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CERTIFICATION TEST REPORT

Manufacturer: Command Electronics, LLC
1224 19th Street Lane NW
Hickory, NC 28601 USA

Applicant: Same as Above

Product Name: PowerMatePro

Product Description: Bluetooth Low Energy Vehicle Power Accessory Controller

Operating Voltage/Frequency: 12VDC

Model: 1S

FCC ID: 2AHCZPOWERMATEPRO

Testing Commenced: June 11, 2018

Testing Ended: Aug. 10, 2018

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



Evaluation Conducted by:

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Report Reviewed by:

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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 DTS operating 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 are 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
F2P18891A-01E	First Issue	Aug. 13, 2018	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
Variation of the Input Power	CFR 47 Part 15.31(e)	Complies*

**EUT was operated using an AC to DC power supply, so Voltage Variation testing in 15.31(3)(e) was performed at the nominal voltage, and then the 85% and 115% of that voltage was tested also. The output power at the Low, Mid 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 increased power was measured at either of the varied voltages on any of the channels.*

Modifications Made to the Equipment
None



3 TABLES OF MEASURED RESULTS

Test	Low Channel 2402 MHz	Mid Channel 2440 MHz	High Channel 2480 MHz
Max Field Strength of Fundamental	84.5 dB μ V/m (18.6 mV/m)	79.3 dB μ V/m (9.3 mV/m)	78.3 dB μ V/m (8.2 mV/m)
Limit for Fundamental	50 millivolts/meter (93.97 dB μ V/m)	50 millivolts/meter (93.97 dB μ V/m)	50 millivolts/meter (93.97 dB μ V/m)
-20dB Occupied Bandwidth (MHz)	1.859	1.827	1.780
Voltage Variations, 85% (dB μ V/m)	80.3	79.10	77.79
Voltage Variations, 115% (dB μ V/m)	84.5	79.3	78.3

The -20dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.



4 ENGINEERING STATEMENT

This report has been prepared on behalf of Command Electronics, LLC 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: PowerMatePro

Model: 1S

Serial No.: None Specified

FCC ID: 2AHCZPOWERMATEPRO

5.2 Trade Name:

Command Electronics, LLC

5.3 Power Supply:

12VDC

5.4 Applicable Rules:

CFR 47, Part 15.249

5.5 Equipment Category:

Radio Transmitter-DTS

5.6 Antenna:

Integral, non-removable

5.7 Accessories:

Programming PCB, Command Electronics, LLC; 3VDC Supply

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

EUT was set up in a normal operating mode. EUT was placed on an 80cm and 1.5m high table on the turntable of a semi-anechoic chamber, 3m from the measuring antenna. Radiated emissions were measured of the fundamental (2402-2480 MHz) and out-of-band spectrums. Measurements were made on three different channels (low, mid and high).



6 LIST OF MEASUREMENT INSTRUMENTATION

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber	CL166-E	AlbatrossProjects	B83117-DF435-T261	US140023	Jan. 9, 2019
Shield Room	0175-3V	Ray Proof	N/A	11645	Feb. 28, 2019
Temp/Hum. Recorder	CL233	Extech	445814	02	Mar. 22, 2019
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Nov. 17, 2018
Receiver	CL204	Rohde & Schwarz	ESR7	101714	Nov. 2, 2018
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	Oct. 11, 2019
Horn Antenna	CL098	Emco	3115	9809-5580	Dec. 28, 2018
Horn Antenna	CL114	A.H. Systems, Inc.	SAS-572	237	Nov. 17, 2018
Pre-Amplifier	CL153	Agilent	83006-69007	MY39500791	Sept. 20, 2018
Pre-Amplifier	CL136	Hewlett Packard	8447E	1937A01894	Mar. 26, 2019
Amplifier w/Monopole & 18" Loop	CL163-Loop	A.H. Systems, Inc.	EHA-52B	100	June 4, 2019
Software:	Tile Version 3.4.B.3.		Software Verified: June 11, 2018		
Software:	EMC 32, Version 8.53.0		Software Verified: June 11, 2018		



7 FCC PART 15.215(c), OCCUPIED BANDWIDTH

7.1 Requirements:

§15.215 Additional provisions to the general radiated emission limitations.

(a) The regulations in §§15.217 through 15.257 provide alternatives to the general radiated emission limits for intentional radiators operating in specified frequency bands. Unless otherwise stated, there are no restrictions as to the types of operation permitted under these sections.

(b) In most cases, unwanted emissions outside of the frequency bands shown in these alternative provisions must be attenuated to the emission limits shown in §15.209. In no case shall the level of the unwanted emissions from an intentional radiator operating under these additional provisions exceed the field strength of the fundamental emission.

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

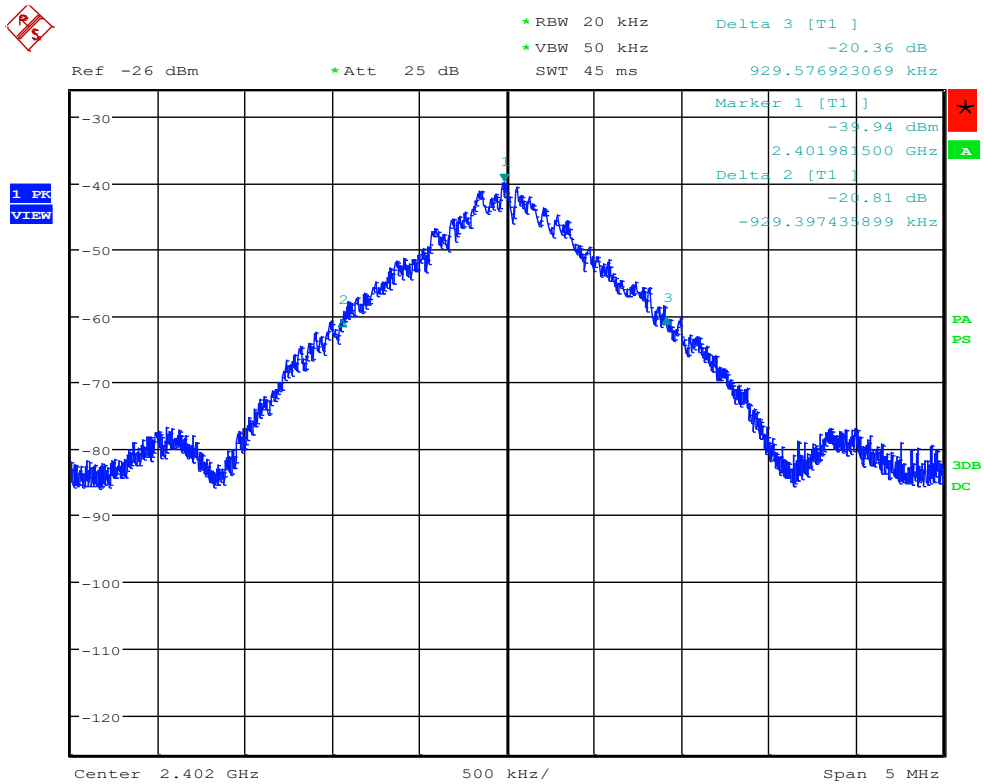
Bandwidth measurements were made at the low (2402), mid (2440) and upper (2480) MHz frequencies. The bandwidth was measured using the analyzer's marker function.



7.2 Occupied Bandwidth Test Data

Test Date(s):	June 29, 2018	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.215(c)	Air Temperature:	21.9°C
		Relative Humidity:	48%

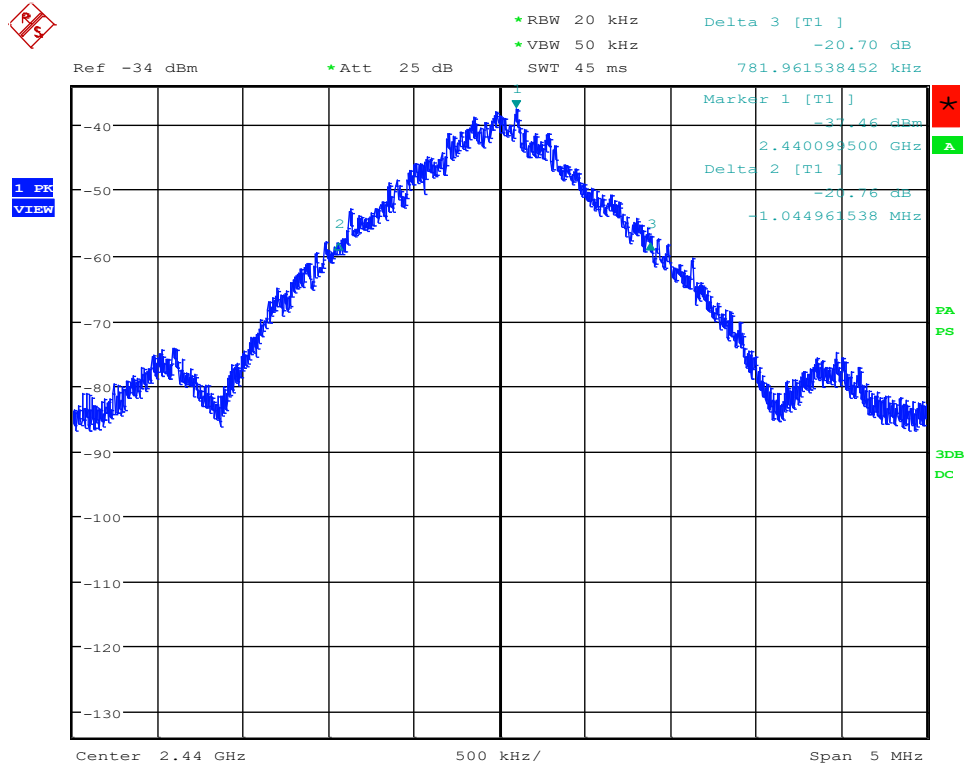
-20dB, Low Channel



Date: 29.JUN.2018 14:28:59



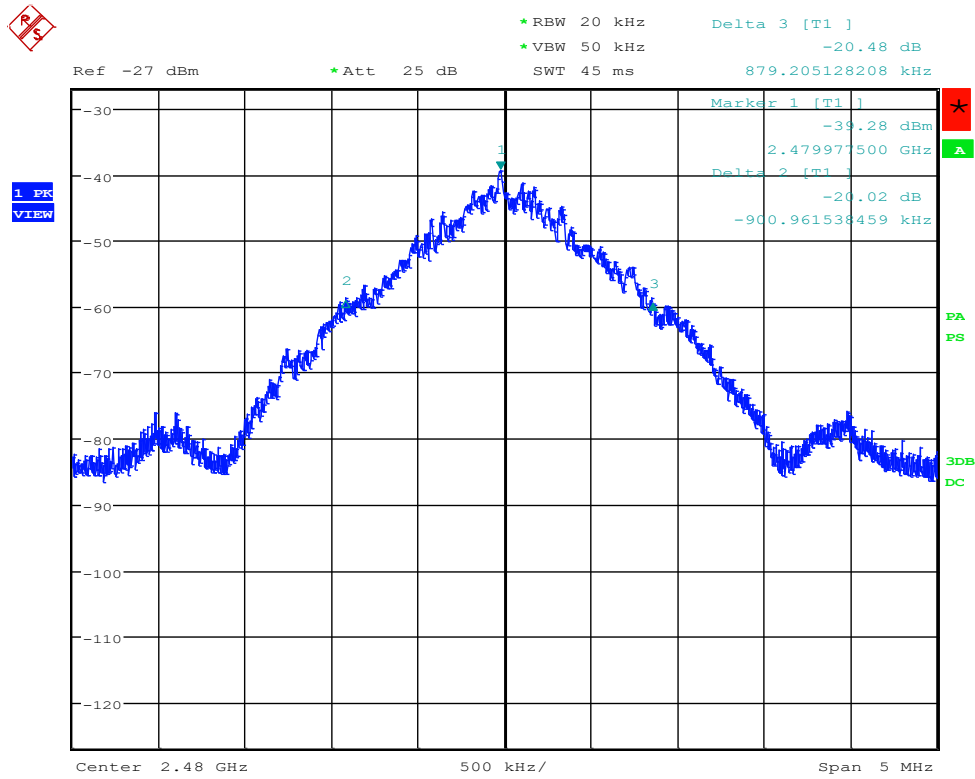
-20dB, Mid Channel



Date: 29.JUN.2018 14:40:59



-20dB, High Channel



Date: 29.JUN.2018 14:46:10



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 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.



8.1 Test Data – Spurious Emissions

Test Date(s):	June 11, 2018	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(a)	Air Temperature:	20.9°C
		Relative Humidity:	47%

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 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.

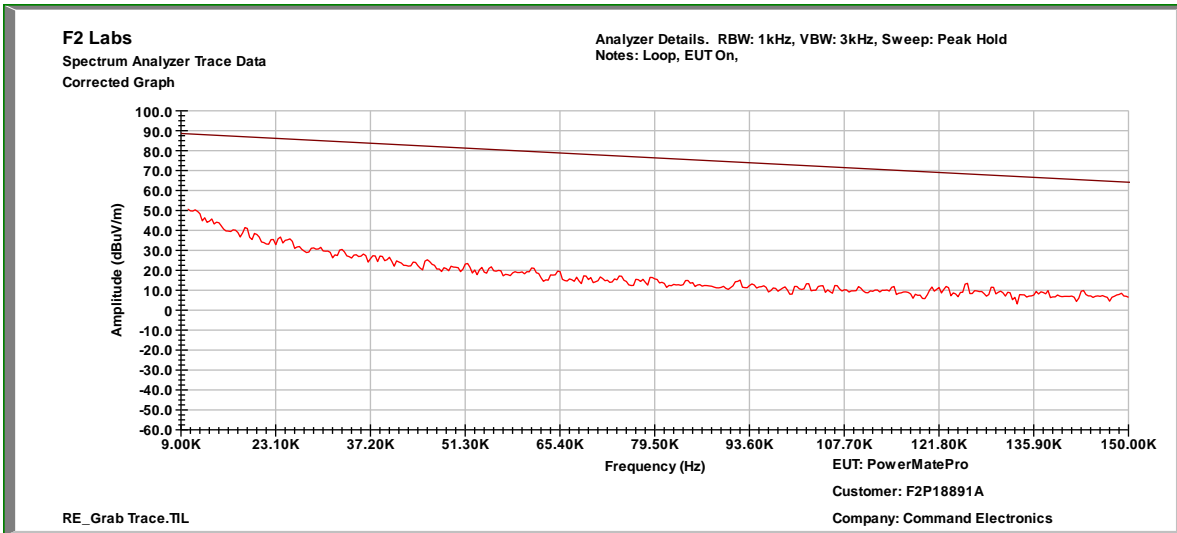
Where emissions from the EUT were visible within 20dB of the limit, at least 6 of the highest frequencies were measured per ANSI 63.4 in a 3-meter anechoic chamber. Frequencies below 1GHz were measured using a quasi-peak detector. The antenna was raised between 1 and 4 meters and the EUT turntable was 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 26 GHz and the highest emissions are listed.

Note: Spurious emissions in these EUTs were tested for all three channels. The results that follow are from the one that was deemed worst-case: 2402 MHz (Low Channel).

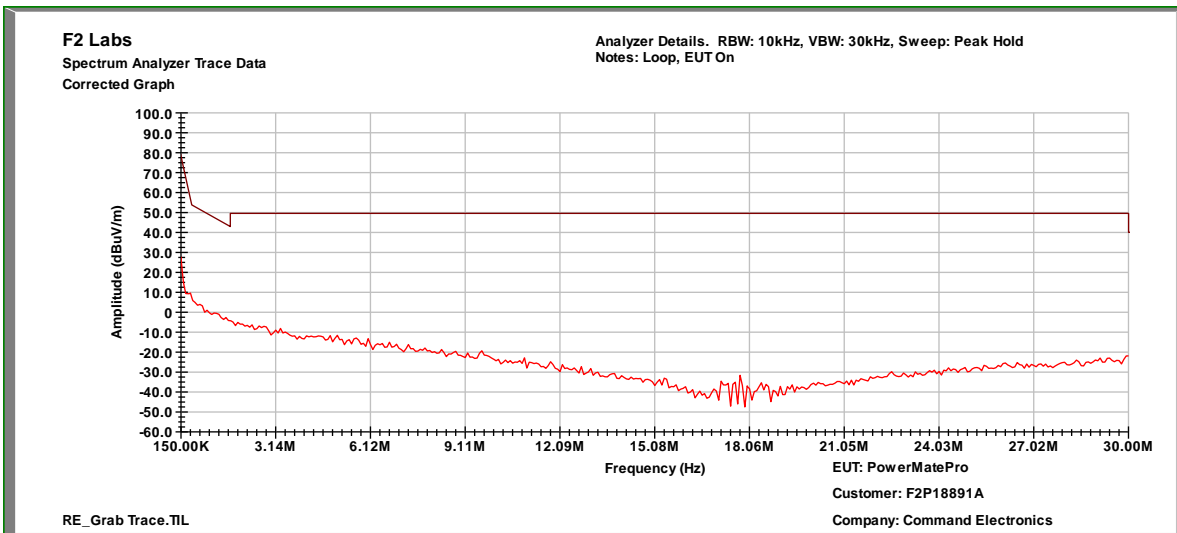


Test Date(s):	June 12, 2018	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(d) / Part 15.209	Air Temperature:	20.9°C
		Relative Humidity:	47%
Results:	Complies		

0.009 MHz to 0.15 MHz, Low Channel

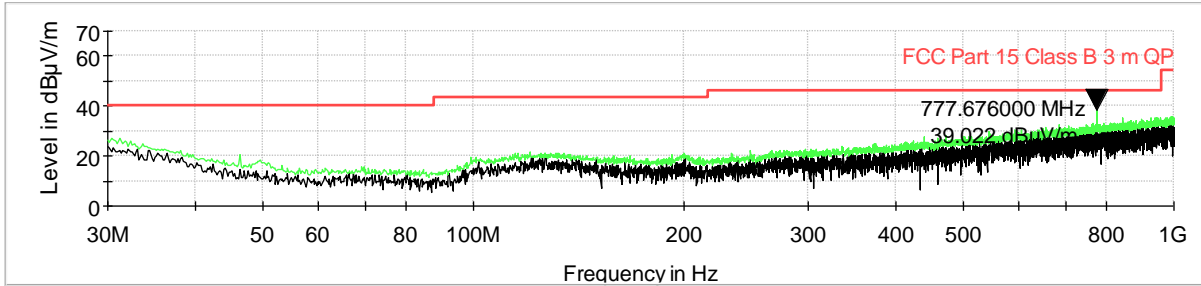


0.15 MHz to 30.0 MHz, Low Channel

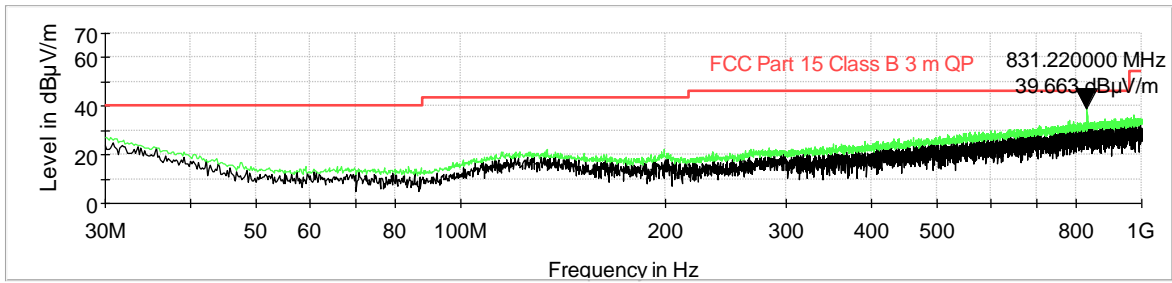




30.0 MHz to 1000 MHz, Low Channel, Vertical



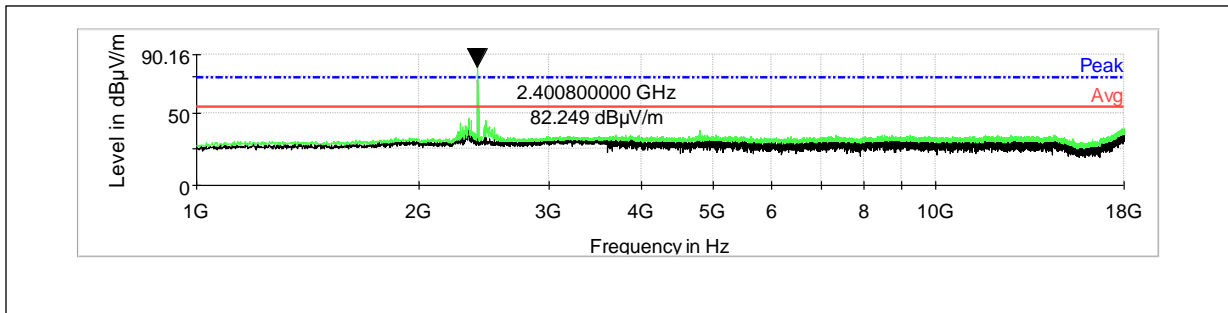
30.0 MHz to 1000 MHz, Low Channel, Horizontal



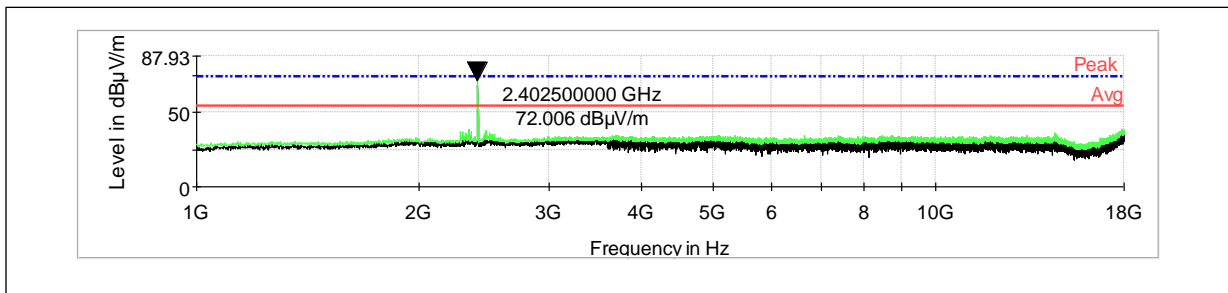
Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBµV)	Correction Factos (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.960000	H	100.00	0.00	15.8	4.5	20.30	40.0	-19.7
46.280000	V	100.00	0.00	16.6	-6.1	10.50	40.0	-29.5
100.600000	V	100.00	0.00	17.3	-5.0	12.30	43.5	-31.2
116.520000	H	100.00	0.00	15.8	-1.6	14.20	43.5	-29.3
198.600000	H	100.00	0.00	15.8	-1.2	14.60	43.5	-28.9
297.120000	V	100.00	0.00	15.9	-0.1	15.80	46.0	-30.2
502.600000	V	100.00	0.00	16.3	4.8	21.10	46.0	-24.9
505.880000	H	100.00	0.00	16.4	4.7	21.10	46.0	-24.9
777.880000	V	100.00	0.00	17.0	10.0	27.00	46.0	-19.0
784.080000	H	100.00	0.00	15.7	10.1	25.80	46.0	-20.2
972.240000	H	100.00	0.00	16.1	12.6	28.70	54.0	-25.3



1 GHz to 18 GHz, Low Channel, Vertical

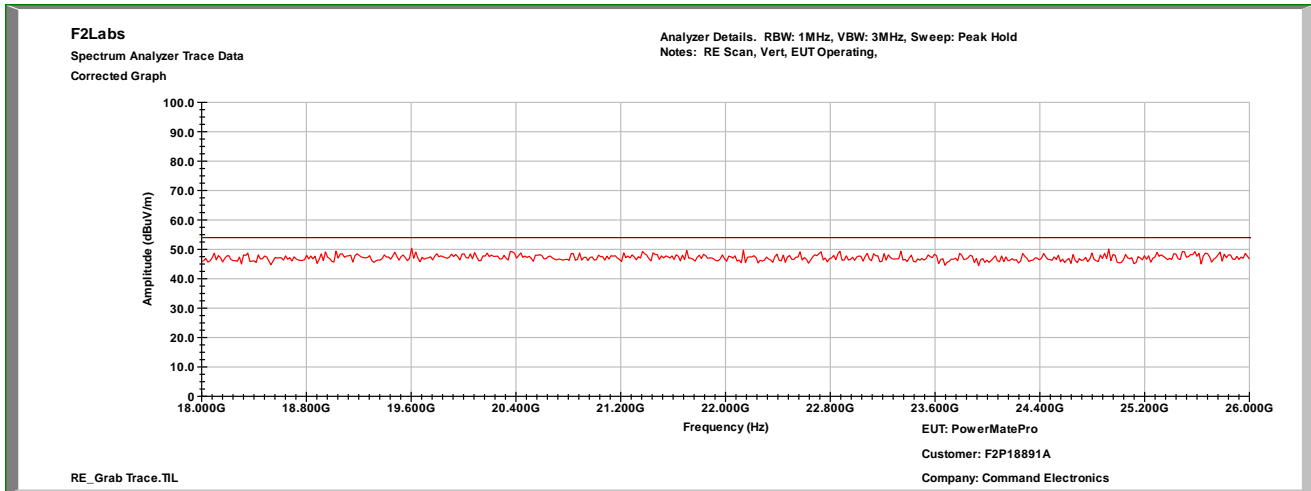


1 GHz to 18 GHz, Low Channel, Horizontal

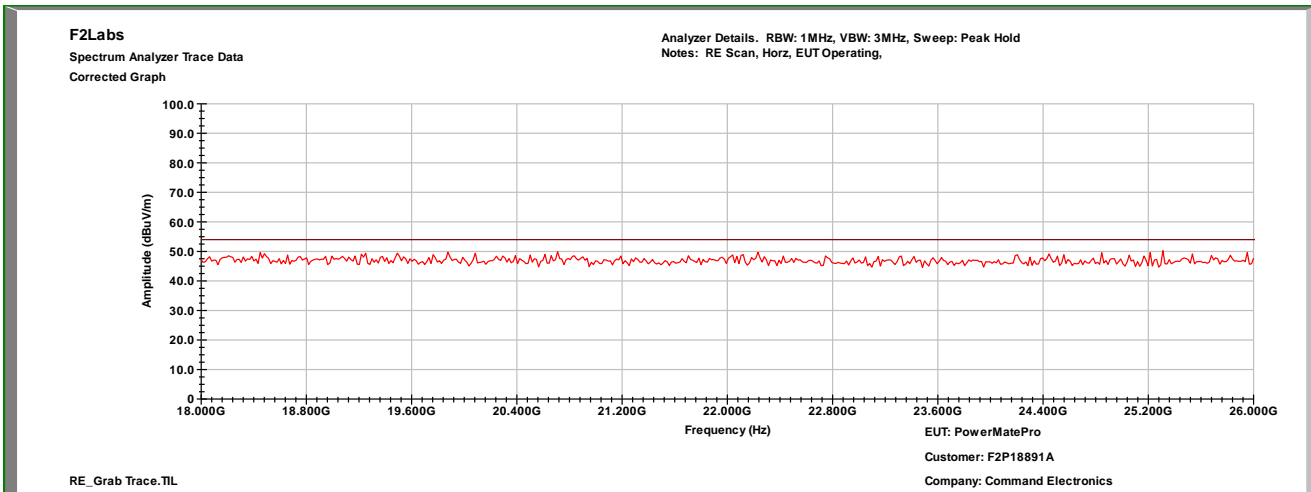




18 GHz to 26 GHz, Low Channel, Vertical

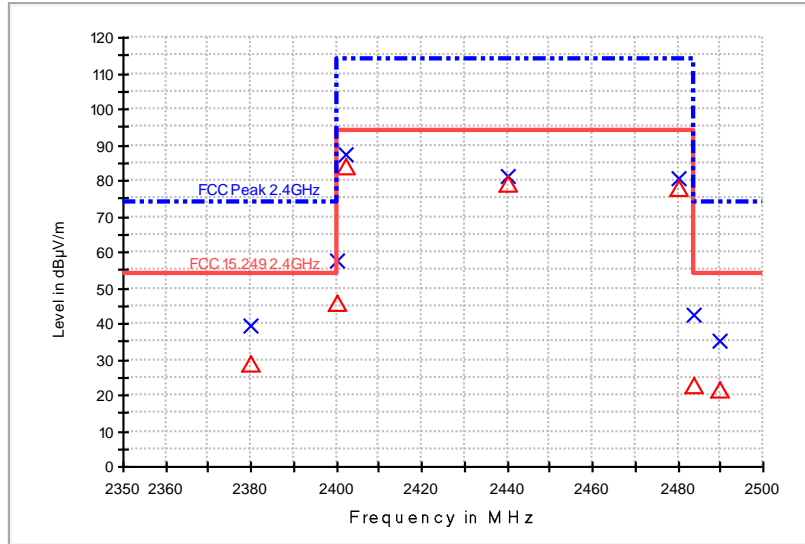


18 GHz to 26 GHz, Low Channel, Horizontal





Band Edges



Frequency (MHz)	Polarity	Antenna Height (cm)	Corr. (dB)	MaxPeak (dBµV/m)	MaxPeak Limit (dBµV/m)	MaxPeak Margin (dB)	Average (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)
2380.000000	V	150.0	-4.4	39.6	74.0	-34.4	29.1	54	-24.9
2400.000000	V	150.0	-4.7	57.5	74.0	-16.5	45.9	54	-8.1
2402.000000	V	150.0	-4.7	87.0	114.0	-27.0	84.5	94	-9.5
2440.000000	V	150.0	-4.3	81.4	114.0	-32.6	79.3	94	-14.7
2480.000000	V	150.0	-4.3	80.6	114.0	-33.4	78.3	94	-15.7
2484.000000	V	150.0	-4.2	42.7	74.0	-31.3	23.3	54	-30.7
2490.000000	V	150.0	-4.2	35.3	74.0	-38.7	21.7	54	-32.3



9 VOLTAGE VARIATIONS, 15.31(e)

9.1 Procedure:

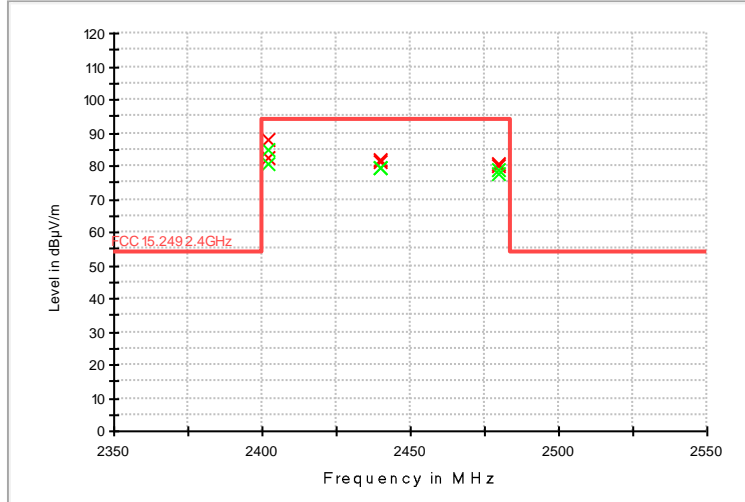
For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery-operated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

A nominal voltage of 12VDC was used and then 10.2VDC and 13.8VDC were used as the 85% and 115% variations.



9.2 Voltage Variations Test Data

Test Date(s):	Aug. 10, 2018	Test Engineer:	J. Chiller
Rule:	FCC PART 15.31(e)	Air Temperature:	22.7° C
Test Results:	Complies	Relative Humidity:	46%



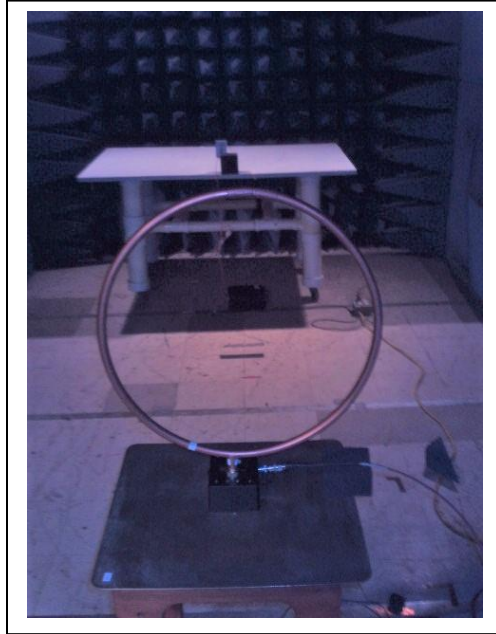
Frequency (MHz)	Polarity	Antenna Height (cm)	Azimuth (deg)	Corr. (dB)	Average (dBµV/m)	Voltage Variance (%)
2402.000000	V	150.0	140.0	-4.7	80.3	-15
2402.000000	V	150.0	140.0	-4.7	84.6	15
2440.000000	V	150.0	160.0	-4.3	79.1	-15
2440.000000	V	150.0	160.0	-4.3	79.6	15
2480.000000	V	150.0	168.0	-4.3	77.8	-15
2480.000000	V	150.0	168.0	-4.3	78.7	15

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.

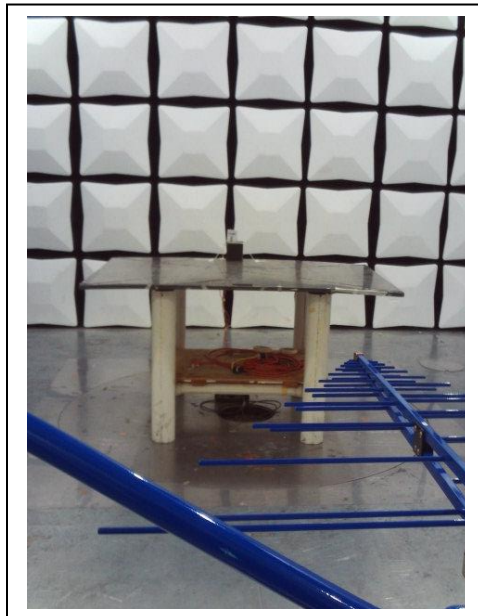


10 PHOTOGRAPHS

Radiated Emissions: Loop Antenna, 0.009 MHz to 30 MHz



Radiated Emissions: 30 MHz to 1000 MHz





Radiated Emissions Above 1 GHz, Occupied Bandwidth

