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CERTIFICATION TEST REPORT

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

Applicant: **Same as Above**

Product Name: **Radio Module**

Product Description: RT module SRF310 is a PCB assembly ready to be attached to a host application. Host application firmware running on the host microcontroller controls the usage of the RF capabilities supported by the RF transceiver IC in the RT module, including: operational state (on, off, sleep, TX, RX), TX frequency, TX modulation type, TX data and X RF power. The RT module will not generate a TX signal until the host application has properly configured the RF transceiver IC. Certain aspects of the RF IC operation are built into its silicon design, while others are configurable via digital registers. All circuits that pertain to RF signal generation and modulation are isolated from the host application via digital registers. TX settings such as RF frequency and TX power are controlled by settings saved in the non-volatile memory (EE) of the host application and are factory-configured or auto-configured by firmware in the field. Design of the host application firmware ensures that only approved operation occurs. The equipment operator cannot enter TX settings that would result in improper operation. The SRF310 RT module may be implemented with or without additional PCB components that are not related RF circuits, provided that the implementation of the RF section of the RT module is not compromised, and the variant is still a proper RT module. Any changes that are Class 2 permissive will undergo RF testing to prove that the RT module operation has not changed with regards to RF emissions.

Model: **SRF310**

FCC ID: **LOBSRF310**



Testing Commenced: Oct. 3, 2016

Testing Ended: Oct. 20, 2016

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. 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 15.247**
- **ANSI C63.10:2013**

Evaluation Conducted by:

Joe Knepper, EMC Proj. Eng.

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 of DTS operating under Section 15.247 and in KDB558074. 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. Note: Only measurements listed below which relate to tests included in this Test Report are applicable to it.

Measurement Range	Expanded Uncertainty	Combined Uncertainty
Radiated Emissions <1 GHz @ 3m	$\pm 5.07\text{dB}$	± 2.54
Radiated Emissions <1 GHz @10m	$\pm 5.09\text{dB}$	± 2.55
Radiated Emissions 1 GHz to 2.7 GHz	$\pm 3.62\text{dB}$	± 1.81
Radiated Emissions 2.7 GHz to 18 GHz	$\pm 3.10\text{dB}$	± 1.55
AC Power Line Conducted Emissions, 150kHz to 30 MHz	$\pm 2.76\text{dB}$	± 1.38

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
F2LQ7361-C3A-02E	First Issue	Oct. 27, 2016	K. Littell

**2 SUMMARY OF TEST RESULTS**

Test Name	Standard(s)	Results
99% Occupied Bandwidth	CFR 47 Part 15.247(a)(2) / KDB558074	Complies
Conducted Output Power	CFR 47 Part 15.247(b)(3) / KDB558074	Complies
Conducted Spurious Emissions	CFR 47 Part 15.247(d) / Part 15.207 / KDB558074	Complies
Radiated Spurious Emission with 2dBi External Antenna and Integral Antenna	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies
Peak Power Spectral Density	CFR 47 Part 15.247(e) / KDB558074	Complies

Note: Product was operated using C batteries.
Requirements of 15.31 were met by using new batteries.

Modifications Made to the Equipment
None



3 TABLE OF MEASURED RESULTS

Test	Low Channel 904 MHz	Mid Channel 914 MHz	High Channel 926 MHz
Conducted Output Power	161.06mW (22.07dBm)	151.01mW (21.79dBm)	133.05mW (21.24dBm)
Conducted Output Power Limit	1 Watt, (30dBm)	1 Watt, (30dBm)	1 Watt, (30dBm)
E.I.R.P. with 2dBi Whip Antenna	255.27mW (24.07dBm)	239.33mW (23.79dBm)	210.86mW (23.24dBm)
E.I.R.P. with 1.4dBi Integral Antenna	222.33mW (23.47dBm)	208.45mW (23.19dBm)	183.65mW (22.64dBm)
E.I.R.P. Limit	4 Watts, (36.02dBm)	4 Watts, (36.02dBm)	4 Watts, (36.02dBm)
Peak Power Spectral Density	7.12dBm	6.87dBm	6.56dBm
Peak Power Spectral Density Limit	8 dBm	8 dBm	8 dBm
-6dB Occupied Bandwidth	0.6923 MHz	0.7259 MHz	0.68108 MHz
-6dB Occupied Bandwidth Limit	≥ 500KHz	≥ 500KHz	≥ 500KHz



4 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 15.247 of the FCC Rules using ANSI C63.10:2013 and KDB558074 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: Radio Module

Model: SRF310

Serial No.: None Specified

FCC ID: LOBSRF310

5.2 Trade Name:

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

5.3 Power Supply:

C Batteries

5.4 Applicable Rules:

CFR 47, Part 15.247, subpart C

5.5 Equipment Category:

Radio Transmitter-DTS

5.6 Antenna:

2dBi External Whip

1.4 dBi Integral Antenna

5.7 Accessories:

N/A

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 testing manner, powered by new batteries. EUT transmitted at low (904 MHz), mid (914 MHz) and High (926 MHz) channels at power setting "07." The highest emissions were recorded in the data tables.

**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	May 12, 2017
Temp/Hum. Recorder	CL137	Extech	RH520	CH16992	June 3, 2017
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Nov. 25, 2016
Pre-amplifier	CL153	Keysight Tech.	83006A	MY39500791	June 6, 2017
Horn Antenna	CL098	Emco	3115	9809-5580	Dec. 10, 2016
Amplifier w/Monopole & 18" Loop	CL163	A.H. Systems, Inc.	EHA-52B	100	May 2, 2017
Software:	Tile Version 1.0 Software Verified: Oct. 19, 2016				
Software:	EMC 32, Version 5.20.2 Software Verified: Oct.19, 2016				
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	Apr. 1, 2017



7 FCC PART 15.247(a)(2) – OCCUPIED BANDWIDTH

7.1 Requirements:

The 6dB bandwidth shall be greater than 500 kHz.

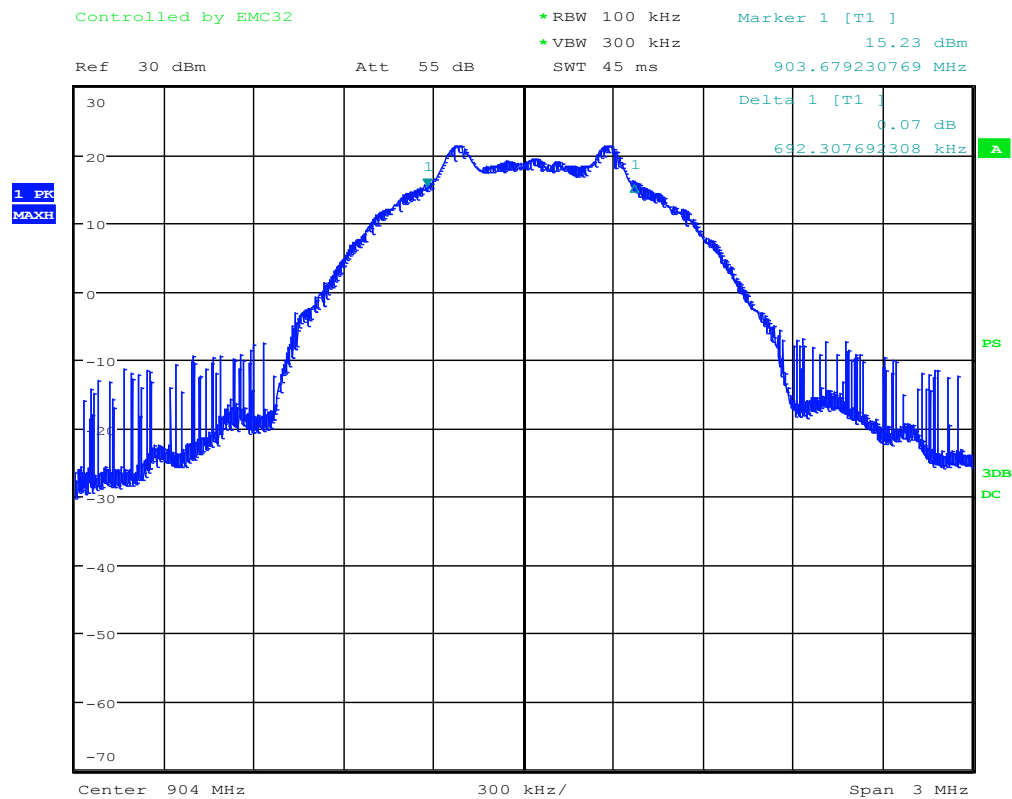
Bandwidth measurements were made at the low (904 MHz), mid (914 MHz) and upper (926 MHz) frequencies. The bandwidth was measured using the analyzer's marker function.



7.2 Occupied Bandwidth Test Data

Test Date:	Oct. 19, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(a)(2); KDB558074	Air Temperature:	24.4°C
		Relative Humidity:	48%

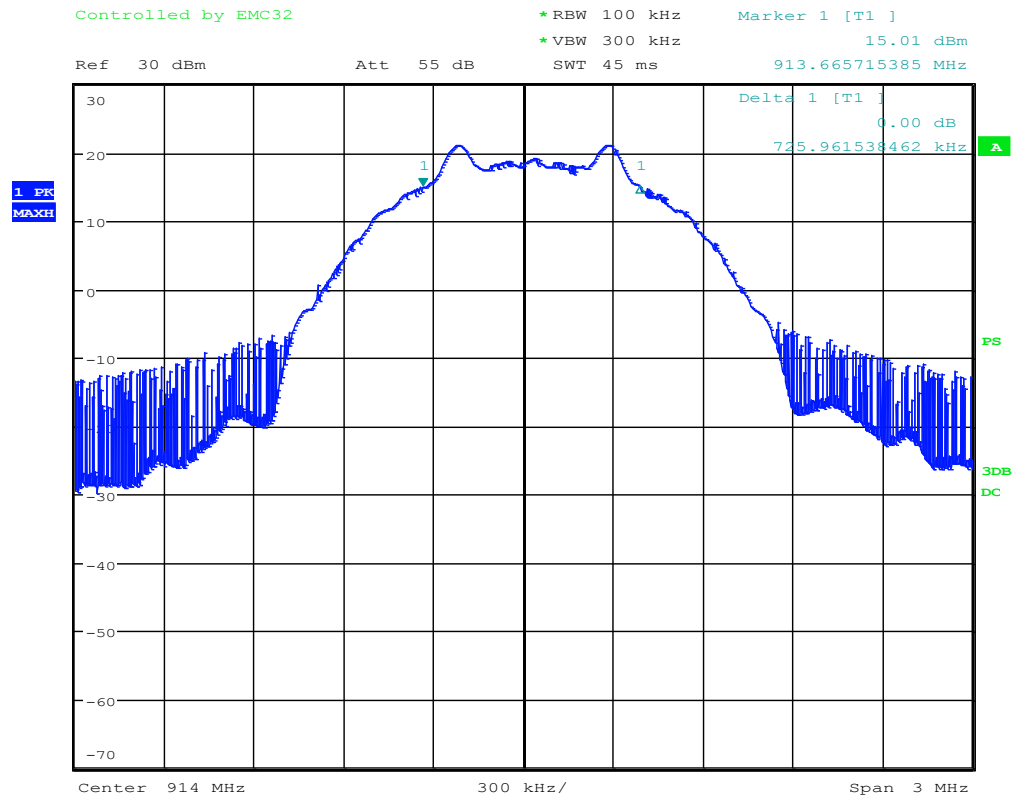
Low Channel



Date: 19.OCT.2016 17:30:30

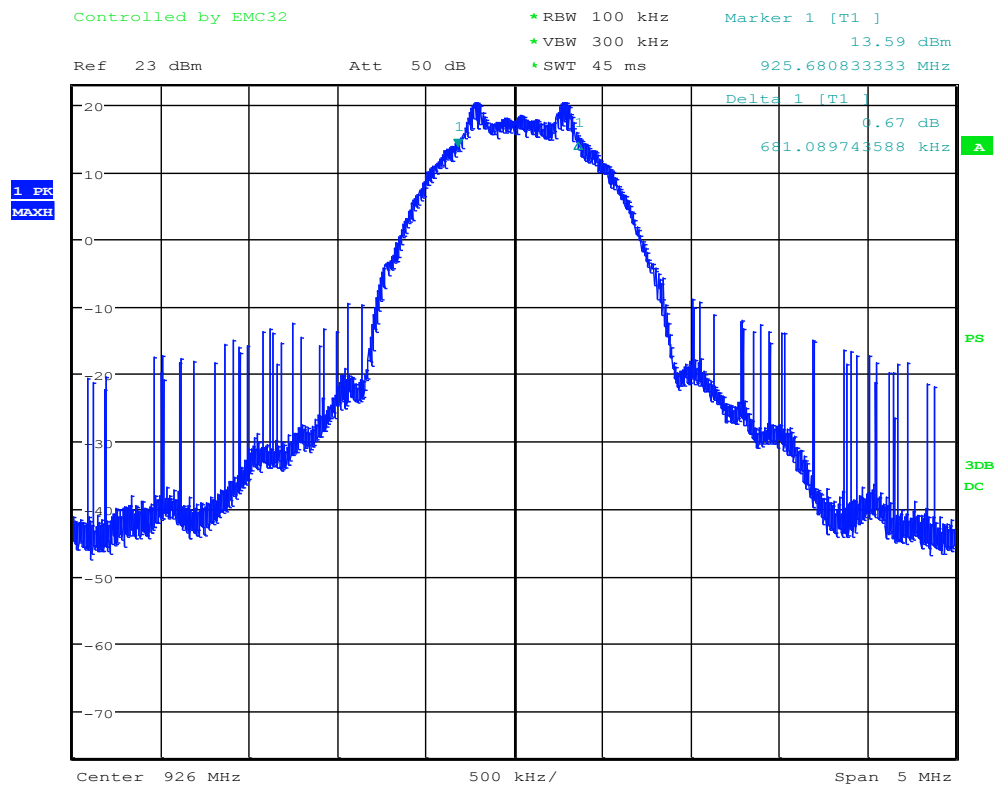


Mid Channel



Date: 19.OCT.2016 17:51:01

High Channel



Date: 19.OCT.2016 16:57:10



8 FCC PART 15.247(b)(3) – CONDUCTED OUTPUT POWER

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the receiver. The peak power output was measured.

8.1 Requirements:

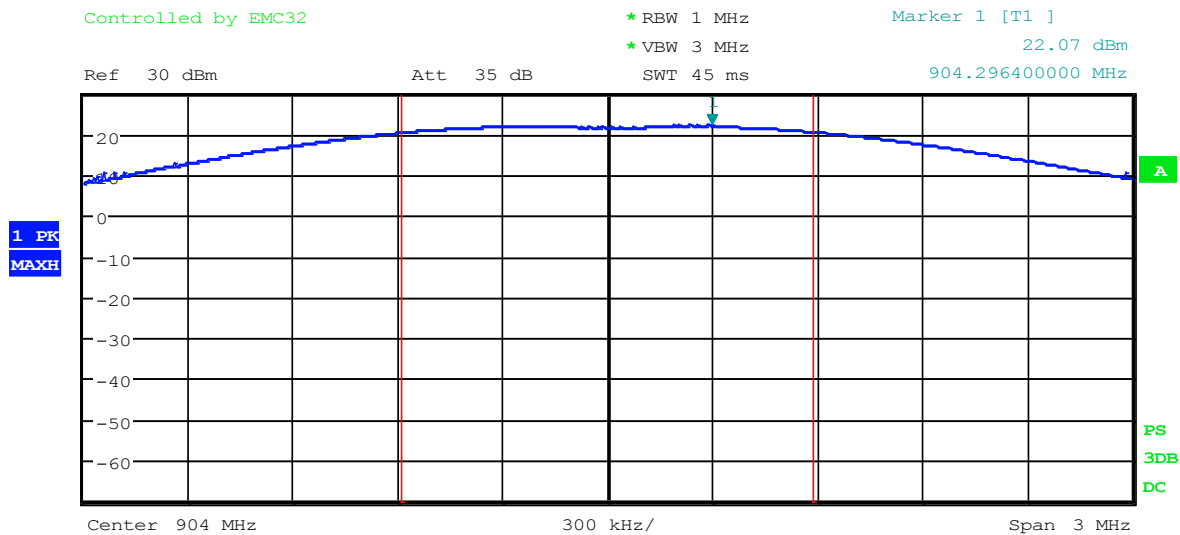
The peak power output shall be 1 watt (30 dBm) or less when using an antenna with a gain of less than 6dBi. For antennas having a gain of more than 6dBi, the limit is reduced by 1dB for every dB the antenna gain is over 6dBi.



8.2 Conducted Output Power Test Data

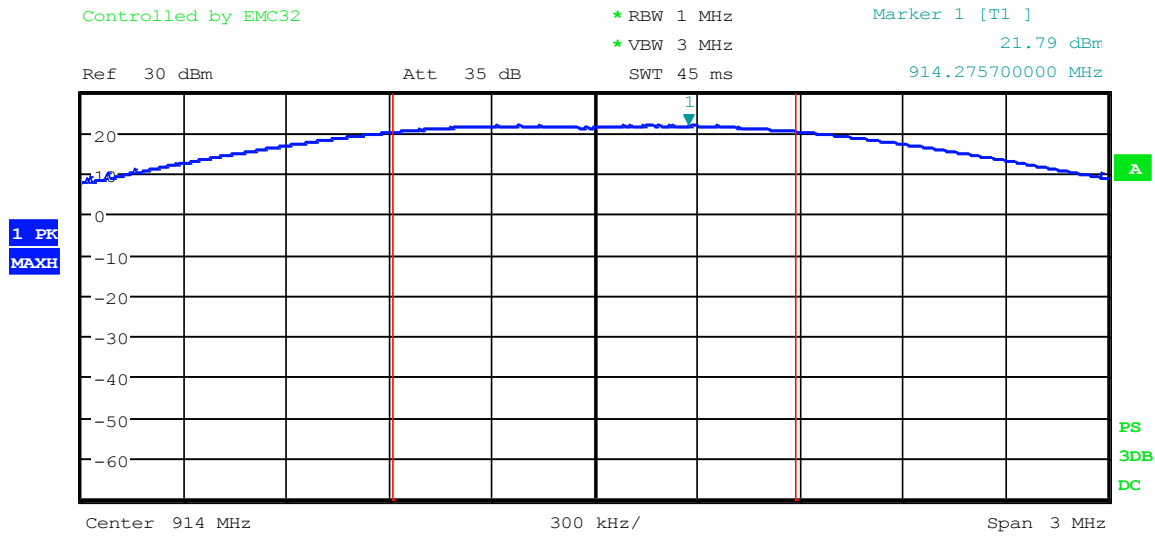
Test Date:	Oct. 19, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(b)(3); KDB558074	Air Temperature:	24.2°C
		Relative Humidity:	47%

Low Channel



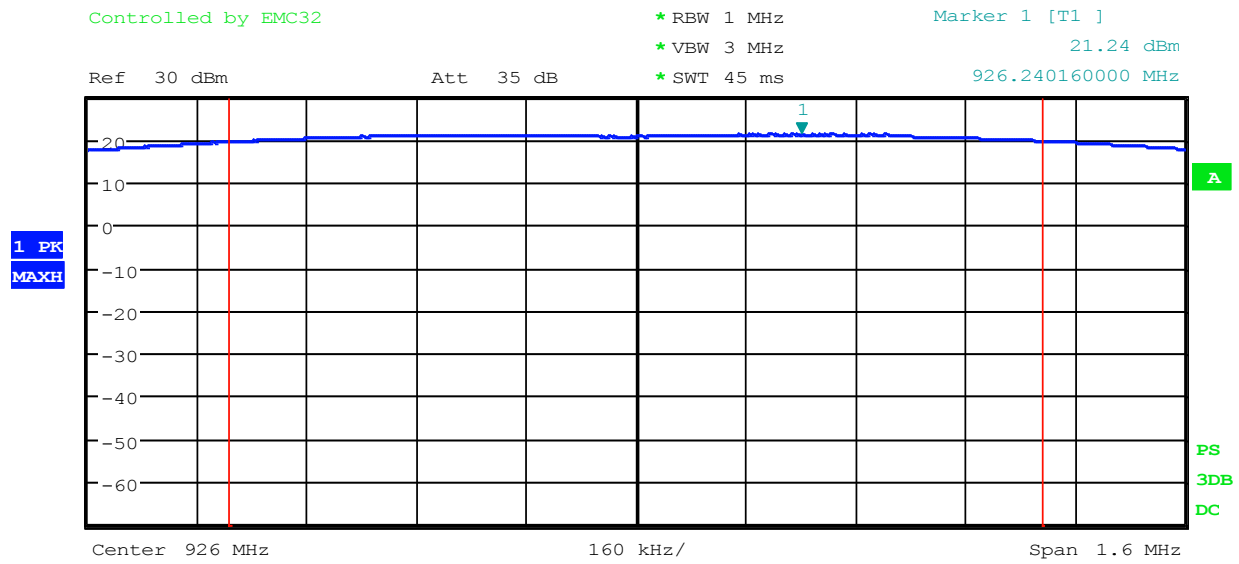


Mid Channel





High Channel





9 FCC Part 15.247(d) – CONDUCTED SPURIOUS EMISSIONS

The following tests were performed to demonstrate compliance.

RF Antenna Conducted Test

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the spectrum analyzer.

9.1 Requirements:

All Spurious Emissions must be at least 20dB down from the highest emission level measured within the authorized band up through the tenth harmonic.

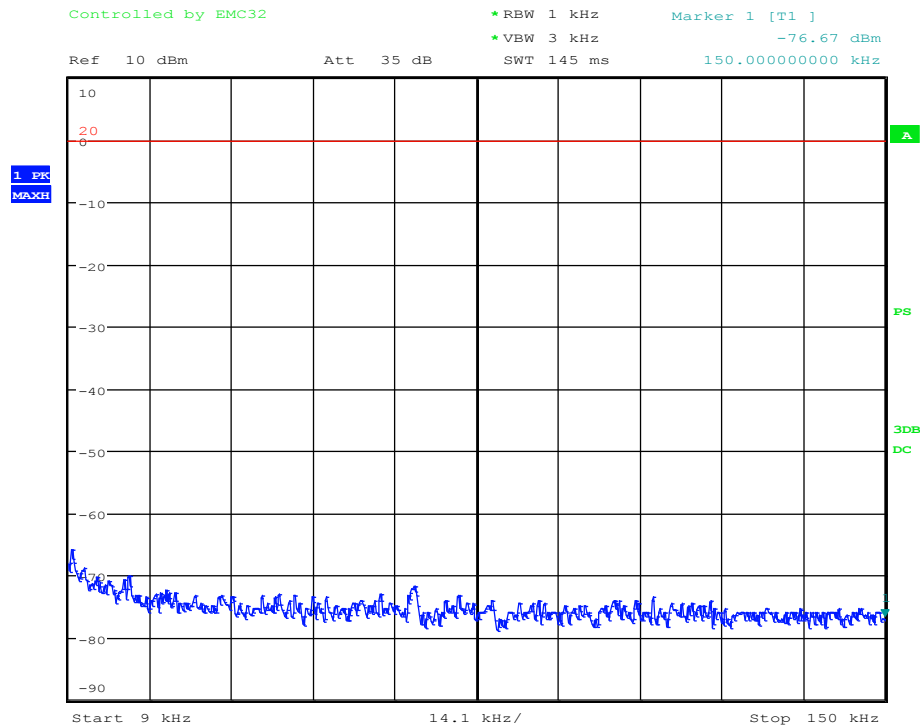
Spurious emissions measurements were made at the low, mid, and upper channels with the appropriate spectrum analyzer impulse bandwidth. Additionally, 20dB down points were measured for the low and high channels to verify band edge compliance.



9.2 Conducted Spurious Emissions Test Data

Test Date:	Oct. 19, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(d) / Part 15.207 KDB558074	Air Temperature:	24.2°C
		Relative Humidity:	47%

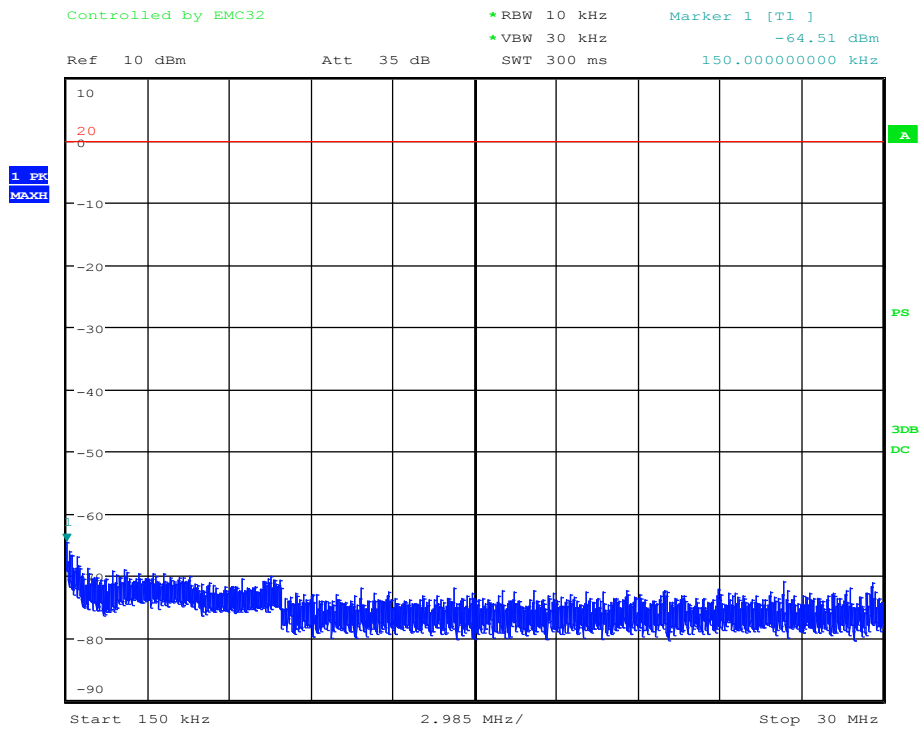
Low Channel



Date: 19.OCT.2016 17:41:31



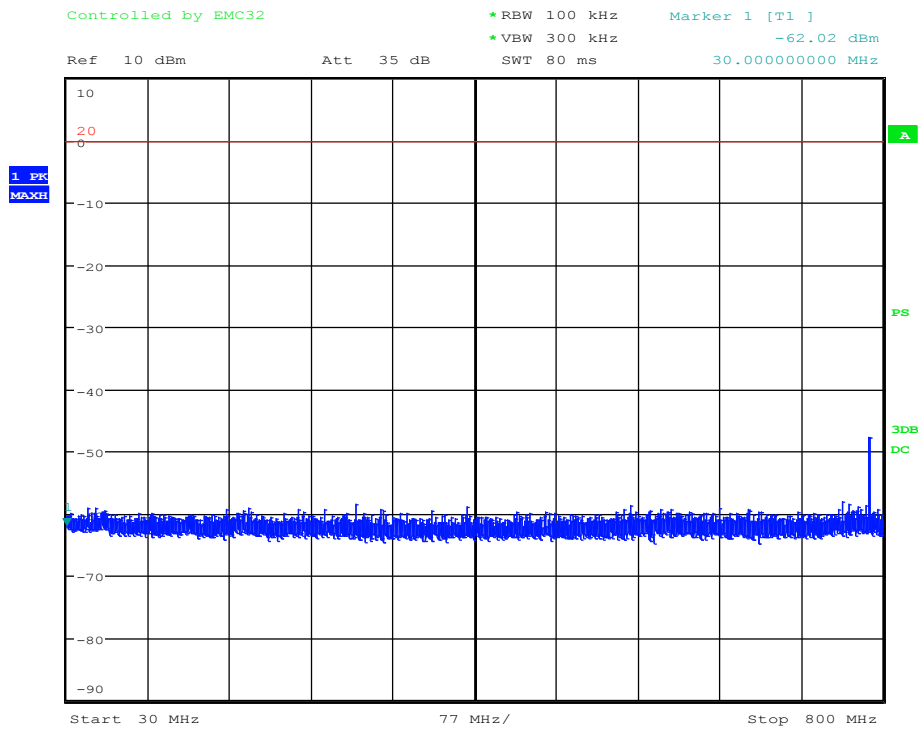
Low Channel, cont'd



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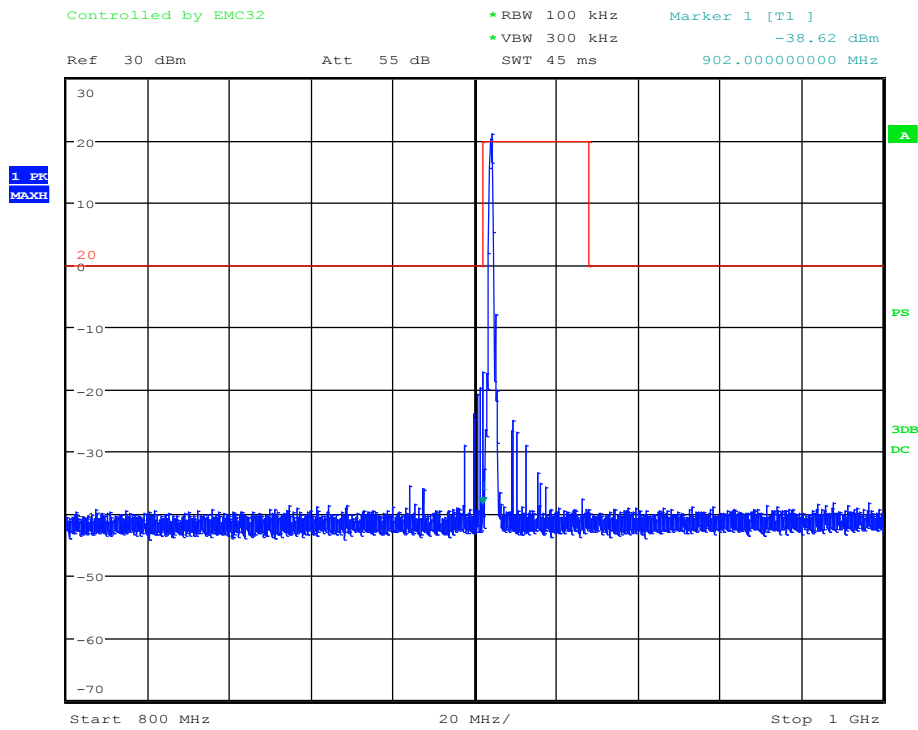
Low Channel, cont'd



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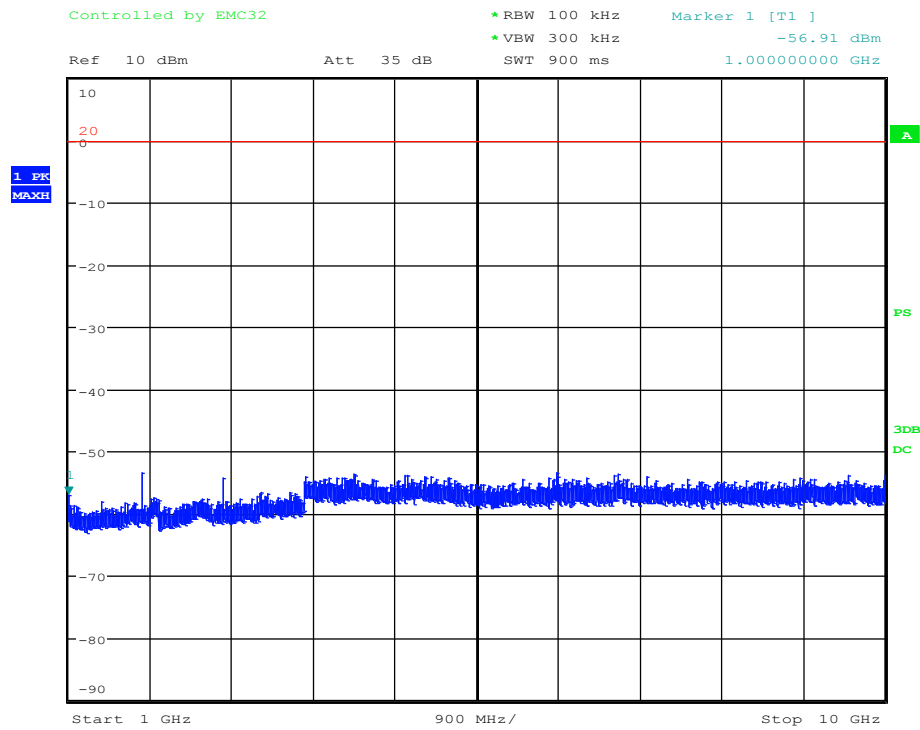
Low Channel, cont'd



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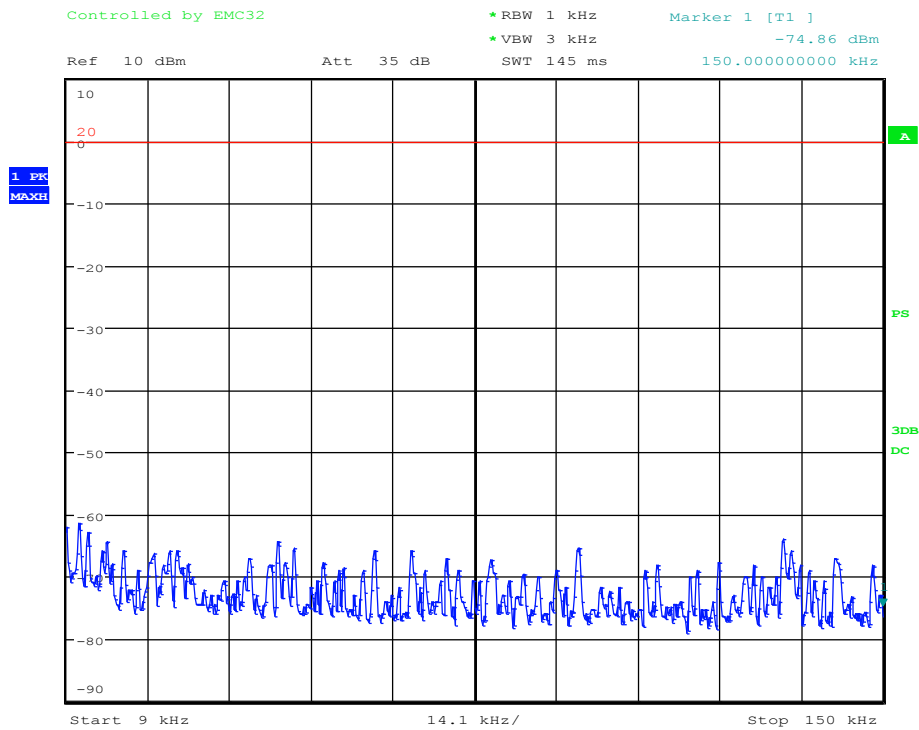
Low Channel, cont'd



Date: 19.OCT.2016 17:45:04



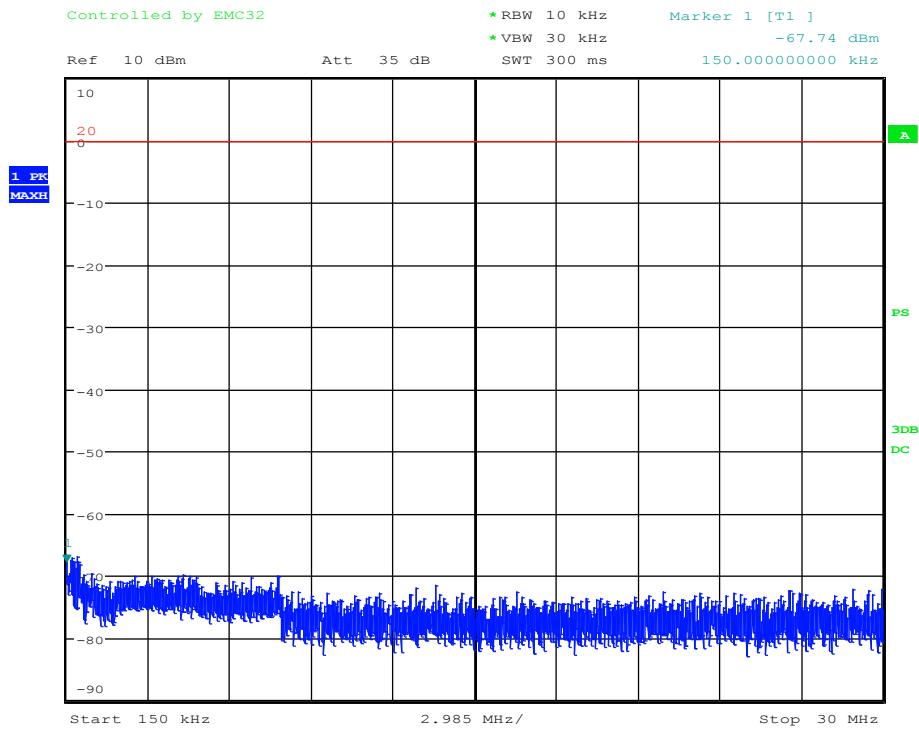
Mid Channel



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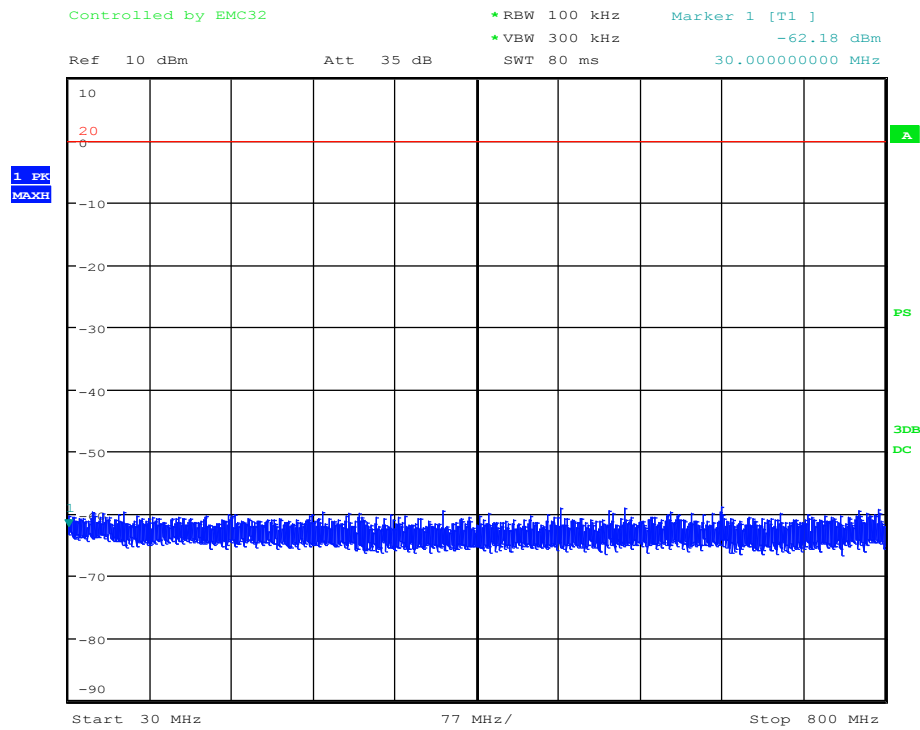
Mid Channel, cont'd



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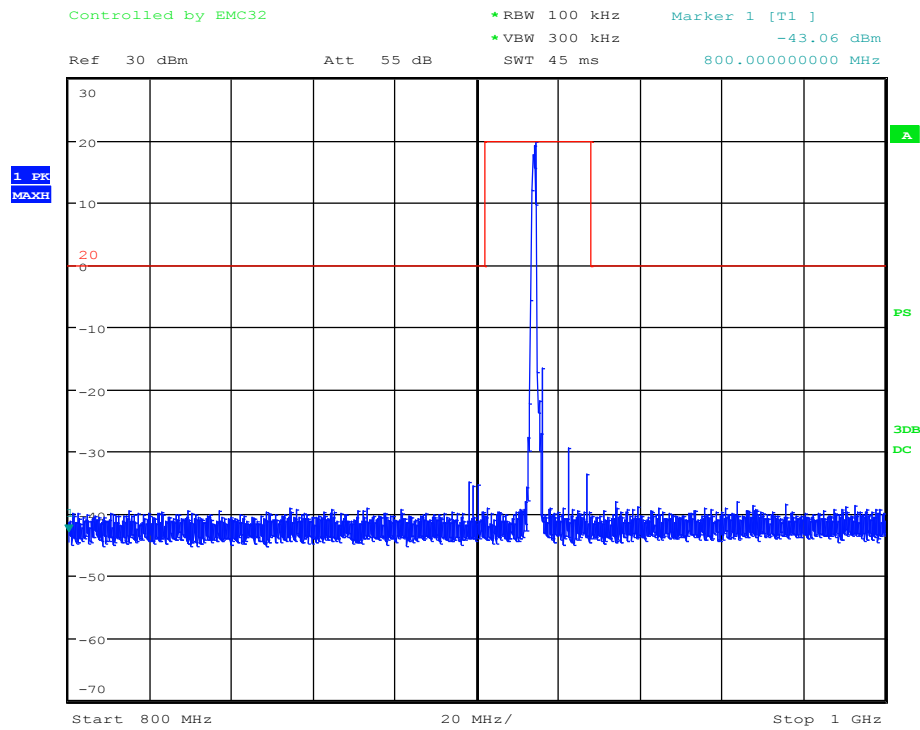
Mid Channel, cont'd



Date: 19.OCT.2016 17:58:17



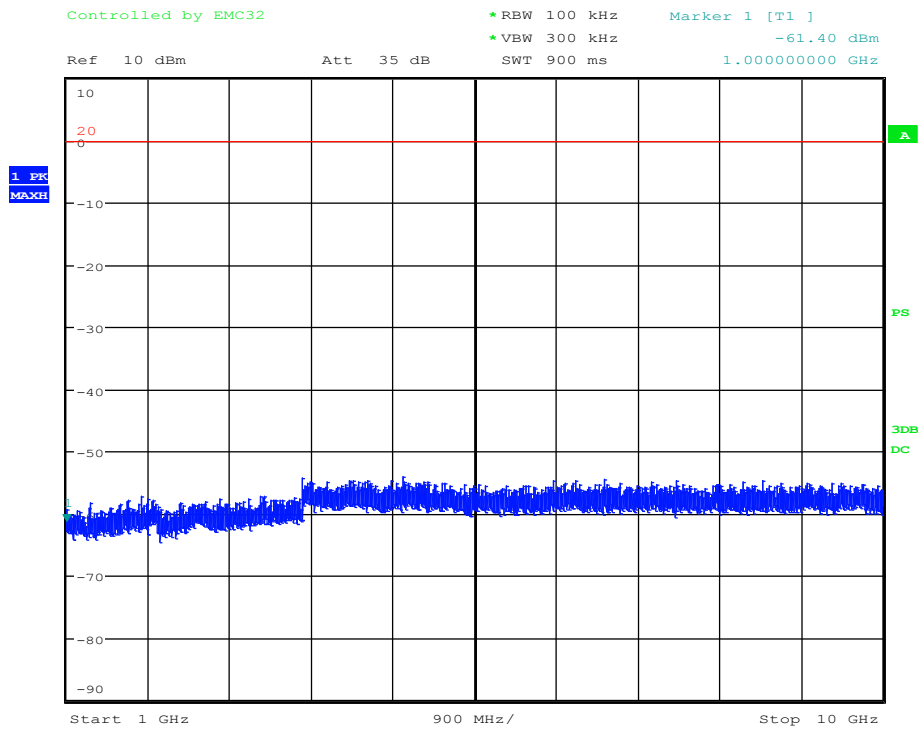
Mid Channel, cont'd



Date: 19.OCT.2016 17:58:43



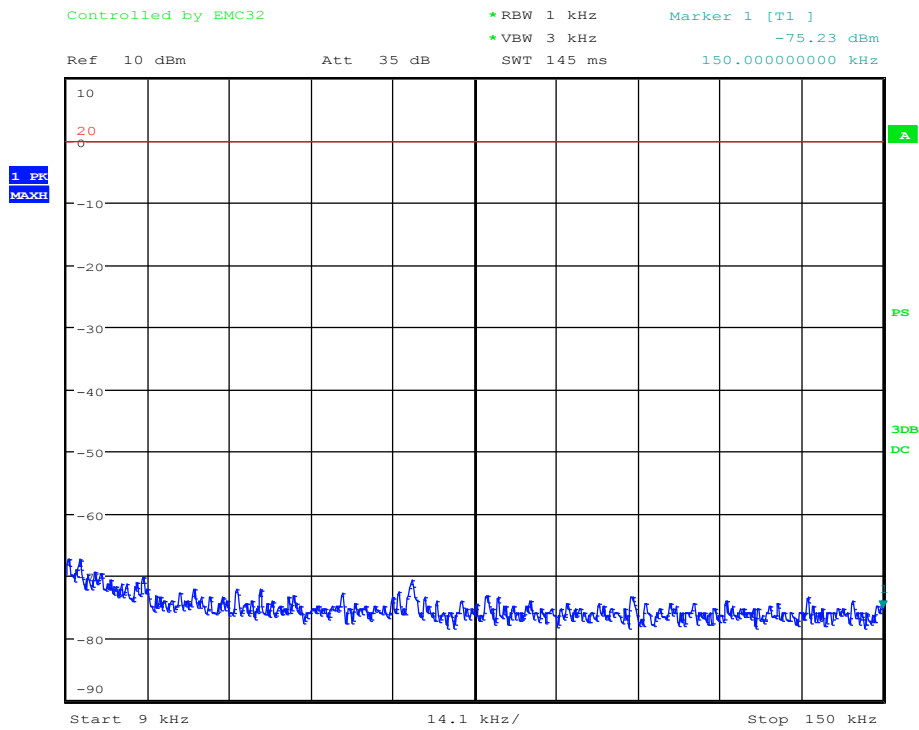
Mid Channel, cont'd



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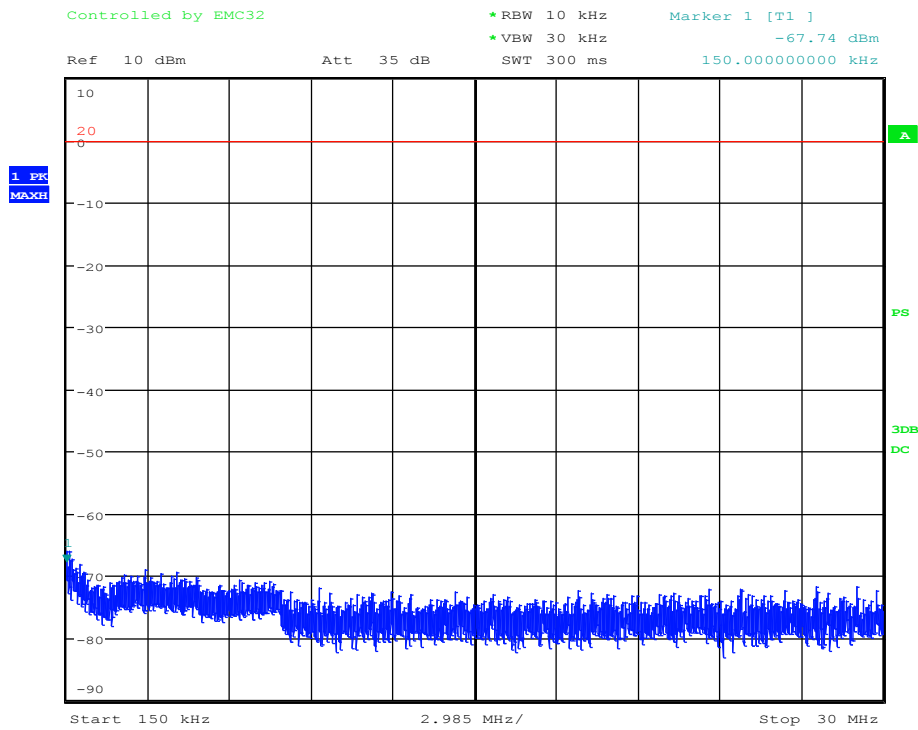
High Channel



Date: 19.OCT.2016 17:22:40



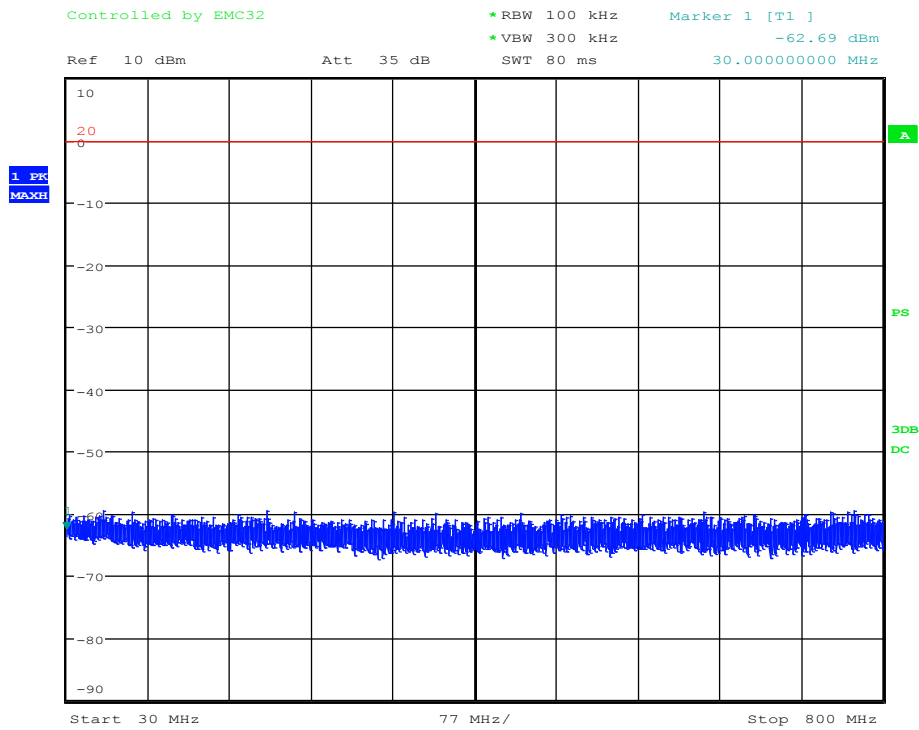
High Channel, cont'd



Date: 19.OCT.2016 17:23:09



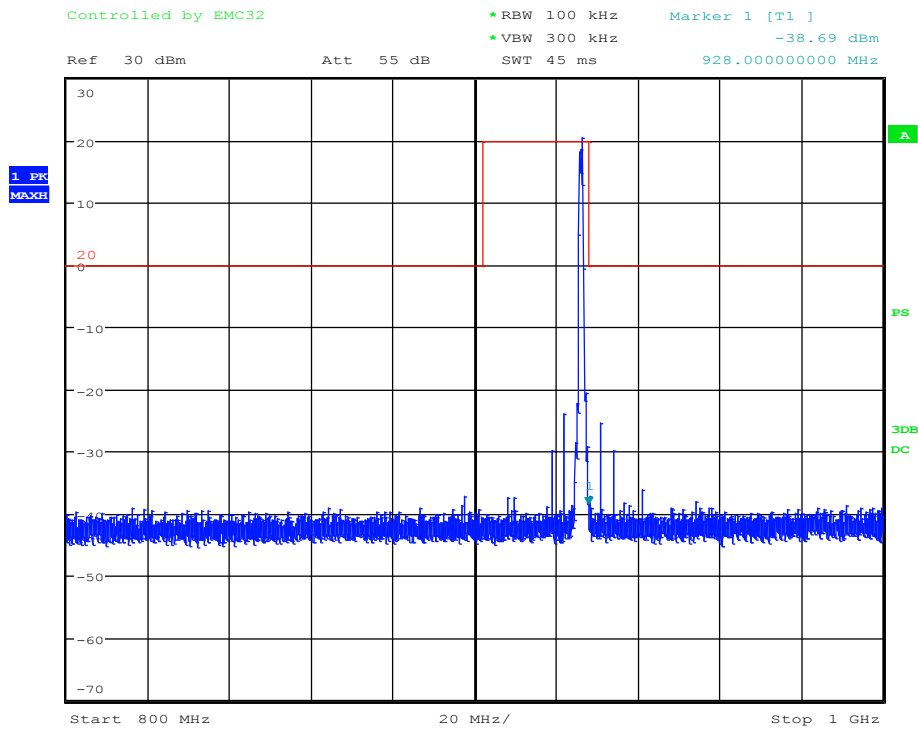
High Channel, cont'd



Date: 19.OCT.2016 17:23:29



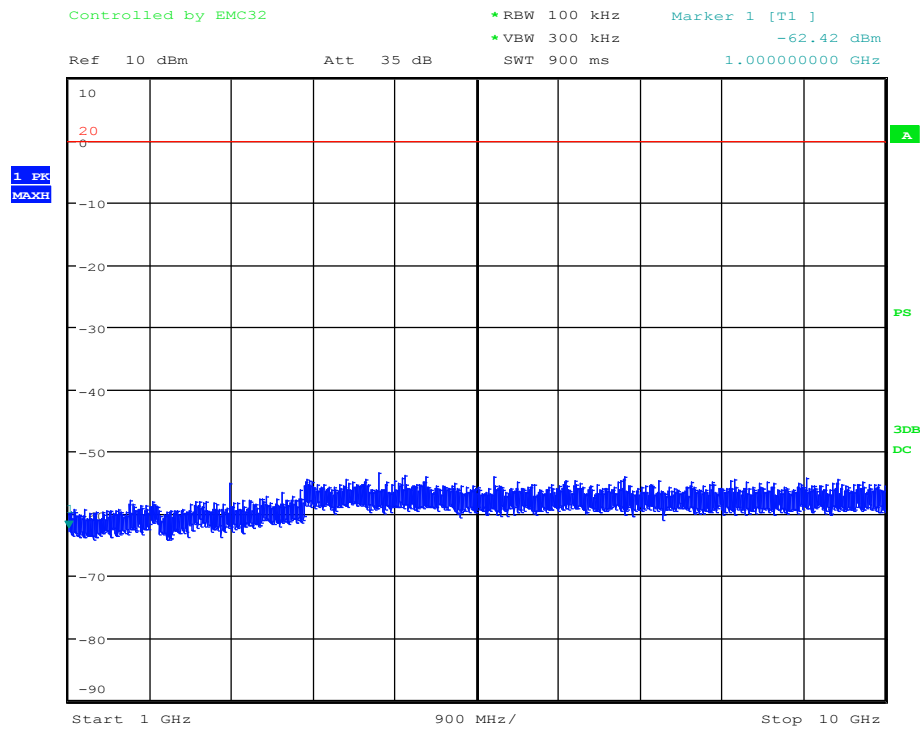
High Channel, cont'd



Date: 19.OCT.2016 17:23:55



High Channel, cont'd



Date: 19.OCT.2016 17:24:23



10 RADIATED SPURIOUS EMISSION

The EUT antenna port was fitted with its integral/internal chip antenna and a 2dBi whip antenna. Radiated emissions were measured in a Semi-Anechoic Chamber. All emissions generated that fall in the restricted bands per FCC Part 15.205 were examined.

10.1 Requirements:

All emissions that fall in the restricted bands defined in FCC Part 15.205 shall not exceed the maximum field strength listed in FCC Part 15.209(a).



10.2 Radiated Spurious Emission Test Data

Test Date(s):	Oct. 19, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(d); Part 15.209 / KDB558074	Air Temperature:	21.2°C
		Relative Humidity:	48%

The equipment was fully exercised with all cabling attached to the EUT and was positioned in the worst-case configuration inside a semi-anechoic chamber for maximum emissions. 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. The worst case emissions tables of measured results can be found below.

From 9 kHz to 30 MHz the EUT was scanned with a loop antenna in all 3 orthogonal positions and there were no emissions above the ambient noise floor. 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.

**Measurements****External Antenna: Low Channel - MaxPeak**

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2711.286000	H	70.4	-4.1	66.30	74.0	-7.7
2711.286000	V	52.9	-4.1	48.80	74.0	-25.2

External Antenna: Low Channel - Average

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2711.286000	H	49.3	-4.1	45.20	54.0	-8.8
2711.286000	V	33.3	-4.1	29.20	54.0	-24.8

External Antenna: Low Channel - QuasiPeak

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
149.900000	H	200.00	127.00	0.5	16.0	16.50	43.5	-27.0
156.520000	H	200.00	127.00	9.6	16.1	25.70	43.5	-17.8
162.440000	H	200.00	127.00	8.5	16.2	24.70	43.5	-18.8
168.910000	H	200.00	127.00	4.9	16.2	21.10	43.5	-22.4
614.000000	V	102.00	12.00	0.6	26.7	27.30	46.0	-18.7
614.000000	H	196.00	12.00	0.6	26.8	27.40	46.0	-18.6
960.000000	H	200.00	66.00	1.2	33.0	34.20	54.0	-19.8
960.000000	V	102.00	0.00	0.7	32.4	33.10	46.0	-12.9

**External Antenna: Mid Channel - MaxPeak**

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2741.248000	H	70.4	-4.1	66.30	74.0	-7.7
2741.259000	V	50.7	-4.1	46.60	74.0	-27.4

External Antenna: Mid Channel - Average

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2741.248000	H	49.1	-4.1	45.00	54.0	-9.0
2741.259000	V	31.7	-4.1	27.60	54.0	-26.4

External Antenna: Mid Channel - QuasiPeak

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
149.900000	H	200.00	276.00	0.6	16.0	16.60	43.5	-26.9
156.900000	H	200.00	276.00	0.8	16.1	16.90	43.5	-26.6
163.060000	H	200.00	276.00	8.4	16.3	24.70	43.5	-18.8
170.760000	H	200.00	276.00	1.3	16.2	17.50	43.5	-26.0
614.000000	H	200.00	276.00	0.6	26.8	27.40	46.0	-18.6
960.000000	H	200.00	276.00	0.8	33.0	33.80	54.0	-20.2
960.000000	V	100.00	355.00	0.8	32.4	33.20	46.0	-12.8

**External Antenna: High Channel - MaxPeak**

Frequency (MHz)	Antenna Polarization	Reading (dB μ V)	Cable Loss & Antenna Factor (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2778.827000	H	72.4	-4.2	68.20	74.0	-5.8
2778.879000	V	53.2	-4.2	49.00	74.0	-25.0

External Antenna: High Channel - Average

Frequency (MHz)	Antenna Polarization	Reading (dB μ V)	Cable Loss & Antenna Factor (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2778.827000	H	51.1	-4.2	46.90	54.0	-7.1
2778.879000	V	33.3	-4.2	29.10	54.0	-24.9

External Antenna: High Channel - QuasiPeak

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dB μ V)	Cable Loss & Antenna Factor (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
149.900000	H	200.00	96.00	0.1	16.0	16.10	43.5	-27.4
156.900000	H	200.00	96.00	0.1	16.1	16.20	43.5	-27.3
163.060000	H	200.00	96.00	6.8	16.3	23.10	43.5	-20.4
167.680000	H	200.00	96.00	1.2	16.3	17.50	43.5	-26.0
960.000000	V	100.00	0.00	0.8	32.4	33.20	54.0	-20.8
960.000000	H	100.00	0.00	6.4	33.0	39.40	46.0	-6.6
964.480000	H	100.00	0.00	4.6	32.8	37.40	54.0	-16.6
971.920000	H	100.00	0.00	3.1	32.7	35.80	54.0	-18.2

**Integral Antenna: Low Channel - MaxPeak**

Frequency (MHz)	Antenna Polarization	Reading (dB μ V)	Cable Loss & Antenna Factor (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2710.270000	H	60.9	-4.4	56.50	74.0	-17.5
2710.270000	V	58.7	-4.4	54.30	74.0	-19.7

Integral Antenna: Low Channel - Average

Frequency (MHz)	Antenna Polarization	Reading (dB μ V)	Cable Loss & Antenna Factor (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2710.270000	H	36.7	-4.4	32.30	54.0	-21.7
2710.270000	V	34.8	-4.4	30.40	54.0	-23.6

**Integral Antenna: Mid Channel - MaxPeak**

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2741.573000	V	59.7	-4.1	55.60	74.0	-18.4
2741.573000	H	61.9	-4.1	57.80	74.0	-16.2

Integral Antenna: Mid Channel - Average

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2741.573000	V	37.3	-4.1	33.20	54.0	-20.8
2741.573000	H	39.2	-4.1	35.10	54.0	-18.9

**Integral Antenna: High Channel - MaxPeak**

Frequency (MHz)	Antenna Polarization	Reading (dB μ V)	Cable Loss & Antenna Factor (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2776.737000	H	61.2	-4.2	57.00	74.0	-17.0
2776.737000	V	58.4	-4.2	54.20	74.0	-19.8

Integral Antenna: High Channel - Average

Frequency (MHz)	Antenna Polarization	Reading (dB μ V)	Cable Loss & Antenna Factor (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2776.737000	H	37.5	-4.2	33.30	54.0	-20.7
2776.737000	V	34.8	-4.2	30.60	54.0	-23.4



11 FCC PART 15.247(e) – PEAK POWER SPECTRAL DENSITY (PSD)

Peak power spectral density measurements were performed.

11.1 Requirements:

The peak power spectral density shall not exceed +8dBm in any 3 kHz band during any time interval of continuous transmission.

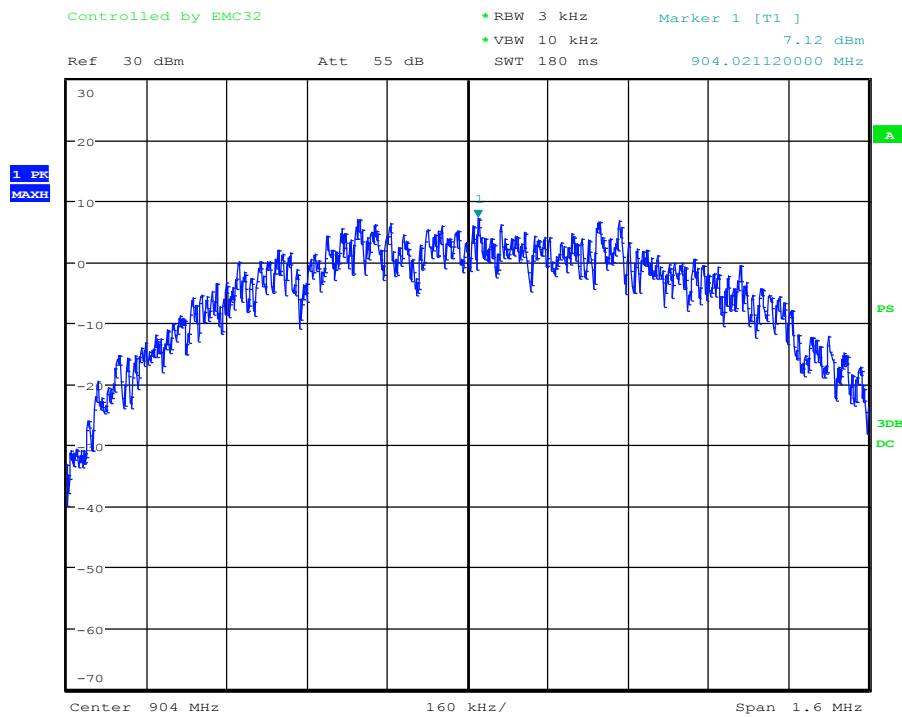
Power spectral density measurements were performed at a resolution bandwidth of 3 kHz (video bandwidth set at 10 KHz). The peak spectral densities were measured at the low, mid, and upper channels.



11.2 Peak Power Spectral Density Test Data

Test Date(s):	Oct. 19, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(e); KDB558074	Air Temperature:	24.2°C
		Relative Humidity:	48%

Low Channel



Date: 19.OCT.2016 17:40:37

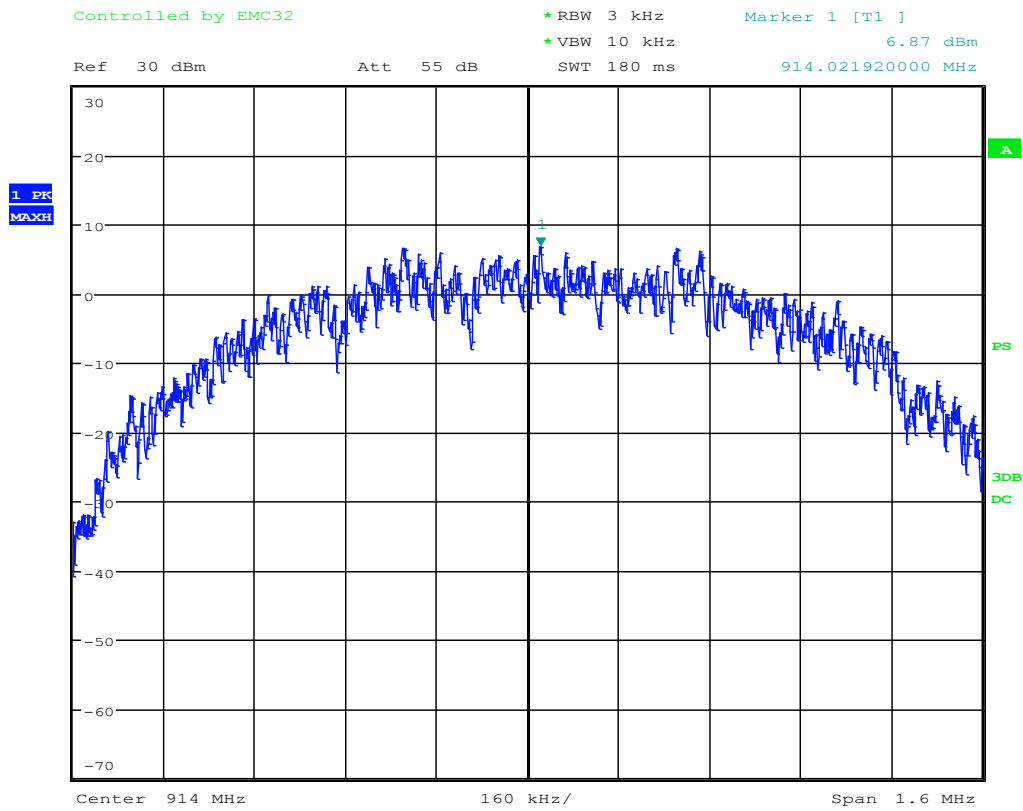


Order Nos.: F2LQ7361A-C3A, F2LQ7361A-C3A-C1

Manufacturer: Cervis Inc.

Model: SRF310

Mid Channel



Date: 19.OCT.2016 17:55:40

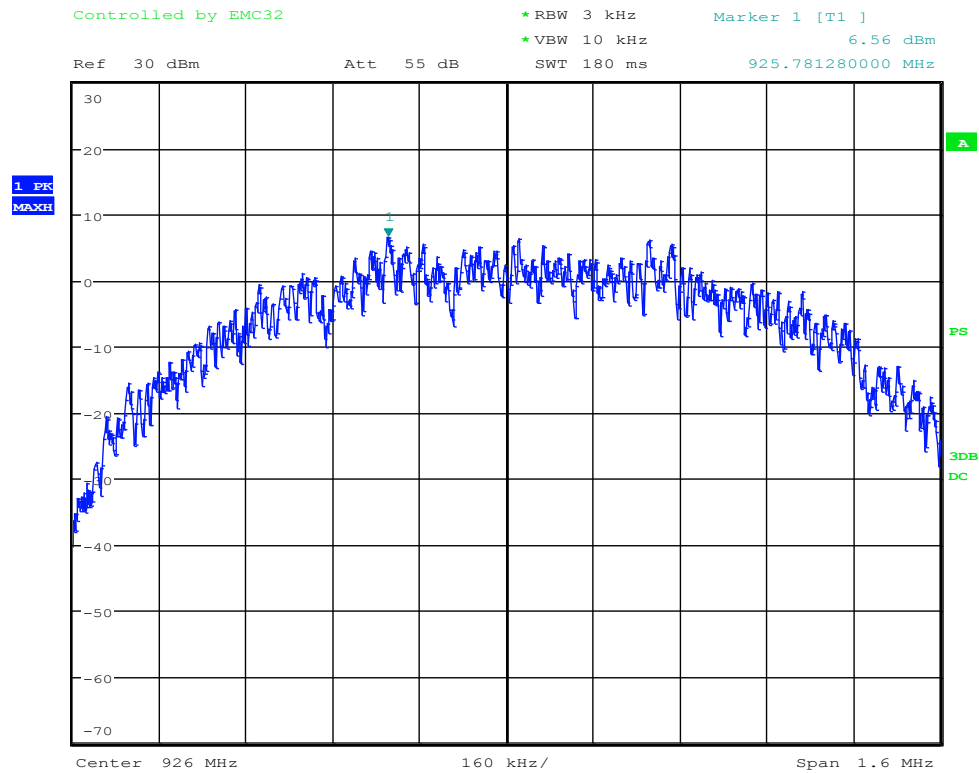


Order Nos.: F2LQ7361A-C3A, F2LQ7361A-C3A-C1

Manufacturer: Cervis Inc.

Model: SRF310

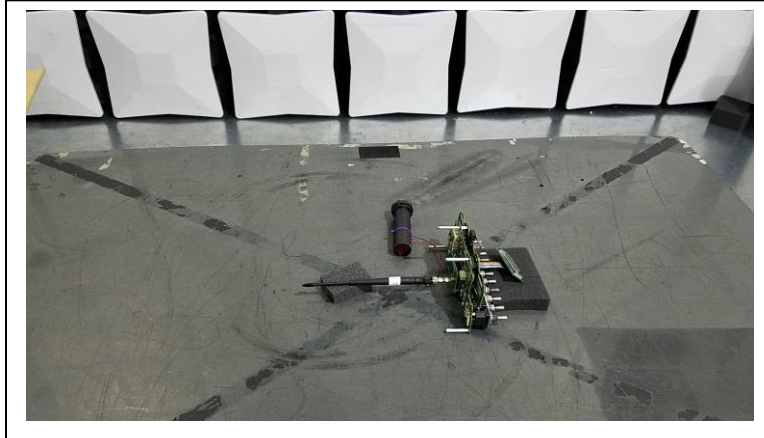
High Channel



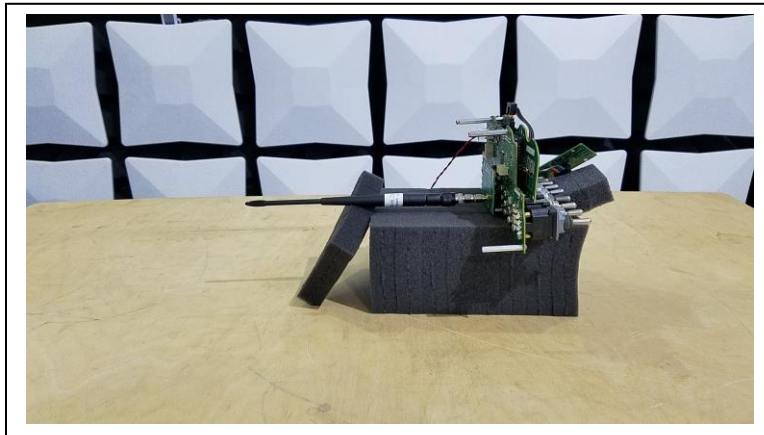
Date: 19.OCT.2016 17:18:15

12 PHOTOGRAPHS/EXHIBITS

Radiated Spurious Emissions, <1 GHz



Radiated Spurious Emissions, >1 GHz





Order Nos.: F2LQ7361A-C3A, F2LQ7361A-C3A-C1

Manufacturer: Cervis Inc.

Model: SRF310

**Conducted Output Power, Peak Power Spectral Density,
Occupied Bandwidth, and Conducted Spurious Emissions**

