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September 11, 2019

HID Global Corporation
6533 Flying Cloud Drive
Eden Prairie, MN 55344

Dear Robert Cresswell,

Enclosed is the EMC test report for compliance testing of the HID Global Corporation, Color Card Printer X002200-003 (CPI Card Group brand name "Spectrum"), tested to the requirements of Title 47 of the CFR, Part 15.225, Subpart C for Certification as an Intentional Radiator.

Thank you for using the services of Eurofins Electrical & Electronics (E&E). If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
EUROFINS MET LABS, INC.

A handwritten signature in blue ink, appearing to read "Mae Ramirez".

Mae Ramirez
Documentation Department

Reference: (\\HID Global Corporation\\EMCA104682-FCC 15.225)

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Electromagnetic Compatibility Criteria Test Report

for the

**HID Global Corporation
Color Card Printer X002200-003 (CPI Card Group brand name "Spectrum")**

Tested under
the FCC Certification Rules
contained in
15.225 Subpart C
for Intentional Radiators

MET Report: EMCA104682-FCC 15.225

September 11, 2019

Prepared For:

**HID Global Corporation
6533 Flying Cloud Drive
Eden Prairie, MN 55344**

Prepared By:
Eurofins Electrical & Electronics (E&E)
13501 McCallen Pass, Austin, TX 78753

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A handwritten signature in blue ink, appearing to read "Adan Arab".

Adan Arab, Project Engineer
Electromagnetic Compatibility Lab

A handwritten signature in blue ink, appearing to read "Mae Ramirez".

Mae Ramirez
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. 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 under normal use and maintenance.

A handwritten signature in blue ink, appearing to read "Jonathan Tavora".

Jonathan Tavora,
Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	September 11, 2019	Initial Issue.

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List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dB μ A	Decibels above one microamp
dB μ V	Decibels above one microvolt
dB μ A/m	Decibels above one microamp per meter
dB μ V/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
μ H	microhenry
μ	microfarad
μ s	microseconds
NEBS	Network Equipment-Building System
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts per meter
VCP	Vertical Coupling Plane

I. *Executive Summary*

A. **Purpose of Test**

An EMC evaluation was performed to determine compliance of the HID Global Corporation Color Card Printer X002200-003 (CPI Card Group brand name “Spectrum”), with the requirements of Part 15, §15.225. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Color Card Printer X002200-003 (CPI Card Group brand name “Spectrum”). 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 Color Card Printer X002200-003 (CPI Card Group brand name “Spectrum”), 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, in accordance with HID Global Corporation, purchase order number 1110970213. All tests were conducted using measurement procedure ANSI C63.10 -2013.

FCC Reference 47 CFR Part 15.225	Description	Compliance
Part 15 §15.203	Antenna Requirement	Compliant
Part 15 §15.207(a)	Conducted Emission Limits	Compliant
Part 15 §15.215(c)	20dB Occupied Bandwidth	Compliant
Part 15 §15.225(a)	Field Strength emissions within the band 13.553 – 13.567 MHz	Compliant
Part 15 §15.225(b)	Field Strength emissions within the band 13.410 – 13.553 MHz and 13.567 – 13.710 MHz	Compliant
Part 15 §15.225(c)	Field Strength emissions within the band 13.110 – 13.410 MHz and 13.710 – 14.010 MHz	Compliant
Part 15 §15.225(d)	Outside-Band Field Strength emissions per 15.209 - 13.110 – 14.010 MHz	Compliant
Part 15 §15.225(e)	Frequency Tolerance of the Carrier	Compliant

Table 1. Executive Summary of EMC Part 15.225 Compliance Testing

II. *Equipment Configuration*

A. Overview

Eurofins Electrical & Electronics (E&E) was contracted by HID Global Corporation to perform testing on the Color Card Printer X002200-003 (CPI Card Group brand name “Spectrum”), under HID Global Corporation’s purchase order number 1110967802.

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, Color Card Printer X002200-003 (CPI Card Group brand name “Spectrum”).

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

Model(s) Tested:	Color Card Printer X002200-003 (CPI Card Group brand name “Spectrum”)		
Model(s) Covered:	Color Card Printer X002200-003 (CPI Card Group brand name “Spectrum”)		
EUT Specifications:	Primary Power: 120 VAC 60 Hz		
	FCC ID: JQ6-X002200003		
	Type of Modulations:	ASK	
	Equipment Code:	DXX	
	Maximum Field Strength (dBuV/m):	Ribbon: 15.55	
		Film: 11.97	
		Encoder: 24.47	
EUT Frequency Ranges:	13.56 MHz		
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:	Adan Arab		
Report Date(s):	September 11, 2019		

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 17025:2005	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

All testing was performed at Eurofins E&E (Eurofins MET Labs), 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.

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.32 dB	2	95%
RF Power Conducted Spurious Emissions	±2.25 dB	2	95%
RF Power Radiated Emissions	±3.01 dB	2	95%

Table 4. Uncertainty Calculations Summary

E. Description of Test Sample

The Color Card Printer X002200-003 (CPI Card Group brand name “Spectrum”), Equipment Under Test (EUT), is a dual sided full color card printer with three separate RFID transmitters which are not transmitting simultaneously and each transmitter is tested separately . It uses a ribbon and film process and receives information regarding image and quantity via connection through an Ethernet connection, and has a single-board computer installed.

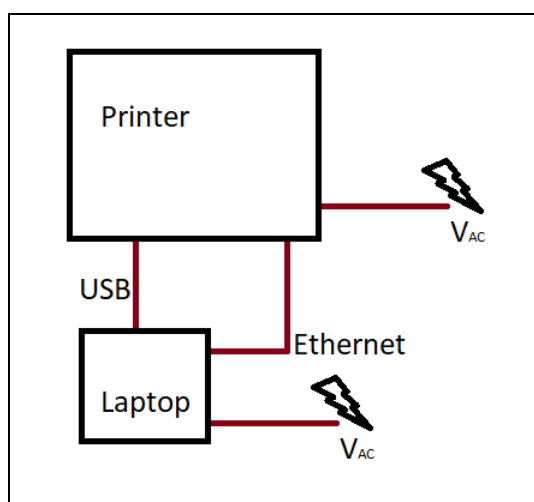


Figure 1. Block Diagram of Test Configuration

F. Equipment Configuration

The EUT was set up as outlined in Figure 1 . All equipment incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
--	--	Color Card Printer with Flipper & Embedded PC	X002200-003	X002200-003	B9151241	--

Table 5. Equipment Configuration

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
NA	Laptop	Dell	Inspiron 15	N.A
*The ‘Customer Supplied Calibration Data’ column will be marked as either not applicable, not available or will contain the calibration date supplied by the Customer.				

Table 6. 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
NA	USB	Data Connection to Laptop	1	1	< 3	N	Data
NA	Ethernet	Network Connection to Laptop	1	1	100	N	Network
NA	Power	Power Cable	1	1	2	N	Power

Table 7. Ports and Cabling Information

I. Mode of Operation

The X002200-003 printer was connected to an Ethernet connection, which permitted remote access (Dell Laptop) to printer control and functions. The printer performed the card printing function for the entirety of the testing.

J. Method of Monitoring EUT Operation

The X002200-003 status screen was monitored for any error messages. The printed product was monitored for accurate printing (color, placement).

K. 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.

L. 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.

III. *Electromagnetic Compatibility Criteria for Intentional Radiators*

§ 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 EUT as tested is compliant the criteria A of §15.203.

Test Engineer(s): Adan Arab

Test Date(s): 08/01/2019

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 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 μ H/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 (dB μ V)	
	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.

Test Procedure: The EUT was placed on a 0.8 m-high non-conductive table above the 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 μ H 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*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω /50 μ H LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement.

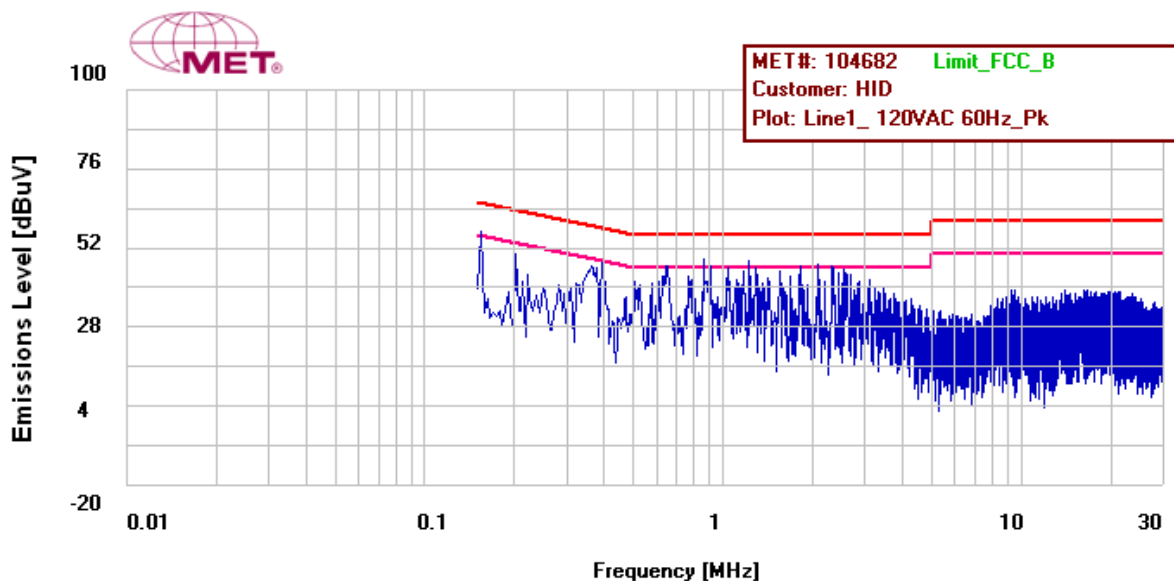
Test Engineer(s): Adan Arab

Test Date(s): 07/24/2019

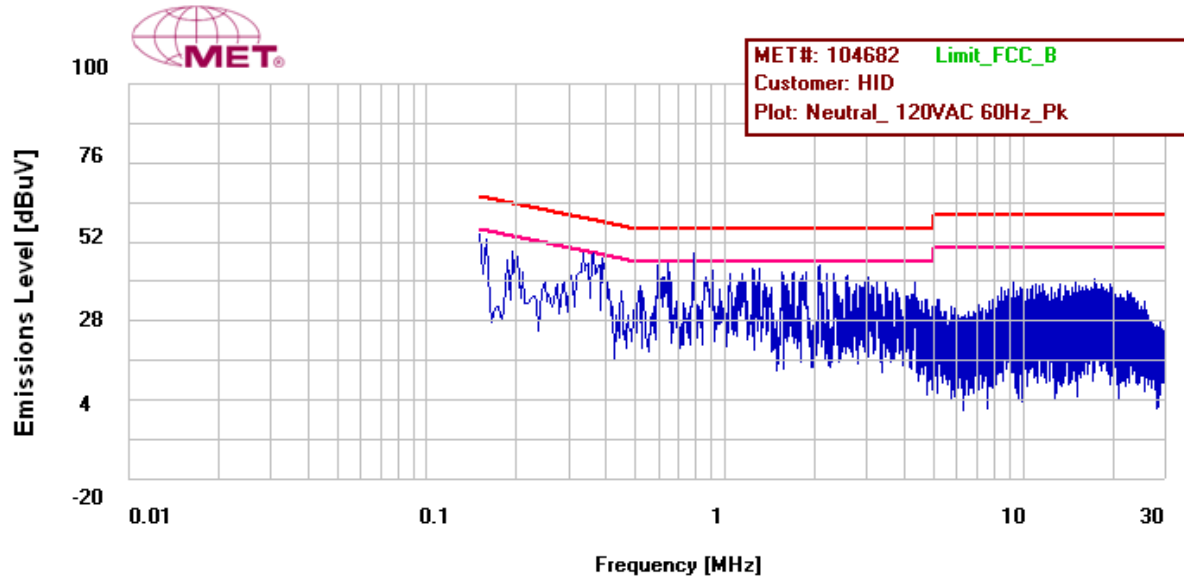
Meas. Location	Meas. m	Limit	Pass/Fail
Bonding measurement from LISN ground to ground plane	0.817 mΩ	< 2.5 mΩ	Pass

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line1_ 120VAV 60Hz	0.154	54.6	65.782	-11.182	Pass	38.4	55.782	-17.382	Pass
	0.202	48.5	63.535	-15.035	Pass	35.7	53.535	-17.835	Pass
	0.866	40.8	56	-15.2	Pass	34.2	46	-11.8	Pass
	1.222	47.1	56	-8.9	Pass	32.7	46	-13.3	Pass
	0.394	44.6	58.001	-13.401	Pass	38.1	48.001	-9.901	Pass
	2.086	44.7	56	-11.3	Pass	38.2	46	-7.8	Pass
Neutral_ 120VAV 60Hz	0.150	56.5	66	-9.5	Pass	42	56	-14	Pass
	0.158	52	65.57	-13.57	Pass	34.8	55.57	-20.77	Pass
	0.194	48.7	63.869	-15.169	Pass	41.2	53.869	-12.669	Pass
	0.790	38.5	56	-17.5	Pass	32.2	46	-13.8	Pass
	0.334	41	59.369	-18.369	Pass	34.2	49.369	-15.169	Pass
	0.362	46.1	58.702	-12.602	Pass	40.8	48.702	-7.902	Pass

Table 9. Conducted Emissions, Class B, Line & Neutral, Test Results



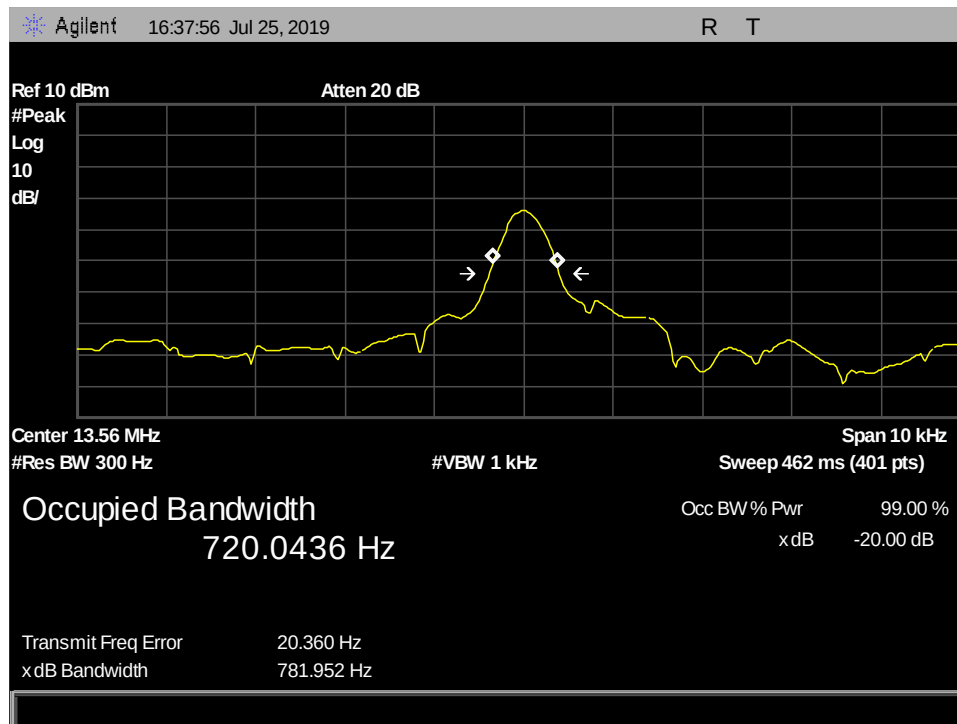
Plot 1. Conducted Emissions, Line



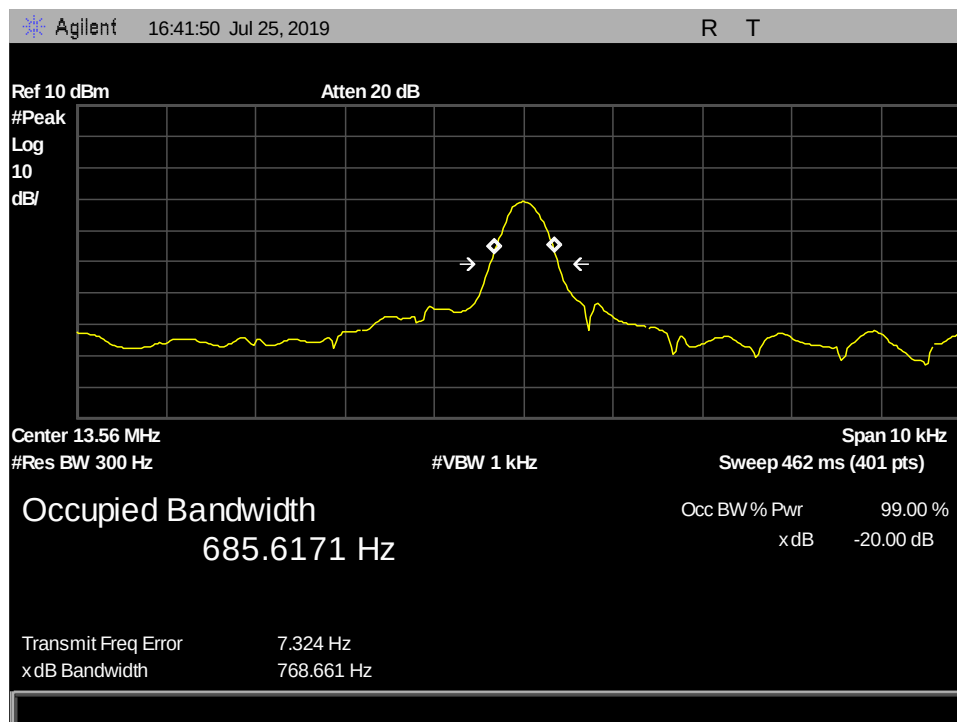
Plot 2. Conducted Emissions, Neutral

Electromagnetic Compatibility Criteria for Intentional Radiators**§ 15.215(c) 20 dB Occupied Bandwidth**

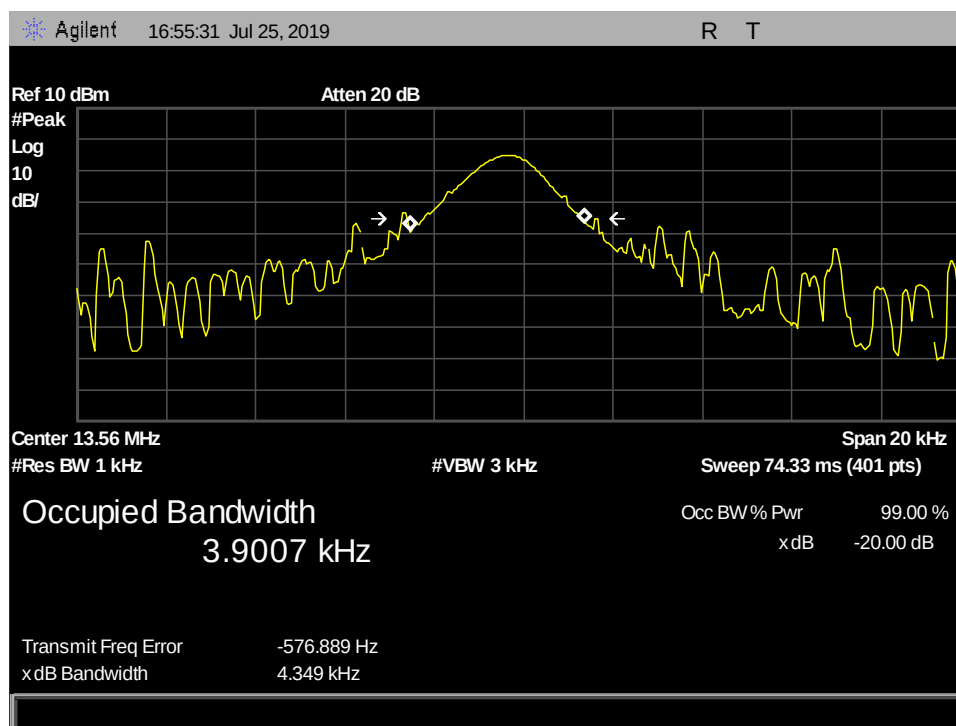
Test Requirement(s):	§ 15.215 (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise 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. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.
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 EUT was compliant with this requirement.
Test Engineer(s):	Adan Arab
Test Date(s):	07/25/2019



Plot 3. - 20dB OBW_ 781.952 Hz_ Film



Plot 4. -20dB OBW_ 768.661 Hz_ Ribbon



Plot 5. -20dB OBW_4.349 KHz_Encoder

Electromagnetic Compatibility Criteria for Intentional Radiators**§ 15.225(a) Field Strength emissions within the band 13.553 – 13.567 MHz**

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.

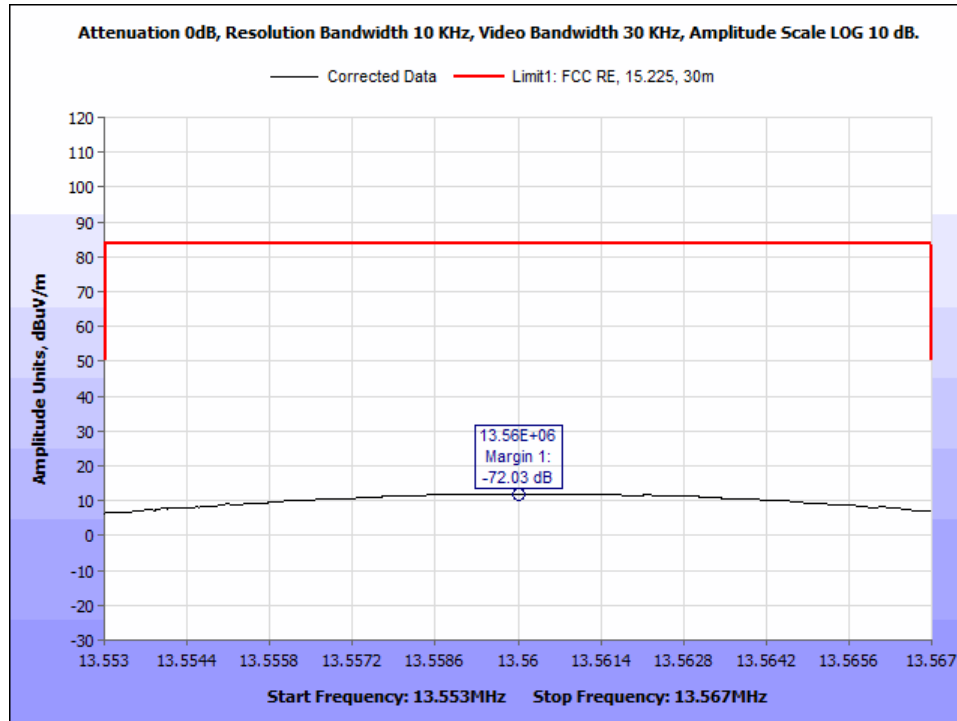
Test Procedure: The EUT was set to transmit and placed on a 0.8m-high non-conductive table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.10: 2013 were used. The loop antenna was located 3m from the EUT. Measurements were conducted with the loop antenna at coaxial (parallel) and planar (perpendicular) orientations. The Spectrum analyzer RBW was set to 10 kHz and VBW was set to 30 kHz. A peak detector was used. The measurements were made at 3m and then extrapolated to 30m using the following correction factor.

$$40\log(3/30) = -40 \text{ dB}$$

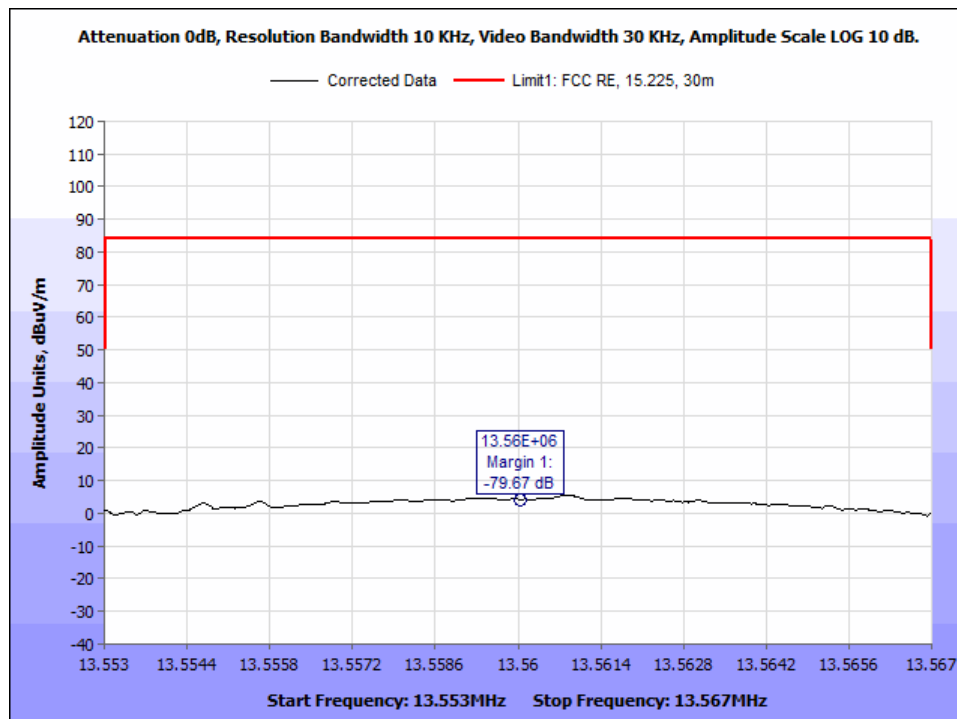
Test Results: The EUT was compliant with the requirements of **§15.225(a)**.

Test Engineer(s): Adan Arab

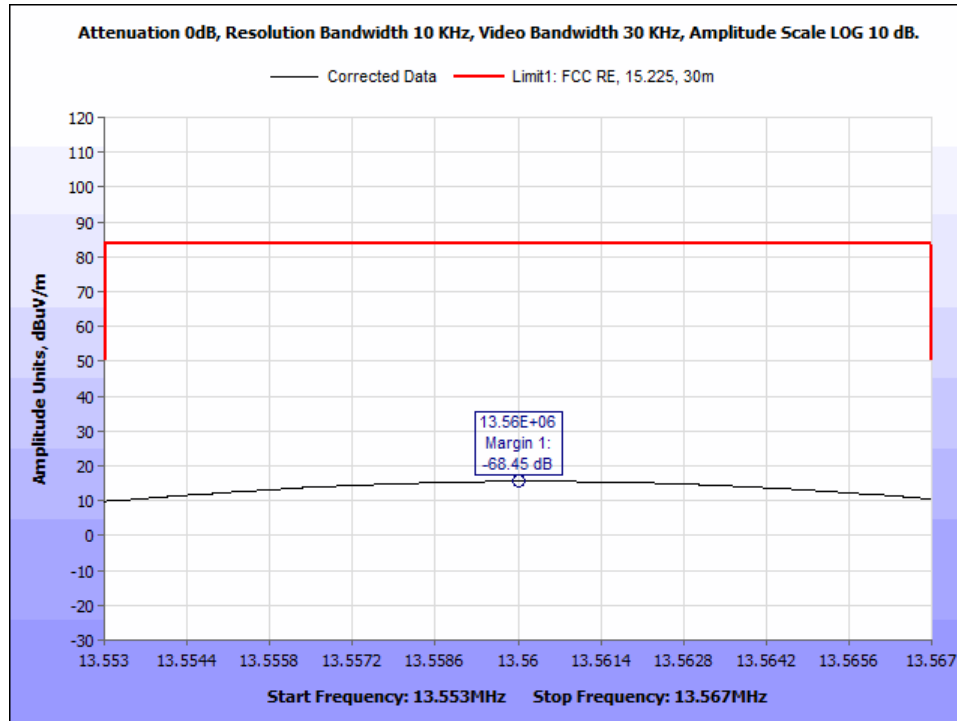
Test Date(s): 07/24/2019



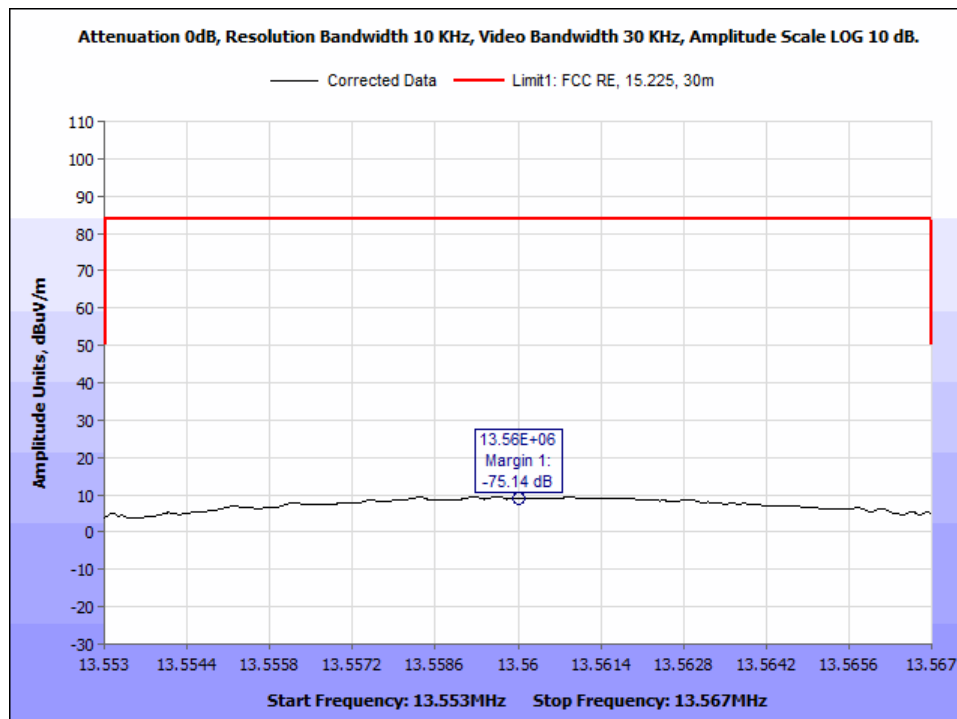
Plot 6. 13.553-13.567 MHz - 0 Deg (Film)



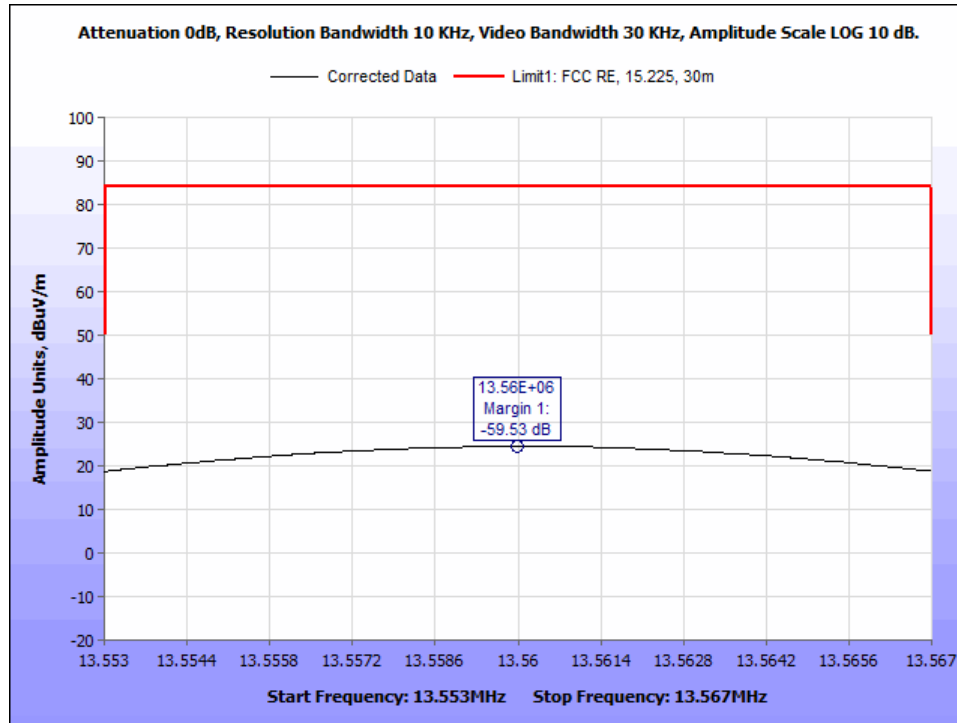
Plot 7. 13.553-13.567 MHz - 90 Deg (Film)



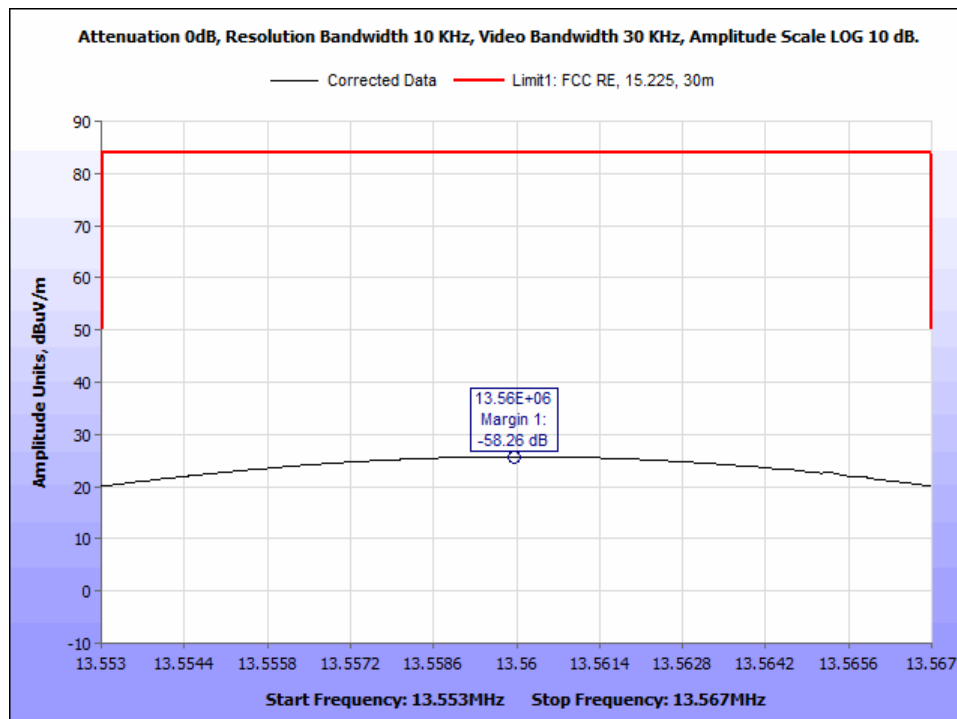
Plot 8. 13.553-13.567 MHz - 0 Deg (Ribbon)



Plot 9. 13.553-13.567 MHz - 90 Deg (Ribbon)



Plot 10. 13.553-13.567 MHz - 0 Deg (Encoder)



Plot 11. 13.553-13.567 MHz - 90 Deg (Encoder)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.225(b) Field Strength emissions within the bands 13.410 – 13.553 MHz and 13.567 – 13.710 MHz

Test Requirement(s): 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.

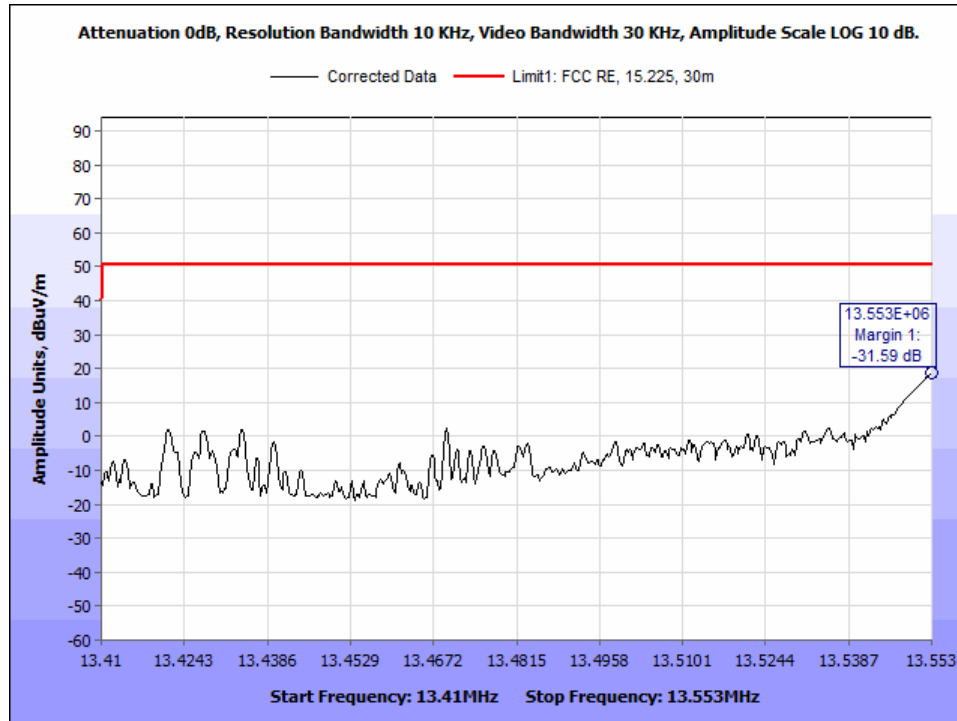
Test Procedures: The EUT was set to transmit and placed on a 0.8m-high a non-conductive table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.10:2013 were used. The loop antenna was located 3m from the EUT. Measurements were conducted with the loop antenna at coaxial (parallel) and planar (perpendicular) orientations. The Spectrum analyzer RBW was set to 10 kHz and VBW was set to 30 kHz. A peak detector was used. The measurements were made at 3m and then extrapolated to 30m using the following correction factor.

$$40\log(3/30) = -40 \text{ dB}$$

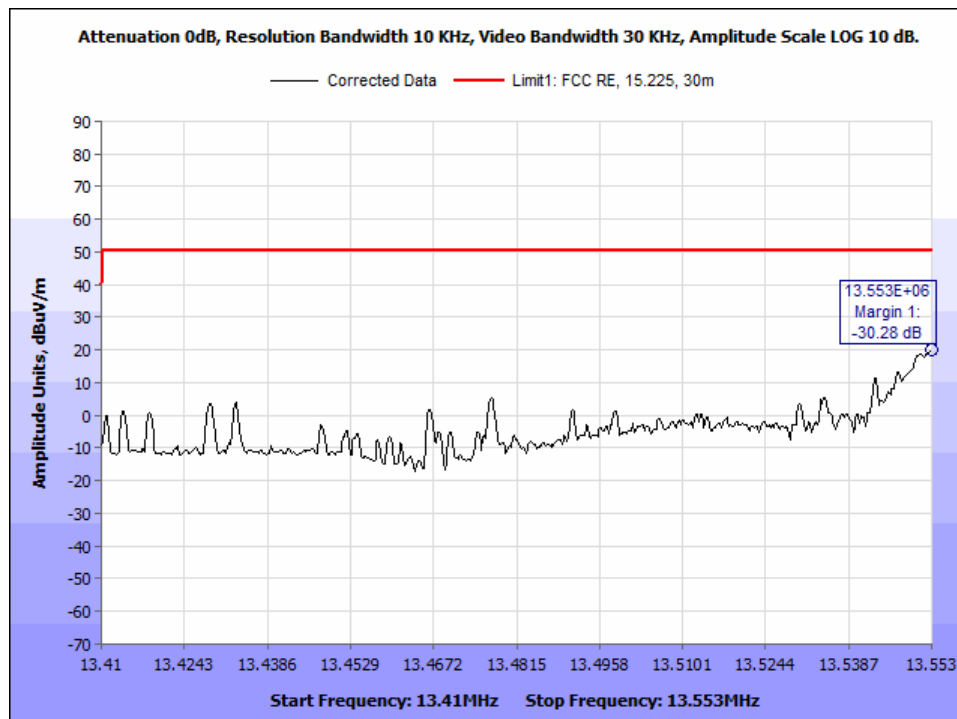
Test Results: The EUT was compliant with the requirements of § 15.225(b).

Test Engineer(s): Adan Arab

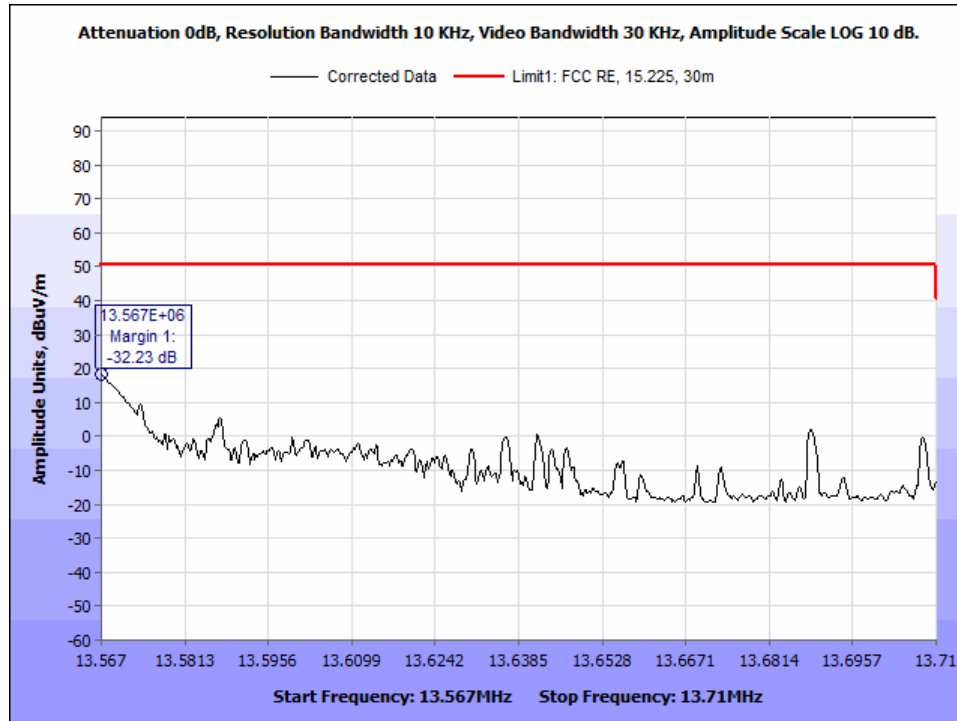
Test Date(s): 07/24/2019



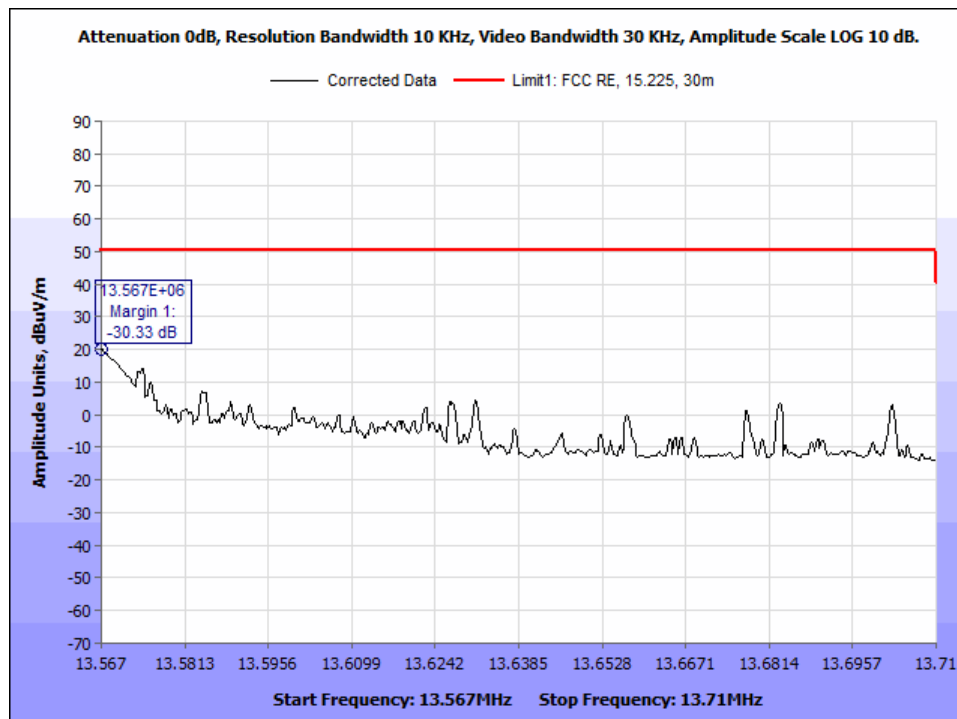
Plot 12. 13.410-13.553 MHz - 0 Deg (Encoder)



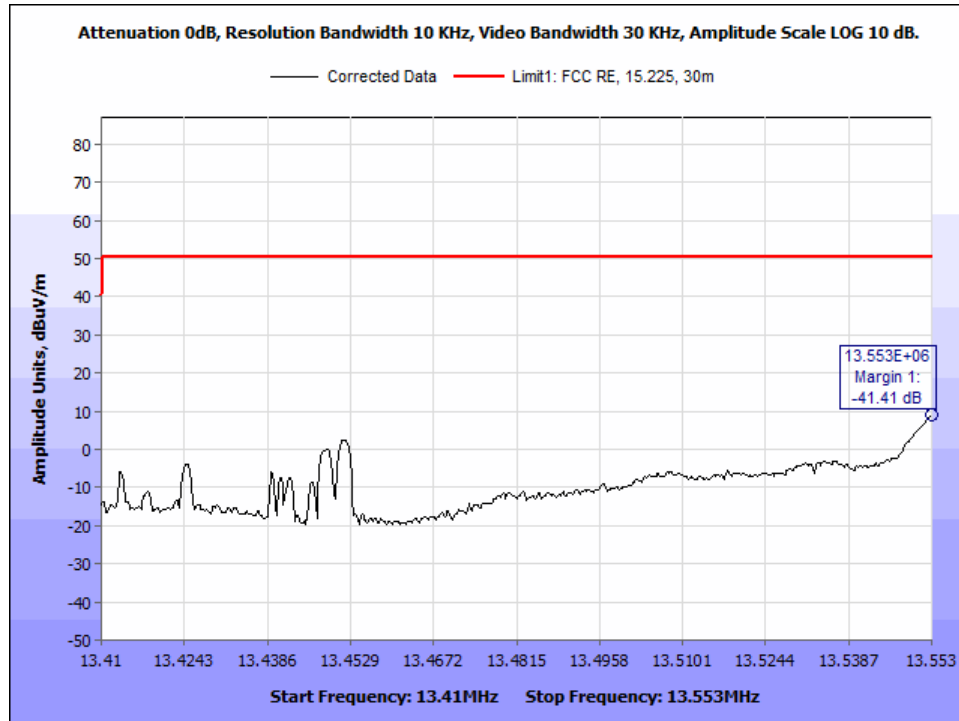
Plot 13. 13.410-13.553 MHz - 90 Deg (Encoder)



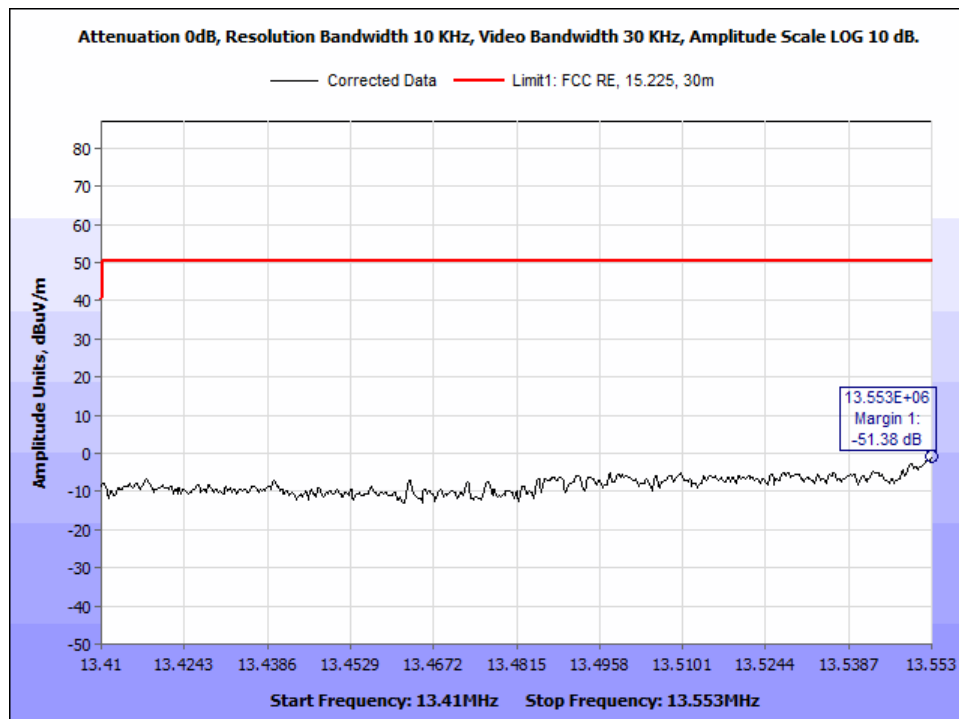
Plot 14. 13.567-13.710 MHz - 0 Deg (Encoder)



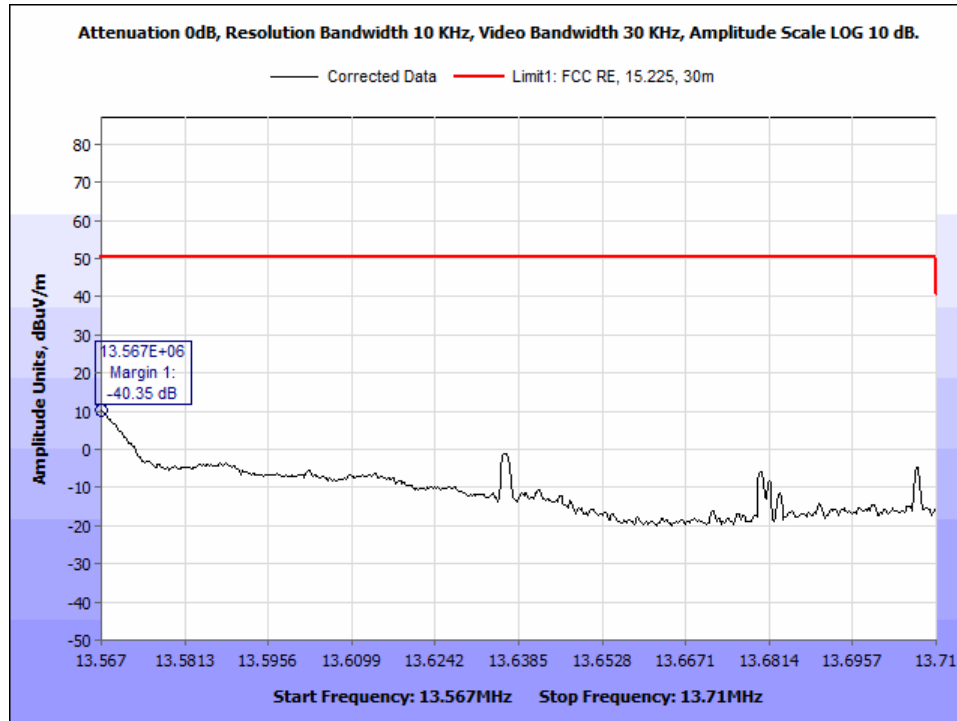
Plot 15. 13.567-13.710 MHz - 90 Deg (Encoder)



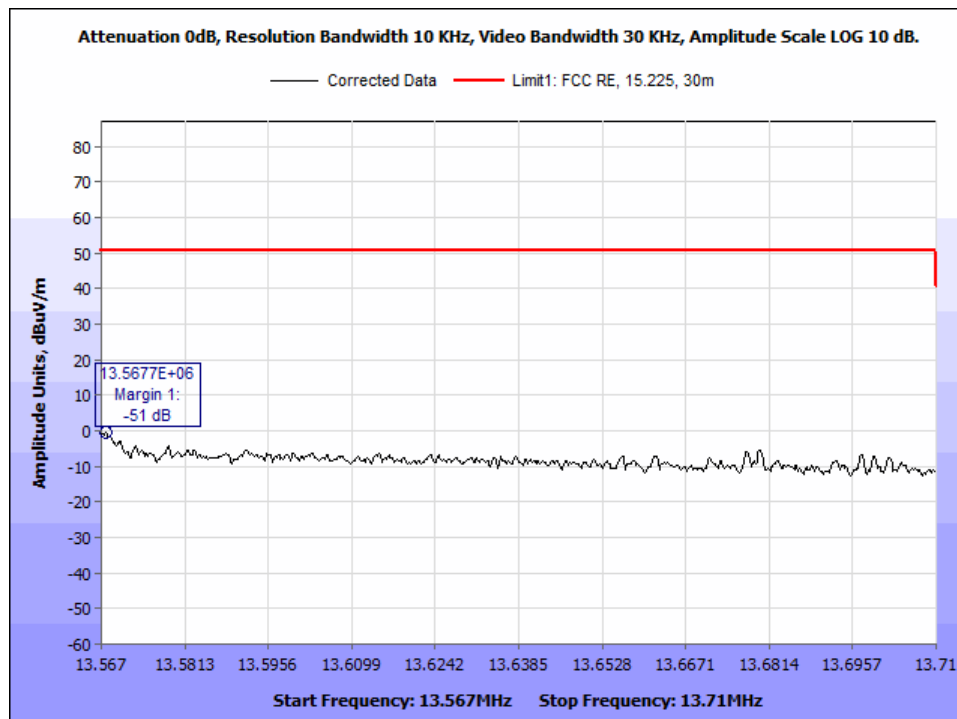
Plot 16. 13.410-13.553 MHz - 0 Deg (Film)



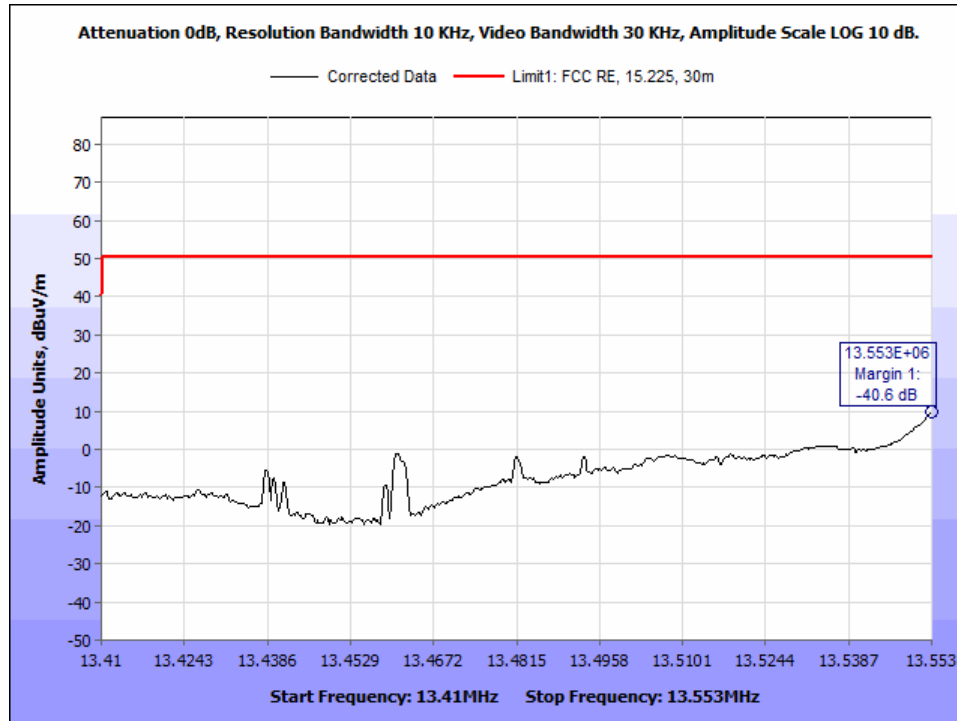
Plot 17. 13.410-13.553 MHz - 90 Deg (Film)



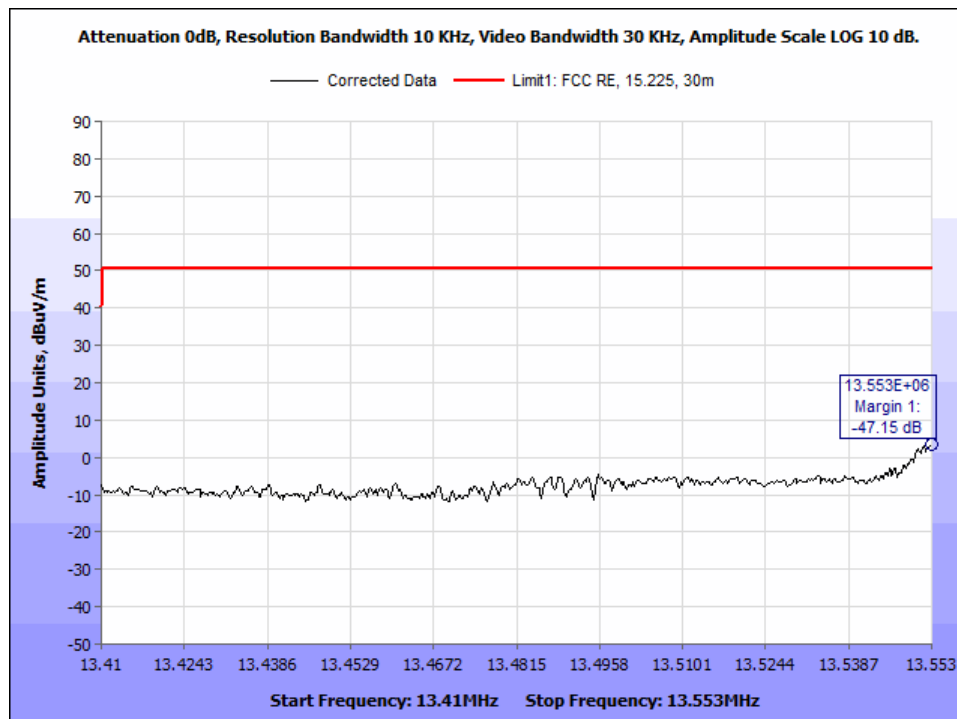
Plot 18. 13.567-13.710 MHz - 0 Deg (Film)



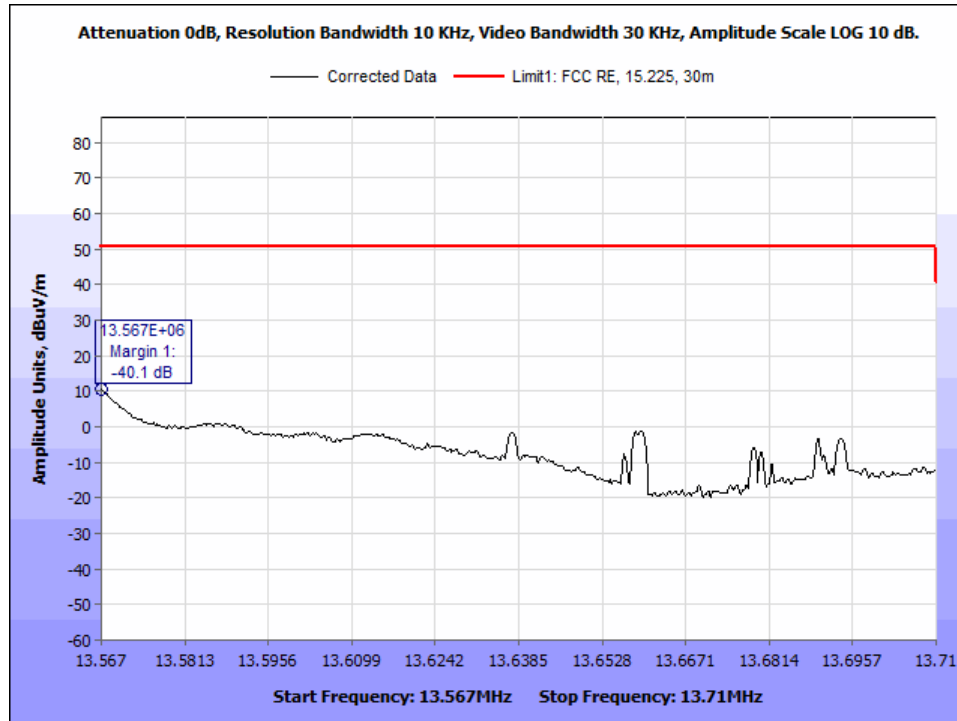
Plot 19. 13.567-13.710 MHz - 90 Deg (Film)



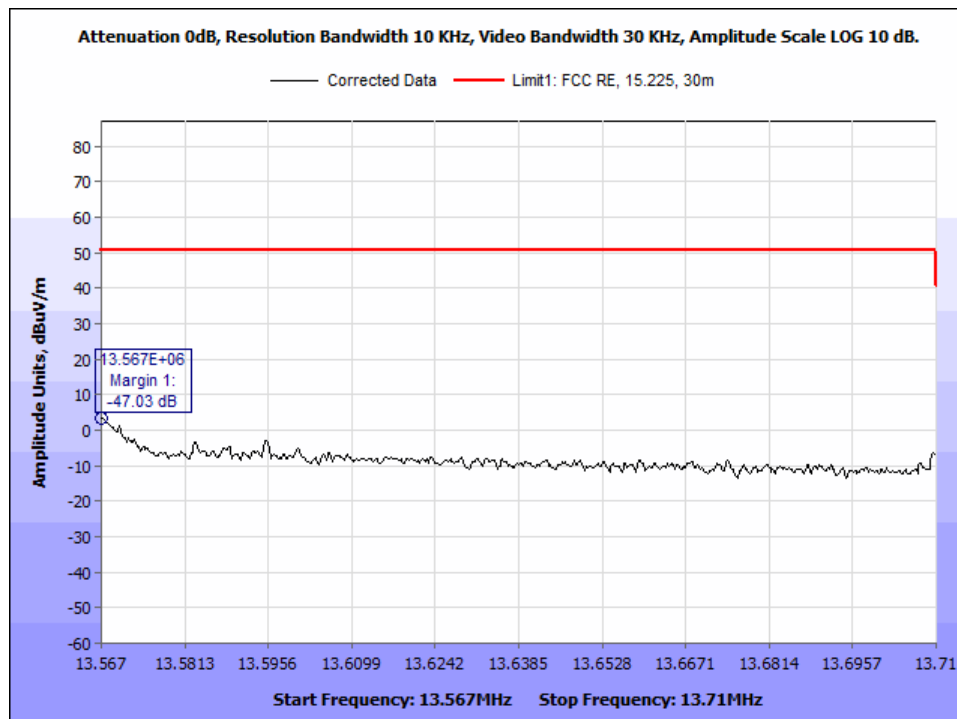
Plot 20. 13.410-13.553 MHz - 0 Deg



Plot 21. 13.410-13.553 MHz - 90 Deg



Plot 22. 13.567- 13.710 MHz - 0 Deg



Plot 23. 13.567- 13.710 MHz - 90 Deg

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.225(c) Field Strength emissions within the bands 13.110 – 13.410 MHz and 13.710 – 14.010 MHz

Test Requirement(s): 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.

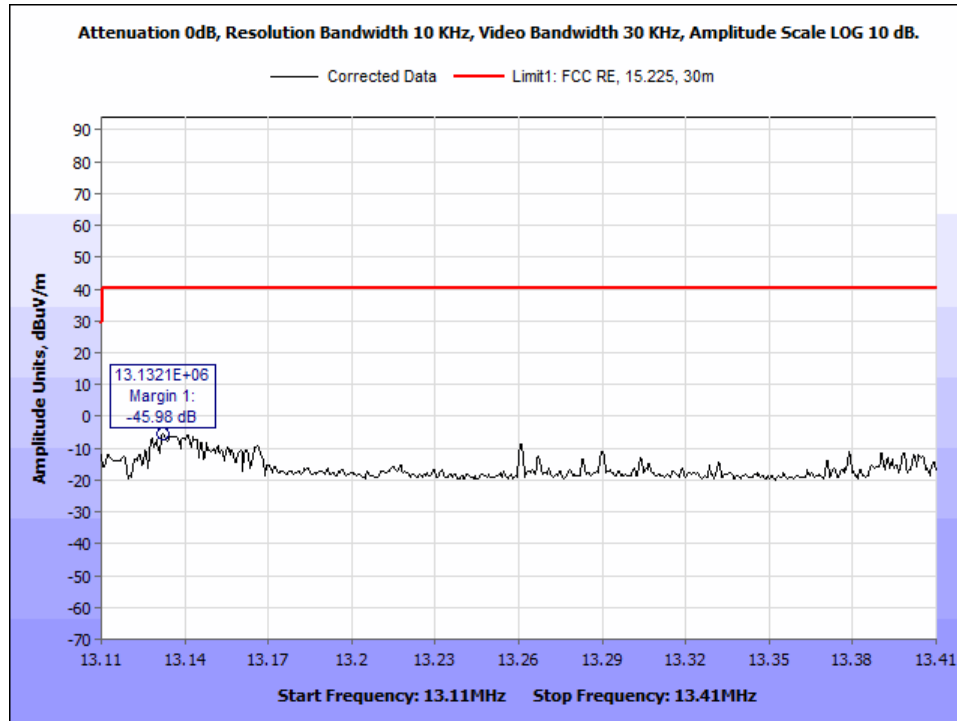
Test Procedures: The EUT was set to transmit and placed on a 0.8m-high non-conductive table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.10: 2013 were used. The loop antenna was located 3m from the EUT. Measurements were conducted with the loop antenna at coaxial (parallel) and planar (perpendicular) orientations. The Spectrum analyzer RBW was set to 10 kHz and VBW was set to 30 kHz. A peak detector was used. The measurements were made at 3m and then extrapolated to 30m using the following correction factor.

$$40\log(3/30) = -40 \text{ dB}$$

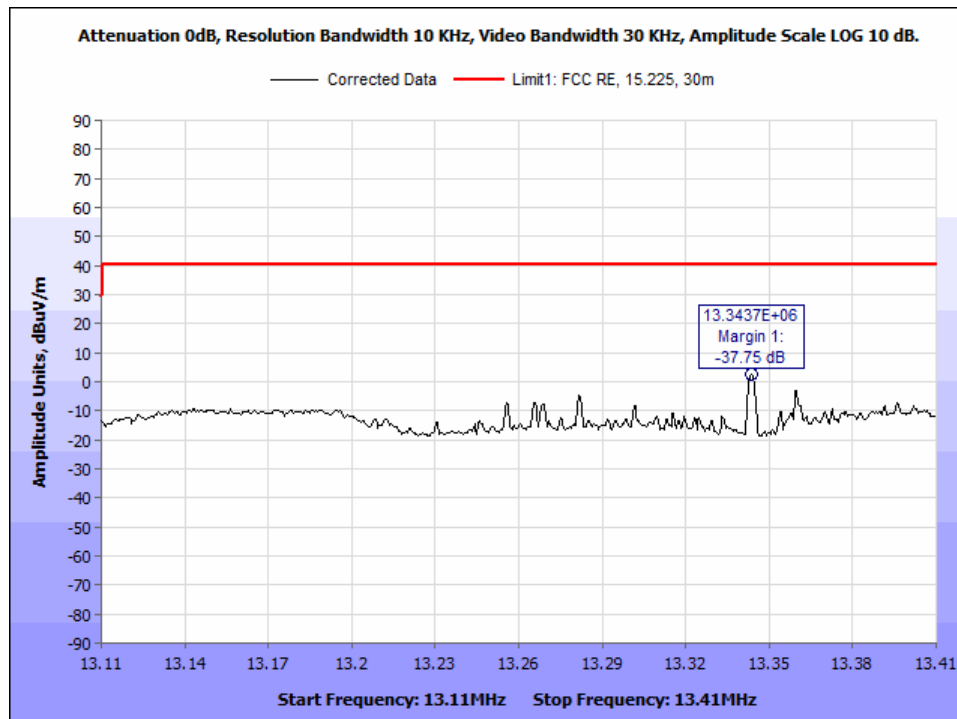
Test Results: The EUT was compliant with the requirements of §15.225(c).

Test Engineer(s): Adan Arab

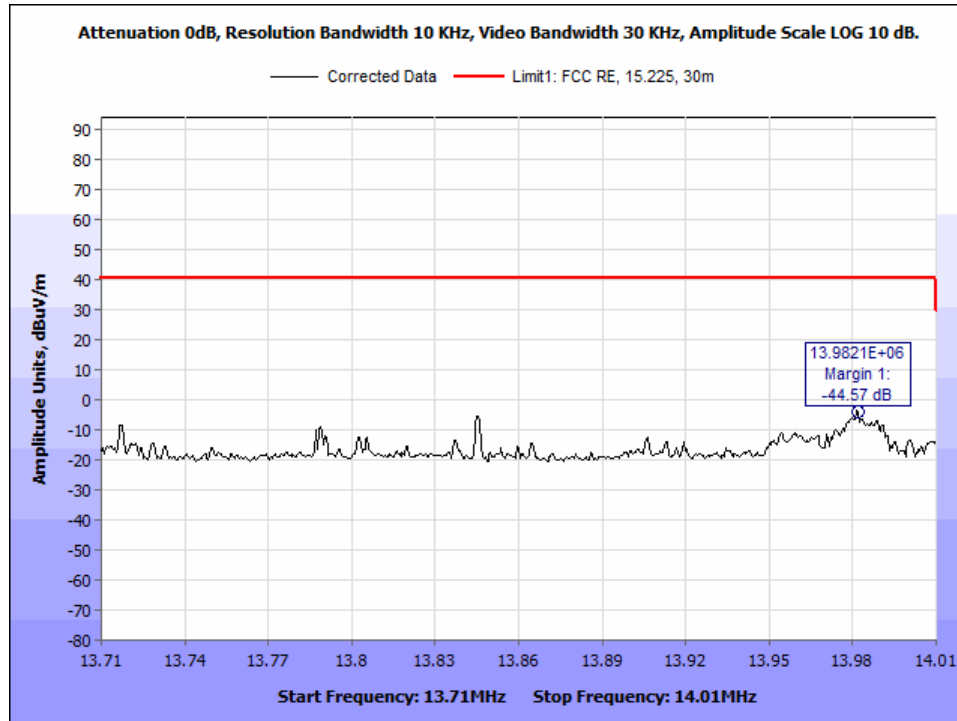
Test Date(s): 07/24/2019



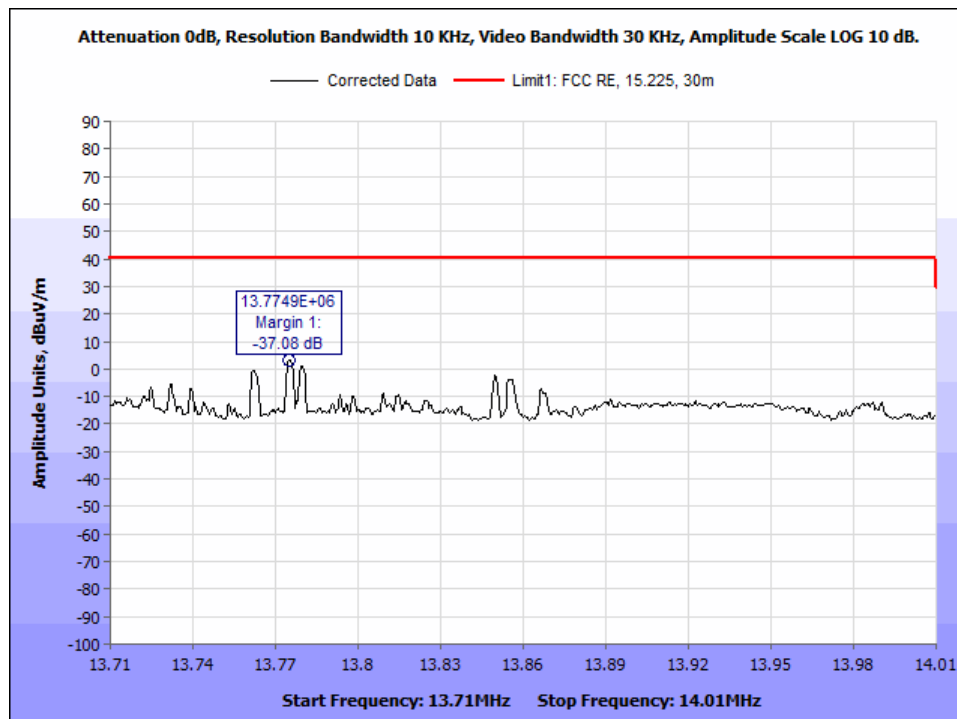
Plot 24. 13.110-13.410 MHz - 0 Deg (Encoder)



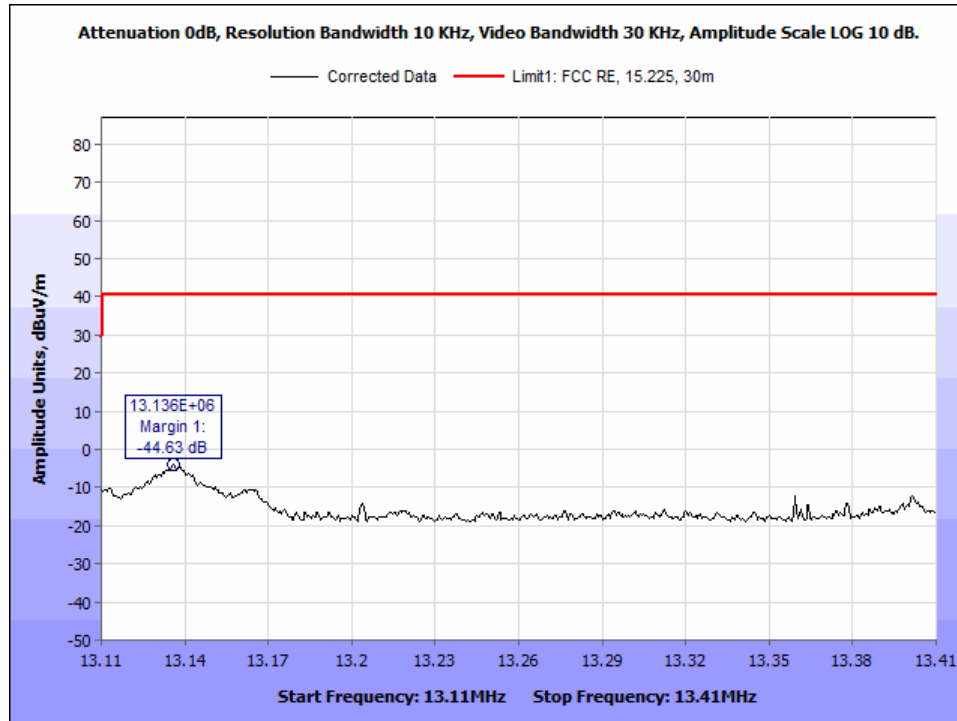
Plot 25. 13.110-13.410 MHz - 90 Deg (Encoder)



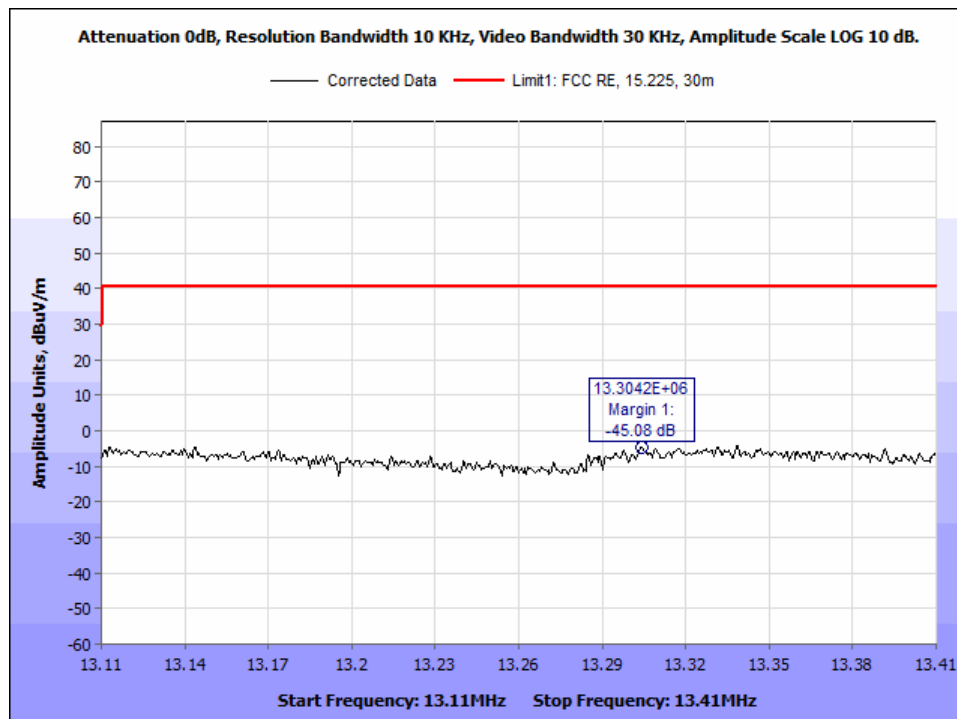
Plot 26. 13.710-14.010 MHz - 0 Deg (Encoder)



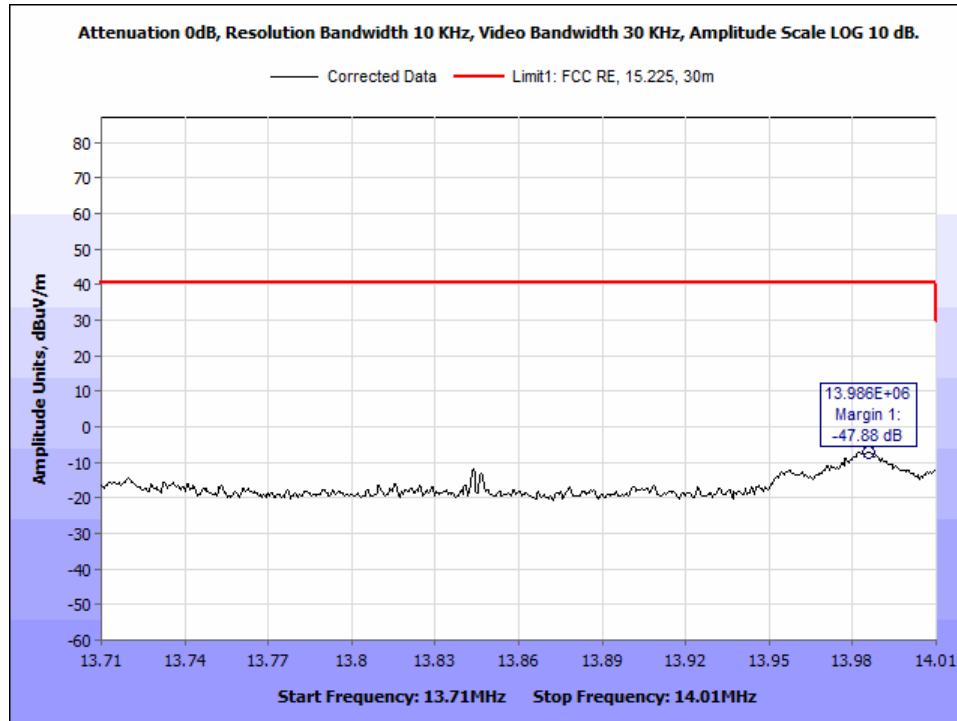
Plot 27. 13.710-14.010 MHz - 90 Deg (Encoder)



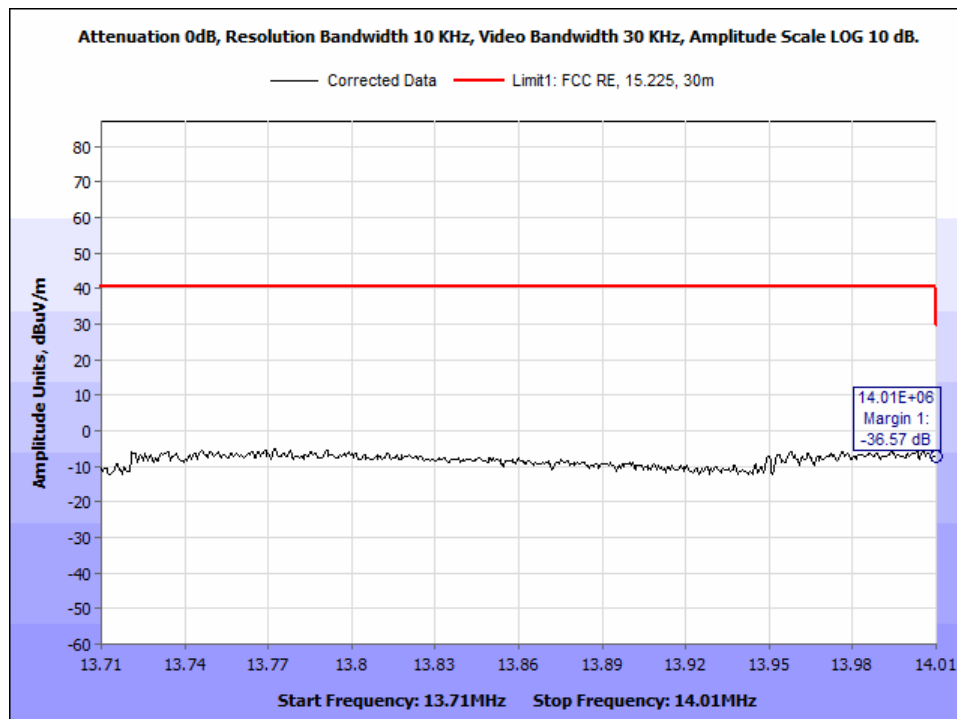
Plot 28. 13.110-13.410 MHz - 0 Deg (Film)



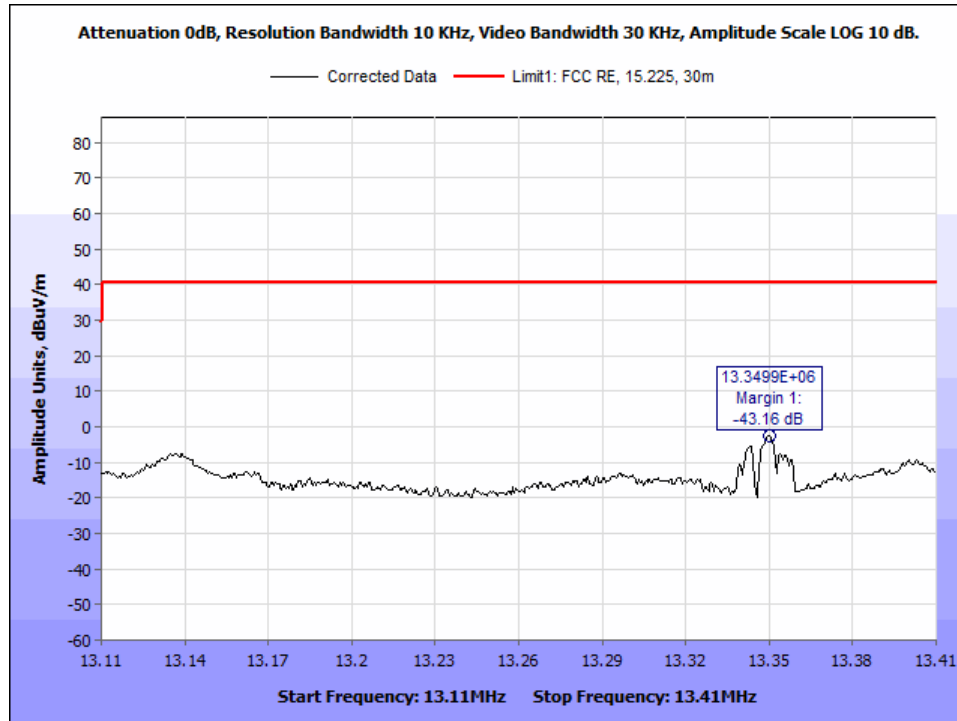
Plot 29. 13.110-13.410 MHz - 90 Deg (Film)



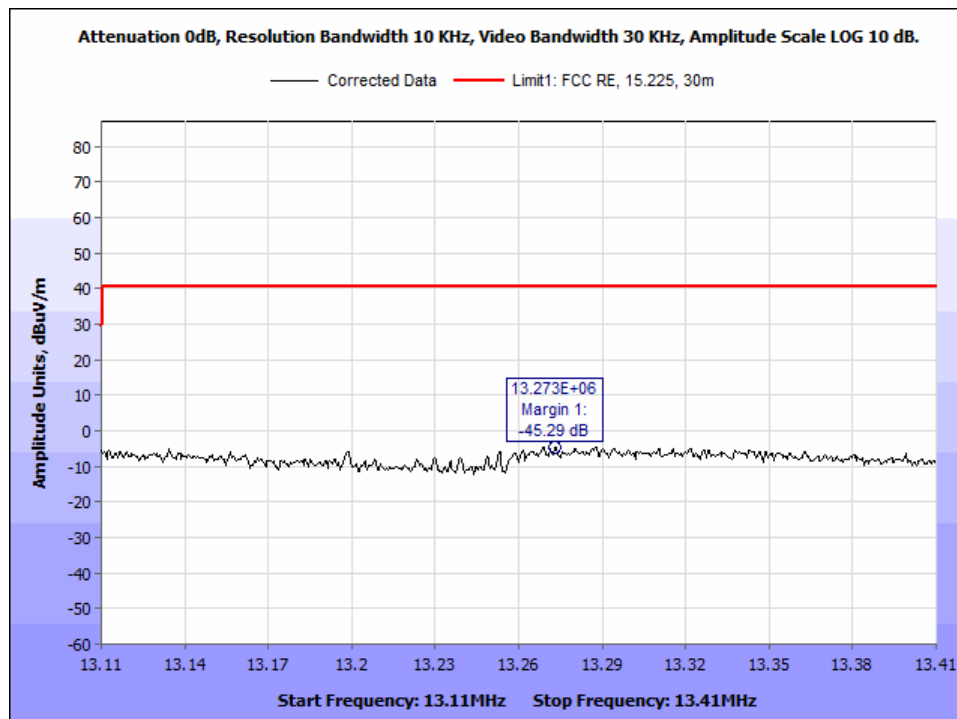
Plot 30. 13.710-14.010 MHz - 0 Deg (Film)



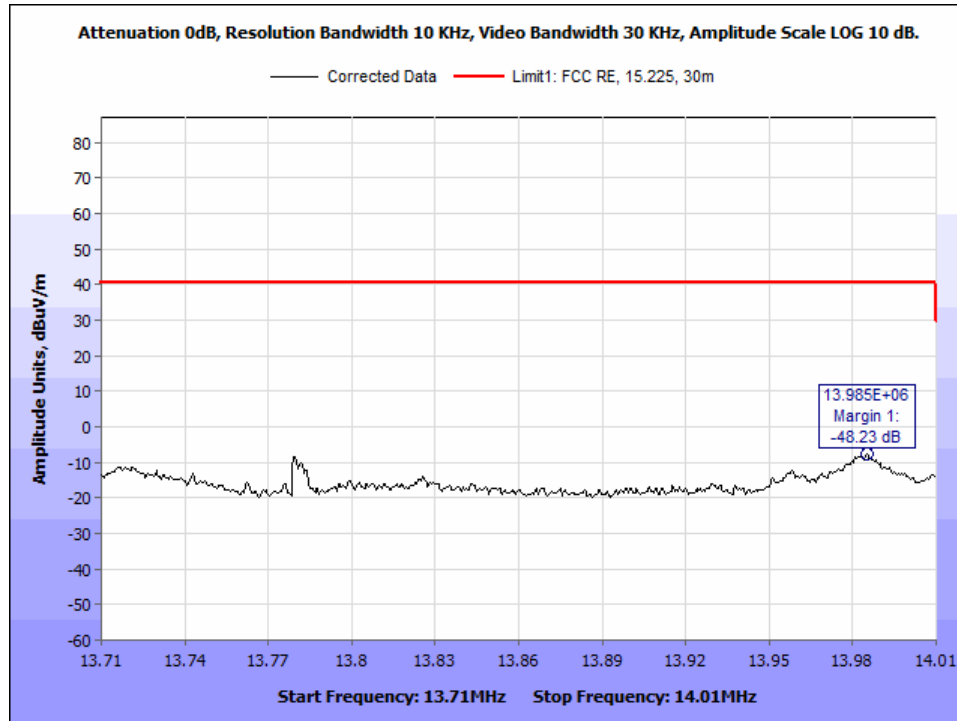
Plot 31. 13.710-14.010 MHz - 90 Deg (Film)



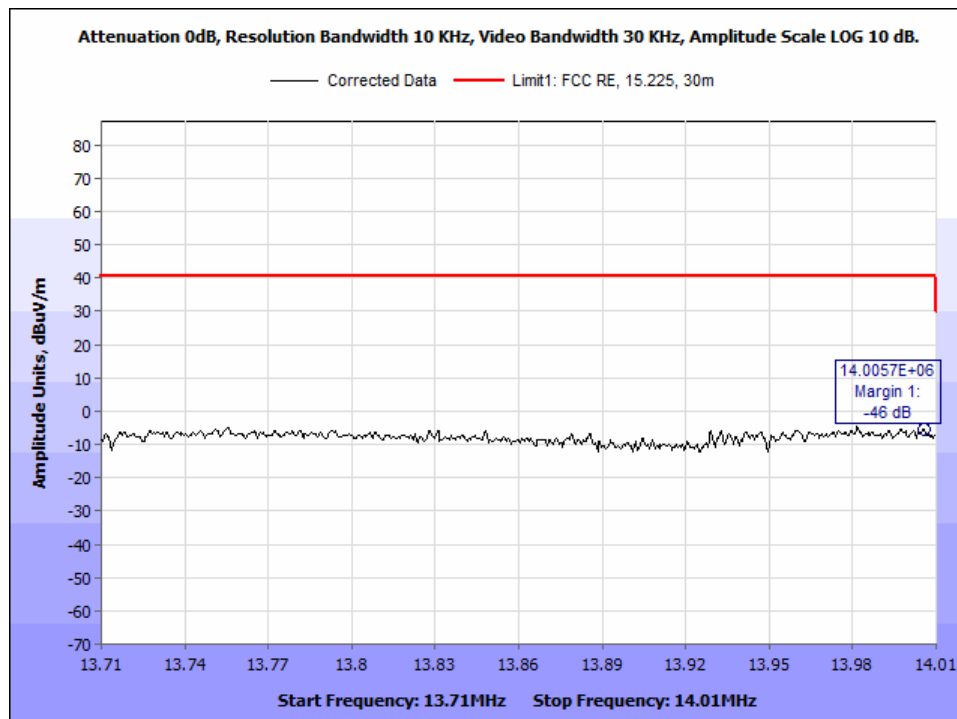
Plot 32. 13.110-13.410 MHz - 0 Deg (Ribbon)



Plot 33. 13.110-13.410 MHz - 90 Deg (Ribbon)



Plot 34. 13.710-14.010 MHz - 0 Deg



Plot 35. 13.710-14.010 MHz - 90 Deg

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.225(d) Outside-Band Field Strength emissions - 13.110 – 14.010 MHz

Test Requirement(s): 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.

Test Procedures: The EUT was set to transmit and placed on a 0.8m-high non-conductive table 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 were conducted with the loop antenna at coaxial (parallel) and planar (perpendicular) orientations. The Spectrum analyzer RBW was set to 10 kHz and VBW was set to 30 kHz. A peak detector was used below 30 MHz and a Quasi-peak detector was used for measurements for above 30 MHz.

The measurements made at 3m with the loop antenna were then extrapolated to 30m or 300 M using the following correction factor.

$$40\log(3/30) = -40 \text{ dB}$$
$$40\log(3/300) = -80 \text{ dB}$$

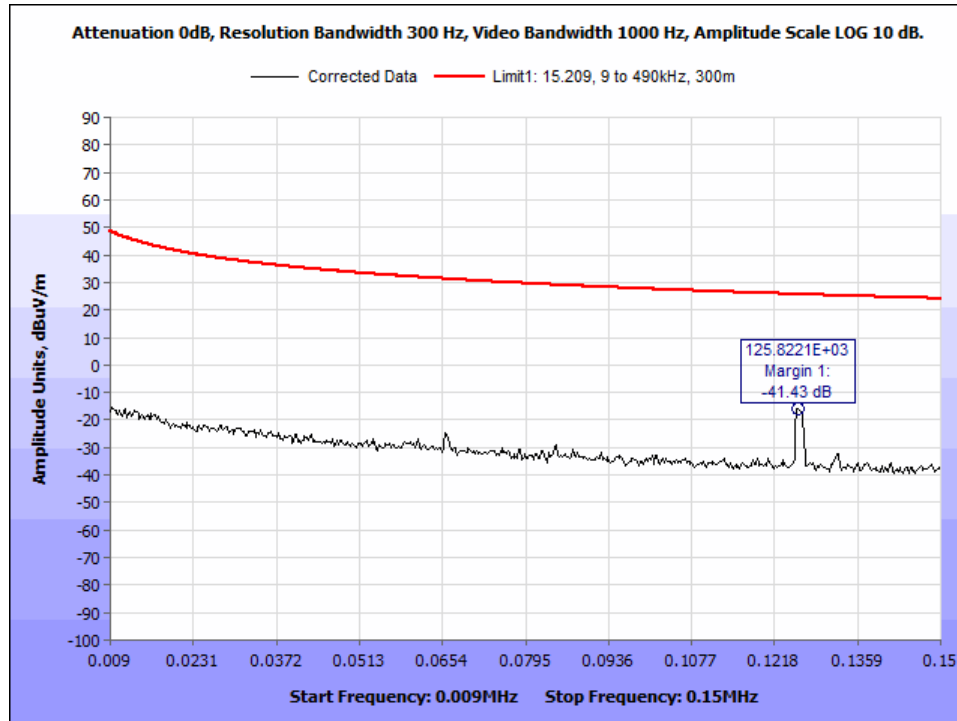
The Measurement made at 10m with the biconilog antenna was then extrapolated to the 3m using the following correction factor.

$$20\log(10/3) = +10.46 \text{ dB}$$

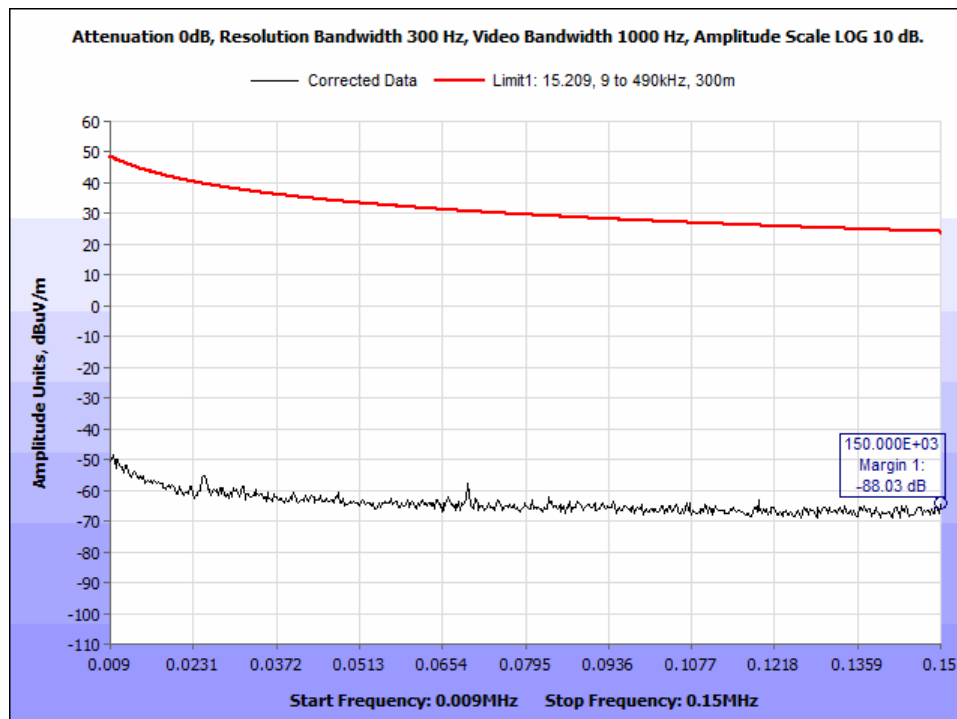
Test Results: The EUT was compliant with requirements of § 15.225 (d).

Test Engineer: Adan Arab

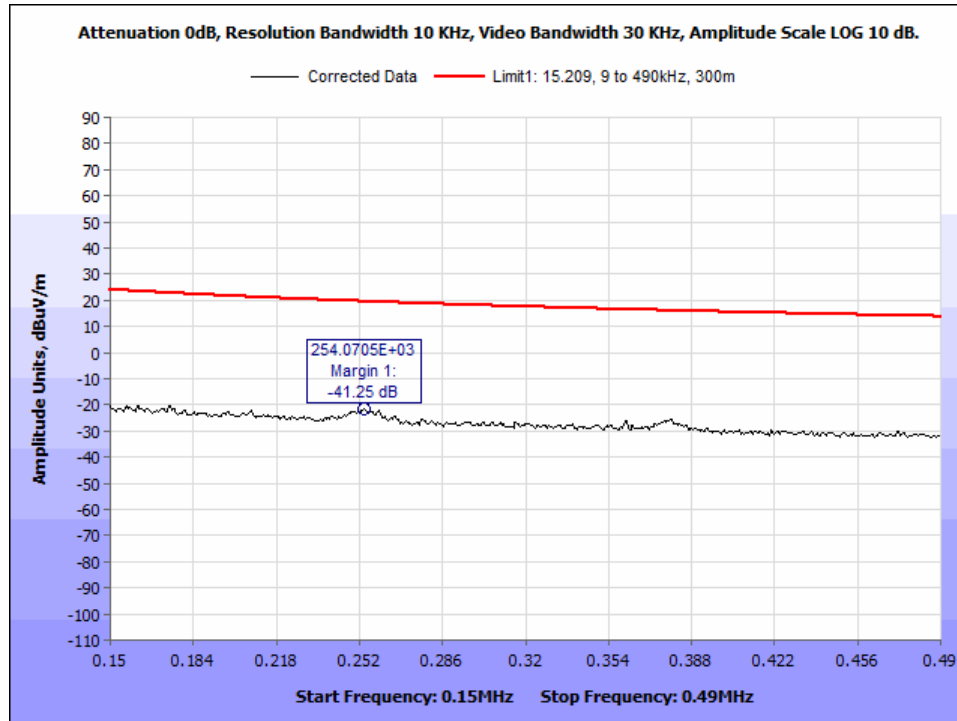
Test Date: 07/22/2019



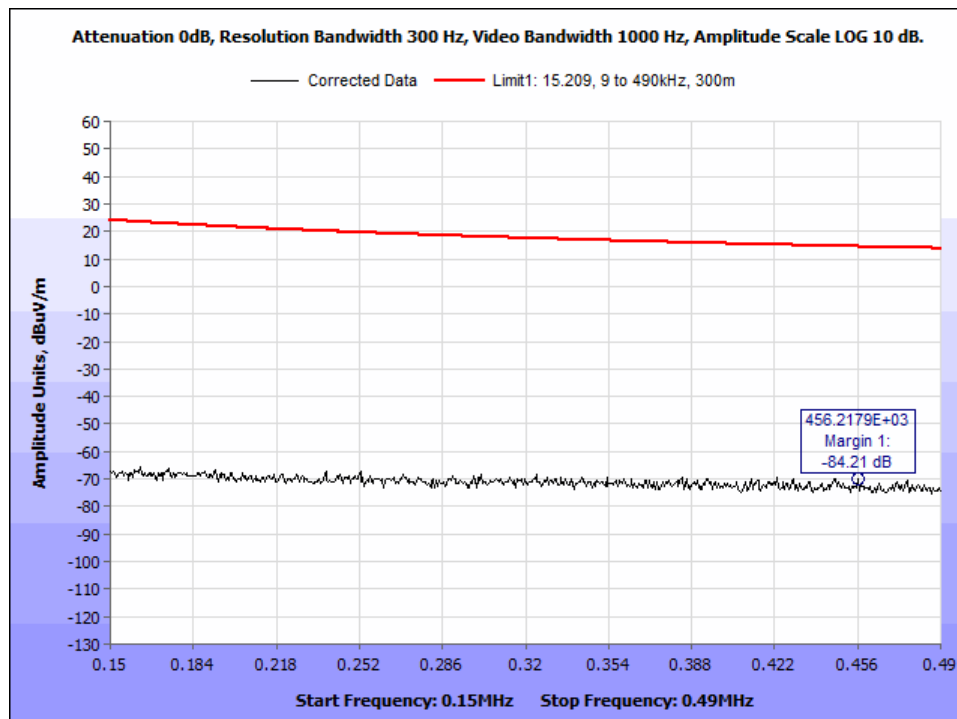
Plot 36. 0.009-0.150 MHz - 0 Deg



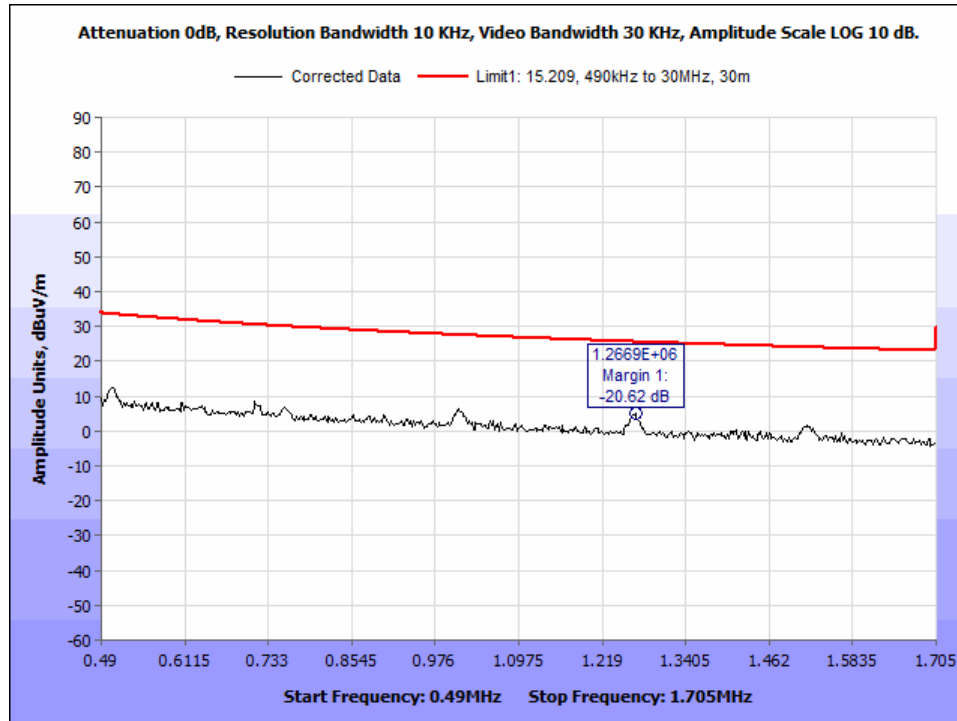
Plot 37. 0.009-0.150 MHz - 90 Deg



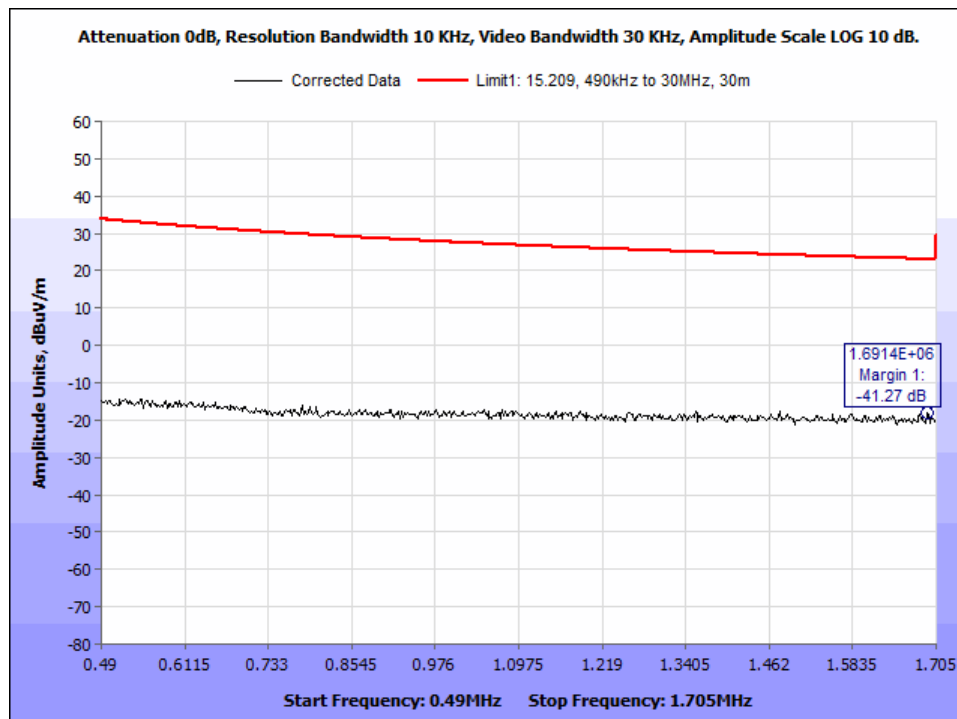
Plot 38. RSE - 0.150-0.490 MHz - 0 Deg



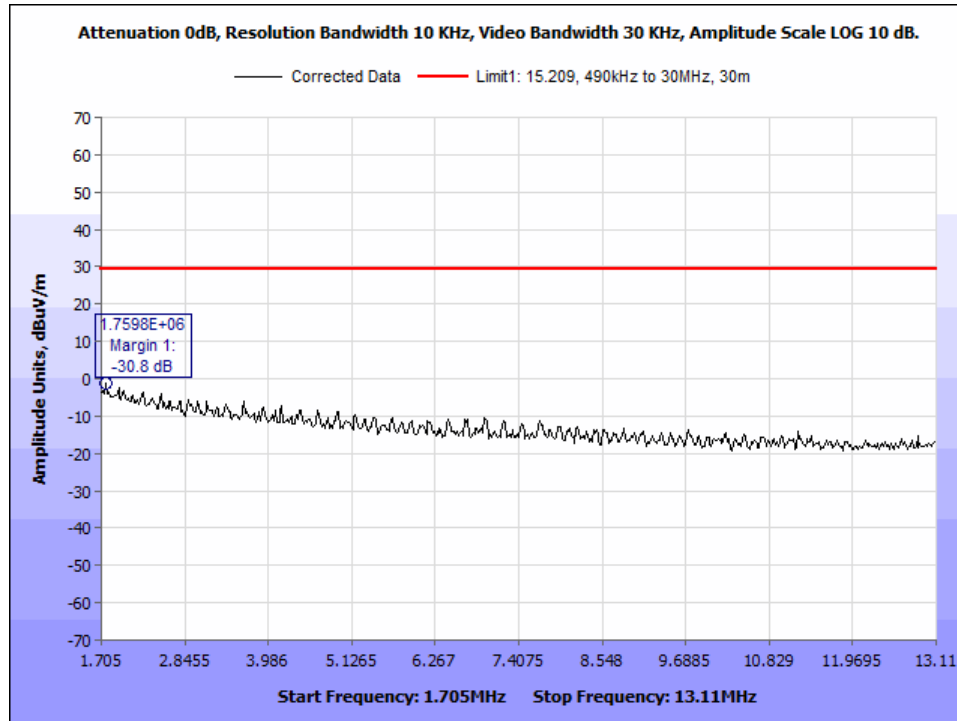
Plot 39. RSE - 0.150-0.490 MHz - 90 Deg



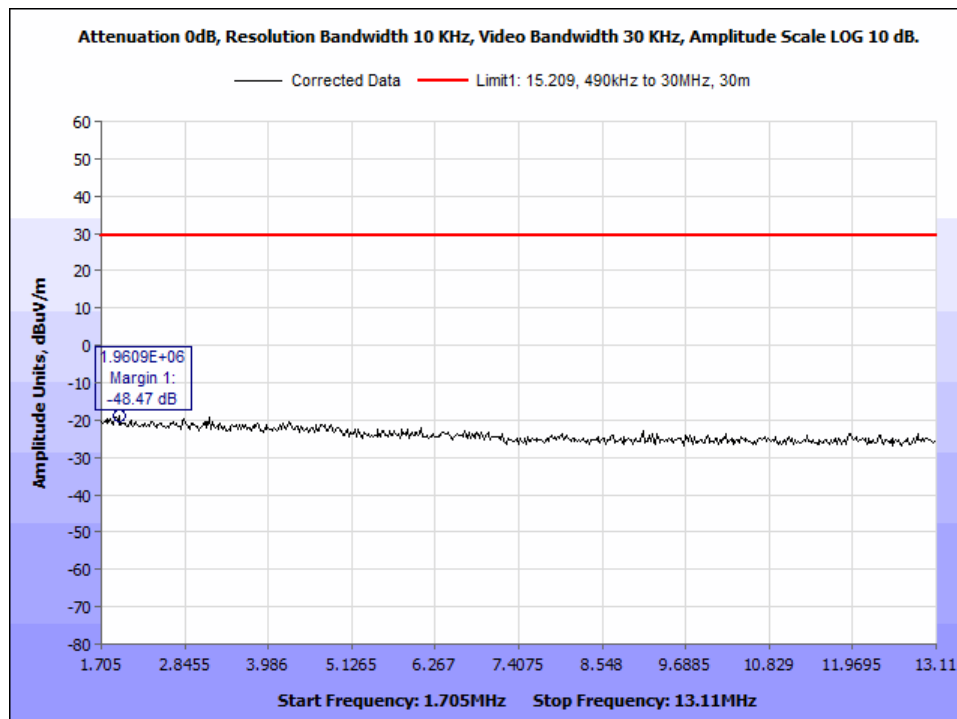
Plot 40. RSE - 0.490-1.705 MHz - 0 Deg



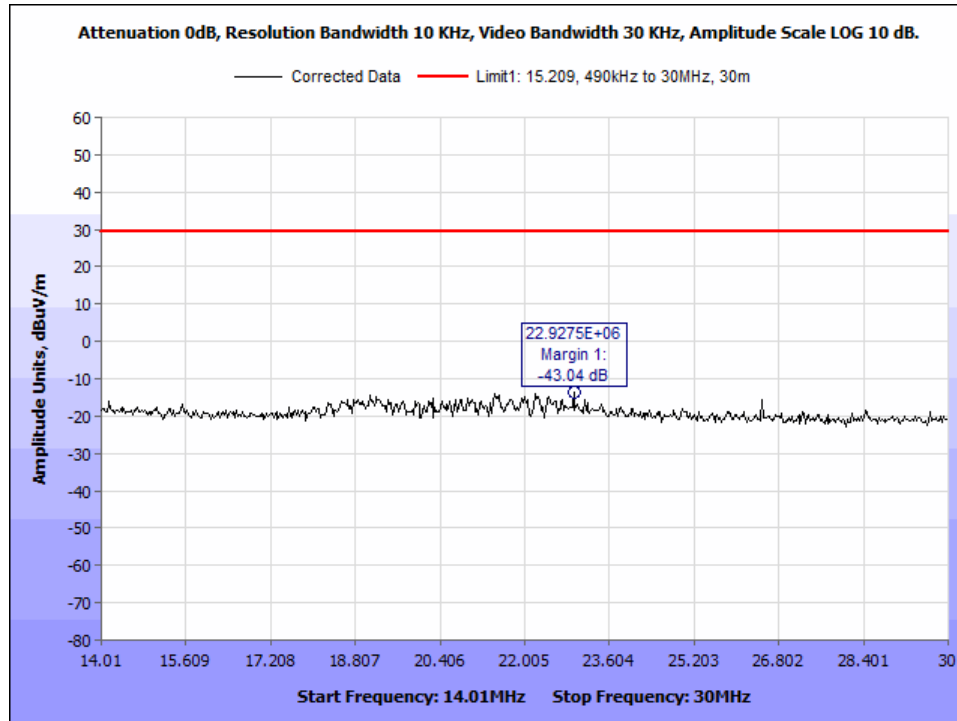
Plot 41. RSE - 0.490-1.705 MHz - 90 Deg



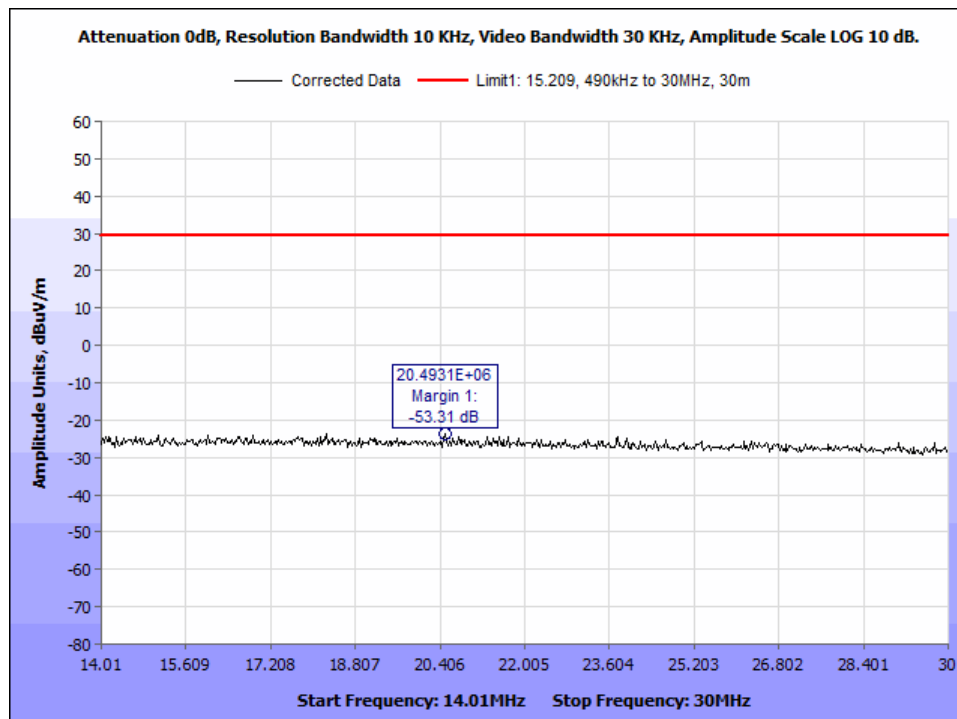
Plot 42. RSE - 1.705-13.110 MHz - 0 Deg



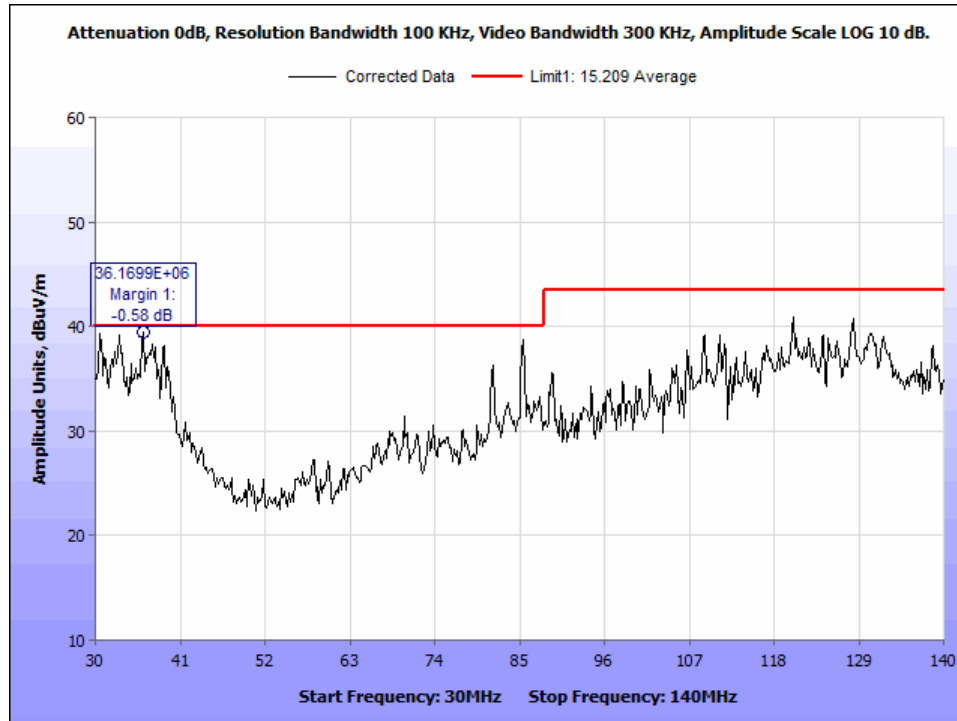
Plot 43. RSE - 1.705-13.110 MHz - 90 Deg



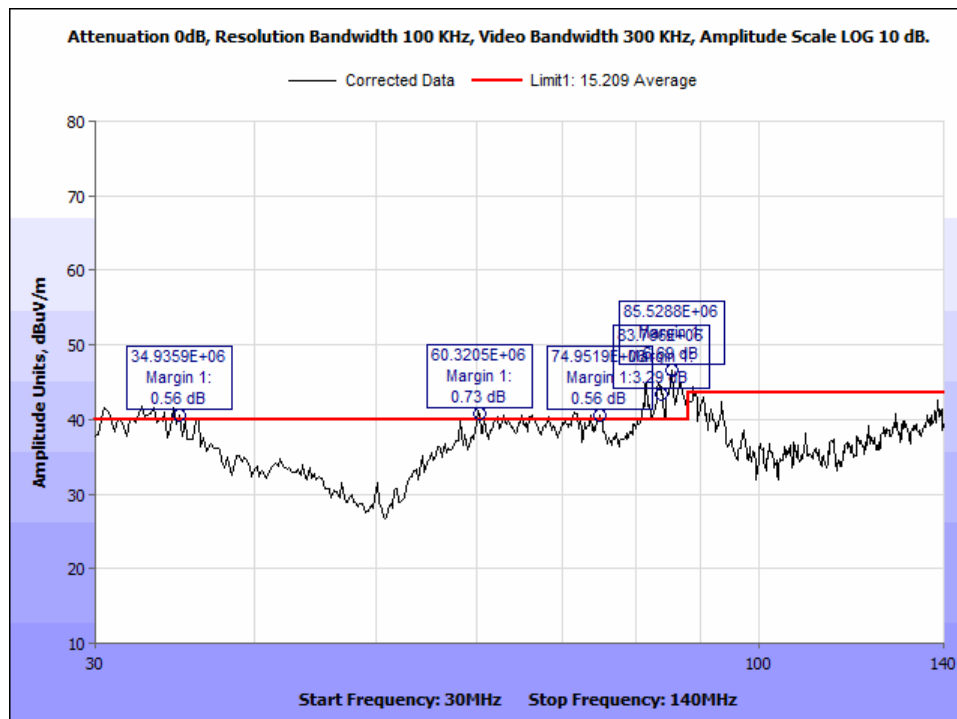
Plot 44. RSE - 14.010-30 MHz - 0 Deg



Plot 45. RSE - 14.010-30 MHz - 90 Deg



Plot 46. RSE - 30-140 MHz – H



Plot 47. RSE - 30-140 MHz – V

Quasi Peak										
Frequency (MHz)	Meter Reading (dBuV)	RBW (KHz)	Azimuth (Degrees)	Height (cm)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Preamp Factor (dB)	Corrected Measurement dBuV/m	Limit , 15.209 Average dBuV/m	Margin (dB)
60.1442	35.1	100	120.8	319.5	10.46	9.99	-24.23	31.32	40	-8.68
30.5288	29.4	100	236.7	229.3	10.46	21.98	-24.78	37.06	40	-2.94
Note	Measurements listed above represent quasi-peak results for spurious related to the 13.56 MHz fundamental frequency. All other spurious emissions above the limit were determined to be sourced from digital devices other than the transmitter.									

Table 10. Spurious Emissions outside of 13.110-14.010 MHz, 30-140 MHz, Vertical, Quasi-Peak Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.225(e) Frequency Stability

Test Requirement(s): 15.225(e) The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ 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.

Test Procedure: Measurements are in accordance with Part 2.1055. 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 -20° to 50°C .

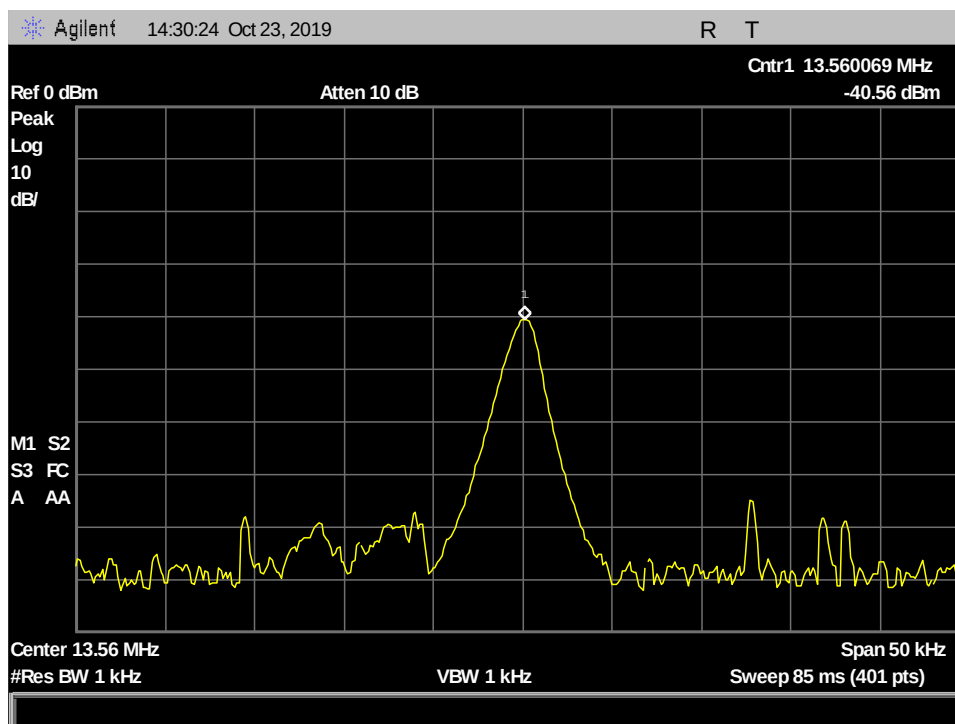
Test Results: The EUT was found compliant with Part 15.225 (e) requirement(s) of this section.

Test Engineer(s): Adan Arab

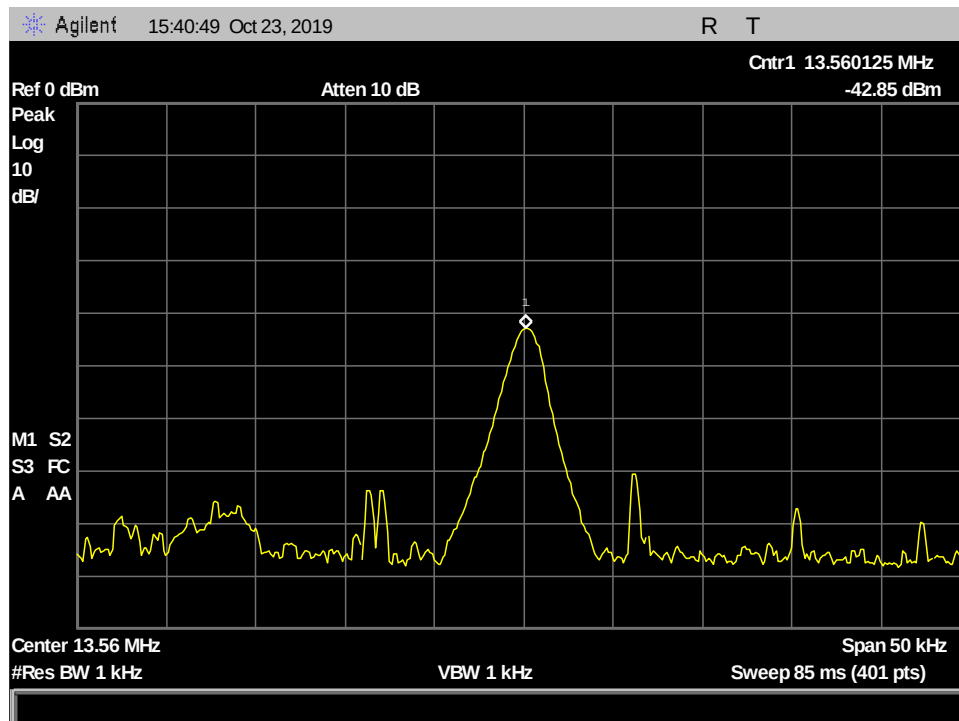
Test Date(s): 10/23/2019

Encoder

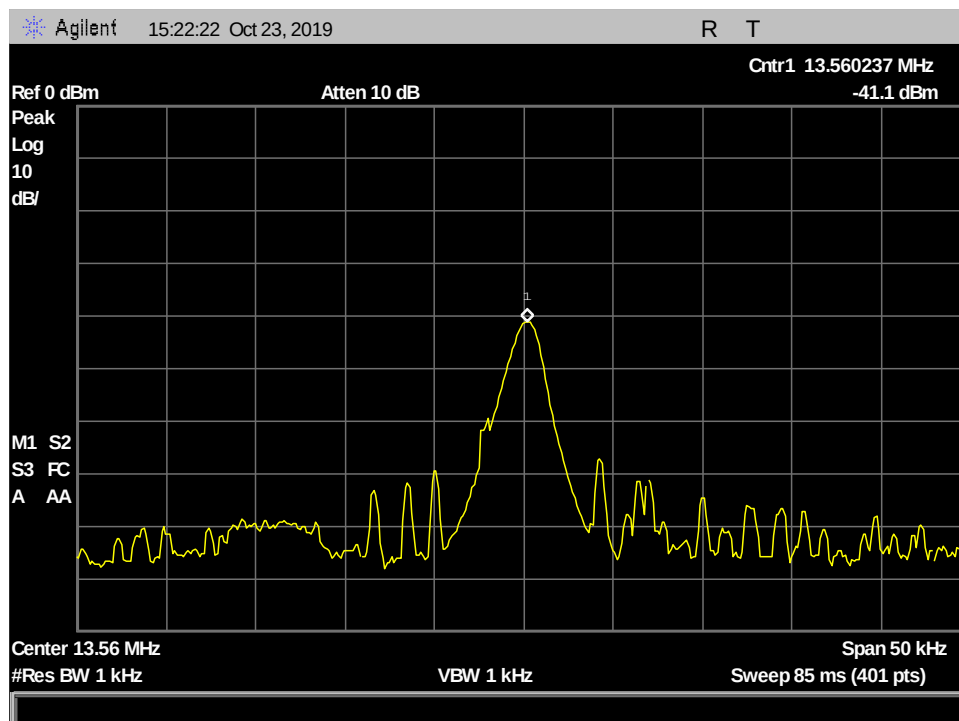
FCC 15.225 (e)	120VAC 60Hz				
Voltage Variation (%)	Temperature (°C)	Nominal Freq (MHz)	Result (MHz)	% Difference	Limit
Vnom	50	13.56	13.559989	-0.0000811	±0.01%
	40	13.56	13.559967	-0.0002434	
	30	13.56	13.560101	0.0007448	
	20	13.56	13.560045	0.0003319	
	10	13.56	13.560125	0.0009218	
	0	13.56	13.560237	0.0017478	
	-10	13.56	13.560216	0.0015929	
	-20	13.56	13.560252	0.0018584	
15	20	13.56	13.55986	-0.0010324	±0.01%
-15	20	13.56	13.560069	0.0005088	



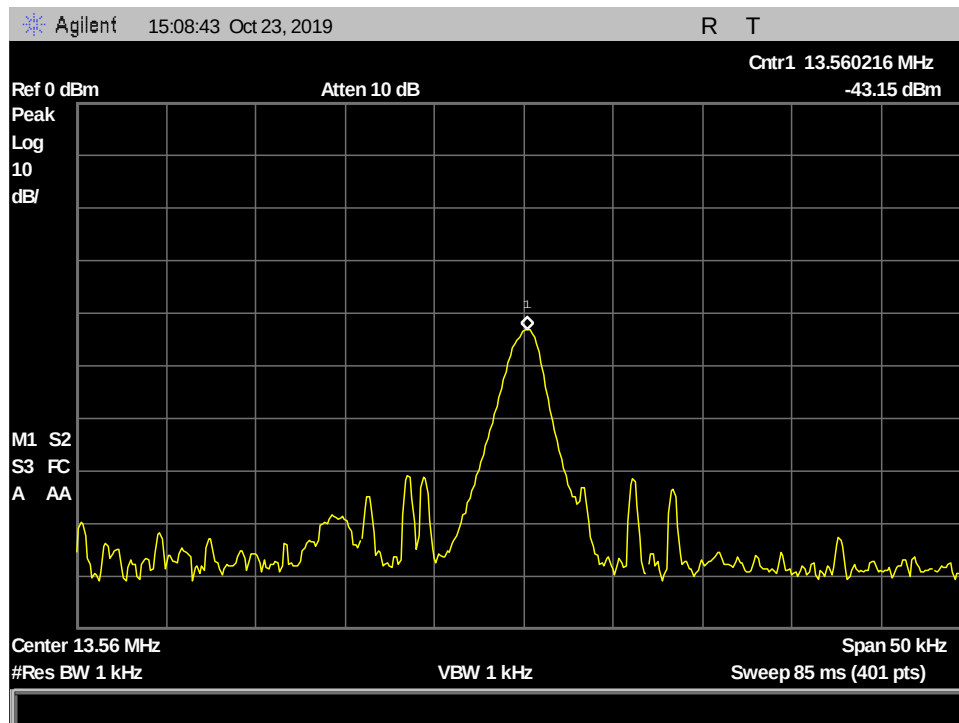
Plot 48. Frequency Stability - Vnorm - 15 _20C



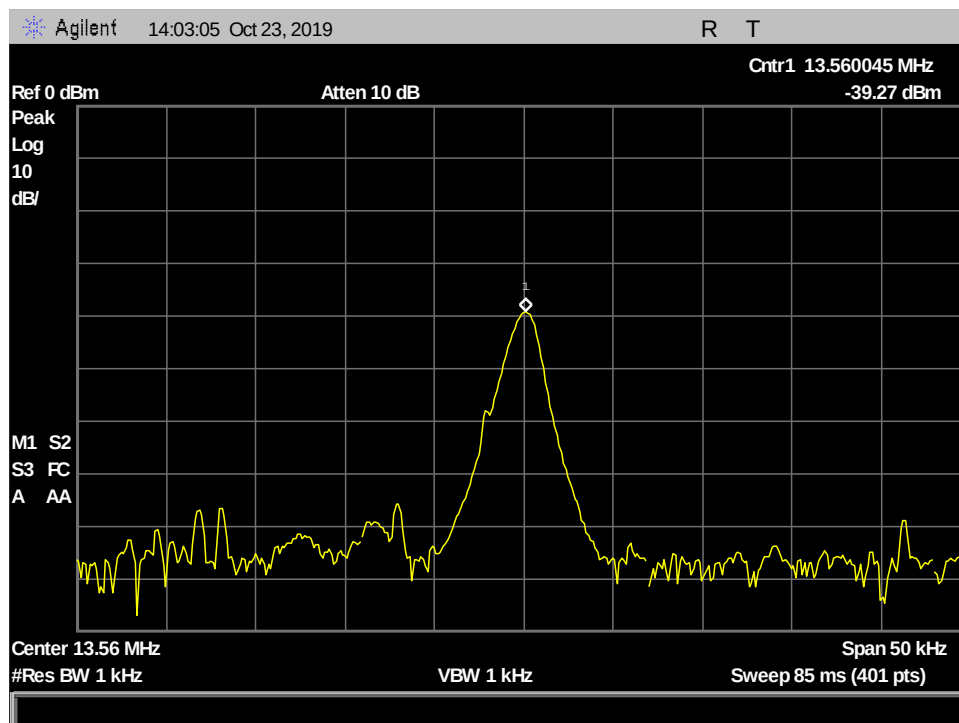
Plot 49. Frequency Stability - Vnorm_10C



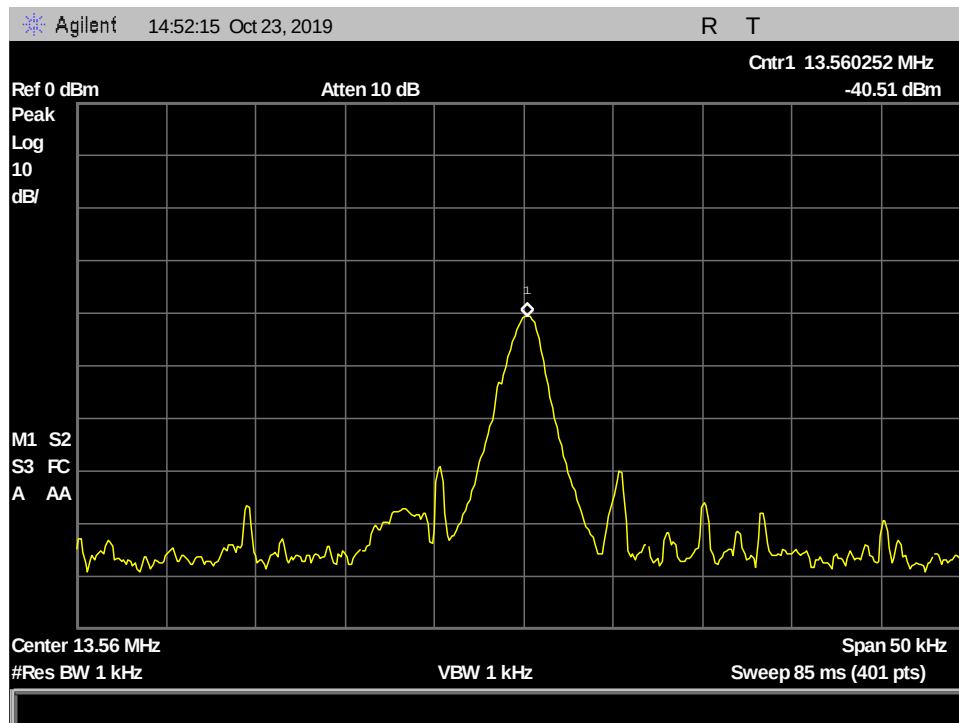
Plot 50. Frequency Stability - Vnorm_0C



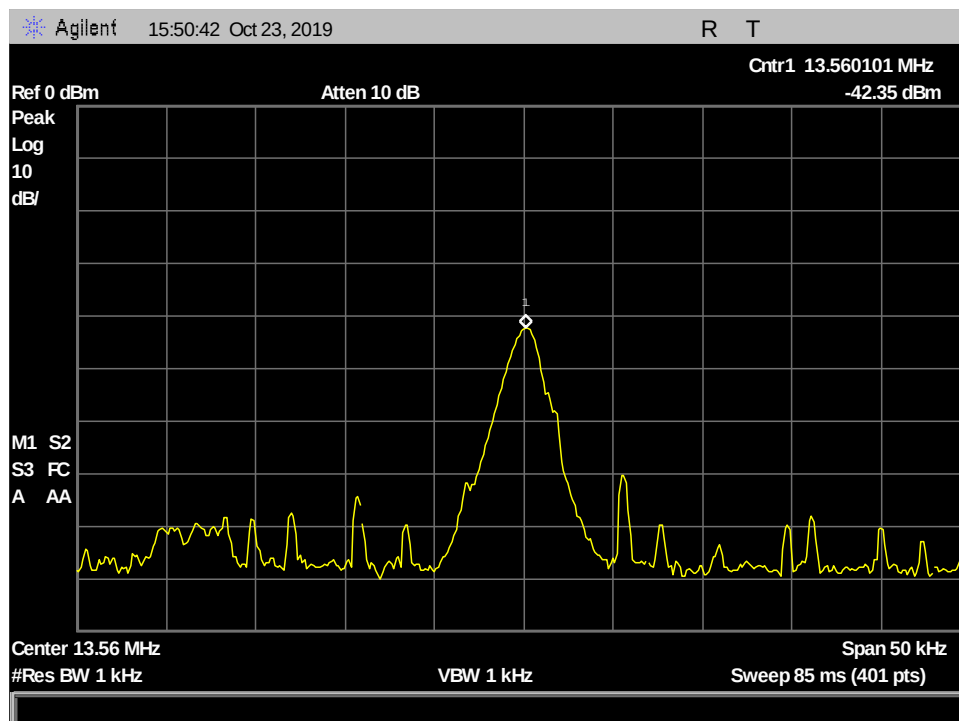
Plot 51. Frequency Stability - Vnorm_-10C



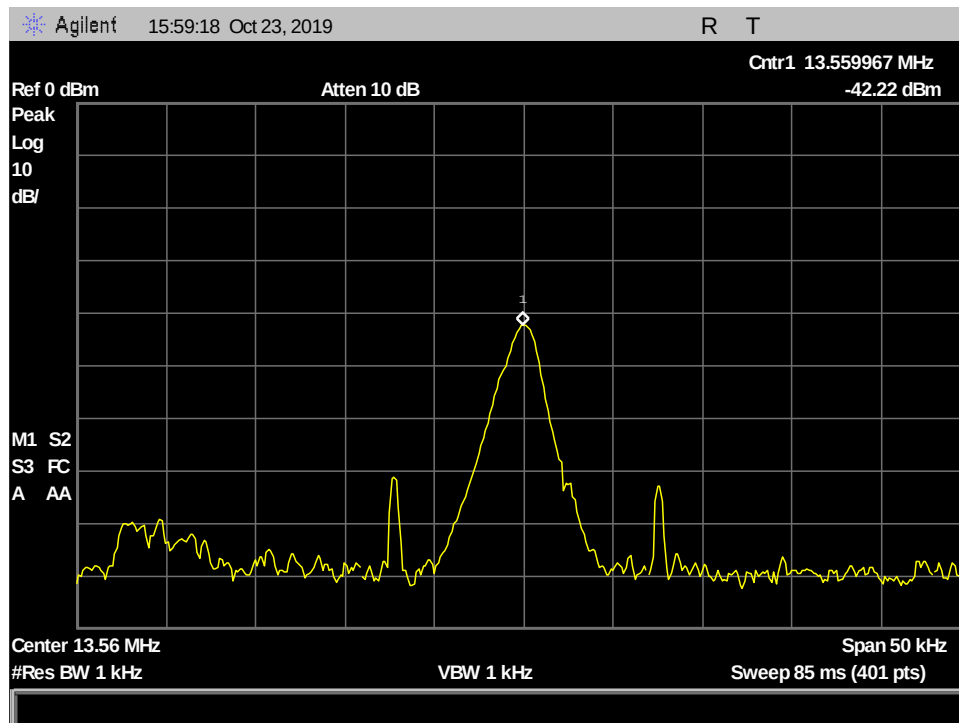
Plot 52. Frequency Stability - Vnorm_20C



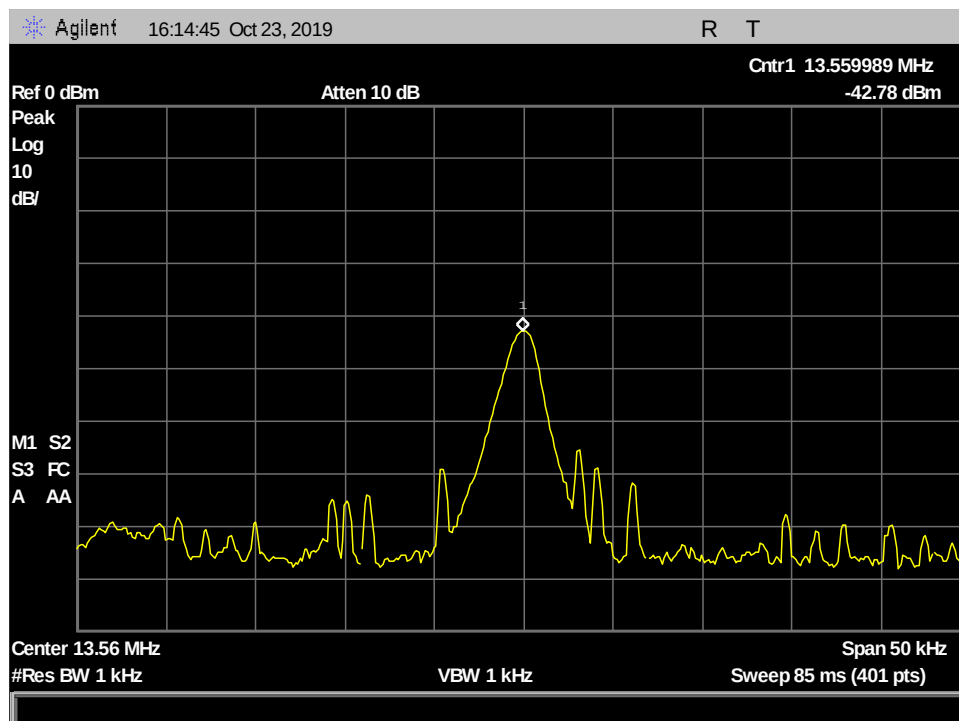
Plot 53. Frequency Stability - Vnorm_-20C



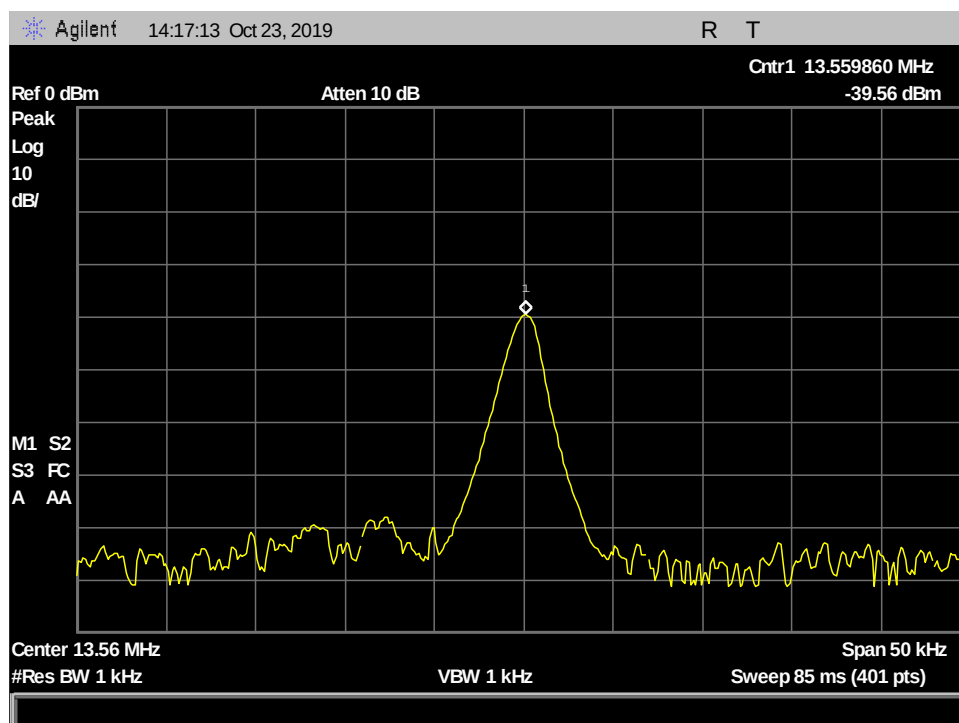
Plot 54. Frequency Stability - Vnorm_30C



Plot 55. Frequency Stability - Vnorm_40C



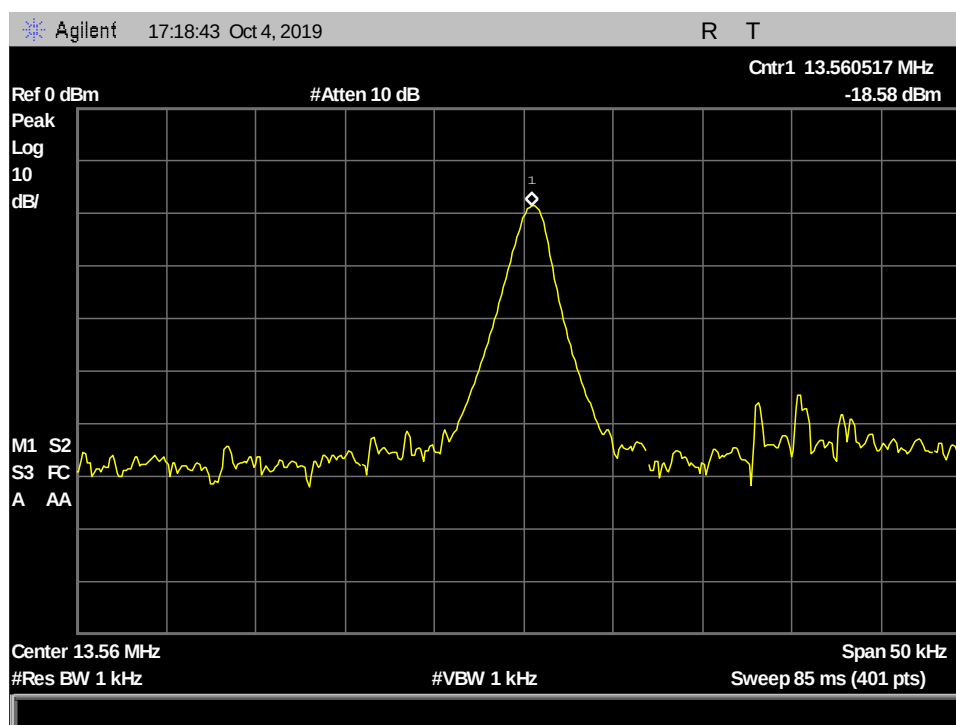
Plot 56. Frequency Stability - Vnorm_50C



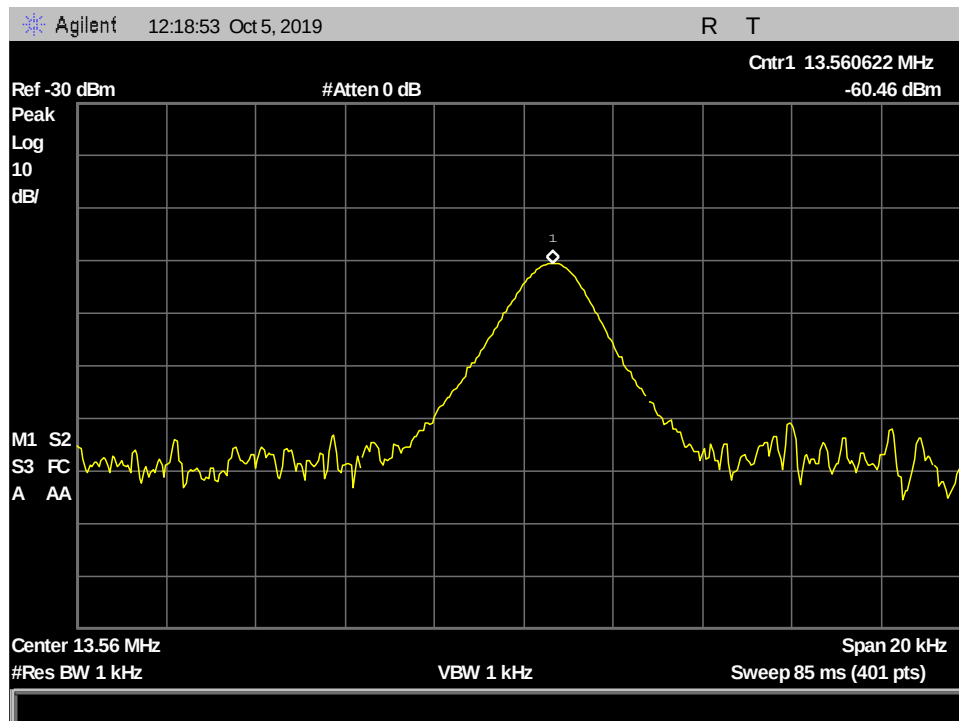
Plot 57. Frequency Stability - Vnorm+15 _ 20C

Ribbon

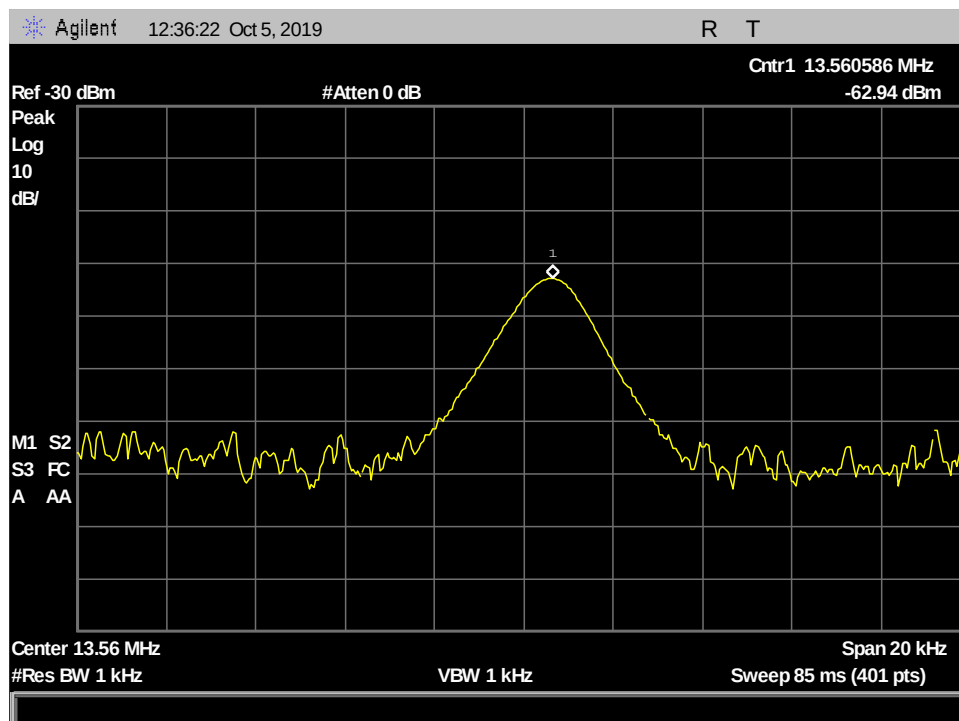
FCC 15.225 (e)	120VAC 60Hz				
Voltage Variation (%)	Temperature (°C)	Nominal Freq (MHz)	Result (MHz)	% Difference	Limit
Vnorm	50	13.56	13.5604600	0.0033923	±0.01%
	40	13.56	13.5604780	0.0035251	
	30	13.56	13.5605550	0.0040929	
	20	13.56	13.5605160	0.0038053	
	10	13.56	13.5605860	0.0043215	
	0	13.56	13.5606220	0.0045870	
	-10	13.56	13.5606280	0.0046313	
	-20	13.56	13.5606260	0.0046165	
15	20	13.56	13.5605170	0.0038127	±0.01%
-15	20	13.56	13.5605160	0.0038053	



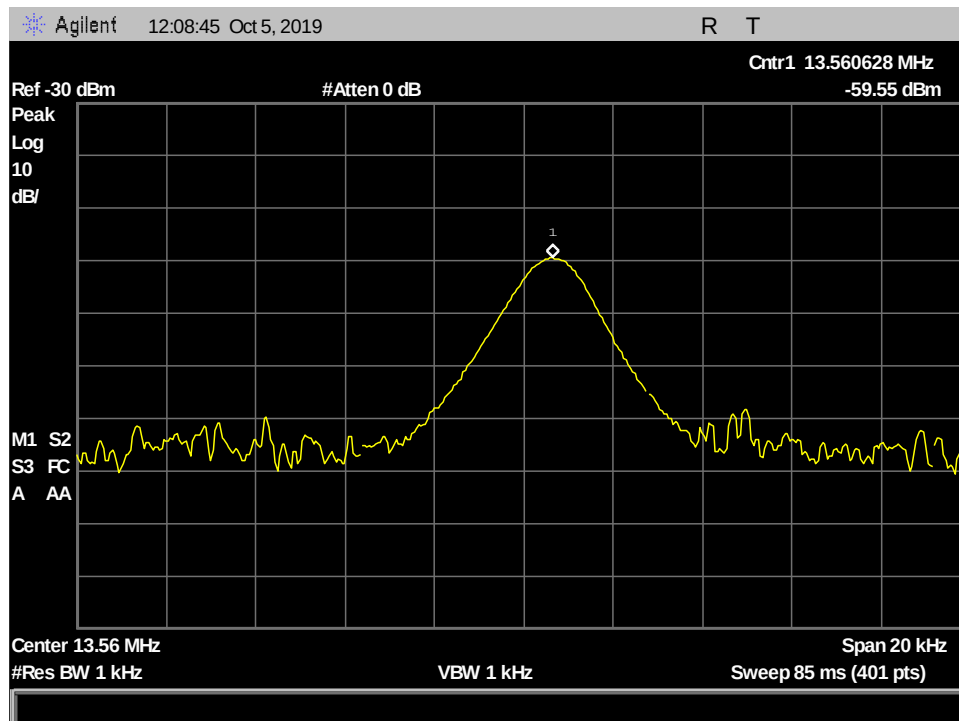
Plot 58. Frequency Stability - Vnorm -15 _20C



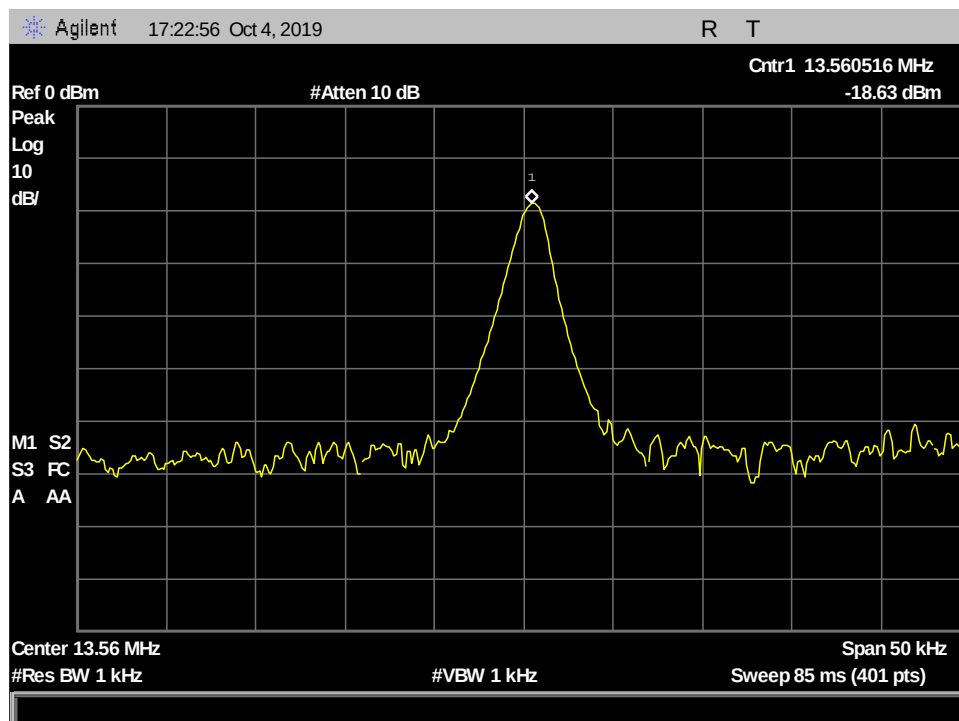
Plot 59. Frequency Stability - Vnorm_0C



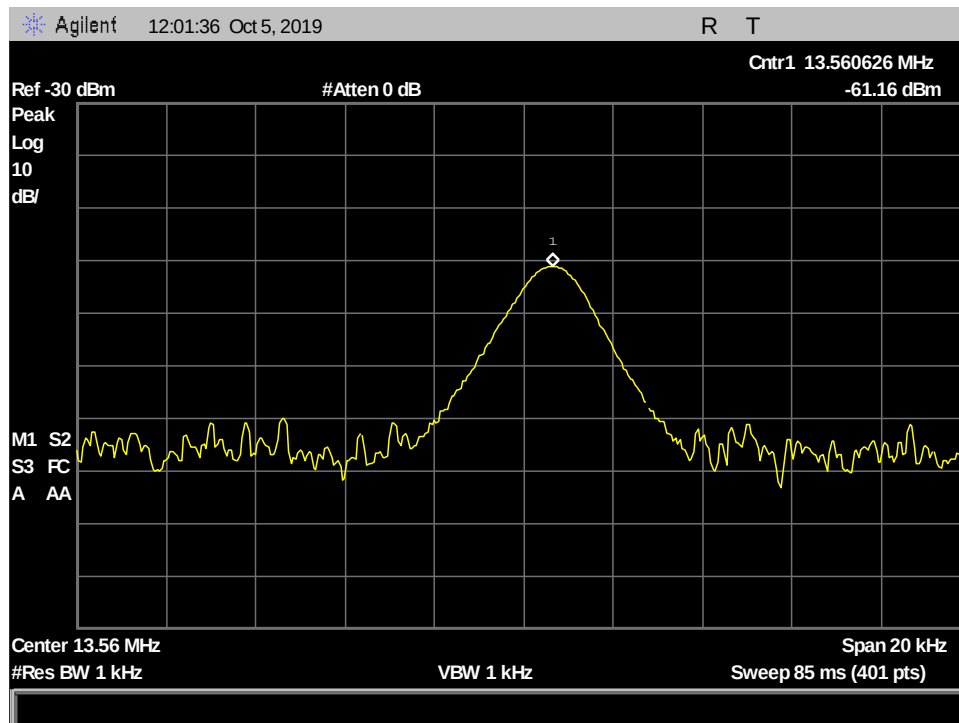
Plot 60. Frequency Stability - Vnorm_10C



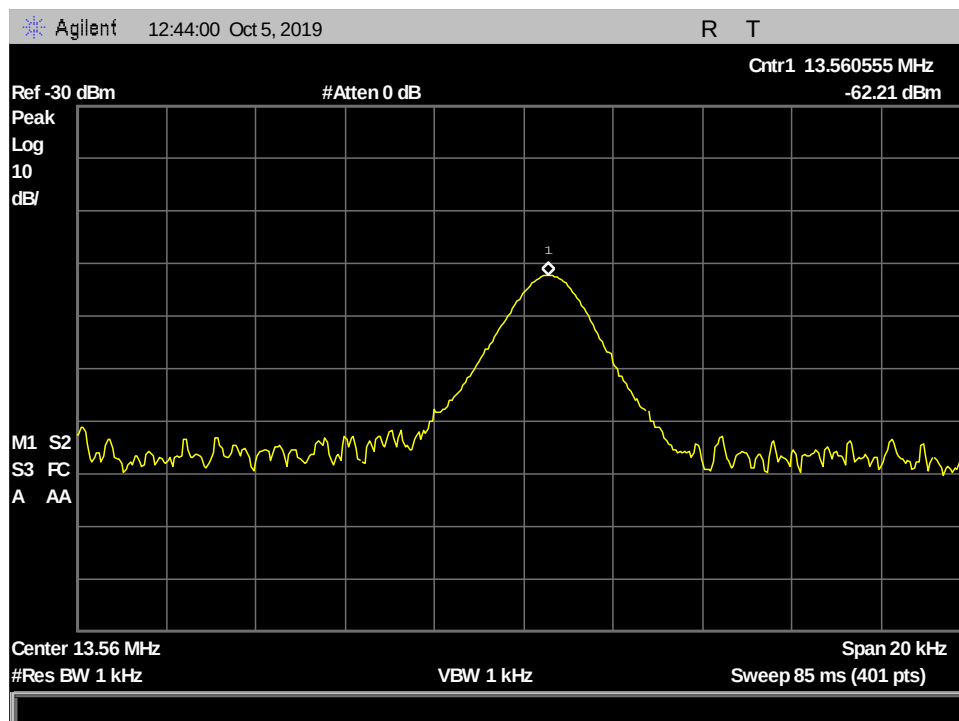
Plot 61. Frequency Stability - Vnorm_-10C



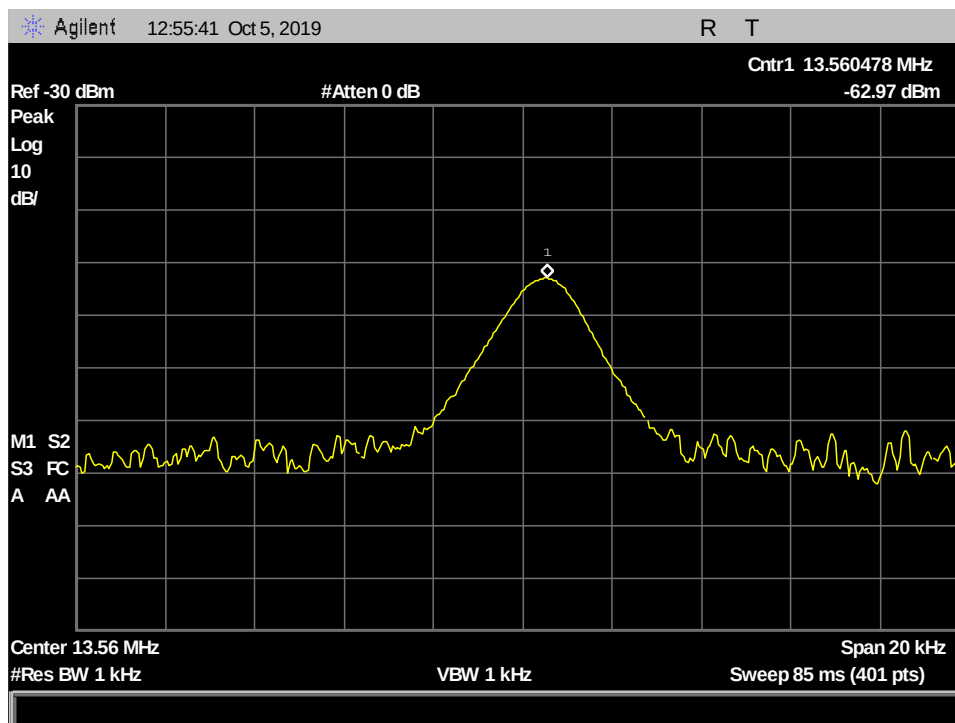
Plot 62. Frequency Stability - Vnorm_20C



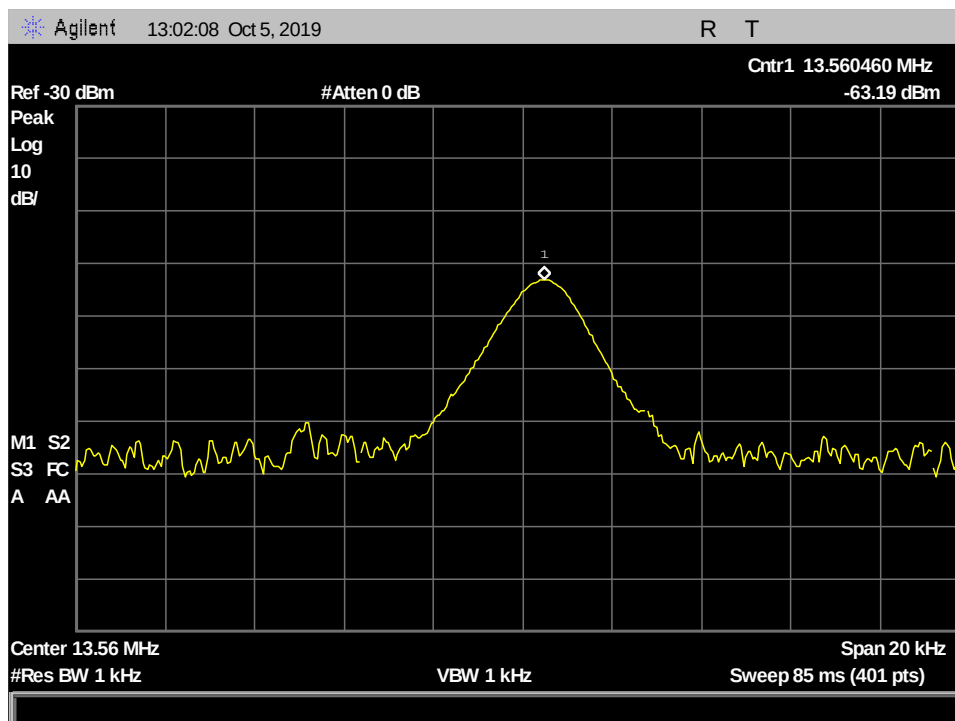
Plot 63. Frequency Stability - Vnorm_-20C



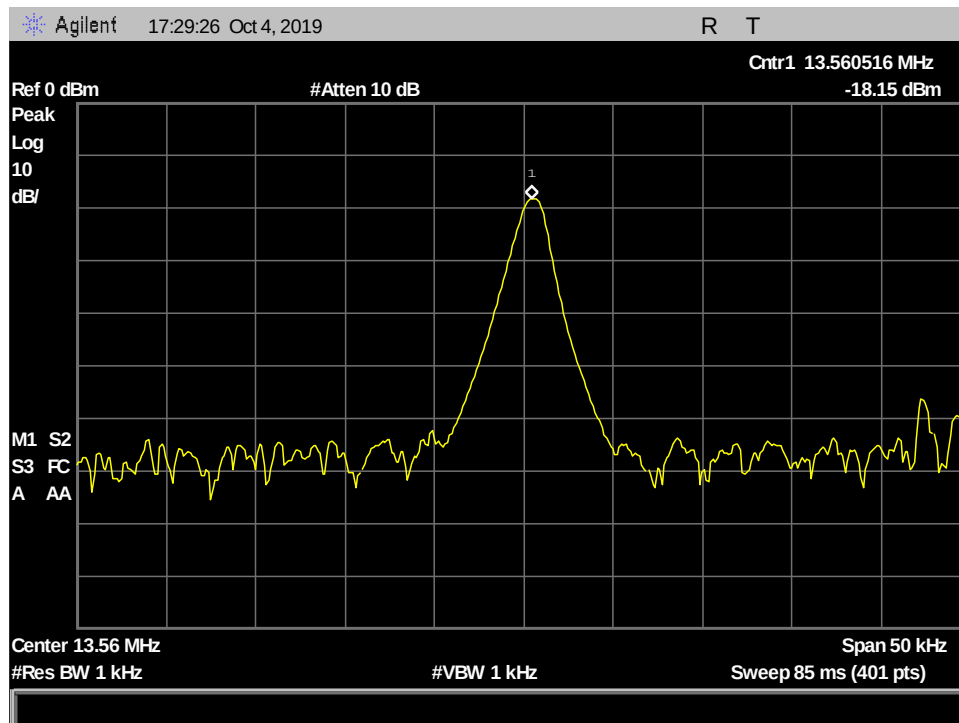
Plot 64. Frequency Stability - Vnorm_30C



Plot 65. Frequency Stability - Vnorm_40C



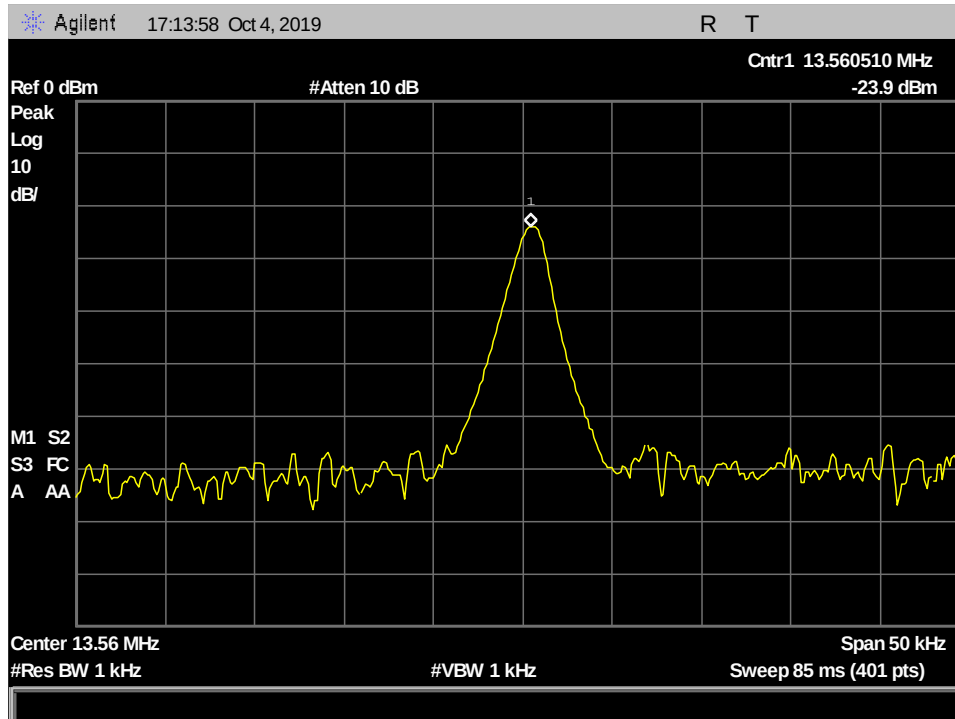
Plot 66. Frequency Stability - Vnorm_50C



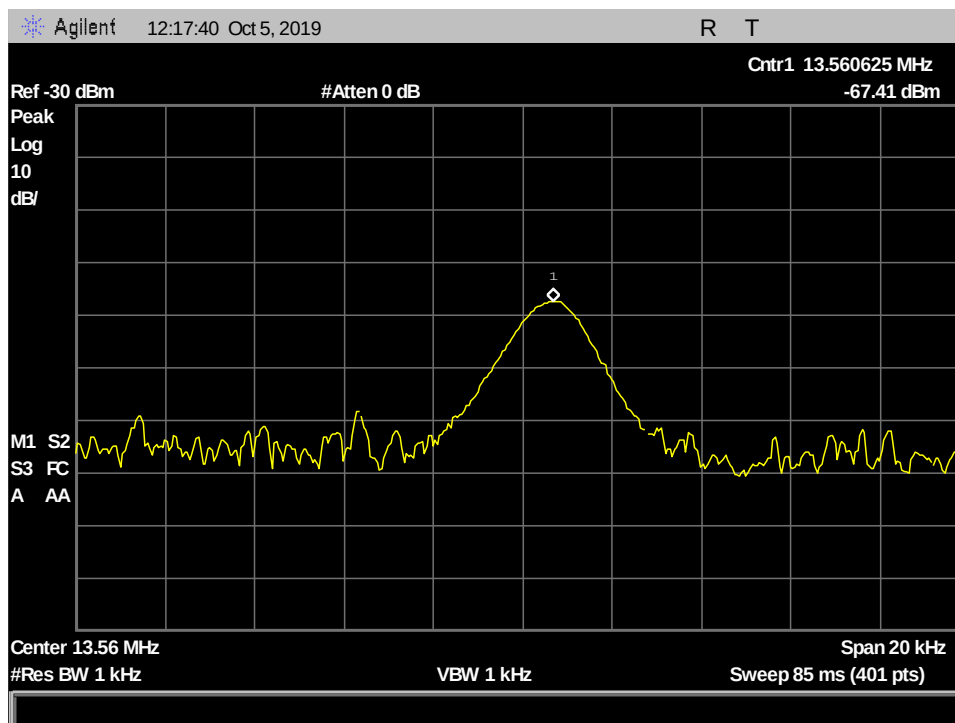
Plot 67. Frequency Stability - Vnorm+15 _ 20C

Film

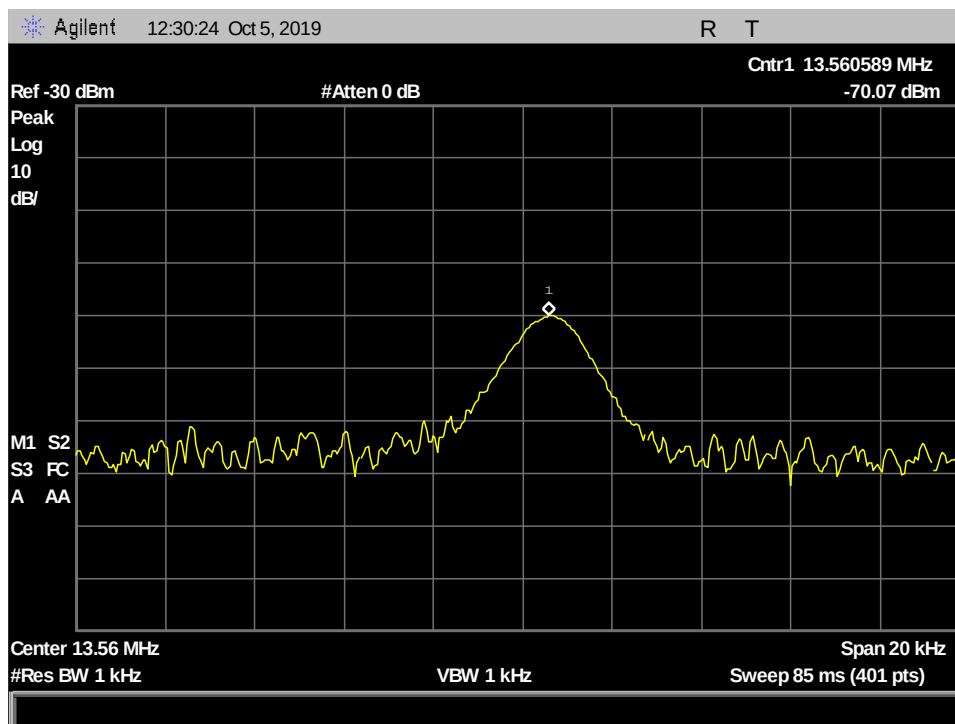
FCC 15.225 (e)	120VAC 60Hz				
Voltage Variation (%)	Temperature (°C)	Nominal Freq (MHz)	Result (MHz)	PPM	Limit
Vnorm	50	13.56	13.5604580	0.0033776	±0.01%
	40	13.56	13.5604910	0.0036209	
	30	13.56	13.5605580	0.0041150	
	20	13.56	13.5605070	0.0037389	
	10	13.56	13.5605890	0.0043437	
	0	13.56	13.5606250	0.0046091	
	-10	13.56	13.5606350	0.0046829	
	-20	13.56	13.5606280	0.0046313	
15	20	13.56	13.5605050	0.0037242	
-15	20	13.56	13.5605100	0.0037611	



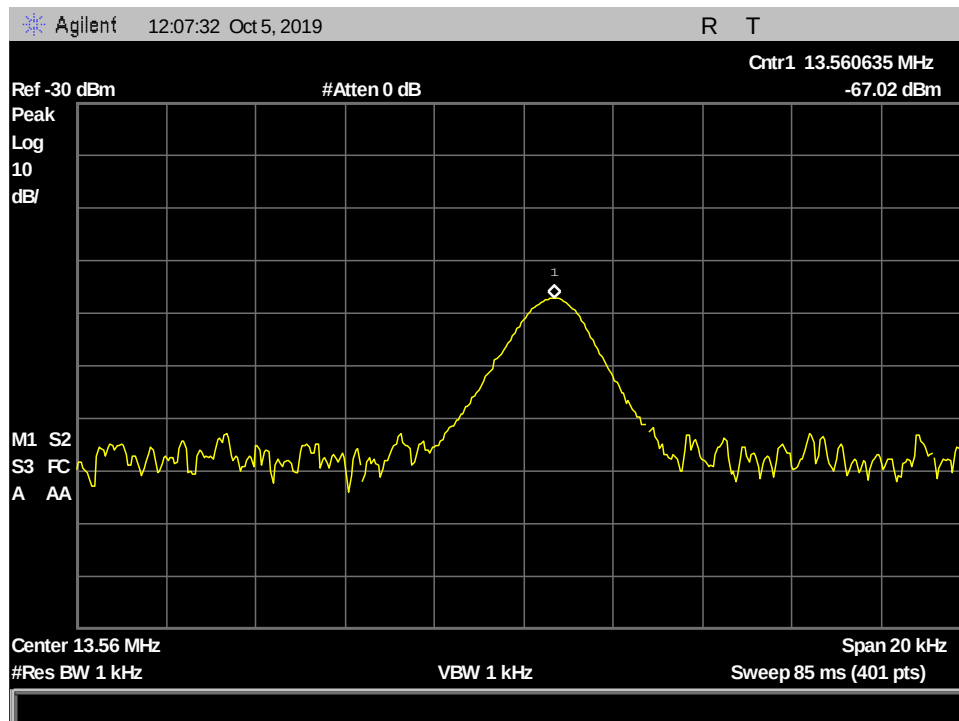
Plot 68. Frequency Stability - Vnorm - 15_20C



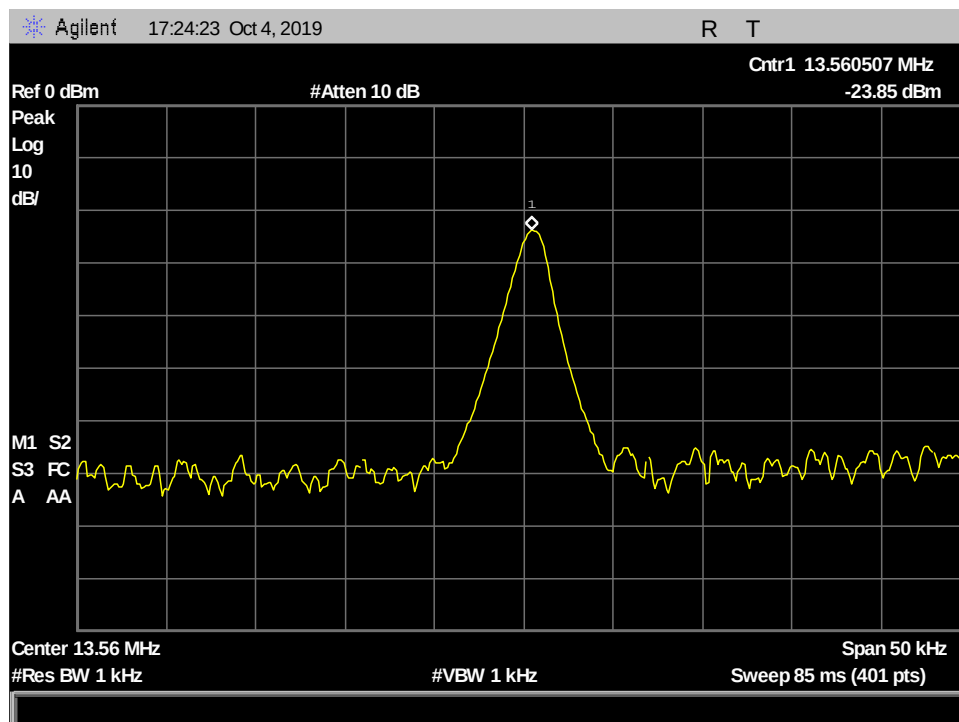
Plot 69. Frequency Stability - Vnorm_0C



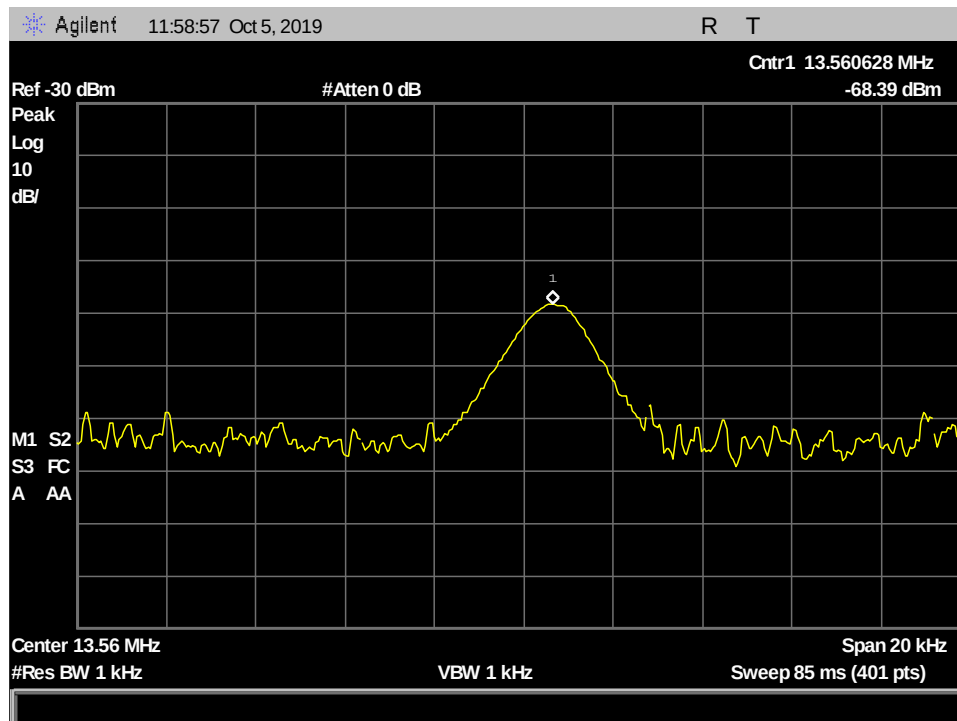
Plot 70. Frequency Stability - Vnorm_10C



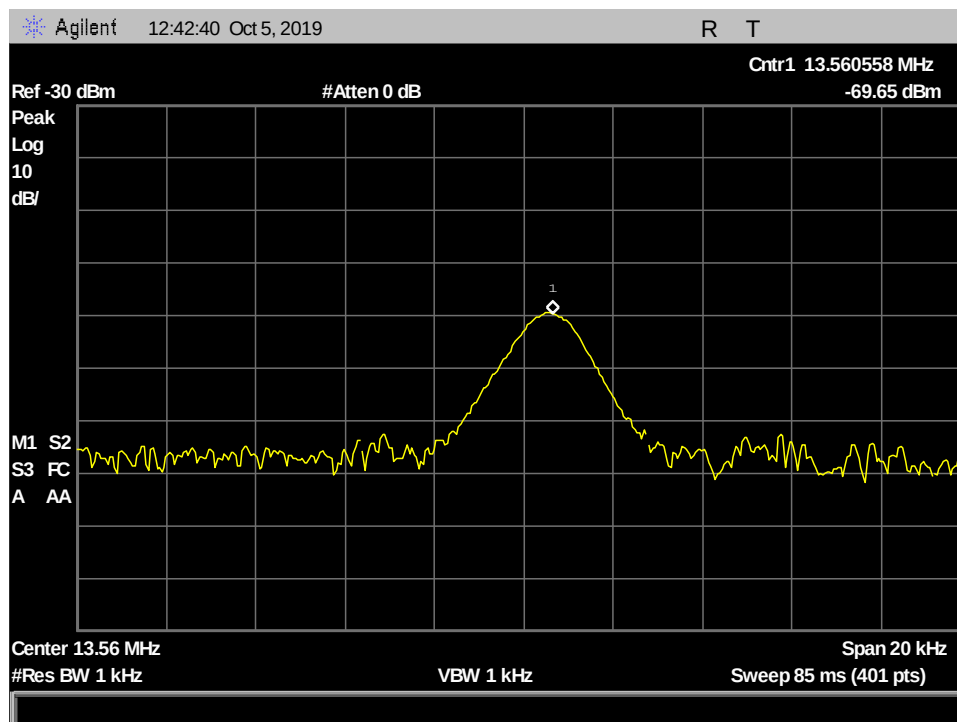
Plot 71. Frequency Stability - Vnorm_-10C



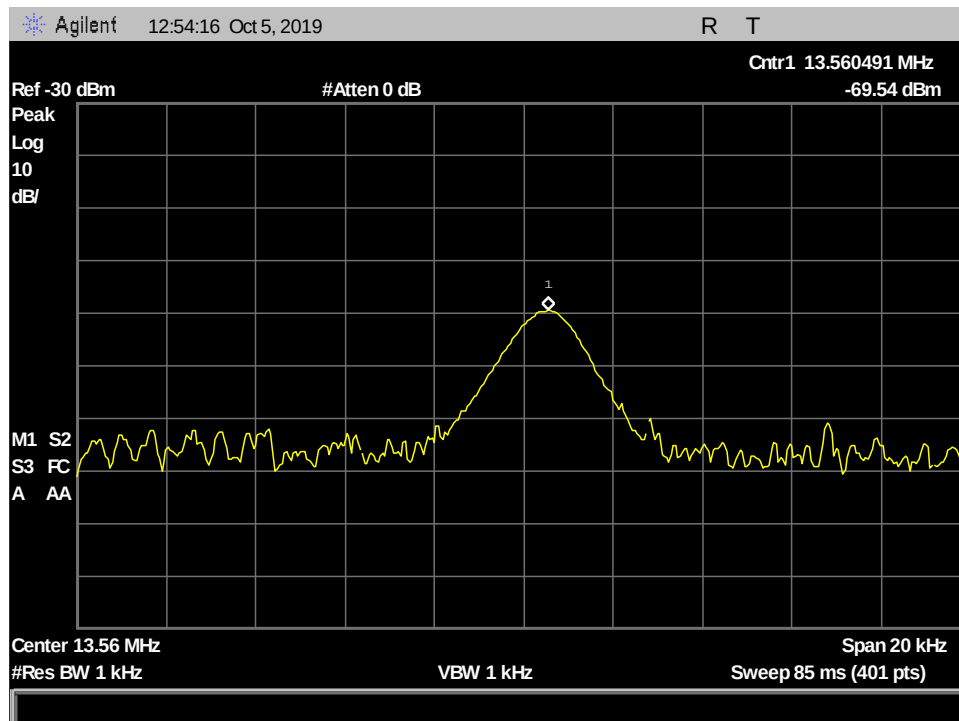
Plot 72. Frequency Stability - Vnorm_20C



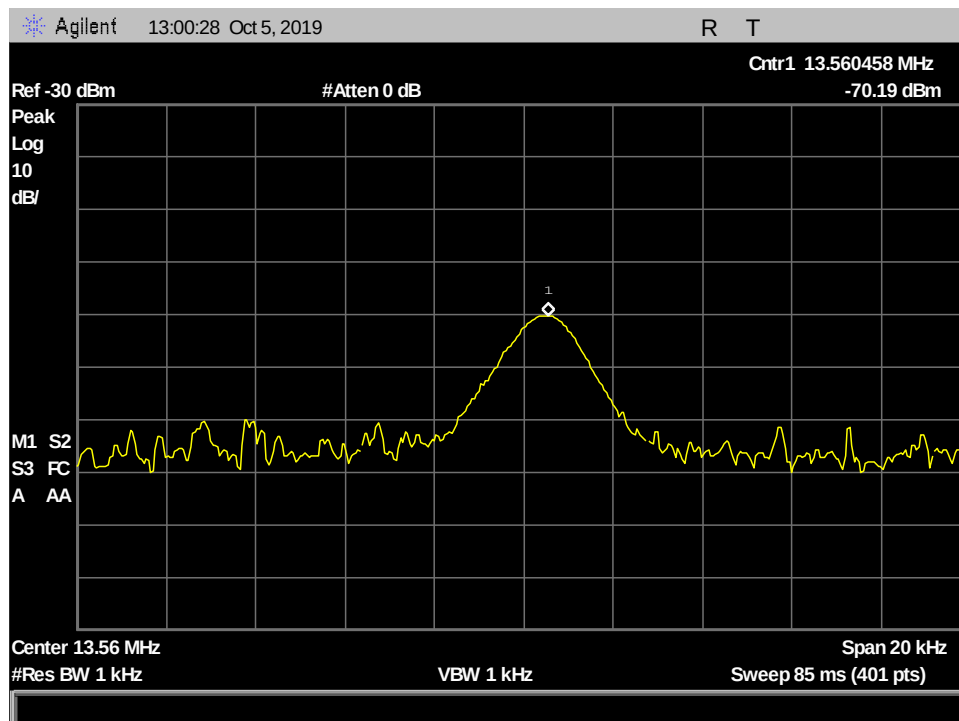
Plot 73. Frequency Stability - Vnorm_-20C



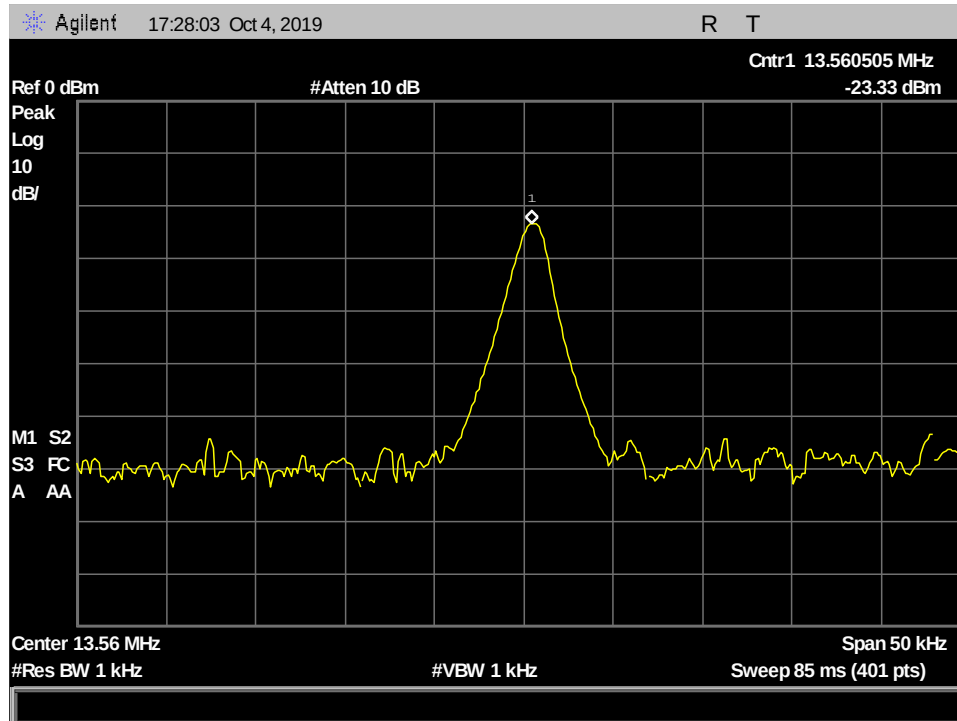
Plot 74. Frequency Stability - Vnorm_30C



Plot 75. Frequency Stability - Vnorm_40C



Plot 76. Frequency Stability - Vnorm_50C



Plot 77. Frequency Stability - Vnorm+15 _ 20C

IV. Test Equipment

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1044	Generator	COM-Power Corp	CG-520	See Note	See Note
1A1099	Generator	COM-Power Corp	CG-51000	See Note	See Note
1A1079	Conducted Comb Generator	COM-Power Corp	CGC-255	See Note	See Note
1A1050	Bilog Antenna (30 MHz to 1 GHz)	Schaffner	CBL 6112D	08/29/2018	02/19/2020
1A1183	Double Ridged waveguide Antenna (1 GHz to 18 GHz)	ETS Lindgren	3117	10/10/2018	04/10/2020
1A1050-A	4 dB Fixed Attenuator	Fairview Microwave	SA6N5WA-04	08/29/2018	02/29/2020
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	04/03/2019	04/03/2020
1A1123	LISN	Teseq	NNB 51	7/18/2019	8/18/2019
1A1065	EMI Receiver	Rohde & Schwarz	ESCI	5/1/2019	5/1/2020
1A1149	Milliohm Meter	GW Instek	GOM-802	18.04/2019	18/04/2020
1A1184	Spectrum Analyzer	Agilent Technologies	E4407B	6/25/2019	6/25/2020
1A1225	Environmental Chamber	Aspec	EXP-2H/New	2/21/2019	2/21/2020
1A1119	Test Area	Custom Made	N/A	See Note	
1A1177	Pulse Limiter / Attenuator	Rohde & Schwarz	ESH3Z2	11/20/2018	11/30/2019
1A1083	EMI Receiver	Rohde & Schwarz	ESU 40	10/17/2018	10/17/2019
1A1106	10 m Chamber (NSA)	ETS Lindgren	Semi-Anechoic	See Note	

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

Table 11. Test Equipment List

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

v. **Certification & User's Manual
Information**

Certification & User’s Manual Information

A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

- (a) The various types of radio communication transmitting devices described throughout this chapter.
- (b) *The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.*
- (c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.
- (d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

- (a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:
 - (1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or
 - (2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.
- (d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

- (e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:
- (i) *Compliance testing;*
 - (ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;
 - (iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;
 - (iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or
 - (v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.
- (e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.
- (f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

- (a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.¹ *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.*
- (b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

- (a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.
- (b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

¹ In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

- (a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.
 - (1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.
 - (i) *If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.*
 - (ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.
 - (2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

Certification & User's Manual Information

1. Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) *In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:*

- (1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

- (2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

- (3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

- (4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.
- (5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Verification & User’s Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

- (a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

- (b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

End of Report