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TEST REPORT

Manufacturer: **Structured Mining Systems, Inc.**
 d.b.a. Cervis Inc.
 170 Thorn Hill Road
 Warrendale, Pennsylvania 15086
 United States of America

Applicant: **Same As Above**

Product: **Module**

Model: **MRF450**

FCC ID: **LOBMRF450**

Testing Commenced: **Aug. 20, 2018**

Testing Ended: **Aug. 24, 2018**

Summary of Test Results: **In Compliance**

Note: This test report reflects Field Strength Emissions and Spurious Emissions results for a PCII due to changes made by the manufacturer.

Standards:

❖ FCC CFR 47 - TELECOMMUNICATION

- **Part 90 – Private Land Mobile Radio Services**
- **Section 90.217 –Exemption from technical standards**
- **FCC Part 2 – Frequency Allocations and Radio Treat Matters; General Rules and Regulations**

❖ TIA/EIA 603 Rev. C (08-17-04) - Land Mobile FM or PM Communications Equipment Measurement and Performance Standards



Order Nos.: F2LQ5719, F2LQ5719-C4A

Client: Cervis Inc.

Model: MRF450

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 recommended FCC procedure of measurement of Private Land Mobile Radio Services under Sections 90.217, FCC sections 2.1046, 2.1049, 2.1051, 2.1053 and 2.1055 and in TIA/EIA 603. A list of the measurement equipment can be found in Section 5.

1.3 Uncertainty Budget:

Radiated Emission

- Combined Uncertainty (+ or -) 2.24 dB
- Expanded Uncertainty (+ or -) 4.48 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.4 Document History:

Document Number	Description	Issue Date	Approved By
F2LQ5719-08E	First Issue	Sept. 10, 2018	K. Littell



2 SUMMARY OF TEST RESULTS

Note: Only the following tests were performed to show continued compliance due to the minor changes made to the EUT since its Certification. This testing is for a Class II Permissive Change.

Test Name	Standard(s)	Results
RF Power Output	FCC Part 2.1046	Complies
Conducted Spurious Emission	FCC Part 2.1051	Complies
Field Strength of Spurious Radiation	FCC Part 2.1053	Complies

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



3 ENGINEERING STATEMENT

This report has been prepared on behalf of Cervis Inc. to provide documentation for the testing described herein. This equipment has been tested and found to comply with Part 90.217 of the FCC Rules using FCC Part 90, Part 2, and TIA/EIA 603 standards. The test results found in this test report relate only to the items tested.



4 EUT INFORMATION AND DATA

4.1 Equipment Under Test:

Product: Module

Model: MRF450

Serial No.: N/A

FCC ID: LOBMRF450

4.2 Trade Name:

Structured Mining Systems, Inc. d.b.a. Cervis Inc.

4.3 Power Supply: Battery Powered

4.4 Applicable Rules:

CFR 47, Part 90.217

CFR 47, Part 2

4.5 Equipment Category:

Module

4.6 Antenna:

0dBi Omni, Vertically polarized

4.7 Accessories:

N/A

4.8 Test Item Condition:

The equipment to be tested was received in good condition.

4.9 Testing Algorithm:

The EUT was configured to permit frequency changes from low-mid-upper transmission channel. For all tests, the EUT was equipped with a 0dBi Omni antenna.

**5 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
Temp/Hum. Recorder	CL233	Extech	445814	02	Mar. 22, 2019
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
Pre-Amplifier	CL153	Agilent	83006-69007	MY39500791	Mar. 26, 2019
Pre-Amplifier	CL136	Hewlett Packard	8447E	1937A01894	Mar. 26, 2019
Software:	EMC 32, Version 8.53.0 Software Verified: Aug. 20-24, 2018				



6 FCC PART 90.217, EXEMPTION FROM TECHNICAL STANDARDS

6.1 Requirements

Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 milliwatts are exempt from the technical requirements set out in this subpart, but must instead comply with the following:

For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

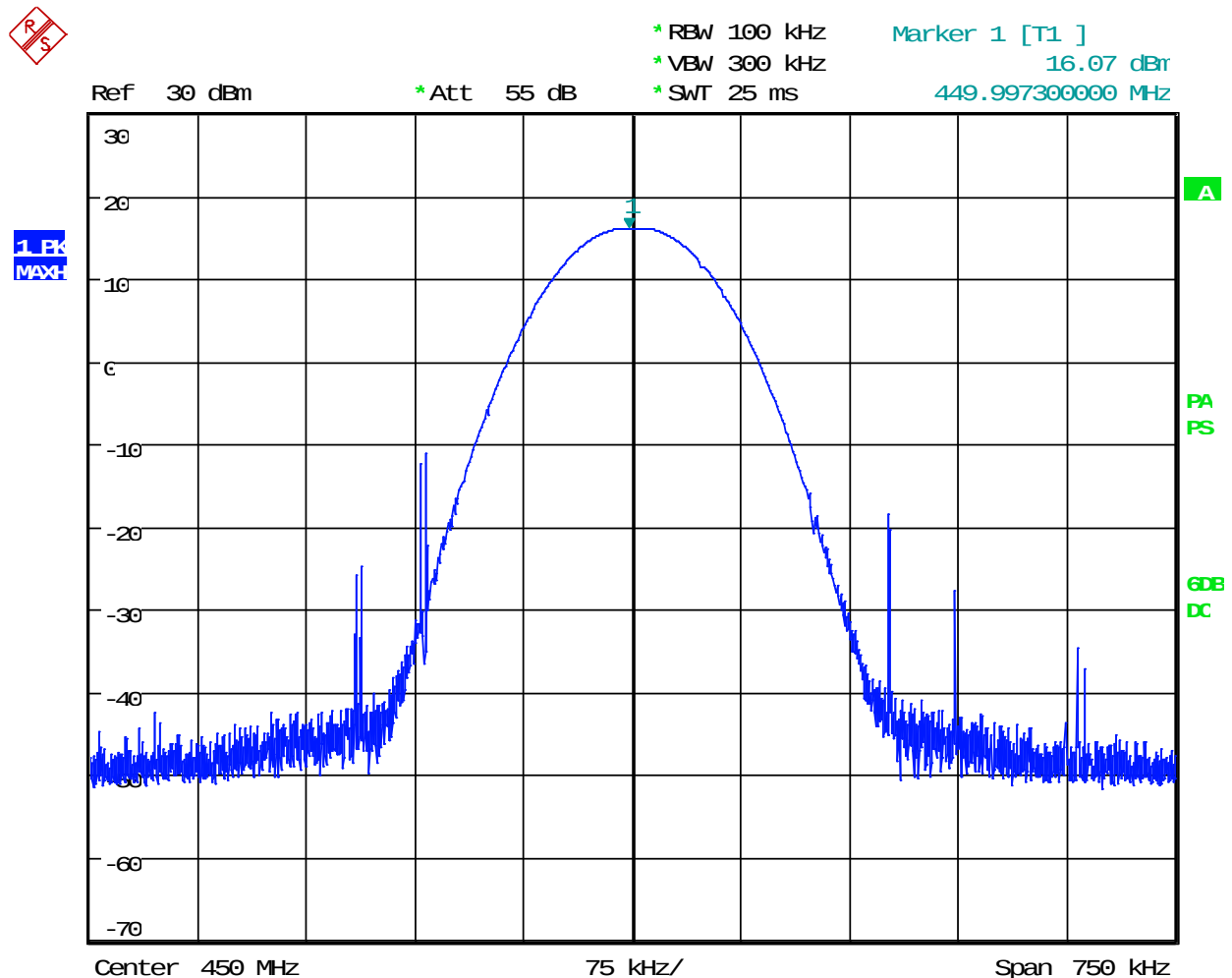


7 RF OUTPUT POWER

Test Date:	Aug. 20, 2018	Test Engineer:	J. Chiller
Standard:	FCC Part 2.1046	Air Temperature:	21.1°C
		Relative Humidity:	41%

There is a limit of 120mW (20.791dBm) for the output power. The graphs on pages 10-12 show the output power is below 20.78dBm.

Low Channel





Mid Channel



* RBW 100 kHz

Marker 1 [T1]

* VBW 300 kHz

16.01 dBm

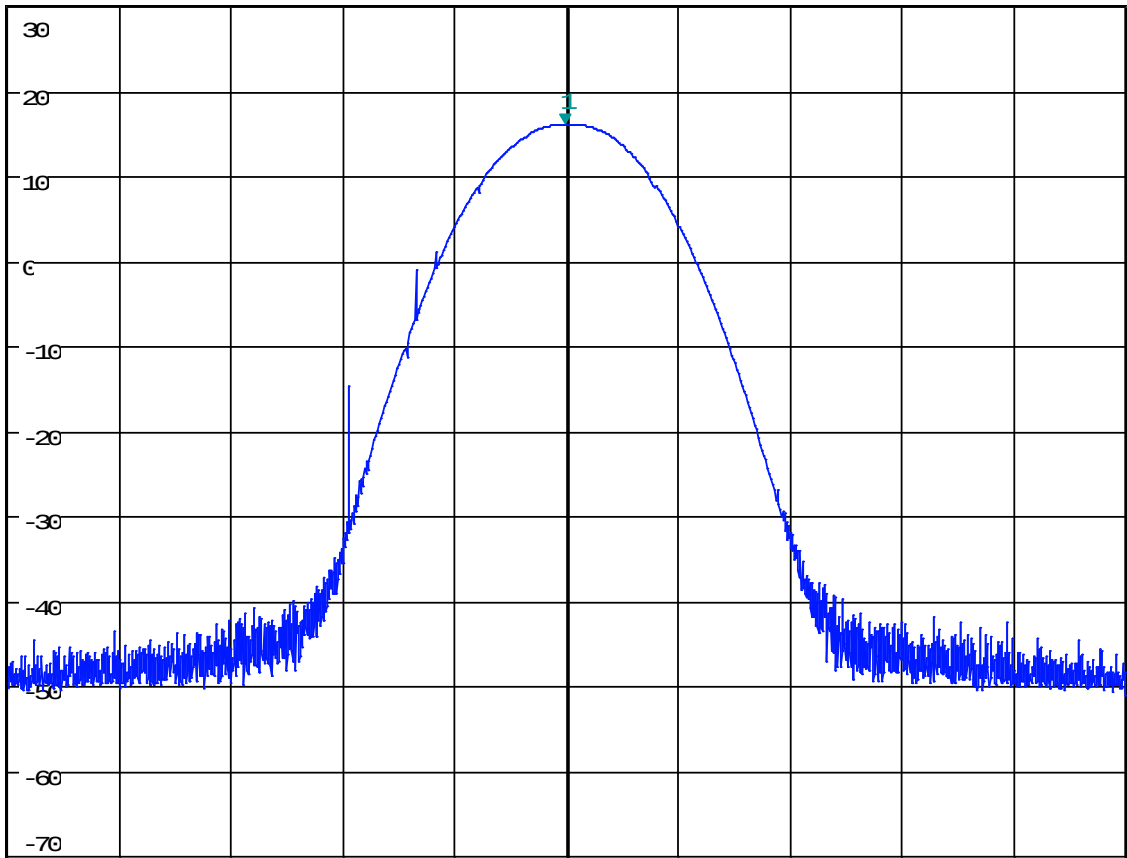
* SWT 25 ms

459.998950000 MHz

Ref 30 dBm

* Att 55 dB

1 PK
MAX



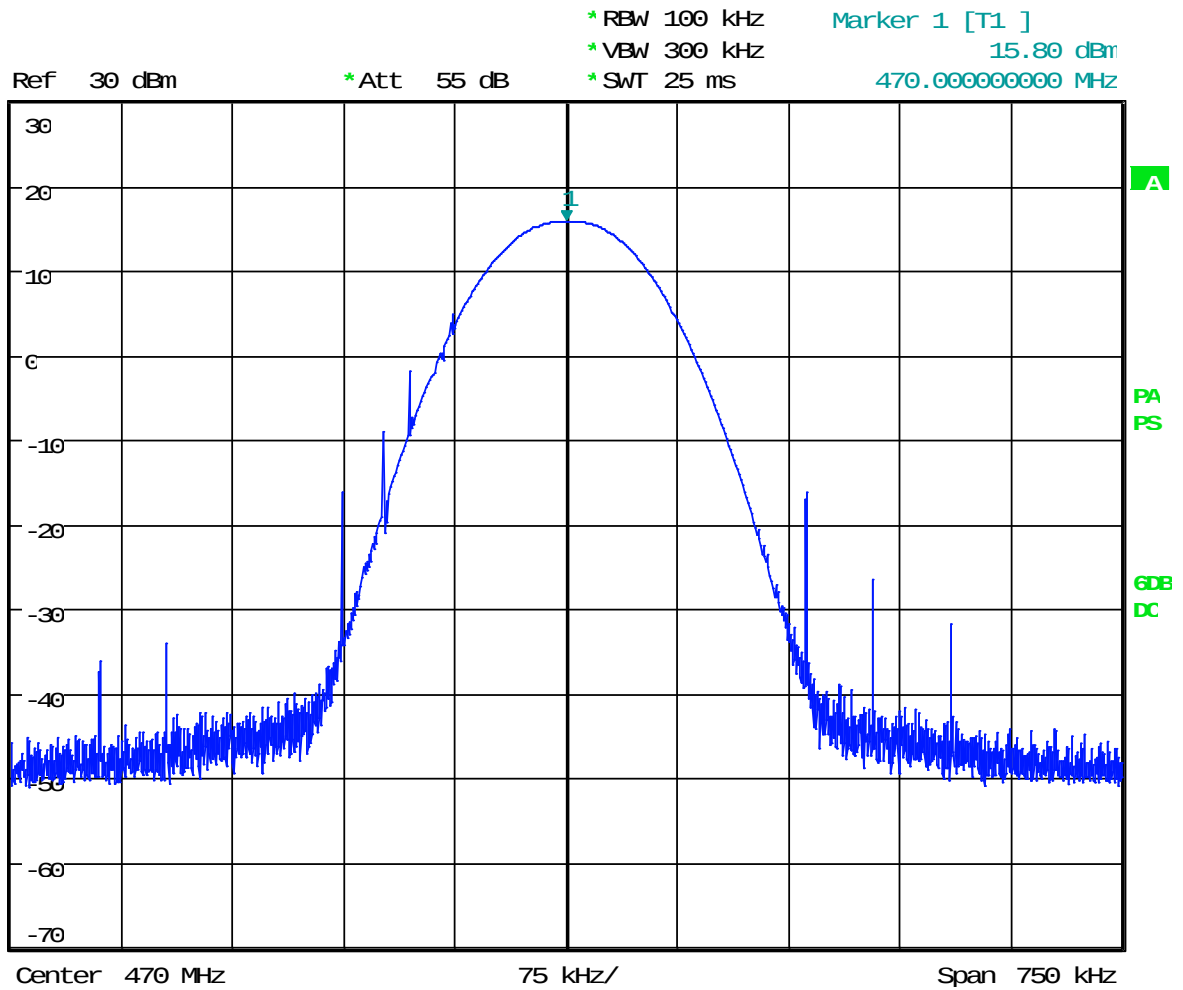
Center 460 MHz

75 kHz/

Span 750 kHz



High Channel

1.8k
MAX

RESULTS: Output power is lower than the previous Certification.

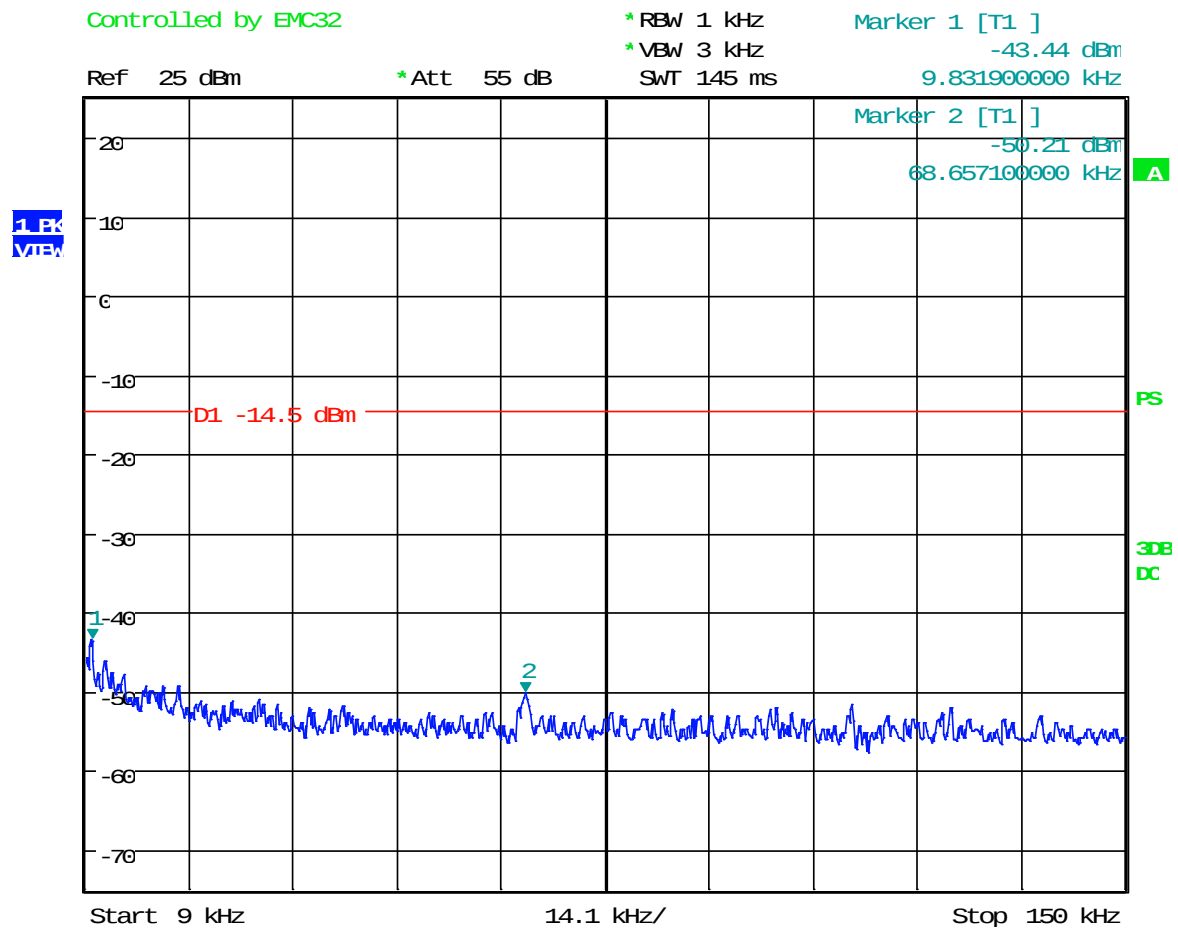
Low Channel (450 MHz)	Mid Channel (460 MHz)	High Channel (470 MHz)
16.07dBm, (40.45mW)	16.01dBm, (39.9mW)	15.80dBm, (38.01mW)



8 CONDUCTED SPURIOUS EMISSION

Test Date:	Aug. 22, 2018	Test Engineer:	J. Chiller
Standard:	FCC Part 2.1051	Air Temperature:	23.2°C
		Relative Humidity:	41%

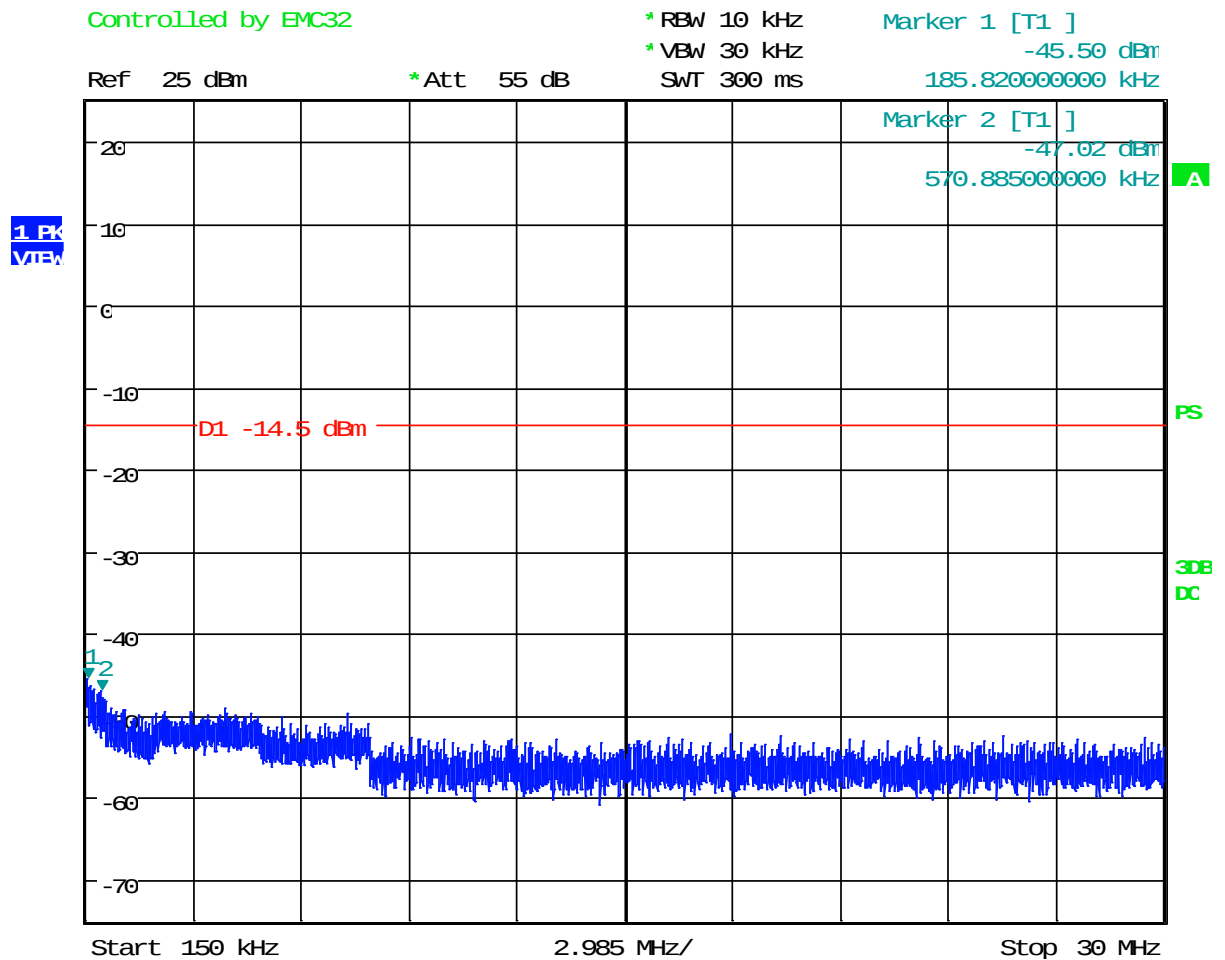
Low Channel, Characterization Scan: 0.009 MHz to 0.15 MHz



Date: 22.AUG.2018 14:47:37



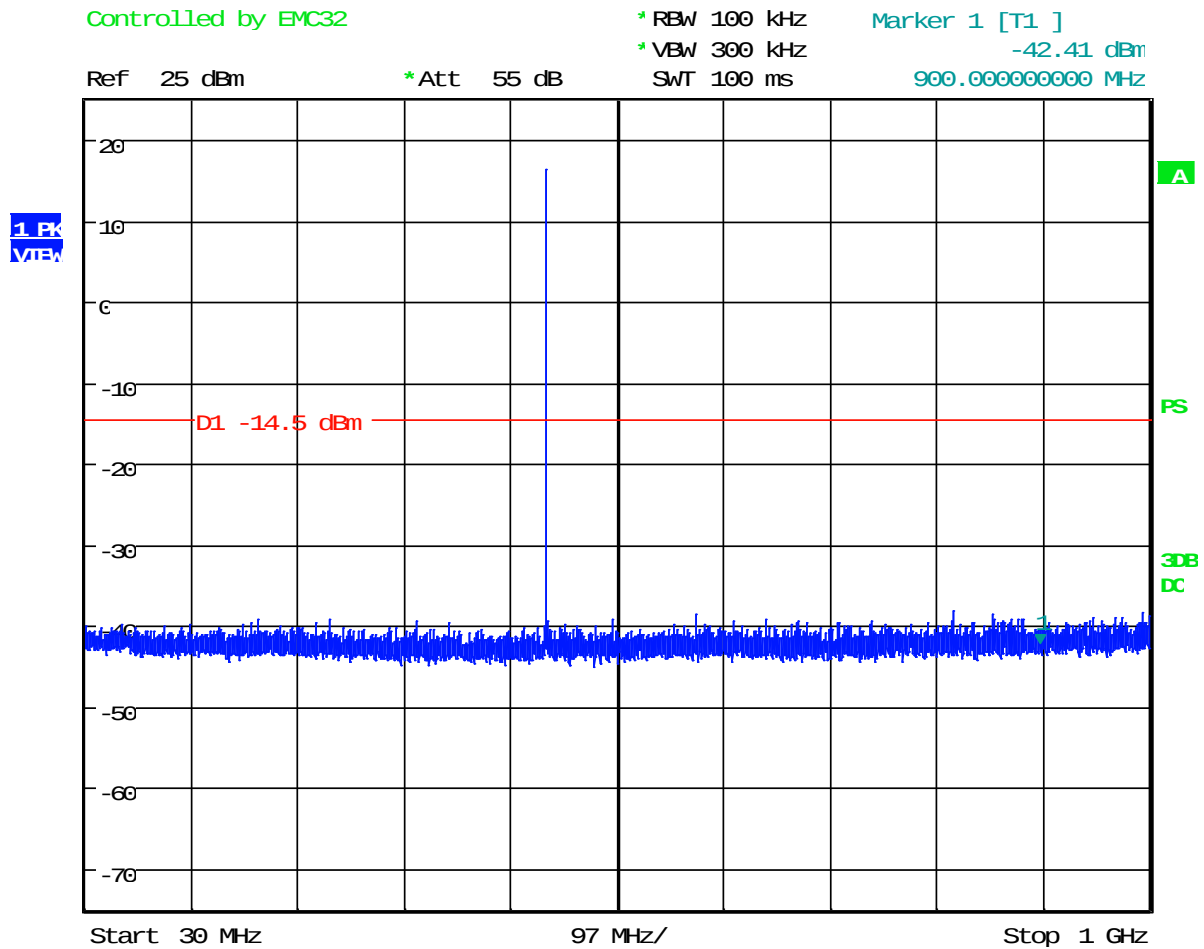
Low Channel, Characterization Scan: 0.15 MHz to 30 MHz



Date: 22.AUG.2018 14:49:02



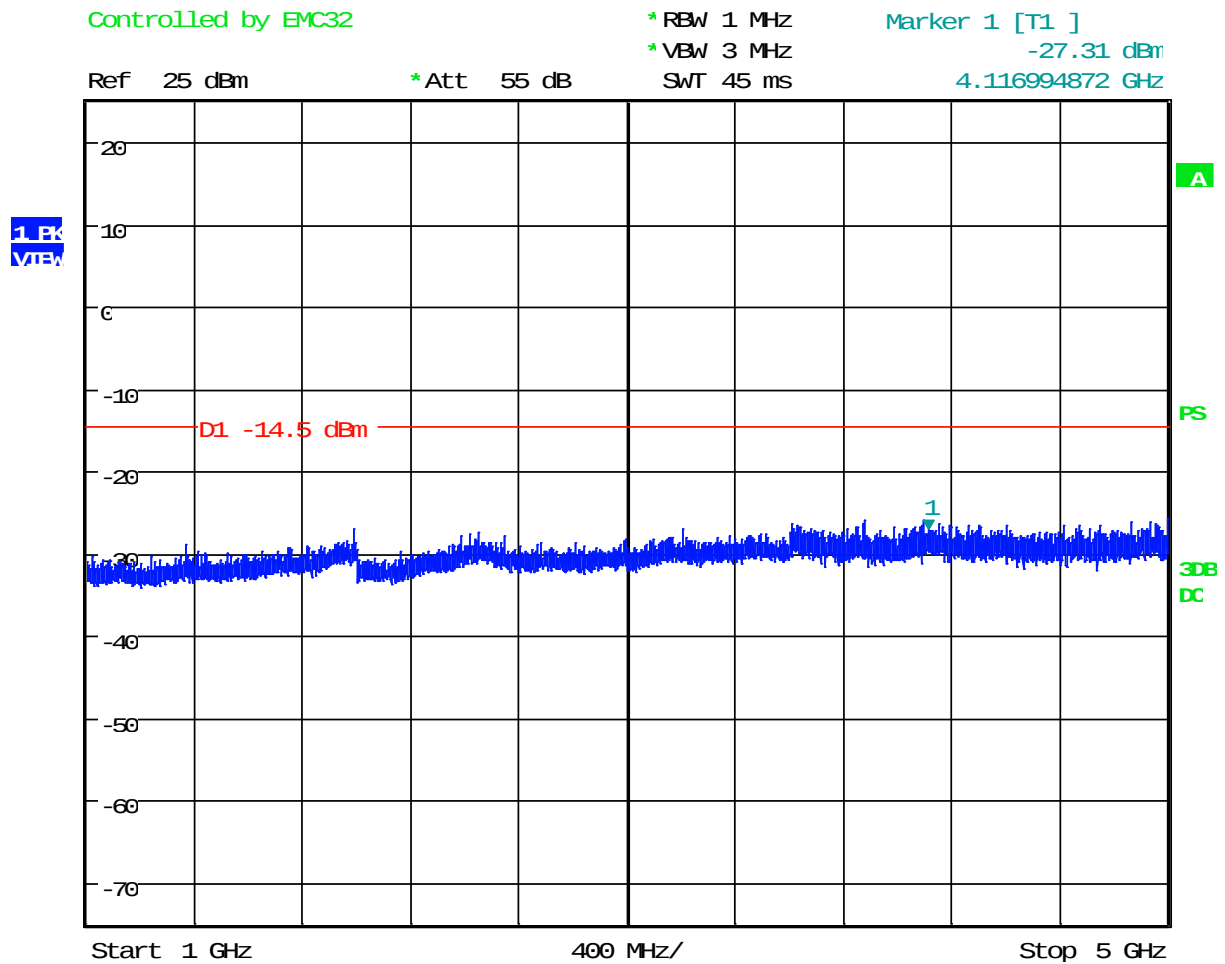
Low Channel, Characterization Scan: 30 MHz to 1000 MHz



Date: 22.AUG.2018 14:56:02



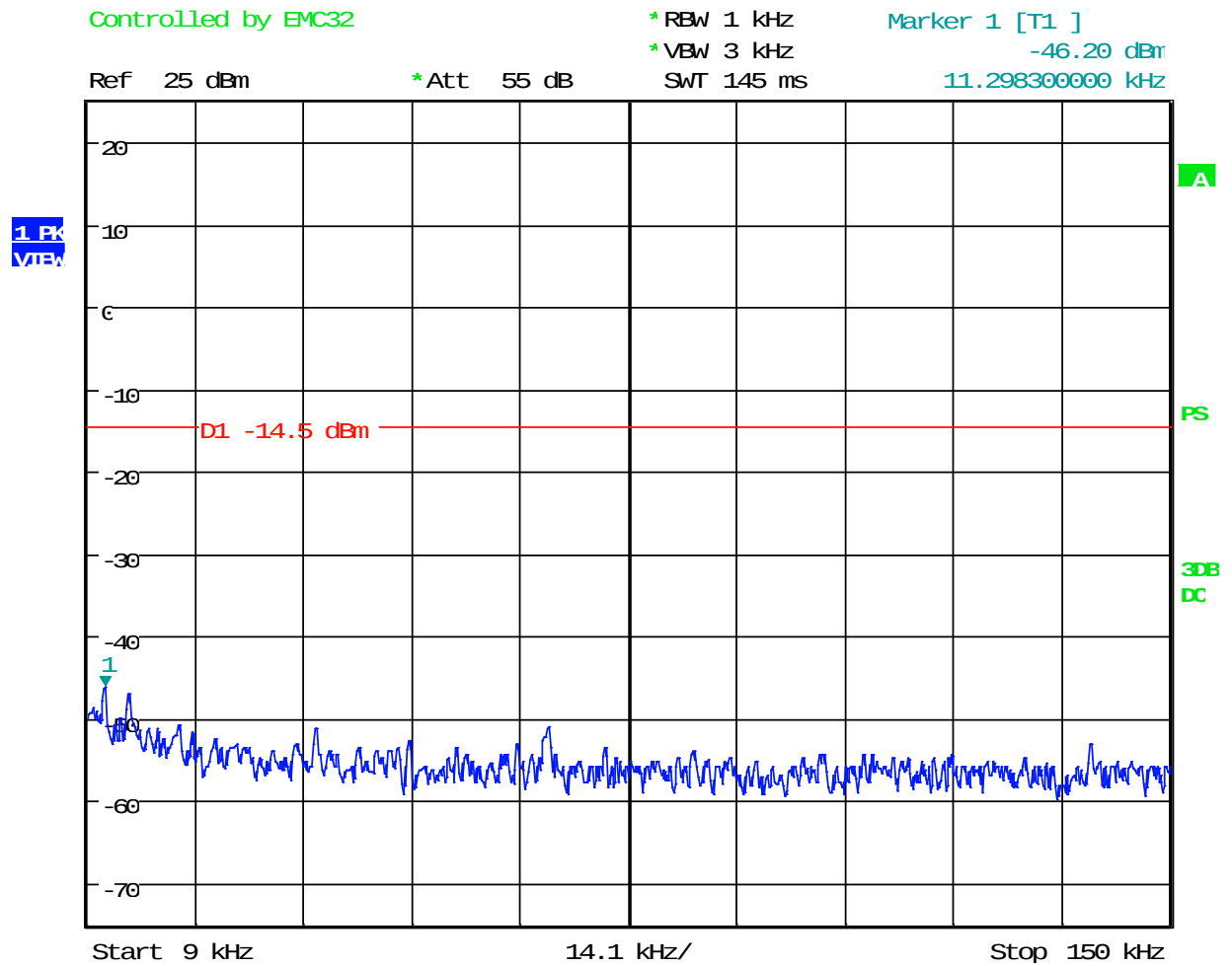
Low Channel, Characterization Scan: 1 GHz to 5 GHz



Date: 22.AUG.2018 14:57:21



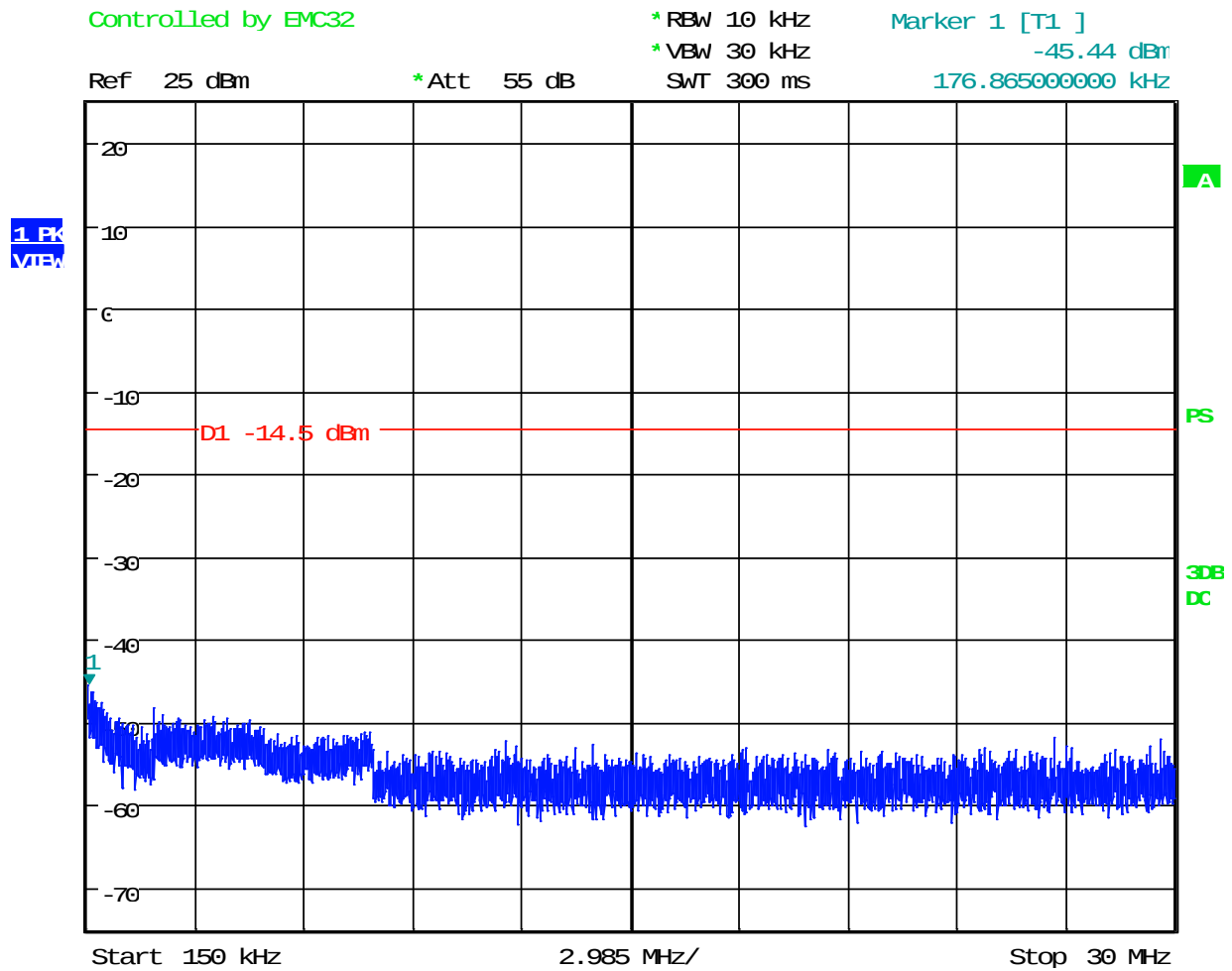
Mid Channel, Characterization Scan: 0.009 MHz to 0.15 MHz



Date: 22.AUG.2018 15:07:45



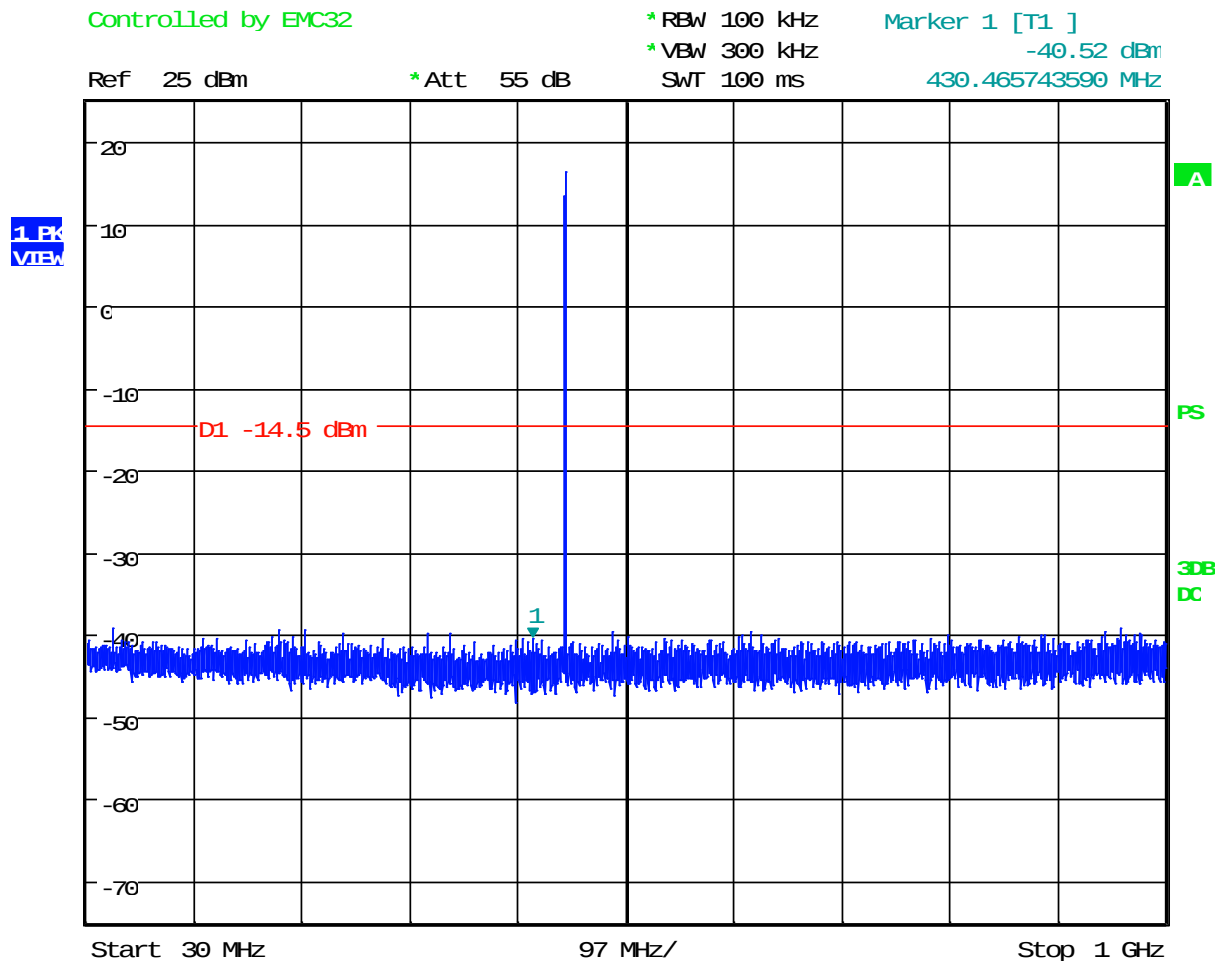
Mid Channel, Characterization Scan: 0.15 MHz to 30 MHz



Date: 22.AUG.2018 15:04:34



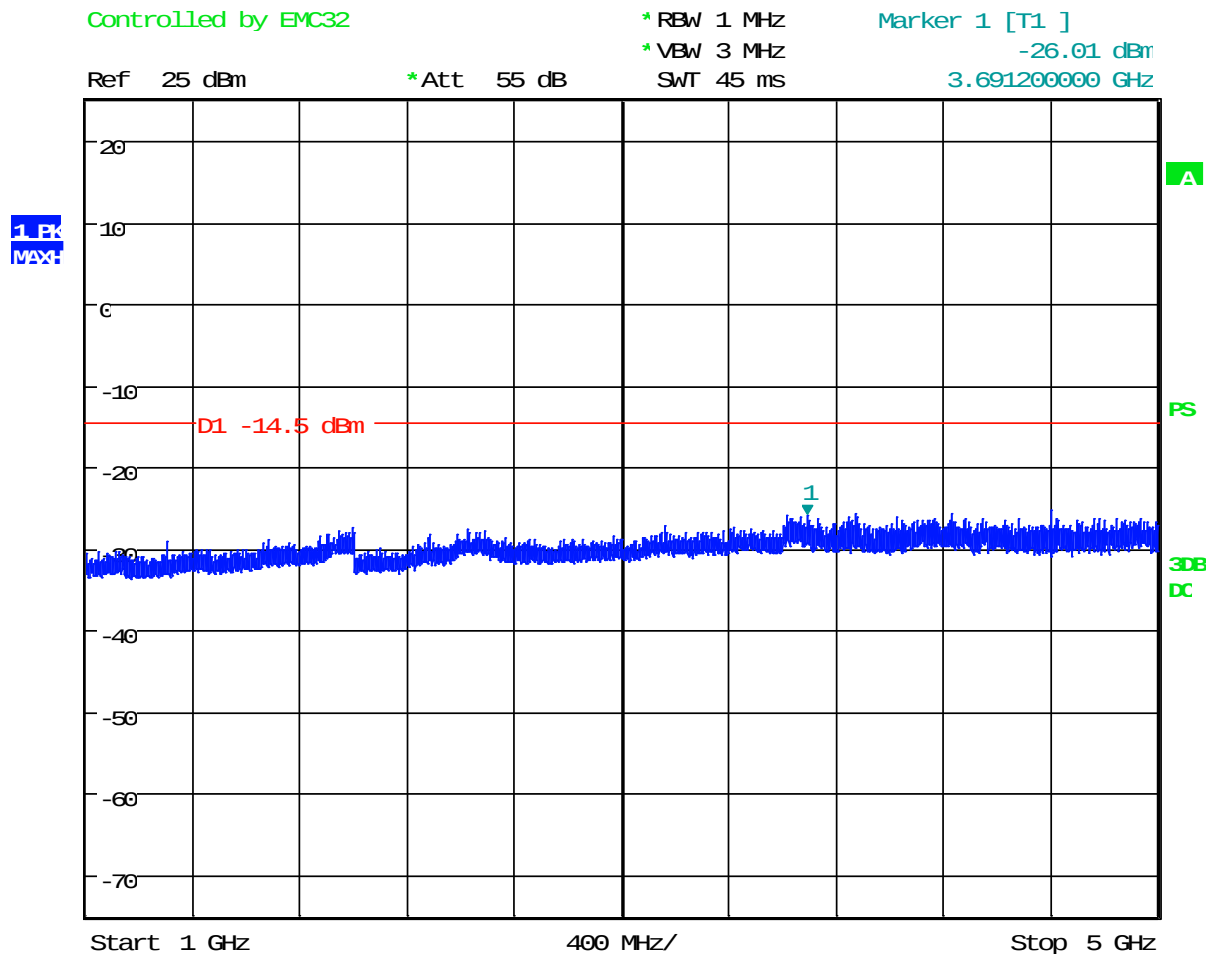
Mid Channel, Characterization Scan: 30 MHz to 1000 MHz



Date: 22.AUG.2018 15:03:16



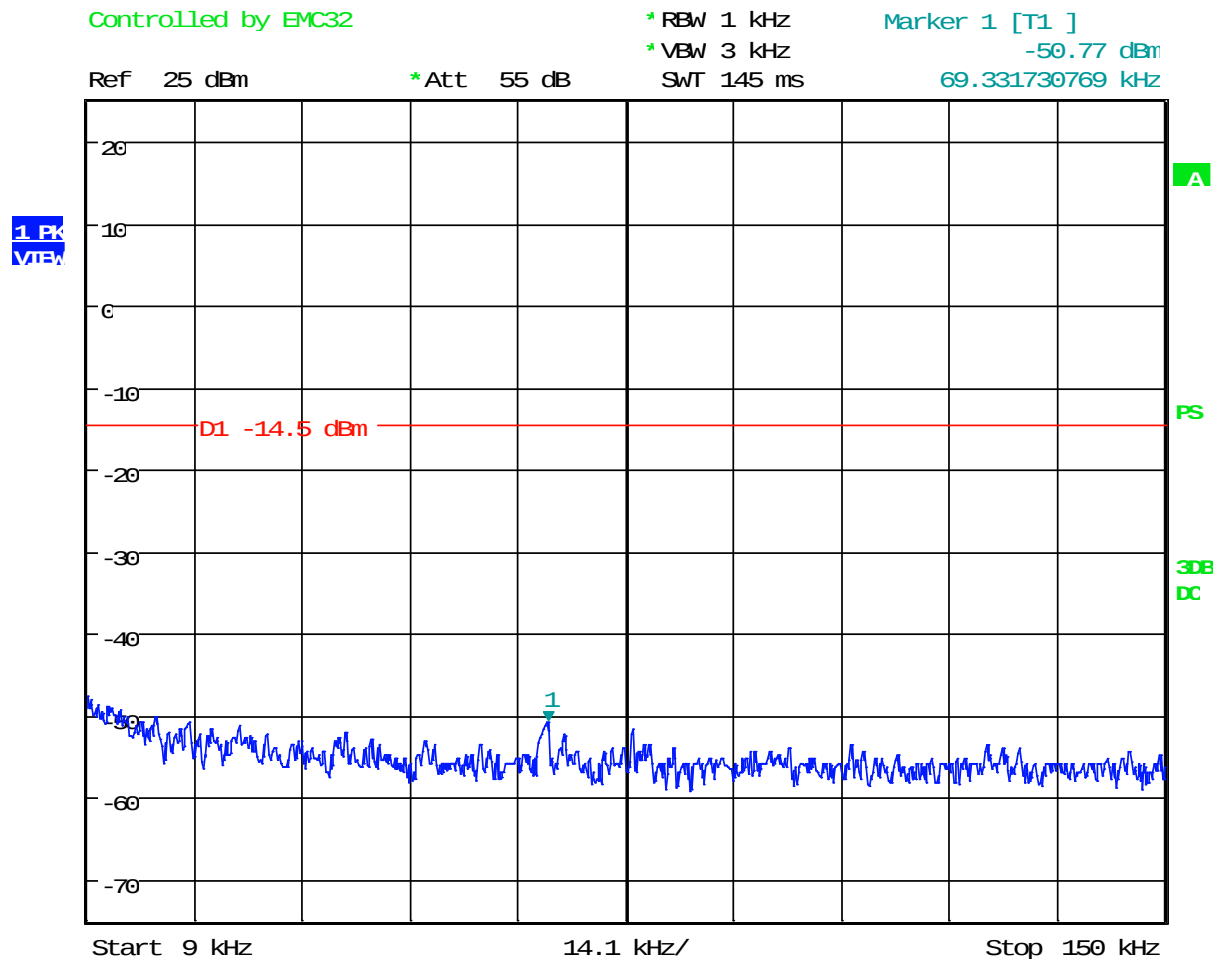
Mid Channel, Characterization Scan: 1 GHz to 5 GHz



Date: 22.AUG.2018 14:58:14



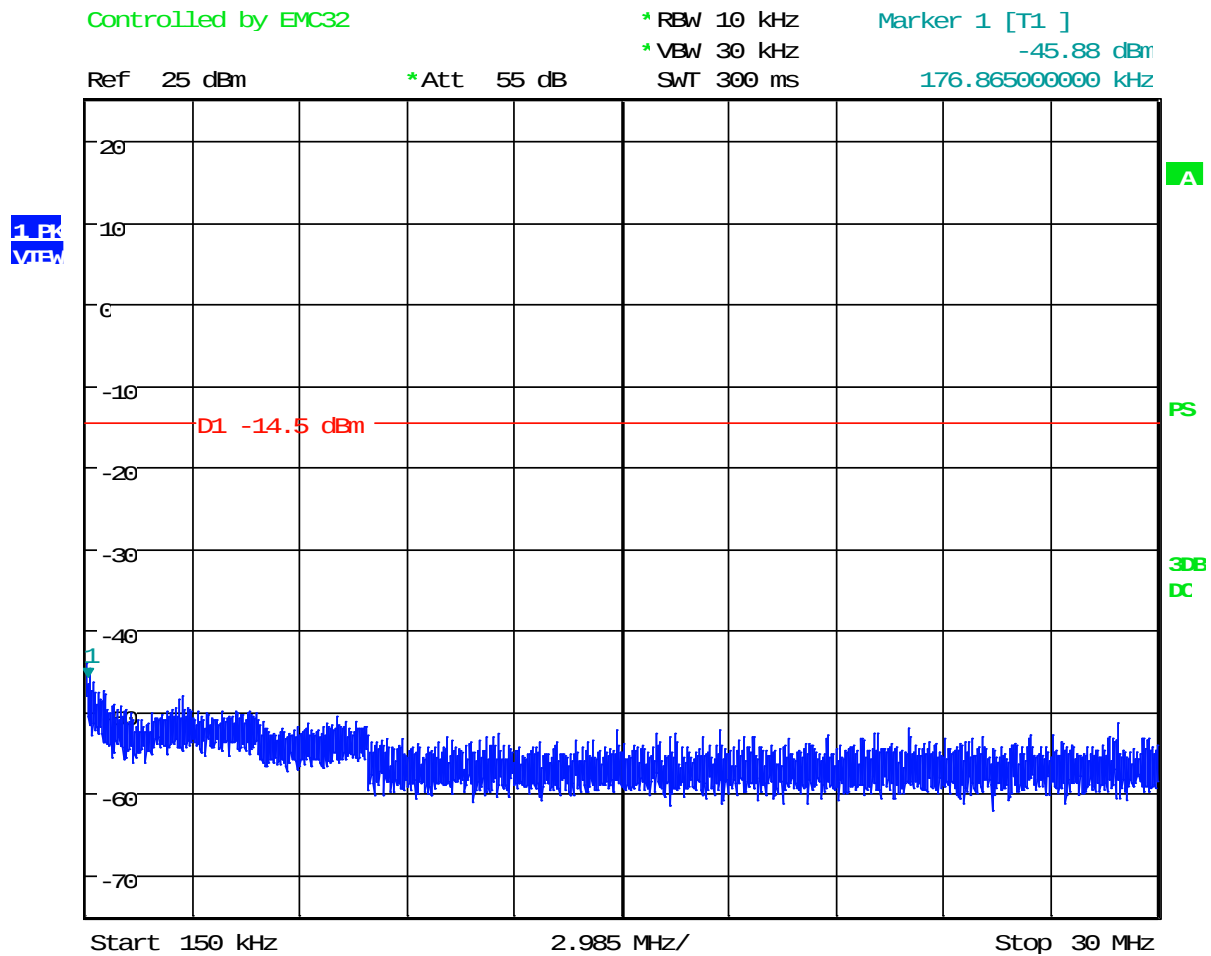
High Channel, Characterization Scan: 0.009 MHz to 0.15 MHz



Date: 22.AUG.2018 15:06:45



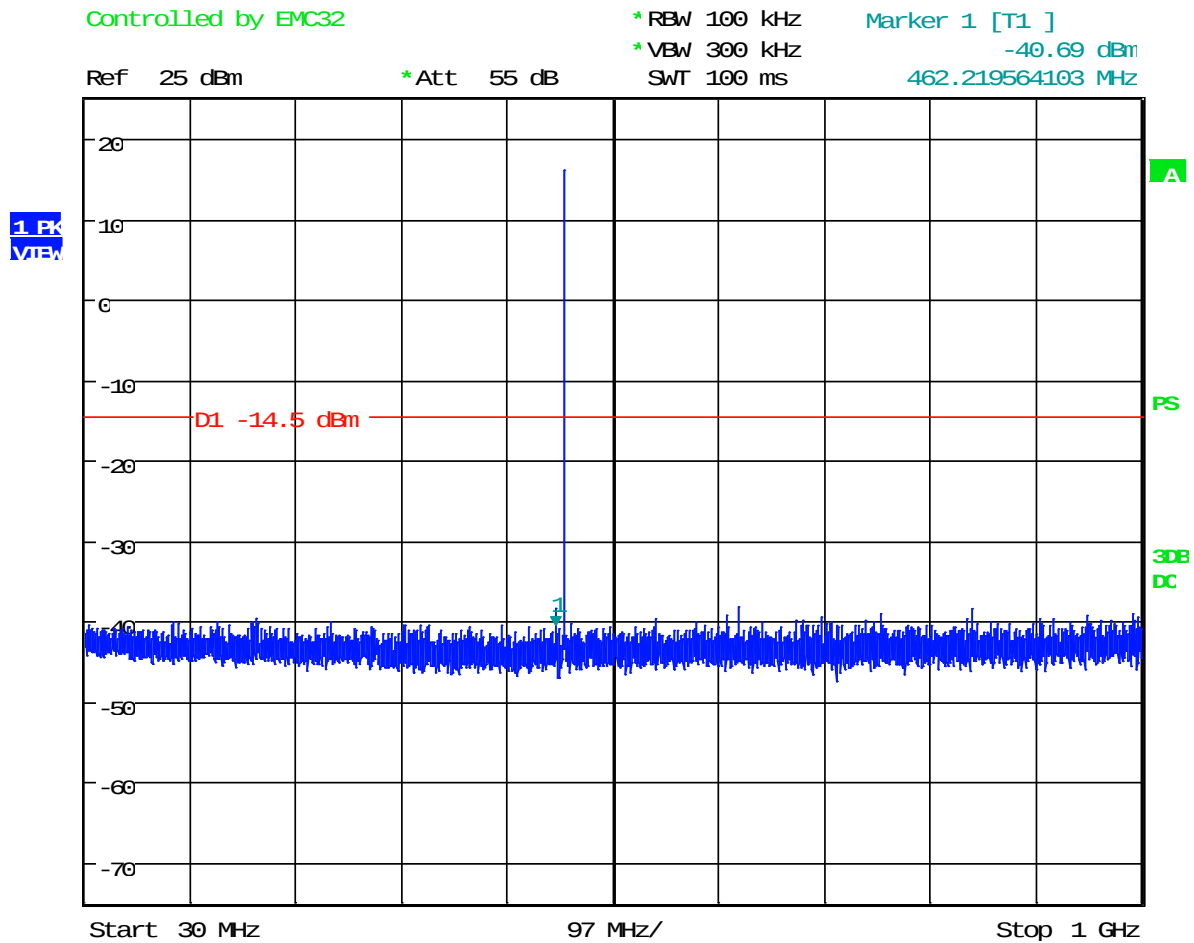
High Channel, Characterization Scan: 0.15 MHz to 30 MHz



Date: 22.AUG.2018 15:05:30



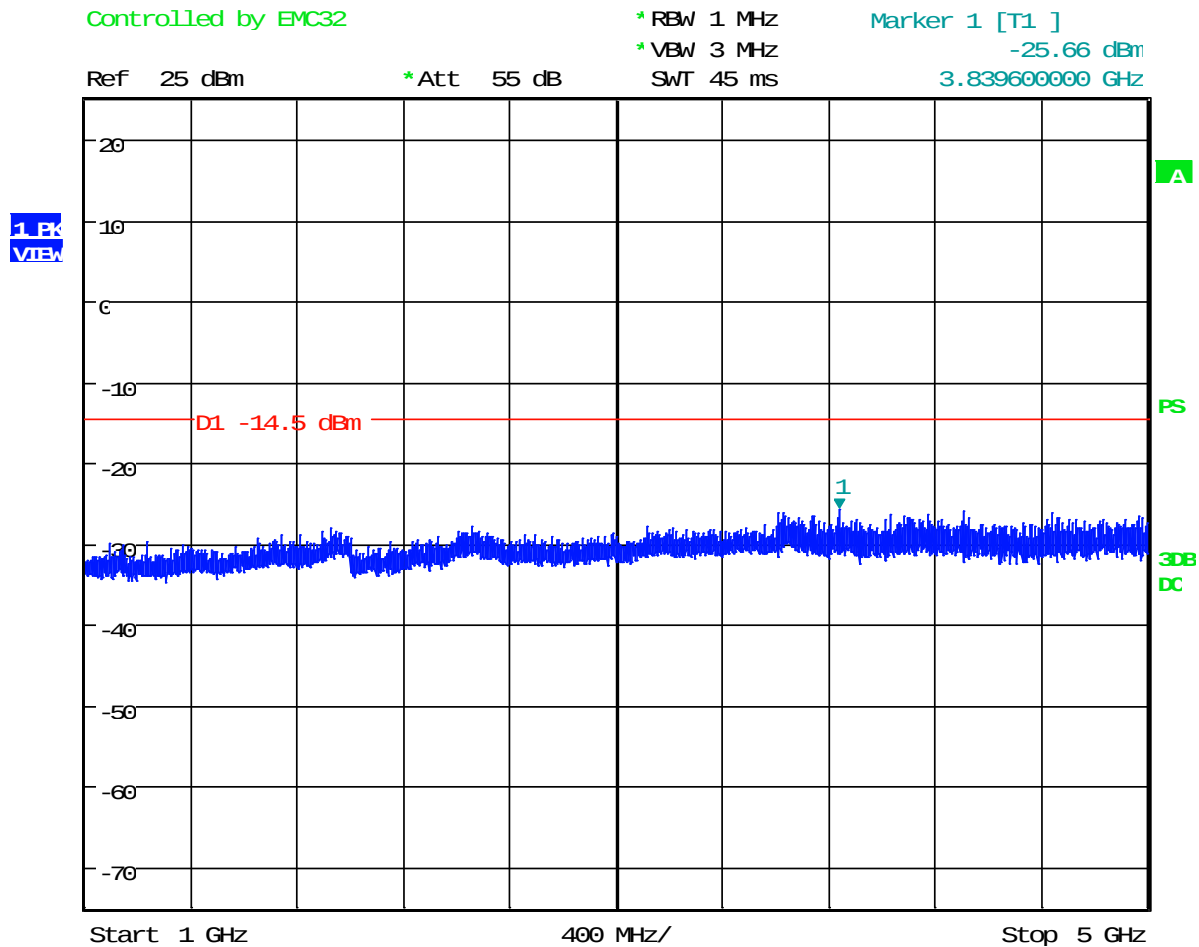
High Channel, Characterization Scan: 30 MHz to 1000 MHz



Date: 22.AUG.2018 15:01:55



High Channel, Characterization Scan: 1 GHz to 5 GHz



Date: 22.AUG.2018 14:58:55



9 FCC PART 2.1053- FIELD STRENGTH OF SPURIOUS RADIATION

9.1 Test Procedure:

The equipment was fully exercised with all cabling attached to the EUT and was positioned for maximum emissions. The EUT antenna was positioned flat against the plastic tabletop and it was verified by placing a foam support between the table and the antenna, that the table had no effect on the emissions at these frequency ranges.

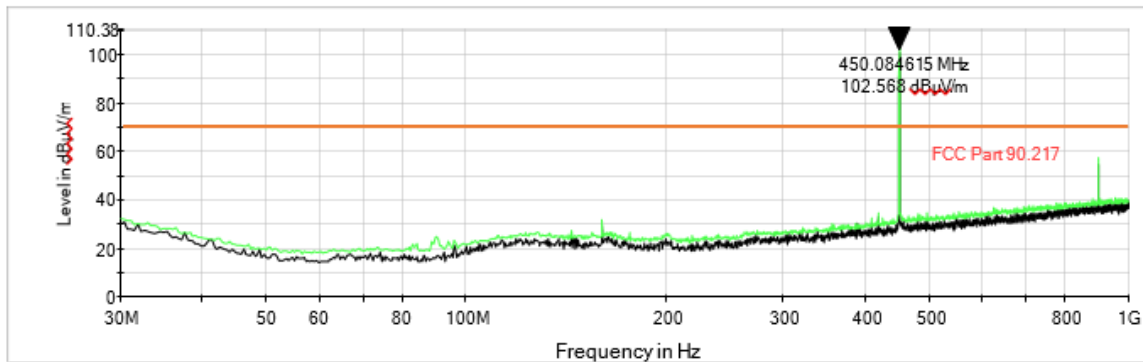
While the equipment was energized, the receiving antenna was scanned from 1.0 meter to 4.0 meters in both vertical and horizontal polarities while the turntable was adjusted 360 degrees to determine the maximum field strength.

Spurious emissions were scanned on the Low, Mid, and High channels, and then measured and recorded on the low channel which was determined the worst-case Spurious Emissions between the Low, Mid, and High channels.

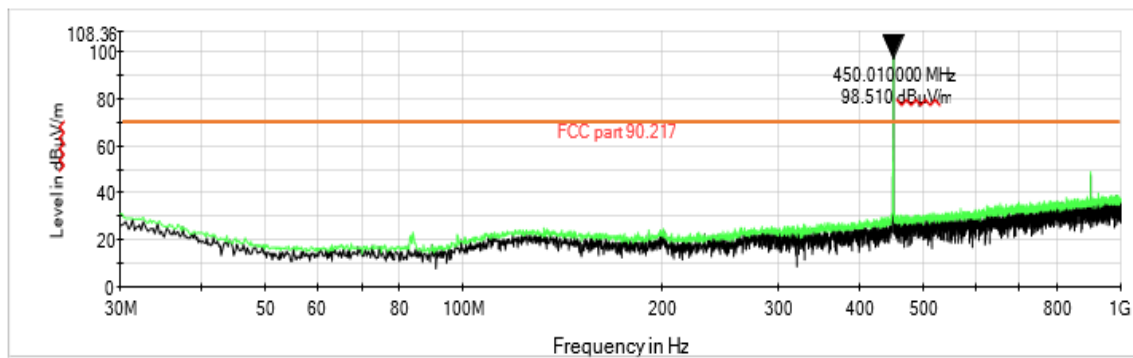
The following graphs are scans and the limit lines are used for reference only and not to show compliance. The actual limits are listed in the data table. The limit was reached by the power being 15.8dBm and the requirement is that the spurious emissions be 30dB down. That makes the limit -14.2dBm. Using the correction formula from ANSI C63.26 section 5.2.7 of $E \text{ (dB}\mu\text{V/m)} = \text{EIRP (dBm)} - 20\log(D) + 104.8$; the limit in dBuV/m would be 81.1.



Low Channel (worst-case) - Pre-scan, Vertical

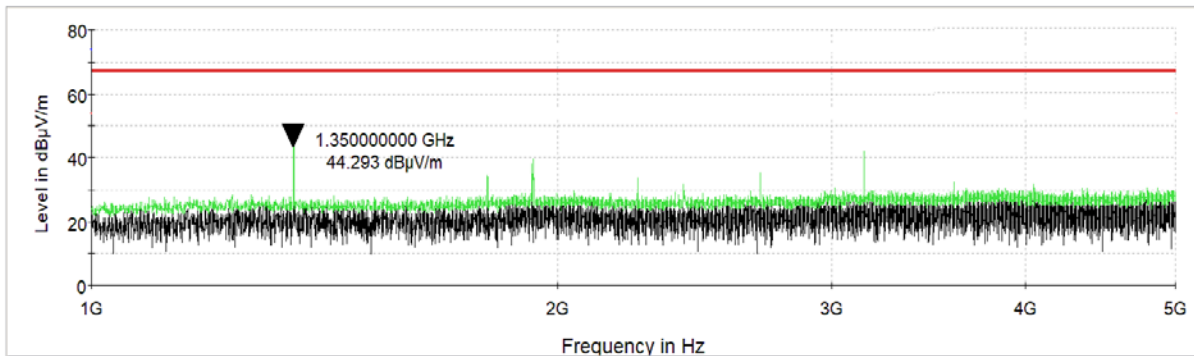


Low Channel (worst-case) - Pre-scan, Horizontal

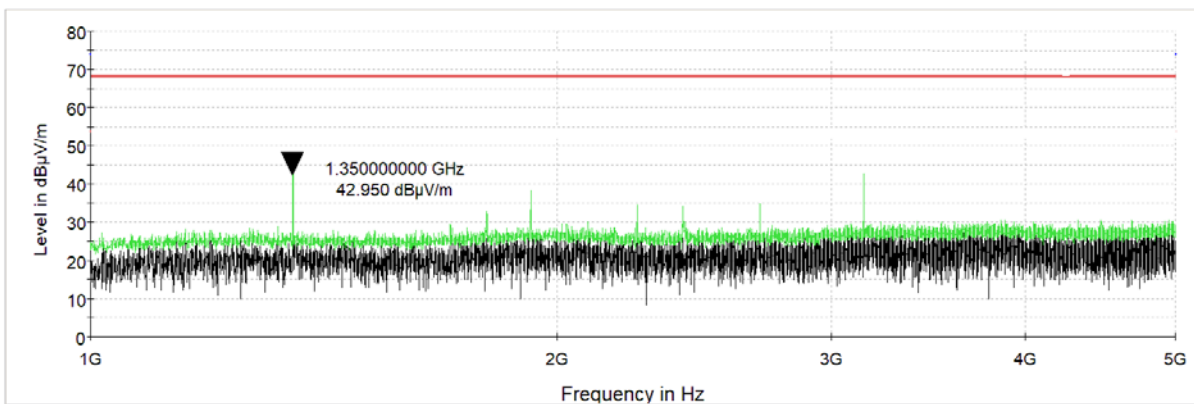




Low Channel (worst-case) - PCB, Characterization Scan: 1 GHz to 5 GHz, Vertical



Low Channel (worst-case) - PCB, Characterization Scan: 1 GHz to 5 GHz, Horizontal



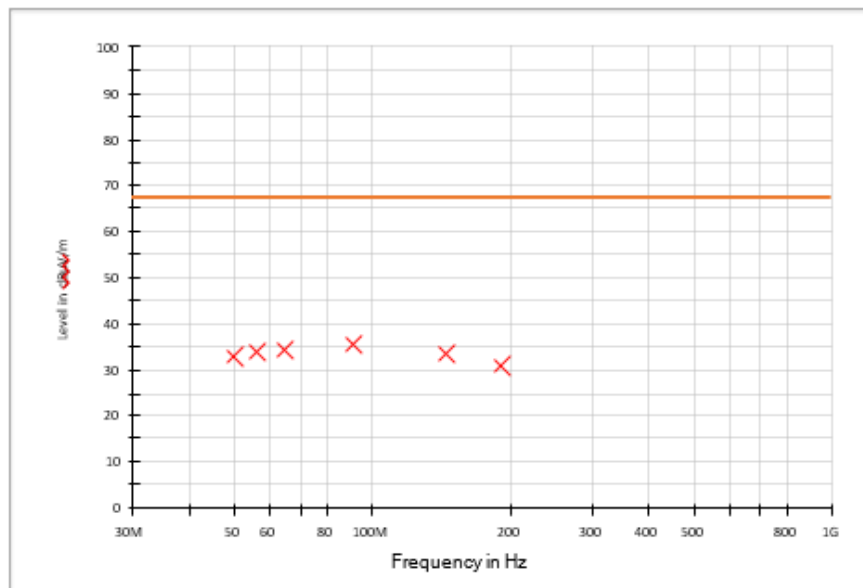


9.2 Test Data

Test Date(s):	Aug. 24, 2018	Test Engineer:	J. Chiller
Standard:	FCC Part 2.1053	Air Temperature:	23.1°C
		Humidity:	42%

Low Channel (worst-case), 30 MHz to 1000 MHz

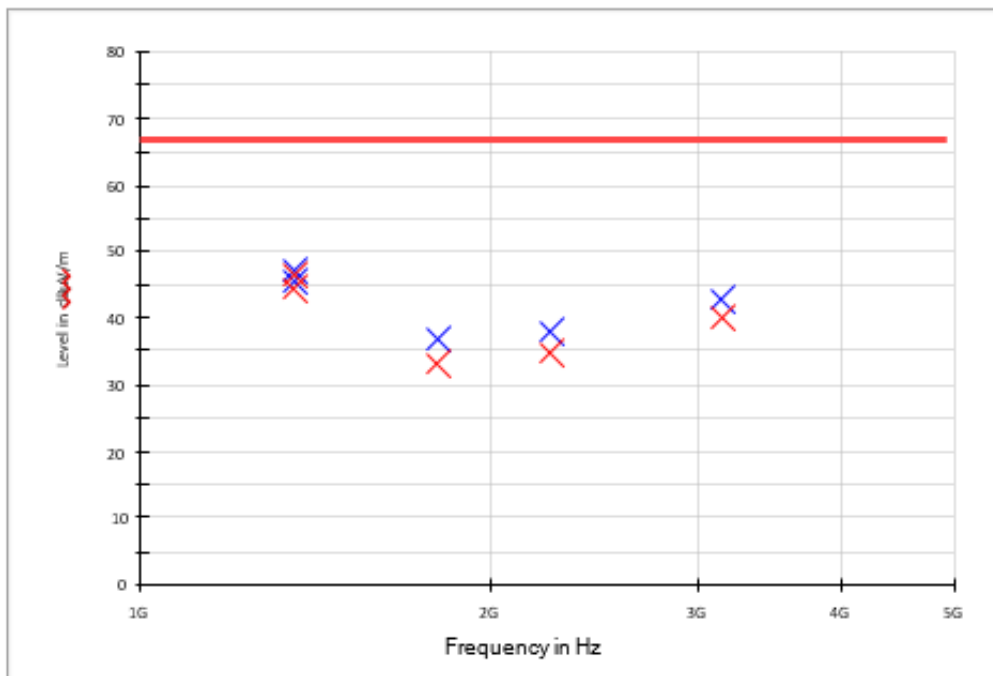
Frequency (MHz)	Antenna Polarization	Average (dB μ V/m)	Correction Factors (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
49.950000	V	33.0	-7.6	25.40	81.1	-55.7
55.440000	H	33.7	-8.5	25.20	81.1	-55.9
64.180000	H	34.2	-8.1	26.10	81.1	-55.0
90.330000	V	35.2	-7.8	27.40	81.1	-53.7
143.970000	V	33.6	-2.1	31.50	81.1	-49.6
190.140000	H	30.80	-3.1	27.70	81.1	-53.4





Low Channel (worst-case), 1 GHz to 5 GHz - Average

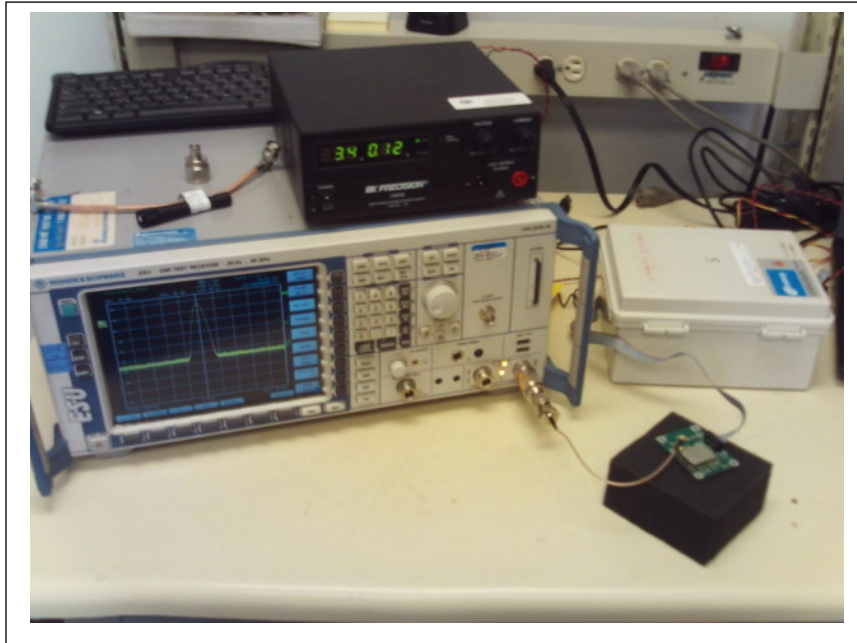
Frequency (MHz)	Antenna Polarization	Average (dB μ V/m)	Correction Factors (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1350.000000	V	50.5	-6.1	44.40	81.1	-36.7
1350.000000	H	52.4	-6.1	46.30	81.1	-34.8
1800.000000	H	38.3	-5.2	33.10	81.1	-48.0
2250.000000	H	39.7	-4.8	34.90	81.1	-46.2
3150.000000	H	43.1	-3.3	39.80	81.1	-41.3



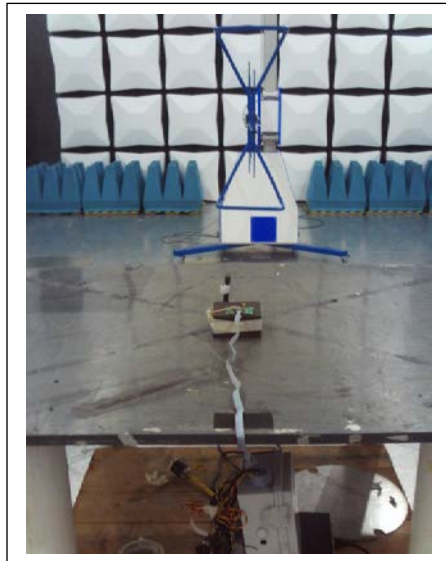


10 PHOTOGRAPHS

Conducted Spurious Emissions



Radiated Spurious Emissions, Less than 1 GHz; Field Strength



Radiated Spurious Emissions, Greater than 1 GHz

