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July 15, 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, OMNIKEY 5427 G2, tested to the requirements of LP0002 Low-power Radio-frequency Devices Technical Regulations for Certification as an Intentional Radiator.

Thank you for using the services of MET Laboratories, Inc. 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,
MET LABORATORIES, INC.

Joel Huna
Documentation Department

Reference: (\HID Global Corporation\EMCA99143-LP0002 Rev. 2)

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Electromagnetic Compatibility Criteria Test Report

for the

**HID Global Corporation
OMNIKEY 5427 G2**

Tested under

LP0002 Low-power Radio-frequency Devices Technical Regulations
for Intentional Radiators

MET Report: EMCA99143-LP0002 Rev. 2

July 15, 2019

Prepared For:

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

Prepared By:
MET Laboratories, Inc.
13501 McCallen Pass
Austin, TX 78753

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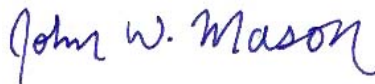


Giuliano Messina, Project Engineer
Electromagnetic Compatibility Lab



Joel Huna
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 LP0002 under normal use and maintenance.



John Mason,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	August 10, 2018	Initial Issue.
1	June 13, 2019	EUT model name change.
2	July 15, 2019	Marker Data Tables added to Emissions Plots

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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 OMNIKEY 5427 G2, with the requirements of LP0002 Low-power Radio-frequency Devices Technical Regulations. In accordance with LP0002, the following data is presented in support of the Certification of the OMNIKEY 5427 G2. 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 OMNIKEY 5427 G2, 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 LP0002, in accordance with HID Global Corporation, purchase order number. All tests were conducted using the measurement procedures of ANSI C63.4-2014 and LP0002 Appendix.

LP0002 Reference	Description	Compliance
2.2	Antenna Requirement	Compliant
2.3	Conducted Emission Limits	Compliant
3.2.1.1	Field Strength emissions within the band 13.553 – 13.567 MHz	Compliant
3.2.1.2	Unwanted Emissions Outside the bands 13.553 – 13.567 MHz	Compliant
3.2.1.3	Frequency Tolerance of the Carrier	Compliant
5.20	RF Exposure	Compliant

Table 1. Executive Summary of EMC LP0002 Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by HID Global Corporation to perform testing on the OMNIKEY 5427 G2, under HID Global Corporation's purchase order number 1110960151.

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, OMNIKEY 5427 G2.

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

Model(s) Tested:	OMNIKEY 5427 G2	
Model(s) Covered:	OMNIKEY 5427 G2	
EUT Specifications:	Primary Power: 5VDC USB, 100-240VAC laptop	
	Type of Modulations:	ASK
	Equipment Code:	DXX
	Peak RF Output Power:	-50.42 dBm
	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:	Giuliano Messina	
Report Date(s):	July 15, 2019	

Table 2. EUT Summary Table

B. References

LP0002: 2016	Low-power Radio-frequency Devices Technical Regulations.
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 MET Laboratories, Inc., 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 LP0002, a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The OMNIKEY 5427 G2, Equipment Under Test (EUT), is designed to support any smart card for any application on any computer and connect via bluetooth. OMNIKEY devices support all relevant operating system from all windows platforms to Linux and Mac OS.

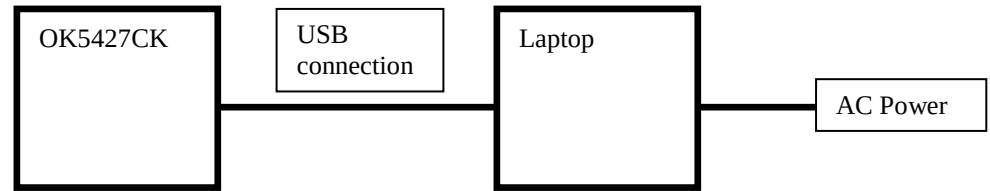


Figure 1. Block Diagram of Test Configuration

E. 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. #
#3	N/A	Omnikey Reader	Omnikey 5027CK Gen 2	N/A	KJ0H4Q004R10622252	A
#5	N/A	Omnikey Reader	Omnikey 5027CK Gen 2	N/A	KJ0H4Q00B610622252	A
#6	N/A	Omnikey Reader	Omnikey 5027CK Gen 2	N/A	KJ0H4Q004K10622252	A

Table 4. Equipment Configuration

F. 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
N/A	Laptop	Dell	Inspiron 15	N/A
N/A	Tablet	Samsung	SM-T230NU	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 5. Support Equipment

G. 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
N/A	USB	USB connection to computer	1	1.5	1.5	N	Data/Power

Table 6. Ports and Cabling Information

H. Mode of Operation

The EUT was connected via USB to a laptop, providing both a power and data connection. An HF card was placed near the EUT to exercise the unit's transmitter.

I. Method of Monitoring EUT Operation

The computer's user interface provided a visible output when the HF card was placed nearby and the transmitter was exercised. To monitor the transmitting frequency, a spectrum analyzer was used.

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.2 Antenna Requirement

Test Requirement: § 2.2: Antenna requirement: Low-power radio frequency transmitter or transceiver (receiver) shall utilize a permanently, semi-permanently attached antenna or uses a unique coupling of the antenna and at any cable connector between the transmitter and the antenna. The antenna shall be an omni-directional type. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector or other than authorized is prohibited. Such standard connectors are for example: BNC, F type, N type, M type, UG type, RCA, SMA, SMB, and other standard type antenna connectors.

Results: The EUT as tested is compliant with §2.2. The EUT utilizes a permanently attached antenna (integrated within the unit) and cannot be modified by the end user.

Test Engineer(s): Giuliano Messina

Test Date(s): June 7, 2018

Gain	Type
1 dBi	Coil

Table 7. Antenna List

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.3 Conducted Emissions Limits

Test Requirement(s): § 2.3: 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)	§ 2.3, 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 § 2.3

Note: (*) Decreases with the logarithm of the frequency.

Test Procedure: The EUT was placed on a 0.8 m-high wooden 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 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 C63.4-2014 and LP0002 Appendix*. 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 EMI receiver. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement. Measured emissions were within applicable limits.

Test Engineer(s): Jonathan Tavira

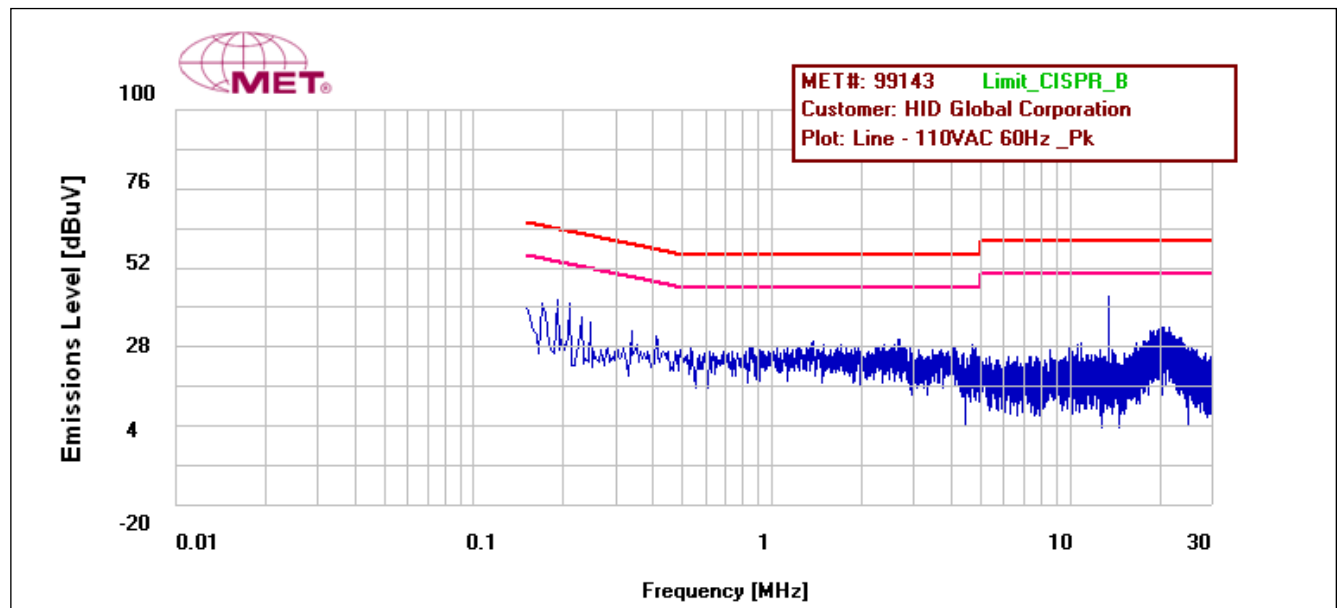
Test Date(s): June 5, 2018

Meas. Location	Meas. m	Limit	Pass/Fail
Bonding measurement from LISN ground to ground plane	0.624	< 2.5 mΩ	Pass

Table 9. Conducted Emissions, Bonding Measurements

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line - 110VAC 60Hz	0.150	49.58	66	-16.42	Pass	31.48	56	-24.52	Pass
Line - 110VAC 60Hz	0.170	46.99	64.963	-17.973	Pass	31.23	54.963	-23.733	Pass
Line - 110VAC 60Hz	0.190	45.36	64.042	-18.682	Pass	30.01	54.042	-24.032	Pass
Line - 110VAC 60Hz	0.210	40.13	63.213	-23.083	Pass	25.98	53.213	-27.233	Pass
Line - 110VAC 60Hz	0.230	36.22	62.459	-26.239	Pass	24.06	52.459	-28.399	Pass
Line - 110VAC 60Hz	0.246	34.9	61.902	-27.002	Pass	23.26	51.902	-28.642	Pass
Line - 110VAC 60Hz	13.562	44.3	60	-15.7	Pass	47.4	50	-2.6	Pass

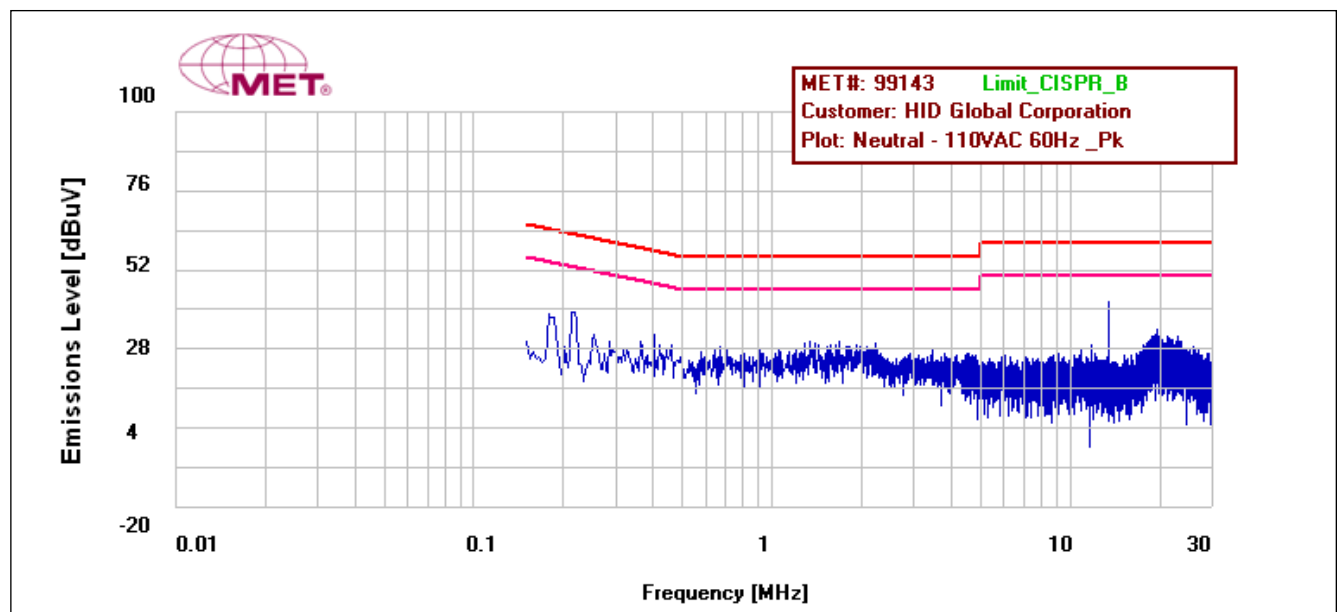
Table 10. Conducted Emissions, Phase Line, 110VAC 60 Hz, Test Results



Plot 1. Conducted Emissions, 110 VAC 60 Hz, Phase Line

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral - 110VAC 60Hz	0.178	47.62	64.582	-16.962	Pass	27.99	54.582	-26.592	Pass
Neutral - 110VAC 60Hz	0.214	41.36	63.057	-21.697	Pass	25.1	53.057	-27.957	Pass
Neutral - 110VAC 60Hz	0.254	35.15	61.637	-26.487	Pass	23.26	51.637	-28.377	Pass
Neutral - 110VAC 60Hz	0.286	32.36	60.654	-28.294	Pass	21.99	50.654	-28.664	Pass
Neutral - 110VAC 60Hz	0.402	27.78	57.834	-30.054	Pass	20.24	47.834	-27.594	Pass
Neutral - 110VAC 60Hz	13.558	37.5	60	-22.5	Pass	40.1	50	-9.9	Pass
Neutral - 110VAC 60Hz	19.786	29.45	60	-30.55	Pass	23.1	50	-26.9	Pass

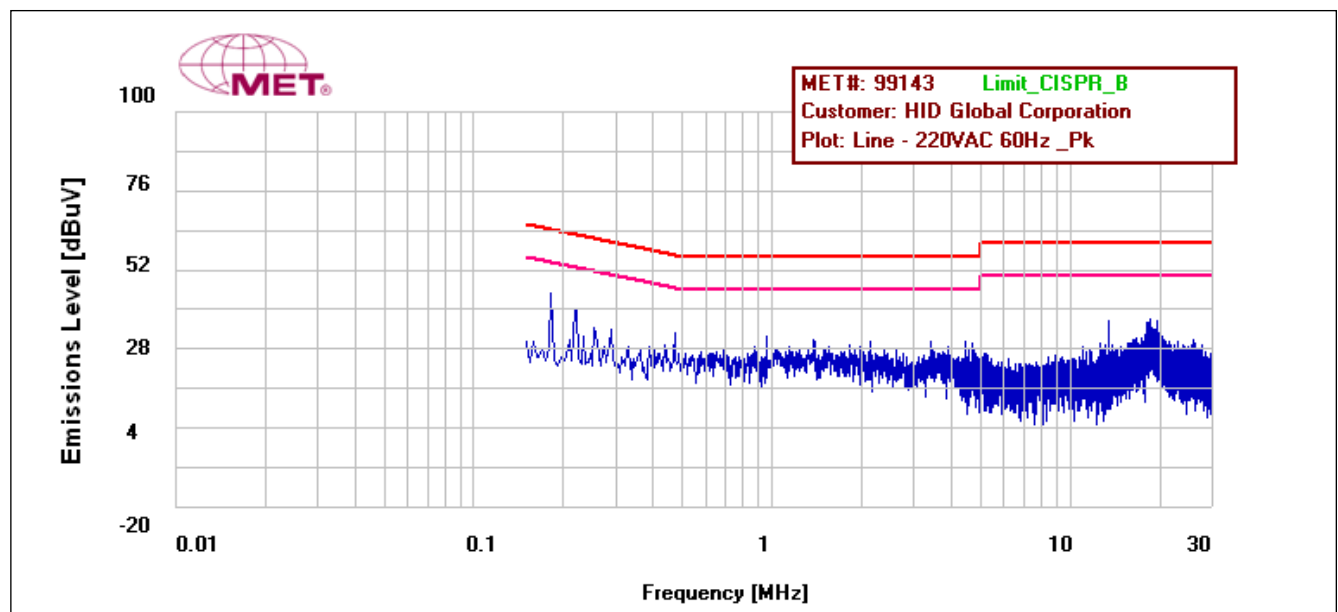
Table 11. Conducted Emissions, 110 VAC 60 Hz, Neutral Line, Test Results



Plot 2. Conducted Emissions, 110 VAC 60 Hz, Neutral Line

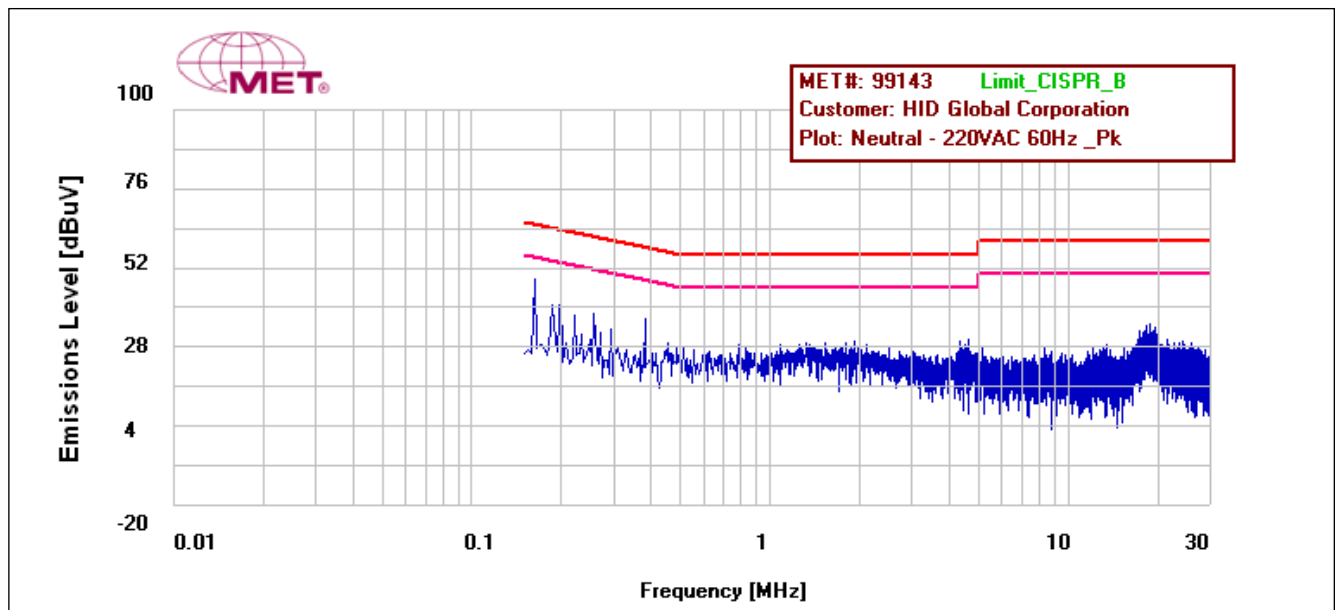
Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line - 220VAC 60Hz	0.182	42.05	64.398	-22.348	Pass	25.65	54.398	-28.748	Pass
Line - 220VAC 60Hz	0.222	39.06	62.753	-23.693	Pass	25.02	52.753	-27.733	Pass
Line - 220VAC 60Hz	0.230	39.64	62.459	-22.819	Pass	24.84	52.459	-27.619	Pass
Line - 220VAC 60Hz	0.254	36.63	61.637	-25.007	Pass	23.79	51.637	-27.847	Pass
Line - 220VAC 60Hz	0.290	33.71	60.539	-26.829	Pass	22.25	50.539	-28.289	Pass
Line - 220VAC 60Hz	13.562	38.08	60	-21.92	Pass	39.7	50	-10.3	Pass
Line - 220VAC 60Hz	18.666	30.64	60	-29.36	Pass	26.29	50	-23.71	Pass

Table 12. Conducted Emissions, 220 VAC 60 Hz, Phase Line, Test Results

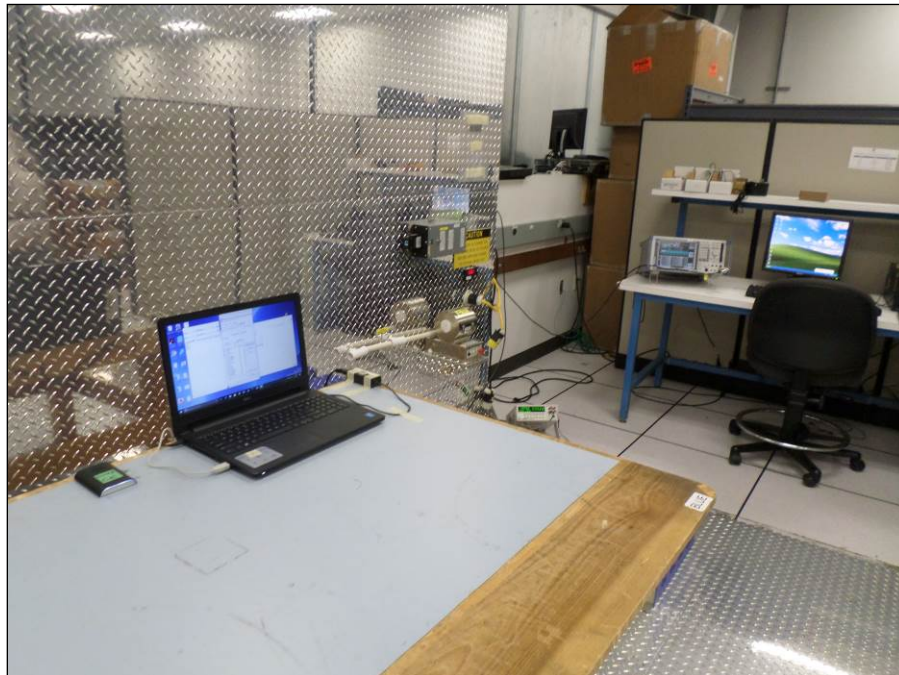


Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral - 220VAC 60Hz	0.162	45.13	65.363	-20.233	Pass	27.94	55.363	-27.423	Pass
Neutral - 220VAC 60Hz	0.186	43.04	64.218	-21.178	Pass	26.22	54.218	-27.998	Pass
Neutral - 220VAC 60Hz	0.198	41.1	63.7	-22.6	Pass	25.17	53.7	-28.53	Pass
Neutral - 220VAC 60Hz	0.222	39.87	62.753	-22.883	Pass	23.73	52.753	-29.023	Pass
Neutral - 220VAC 60Hz	0.230	39.56	62.459	-22.899	Pass	24.26	52.459	-28.199	Pass
Neutral - 220VAC 60Hz	0.258	36.6	61.508	-24.908	Pass	22.97	51.508	-28.538	Pass
Neutral - 220VAC 60Hz	0.382	30.23	58.257	-28.027	Pass	25.23	48.257	-23.027	Pass

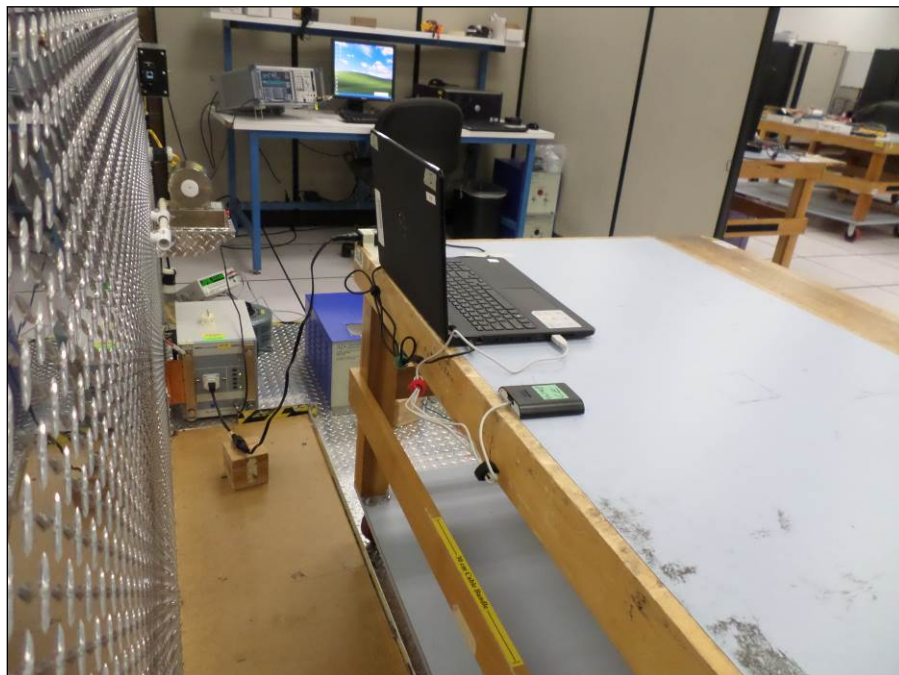
Table 13. Conducted Emissions, 220 VAC 60 Hz, Neutral Line, Test Results



Plot 4. Conducted Emissions, 220 VAC 60 Hz, Neutral Line



Photograph 1. Conducted Emissions, Setup, Front



Photograph 2. Conducted Emissions, Setup, Rear

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 3.2.1.1 Operation within the band 13.553 – 13.567 MHz

Test Requirement(s): § 3.2.1.1: 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-reflective (acrylic) table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4: 2014 and LP0002 appendix were used. The loop antenna was located 3 m 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.

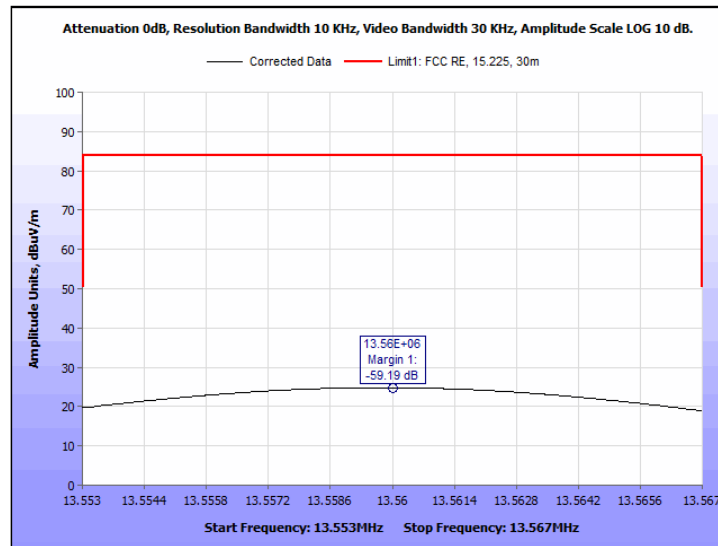
The measurements were made at 3m and then extrapolated to 30m using the following correction factor.

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

Test Results: The EUT was compliant with the requirements of §3.2.1.1.

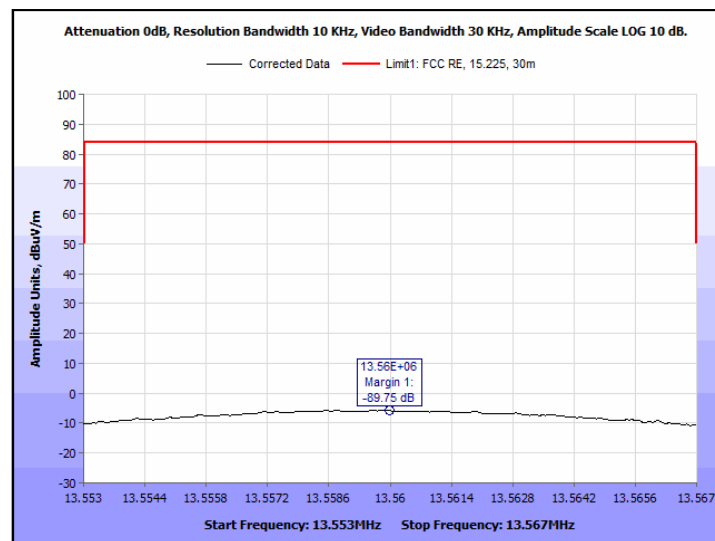
Test Engineer(s): Giuliano Messina

Test Date(s): June 4, 2018



Frequency (kHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable 1Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
13.56	54.11	10	-40	10.7	0	24.81	84	-59.19

Plot 5. Operation Within the Band 13.553 – 13.567 MHz, 0 degrees



Frequency (kHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable 1Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
13.56	23.55	10	-40	10.7	0	-5.75	84	-89.75

Plot 6. Operation Within the Band 13.553 – 13.567 MHz, 90 degrees

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 3.2.1.2 Unwanted Emissions Outside 13.553 – 13.567 MHz

Test Requirement(s): § 3.2.1.2: The field strength of unwanted emissions shall not exceed the general radiated emissions limits in LP0002 § 2.8

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009 – 0.490 (included)	2,400/Freq. (kHz)	300
0.490 (excluded) – 1.705 (included)	24,000/Freq. (kHz)	30
1.705 (excluded) – 30 (excluded)	30	30
30 (included) – 88 (included)	100	3
88 (excluded) – 216 (included)	150	3
216 (excluded) – 960 (included)	200	3
Above 960 (excluded)	500	3

Table 14. General Radiated Emissions Limits of §2.8

Test Procedures: The EUT was set to transmit and placed on a 0.8m-high non-reflective (acrylic) table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4: 2014 and LP0002 Appendix were used. For measurements below 30 MHz a loop antenna placed 3m away from the unit was used. For measurements above 30 MHz a biconilog 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 300 Hz for measurements below 150 kHz, 10 kHz for measurements between 150 kHz and 30 MHz, and 100 kHz for measurements above 30 MHz. A peak detector was used for scanned measurements.

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

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

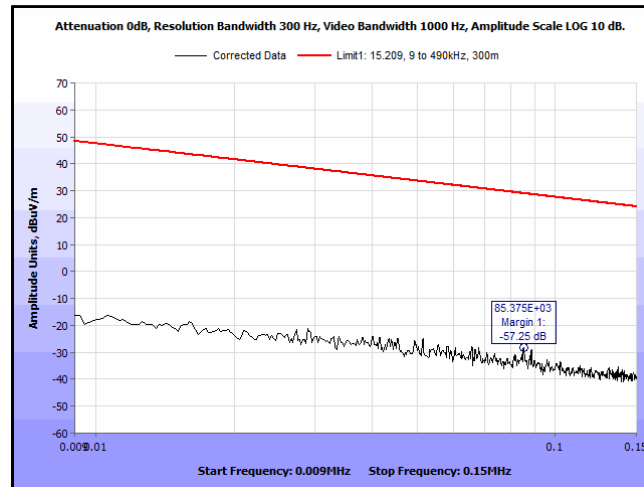
The measurements made at 10m with the biconilog antenna were then extrapolated to the 3m using the following correction factor.

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

Test Results: The EUT was compliant with the requirements of § 3.2.1.2.

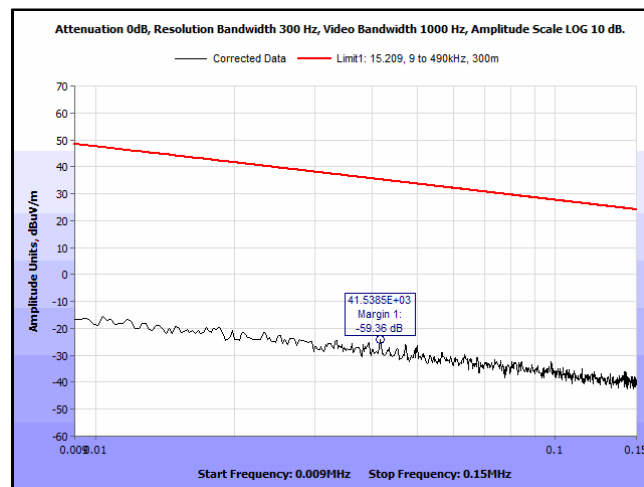
Test Engineer(s): Giuliano Messina

Test Date(s): June 4, 2018



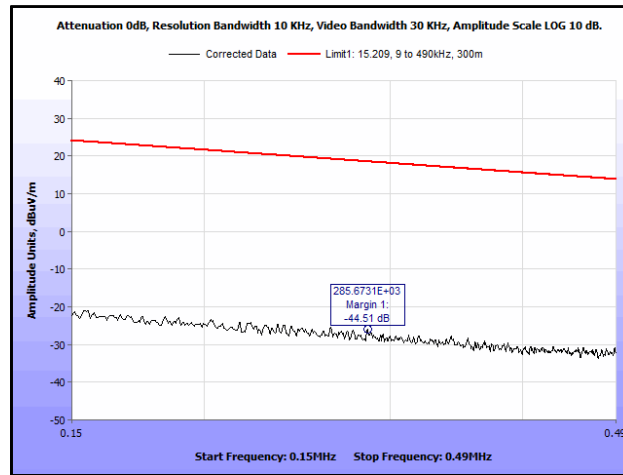
Frequency (kHz)	Meter Reading (dBuV)	RBW (Hz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 9 to 490kHz, 300m dBuV/m	Margin (dB)
85.375	40.07	300	-80	11.65	0	-28.27	28.98	-57.25

Plot 7. Spurious Emissions, Outside the Bands, 9 – 150 kHz, 0 degrees



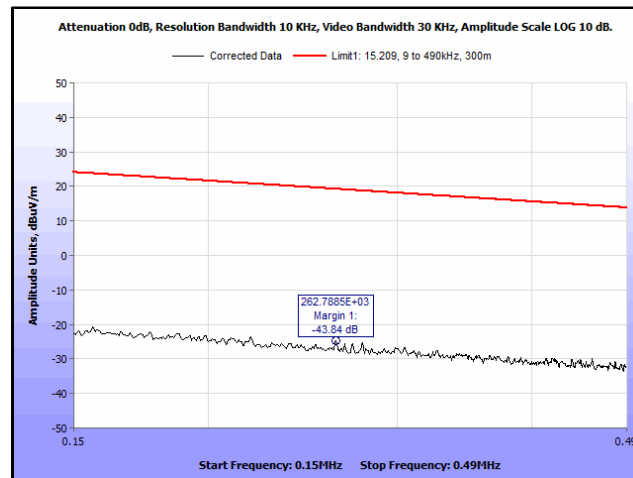
Frequency (kHz)	Meter Reading (dBuV)	RBW (Hz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 9 to 490kHz, 300m dBuV/m	Margin (dB)
41.5385	43.04	300	-80	12.85	0	-24.12	35.24	-59.36

Plot 8. Spurious Emissions, Outside the Bands, 9 – 150 kHz, 90 degrees



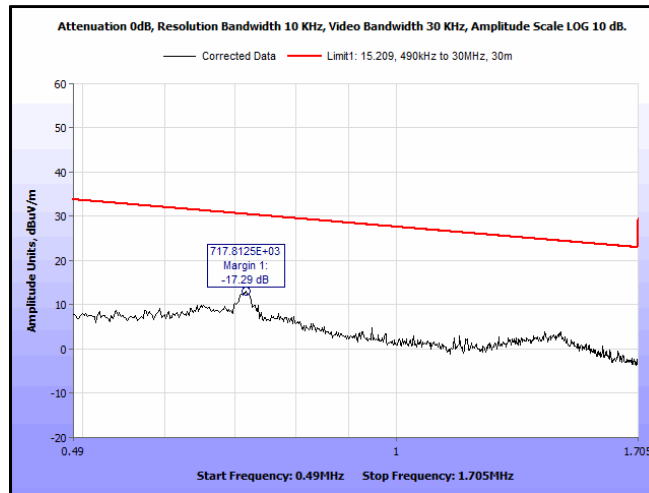
Frequency (kHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 9 to 490kHz, 300m dBuV/m	Margin (dB)
285.6731	42.87	10	-80	11.11	0	-26.02	18.49	-44.51

Plot 9. Spurious Emissions, Outside the Bands, 150 – 490 kHz, 0 degrees



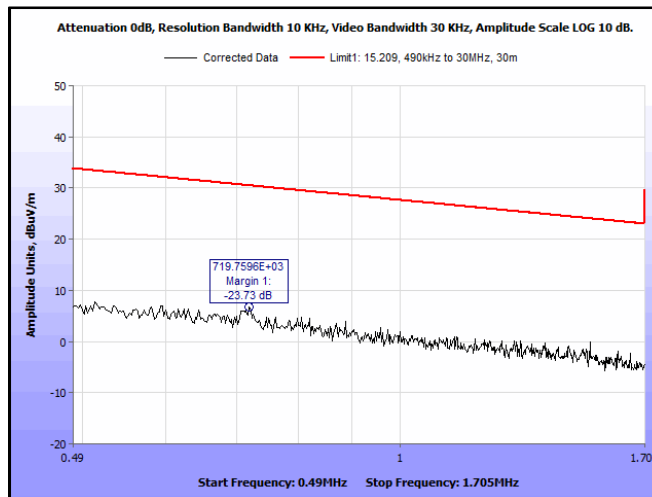
Frequency (kHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 9 to 490kHz, 300m dBuV/m	Margin (dB)
262.7885	44.23	10	-80	11.14	0	-24.63	19.21	-43.84

Plot 10. Spurious Emissions, Outside the Bands, 150 – 490 kHz, 90 degrees



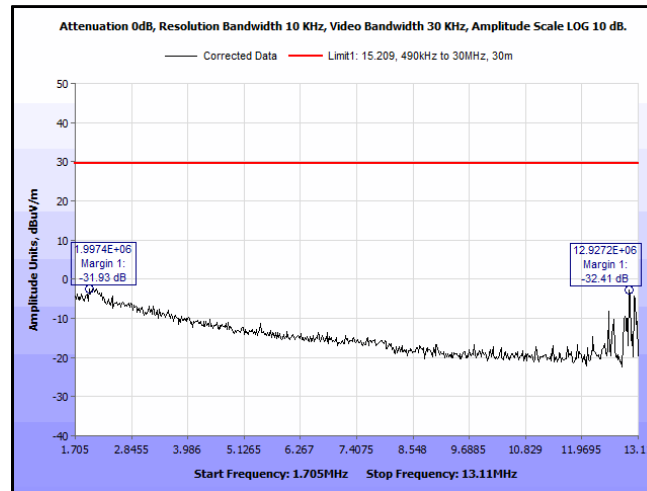
Frequency (kHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
717.8125	41.99	10	-40	11.2	0	13.19	30.48	-17.29

Plot 11. Operation, Outside the Band, 0.490 – 1.705 MHz, 0 degrees



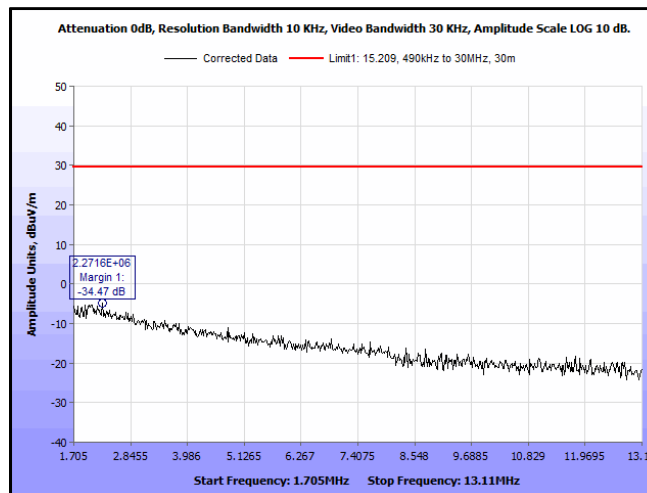
Frequency (kHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
719.7596	35.53	10	-40	11.2	0	6.73	30.46	-23.73

Plot 12. Operation, Outside the Band, 0.490 – 1.705 MHz, 90 degrees



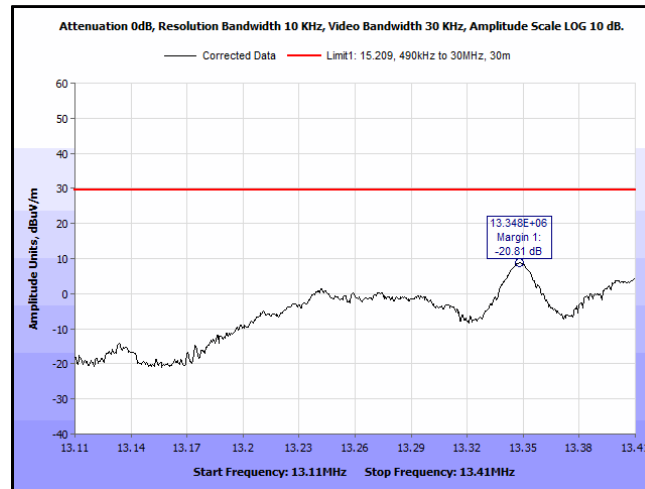
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
1.9974	26.11	10	-40	11.5	0	-2.39	29.54	-31.93
12.9272	26.43	10	-40	10.71	0	-2.87	29.54	-32.41

Plot 13. Spurious Emissions, Outside the Bands, 1.705 – 13.11 MHz, 0 degrees



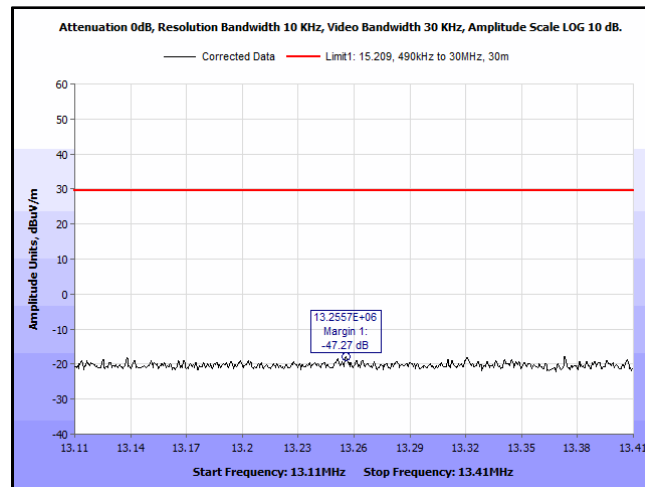
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
2.2716	23.6	10	-40	11.47	0	-4.93	29.54	-34.47

Plot 14. Spurious Emissions, Outside the Bands, 1.705 – 13.11 MHz, 90 degrees



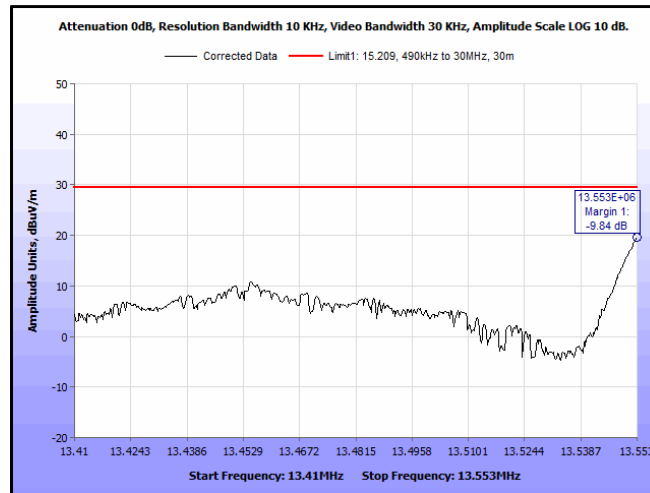
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
13.348	38.03	10	-40	10.7	0	8.73	29.54	-20.81

Plot 15. Spurious Emissions, Outside the Bands, 13.110 – 13.410 MHz, 0 degrees



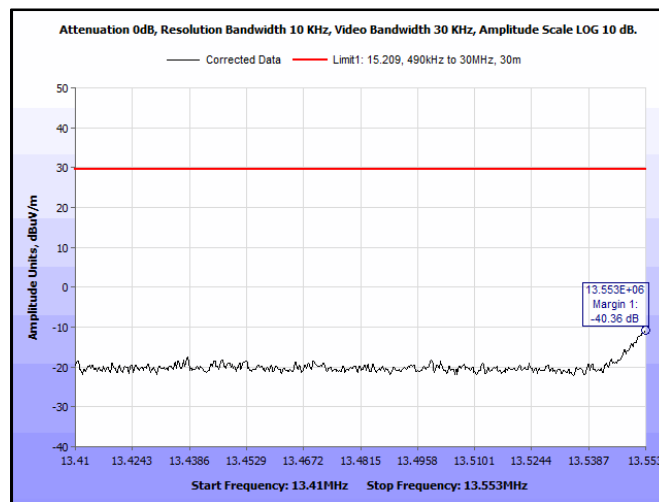
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
13.2557	11.57	10	-40	10.7	0	-17.73	29.54	-47.27

Plot 16. Spurious Emissions, Outside the Bands, 13.110 – 13.410 MHz, 90 degrees



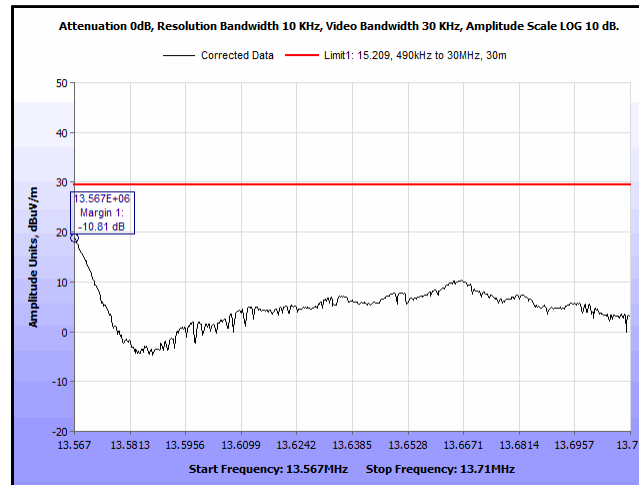
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
13.553	49	10	-40	10.7	0	19.7	29.54	-9.84

Plot 17. Spurious Emissions, Outside the Bands, 13.410 – 13.553 MHz, 0 degrees



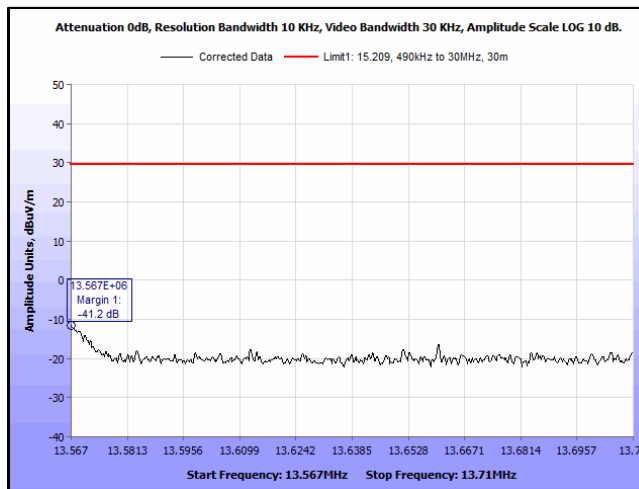
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
13.553	18.48	10	-40	10.7	0	-10.82	29.54	-40.36

Plot 18. Spurious Emissions, Outside the Bands, 13.410 – 13.553 MHz, 90 degrees



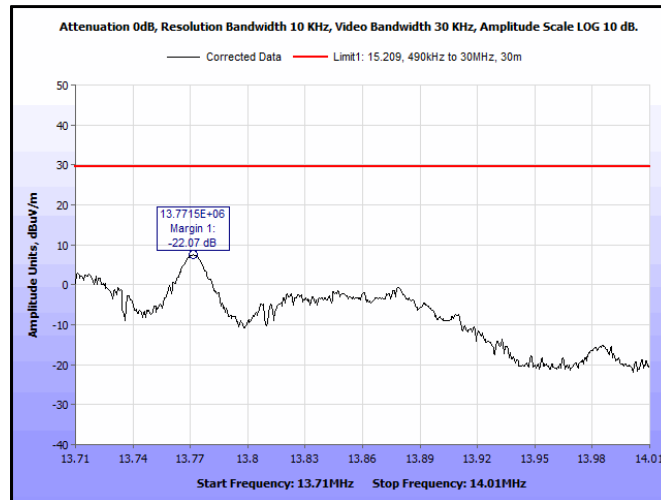
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
13.567	48.03	10	-40	10.7	0	18.73	29.54	-10.81

Plot 19 Spurious Emissions, Outside the Bands, 13.567 – 13.710 MHz, 0 degrees



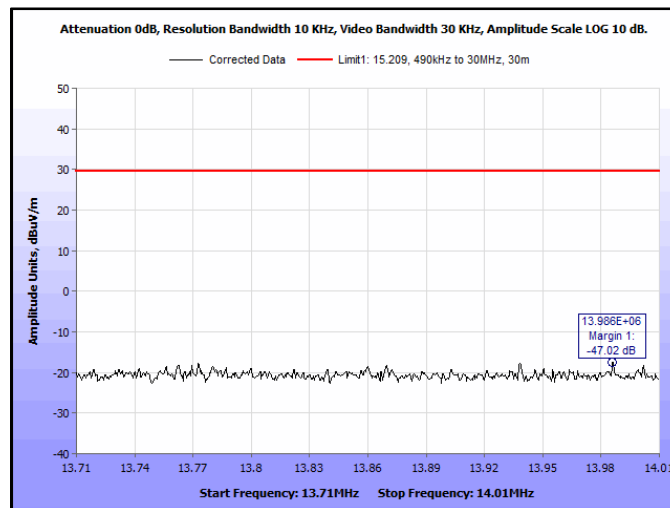
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
13.567	17.64	10	-40	10.7	0	-11.66	29.54	-41.2

Plot 20. Spurious Emissions, Outside the Bands, 13.567 – 13.710 MHz, 90 degrees



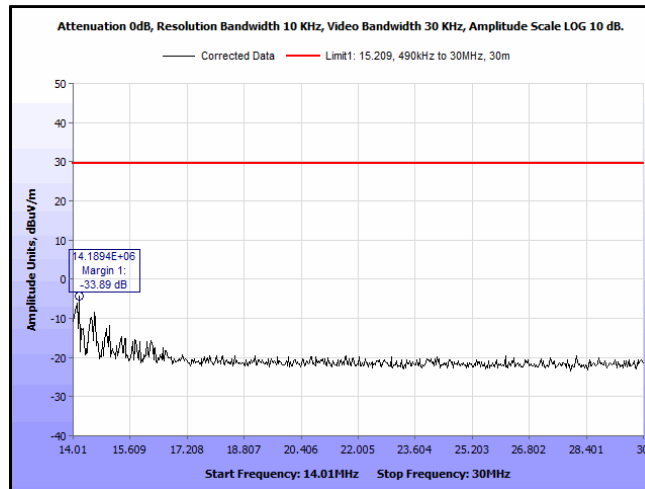
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
13.7715	36.77	10	-40	10.7	0	7.47	29.54	-22.07

Plot 21. Spurious Emissions, Outside the Bands, 13.710 – 14.010 MHz, 0 degrees



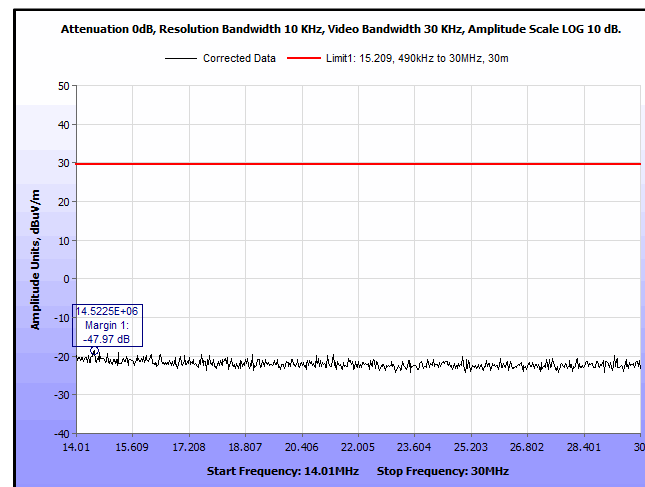
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
13.986	11.82	10	-40	10.7	0	-17.48	29.54	-47.02

Plot 22. Spurious Emissions, Outside the Bands, 13.710 – 14.010 MHz, 90 degrees



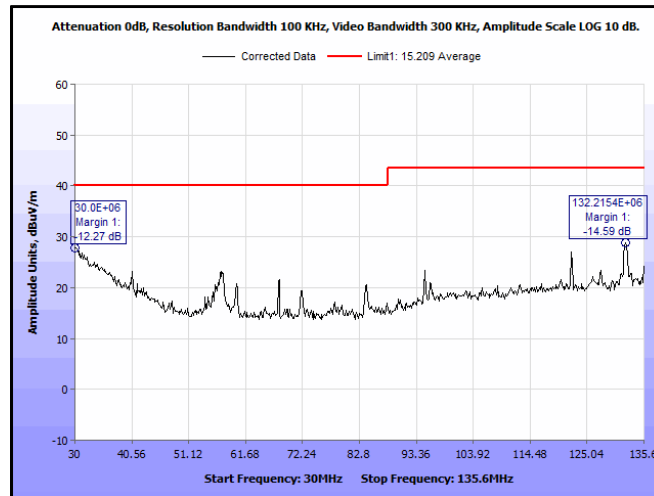
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
14.1894	24.97	10	-40	10.68	0	-4.35	29.54	-33.89

Plot 23. Spurious Emissions, Outside the Bands, 14.010 – 30 MHz, 0 degrees



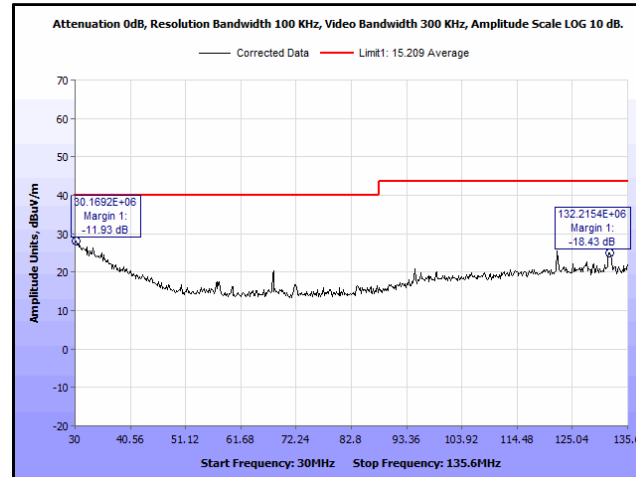
Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Cable Insertion Loss Factor (dB)	Corrected Measurement dBuV/m	15.209, 490kHz to 30MHz, 30m dBuV/m	Margin (dB)
14.5225	10.92	10	-40	10.65	0	-18.43	29.54	-47.97

Plot 24. Spurious Emissions, Outside the Bands, 14.010 – 30 MHz, 90 degrees



Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Preamplifier Factor (dB)	Corrected Measurement dBuV/m	15.209 Average dBuV/m	Margin (dB)
30.0	21.39	100	10.46	20.7	-24.82	27.73	40	-12.27
132.2154	29.1	100	10.46	12.82	-23.47	28.91	43.5	-14.59

Plot 25. Spurious Emissions, Outside the Bands, 30 – 135.6 MHz, Horizontal



Frequency (MHz)	Meter Reading (dBuV)	RBW (kHz)	Distance Correction Factor (dB)	Measurement Sensor Factor Amplitude (dBuV)	Preamplifier Factor (dB)	Corrected Measurement dBuV/m	15.209 Average dBuV/m	Margin (dB)
30.1692	21.87	100	10.46	20.55	-24.81	28.07	40	-11.93
132.2154	25.26	100	10.46	12.82	-23.47	25.07	43.5	-18.43

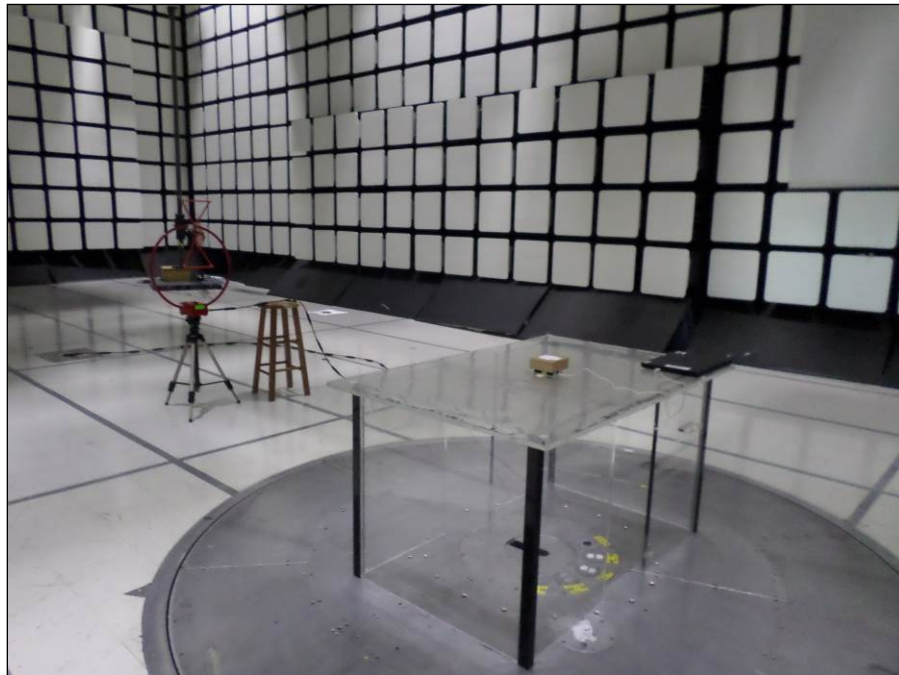
Plot 26. Spurious Emissions, Outside the Bands, 30 – 135.6 MHz, Vertical



Photograph 3. Spurious Emissions, Below 30 MHz, Antenna Setup



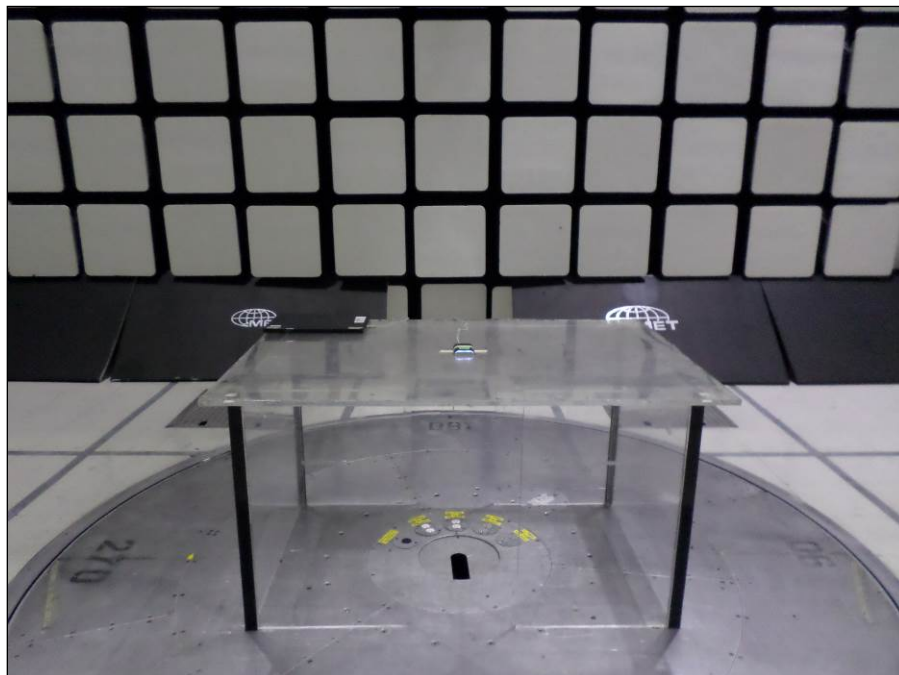
Photograph 4. Spurious Emissions, Below 30 MHz, EUT Close up



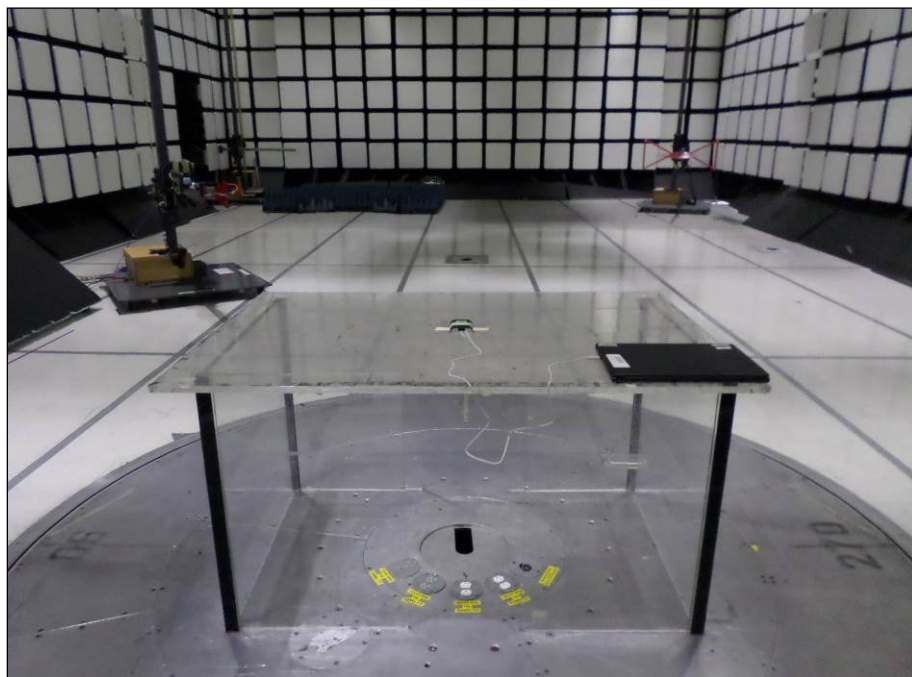
Photograph 5. Spurious Emissions, Below 30 MHz, Rear View



Photograph 6. Spurious Emissions, Above 30 MHz, Antenna Setup



Photograph 7. Spurious Emissions, Above 30 MHz, Front View



Photograph 8. Spurious Emissions, Above 30 MHz, Rear View

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 3.2.1.3 Frequency Tolerance

Test Requirement(s): § 3.2.1.3: 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 3.2.1.3. 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.

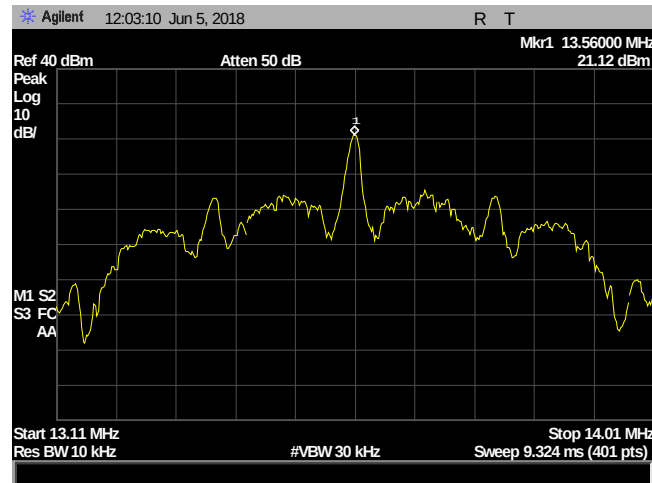
Test Results: The EUT was found **compliant** with §3.2.1.3 requirement(s) of this section.

Test Engineer(s): Giuliano Messina

Test Date(s): June 5, 2018

Voltage (DC)	Temp (°C)	Nominal Freq (MHz)	Result (MHz)	PPM
Vnom	20	13.56	13.56	0
Vnom	50	13.56	13.56	0
Vnom	-20	13.56	13.56	0
15%	20	13.56	13.56	0
-15%	20	13.56	13.56	0

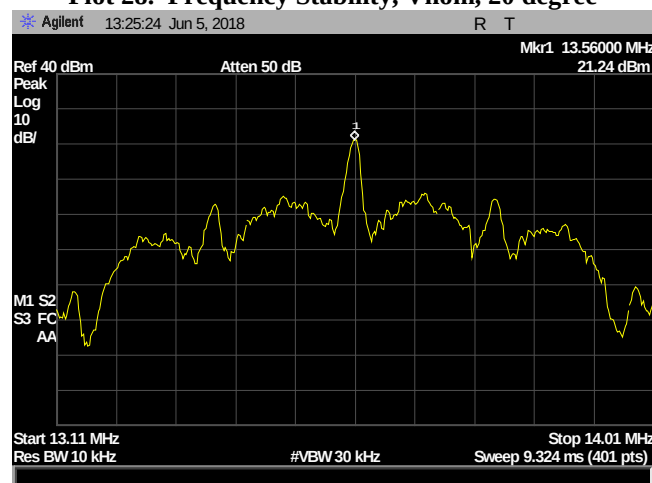
Table 15. Frequency Stability, Test Results



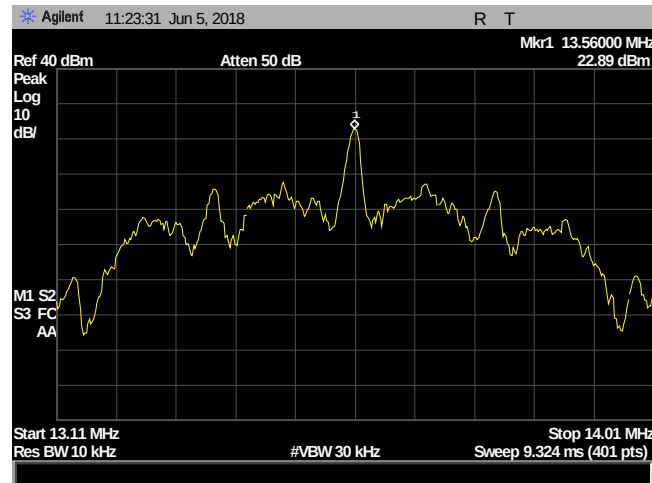
Plot 27. Frequency Stability, Vnom, -20 degree



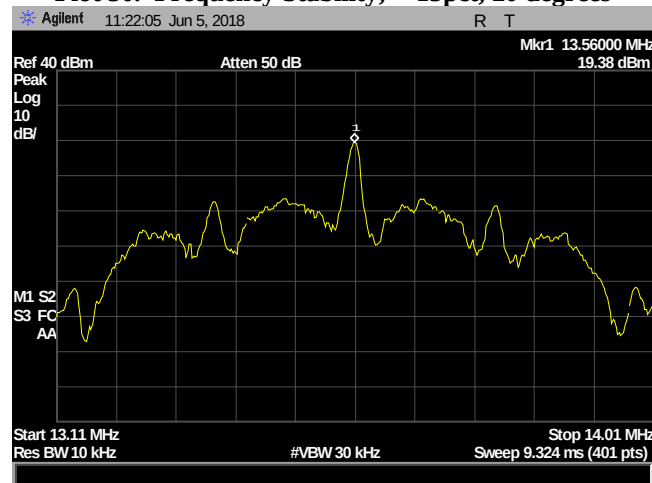
Plot 28. Frequency Stability, Vnom, 20 degree



Plot 29. Frequency Stability, Vnom, 50 degree



Plot 30. Frequency Stability, -+15pct, 20 degrees



Plot 31. Frequency Stability, -15 pct, 20 degrees

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 5.20 Radiofrequency radiation exposure

RF Exposure Requirements: **FCC §1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **FCC §1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

FCC §2.1093: As specified in this section, a portable device is defined as a transmitting device designed to be used so that the radiated structure(s) of the device is within 20 centimeters of the body of the user.
Calculations below are in accordance with KDB 447498 D01 General RF Exposure Guidance v06, Section 4.3 General SAR test exclusion guidance.
The SAR test exclusion thresholds are 3.0 for 1-g SAR and 7.5 for 10-g extremity SAR.

13.56 MHz SAR Exclusion Calculation

Per KDB 447498, Section 4.3.1 (c)(2), applicable for frequencies below 100 MHz and test separation distances ≤ 50 mm:

- Using the information from 4.3.1 (b), the formula from 4.3.1 (a), and using the 1-g SAR limit of 3.0:

Power allowed at numeric threshold for 50 mm and 100 MHz in step 4.3.1 (a) =

$$\left(\frac{3}{\sqrt{0.1}} \right) * 50 \text{ mm} = 474.34 \text{ mW}$$

- Using information from 4.3.1 (c)(1) and the formula from 4.3.1 (b), defined at 50 mm and 100 MHz:

$$\begin{aligned} & \left(\text{Power allowed at numeric threshold for 50 mm in step 4.3.1 (a)} \right) + \\ & \left(\text{test separation distance} - 50 \text{ mm} \right) * \left(\frac{f [\text{MHz}]}{150} \right) \end{aligned}$$

$$(474.34 \text{ mW}) + (50 \text{ mm} - 50 \text{ mm}) * \left(\frac{100 \text{ MHz}}{150} \right) = 474.34 \text{ mW}$$

- Using the information from 4.3.1 (c)(2) and the formula from 4.3.1 (c)(1), defined at 13.56 MHz, the final max power should be:

Max Power of 13.56MHz Transmitter under the 1g SAR Limit =

$$\frac{1}{2} * 474.34 \text{ mW} \left[1 + \log \left(\frac{100 \text{ MHz}}{13.56 \text{ MHz}} \right) \right] = 442.972 \text{ mW}$$

Frequency (MHz)	Corrected Meter Reading (dBuV/m), 30m	TX Power (dbm)	TX Power (mW)	1.0-g SAR Limit (mW)	Margin (mW)	Result
13.56	24.82	-50.407	9.105E-6	11.812	-11.812	Pass

IV. Test Equipment

Test Equipment

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

MET Asset #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1065	EMI Receiver	Rohde & Schwarz	ESCI	03/23/2018	03/23/2019
1A1177	Attenuator	Rohde & Schwarz	ESH3Z2	02/21/2017	08/21/2018
1A1123	LISN	TESEQ	NNB 51	08/25/2017	08/25/2018
1A1119	Test Area	Custom Made	N/A	02/13/2017	08/13/2018
1A1076	Variable AC Transformer	Powerstat	N/A	See Note	
1A1083	EMI Test Receiver	Rohde & Schwarz	ESU40	9/12/2017	9/12/2018
1A1106	10m Chamber (FCC)	ETS	Semi-Anechoic	See Note	
1A1147	Bilog Antenna (30MHz to 1GHz)	Sunol Sciences Corp	JB3	3/9/2017	9/9/2018
1A1176	Active Loop Antenna	ETS-Lindgren	6502	1/31/2018	7/31/2019
1A1099	Generator	COM-Power Corp	CGO-51000	See Note	
1A1088	Pre-Amp	Rohde & Schwarz	TS-PR1	See Note	
1A1044	Generator	COM-Power Corp	CG-520	See Note	
1A1073	Multi Device Controller	ETS EMCO	2090	See Note	
1A1074	System Controller	Panasonic	WV-CU101	See Note	
1A1075	System Controller	Panasonic	WV-CU101	See Note	

Table 16. Test Equipment List

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

End of Report