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CERTIFICATION TEST REPORT

Manufacturer:	**Heat Watch LLC** **818 Sixth Avenue, Suite 4N** **New York, New York 10001 USA**
Applicant:	**Same As Above**
Product Name:	**Heat Watch Temperature Sensor**
Product Description:	Product is battery-powered and takes temperature from various spaces in a building. It relays this temperature to a Heat Watch gateway module, so the control knows the space temperatures and can better control the boiler.
Operating Voltage/Frequency:	Battery-Operated (3.6VDC)
Model:	**V5.0**
FCC ID:	**2AQX2-HWSEN915**
Testing Commenced:	June 27, 2018
Testing Ended:	June 28, 2018
Summary of Test Results:	**In Compliance, with Modifications** 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**
- **FCC Part 15.31(e)**
- **ANSI C63.10:2013**

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 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 Uncertainly
Radiated Emissions <1 GHz @ 3m	±5.07dB	±2.54
Radiated Emissions <1 GHz @10m	±5.09dB	±2.55
Radiated Emissions 1 GHz to 2.7 GHz	±3.62dB	±1.81
Radiated Emissions 2.7 GHz to 18 GHz	±3.10dB	±1.55
AC Power Line Conducted Emissions, 150kHz to 30 MHz	±2.76dB	±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
F2LQ10581A-01E	First Issue	Nov. 9, 2018	K. Littell

2 SUMMARY OF TEST RESULTS

Test Name	Standard(s)	Results
-6dB Occupied Bandwidth	CFR 47 Part 15.247(a)(2) / KDB558074	Complies
Conducted Output Power	CFR 47 Part 15.247(b)(3) / KDB558074	Complies
Voltage Variations	CFR 47 Part 15.31(e)	Complies*
Radiated Spurious Emission	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies
Peak Power Spectral Density	CFR 47 Part 15.247(e) / KDB558074	Complies

*Product was operated using a 3.6VDC 19a/H Lithium battery.
Requirements of 15.31 were met by using a new battery.

Modifications Made to the EUT
The following modifications were made to the EUT to meet Peak Power Spectral Density requirements: • The empty PCB position for C6 was populated with a 1.5pF capacitor.

3 TABLE OF MEASURED RESULTS

Test	915 MHz
Conducted Output Power	65.16mW (18.14dBm)
Conducted Output Power Limit	1 Watt, (30dBm)
E.I.R.P. with 3dBi Integral Antenna	130.01mW (21.14dBm)
E.I.R.P. Limit	4 Watts, (36.02dBm)
Peak Power Spectral Density	6.31 dBm
Peak Power Spectral Density Limit	8 dBm
-6dB Occupied Bandwidth	0.595 MHz
-6dB Occupied Bandwidth Limit	≥ 500KHz

Note: Requirements of 15.31 were met by using new batteries.

4 ENGINEERING STATEMENT

This report has been prepared on behalf of Heat Watch LLC 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: Heat Watch Temperature Sensor
Model: V5.0
Serial No.: None Specified
FCC ID: **2AQX2-HWSEN915**

5.2 Trade Name:

Heat Watch LLC

5.3 Power Supply:

Battery-operated (3.6VDC)

5.4 Applicable Rules:

CFR 47, Part 15.247, subpart C

5.5 Equipment Category:

Radio Transmitter-DTS

5.6 Antenna:

Integral Antenna, 3dBi gain

5.7 Accessories:

N/A

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

The EUT was configured to operate at full output power on the one intended frequency of 915 MHz. For RF antenna conducted tests the EUT was equipped with an SMA connector for connection to the measuring equipment. For radiated emissions tests, in a semi-anechoic chamber, the EUT was equipped with 3dBi gain integral antenna. 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	Albatross Projects	B83117-DF435-T261	US140023	Jan. 9, 2019
Shield Room	0175-3V	Ray Proof	N/A	11645	Feb. 28, 2019
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Nov. 17, 2019
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	Oct.11, 2019
Pre-amplifier	0197	Hewlett Packard	8447D	1726A01006	Verified
Pre-amplifier	CL153	Keysight Tech.	83006A	MY39500791	Sept. 20, 2018
Amplifier w/Monopole & 18" Loop	CL163-Loop	A.H. Systems, Inc.	EHA-52B	100	June 4, 2019
Horn Antenna	CL098	Emco	3115	9809-5580	Dec. 28, 2018
Software:	Tile Version 3.4.B.3.		Software Verified: June 28, 2018		
Software:	EMC 32, Version 8.53.0		Software Verified: June 28, 2018		

7 OCCUPIED BANDWIDTH

7.1 Requirements:

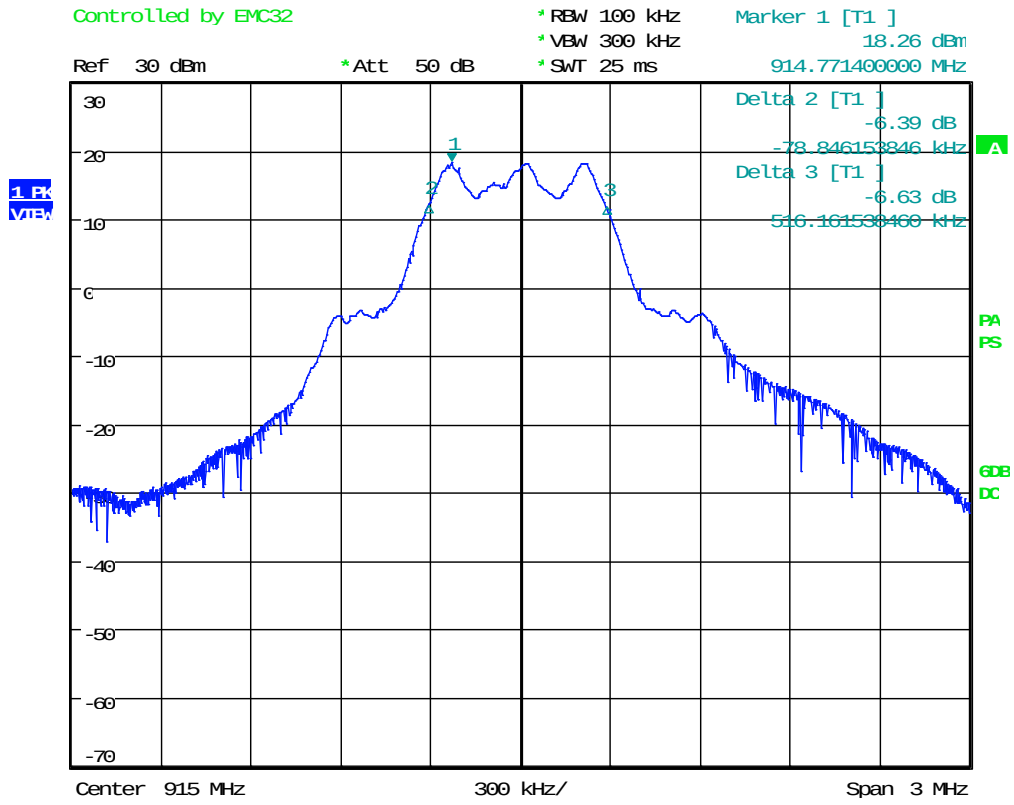
The 6dB bandwidth shall be greater than 500 kHz.

Bandwidth measurements were made at the single intended operating frequency of 915 MHz. The bandwidth was measured using the analyzer's marker function.

7.2 Occupied Bandwidth Test Data

Test Date:	June 27, 2018	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(a)(2); KDB558074	Air Temperature:	21.6ºC
		Relative Humidity:	45%

-6dB



Date: 27.JUN.2018 15:43:39

8 CONDUCTED OUTPUT POWER

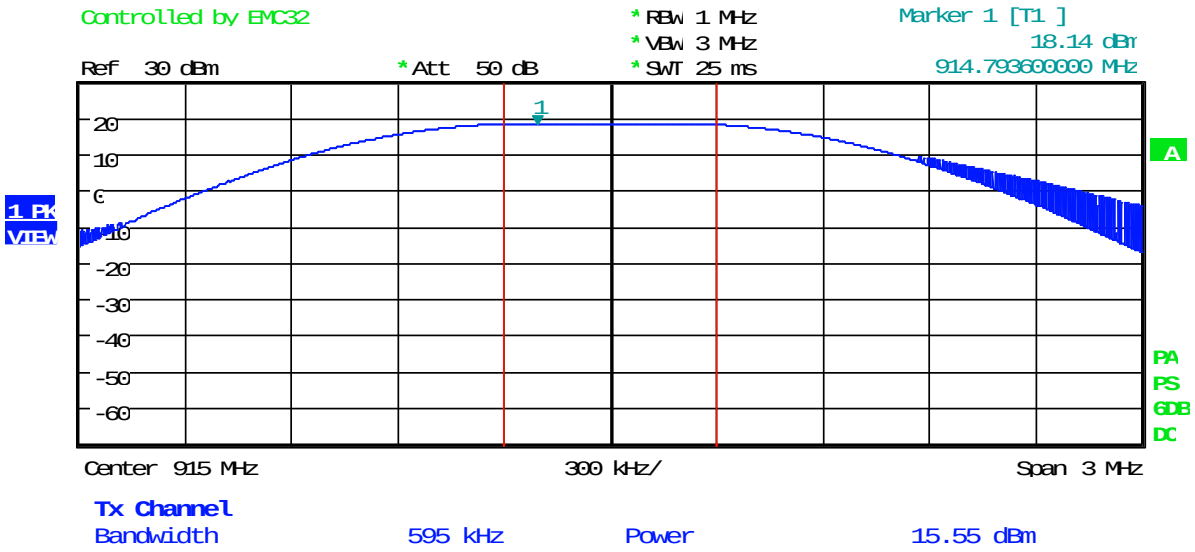
The EUT antenna port was fitted with an SMA connector and directly connected to the input of the receiver. The peak power output was measured.

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:	June 27, 2018	**Test Engineer:**	J. Chiller
Standards:	CFR 47 Part 15.247(b)(3); KDB558074	**Air Temperature:**	21.9ºC
		Relative Humidity:	45%



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9 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 single intended operating frequency of 915 MHz with the appropriate spectrum analyzer impulse bandwidth. Different RBW was used for 9kHz to 30 MHz range for a clearer detailed scan. No emissions were detected. 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:	June 27-28, 2018	**Test Engineer:**	J. Chiller
Standards:	CFR 47 Part 15.247(d) / KDB558074	**Air Temperature:**	21.9ºC
		Relative Humidity:	43%

0.009 MHz to 0.15 MHz

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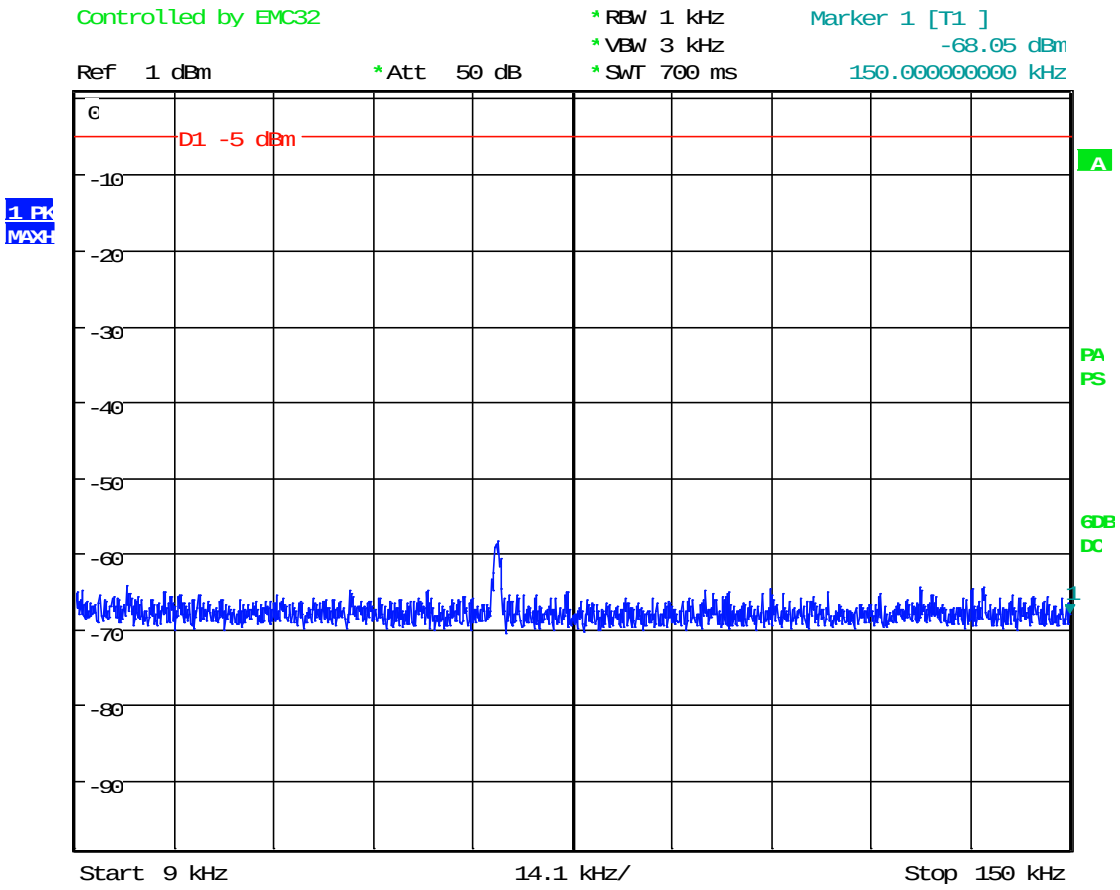

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0.15 MHz to 30.0 MHz

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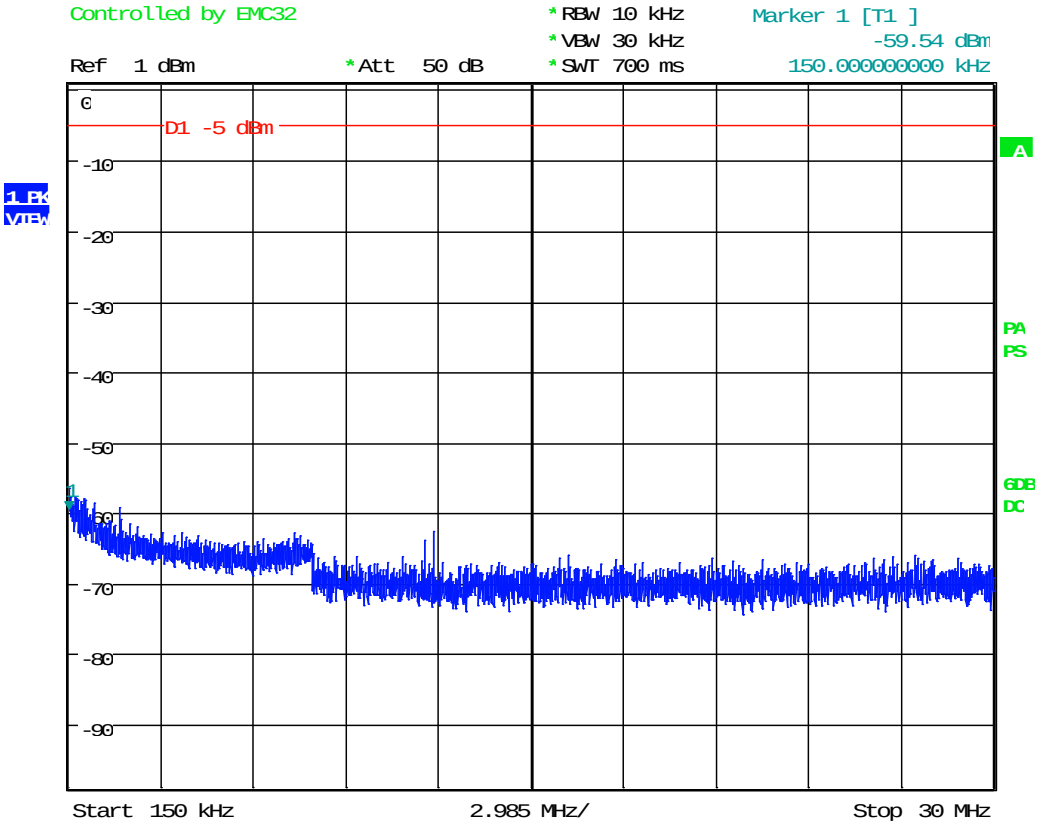

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30 MHz to 1000 MHz

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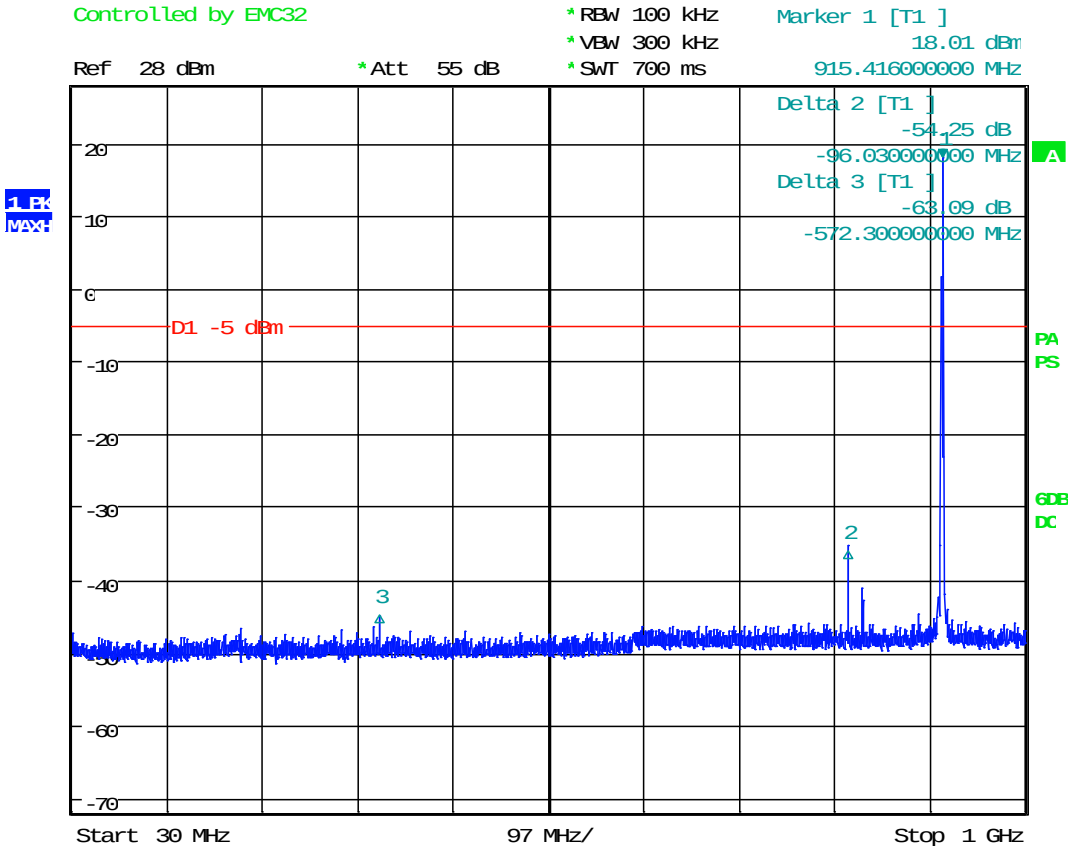

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1 GHz to 10 GHz

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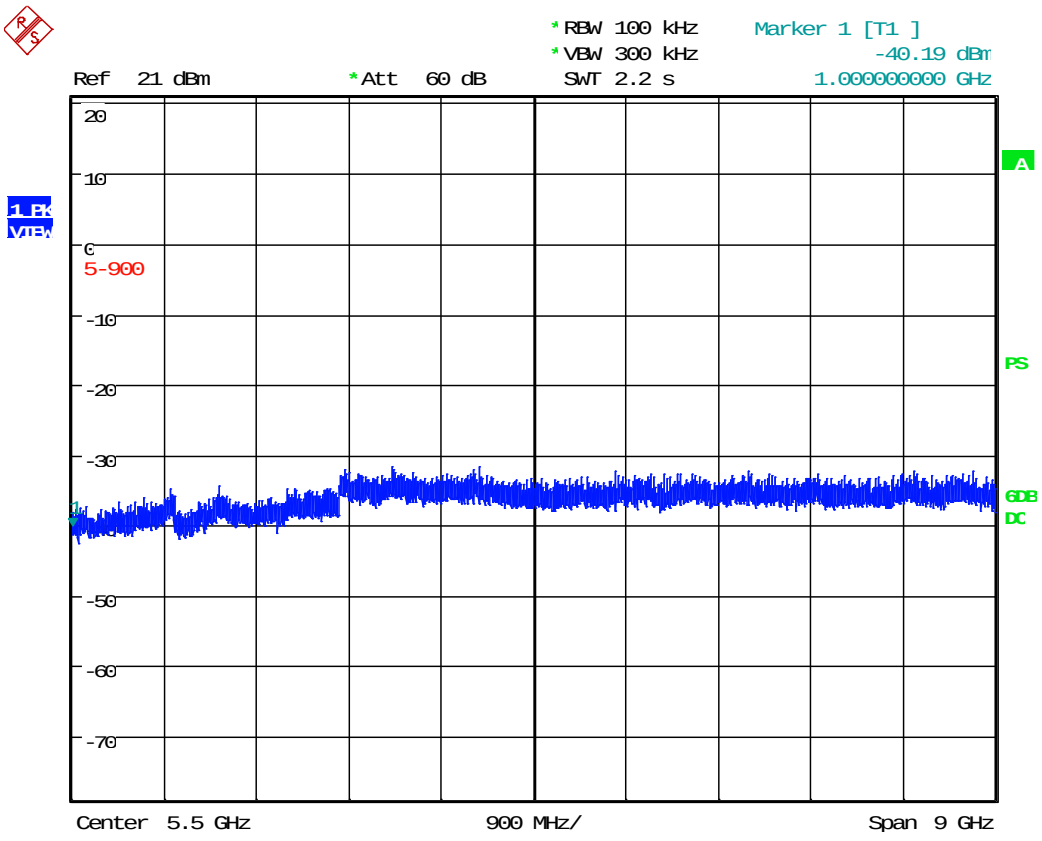

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Band Edges

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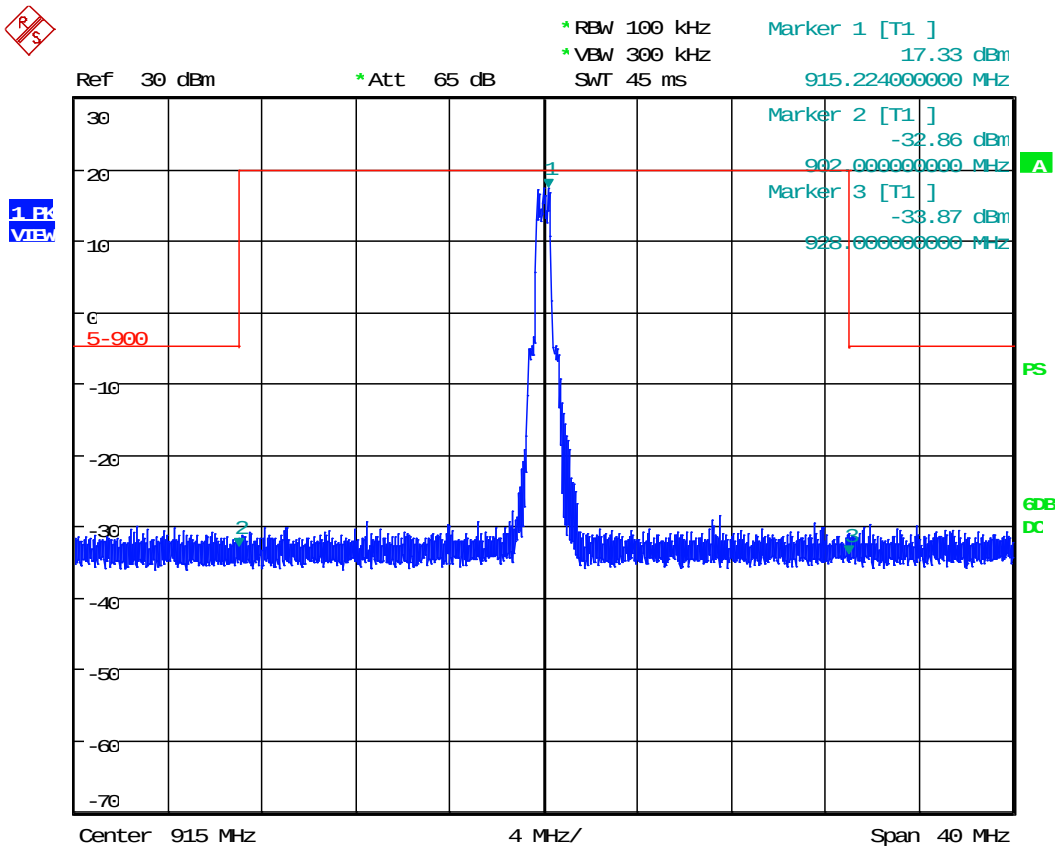


Date: 28.JUN.2018 16:26:50

10 RADIATED SPURIOUS EMISSION

The EUT antenna port was fitted with its integral antenna of 3dBi gain. 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).

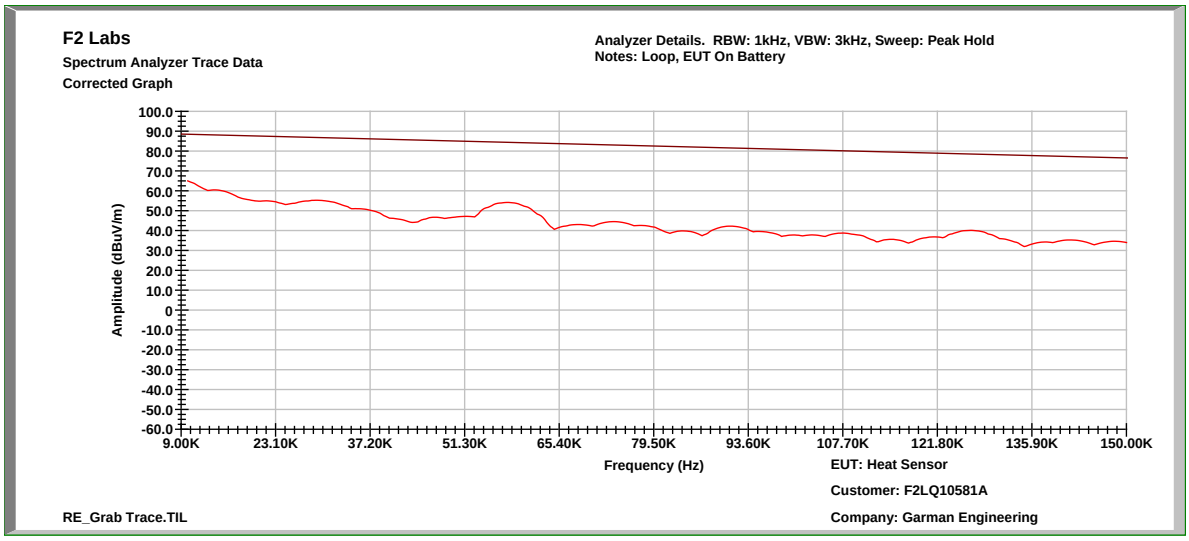
10.2 Radiated Spurious Emission Test Data

Test Date(s):	June 27-28, 2018	**Test Engineer:**	J. Chiller
Standards:	CFR 47 Part 15.247(d); Part 15.209 / KDB558074	**Air Temperature:**	22.2ºC
		Relative Humidity:	44%

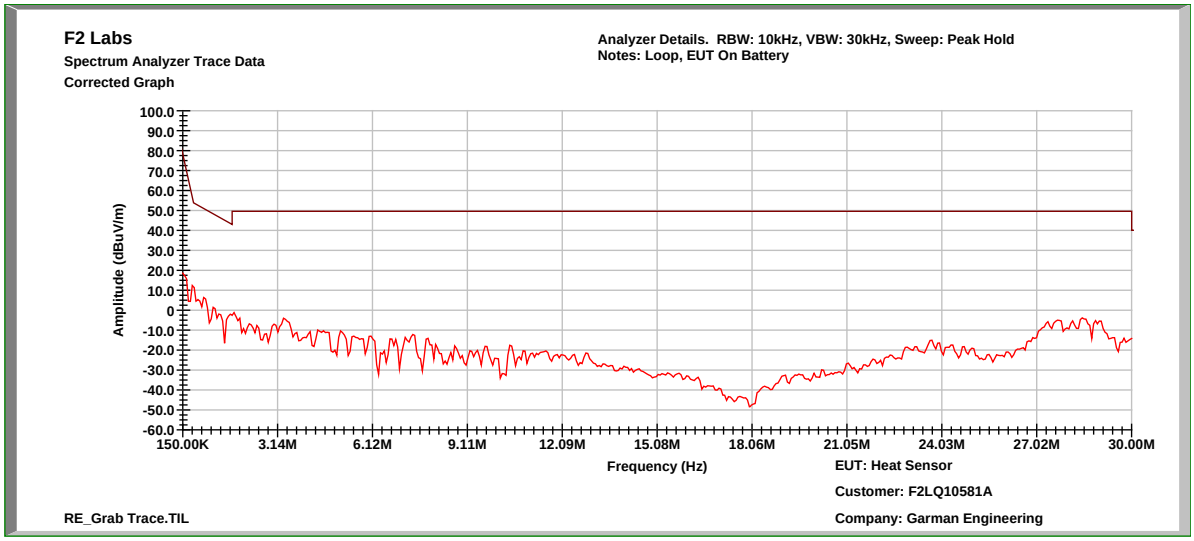
Notes: Plots are peak, max hold pre-scan data included only to determine what frequencies to investigate and measure. The EUT was initially placed in a semi-anechoic chamber, and rotated in all three orthogonal positions to maximize the emissions. Characterization measurements were then performed to determine at which frequencies significant emissions occurred. These graphs are shown below.

The equipment was fully exercised with all cabling attached to the EUT and was positioned on the non-conductive table 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 tables of measured results can be found below.

0.009 MHz to 0.15 MHz



0.15 MHz to 30.0 MHz

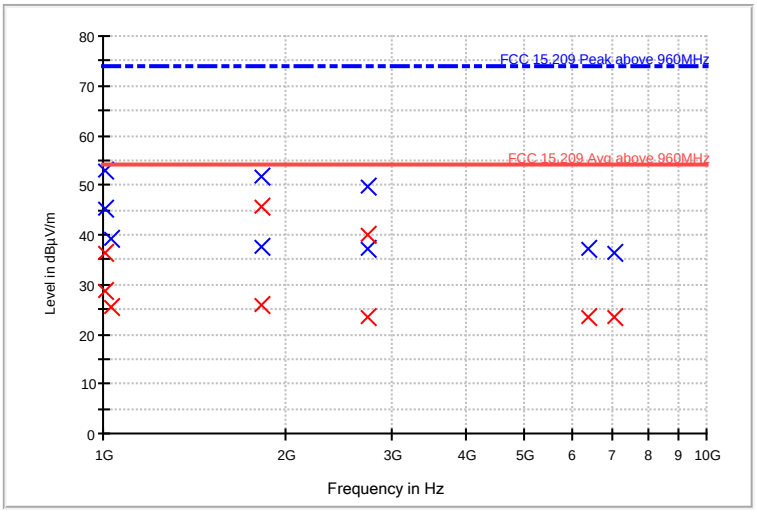


QuasiPeak

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (deg)	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.600000	H	100.00	358.00	21.2	4.8	26.00	40.0	-14.0
32.120000	V	100.00	2.00	21.0	3.6	24.60	40.0	-15.4
127.200000	H	100.00	202.00	20.9	-0.9	20.00	43.5	-23.5
128.360000	V	100.00	346.00	20.8	-0.9	19.90	43.5	-23.6
199.360000	V	100.00	11.00	20.4	-1.1	19.30	43.5	-24.2
199.760000	H	100.00	5.00	20.4	-1.1	19.30	43.5	-24.2
447.480000	H	100.00	349.00	21.3	3.3	24.60	46.0	-21.4
488.440000	V	100.00	11.00	21.3	4.8	26.10	46.0	-19.9
819.000000	H	100.00	224.00	25.6	10.5	36.10	46.0	-9.9
819.000000	V	100.00	224.00	21.6	10.5	32.10	46.0	-13.9
831.400000	H	100.00	88.00	33.7	1.9	35.60	46.0	-10.4

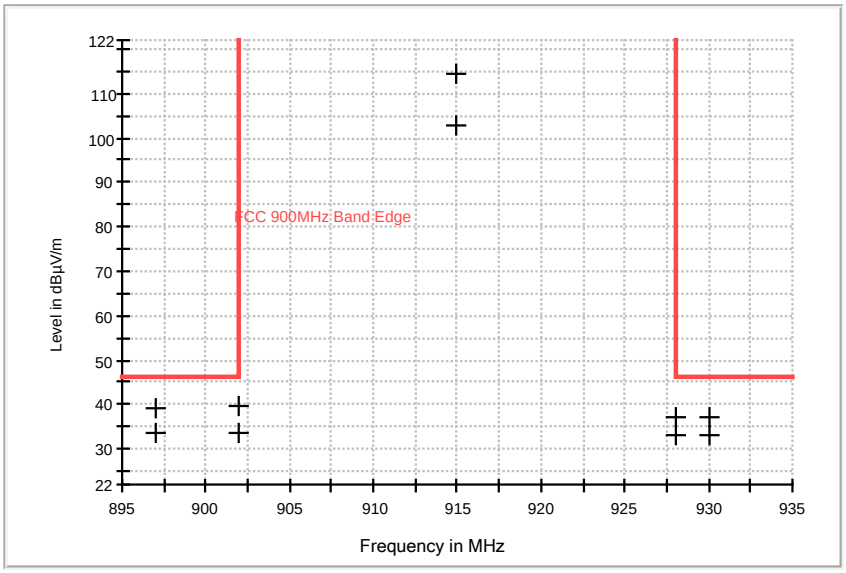
1 GHz to 10 GHz, Average

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (deg)	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1011.000000	H	100.00	0.00	43.5	-7.3	36.20	54.0	-17.8
1011.000000	V	260.00	53.00	36.2	-7.3	28.90	54.0	-25.1
1035.000000	H	100.00	337.00	32.5	-7.2	25.30	54.0	-28.7
1830.000000	H	100.00	305.00	50.5	-5.0	45.50	54.0	-8.5
1831.000000	V	100.00	128.00	30.6	-4.9	25.70	54.0	-28.3
2744.000000	V	100.00	99.00	28.0	-4.4	23.60	54.0	-30.4
2745.000000	H	100.00	310.00	44.6	-4.4	40.20	54.0	-13.8
6351.000000	H	100.00	25.00	27.5	-4.2	23.30	54.0	-30.7
7033.000000	V	100.00	113.00	27.4	-4.0	23.40	54.0	-30.6



Band Edges

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (deg)	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
897.000000	V	325.00	13.00	22.1	11.6	33.70	46.0	-12.3
897.000000	H	180.00	302.00	27.4	11.6	39.00	46.0	-7.0
902.000000	H	180.00	301.00	28.0	11.6	39.60	46.0	-6.4
928.000000	H	180.00	302.00	24.9	12.1	37.00	46.0	-9.0
930.000000	H	180.00	302.00	24.8	12.1	36.90	46.0	-9.1
930.000000	V	325.00	13.00	21.0	12.1	33.10	46.0	-12.9



11 PEAK POWER SPECTRAL DENSITY (PSD)

Peak power spectral density measurements were performed.

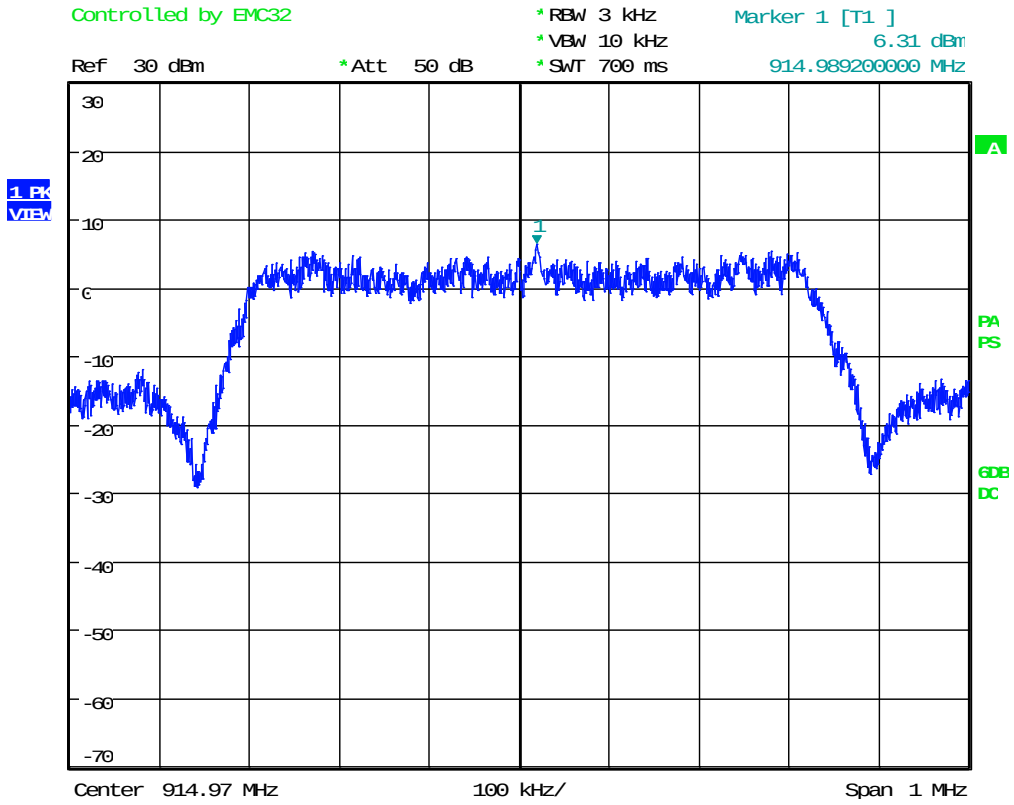
11.1 Requirements:

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 915 MHz.

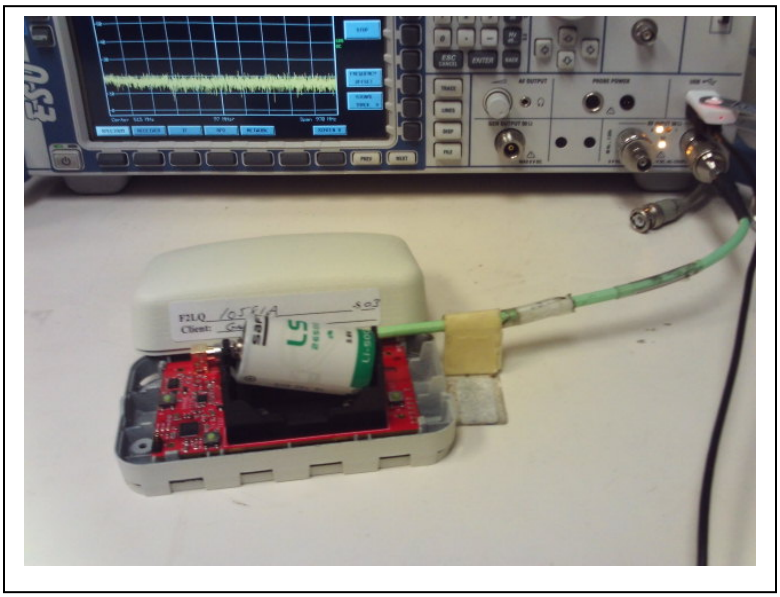
11.2 Peak Power Spectral Density Test Data

Test Date(s):	June 27, 2018	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(e); KDB558074	Air Temperature:	22.0ºC
		Relative Humidity:	45%



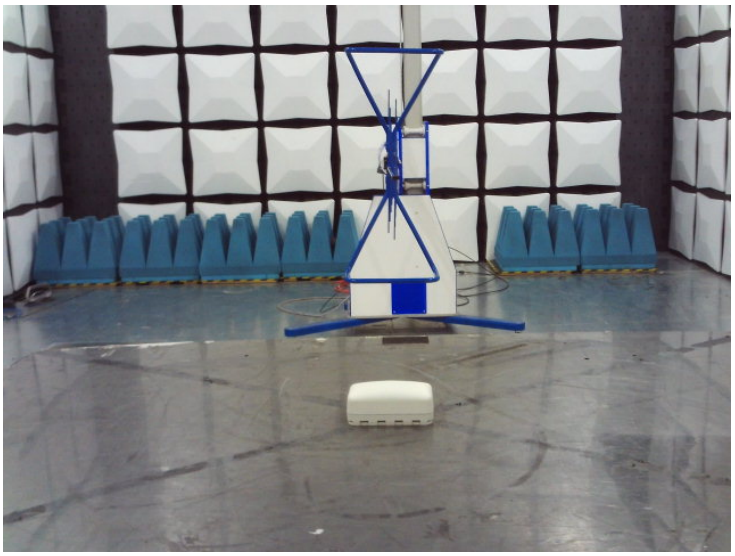
12 PHOTOGRAPHS

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



Radiated Spurious, Loop Antenna (0.009 MHz to 30 MHz)

Radiated Emissions 30 MHz to 1000 MHz



Radiated Emissions Greater than 1000 MHz