MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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August 20, 2018

InVue
9201 Baybrook Lane
Charlotte, North Carolina 28277

Dear Adam Krause,

Enclosed is the EMC test report for limited compliance testing of the InVue, Watch Charger, for Class B device, tested to the requirements of Title 47 of the CFR, Ch. 1 Part 18 for Industrial, Scientific, and Medical (ISM) Equipment, Ultrasonic Devices..

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,
MET LABORATORIES, INC.

Joel Huna
Documentation Department

Reference: (\InVue\EMC99785-FCC18 Rev. 1)

A2LA ACCREDITED
TESTING CERT #0591.01

Electromagnetic Compatibility
Test Report

for

InVue
Watch Charger

Tested under

Title 47 of the CFR, Part 18
for Industrial, Scientific, and Medical (ISM) Equipment, Ultrasonic Devices

MET Report: EMC99785-FCC18 Rev. 1

August 20, 2018

Bradley Jones
Test Engineer, EMC 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 applicable limits. 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 Title 47 of the CFR, Part 18 for a Class B Digital Device under normal use and maintenance.

John Mason
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	August 7, 2018	Initial Issue.
1	August 20, 2018	Typo Correction.

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
CISPR	**C**omite **I**nternational **S**pecial des **P**erturbations **R**adioelectriques (International Special Committee on Radio Interference)
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**micro**henry
µF	**micro**farad
µs	**micros**econds
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

Table 1: List of Abbreviations

1.0 Testing Summary

The following tests specified below were performed with the following results.

Reference and Test Description	Results	Comments
Title 47 of the CFR, Part 18 - 18.309 (a) Conducted Emission Limits for Industrial, Scientific, and Medical (ISM) Equipment, Ultrasonic Devices	Compliant	Measured emissions were within applicable limits.
Title 47 of the CFR, Part 18 - 18.305 (b) Radiated Emission Limits for Industrial, Scientific, and Medical (ISM) Equipment, Ultrasonic Devices	Compliant	Measured emissions were within applicable limits.

Table 2: Testing Summary

2.0 Equipment Configuration

2.1 Overview

MET Laboratories, Inc. was contracted by InVue to perform testing on the Watch Charger, under InVue purchase order number 57873.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the InVue, Watch Charger.

In accordance with §2.955(a) (3), the following data is presented in support of the verification of the InVue, Watch Charger. InVue should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Watch Charger has been **permanently** discontinued, as per §2.955(b).

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

Model(s) Tested:	Watch Charger
Model(s) Covered:	Watch Charger
Primary Power as Tested:	4.5-5.5 VDC
Equipment Emissions Class:	B
Highest Clock Frequency:	N/A
Evaluated by:	Bradley Jones
Report Date:	August 20, 2018

Table 3. EUT Overview

2.2 Test Site

All testing was performed at MET Laboratories, Inc., 914 West Patapsco Avenue, Baltimore, MD 21230 All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

MET Laboratories is a ISO/IEC 17025 accredited site by A2LA, #0591.01.

Radiated Emissions measurements were performed in a semi-anechoic chamber. In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

2.3 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

2.4 Description of Test Sample

The Watch Charger (EUT) is a device used to charge smart watches using inductively coupled power transfer. The intent is to place the EUT on a variety of stands/displays that are designed to display smart watches in a retail environment (in a store). The watch is placed in contact with the EUT. The EUT is not intended to charge the watch at a distance. Powering the EUT is a 5V wall outlet power supply connected to the attached cable with a USB-A connector.

2.5 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. #
A		**Watch Charger (EUT)**	**F1671**	**F1671107**	**N/A**	**0**

Table 5. Equipment Configuration

2.6 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
B	Power Supply (5V)	InVue	PS515	N/A
C	Smart Watch	Confidential	Confidential	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

2.7 Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded? (Y/N)	Termination Box ID & Port Name
1	Vin	2 conductor, 24AWG	1	1	1.1	No	B.Vout
2	RFout	Wireless power transfer (no cable)	1	N/A	N/A	No	C.RFin

Table 7. Ports and Cabling Information

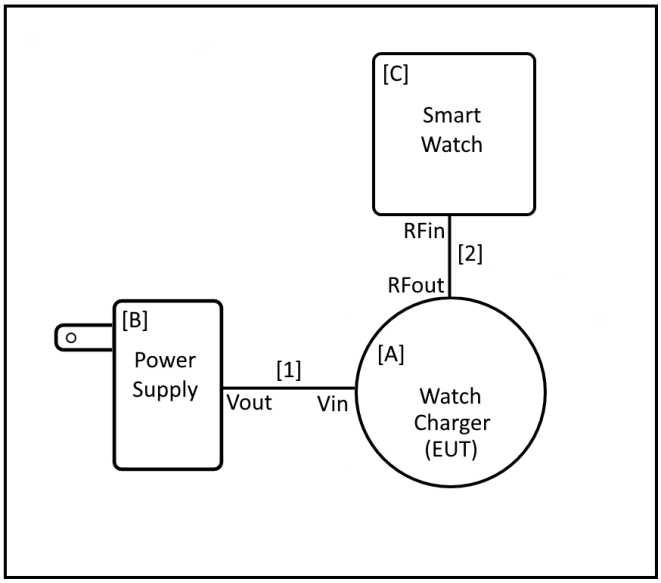


Figure 1. Block Diagram of Test Configuration

2.8 Mode of Operation

There are three devices supplied for testing. One with production firmware (gPC0808) that utilizes the full frequency band (120kHz-190kHz). There is one that radiates only at 120kHz to make it easy to analyze harmonics, etc., at that frequency. There is a third device that radiates at 155kHz for the same reason. These frequencies were identified as the most interesting frequencies through testing a very similar device with the same parts. Each of these devices can be tested both with the supplied smart watch placed on it's surface (charging mode) and without the smart watch (idle mode). Both modes require only that the supplied 5V power supply is attached to wall power and that the EUT is plugged into it.
NOTE: If it is found that frequencies different from 120kHz and 155kHz are needed, they can be suppled.

2.9 Method of Monitoring EUT Operation

1. The supplied smart watch will be charging when the EUT is performing its intended function. This can be observed by viewing the display of the watch when it is off (there will be a lightning bolt on the screen).
2. When the EUT is not functioning properly, there will not be a lightning bolt on the screen of the smart watch when placed on the charger.

2.10 Modifications

2.10.1 Modifications to the EUT

No modifications were made to the EUT.

2.10.2 Modifications to the Test Standard

No modifications were made to the test standard.

2.11 Disposition of EUT

The test sample including all support equipment (if any), submitted to the Electro-Magnetic Compatibility Lab for testing was returned to InVue upon completion of testing.

2.12 Test Software Used

Conducted Emissions - Trace Data Grabber version 01/26/2016
Radiated Emissions- EMC-REG-TDS-11, Radiated Emissions Prescan.xls version 06/29/11

3.0 Electromagnetic Compatibility Emission Criteria

3.1 Conducted Emission Limits

Test Requirement(s): **18.307** For the following equipment, when 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 shall not exceed the limits in the following tables. 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 using a 50 µH/50 Ohms Line Impedance Stabilization Network (LISN).

(b) All other part 18 consumer devices:

Frequency of Emission (MHz)	18.307(a) ISM Conducted Limits (dBµV)	
	Quasi-Peak	Average
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5	56	46
5 - 30	60	50
Note 1 — The lower limit shall apply at the transition frequencies. Note 2 — *The limit decreases linearly with the logarithm if the frequency in the range 0.05 MHz to 0.5 MHz.		

Table 8. Conducted Limits for ISM (Ultrasonic Equipment) calculated from FCC Part 18 Section 18.307(a)

18.311 The measurement techniques which will be used by the FCC to determine compliance with the technical requirements of this part are set out in FCC Measurement Procedure MP–5, ‘‘Methods of Measurements of Radio Noise Emissions from ISM equipment’’. Although the procedures in MP–5 are not mandated, manufacturers are encouraged to follow the same techniques which will be used by the FCC.

Test Procedure: The EUT was setup on a wooden table, 80cm above the ground plane. The method of testing, test conditions, and test procedures of CISPR 22 were used. The EUT was powered through a 50Ω/50µH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 20 dB of the limit, six highest peaks were re-measured using a quasi-peak and average detector.

Environmental Conditions for Conducted Emissions	
Ambient Temperature (°C)	23.7
Relative Humidity (%)	38

Test Results: The EUT was **compliant** with the of this section. Measured emissions were within applicable limits.

Test Technician(s): Bradley Jones

Test Date(s): July 20, 2018

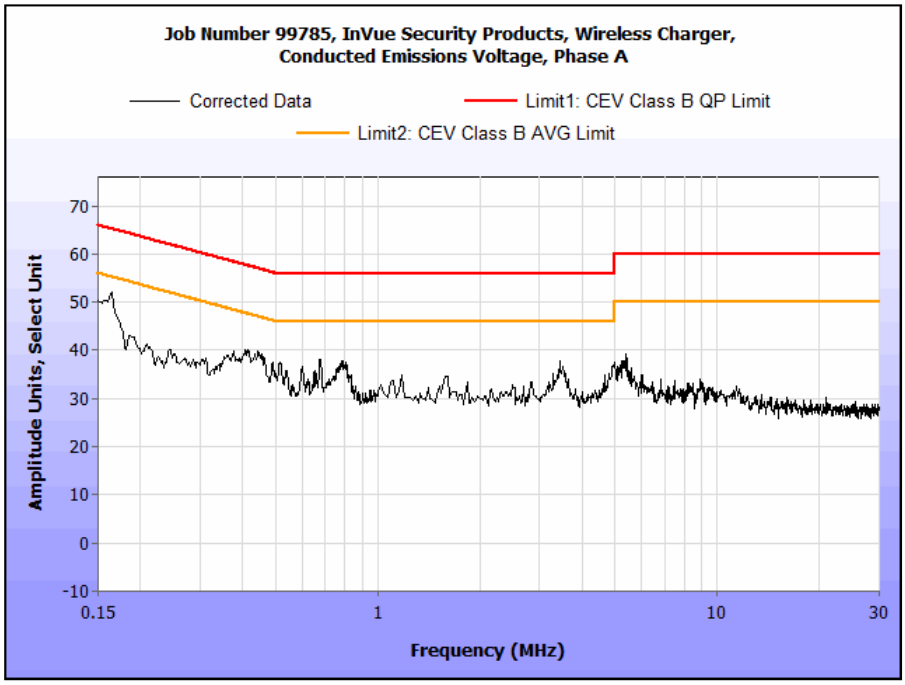
Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.209	17.16	0	17.16	63.25	-46.09	13.82	0	13.82	53.25	-39.43
0.292	17.93	0	17.93	60.47	-42.54	14.86	0	14.86	50.47	-35.61
0.368	15.58	0	15.58	58.55	-42.97	11.89	0	11.89	48.55	-36.66
11.39	16.71	0.09	16.8	60	-43.2	8.668	0.09	8.758	50	-41.242
16.97	16.91	0.13	17.04	60	-42.96	8.294	0.13	8.424	50	-41.576
25.14	19.83	0.21	20.04	60	-39.96	10.05	0.21	10.26	50	-39.74

Table 9. Conducted Emissions, Phase Line, Test Results

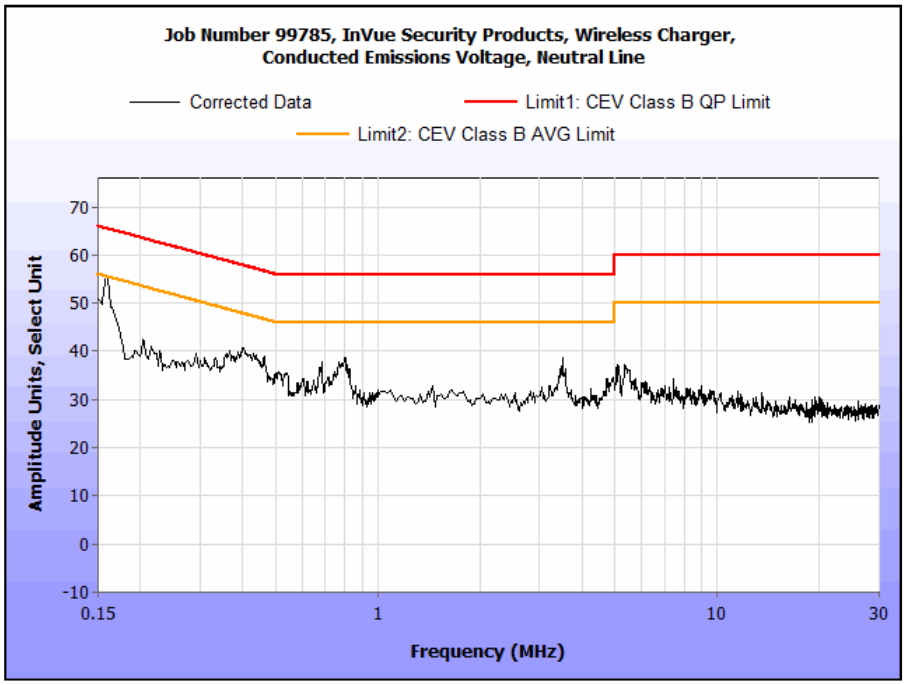
Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.206	17.85	0	17.85	63.37	-45.52	14.7	0	14.7	53.37	-38.67
0.29	18.54	0	18.54	60.52	-41.98	15.74	0	15.74	50.52	-34.78
0.454	16.59	0	16.59	56.8	-40.21	13.27	0	13.27	46.8	-33.53
11.45	16.77	0.09	16.86	60	-43.14	9.714	0.09	9.804	50	-40.196
16.62	18.93	0.13	19.06	60	-40.94	9.779	0.13	9.909	50	-40.091
25.37	20.01	0.2	20.21	60	-39.79	9.671	0.2	9.871	50	-40.129

Table 10. Conducted Emissions, Neutral Line, Test Results

Conducted Emissions at the Mains Terminal Test Data:



Plots 1. Conducted Emissions at the Mains Terminal Test Data – Line Plot



Plots 2. Conducted Emissions at the Mains Terminal Test Data – Neutral Plot

Photograph 1: Conducted Emissions at the Mains Terminal Test Setup

3.2 Radiated Emission: Limits of Electromagnetic Radiation Disturbance

Test Method: **ANSI C63.4- American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz**

Test Standard: **Title 47 of the Code of Federal Regulations (CFR), Part 18 Subpart C**

Test Requirement(s): 18.305 Field strength limits:
(a) ISM equipment operating on a frequency specified in § 18.301 is permitted unlimited radiated energy in the band specified for that frequency.
(b) The field strength levels of emissions which lie outside the bands specified in § 18.301, unless otherwise indicated, shall not exceed the following:

Equipment	Operating frequency	RF Power generated by equipment (watts)	Field strength limit (uV/m)	Distance (meters)
Any type unless otherwise specified (miscellaneous)	Any ISM frequency	Below 500 500 or more	25 25×SQRT(power/500)	300 [1]300
	Any non-ISM frequency	Below 500 500 or more	15 15×SQRT(power/500)	300 [1]300
Industrial heaters and RF stabilized arc welders	On or below 5,725 MHz Above 5,725 MHz	Any Any	10 ([2])	1,600 ([2])
Medical diathermy	Any ISM frequency Any non-ISM frequency	Any Any	25 15	300 300
Ultrasonic	Below 490 kHz	Below 500 500 or more	2,400/F(kHz) 2,400/F(kHz)× SQRT(power/500)	300 [3]300
	490 to 1,600 kHz Above 1,600 kHz	Any Any	24,000/F(kHz) 15	30 30
Induction cooking ranges	Below 90 kHz On or above 90 kHz	Any Any	1,500 300	[4]30 [4]30

[1] Field strength may not exceed 10 μV/m at 1600 meters. Consumer equipment operating below 1000 MHz is not permitted the increase in field strength otherwise permitted here for power over 500 watts.
[2] Reduced to the greatest extent possible.
[3] Field strength may not exceed 10 μV/m at 1600 meters. Consumer equipment is not permitted the increase in field strength otherwise permitted here for over 500 watts.
[4] Induction cooking ranges manufactured prior to February 1, 1980, shall be subject to the field strength limits for miscellaneous ISM equipment.

18.311 The measurement techniques which will be used by the FCC to determine compliance with the technical requirements of this part are set out in FCC Measurement Procedure MP–5, ‘‘Methods of Measurements of Radio Noise Emissions from ISM equipment’’. Although the procedures in MP–5 are not mandated, manufacturers are encouraged to follow the same techniques which will be used by the FCC.

Test Procedures: The EUT was placed on a non-metallic table, 80 cm above the ground plane (See Photograph 2 - 5) inside a semi-anechoic chamber. Measurements were made with a loop antenna.

Radiated Emission measurements were made in accordance with the general procedures of ANSI C63.4-1992 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz" as well as the procedures delineated in FCC Measurement Procedure MP-5, “Methods of Measurements of Radio Noise Emissions from ISM equipment”.

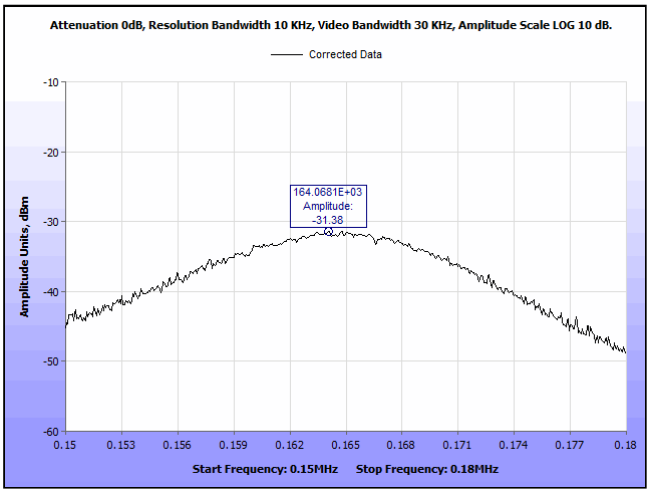
For each point of measurement, the turntable was rotated, the positions of the interface cables were varied, and the antenna height was varied in order to find the maximum radiated emissions.
Measurements were made at 3m. The limit line was corrected for 3m using 40 Log($^{d1}/_{d2}$).

Environmental Conditions for Radiated Emissions	
Ambient Temperature (°C)	23.7
Relative Humidity (%)	38

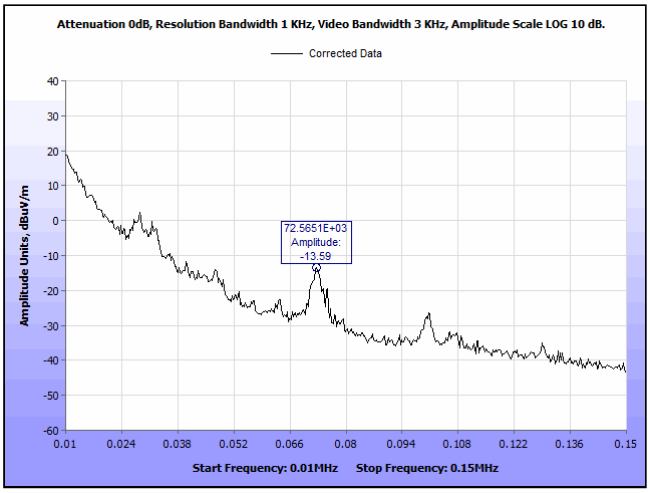
Test Results: The EUT was **compliant** with the requirements of this section. Measured emissions were within applicable limits.

Test Technician(s): Bradley Jones

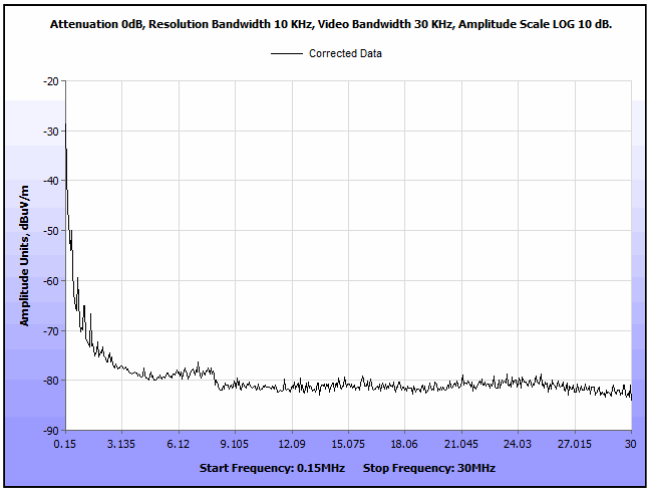
Test Date(s): July 30, 2018



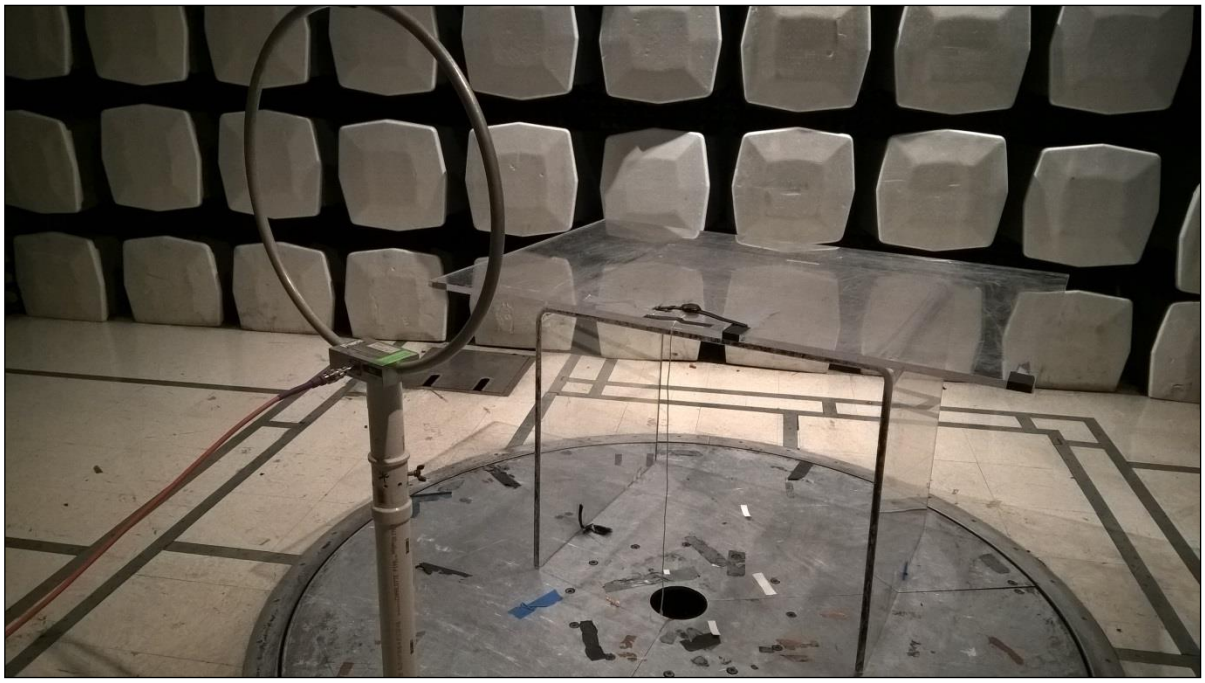
Plots 3. Radiated Emission – Fundamental 150 – 180 kHz Plot



Plots 4. Radiated Emission – 10 – 150 kHz Plot



Plots 5. Radiated Emission – 150 kHz – 30 MHz Plot



Photograph 2: Radiated Emission, Test Setup, Below 1 GHz

4.0 Test Equipment

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

Test Name: Conducted Emissions (AC Power)				**Test Date(s):** July 30,2018	
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1T4563	LISN (10 AMP)	Solar Electronics Company	9322-50-R-10-BNC	03/13/2017	09/13/2018
1T4612	Spectrum Analyzer	Agilent Technologies	E4407B	05/15/2018	11/15/2019
1T4503	Shielded Room	Universal Shielding Corp	N/A	Not Required	
Test Name: Radiated Emissions				**Test Date(s):** July 30, 2018	
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1T4800	Antenna, Loop	EMCO	6512	04/12/2017	10/12/2018
1U0150	EMI Test Receiver	Rohde & Schwarz	ESIB7	06/29/2018	07/14/2018
1T4300A	SEMI-ANECHOIC CHAMBER # 1 (FCC)	EMC TEST SYSTEMS	NONE	01/31/2016	01/31/2019
Note: Functionally verified test equipment is verified using calibrated instrumentation at the time of testing.					

Table 11: Test Equipment List