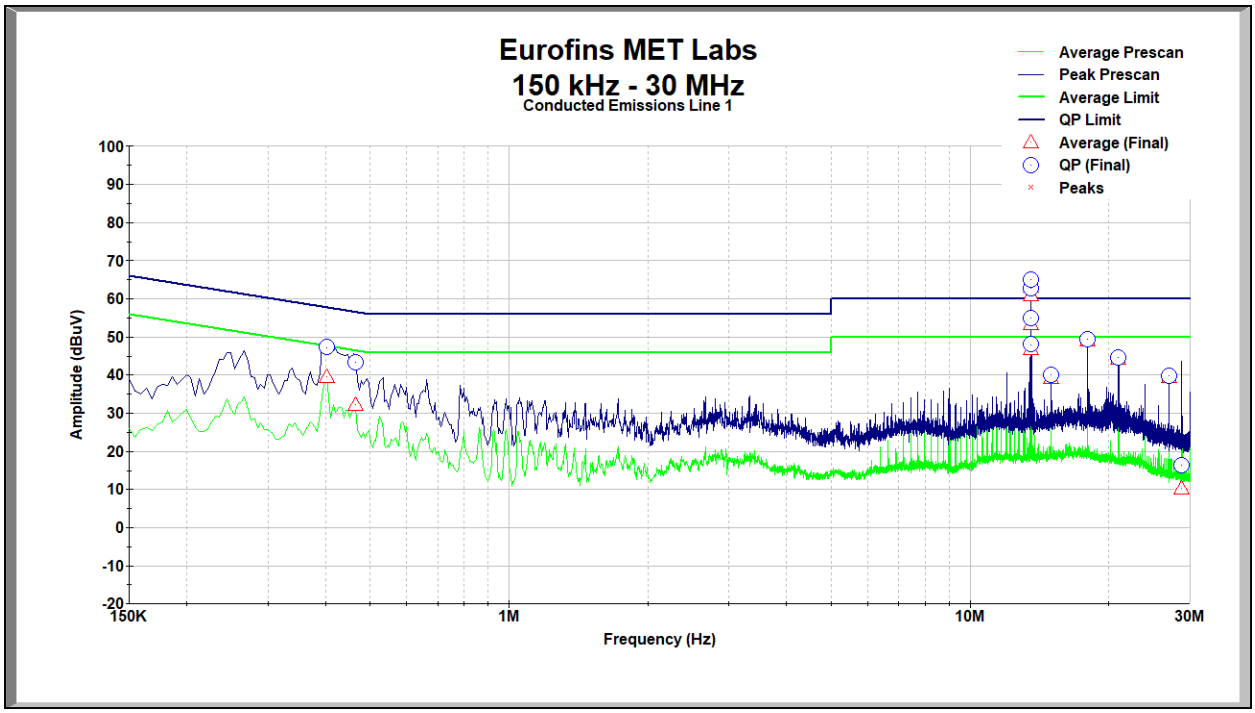
Table 11. Conducted Emissions, Phase, Encoder



Plot 2. Conducted Emissions, Neutral, Encoder

Frequency	Quasi-Peak (dBuV/m)	Quasi-Peak Limit (dBuV/m)	Quasi-Peak Margin (dB)	Average (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
0.402	39.274	58.8	19.526	29.421	48.8	19.379
0.4605	37.236	57.129	19.893	27.566	47.129	19.562
11.9985	31.513	60	28.487	29.854	50	20.146
15.0015	32.123	60	27.877	31.587	50	18.413
17.9955	34.604	60	25.396	34.45	50	15.55
18.000	40.438	60	19.562	40.334	50	9.666
18.0045	34.149	60	25.851	33.978	50	16.022
20.9985	34.19	60	25.81	33.976	50	16.024
21.003	31.896	60	28.104	31.51	50	18.49
23.61	12.066	60	47.934	5.738	50	44.262
27.000	31.123	60	28.877	30.943	50	19.057

Table 12. Conducted Emissions, Neutral, Encoder

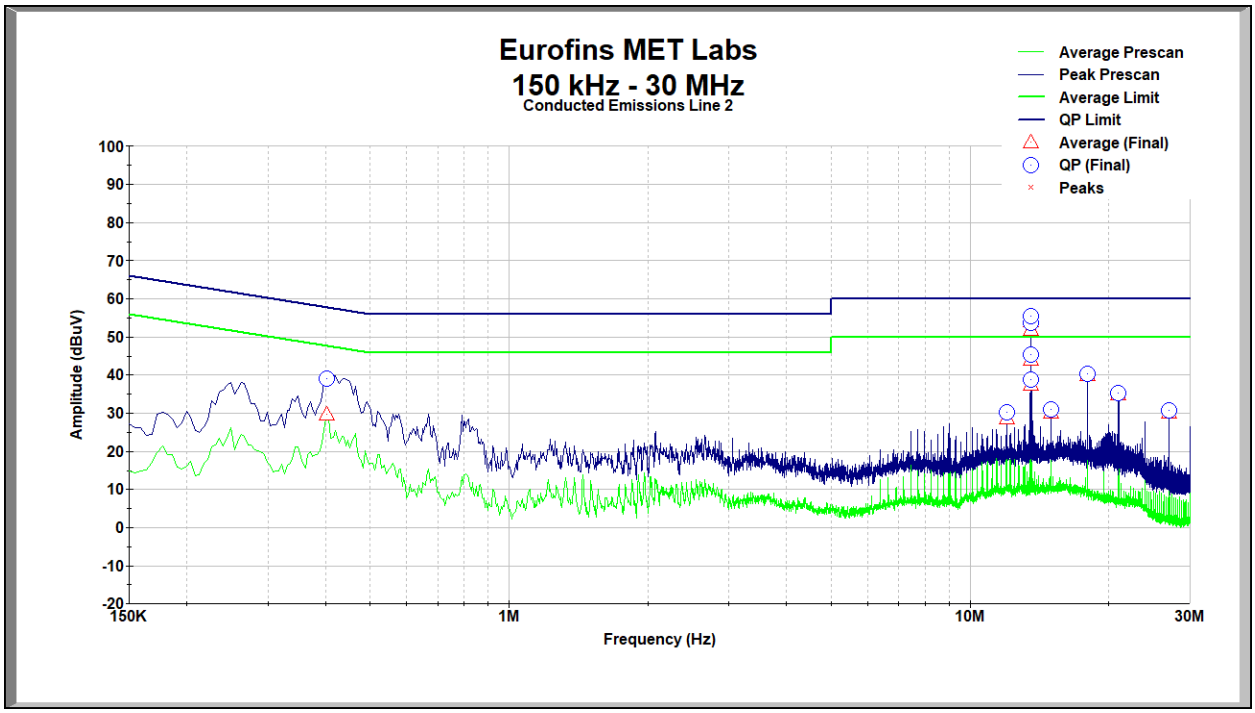


Note: the emission at 13.56MHz is from the RFID antenna

Plot 3. Conducted Emissions, Phase, Ribbon

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.402	47.246	58.800	11.554	39.465	48.800	9.335
0.465	43.308	57.000	13.692	32.351	47.000	14.649
13.5525	48.018	60.000	11.982	46.779	50.000	3.221
15.0015	40.201	60.000	19.799	39.430	50.000	10.570
18.000	49.485	60.000	10.515	49.096	50.000	0.904
20.9985	44.582	60.000	15.418	44.317	50.000	5.683
27.000	39.790	60.000	20.210	39.508	50.000	10.492
28.8105	16.417	60.000	43.583	10.311	50.000	39.689

Table 13. Conducted Emissions, Phase, Ribbon



Note: the emission at 13.56MHz is from the RFID antenna

Plot 4. Conducted Emissions, Neutral, Ribbon

Frequency	Quasi-Peak (dBuV/m)	Quasi-Peak Limit (dBuV/m)	Quasi-Peak Margin (dB)	Average (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
0.402	39.052	58.800	19.748	29.772	48.800	19.028
11.9985	30.250	60.000	29.750	28.693	50.000	21.307
13.5525	38.928	60.000	21.072	37.555	50.000	12.445
15.0015	31.106	60.000	28.894	30.246	50.000	19.754
18.000	40.210	60.000	19.790	39.963	50.000	10.037
20.9985	35.304	60.000	24.696	35.013	50.000	14.987
27.000	30.654	60.000	29.346	30.344	50.000	19.656

Table 14. Conducted Emissions, Neutral, Ribbon

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 measure with the spectrum analyzer using an RBW approximately 1% of the total emission bandwidth. The 20 dB Bandwidth was measured and recorded.

Test Results: The Encoder and Ribbon reader were compliant with this requirement.

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 measure with the spectrum analyzer using an RBW approximately 1% to 5% of the total emission bandwidth. The 99% Bandwidth was measured and recorded.

Test Engineer(s): Bryan Taylor

Test Date(s): 02/21/2022

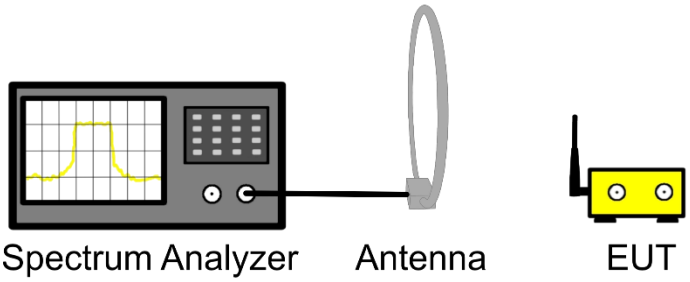
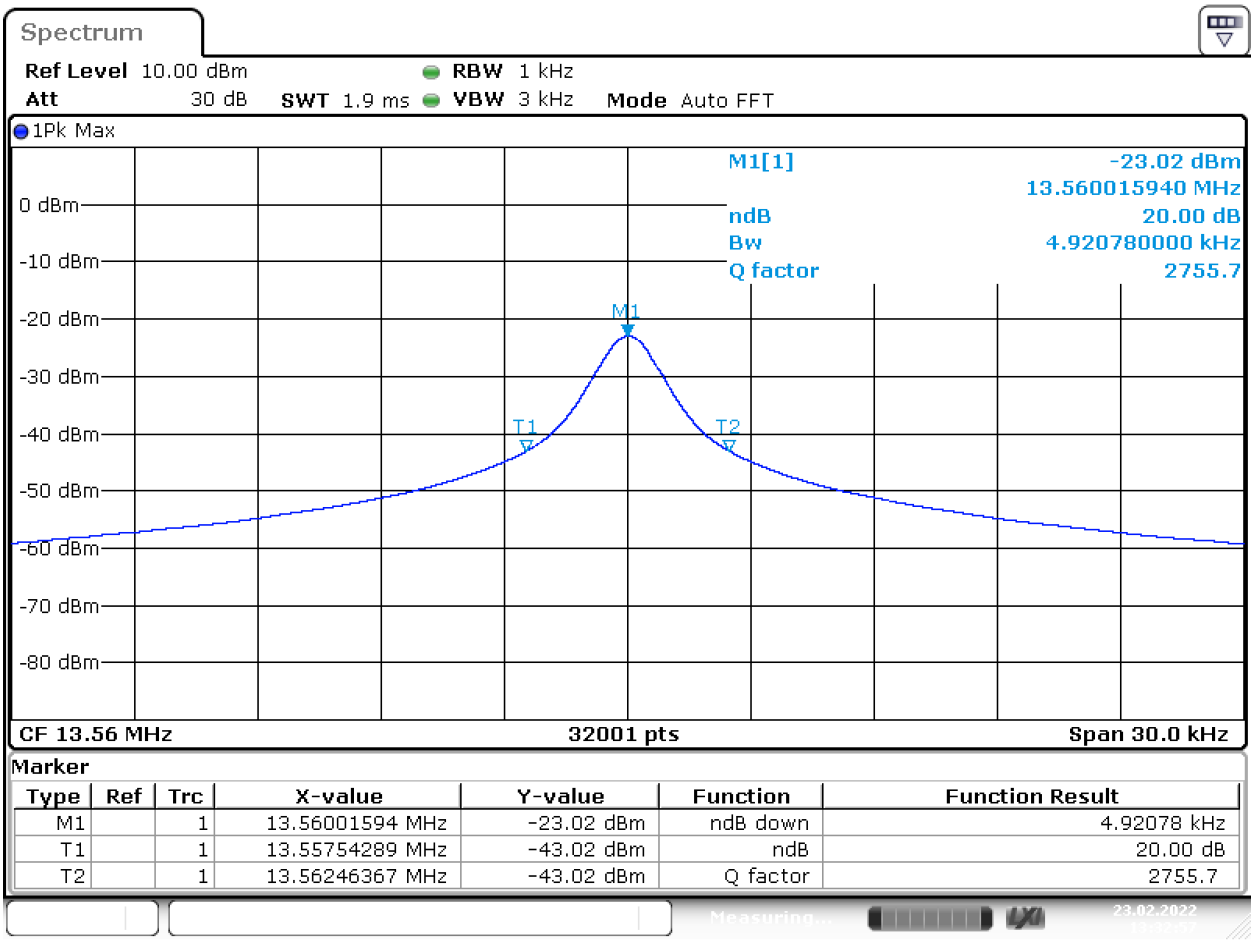


Figure 3. 20 dB Bandwidth and 99% Bandwidth Test Setup

Center Frequency (MHz)	20 dB Bandwidth of Emission (kHz)
13.56	4.920kHz

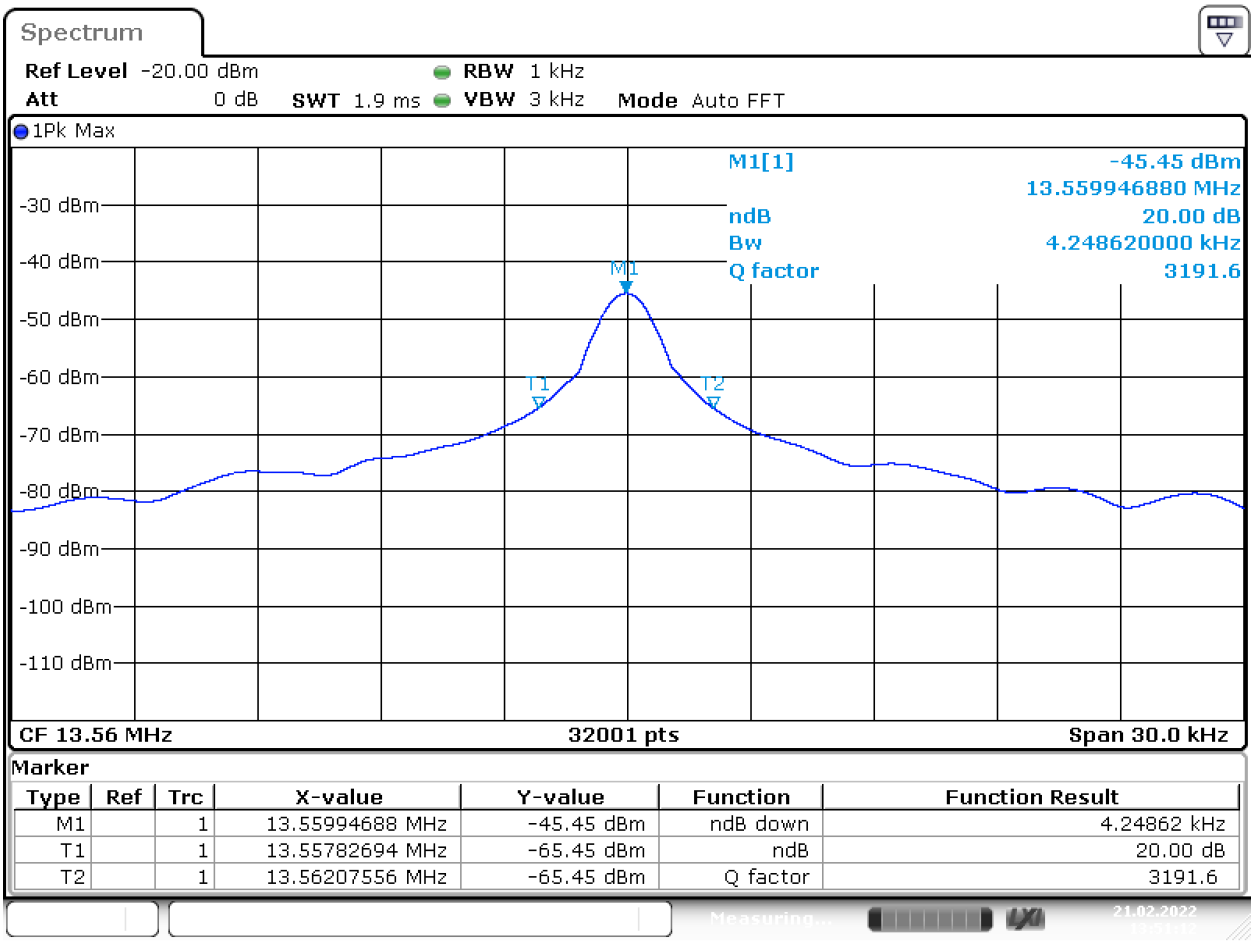
Table 15. 20 dB Emission Bandwidth Test Results, Encoder



Plot 5. 20 dB Occupied Bandwidth, Encoder

Center Frequency (MHz)	20 dB Bandwidth of Emission (kHz)
13.56	4.248kHz

Table 16. 20 dB Emission Bandwidth Test Results, Ribbon



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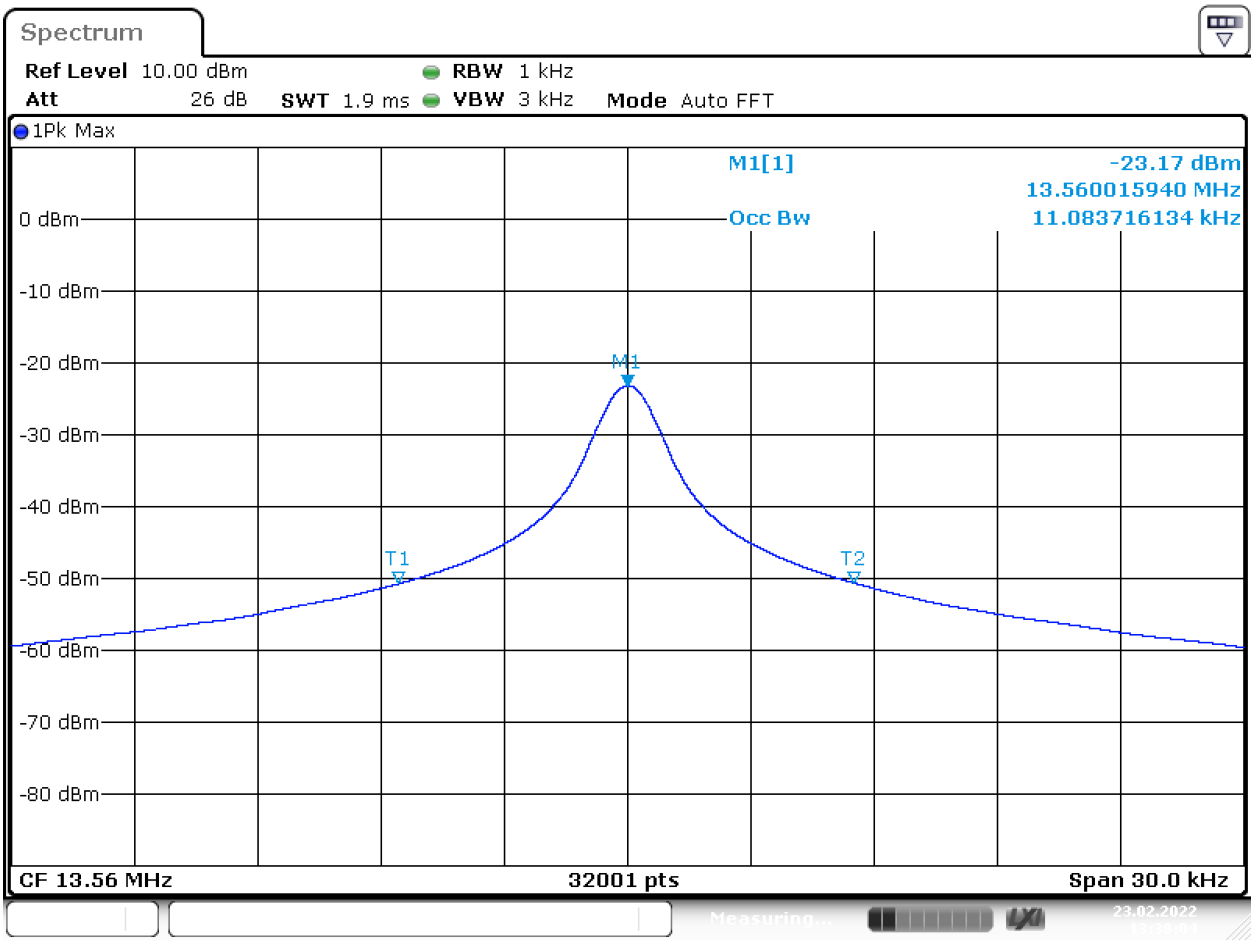
Plot 6. 20 dB Occupied Bandwidth, Ribbon

Center Frequency (MHz)	99% Bandwidth of Emission (kHz)
13.56	11.08kHz

Table 17. 99% Occupied Bandwidth Test Results, Encoder



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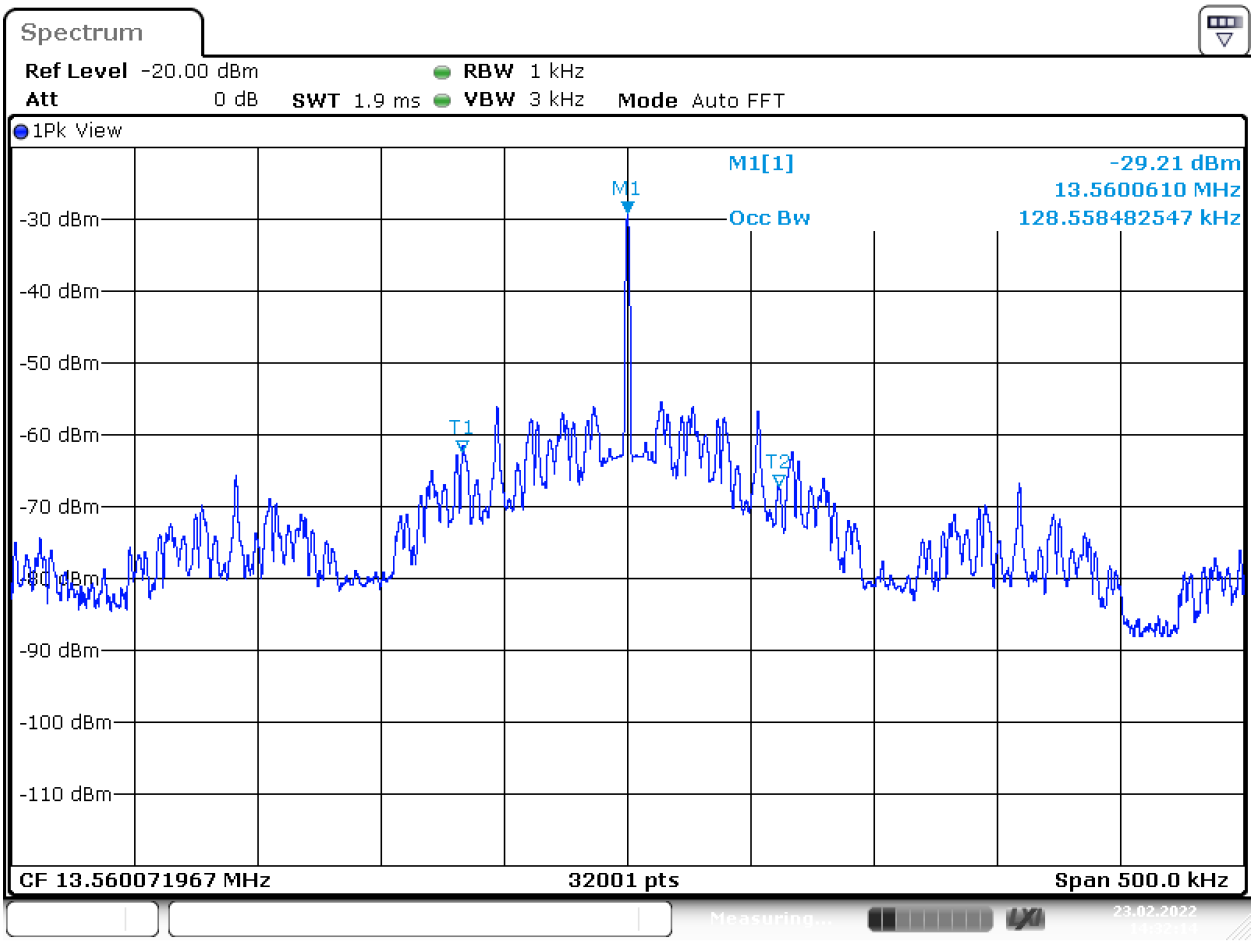
Plot 7. 99% Occupied Bandwidth, Encoder

Center Frequency (MHz)	99% Bandwidth of Emission (kHz)
13.56	128.5kHz

Table 18. 99% Occupied Bandwidth Test Results, Ribbon



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Plot 8. 99% Occupied Bandwidth, Ribbon

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 0.8m-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 10m 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 1GHz. 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 made at 3m with the loop antenna (below 30MHz) were then extrapolated to 30m or 300 m using the following correction factors which were applied to the limit.

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

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

20log(10/3) = +10.46 dB

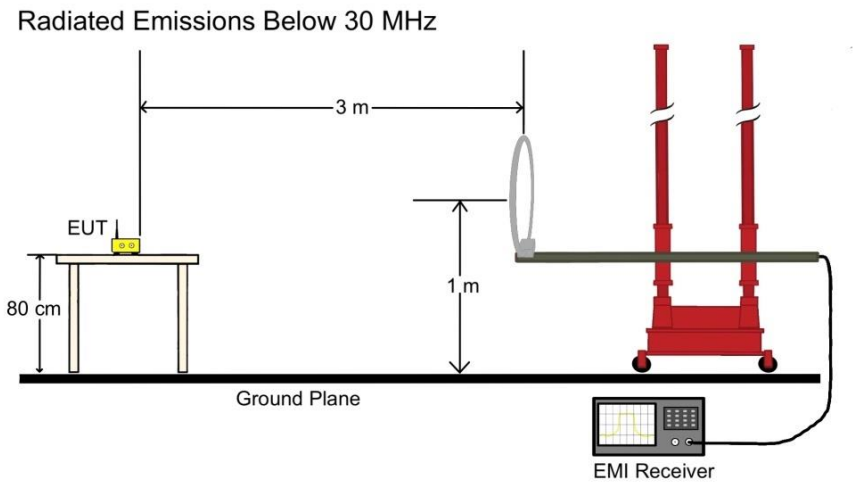


Figure 4: Radiated Emissions (Below 30MHz), Test Setup

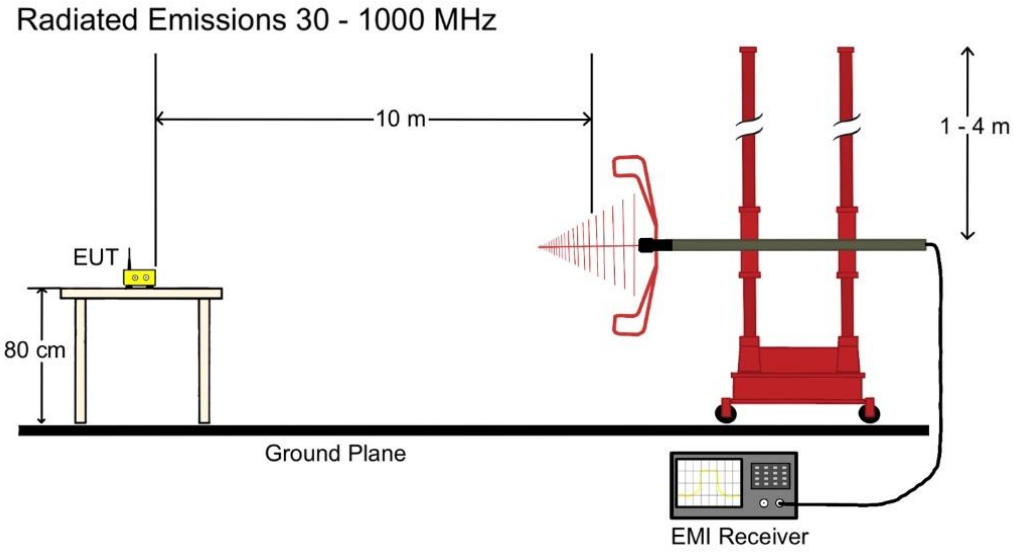
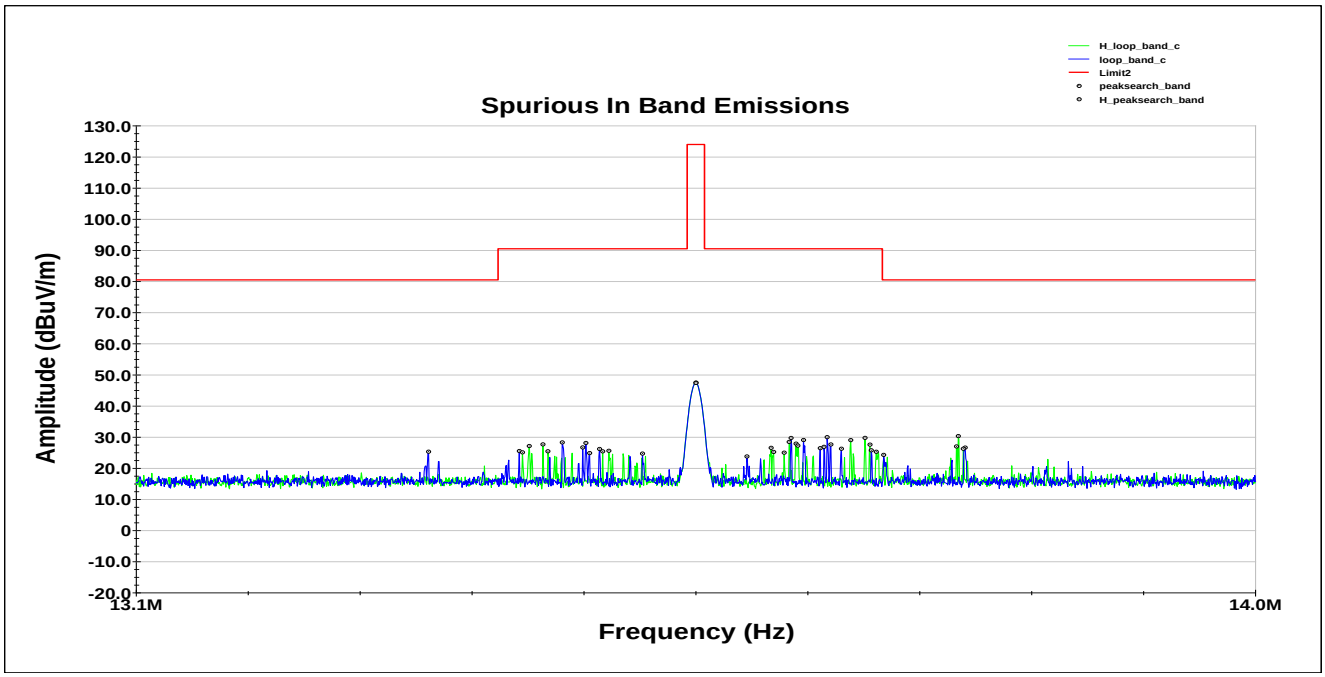


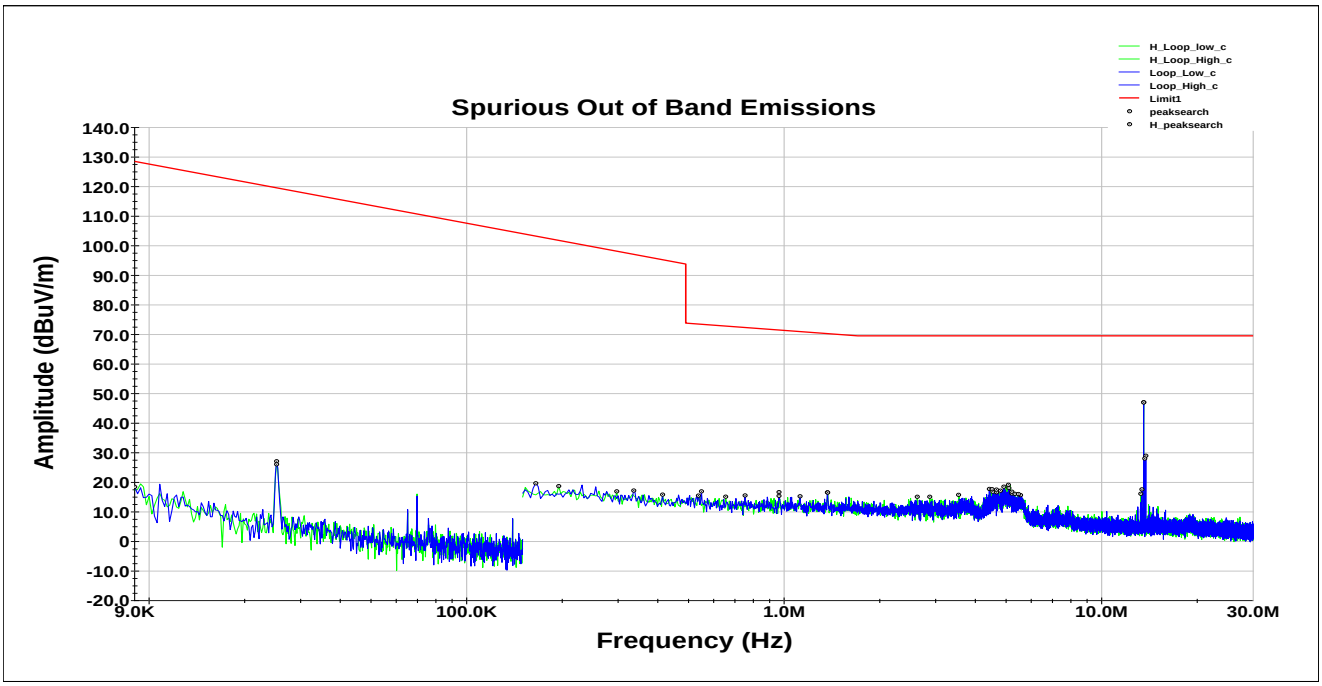
Figure 5. Radiated Emissions (Above 30MHz), Test Setup

Test Results:	The Encoder and Ribbon Reader were 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):	Bryan Taylor
Test Date(s):	02/22/2022

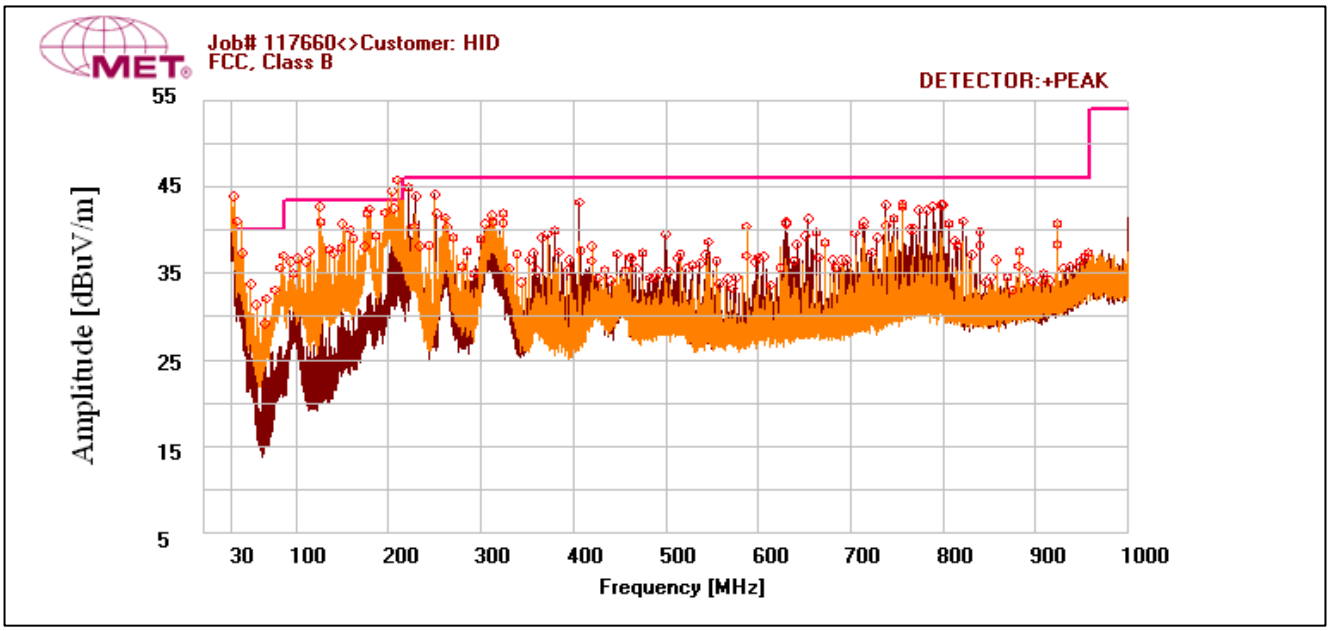
Radiated Field Strength, Encoder



Plot 9. Spurious Emissions Within the Band 13.11 – 14.010 MHz, Encoder



Plot 10. Spurious Emissions Below 30MHz, Out of Band, Encoder



Plot 11. Spurious Emissions Above 30MHz, Out of Band, Encoder

Frequency (MHz)	Un-Corrected amplitude (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
13.345	13.761	10.7	0.887	25.348	80.500	-55.152	Pass
13.418	13.986	10.7	0.888	25.574	90.500	-64.926	Pass
13.453	16.737	10.7	0.889	28.326	90.500	-62.174	Pass
13.469	15.126	10.7	0.889	26.715	90.500	-63.785	Pass
13.472	16.563	10.7	0.889	28.152	90.500	-62.348	Pass
13.475	13.321	10.7	0.889	24.91	90.500	-65.590	Pass
13.482	14.63	10.7	0.889	26.219	90.500	-64.281	Pass
13.517	13.155	10.7	0.889	24.744	90.500	-65.756	Pass
13.56	35.971	10.7	0.89	47.561	124.000	-76.439	Pass
13.601	12.236	10.7	0.891	23.827	90.500	-66.673	Pass
13.636	18.169	10.7	0.891	29.76	90.500	-60.740	Pass
13.646	17.499	10.7	0.892	29.091	90.500	-61.409	Pass
13.66	14.885	10.7	0.892	26.477	90.500	-64.023	Pass
13.663	15.311	10.7	0.892	26.903	90.500	-63.597	Pass
13.665	18.438	10.7	0.892	30.03	90.500	-60.470	Pass
13.668	16.07	10.7	0.892	27.662	90.500	-62.838	Pass
13.677	14.72	10.7	0.892	26.312	90.500	-64.188	Pass
13.701	14.2	10.7	0.893	25.793	90.500	-64.707	Pass
13.711	12.743	10.7	0.893	24.336	80.500	-56.164	Pass
13.777	15.072	10.7	0.894	26.666	80.500	-53.834	Pass

Table 19. Spurious Emissions Within the Band 13.11 – 14.010 MHz, Zero Degree Loop, Encoder

Frequency (MHz)	Un-Corrected amplitude (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
13.421	13.542	10.7	0.888	25.13	90.5	-65.37	Pass
13.426	15.59	10.7	0.888	27.178	90.5	-63.322	Pass
13.437	16.115	10.7	0.888	27.703	90.5	-62.797	Pass
13.441	13.898	10.7	0.889	25.487	90.5	-65.013	Pass
13.485	13.858	10.7	0.889	25.447	90.5	-65.053	Pass
13.49	14.055	10.7	0.889	25.644	90.5	-64.856	Pass
13.56	35.841	10.7	0.89	47.431	124	-76.569	Pass
13.62	15.008	10.7	0.891	26.599	90.5	-63.901	Pass
13.623	13.692	10.7	0.891	25.283	90.5	-65.217	Pass
13.631	13.454	10.7	0.891	25.045	90.5	-65.455	Pass
13.635	16.906	10.7	0.891	28.497	90.5	-62.003	Pass
13.64	16.359	10.7	0.892	27.951	90.5	-62.549	Pass
13.642	15.703	10.7	0.892	27.295	90.5	-63.205	Pass
13.684	17.486	10.7	0.892	29.078	90.5	-61.422	Pass
13.696	18.191	10.7	0.893	29.784	90.5	-60.716	Pass
13.7	16.042	10.7	0.893	27.635	90.5	-62.865	Pass
13.705	13.73	10.7	0.893	25.323	90.5	-65.177	Pass
13.77	15.449	10.7	0.894	27.043	80.5	-53.457	Pass
13.771	18.776	10.7	0.894	30.37	80.5	-50.13	Pass
13.775	14.714	10.7	0.894	26.308	80.5	-54.192	Pass

Table 20. Spurious Emissions Within the Band 13.11 – 14.010 MHz, 90 Degree Loop, Encoder

Frequency (MHz)	Un-Corrected amplitude (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
0.009	-2.143	19.9	0.72	18.477	128.500	-110.023	Pass
0.025	12.076	14.34	0.72	27.136	127.331	-100.195	Pass
0.165	7.719	11.235	0.722	19.676	117.246	-97.570	Pass
0.336	5.524	11	0.724	17.248	104.912	-87.664	Pass
0.549	5.028	11.2	0.727	16.955	73.591	-56.636	Pass
0.753	3.66	11.2	0.729	15.589	72.870	-57.281	Pass
0.963	4.546	11.426	0.732	16.704	72.127	-55.423	Pass
1.122	3.074	11.5	0.734	15.308	71.564	-56.256	Pass
1.368	4.385	11.5	0.737	16.622	70.694	-54.072	Pass
4.427	5.737	11.257	0.775	17.769	69.500	-51.731	Pass
4.538	4.824	11.246	0.777	16.847	69.500	-52.653	Pass
4.667	4.63	11.233	0.778	16.641	69.500	-52.859	Pass
4.799	5.178	11.22	0.78	17.178	69.500	-52.322	Pass
4.919	6.551	11.208	0.782	18.541	69.500	-50.959	Pass
5.102	6.102	11.19	0.784	18.076	69.500	-51.424	Pass
5.216	4.257	11.178	0.785	16.22	69.500	-53.280	Pass
5.552	3.75	11.145	0.79	15.685	69.500	-53.815	Pass

Table 21. Spurious Out of Band (Below 30MHz), Zero Degree Loop, Ribbon

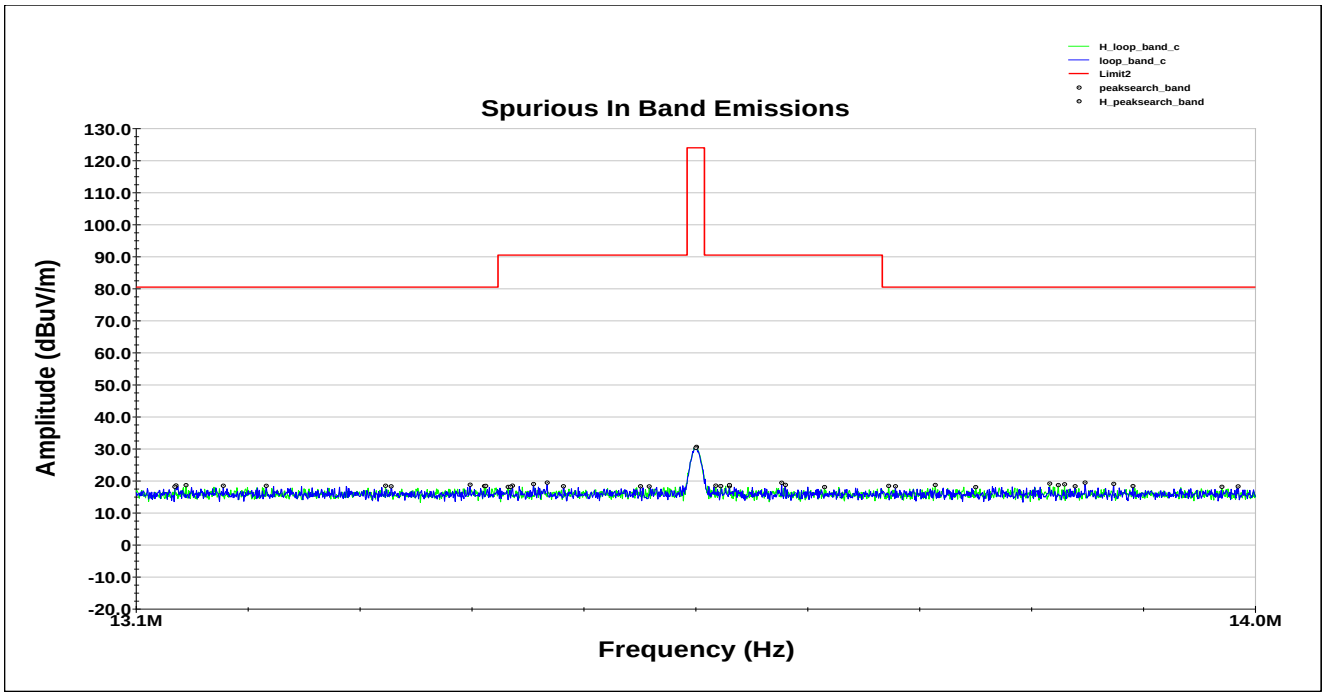
Frequency (MHz)	Un-Corrected amplitude (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
0.025	11.042	14.34	0.72	26.102	127.331	-101.229	Pass
0.195	6.798	11.205	0.722	18.725	115.082	-96.357	Pass
0.297	5.216	11.006	0.724	16.946	107.725	-90.779	Pass
0.414	4.102	11.028	0.725	15.855	99.287	-83.432	Pass
0.537	3.588	11.2	0.727	15.515	73.634	-58.119	Pass
0.654	3.221	11.2	0.728	15.149	73.220	-58.071	Pass
0.963	3.286	11.426	0.732	15.444	72.127	-56.683	Pass
1.371	4.313	11.5	0.737	16.55	70.683	-54.133	Pass
2.625	2.934	11.438	0.753	15.125	69.500	-54.375	Pass
2.873	2.95	11.413	0.756	15.119	69.500	-54.381	Pass
3.542	3.67	11.346	0.764	15.78	69.500	-53.720	Pass
4.517	5.655	11.248	0.777	17.68	69.500	-51.820	Pass
4.661	5.53	11.234	0.778	17.542	69.500	-51.958	Pass
5.084	7.2	11.192	0.784	19.176	69.500	-50.324	Pass
5.21	4.877	11.179	0.785	16.841	69.500	-52.659	Pass
5.33	4.146	11.167	0.787	16.1	69.500	-53.400	Pass
5.465	4.124	11.154	0.788	16.066	69.500	-53.434	Pass

Table 22. Spurious Out of Band (Below 30MHz), 90 Degree Loop, Ribbon

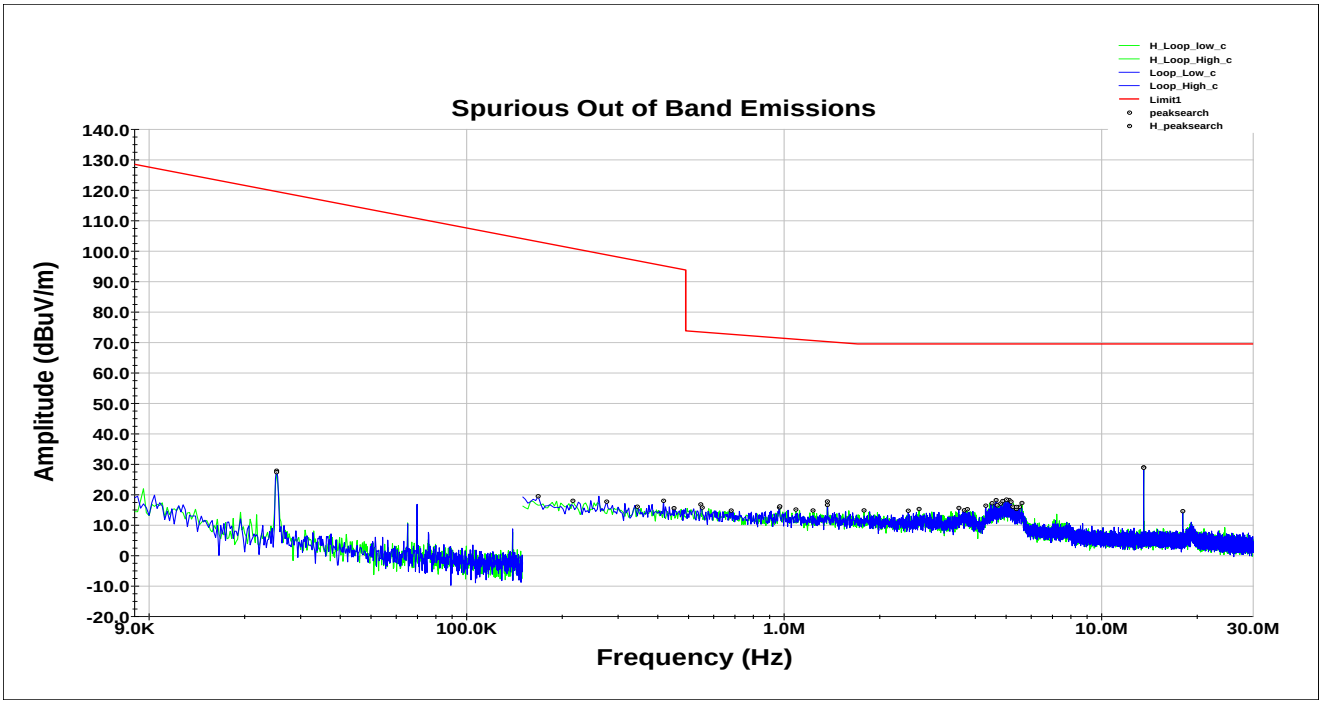
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain & CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
40.68	V	95.3	104.3	37.2	15.992	24.566	10.46	39.086	40	-0.914
40.68	H	128.9	131.7	36.9	16.892	24.566	10.46	39.686	40	-0.314
122.04	H	175.4	101.9	37.1	16.4	23.506	10.46	40.454	43.5	-3.046
122.04	V	102.2	149.7	29.9	16	23.506	10.46	32.854	43.5	-10.646
203.4	V	120.2	124.8	40.3	14.6	22.952	10.46	42.408	43.5	-1.092
176.28	V	233.7	123.7	37.8	13.5	23.107	10.46	38.653	43.5	-4.847
81.36	V	18.7	164.8	32.4	11.836	23.898	10.46	30.798	40	-9.202
212.23	H	210	261.9	37.14	13.177	22.816	10.46	37.961	43.5	-5.539
212.23	V	58	100.1	36.5	14.4	22.816	10.46	38.544	43.5	-4.956

Table 23. Spurious Emissions Above 30MHz, Out of Band, Encoder

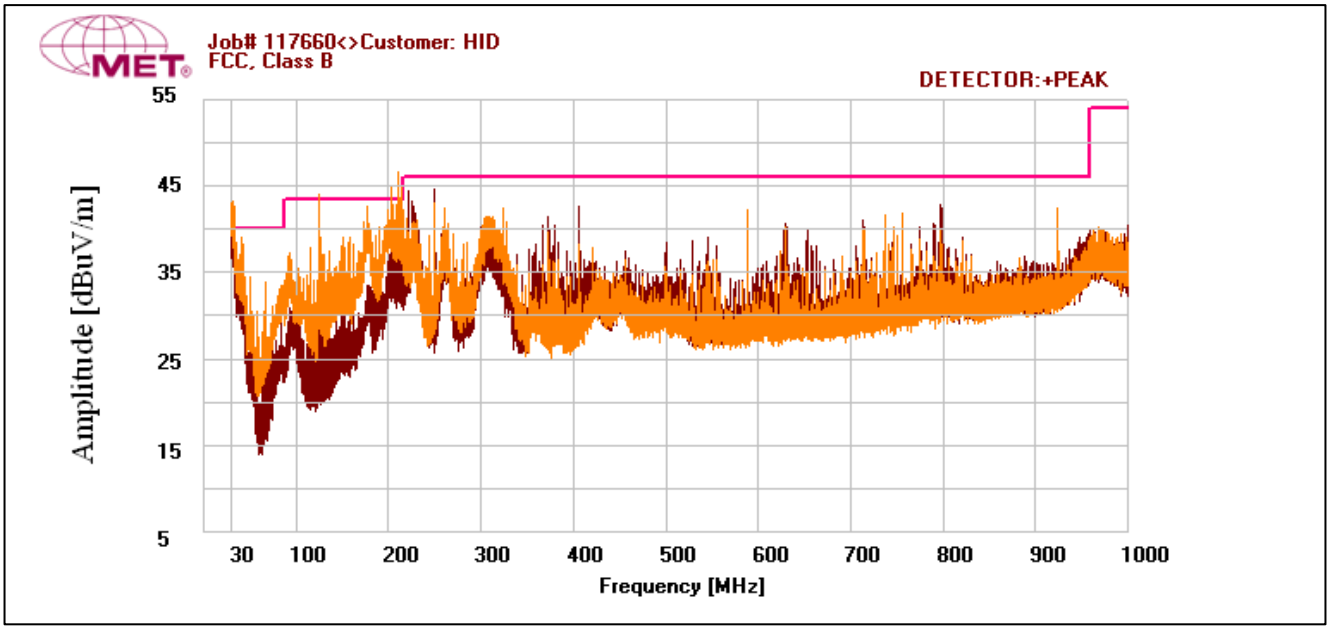
Radiated Field Strength, Ribbon



Plot 12. Spurious Emissions Within the Band 13.11 – 14.010 MHz, Ribbon



Plot 13. Spurious Emissions Below 30MHz, Out of Band, Ribbon



Plot 14. Spurious Emissions Above 30MHz, Out of Band, Ribbon

Frequency (MHz)	Un-Corrected amplitude (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
13.142	7.014	10.7	0.885	18.599	80.500	-61.901	Pass
13.18	6.93	10.7	0.885	18.515	80.500	-61.985	Pass
13.214	6.91	10.7	0.886	18.496	80.500	-62.004	Pass
13.315	6.757	10.7	0.887	18.344	80.500	-62.156	Pass
13.379	7.255	10.7	0.888	18.843	80.500	-61.657	Pass
13.412	6.965	10.7	0.888	18.553	90.500	-71.947	Pass
13.43	7.452	10.7	0.888	19.04	90.500	-71.460	Pass
13.441	7.904	10.7	0.889	19.493	90.500	-71.007	Pass
13.454	6.779	10.7	0.889	18.368	90.500	-72.132	Pass
13.515	6.779	10.7	0.889	18.368	90.500	-72.132	Pass
13.56	19.076	10.7	0.89	30.666	124.000	-93.334	Pass
13.587	6.801	10.7	0.891	18.392	90.500	-72.108	Pass
13.629	7.851	10.7	0.891	19.442	90.500	-71.058	Pass
13.632	7.188	10.7	0.891	18.779	90.500	-71.721	Pass
13.72	6.775	10.7	0.893	18.368	80.500	-62.132	Pass
13.865	6.772	10.7	0.896	18.368	80.500	-62.132	Pass
13.873	7.897	10.7	0.896	19.493	80.500	-61.007	Pass
13.896	7.501	10.7	0.896	19.097	80.500	-61.403	Pass
13.912	6.828	10.7	0.897	18.425	80.500	-62.075	Pass
13.996	6.722	10.7	0.898	18.32	80.500	-62.180	Pass

Table 24. Spurious Emissions Within the Band 13.11 – 14.010 MHz, Zero Degree Loop, Ribbon

Frequency (MHz)	Un-Corrected amplitude (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
13.141	6.614	10.7	0.885	18.199	80.5	-62.301	Pass
13.15	7.116	10.7	0.885	18.701	80.5	-61.799	Pass
13.31	6.928	10.7	0.887	18.515	80.5	-61.985	Pass
13.39	6.823	10.7	0.888	18.411	80.5	-62.089	Pass
13.391	6.885	10.7	0.888	18.473	80.5	-62.027	Pass
13.409	6.567	10.7	0.888	18.155	90.5	-72.345	Pass
13.411	6.601	10.7	0.888	18.189	90.5	-72.311	Pass
13.523	6.716	10.7	0.89	18.306	90.5	-72.194	Pass
13.56	18.781	10.7	0.89	30.371	124	-93.629	Pass
13.576	6.949	10.7	0.89	18.539	90.5	-71.961	Pass
13.58	6.821	10.7	0.89	18.411	90.5	-72.089	Pass
13.587	7.142	10.7	0.891	18.733	90.5	-71.767	Pass
13.664	6.499	10.7	0.892	18.091	90.5	-72.409	Pass
13.715	6.88	10.7	0.893	18.473	80.5	-62.027	Pass
13.752	7.162	10.7	0.894	18.756	80.5	-61.744	Pass
13.785	6.497	10.7	0.894	18.091	80.5	-62.409	Pass
13.845	7.607	10.7	0.895	19.202	80.5	-61.298	Pass
13.851	7.147	10.7	0.895	18.742	80.5	-61.758	Pass
13.857	7.382	10.7	0.896	18.978	80.5	-61.522	Pass
13.983	6.581	10.7	0.898	18.179	80.5	-62.321	Pass

Table 25. Spurious Emissions Within the Band 13.11 – 14.010 MHz, 90 Degree Loop, Ribbon

Frequency (MHz)	Un-Corrected amplitude (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
0.025	12.83	14.34	0.72	27.89	127.331	-99.441	Pass
0.168	7.568	11.232	0.722	19.522	117.030	-97.508	Pass
0.276	5.98	11.048	0.723	17.751	109.240	-91.489	Pass
0.417	6.27	11.034	0.725	18.029	99.070	-81.041	Pass
0.546	4.915	11.2	0.727	16.842	73.602	-56.760	Pass
0.681	2.88	11.2	0.728	14.808	73.124	-58.316	Pass
0.966	3.7	11.432	0.732	15.864	72.116	-56.252	Pass
1.368	4.441	11.5	0.737	16.678	70.694	-54.016	Pass
2.46	2.562	11.454	0.751	14.767	69.500	-54.733	Pass
3.548	3.564	11.345	0.764	15.673	69.500	-53.827	Pass
3.692	2.797	11.331	0.766	14.894	69.500	-54.606	Pass
4.316	4.367	11.268	0.774	16.409	69.500	-53.091	Pass
4.649	6.235	11.235	0.778	18.248	69.500	-51.252	Pass
4.808	5.129	11.219	0.78	17.128	69.500	-52.372	Pass
5.111	6.301	11.189	0.784	18.274	69.500	-51.226	Pass
5.249	4.134	11.175	0.786	16.095	69.500	-53.405	Pass
5.384	3.414	11.162	0.787	15.363	69.500	-54.137	Pass
5.513	4.106	11.149	0.789	16.044	69.500	-53.456	Pass
17.999	3.248	10.4	0.974	14.622	69.500	-54.878	Pass

Table 26. Spurious Out of Band (Below 30MHz), Zero Degree Loop, Ribbon

Frequency (MHz)	Un-Corrected amplitude (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
0.025	12.363	14.34	0.72	27.423	127.331	-99.908	Pass
0.216	6.133	11.168	0.723	18.024	113.568	-95.544	Pass
0.345	4.356	11	0.724	16.08	104.263	-88.183	Pass
0.45	3.773	11.1	0.726	15.599	96.690	-81.091	Pass
0.552	3.869	11.2	0.727	15.796	73.581	-57.785	Pass
0.969	4.021	11.438	0.732	16.191	72.105	-55.914	Pass
1.089	2.926	11.5	0.734	15.16	71.681	-56.521	Pass
1.233	2.615	11.5	0.735	14.85	71.171	-56.321	Pass
1.368	5.573	11.5	0.737	17.81	70.694	-52.884	Pass
1.785	2.639	11.5	0.742	14.881	69.500	-54.619	Pass
2.66	3.127	11.434	0.753	15.314	69.500	-54.186	Pass
3.776	3.174	11.322	0.767	15.263	69.500	-54.237	Pass
4.517	5.205	11.248	0.777	17.23	69.500	-52.270	Pass
4.685	4.54	11.231	0.779	16.55	69.500	-52.950	Pass
4.877	5.95	11.212	0.781	17.943	69.500	-51.557	Pass
5.012	6.444	11.199	0.783	18.426	69.500	-51.074	Pass
5.186	5.758	11.181	0.785	17.724	69.500	-51.776	Pass
5.387	4.062	11.161	0.787	16.01	69.500	-53.490	Pass
5.609	5.349	11.139	0.79	17.278	69.500	-52.222	Pass

Table 27. Spurious Out of Band (Below 30MHz), 90 Degree Loop, Ribbon

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain & CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
203.2	V	84.2	100	39.6	14.6	22.956	10.46	41.704	43.5	-1.796
122.04	V	133	100	29.2	16	23.506	10.46	32.154	43.5	-11.346
176.28	V	25.1	105	39.1	13.5	23.107	10.46	39.953	43.5	-3.547
40.68	V	314	117	36.8	15.992	24.566	10.46	38.686	40	-1.314
67.8	V	111.6	341.6	35.6	10.52	24.096	10.46	32.484	40	-7.516
40.68	H	300.1	156.8	36.2	16.892	24.566	10.46	38.986	40	-1.014
108.48	V	99.9	100	28.7	15.7	23.637	10.46	31.223	43.5	-12.277
203.2	H	215.9	390.3	36.3	13.7	22.956	10.46	37.504	43.5	-5.996

Table 28. Spurious Emissions Above 30MHz, Out of Band, Ribbon

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 used to measure the frequency drift. 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.

Test Results:

The Encoder and Ribbon Reader were 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):

02/21/2022 – 02/22/2022

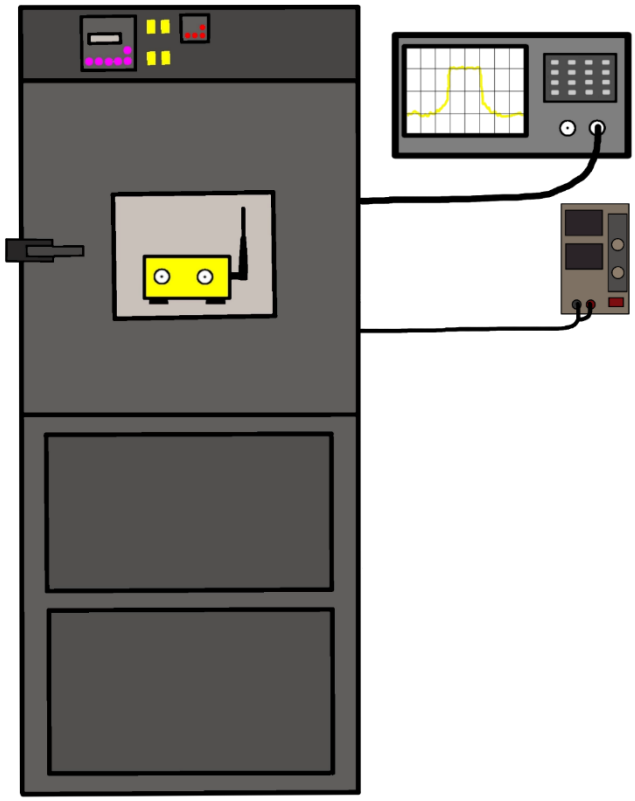
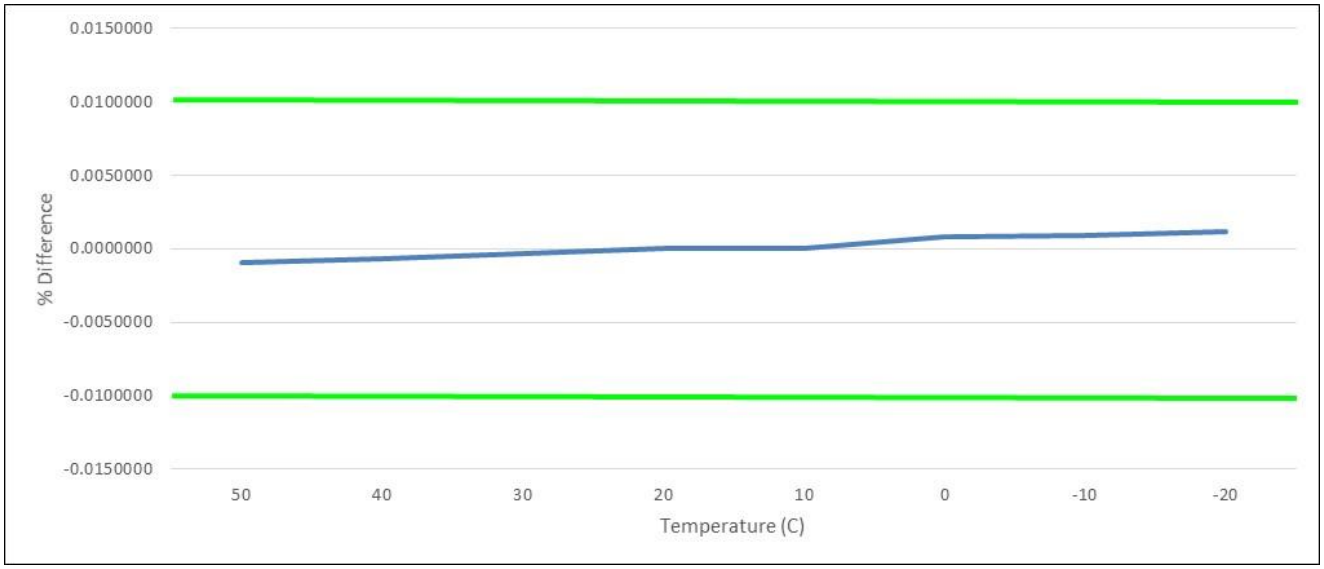


Figure 6. Temperature Stability Test Setup

FCC 15.225 (e)	120VAC 60Hz				
Voltage Variation (%)	**Temperature (°C)**	**Nominal Freq (MHz)**	**Result (MHz)**	**% Difference**	**Limit**
V_{NOM}	50	13.56	13.55987916	-0.0008912	**±0.01%**
	40	13.56	13.55990725	-0.0006840	
	30	13.56	13.55995391	-0.0003399	
	20	13.56	13.56000647	0.0000477	
	10	13.56	13.56000585	0.0000431	
	0	13.56	13.56011341	0.0008364	
	-10	13.56	13.56012697	0.0009364	
	-20	13.56	13.56016068	0.0011850	
15	20	13.56	13.56000566	0.0000417	
-15	20	13.56	13.56000911	0.0000672	

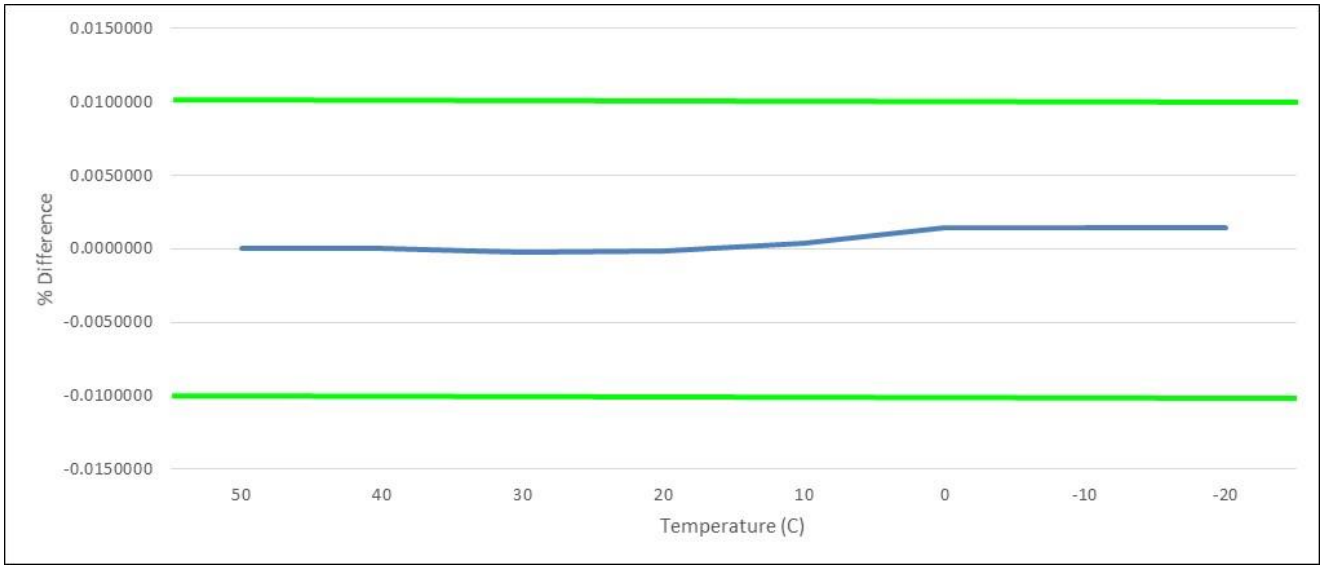
Table 29. Frequency Stability, Test Results, Encoder



Plot 15. Frequency Stability vs Temperature, Encoder

FCC 15.225 (e)	120VAC 60Hz				
Voltage Variation (%)	**Temperature (°C)**	**Nominal Freq (MHz)**	**Result (MHz)**	**% Difference**	**Limit**
V_{NOM}	50	13.56	13.56000775	0.0000571	**±0.01%**
	40	13.56	13.56000782	0.0000577	
	30	13.56	13.55997094	-0.0002143	
	20	13.56	13.55998303	-0.0001251	
	10	13.56	13.56005743	0.0004235	
	0	13.56	13.56019799	0.0014601	
	-10	13.56	13.56019846	0.0014636	
	-20	13.56	13.56020034	0.0014774	
15	20	13.56	13.55998189	-0.0001336	
-15	20	13.56	13.55998021	-0.0001459	

Table 30. Frequency Stability, Test Results, Ribbon



Plot 16. Frequency Stability vs Temperature, Ribbon

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 #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1050	Bi-conilog Antenna (30MHz to 1GHz)	Schaffner	CBL6112D	2/09/2021	2/09/2022
1A1088	Pre-Amp	Rhode & Schwarz	TS-PR1	See Note	
1A1073	Multi Device Controller	ETS Lindgren	2090		
1A1195	Preamplifier	A.H. Systems	PAM-0018P		
1A1074	System Camera Controller	Panasonic	WV-CU101		
1A1075	System Camera Controller	Panasonic	WV-CU101		
1A1080	Multi Device Controller	ETS Lindgren	2090		
1A1176	Active Loop Antenna	ETS-Lindgren	6502	6/28/2021	6/28/2022
1A1122	LISN	Teseq	NNB 51	9/13/2021	9/13/2022
1A1065	EMI Receiver	Rohde & Schwarz	ESCI	7/01/2021	7/01/2022
1A1149	Milliohm Meter	GW Instek	GOM-802	7/08/2021	7/08/2022
1A1234	Signal Analyzer	Rohde & Schwarz	FSV	1/20/2022	1/20/2023
1A1225	Environmental Chamber	Thermotron	EXP-2H	3/11/2021	3/11/2022
1A1119	Test Area	Custom Made	N/A	See Note	
1A1177	Pulse Limiter / Attenuator	Rohde & Schwarz	ESH3Z2	6/30/2021	6/30/2022
1A1083	Test Receiver	Rohde & Schwarz	ESU40	10/12/2022	10/12/2023
1A1106	10 m Chamber (NSA)	ETS Lindgren	Semi-Anechoic	See Note	
Note	Functionally tested equipment is verified using calibrated instrumentation at the time of testing.				

Figure 7. Test Equipment List

End of Report

