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CERTIFICATION TEST REPORT

Manufacturer: deister electronic GmbH
11 Hermann Bahlsen Str
Barsinghausen 30890 GERMANY

Applicant: Deister Electronics USA, Inc.
8756 Wellington Rd
Manassas, VA 20109 USA

Product Name: amanTag Tracking Transceiver Module

Product Description: 920 MHz Airlink Module for optional connection to the amanTag line of readers for communication to Deister 920 MHz amanTag transponders.

Operating Voltage/Frequency: 3.3-5.5VDC

Model: MAL1

FCC ID: IXLMAL1

Testing Commenced: Oct. 4, 2019

Testing Ended: Oct. 14, 2019

Summary of Test Results: **In Compliance**

The EUT complies with the EMC requirements when manufactured identically as the unit tested in this report, including any required modifications and/or manufacturer's statement. Any changes to the design or build of this unit subsequent to this testing may deem it non-compliant.

Standards:

- ❖ **FCC Part 15 Subpart C, Section 15.249**
- ❖ **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**



Order Number: F2P22012

Applicant: Deister Electronics USA, Inc.

Model: MAL1

Evaluation Conducted by:

Julius Chiller, EMC/Wireless Engineer

Report Reviewed by:

Ken Littell, Director of EMC & Wireless Operations

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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 under Section 15.249. 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
F2P22012-01E	First Issue	Nov. 11, 2019	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 15.249(a)(d)	Complies
Radiated Spurious Emissions	CFR 47 Part 15.249(d) / Part 15.209	Complies
Conducted Emissions	CFR 47 Part 15.207(a)	N/A
Variation of the Input Power	CFR 47 Part 15.31(e)	Complies
Conducted Emissions	CFR 47 Part 15.207(a)	Complies

Modifications Made to the Equipment
None

**3 TABLE OF MEASURED RESULTS**

Test	Low Channel 910 MHz	Mid 917.6 MHz	High 925 MHz
Field Strength of Fundamental at Nominal	91.3 dB μ V/m	92.5 dB μ V/m	92.4 dB μ V/m
Limit for Fundamental	94 dB μ V/m	94 dB μ V/m	94 dB μ V/m
-20dB Occupied Bandwidth	0.1269 MHz	0.133 MHz	0.131 MHz
Field Strength of Fundamental at 102VAC	90.8 dB μ V/m	92.2 dB μ V/m	91.3 dB μ V/m
Field Strength of Fundamental at 138VAC	90.8 dB μ V/m	92.2 dB μ V/m	91.3 dB μ V/m
Field Strength of Fundamental at 3.3VDC	90.8 dB μ V/m	92.1 dB μ V/m	91.3 dB μ V/m
Field Strength of Fundamental at 5.5VDC	90.9 dB μ V/m	92.5 dB μ V/m	92.4 dB μ V/m



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 15.249 of the FCC Rules using ANSI C63.10 2013 standard. 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: amanTag Tracking Transceiver Module

Model: MAL1

Serial Nos.: None Specified

F2 Labs' Sample Nos.: 910 MHz, S02; 917.6 MHz, S03; 925 MHz, S04

FCC ID: **IXLMAL1**

5.2 Trade Name:

Deister Electronics USA, Inc.

5.3 Power Supply:

5VDC

5.4 Applicable Rules:

CFR 47, Part 15.249

5.5 Equipment Category:

Radio Transmitter

5.6 Antenna:

-8dBi Integral Antenna

5.7 Accessories:

Test Board, Deister s/n 190802

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

EUT was set to transmit a continuous modulated signal at low, mid and high channels in the 900 MHz band, powered 5VDC.

**6 LIST OF MEASUREMENT INSTRUMENTATION**

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber 2014	CL166-E	AlbatrossProjects	B83117-DF435-T261	US140023	Nov. 30, 2019
Shield Room	0175-3V	Ray Proof	N/A	11645	Apr. 23, 2020
Temp/Hum. Recorder	CL261	Extech	445814	04	Mar. 6, 2020
Temp/Hum. Recorder	CL262	Extech	445814	05	Mar. 6, 2020
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Oct. 21, 2020
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	Oct. 14, 2020
Antenna, Bilog	CL211	Sunol Sciences, Inc.	JB1	A021017	Oct. 3, 2020
Horn Antenna	CL098	Emco	3115	9809-5580	Jan. 31, 2021
Loop Antenna	CL163-Loop	AH Systems, Inc.	EAH-52B	100	July 24, 2020
Pre-Amplifier	CL153	Agilent	83006-69007	MY39500791	Aug. 5, 2020
Pre-Amplifier	0197	Hewlett Packard	8447D	1726A01006	Oct. 25, 2019
Software:	Tile Version 3.4.B.3.		Software Verified: Oct. 14, 2019		
Software:	EMC 32, Version 8.53.0		Software Verified: Oct. 14, 2019		
Temp/Hum. Recorder	CL263	Extech	445814	06	Mar. 6, 2020
Transient Limiter	CL102	Hewlett Packard	11947A	3107A03325	Feb. 7, 2020
Spectrum Analyzer	CL147	Agilent	E7402A	MY45101241	Jan. 25, 2020
LISN	CL181	Com-Power	LI-125A	191226	Sept. 6, 2020
LISN	CL182	Com-Power	LI-125A	191225	Sept. 6, 2020



7 FCC PART 15.215(e), 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.

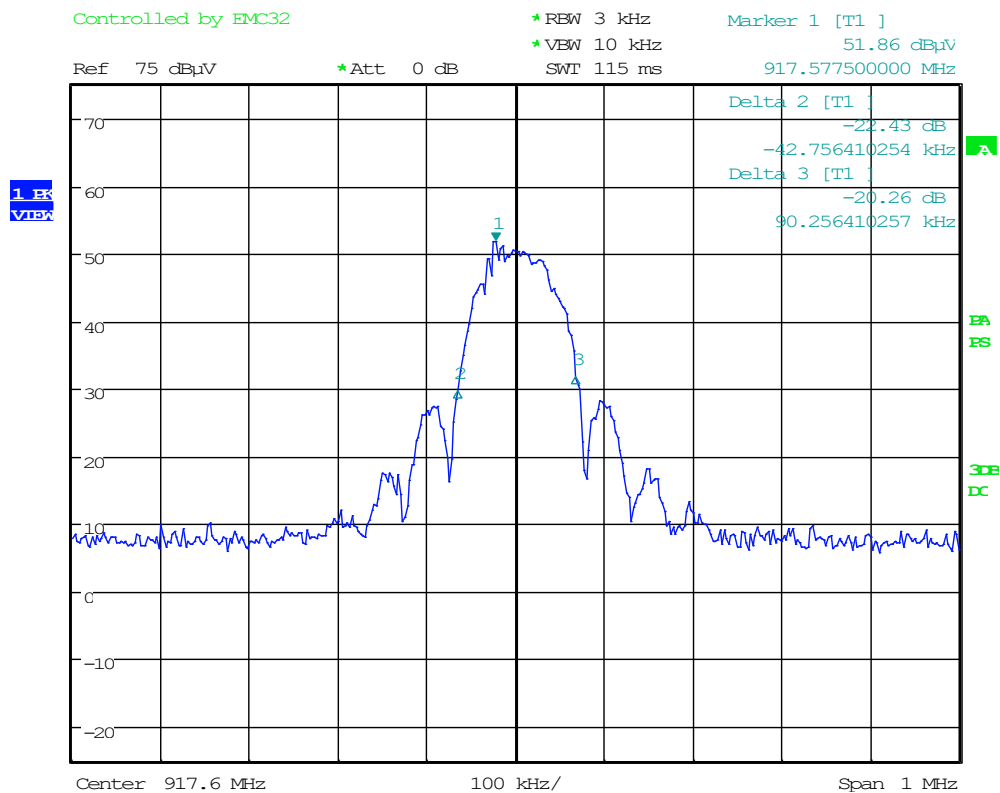
Bandwidth measurements were made at the low, mid and high channels. The bandwidth was measured using the marker delta method.



7.2 Occupied Bandwidth Test Data

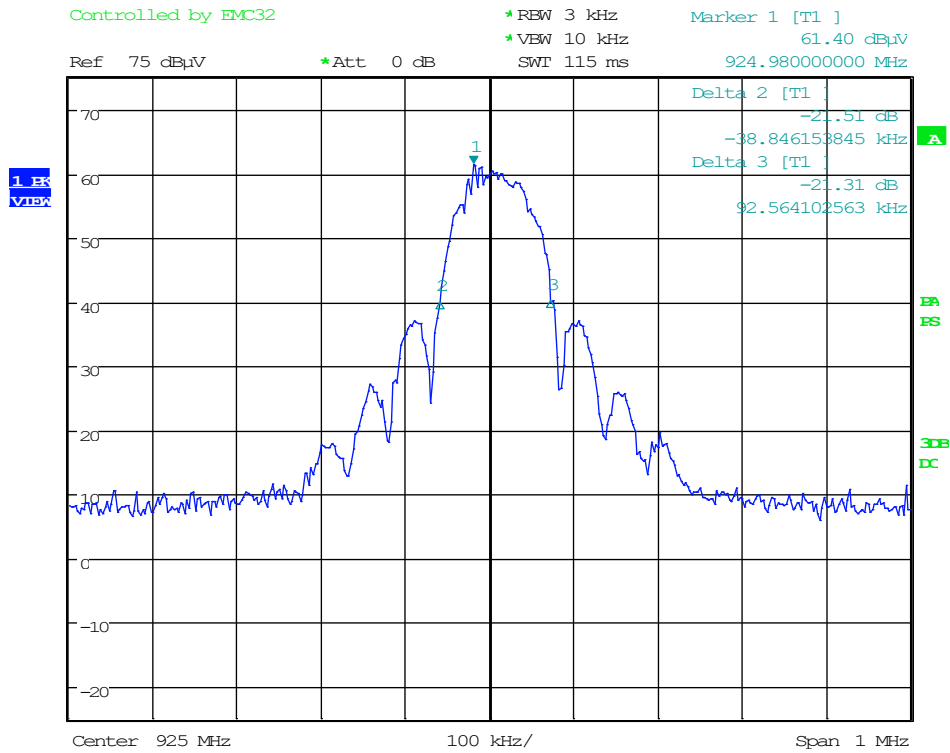
Test Date(s):	Oct. 4, 2019	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.215(c)	Air Temperature:	20.0°C
		Relative Humidity:	58%

Mid





High

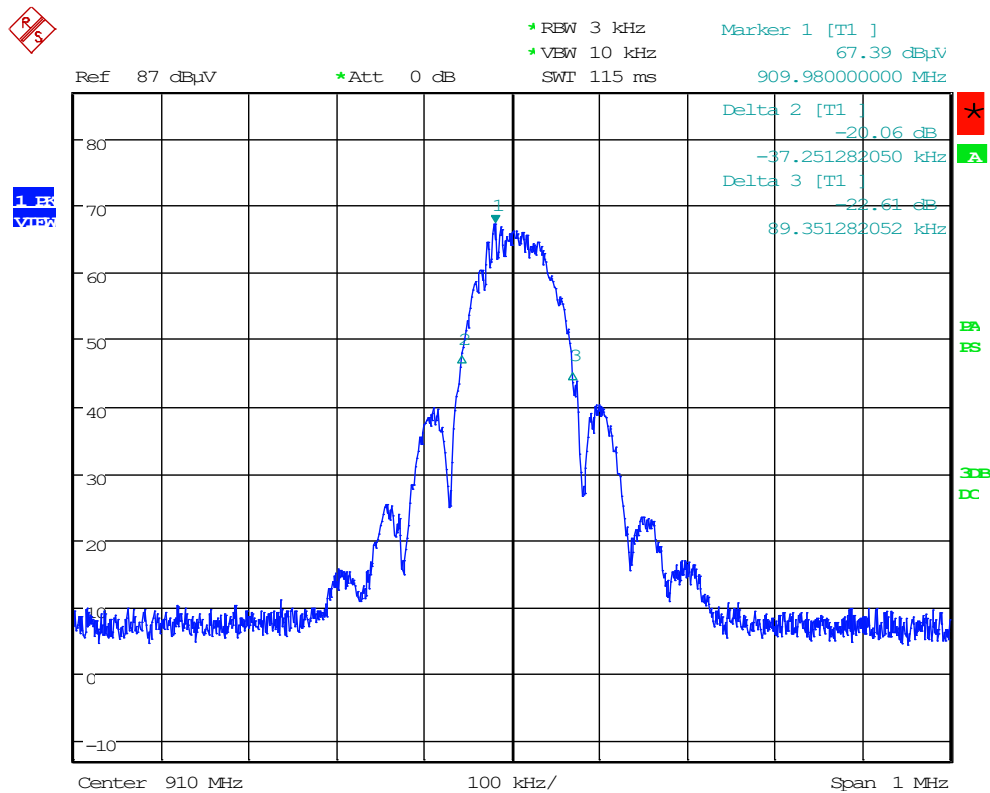


Date: 4.OCT.2019 16:37:44



Test Date(s):	Oct. 14, 2019	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.215(c)	Air Temperature:	20.0°C
		Relative Humidity:	42%

Low



**8 FCC PART 15.249(a)(d) – FIELD STRENGTH OF EMISSIONS FROM INTENTIONAL RADIATORS**

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

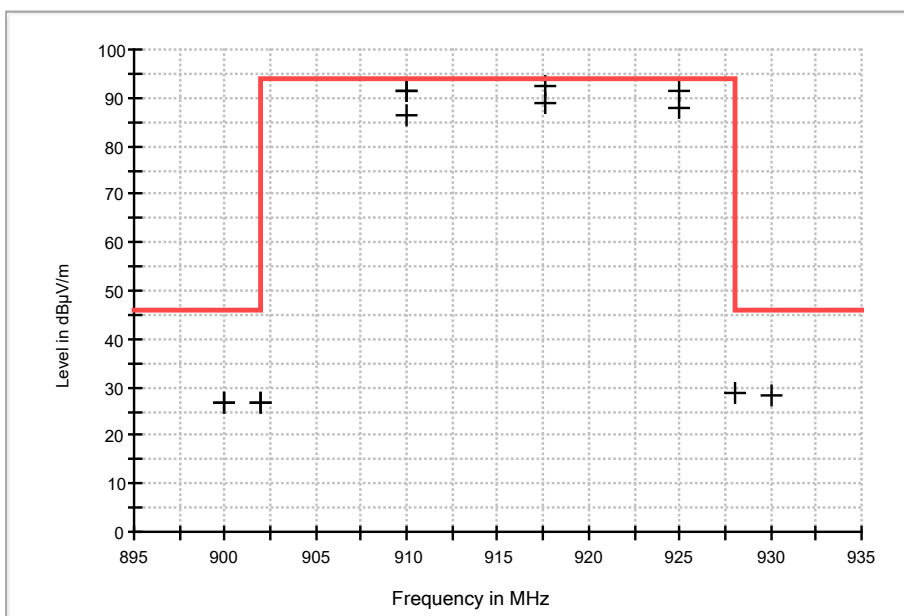
NOTE: During the pre-scan evaluation, the EUT was rotated in all possible directions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions.



8.1 Test Data - Field Strength of Emissions from Intentional Radiators

Test Date(s):	Oct. 4, 2019	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(a)	Air Temperature:	20.1 °C
		Relative Humidity:	58%

Characterization Scan, Band Edge

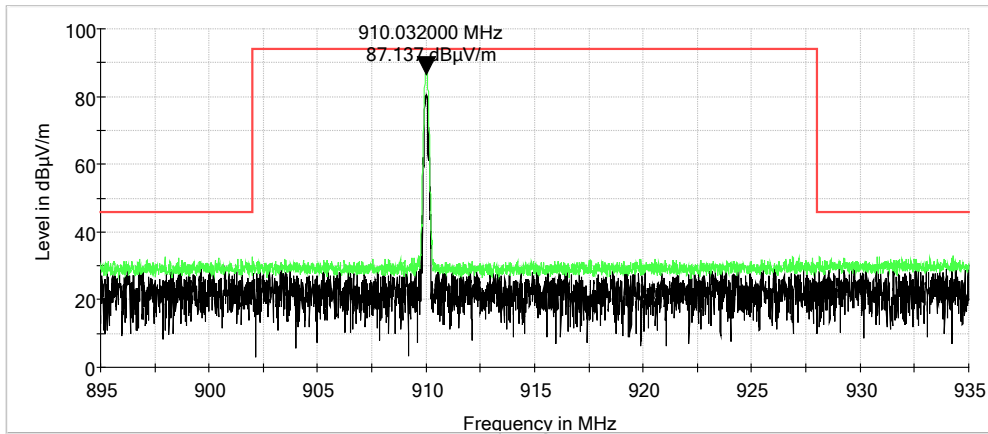


Measurements

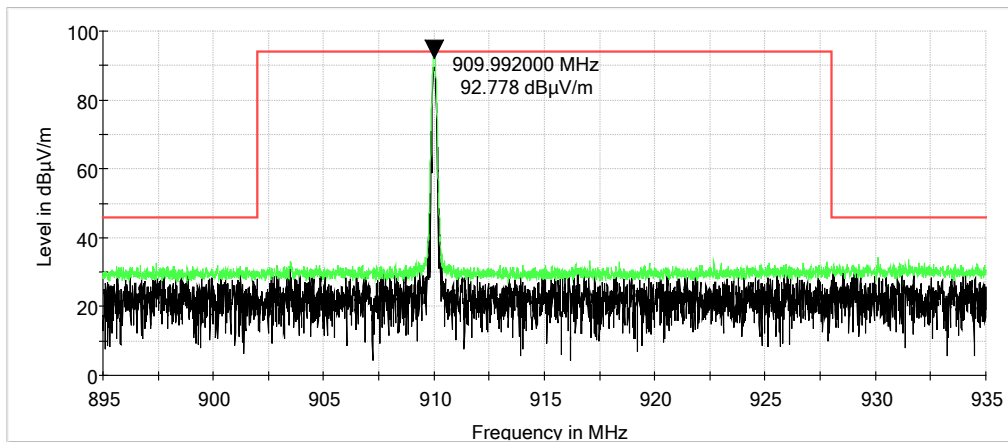
Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
900.000000	H	100.00	301.00	19.6	7.2	26.80	46.0	-19.2
900.000000	V	100.00	130.00	19.6	7.2	26.80	46.0	-19.2
902.000000	V	100.00	130.00	19.7	7.1	26.80	46.0	-19.2
902.000000	H	100.00	301.00	19.7	7.1	26.80	46.0	-19.2
910.000000	V	100.00	301.00	84.1	7.2	91.30	94.0	-2.7
910.000000	H	100.00	130.00	79.3	7.2	86.50	94.0	-7.5
917.600000	V	100.00	126.00	81.5	7.2	88.70	94.0	-5.3
917.600000	H	100.00	301.00	85.3	7.2	92.50	94.0	-1.5
925.000000	V	100.00	130.00	80.5	7.4	87.90	94.0	-6.1
925.000000	H	100.00	301.00	83.9	7.4	92.40	94.0	-1.6
928.000000	H	100.00	301.00	21.3	7.4	28.70	46.0	-17.3
930.000000	H	100.00	301.00	20.7	7.5	28.20	46.0	-17.8



Characterization Scan, Band Edge: Low Channel, Vertical

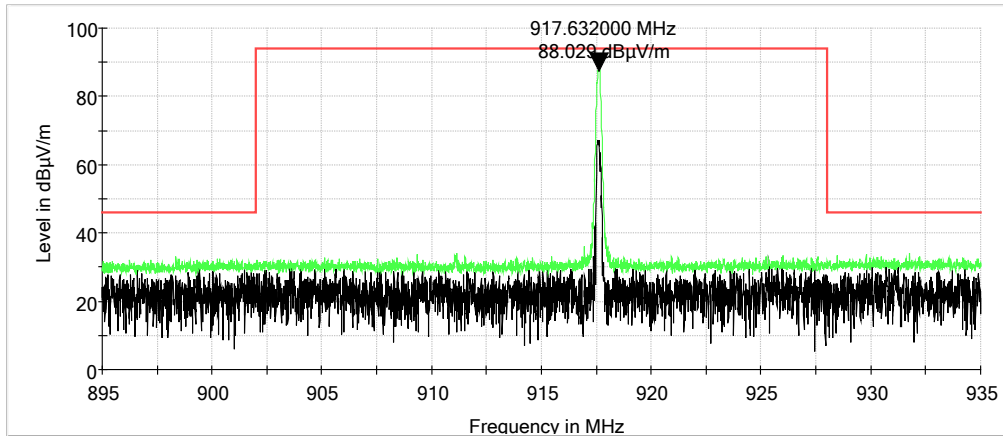


Characterization Scan Band Edge: Low Channel, Horizontal

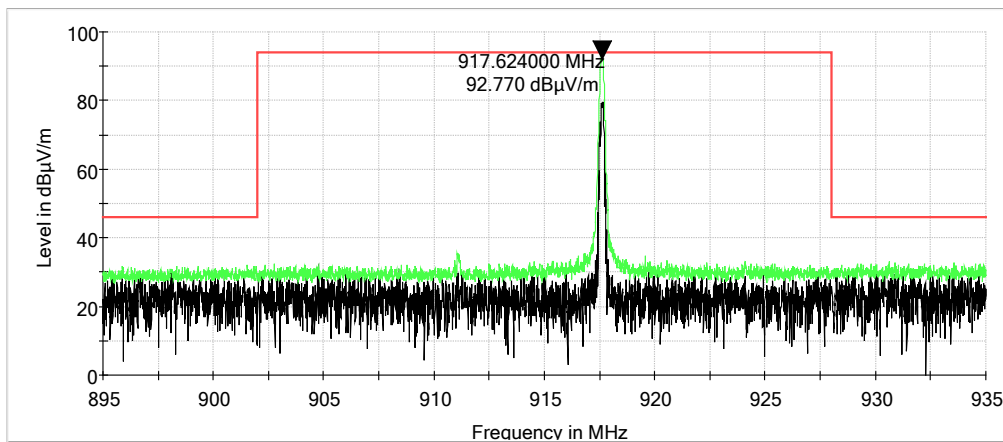




Characterization Scan, Band Edge: Mid Channel, Vertical

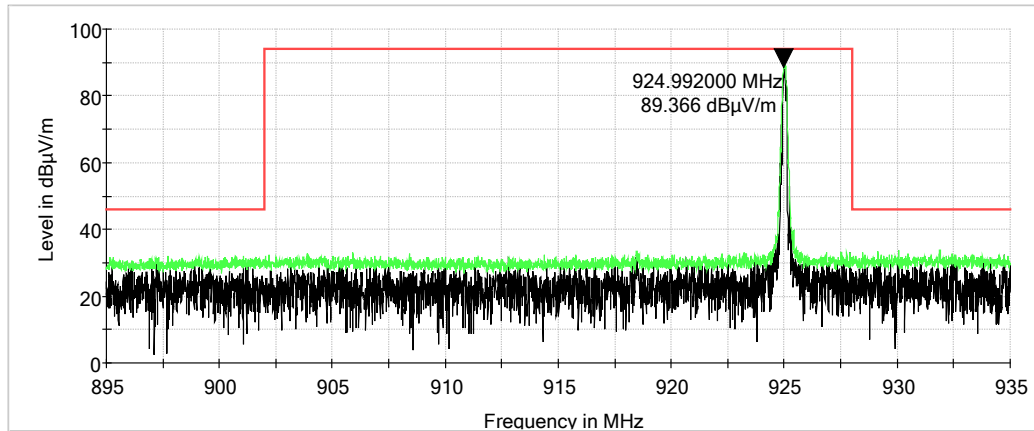


Characterization Scan Band Edge: Mid Channel, Horizontal

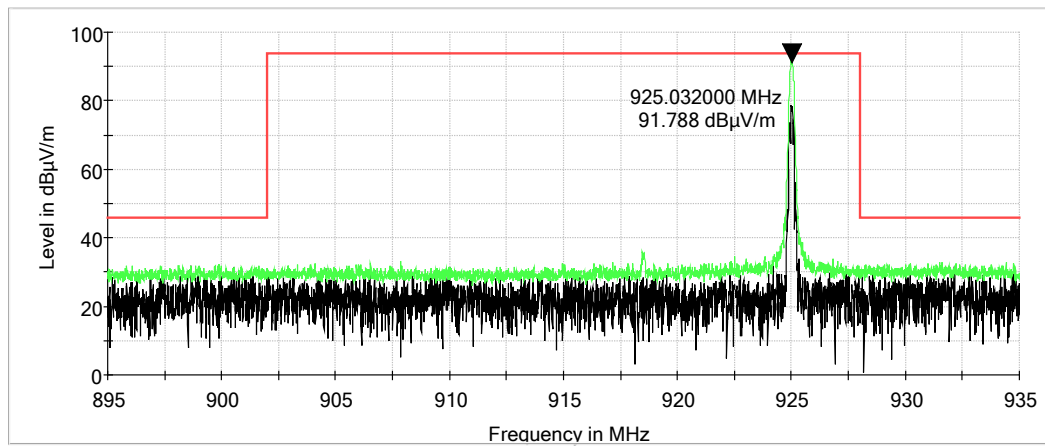




Characterization Scan, Band Edge: High Channel, Vertical



Characterization Scan Band Edge: High Channel, Horizontal





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 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.

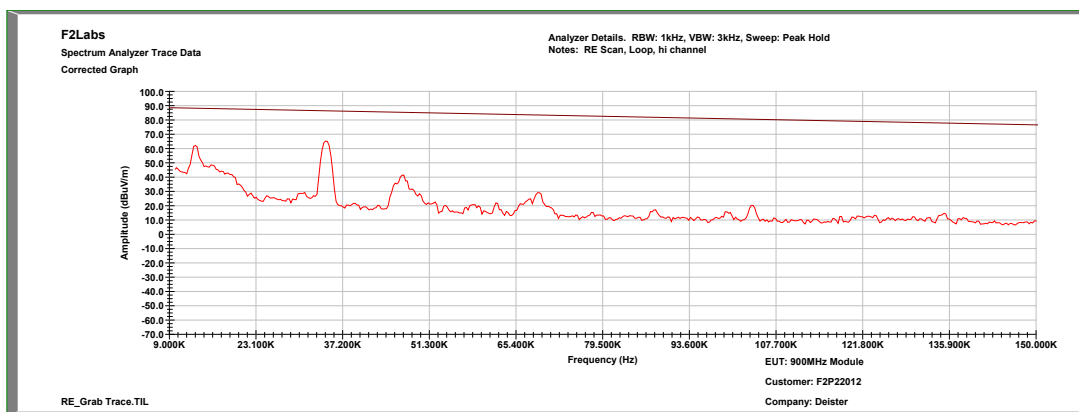
At least 6 of the highest frequencies were measured per ANSI 63.4 in a 3-meter anechoic chamber. Frequencies below 1GHz were measured using a quasi-peak detector. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions. Some of the frequencies 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 10 GHz and the highest emissions from High, Mid, and Low channels are listed below.

In the following plots, the black line indicates the active scan and the green line indicates the Max Pk measurement reached during the rotation with the EUT on. Emissions to be found by the EUT were measured and listed in tables below.

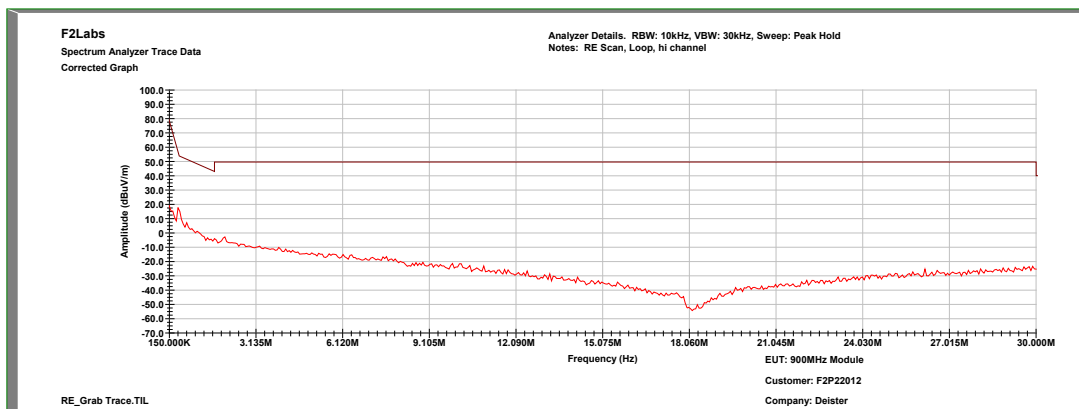


Test Date(s):	Oct. 4, 2019	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(d) / Part 15.209	Air Temperature:	20.0°C
Results:	Complies	Relative Humidity:	58%

0.009 MHz to 0.15 MHz (Loop Antenna)

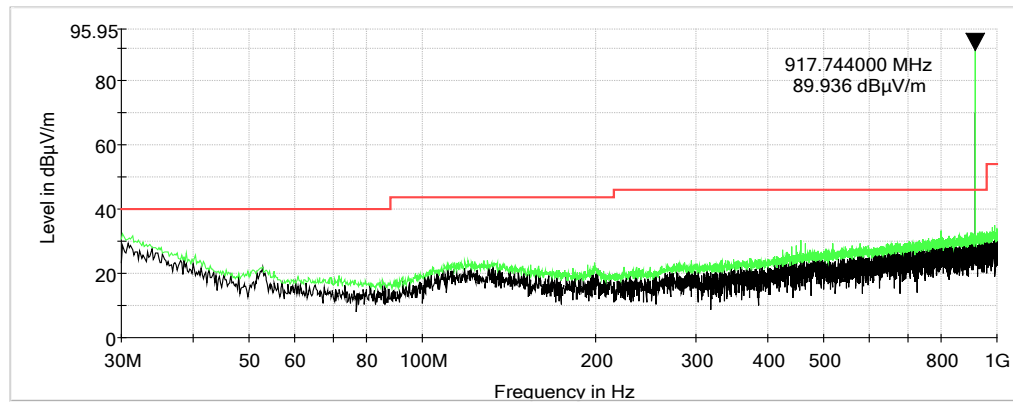


0.15 MHz to 30 MHz (Loop Antenna)

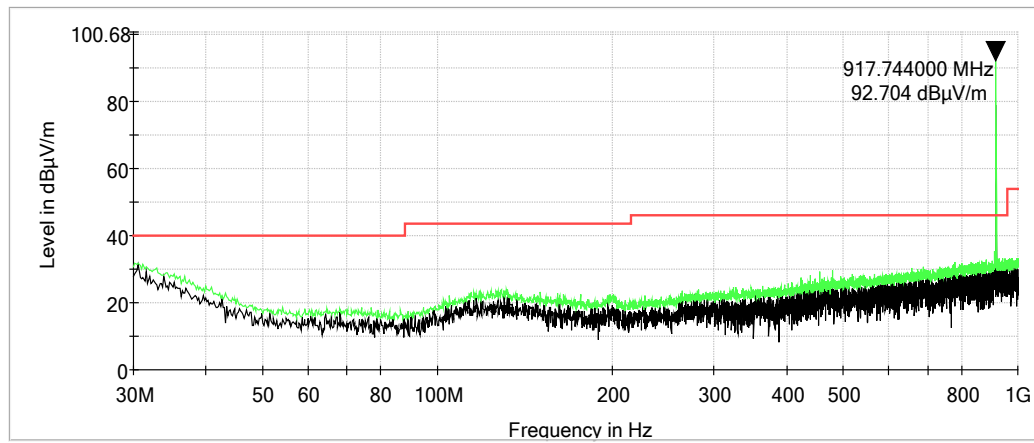




Characterization Scan: 30 MHz to 1000 MHz, Vertical



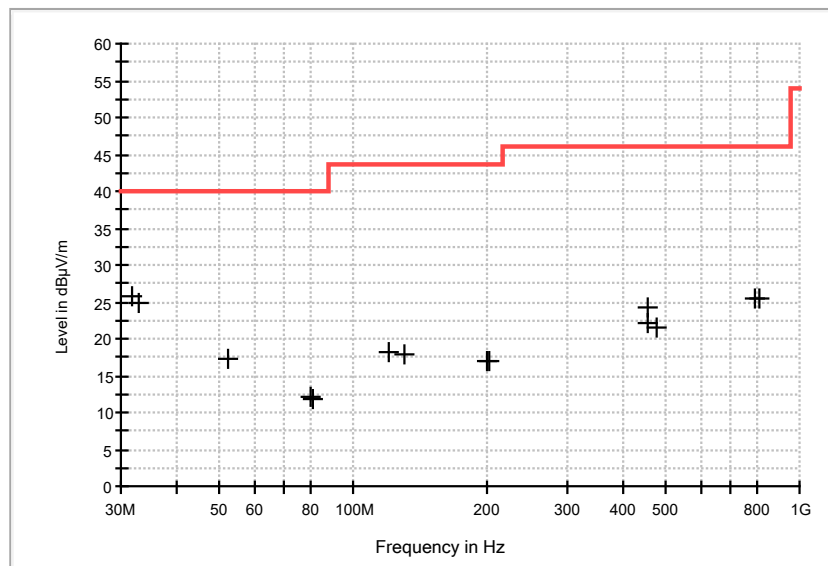
Characterization Scan: 30 MHz to 1000 MHz, Horizontal





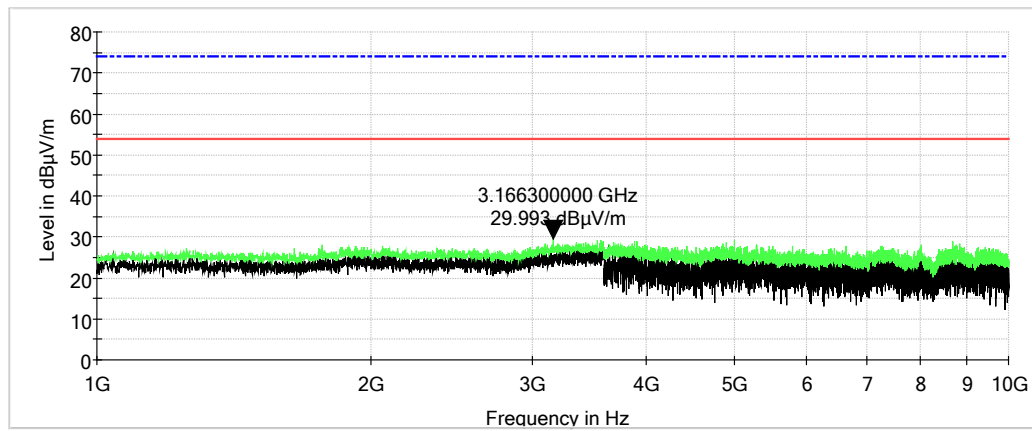
Measurements: 30 MHz to 1000 MHz

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Correction Factors (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
31.760000	V	100.00	0.00	20.1	5.5	25.60	40.0	-14.4
32.720000	H	100.00	0.00	19.9	4.8	24.70	40.0	-15.3
52.120000	V	100.00	0.00	24.4	-7.1	17.30	40.0	-22.7
80.240000	V	100.00	327.00	19.8	-7.6	12.20	40.0	-27.8
80.840000	H	100.00	0.00	19.6	-7.7	11.90	40.0	-28.1
119.240000	V	100.00	0.00	20.2	-1.9	18.30	43.5	-25.2
130.120000	H	100.00	0.00	19.6	-1.7	17.90	43.5	-25.6
199.560000	V	100.00	0.00	19.5	-2.5	17.00	43.5	-26.5
200.720000	H	100.00	0.00	19.5	-2.5	17.00	43.5	-26.5
456.040000	H	100.00	0.00	20.3	1.8	22.10	46.0	-23.9
456.040000	V	100.00	119.00	22.3	1.8	24.10	46.0	-21.9
480.080000	H	100.00	0.00	19.0	2.6	21.60	46.0	-24.4
792.800000	H	100.00	0.00	19.4	6.2	25.60	46.0	-20.4
808.720000	V	100.00	1.00	19.3	6.3	25.60	46.0	-20.4

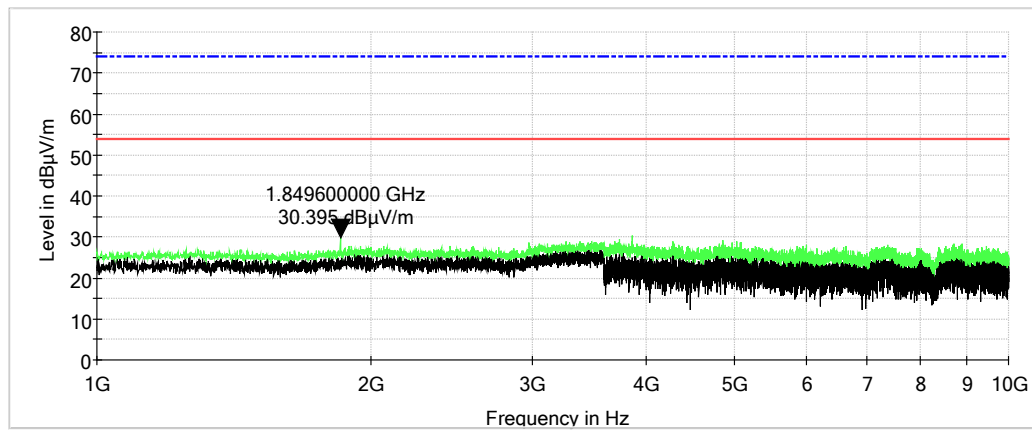




Characterization Scan: 1 GHz to 10 GHz, Vertical



Characterization Scan: 1 GHz to 10 GHz, Horizontal





9 VARIATION OF THE INPUT POWER, 15.31(e)

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.

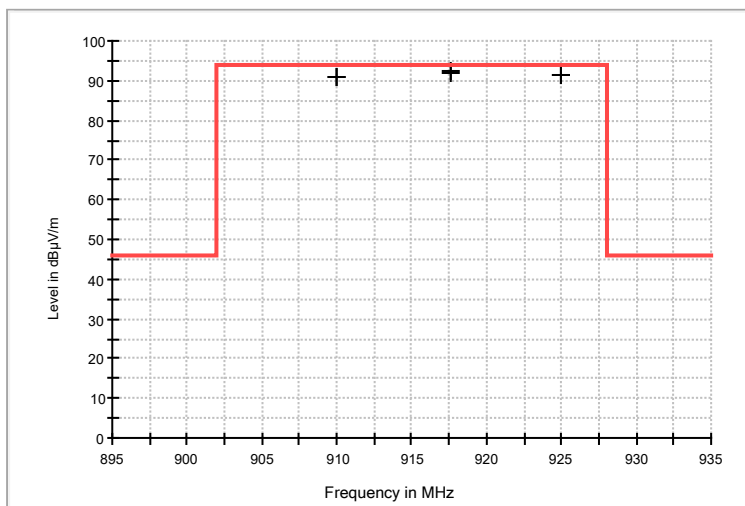
This DC device is rated to operate at 3.3VDC to 5.5VDC.

RESULTS: 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.



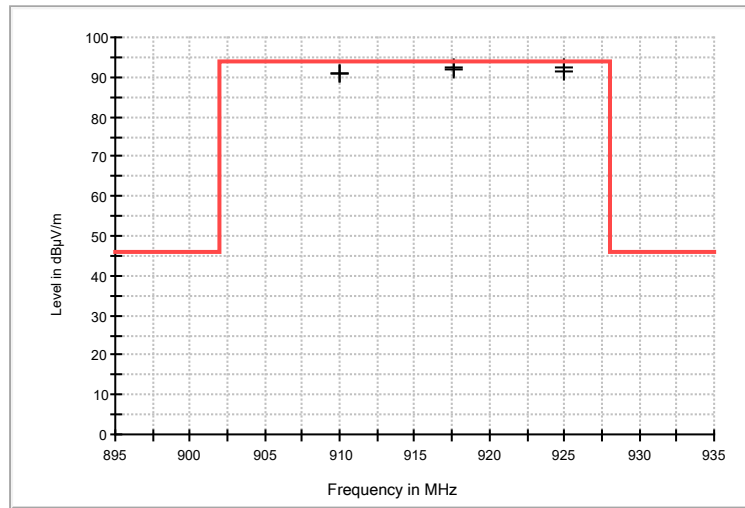
Test Date(s):	Oct. 7, 2019	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(d) / Part 15.31(e)	Air Temperature:	19.6°C
Results:	Complies	Relative Humidity:	58%

Test Date(s):	Oct. 14, 2019	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(d) / Part 15.31(e)	Air Temperature:	20.0°C
Results:	Complies	Relative Humidity:	42%



Voltage Variation, 102VAC/138VAC

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Correction Factors (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
910.000000	H	100.0	301.0	83.6	7.2	90.80	94.0	-3.2
910.000000	H	100.0	301.0	83.6	7.2	90.80	94.0	-3.2
917.600000	H	100.0	301.0	85.0	7.2	92.20	94.0	-1.8
917.600000	H	100.0	301.0	85.0	7.2	92.20	94.0	-1.8
925.000000	H	100.0	301.0	83.9	7.4	91.30	94.0	-2.7
925.000000	H	100.0	301.0	83.9	7.4	91.30	94.0	-2.7

**Voltage Variation, 3.3VDC/5.5VDC**

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Correction Factors (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
910.000000	H	100.0	301.0	83.6	7.2	90.80	94.0	-3.2
910.000000	H	100.0	301.0	83.7	7.2	90.90	94.0	-3.1
917.600000	H	100.0	301.0	84.9	7.2	92.10	94.0	-1.9
917.600000	H	100.0	301.0	85.3	7.2	92.50	94.0	-1.5
925.000000	H	100.0	301.0	85.0	7.4	92.40	94.0	-1.6
925.000000	H	100.0	301.0	83.9	7.4	91.30	94.0	-2.7



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 μ H/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 (dB μ V)	
	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

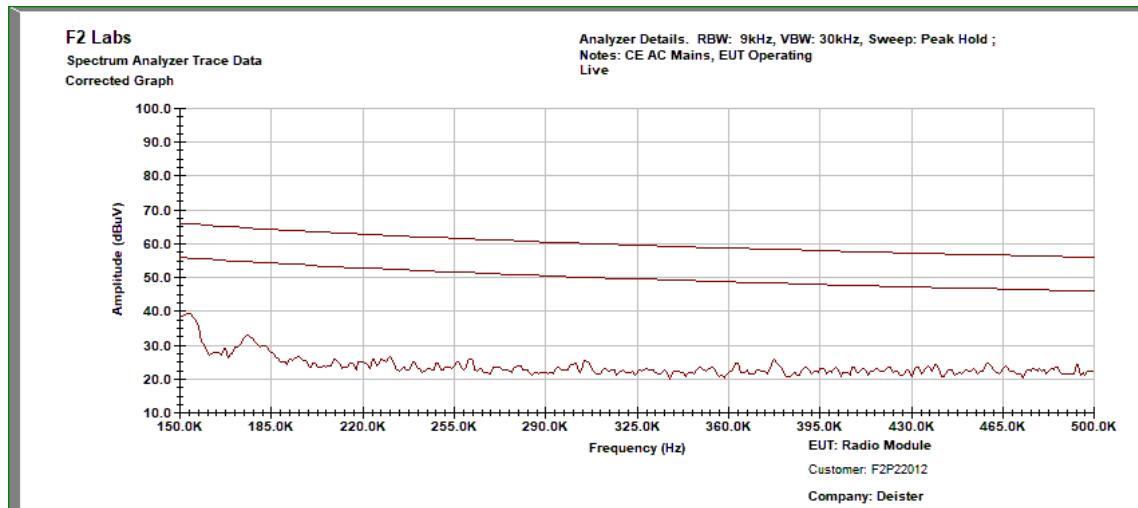
The EUT was placed on a 1.0 x 1.5 meter non-conductive table, 0.8 meter above a horizontal ground plane and 0.4 meter from a vertical ground plane. Power was provided to the EUT through a LISN bonded to a 3 x 2 meter ground plane. The LISN and peripherals were supplied power through a filtered AC power 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.



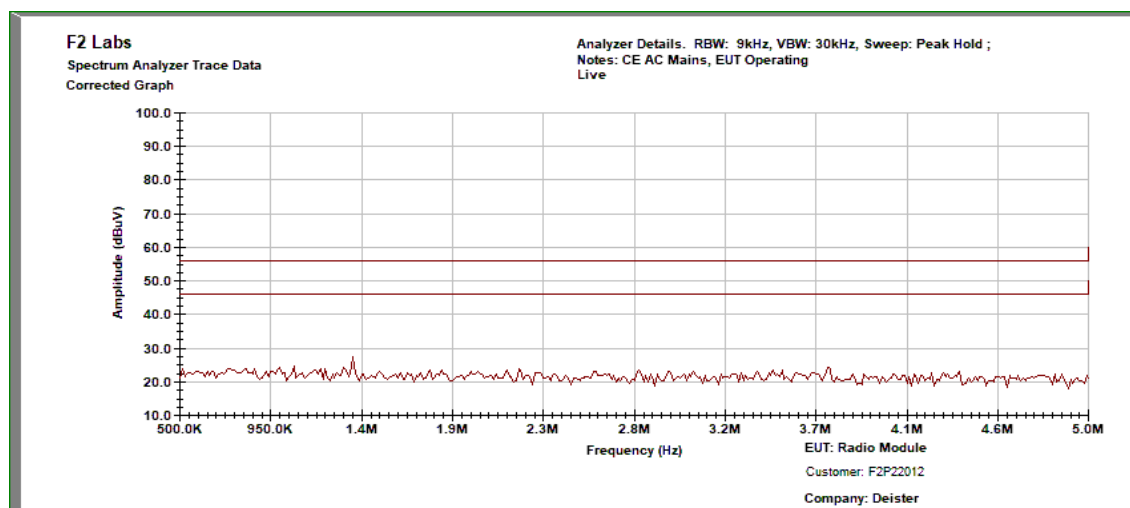
10.3 Conducted Emissions Test Data

Test Date(s):	Oct. 14, 2019	Test Engineer:	J. Chiller
Rule:	15.207, Class B	Air Temperature:	18.6° C
Test Results:	Complies	Relative Humidity:	47%

Conducted Test – Line 1: 0.15 MHz to 0.5 MHz

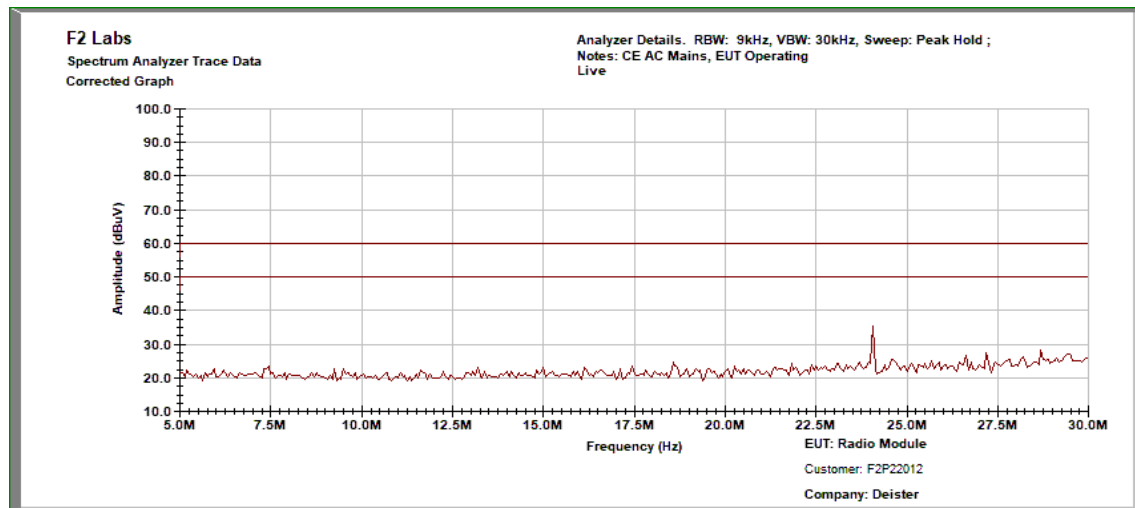


Conducted Test – Line 1: 0.5 MHz to 5.0 MHz





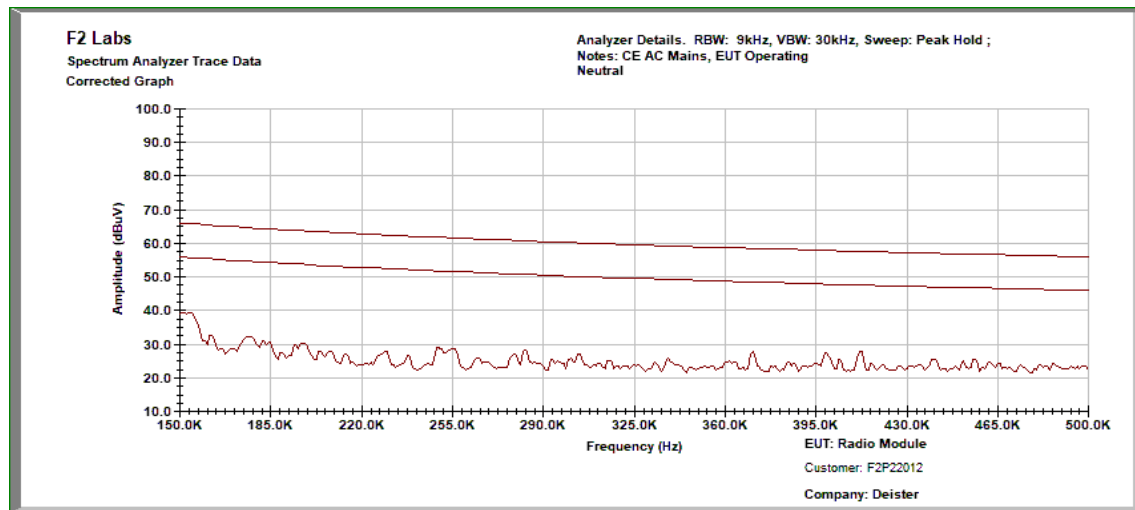
Conducted Test – Line 1: 5.0 MHz to 30.0 MHz



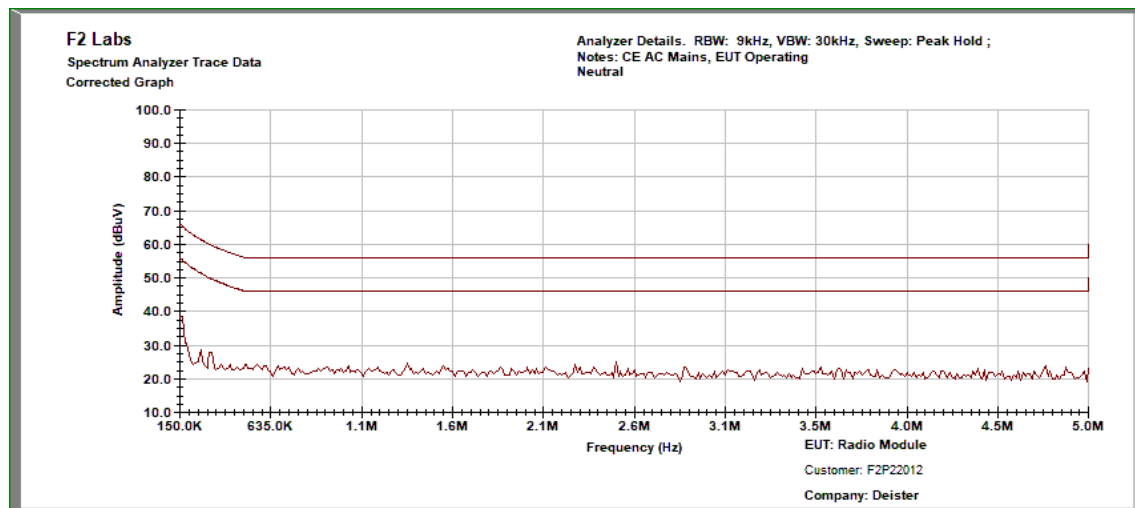
Note: No measurable points.



Conducted Test – Line 2: 0.15 MHz to 0.5 MHz

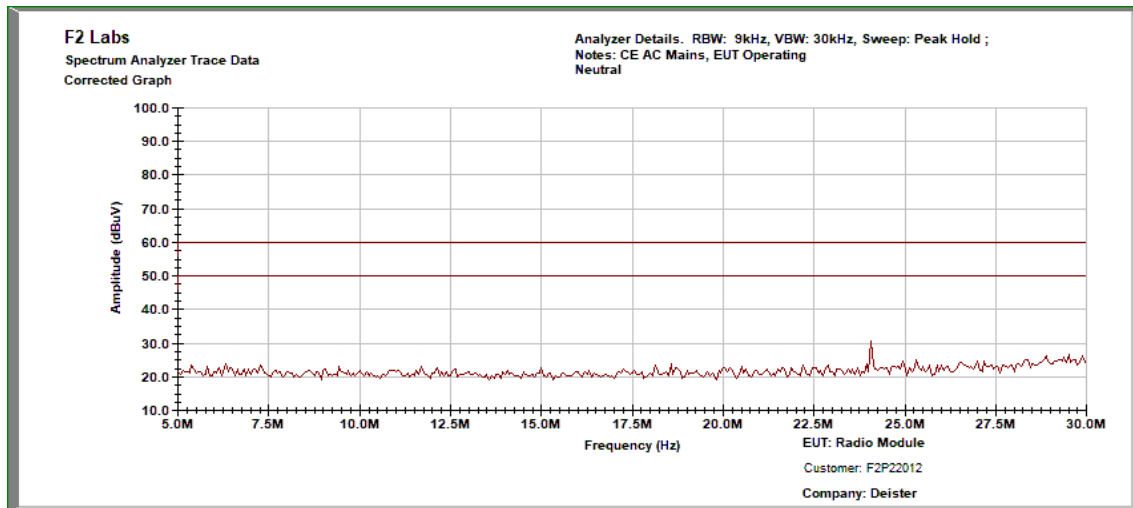


Conducted Test – Line 2: 0.5 MHz to 5.0 MHz





Conducted Test – Line 2: 5.0 MHz to 30.0 MHz

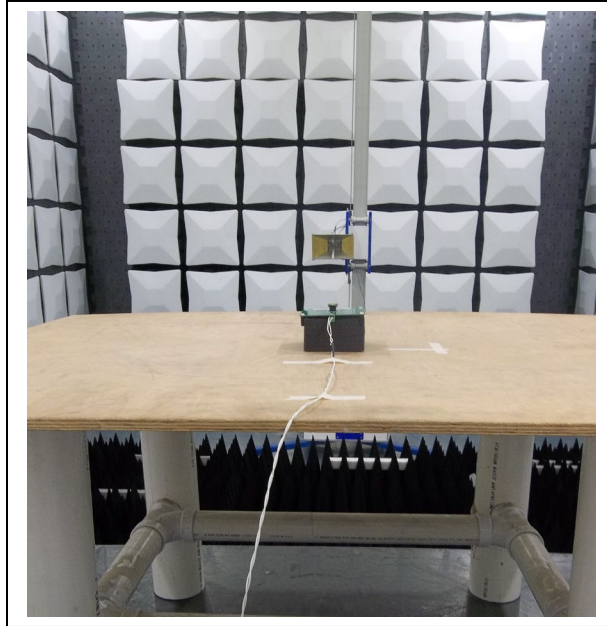


Note: No measurable points.

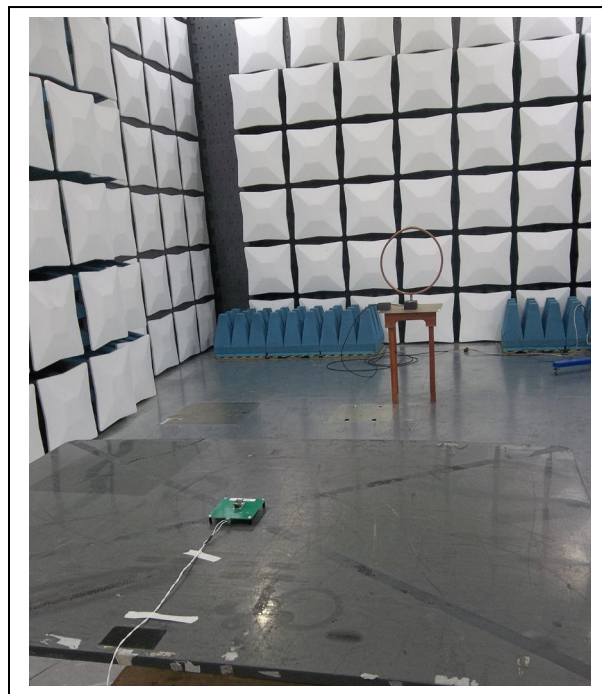


11 PHOTOGRAPHS

Field Strength of Emissions, Occupied Bandwidth

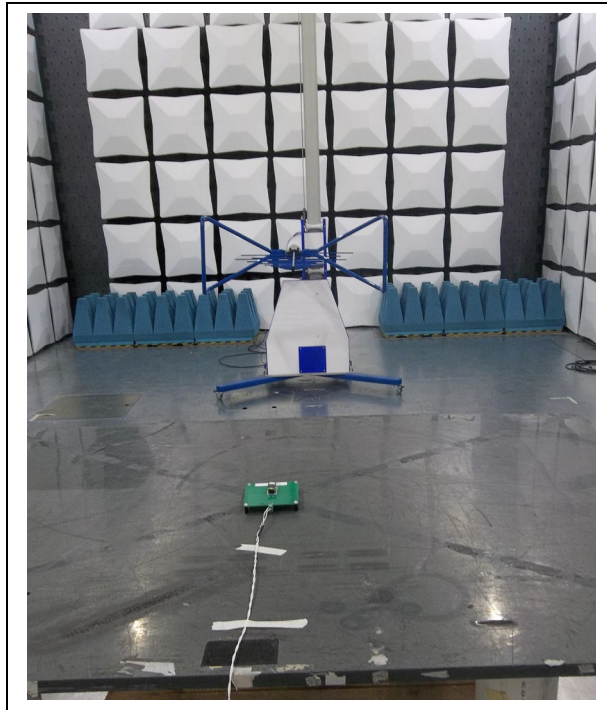


Loop Antenna





Radiated Spurious Emissions: 30 MHz to 1000 MHz

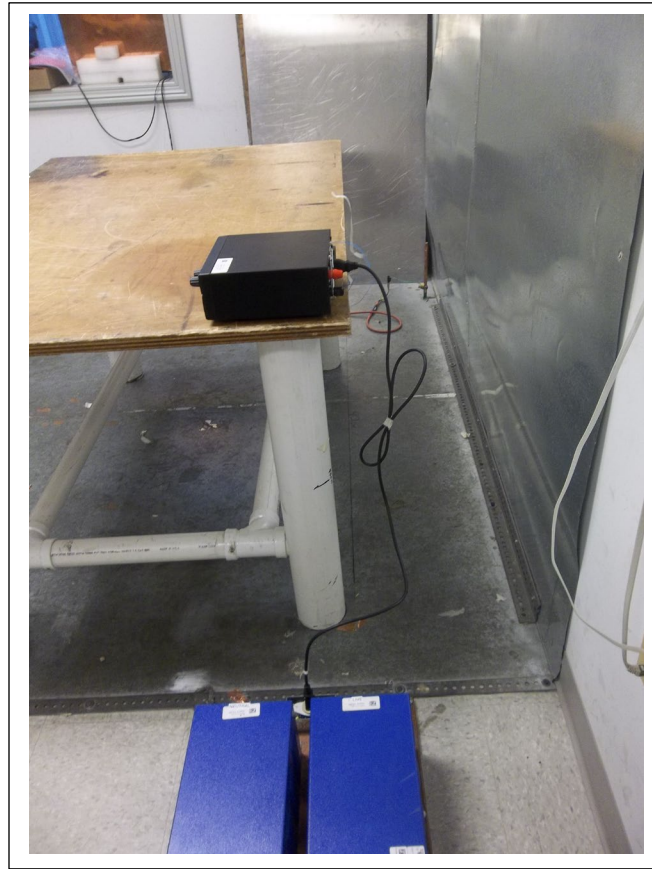


Radiated Spurious Emissions: 1 GHz to 18 GHz





Conducted Emissions





Voltage Variations

