F2 Labs
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United States of America
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CERTIFICATION TEST REPORT

Manufacturer:	**Deister Electronics USA, Inc.** **8576 Wellington Road** **Manassas, Virginia 20109 USA**
Product Name:	**Prox/Smart Card Reader Module**
Product Description:	Prox/Smart Card Reader Module
Operating Voltage/Frequency:	**12VDC**
Model:	**PRDi/4 iClass**
FCC ID:	**IXLPRDI4IC**
Testing Commenced:	2021-03-17
Testing Ended:	2021-09-13
Summary of Test Results:	**In Compliance**

Standards:

- **FCC Part 15 Subpart C, Section 15.209**
- **FCC Part 15 Subpart C, Section 15.215(c) – Additional provisions to the general radiated emission limitations**
- **FCC Part 15 Subpart A, Section 15.31(e) – Measurement Standards**
- **FCC15.207 - Conducted Limits**

Evaluation Conducted by:

Julius Chiller, EMC/Wireless Engineer

Report Reviewed by:

Ken Littell, Vice President of EMC

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1 ADMINISTRATIVE INFORMATION

1.1 Measurement Location:

F2 Labs in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD.

1.2 Measurement Procedure:

All measurements were performed according to the 2013 version of ANSI C63.10 and recommended FCC procedure of measurement of equipment operating under Section 15.209. A list of the measurement equipment can be found in Section 6.

1.3 Uncertainty Budget:

The uncertainty in EMC measurements arises from several factors which affect the results, some associated with environmental conditions in the measurement room, the test equipment being used, and the measurement techniques adopted.

The measurement uncertainty budgets detailed below are calculated from the test and calibration data and are expressed with a 95% confidence factor using a coverage factor of k=2. The Uncertainty for a laboratory is referred to as *U*lab. For Radiated and Conducted Emissions, the Expanded Uncertainty is compared to the *U*cispr values to determine if a specific margin is required to deem compliance.

*U*lab

Measurement Range	Combined Uncertainty	Expanded Uncertainty
Radiated Emissions <1 GHz @ 3m	2.54	5.07dB
Radiated Emissions <1 GHz @ 10m	2.55	5.09dB
Radiated Emissions 1 GHz to 2.7 GHz	1.81	3.62dB
Radiated Emissions 2.7 GHz to 18 GHz	1.55	3.10dB
AC Power Line Conducted Emissions, 150kHz to 30 MHz	1.38	2.76dB
AC Power Line Conducted Emissions, 9kHz to 150kHz	1.66	3.32dB

*U*cispr

Measurement Range	Expanded Uncertainty
Radiated Emissions <1 GHz @ 3m	5.2dB
Radiated Emissions <1 GHz @ 10m	5.2dB
Radiated Emissions 1 GHz to 2.7 GHz	Under Consideration
Radiated Emissions 2.7 GHz to 18 GHz	Under Consideration
AC Power Line Conducted Emissions, 150kHz to 30 MHz	3.6dB
AC Power Line Conducted Emissions, 9kHz to 150kHz	4.0dB

If *U*lab is less than or equal to *U*cispr, then:
- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If *U*lab is greater than *U*cispr in table 1, then:
- compliance is deemed to occur if no measured disturbance, increased by (*U*lab – *U*cispr), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance, increased by (*U*lab – *U*cispr), exceeds the disturbance limit.

Note: Only measurements listed in the tables above that relate to tests included in this Test Report are applicable.

1.4 Document History:

Document Number	Description	Issue Date	Approved By
F2P23886A-02E	First Issue	2021-09-20	K. Littell

2 SUMMARY OF TEST RESULTS

Test Name	Standard(s)	Results
-20dB Occupied Bandwidth	CFR 47 Part 15.215(c)	Complies
Field Strength of Emissions	CFR 47 Part 15.209	Complies
Radiated Spurious Emissions	CFR 47 Part 15.209	Complies
Variation of the Input Power	CFR 47 Part 15.31(e)	Complies
Conducted Emissions	CFR 47, Part 15.207	Complies

Note: Product was operated using an AC to DC power supply, so Variation of the Input Power testing was performed at the nominal voltage, and then 85% and 115% of that voltage as well. The output power at the Low and High channels was measured to verify how much the power and frequency were affected by the variation of the input power. No shift in frequency or power was measured at either of the varied voltages on any of the channels.

Modifications Made to the Equipment
No modifications were made to the EUT.

3 TABLE OF MEASURED RESULTS

Test	125kHz	13.56 MHz
Limit for Fundamental	25.65 dBµV/m @ 300m	29.5 dBµV/m @ 30m
Field Strength of Fundamental corrected for 40dB/decade	-20.65 dBµV/m	28.1 dBµV/m -23.40 dBµA/m
Field Strength of Fundamental at a shorter distance	59.35 dBµV/m (Converted) 7.85 dBµA/m (Measured)	68.10 dBµV/m (Converted) 16.60 dBµA/m (Measured)
Limit for Fundamental with 40dB/decade correction.	125.65 dBµV/m @ 1m	69.5 dBµV/m @ 3m
-20dB Occupied Bandwidth (kHz)	0.592	120
*Voltage Variations at 9VDC	34.15 dBµA	34.94 dBµA
*Voltage Variations at 24VDC	33.62 dBµA	34.95 dBµA

Note: Field Strength for the 13.56 MHz was measured at 3-meters, and the 125 kHz was measured at 1-meter. The dBµA/m were converted to dBµV/m by adding 51.5dB.

Conversion to dBuV/m: dBµA/m + 51.5dB = dBµV/m

**This DC device is rated to operate at 12VDC and not to exceed 24VDC. The low voltage testing was done at 9VDC below which the unit ceased to function. Readings were recorded at 1m distance.*

Stability tested at 3 meters

4 ENGINEERING STATEMENT

This report has been prepared on behalf of **Deister Electronics USA, Inc.** to provide documentation for the testing described herein. This equipment has been tested and found to comply with Part 15.209 of the FCC Rules using ANSI C63.10 2013 and Part 15 standards. The test results found in this test report relate only to the items tested.

5 EUT INFORMATION AND DATA

5.1 Equipment Under Test:

Product: **Prox/Smart Card Reader Module**
Model: **PRDi/4 iClass**
Serial No.: 125kHz, s/n 1008-125; 13.56 MHz, 1009-1356; Dual, 1007
Firmware Version: d97
Software Version: Not applicable
FCC ID: **IXLPRDI4IC**

5.2 Trade Name:

Deister Electronics USA, Inc.

5.3 Power Supply:

7-24VDC from external power supply

5.4 Applicable Rules:

CFR 47, Part 15.209

5.5 Equipment Category:

Radio Transmitter – RFID Reader

5.6 Antenna:

0dBi Inductor Antenna

5.5 Accessories:

DC Supply: BK Precision 1685B, s/n 7611-3204-1010

5.6 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

EUT was configured to transmit in the continuous mode on 125kHz and 13.56 MHz.

6 LIST OF MEASUREMENT INSTRUMENTATION

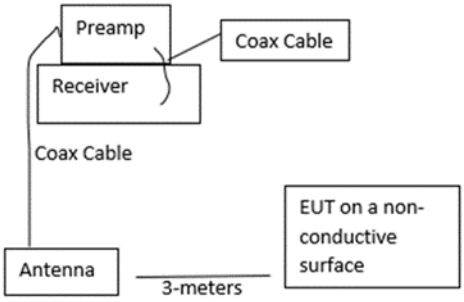
Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber	CL166-E	Albatross Projects	B83117-DF435-T261	US140023	2022-03-09
Temp/Hum. Recorder	CL263	Extech	445814	06	2022-03-19
Receiver	CL151	Rohde & Schwarz	ESU40	100319	2021-10-06
Receiver	CL204	Rohde & Schwarz	ESR7	101714	2022-07-07
Low Loss Cable Set	--	Pasternack	PE3C0666-252 / PE3C066-50CM	None Spec.	2023-10-12
Pre-Amplifier	CL285	Com-Power	PAM-0207	322	2021-11-04
Active 18” Loop Antenna	CL163-Loop	A.H. Systems, Inc.	EHA-52B	100	2021-10-15
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	2021-11-05
Software:	Tile Version 3.4.B.3		Software Verified: 2021-03-18 to 2021-03-19		
Software:	EMC 32, Version 8.53.0		Software Verified: 2021-03-18 to 2021-03-19		
Spectrum Analyzer	0204	Hewlett Packard	HP8591A	3149A02546	2022-02-04
Software:	EMC Analyzer 85712D Rev. A.00.01			Date Verified:	2021-03-17
Transient Limiter	0202	Hewlett Packard	11947A	3107A00729	2022-02-04
Software:	Tile Version 3.4.B.3.		Software Verified: 2021-03-17		
LISN	CL181	Com-Power	LI-125A	191226	2023-12-01
LISN	CL182	Com-Power	LI-125A	191225	2023-12-01
Temp/Hum. Recorder	CL234	Extech	445814	03	2022-03-08

7 OCCUPIED BANDWIDTH

7.1 Requirements:

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 -20dB 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. 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.

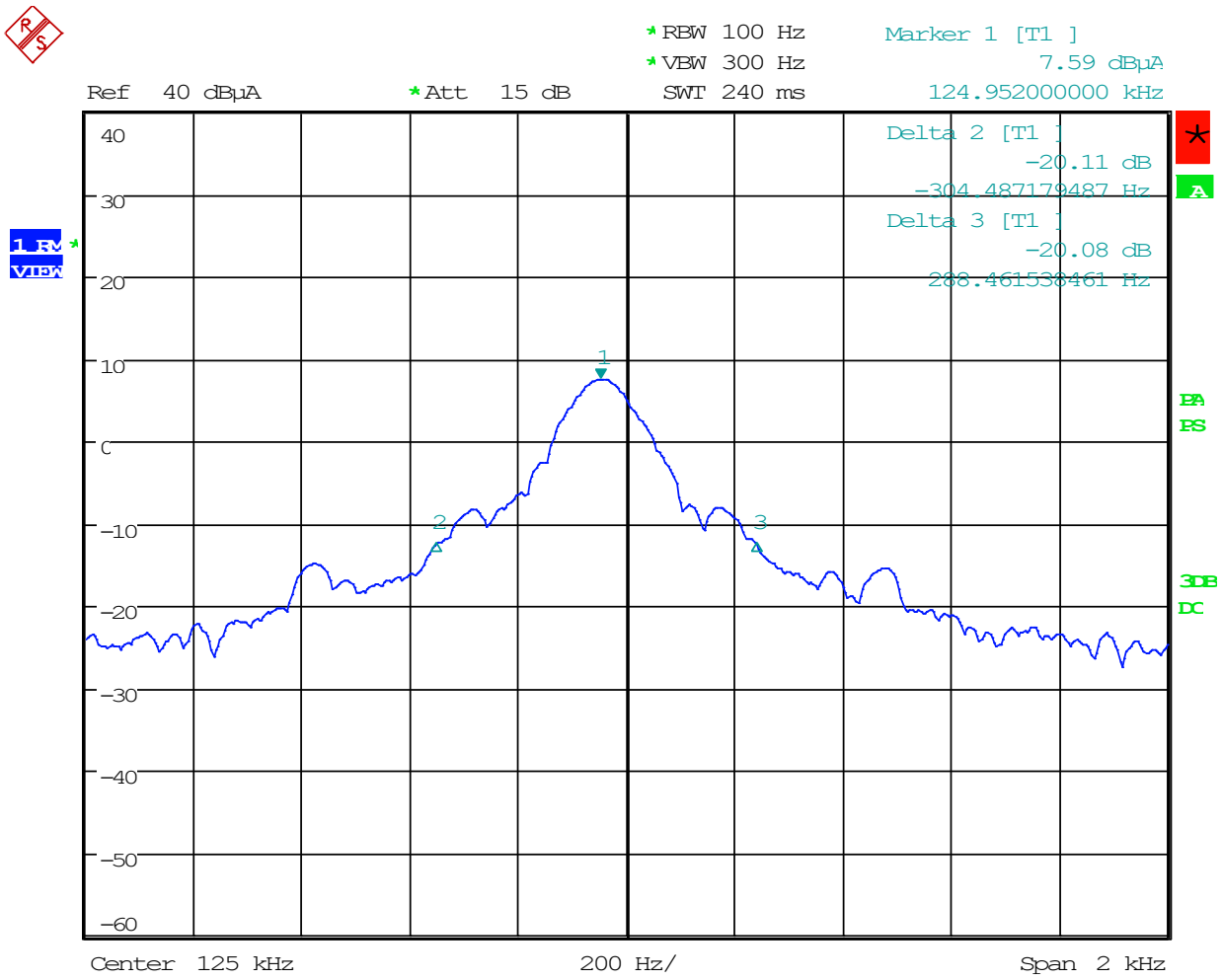
Bandwidth measurements were made at 200Hz RBW using the Marker Delta method.



7.2 Test Data - Occupied Bandwidth

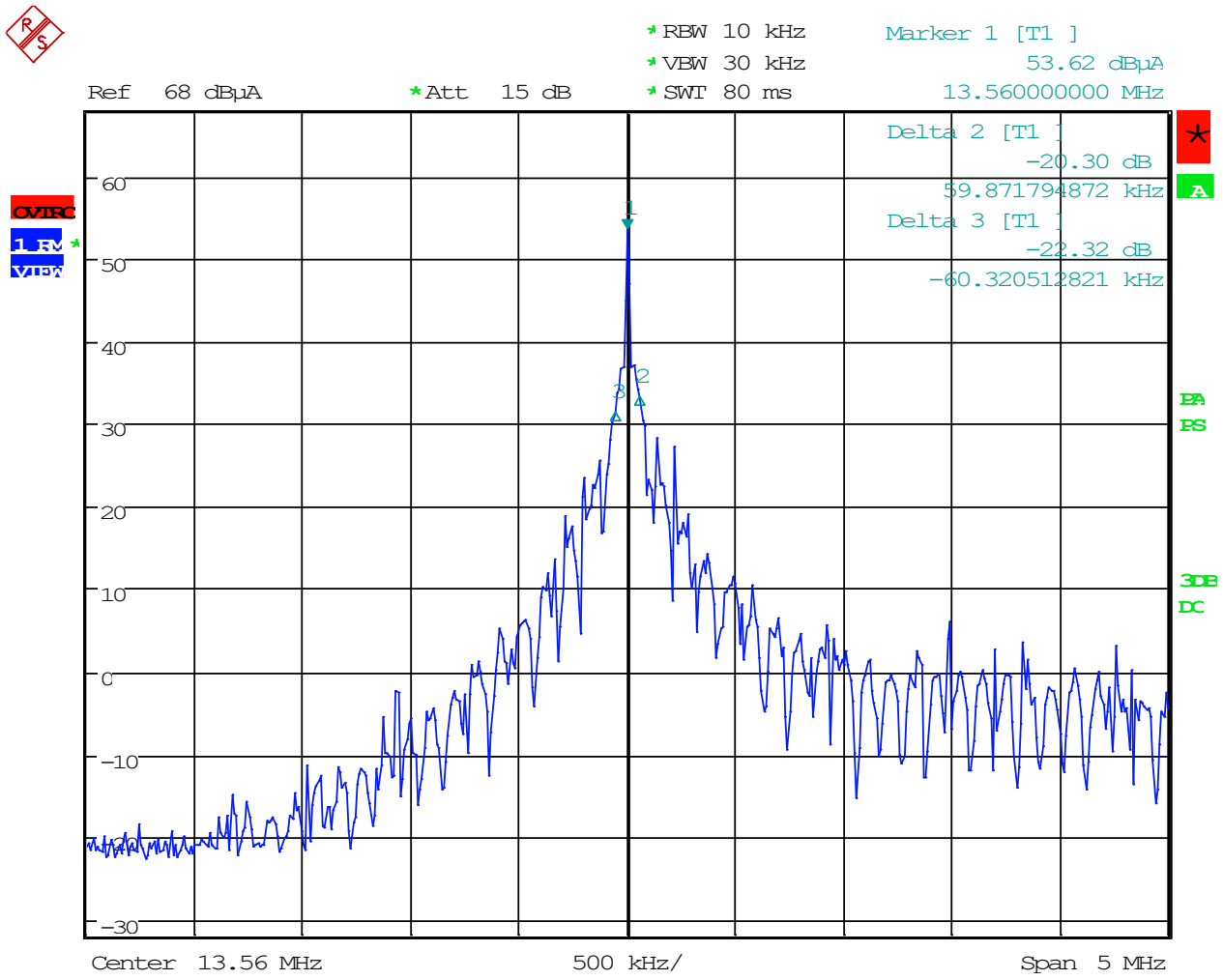
Test Date(s):	2021-03-17	**Test Engineer(s):**	J. Chiller
Standards:	CFR 47 Part 15.215(c)	**Air Temperature:**	23.6ºC
		Relative Humidity:	28%

-20dB: 125kHz



Date: 17.MAR.2021 12:17:19

-20dB: 13.56 MHz



Date: 17.MAR.2021 12:21:10

8 FIELD STRENGTH OF EMISSIONS FROM INTENTIONAL RADIATORS

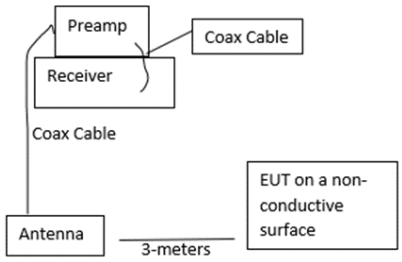
Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

Notes:

During the pre-scan evaluation, the EUT was rotated in all possible directions and all three orthogonal positions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions. The following plots are just prescan plots and do not necessarily reflect the actual limits. The measurement table has the correct limits.

125 kHz Field Strength was measured at 3m.

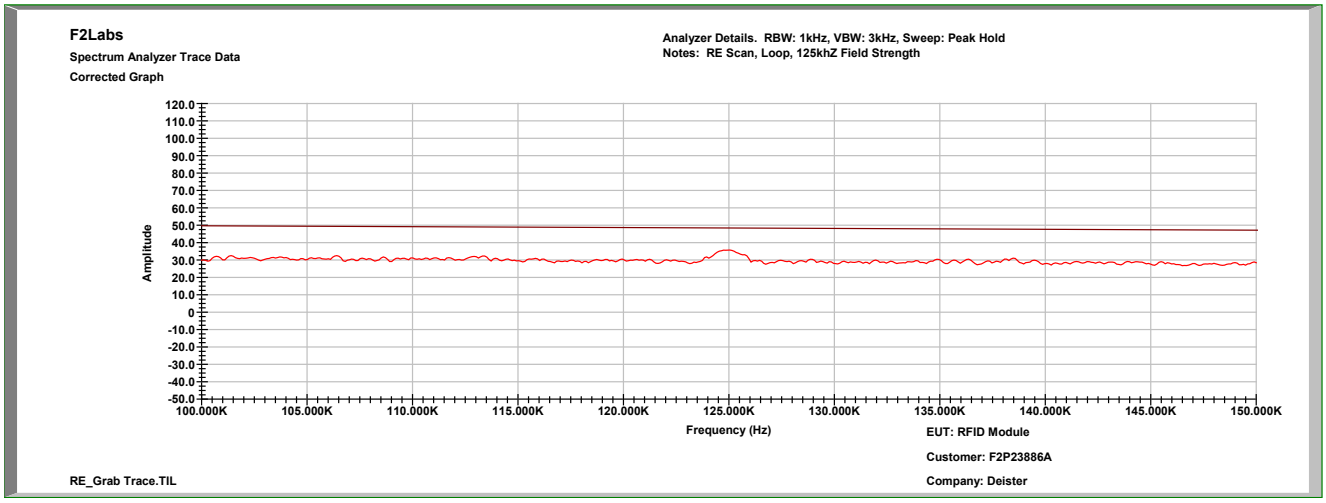


8.1 Test Data - Field Strength of Emissions from Intentional Radiators

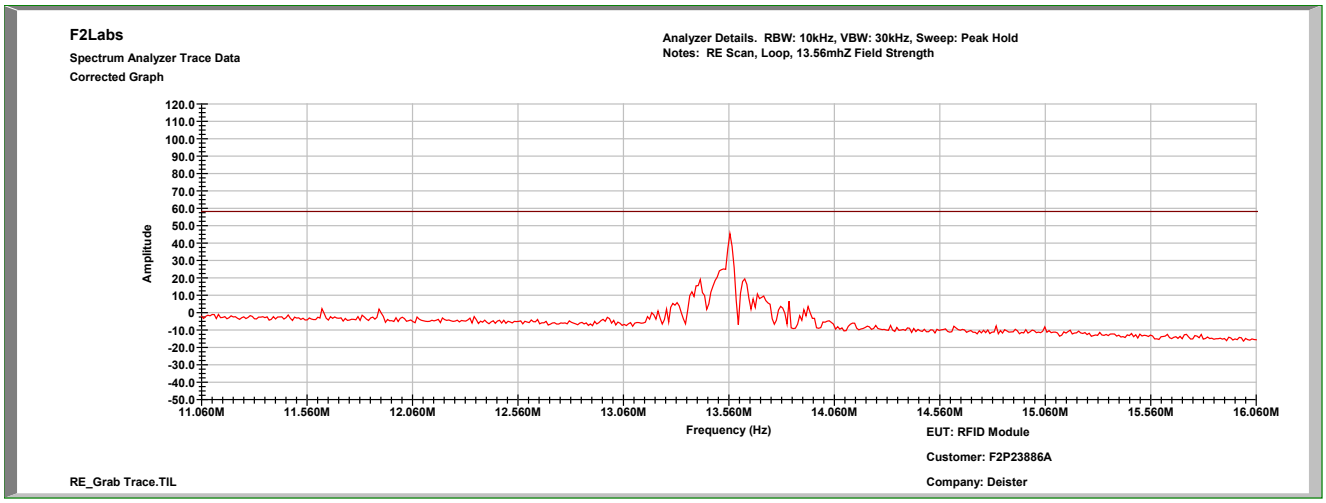
Test Date(s):	2021-03-17	**Test Engineer(s):**	J. Chiller
Standards:	CFR 47 Part 15.209	**Air Temperature:**	23.6ºC
		Relative Humidity:	27%
Results:	Complies		

Note: 125kHz Field Strength was measured at 1m using an Average Detector. 13.56 MHz Field Strength was measured at 3m using a Quasi-Peak Detector.

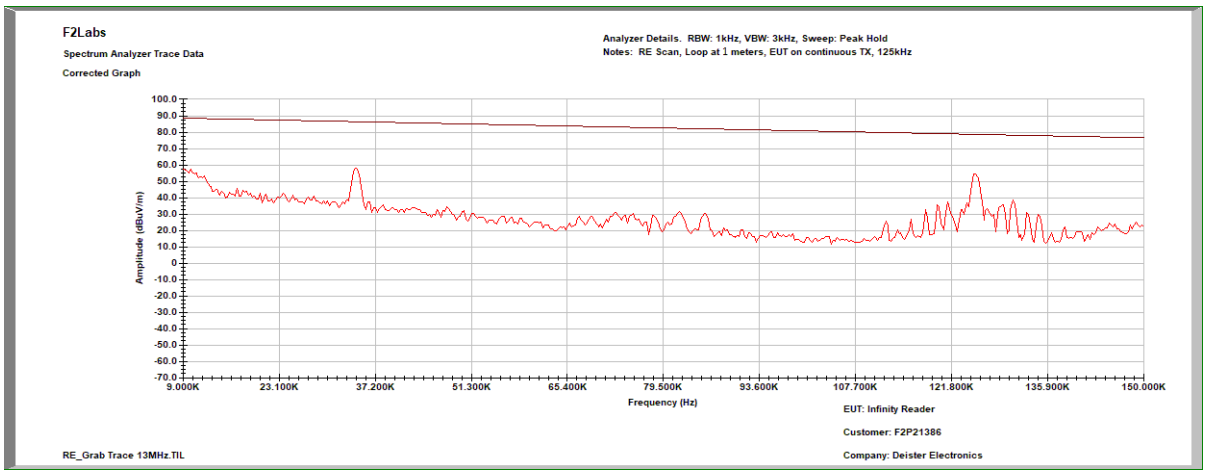
Field Strength: 125kHz



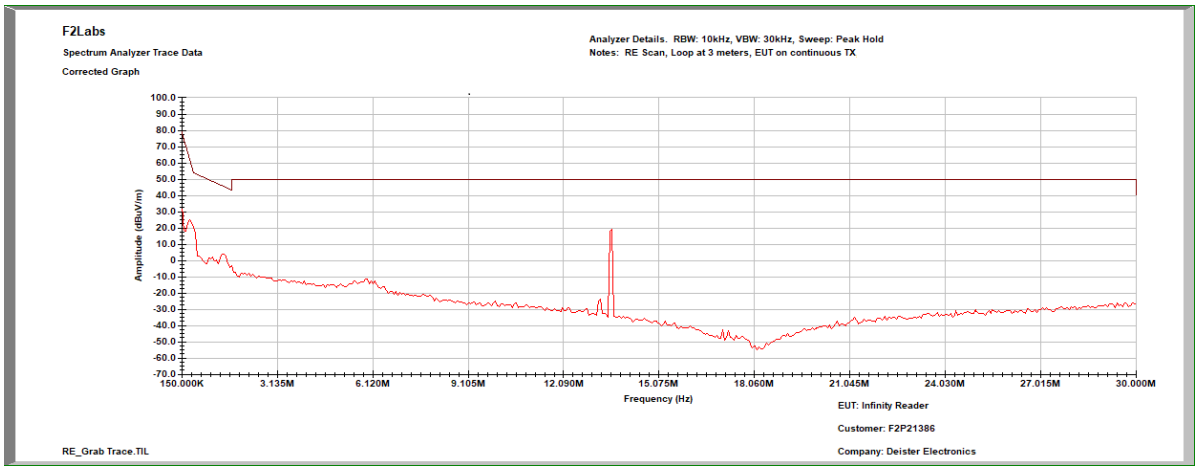
Field Strength: 13.56 MHz



0.009 MHz to 0.15 MHz



0.15 MHz to 30 MHz



Measurements

Frequency (MHz)	Antenna Height (m)	Azimuth (degrees)	Reading (dBµV/m)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
0.125000	1.00	87.00	56.25	3.1	59.35	105.7	46.3
13.560000	1.00	37.00	16.20	51.9	68.10	69.5	1.4

8.2 Test Data – Spurious Emissions

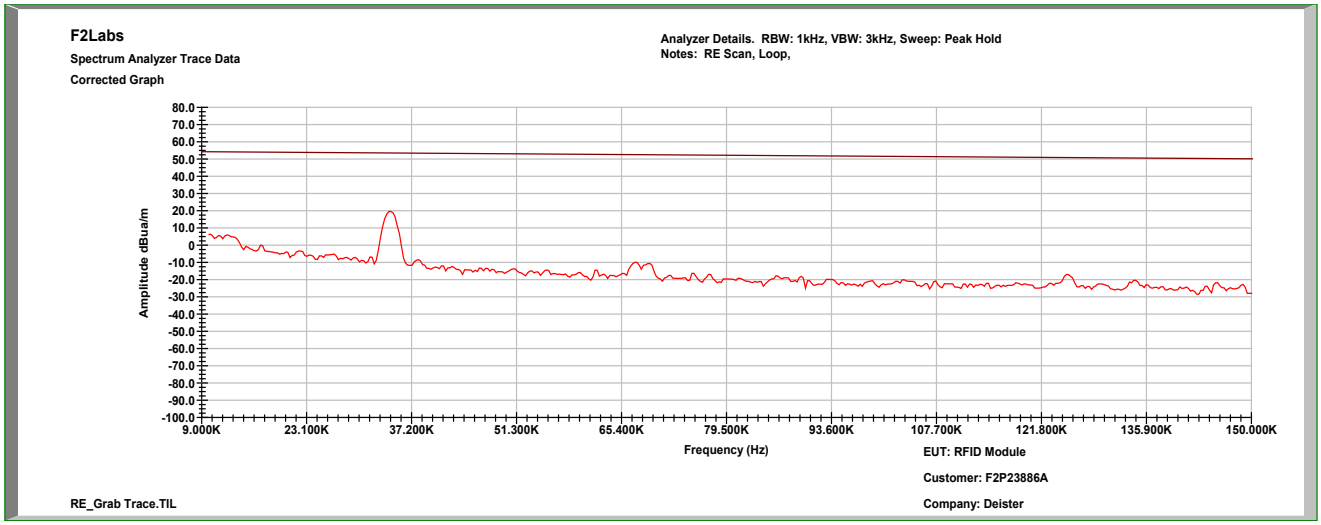
Notes: Plots are peak, max hold pre-scan data included only to determine what frequencies to investigate and measure. During the pre-scan evaluation, the EUT was rotated in all possible directions and three orthogonal positions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. At some frequencies, no emissions from the EUT were measurable over the ambient noise floor. The readings did not change with EUT on and EUT off.

At least 6 of the highest frequencies were measured per ANSI 63.4 in a 3-meter anechoic chamber. Frequencies below 1GHz were measured using a quasi-peak detector. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions. Some of the frequencies did not change with the EUT on or off. At those frequencies, the test distance was shortened to 1 meter and still no emissions from the EUT were visible or over the ambient or limit. Frequencies were scanned from 9kHz to 1000 MHz and the highest emissions are presented.

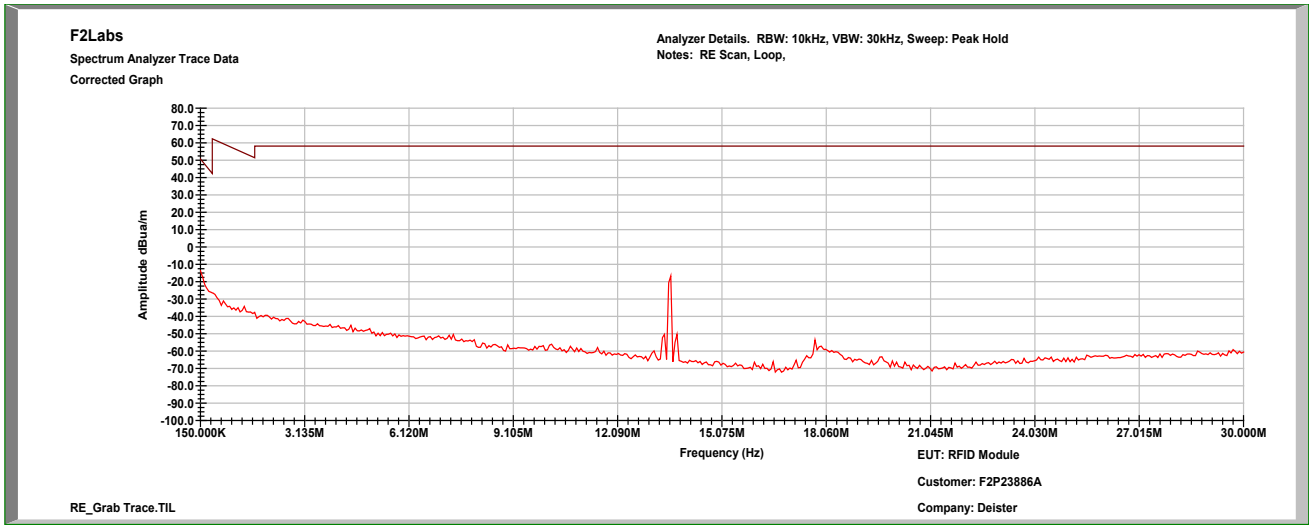
In the following plots, the red line indicates the measurement with the EUT on. Emissions to be found by the EUT were measured and listed in tables below.

Test Date(s):	2021-08-06	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.209	Air Temperature:	23.4ºC
Results:	Complies	Relative Humidity:	28%

0.009 MHz to 0.15 MHz (both radios on)

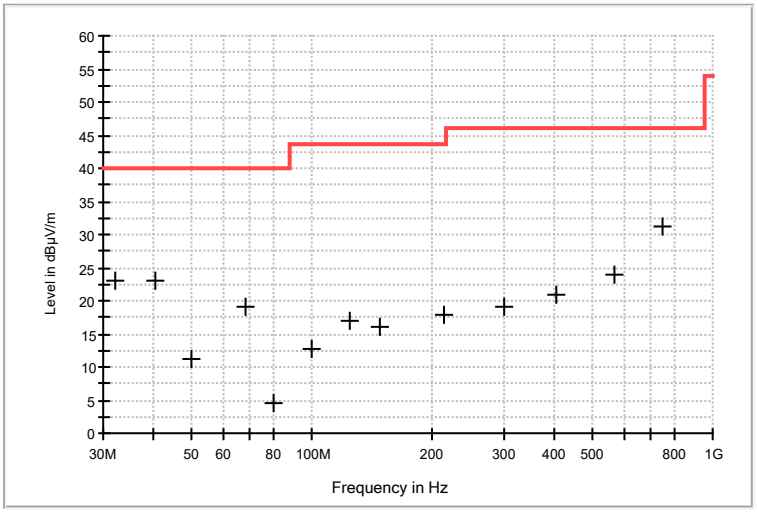


0.15 MHz to 30 MHz (both radios on)

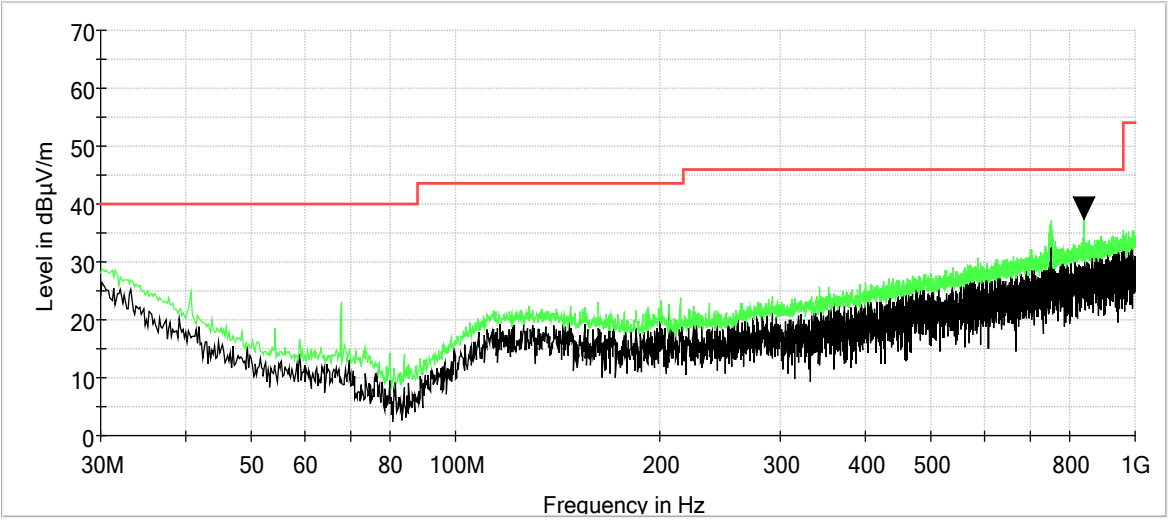


Measurements

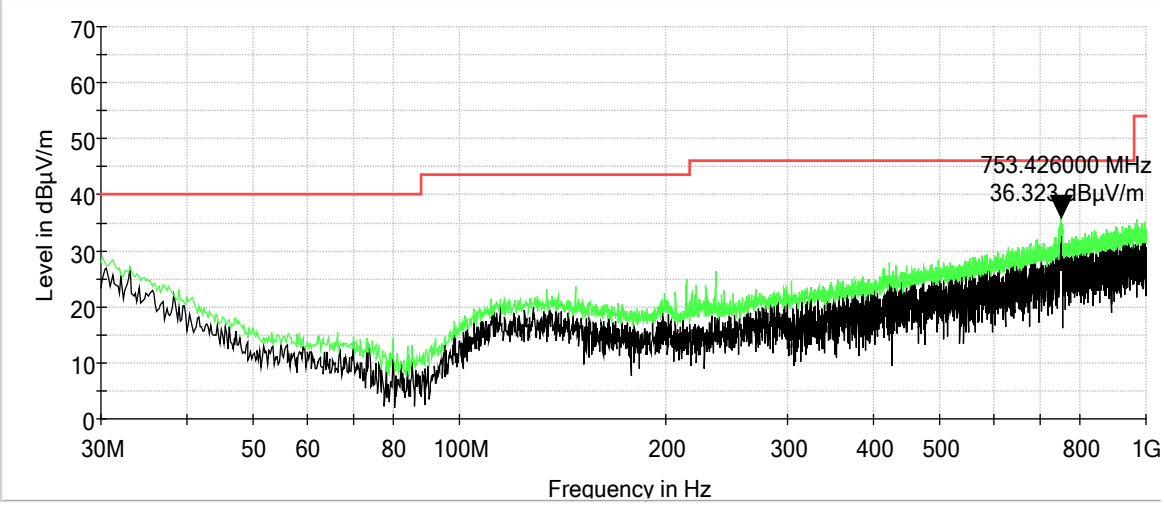
Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBµV)	Correcton Factors (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
32.120000	V	100.00	0.00	25.7	-2.7	23.00	40.0	-17.0
40.680000	V	100.00	0.00	32.3	-9.2	23.10	40.0	-16.9
49.800000	H	100.00	0.00	25.3	-14.2	11.10	40.0	-28.9
67.840000	V	100.00	0.00	33.8	-14.6	19.20	40.0	-20.8
79.840000	H	100.00	0.00	19.3	-14.7	4.60	40.0	-35.4
100.040000	H	100.00	0.00	24.6	-12.0	12.60	43.5	-30.9
123.520000	H	100.00	0.00	25.2	-8.3	16.90	43.5	-26.6
147.360000	V	100.00	0.00	25.3	-9.3	16.00	43.5	-27.5
213.920000	V	100.00	0.00	28.4	-10.6	17.80	43.5	-25.7
299.840000	H	100.00	0.00	26.4	-7.4	19.00	46.0	-27.0
408.480000	V	100.00	0.00	25.2	-4.2	21.00	46.0	-25.0
568.360000	H	100.00	0.00	24.8	-0.7	24.10	46.0	-21.9
753.640000	V	100.00	0.00	28.6	2.6	31.20	46.0	-14.8



Characterization Scan, 30 MHz to 1000 MHz, Vertical (both radios on)



Characterization Scan, 30 MHz to 1000 MHz, Horizontal (both radios on)



9 VARIATION OF THE INPUT POWER, 15.31(e)

9.1 Requirements:

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

This DC device is rated to operate at 12VDC and not to exceed 24VDC. The low voltage testing was done at 9VDC, high voltage at 24VDC.

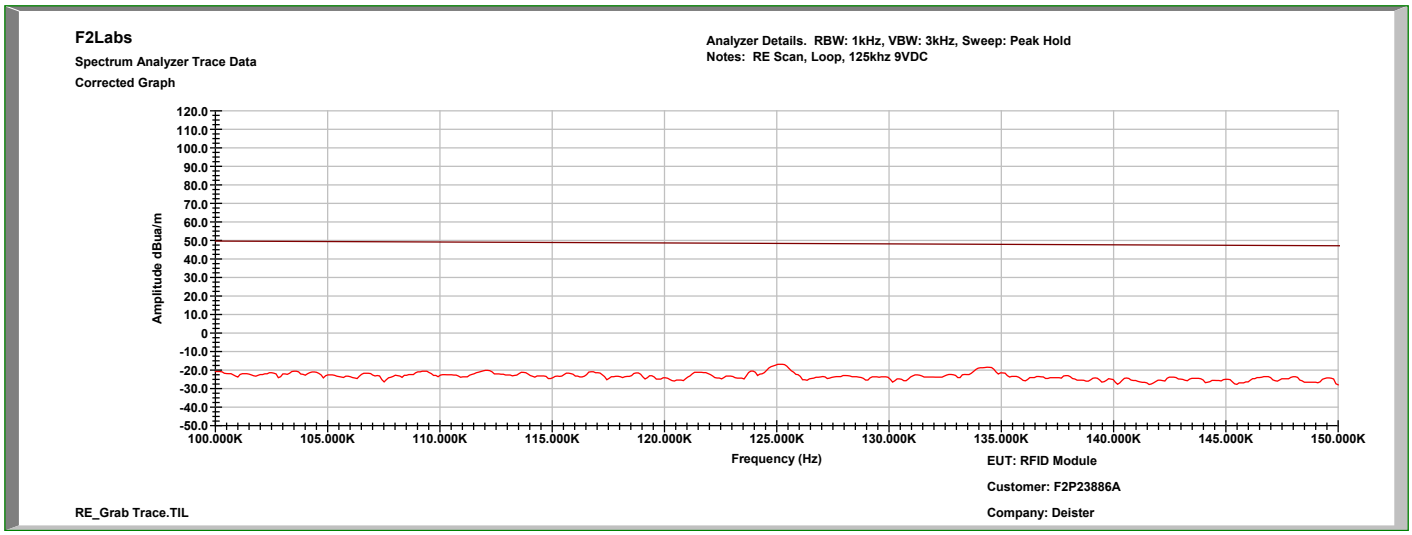
The following plots verify the frequency and amplitude do not vary with change in supply voltage.

9.2 Test Data – Variation of the Input Power

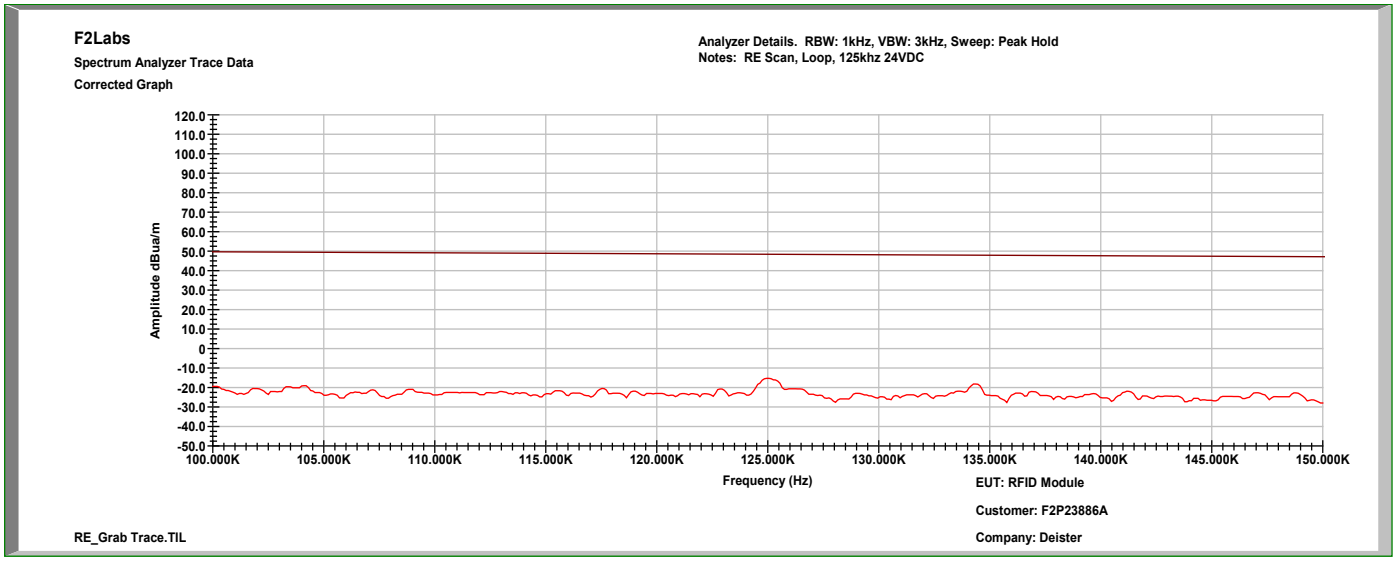
Test Date(s):	2021-08-06	**Test Engineer(s):**	J. Chiller
Standards:	CFR 47 Part 15.31(e)	**Air Temperature:**	23.5ºC
		Relative Humidity:	28%
Results:	Complies*		

** The results showed that the fundamental frequency did not move outside the frequency band and the field strength did not increase above the limit during the variations.*

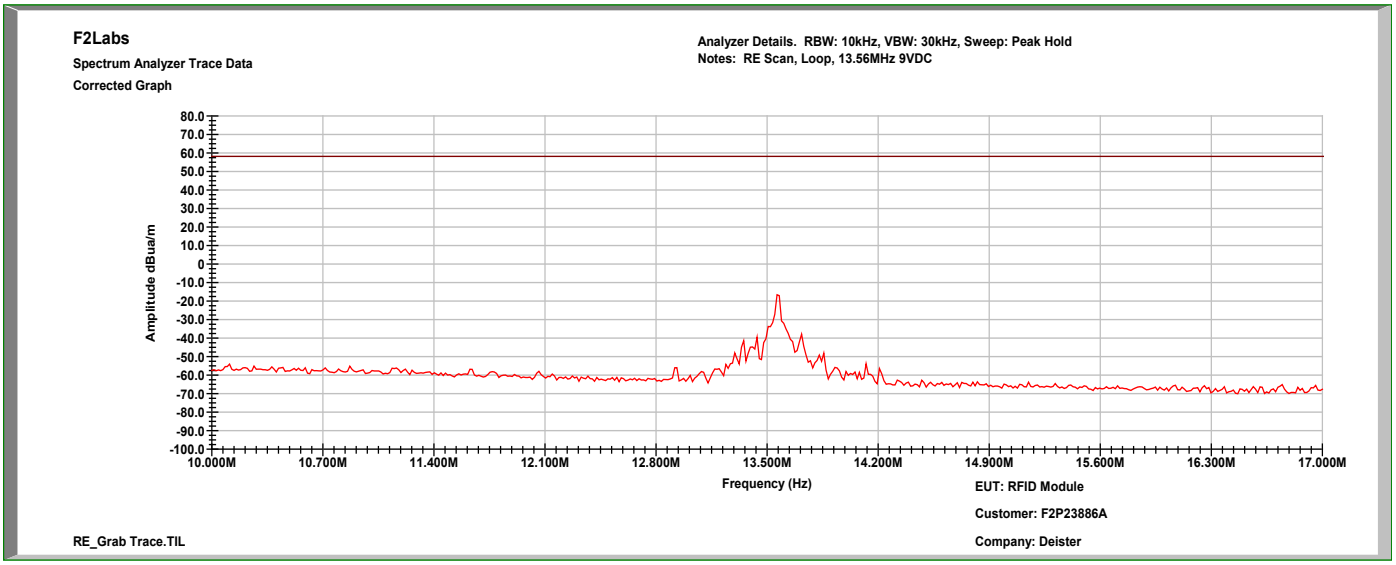
125kHz: 9V



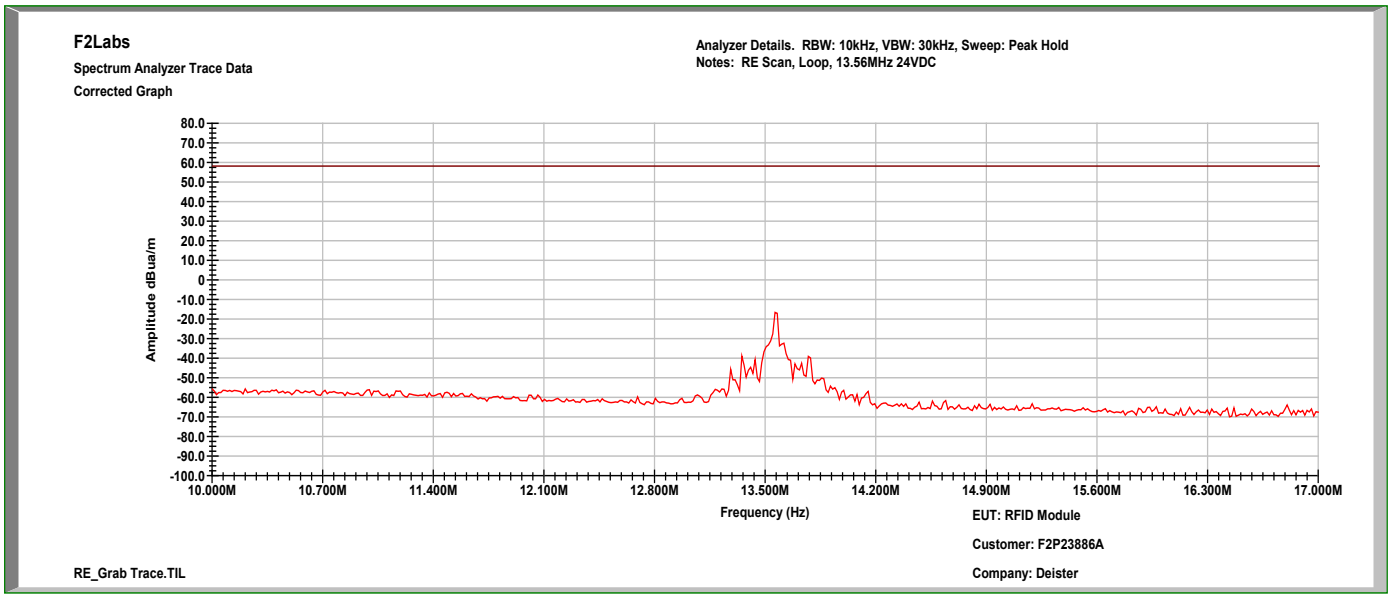
125kHz: 24V



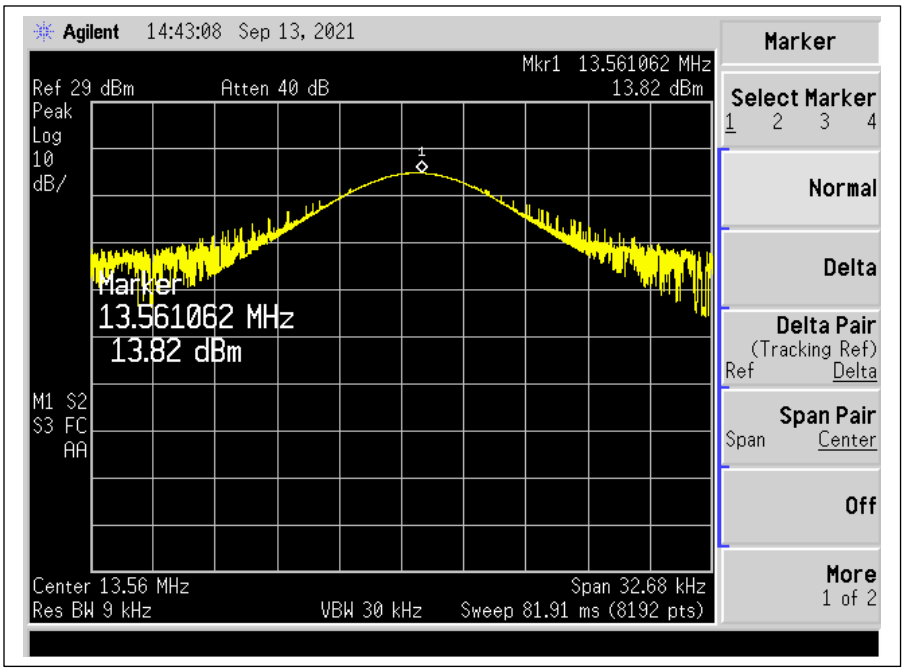
13.56 MHz: 9V



13.56 MHz: 24V



Test Date(s):	2021-09-13	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.31(e)	Air Temperature:	23.5 ° C
Results:	Complies	Relative Humidity:	58%



Temp. Stability							
Deister F2P23886A							
Variance limit is +/-100ppm at 13.56MHz = 1.356kHz (1356 hz)							
Temp. C	Startup	2 min	5 min	10 min	max	min	Variance (hz)
50	735	817	817	871	871	735	136
40	898	734	896	571	898	571	327
30	653	735	980	863	980	653	327
20	718	749	851	898	898	718	180
10	655	818	742	817	818	655	163
0	736	862	916	1012	1012	736	276
-10	980	988	963	896	988	896	92
-20	899	981	1062	735	1062	735	327
-30	887	760	907	490	907	490	417

Data shows last 4 digits. Ex.: 13.56xxxx MHz

10 CONDUCTED EMISSIONS

10.1 Requirements

In accordance with FCC CFR 47 Part 15.207(a), “Except as shown in paragraphs (b) and (c) of this section, 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 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms 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 of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

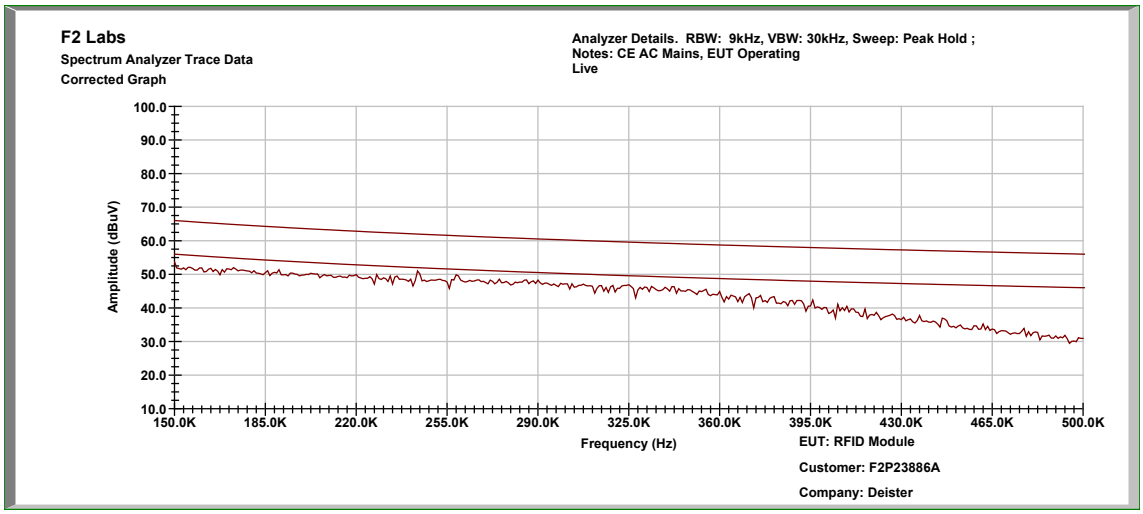
10.2 Procedure

The EUT was placed on a 1.0 x 1.5 meter non-conductive table, 0.8 meter above a horizontal ground plane and 0.4 meter from a vertical ground plane. Power was provided to the EUT through a LISN bonded to a 3 x 2 meter ground plane. The LISN and peripherals were supplied power through a filtered AC power source. The output of the LISN was connected to the input of the receiver via a transient limiter, and emissions in the range 150 kHz to 30 MHz were measured. The measurements were recorded using the quasi-peak and average detectors as directed by the standard, and the resolution bandwidth during testing was 9 kHz. The raw measurements were corrected to allow for attenuation from the LISN, transient limiter and cables.

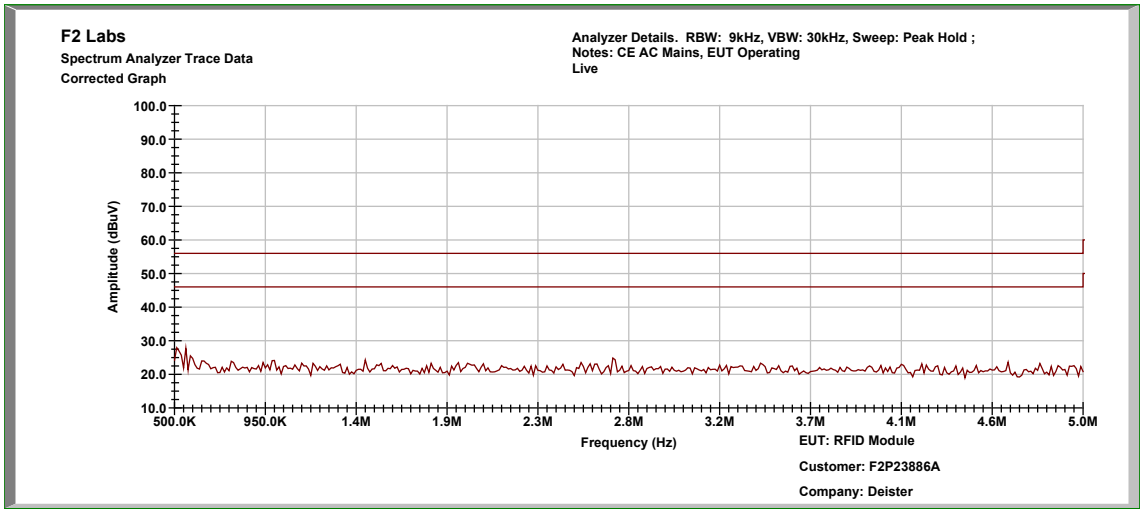
10.3 Conducted Emissions Test Data

Test Date:	2021-03-17	**Test Engineer:**	J. Chiller
Rule:	15.207	**Air Temperature:**	24.9º C
Test Results:	Pass	**Relative Humidity:**	32%

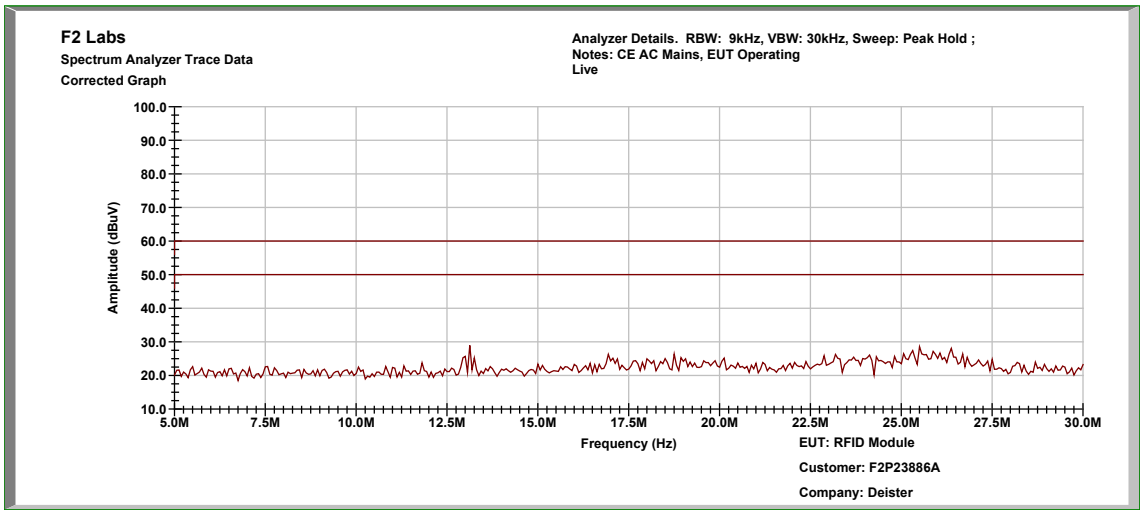
Conducted Test – Live: 0.15 MHz to 0.5 MHz



Conducted Test – Live: 0.5 MHz to 5.0 MHz

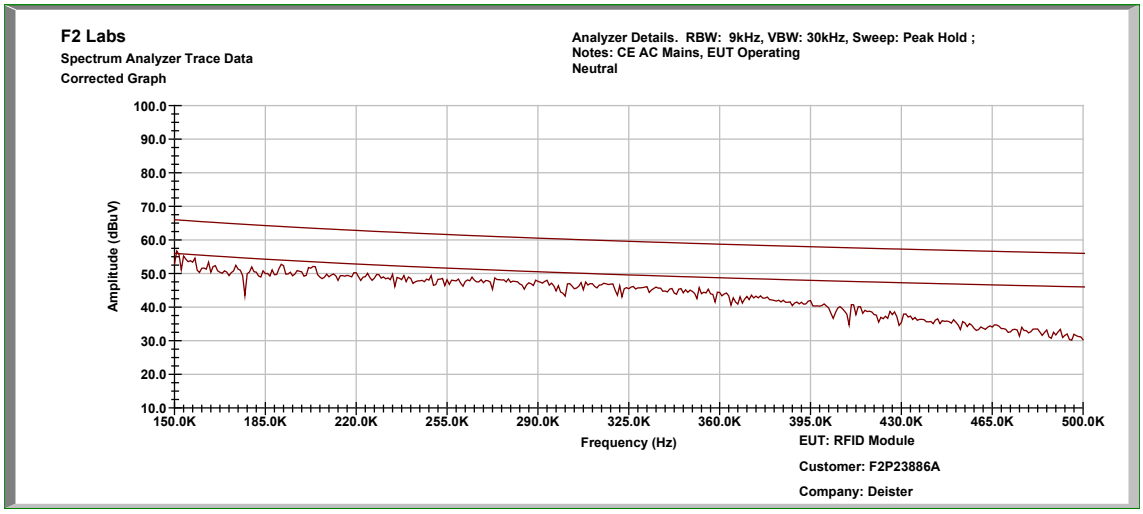


Conducted Test – Live: 5.0 MHz to 30.0 MHz

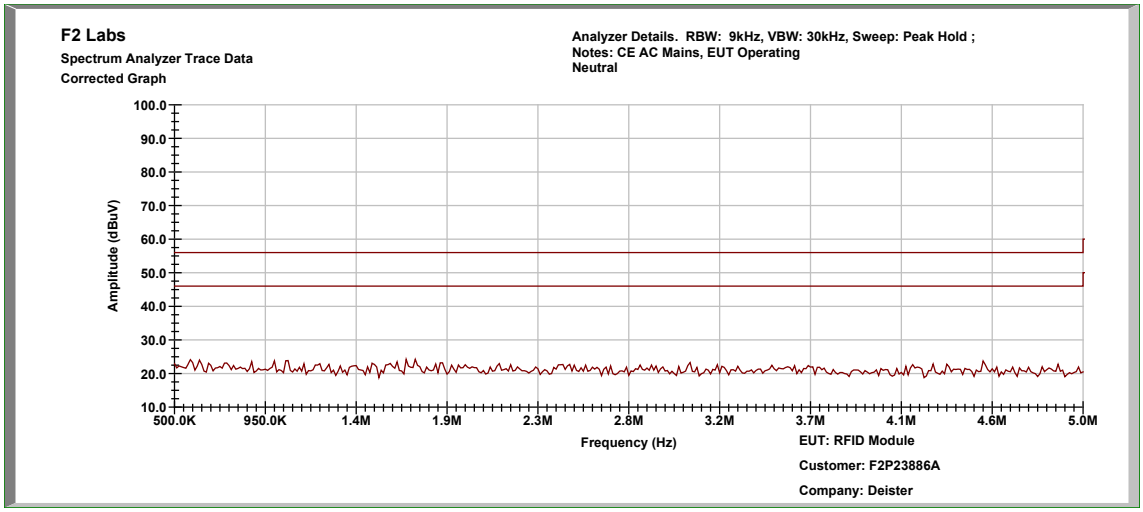


Top Discrete Measurements								
No.	**Conductor**	**Frequency (MHz)**	**Detector**	**Level (dBµV)**	**Adjustment (dB)**	**Results (dBµV)**	**Limit (dBµV)**	**Margin (dB)**
1	Live	0.190	Quasi-Peak	34.74	10.792	45.53	64.026	-18.5
			Average	8.88	10.792	19.67	54.026	-34.4
2	Live	0.2445	Quasi-Peak	30.53	10.513	41.04	61.942	-20.9
			Average	6.59	10.513	17.10	51.942	-34.8
3	Live	0.260	Quasi-Peak	30.76	10.474	41.23	61.424	-20.2
			Average	5.44	10.474	15.91	51.424	-35.5
4	Live	0.325	Quasi-Peak	28.08	10.355	38.44	29.578	8.9
			Average	3.68	10.355	14.04	49.578	-35.5
5	Live	0.395	Quasi-Peak	22.40	10.307	32.71	57.958	-25.3
			Average	2.69	10.307	13.00	47.958	-35.0

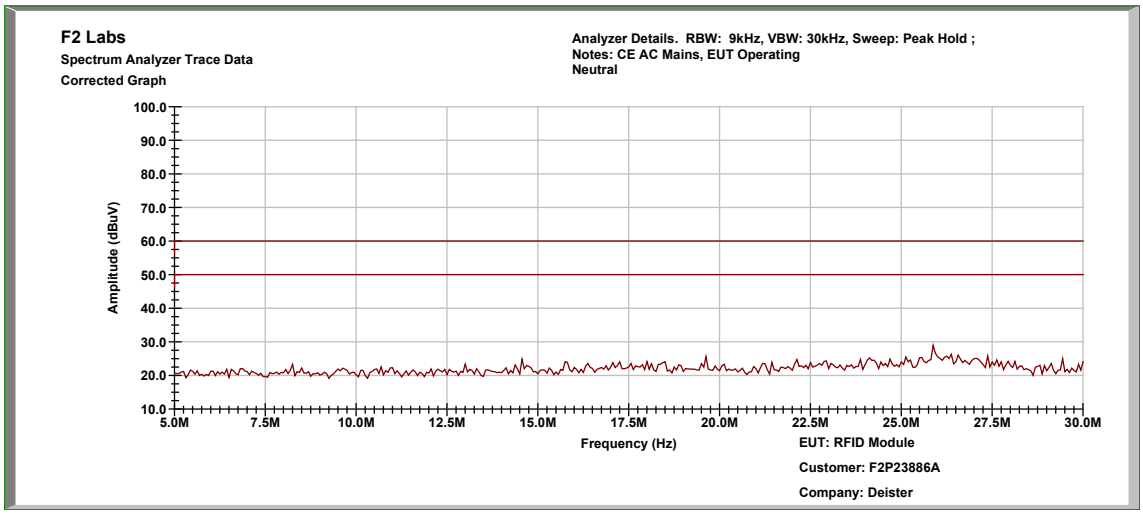
Conducted Test – Neutral: 0.15 MHz to 0.5 MHz



Conducted Test – Neutral: 0.5 MHz to 5.0 MHz



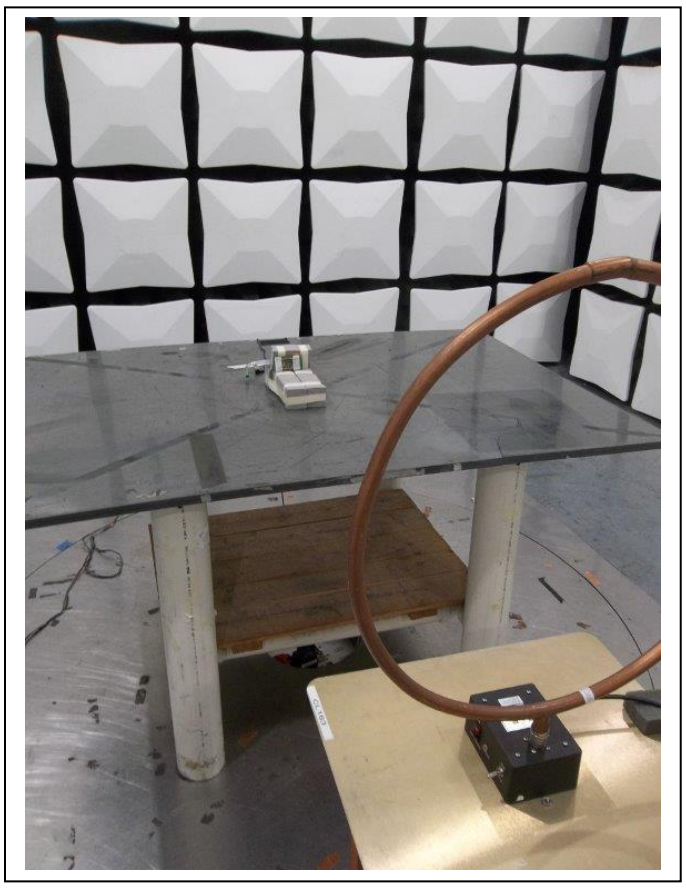
Conducted Test – Neutral: 5.0 MHz to 30.0 MHz



Top Discrete Measurements								
No.	Conductor	Frequency (MHz)	Detector	Level (dBµV)	Adjustment (dB)	Results (dBµV)	Limit (dBµV)	Margin (dB)
1	Neutral	0.155	Quasi-Peak	34.99	11.097	46.09	65.728	-19.6
			Average	10.35	11.097	21.45	55.728	-34.3
2	Neutral	0.165	Quasi-Peak	33.34	10.970	44.31	65.208	-20.9
			Average	10.04	10.970	21.01	55.208	-34.2
3	Neutral	0.192	Quasi-Peak	32.17	10.781	42.95	63.951	-21.0
			Average	8.10	10.781	18.88	53.951	-35.1
4	Neutral	0.2045	Quasi-Peak	33.22	10.705	43.93	63.437	-19.5
			Average	11.01	10.705	21.72	53.437	-31.7
5	Neutral	0.248	Quasi-Peak	30.77	10.504	41.27	61.824	-20.6
			Average	7.10	10.504	17.60	51.824	-34.2
6	Neutral	0.293	Quasi-Peak	29.03	10.398	39.43	60.426	-21.0
			Average	4.39	10.398	14.79	50.426	-35.6
7	Neutral	0.352	Quasi-Peak	27.18	10.312	37.49	58.913	-21.4
			Average	3.29	10.312	13.60	48.913	-35.3

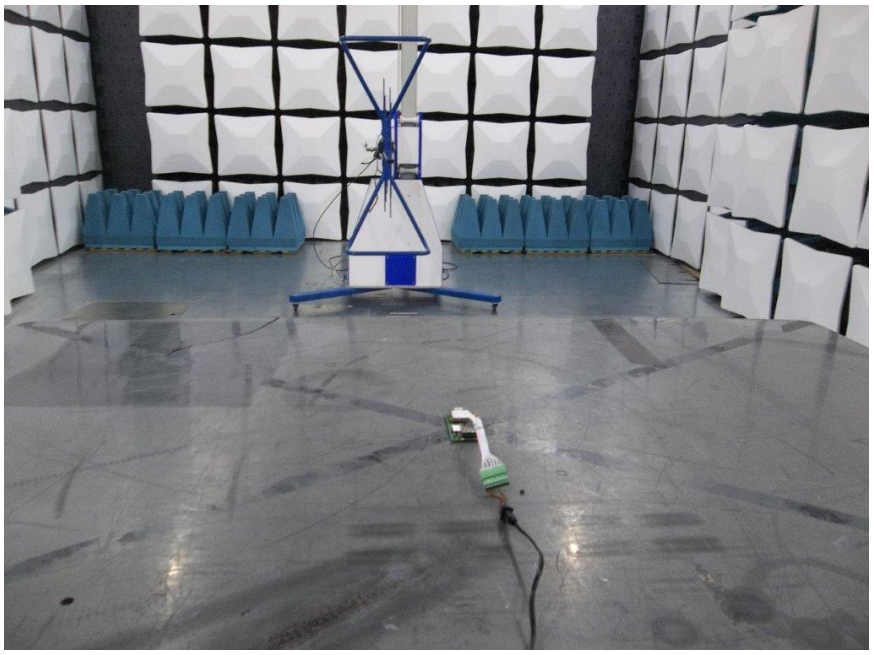
11 TEST SETUP PHOTOGRAPHS

Occupied Bandwidth

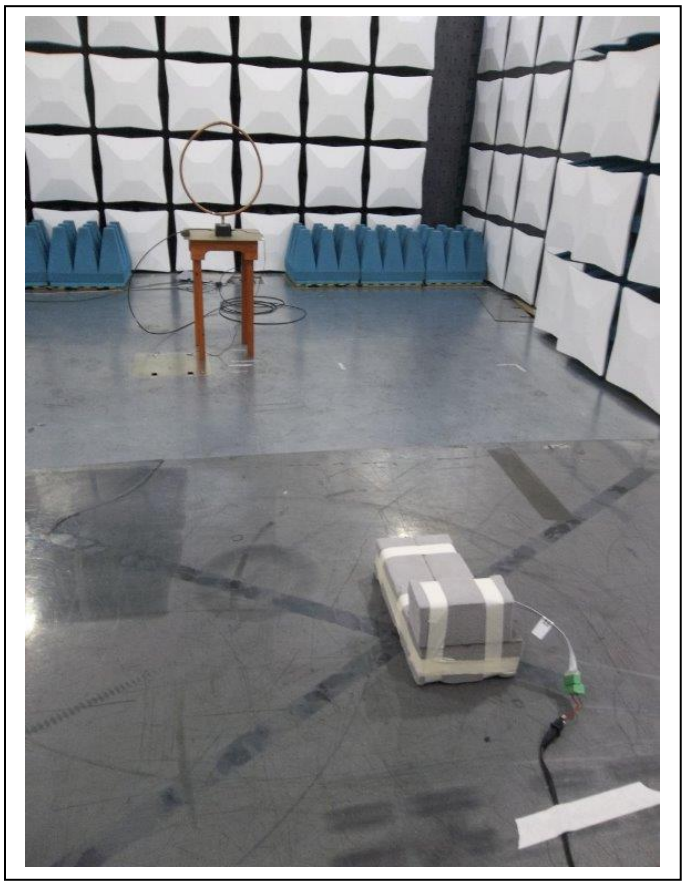


Radiated Spurious Emissions, Less Than 30 MHz

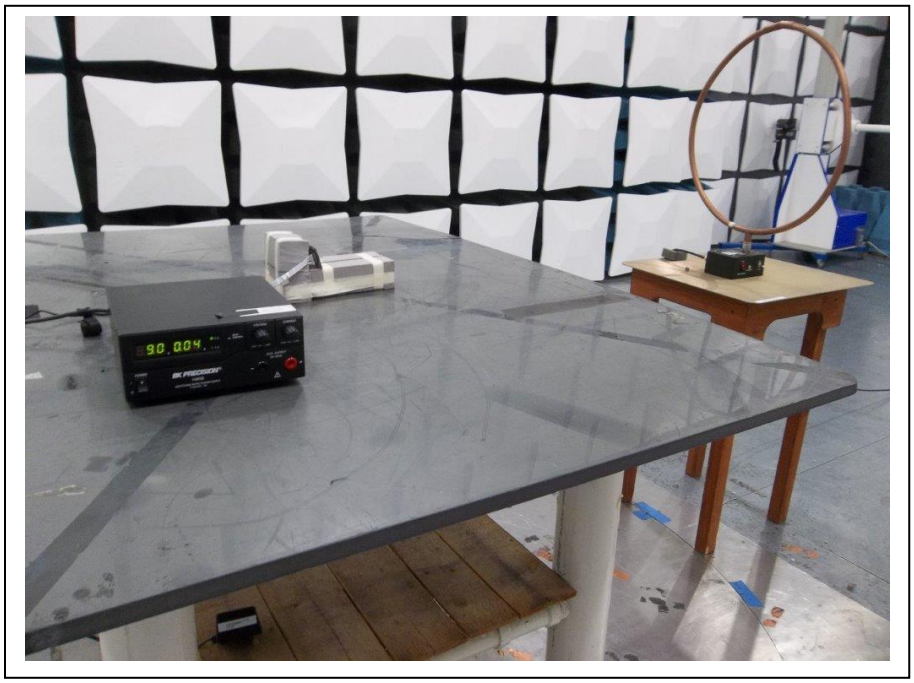
Radiated Spurious Emissions, 30 MHz to 1000 MHz

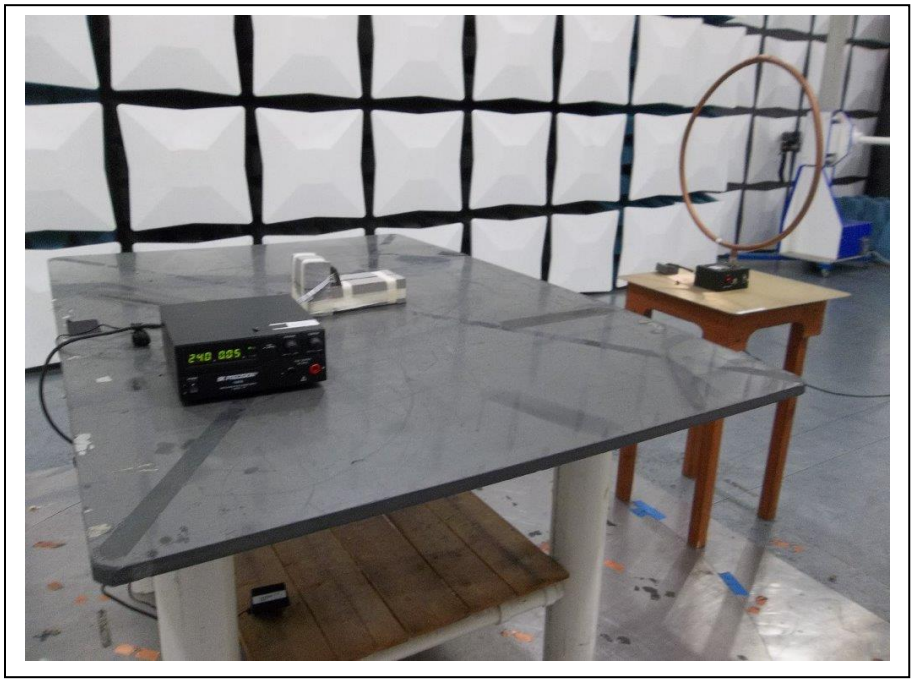


Field Strength of Emissions



Variation of the Input Power





Conducted Emissions