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Bulldog Technologies Inc.
515-00054
2.4 GHz Wireless Monitor
EMC Test Report

7 November 2005

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Revision History

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1.0 General Information

1.1 EUT Description

Product Name	Telemetry Temperature Monitor
Company Name	Bulldog Technologies Inc.
FCC ID	PENDING
Model No.	515-00054
Frequency Range	2400-2483.5 Mhz
Number of Channels	15
Type of Modulation	O-QPSK
Antenna Type	SMA Connector
Antenna Gain	9 dBi Max
Product Software	TTM.exe V 1.0.0.2
Test Software	Custom Test Firmware
Operator Channel Selection	By Software
Power Adapter	CUI Inc. KSAFD1200125W1US Input: 100~240V 50/60 Hz 0.4A Output: +12V DC 1.25A E215890

Product samples tested:

Manufacterer	Model No.	Serial No.
Bulldog Technologies	515-00054	ENGR-001

Frequency of each channel:

- 0 : 2.405GHz
- 1 : 2.410GHz
- 2 : 2.415GHz
- 3 : 2.420GHz
- 4 : 2.425GHz
- 5 : 2.430GHz
- 6 : 2.435GHz
- 7 : 2.440GHz
- 8 : 2.445GHz
- 9 : 2.450GHz
- 10: 2.455GHz
- 11: 2.460GHz
- 12: 2.465GHz
- 13: 2.470GHz
- 14: 2.475GHz
- 15: 2.480GHz

The EUT includes a 2.4 GHz receive function and a 2.4 GHz digital modulation transmit function. The unit is fitted with an SMA antenna connector. There are no user serviceable parts inside the unit. As described below, the EUT can be configured as either a coordinator or base station unit. On the base station units, the RS232 connector is removed.

The EUT was a coordinator module equipped with the RS232 Connector. This connector was exercised appropriately throughout testing.

The tests were performed on production sample models to demonstrate compliance with FCC Part 15 Subpart B and Subpart C, as well as Industry Canada RSS-210 Issue 5 for digitally modulated devices.

1.2 Operational Description

The Bulldog Telemetry Temperature Monitor a system that consists of three parts that interact to remotely monitor temperature. The three parts the TTM consist of are:

1. The Coordinator (or Base Station). This is an electronic device that permits the computer to contact and query the remote devices utilizing radio frequency. This devices has a RS422 serial connector to allow the connection with the Computer that contains the application

2. The Remote devices (or Remote Units) are electronic devices that contain Radio Frequency capabilities and also contain the Thermometer utilized to measure the temperature around them. The devices are encased in a metallic box that permits the thermometer to have a very close contact with the external temperature and also it increases the thermometer temperature readings accuracy. The devices can go within range and out of range, re-registering themselves in the network without the need of intervention. Currently, the system only allows devices ids with two characters. However, letter case is not important, that is, the unit 0A is different to the unit 0a so there is some room for a good amount of devices. If we utilize all the numbers and upper case and lower case letters, we can have thousands of devices utilizing only two characters to identify the devices.

3. The Computer Application (TTM.exe) is a windows application that will query the remote units via the Coordinator in a timely basis. This application will also detect temperatures out of specification and will generate an 'alarm' email to be sent to the email recipient set in the settings section of the application.

The EUT is used exclusively in a professionally installed, fixed point-to-point environment.

1.3 EUT Testing Configuration

The EUT was a coordinator module equipped with the RS232 Connector. This connector was exercised appropriately throughout testing. Where radiated measurements were taken, the antenna was connected to the unit with the included 1m of shielded coaxial cable.

The EUT is placed on a custom non-metallic stand located an appropriate height above the ground plane.

The EUT was tested in the following modes:

1) Standby/Receive mode: In this mode the EUT beacons at the lowest possible rate.

2) TXM Mode: In this mode the EUT transmits a continuously modulated carrier with 100% duty cyle. The EUT alternates between transmitting on the lowest, middle and highest TX frequencies.

3) Packet Test mode: In this mode the EUT transmits a simulated maximum data rate transmission signal.

1.4 EUT Modifications

No modifications were necessary for this unit to comply with FCC Part 15 and Industry Canada RSS-210 Issue 5

1.5 Test Facilities

Tranzeo EMC Labs
#2-11720 Stewart Cres.
Maple Ridge, BC Canada
V2X 9E7

Phone: (604) 460-6002
Fax: (604) 460-6005

FCC registration number: 960532
Industry Canada Number: 5238A

1.6 Test Equipment

Manufacturerer	Model	Description	Serial Number	Last Cal
Hewlett Packard	85650A	Quasi Peak Adapter	2043A00187	13-Aug-05
Hewlett Packard	8566B	Spectrum Analyzer	2637A04169	7-Feb-05
Hewlett Packard	85685A	Preselector	3010A1095	7-Feb-05
Sunol Sciences	SM46C	Turntable	051204-2	N/R
Sunol Sciences	Custom	Mast Motor	TREML0001	N/R
Sunol Sciences	JB3	Antenna	A042004	05-May-05
Sunol Sciences	DRH-118	Antenna	A052804	02-Jun-05
FCC	FCC-LISN-50-25-2	LISN	105	02-Jun-04
Rohde & Schwarz	FSP40	Spectrum Analyzer	100184	24-Aug-2005
Rohde & Schwarz	NRP	Power Meter	100055	02-Aug-2005

1.7 Test System Details

The following auxiliary equipment and cables were used for performing the tests:

1.8 Test Results

The EUT complies with FCC Part 15 Subparts B and C, as well as Industry Canada RSS-210 Issue 5.

2.0 Conducted Emissions

2.1 Test Standard

FCC Part 15 Subpart C Section 15.207a

(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 30MHz shall not exceed the limits in the following table, as measured using a 50 µH/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.

2.2 Test Limits

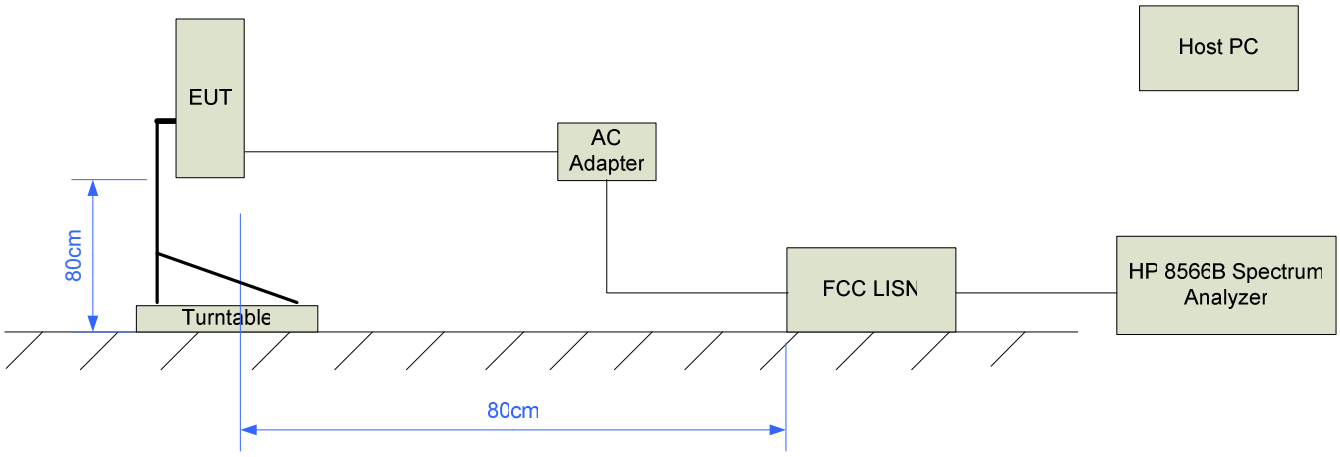
requency (MHz)	**Maximum Level (dBuV) Quasi-Peak**	**Maximum Level (dBuV) Average**
0.15-0.50	66-56 (Log Delta)	56-46 (Log Delta)
0.50-5.00	56	46
5.00-30.0	60	50

2.3 Test Setup

Testing was performed over the frequency range of 0.15 MHz to 30 MHz. Only worst case data is shown below.

The unit was exercised in TXM mode as described above.

2.3.1 Test Setup Block Diagram



Note: The unused LISN terminal is terminated with a 50 Ohm terminator.

2.4 Test Results

2.4.1 Test Data

EUT - Line

Frequency (MHz)	Reading (dBµV)	Correction (dB)	Corr Reading (dBµV)	Limit (dBµV)	Margin (dBµV)	Polarity	Reading type	Result
0.163	51.6	2.0	53.6	55.3	-1.7	Line	QP	PASS
0.166	-60.0	2.0	-58.0	55.2	-113.2	Line	Ave	PASS
0.197	57.9	2.0	59.9	64.2	-4.3	Line	QP	PASS
0.204	16.1	2.0	18.1	53.5	-35.4	Line	Ave	PASS
0.377	37.8	2.0	39.8	48.3	-8.5	Line	QP	PASS
0.377	21.1	2.0	23.1	48.3	-25.2	Line	Ave	PASS
0.387	42.5	2.0	44.5	48.1	-3.6	Line	Peak	PASS
0.390	41.5	2.0	43.5	48.1	-4.6	Line	Peak	PASS
0.393	41.9	2.0	43.9	48.0	-4.1	Line	Peak	PASS
0.397	40.1	2.0	42.1	47.9	-5.8	Line	Peak	PASS
0.403	39.9	2.0	41.9	47.8	-5.9	Line	Peak	PASS
0.415	40.5	2.0	42.5	47.5	-5.0	Line	Peak	PASS
0.549	37.9	2.0	39.9	46.0	-6.1	Line	Peak	PASS
2.519	36.9	2.0	38.9	46.0	-7.1	Line	Peak	PASS

EUT – Neutral

Frequency (MHz)	Reading (dBµV)	Correction (dB)	Corr Reading (dBµV)	Limit (dBµV)	Margin (dBµV)	Polarity	Reading type	Result
0.151	-60	2.0	-58.0	56.0	-114.0	Neutral	Ave	PASS
0.153	-60	2.0	-58.0	55.8	-113.8	Neutral	Ave	PASS
0.163	55.3	2.0	57.3	65.3	-8.0	Neutral	QP	PASS
0.164	55	2.0	57.0	65.3	-8.3	Neutral	QP	PASS
0.172	56.3	2.0	58.3	64.8	-6.5	Neutral	QP	PASS
0.179	14.2	2.0	16.2	54.5	-38.3	Neutral	Ave	PASS
0.186	58.2	2.0	60.2	64.2	-4.0	Neutral	QP	PASS
0.201	17.8	2.0	19.8	53.6	-33.8	Neutral	Ave	PASS
0.373	38.3	2.0	40.3	58.4	-18.1	Neutral	QP	PASS
0.381	29.4	2.0	31.4	48.3	-16.9	Neutral	Ave	PASS
0.382	27.8	2.0	29.8	48.2	-18.4	Neutral	Ave	PASS
0.383	44	2.0	46.0	48.2	-2.2	Neutral	Peak	PASS
0.388	37.5	2.0	39.5	58.1	-18.6	Neutral	QP	PASS
0.389	42.2	2.0	44.2	48.1	-3.9	Neutral	Peak	PASS
0.391	41.3	2.0	43.3	48.0	-4.7	Neutral	Peak	PASS
0.395	41.5	2.0	43.5	48.0	-4.5	Neutral	Peak	PASS
0.399	41.5	2.0	43.5	47.9	-4.4	Neutral	Peak	PASS
0.545	38	2.0	40.0	46.0	-6.0	Neutral	Peak	PASS

3.0 Peak Power Output

3.1 Test Standard

FCC CFR47, Part 15, Subpart B 15.247b

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(4)(i) and (c)(4)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

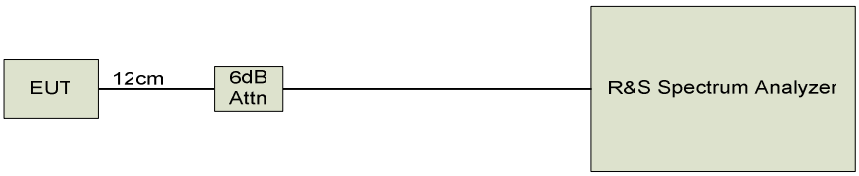
3.2 Test Limits

The maximum conducted output power is 1 watt. With a 9.5 dBi (worst case) antenna and 0dB of cable loss, the maximum conducted output power is 28 dBm.

3.3 Test Setup

The measurement equipment is connected directly to the EUT through a suitable attenuator. This test is performed in TXM mode as described above.

3.3.1 Test Setup Block Diagram



3.4 Test Results

Channel	Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
1	2409	8.51	28	PASS
7	2445	8.39	28	PASS
15	2476	8.35	28	PASS

4.0 Radiated Emissions, General Requirements.

4.1 Test Standard

FCC Part 15 Subpart C Section 15.209 Radiated emission limits, general requirements.

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.,Sections 15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other Sections within this Part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

4.2 Test Limits

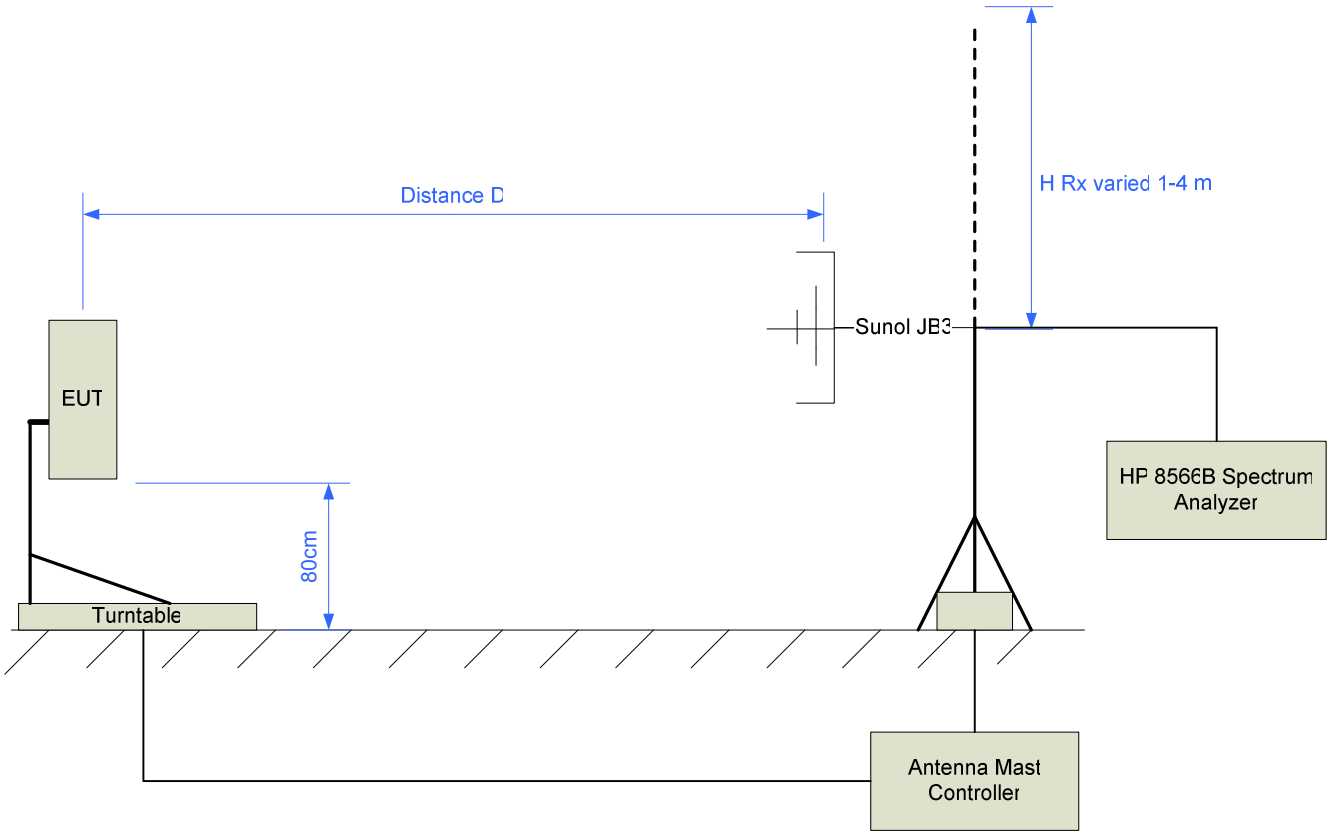
Frequency (MHz)	Maximum Field Strength (uV/m @ 3M	Maximum Field Strength (dBuV/m @ 3m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-1000	500	54.0

4.3 Test Setup

The unit was tested in both receive mode and TXM mode. Only the data taken from the worst case is shown below.

The EUT is connected to the antenna via 1m of shielded coaxial cable.

4.3.1 Test Setup Block Diagram



Note: Measurements below 1 GHz were performed with the Sunol JB3 antenna with a measurement distance of 3m. Compliance above 1 Ghz is covered in section 5.0.

4.4 Test Results

Frequency (MHz)	Meter (dBuV)	Correction (dBuV)	Corr Reading (dBuV)	Limit (dBuV)	Margin (dB)	Polarization	Rtype	Result
37.020	16.6	17.3	33.9	40.0	-6.1	Vert	Peak	Pass
40.020	18.2	15.2	33.4	40.0	-6.6	Vert	QP	Pass
479.900	19.6	20.6	40.2	46.0	-5.8	Horiz	Peak	Pass
576.000	17.8	21.9	39.7	46.0	-6.3	Horiz	Peak	Pass
608.000	18.6	21.8	40.4	46.0	-5.6	Horiz	Peak	Pass
704.000	15.3	23.7	39.0	46.0	-7.0	Horiz	Peak	Pass
736.000	14.6	24.3	38.9	46.0	-7.1	Horiz	Peak	Pass
767.500	16.2	24.5	40.7	46.0	-5.3	Horiz	Peak	Pass
799.500	16.1	25.0	41.1	46.0	-4.9	Horiz	Peak	Pass
831.500	14.5	25.4	39.9	46.0	-6.1	Horiz	Peak	Pass

5.0 Harmonic and Spurious Emissions

5.1 Test Standard

FCC CFR 47, Part 15, Subpart B 15.247d

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

5.2 Test Limits

2400-2483.5 MHz limits:
Fundamental Limit = 137 dBuV
Harmonics and Spurious Emissions = 20 dBc
Restricted Band Emissions = AVG 54 dBuV, PK 74dBuV

5.3 Test Setup – Spurious Emissions

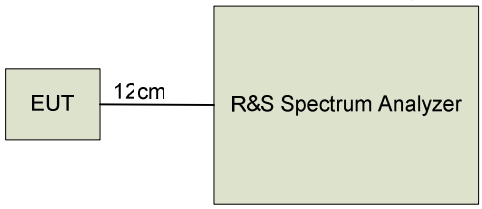
For conducted measurements, the unit is connected directly to the measurement equipment. The EUT is exercised in TXM mode and the emissions are swept with a max hold detector and an appropriate measurement duration to ensure that all emissions are maximized.

In addition to conducted measurements, extensive radiated prescanning above 1 GHz is performed. The measurement antenna is scanned around all sides of the EUT at a distance of 1m to identify signals of interest. Additional measurements at an appropriate measurement distance are performed to ensure that emissions were at maximum.

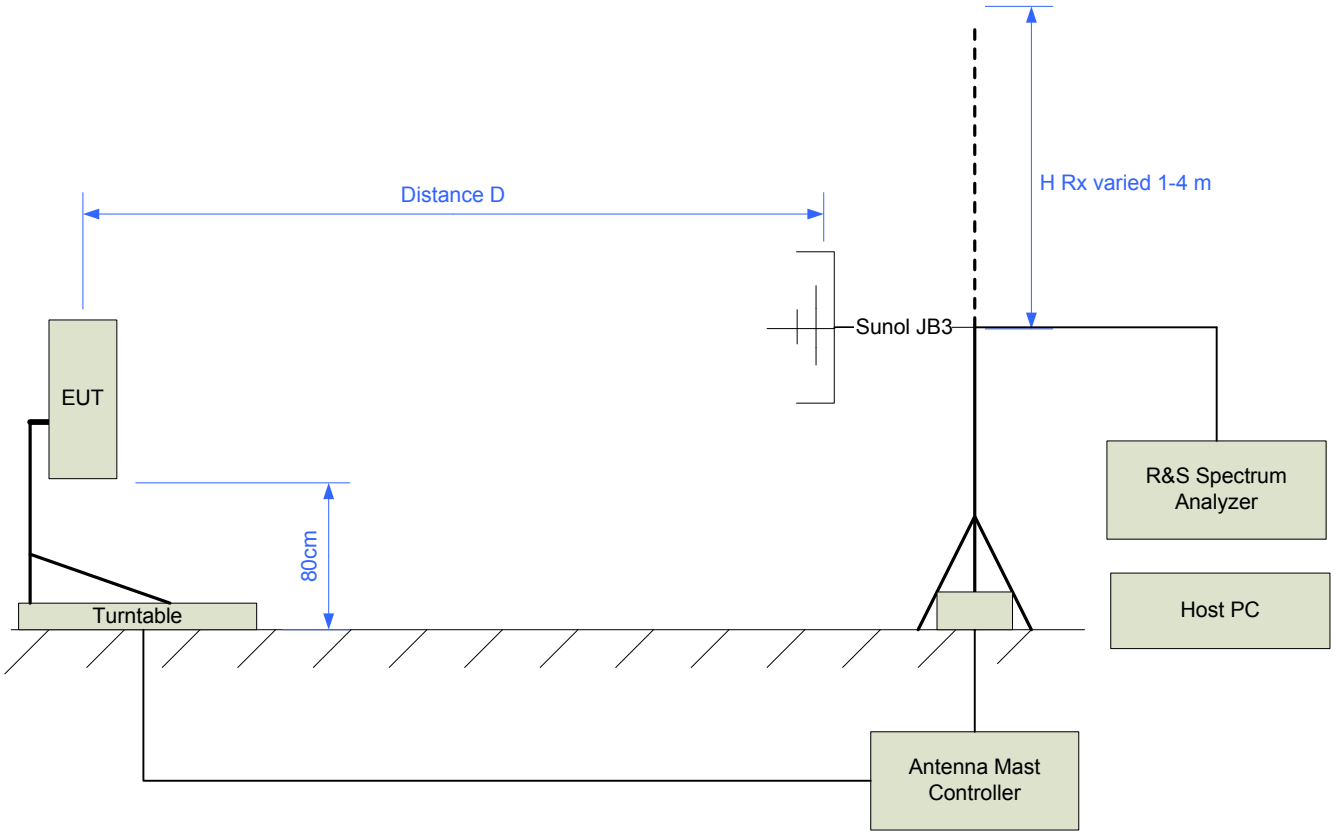
For radiated measurements, the EUT is connected to the antenna via 1m of shielded coaxial cable.

In TXM mode the unit alternates between transmitting at the **lowest, middle and highest channels**. Therefore the device was tested at 3 places in the band as per Part 15.31(m).

5.3.1 Test Setup Block Diagram – Conducted Measurements (Harmonics)

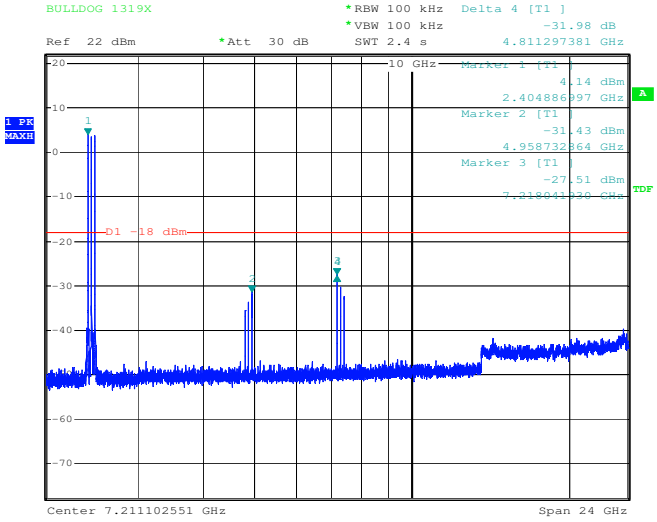


5.3.2 Test Setup Block Diagram – Radiated Measurements (Spurious)



5.4 Test Results

5.4.1 Test Results 15.247–Harmonics -20 dBc



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The above plot shows the conducted output of the transmitter. All conducted harmonics are at least -20 dBc

5.4.3 Test Results 15.247– Restricted Bands (Spurious Emissions)

The following data is taken from frequencies identified during radiated pre-testing at 1m. Data presented below was taken at a measurement distance of 3m. Only worst case data is shown.

Frequency (MHz)	Corr Reading (dBuV)	Limit (dBuV)	Margin (dB)	Polarization	Rtype	Result
4888.416	69.3	74.0	-4.7	Vertical	Peak	PASS
7443.656	65.0	74.0	-9.0	Vertical	Peak	PASS
9620.421	62.0	74.0	-12.0	Vertical	Peak	PASS

Please note Peak-Avg duty cycle delta is **29.8 dB**, therefore only peak data is shown.

6.0 Band Edge

6.1 Test Standard

FCC CFR 47, Part 15, Subpart B 15.247d

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

6.2 Test Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Sec. 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Sec. 15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a) (see Sec. 15.205(c)).

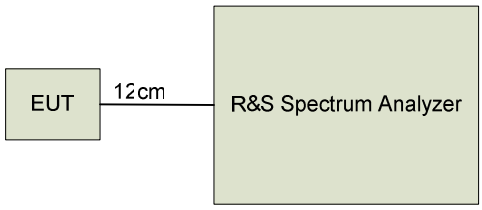
6.3 Test Setup

This was a conducted measurement. For this test the unit was configured in TXM mode on channel being investigated.

This test is performed on channels 1, and 15.

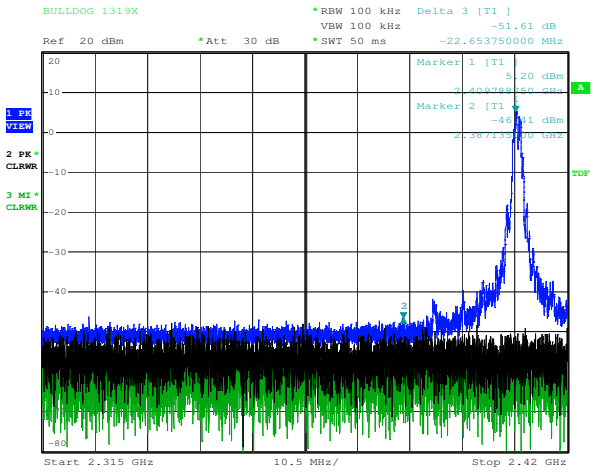
6.3.1 Test Setup Block Diagram

Conducted Setup



6.4 Test Results

This measurement is performed using the delta method. The conducted delta is measured using bandwidth settings of RBW, VBW = 100 KHz. This delta is then subtracted from the peak radiated power which is measured using settings of RBW,VBW = 1 MHz.



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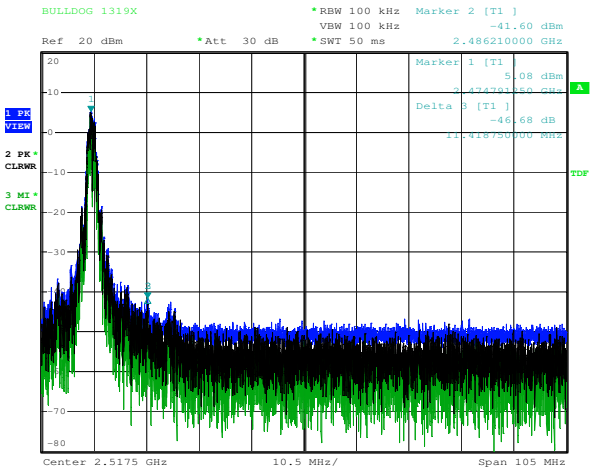

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Test result, Channel 1

Hi Reading (dBm)	Lo Reading (dBm)	Delta (dB)	Peak Rdg RBW,VBW = 1 MHz (dBuV)	Low Rdg RBW,VBW = 1MHz (dBuV)	Limit (dBuV)	Margin	Result
5.2	-46.41	-51.61	115.01	63.4	74.0	-10.6	PASS

Average Value (dBuV)	Limit (dBuV)	Margin	Result
33.6	54.0	-19.6	Pass

Test result, Channel 15

Hi Reading (dBm)	Lo Reading (dBm)	Delta (dB)	Peak Rdg RBW,VBW = 1 MHz (dBuV)	Low Rdg RBW,VBW = 1MHz (dBuV)	Limit (dBuV)	Margin	Result
5.08	-41.6	-46.68	115.01	68.33	74.0	-5.7	PASS

Average Value (dBuV)	Limit (dBuV)	Margin	Result
38.53	54.0	-14.7	PASS

7.0 Occupied Bandwidth

7.1 Test Standard

FCC CFR47, Part 15, Subpart B 15.247a

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(2) Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

7.2 Test Limits

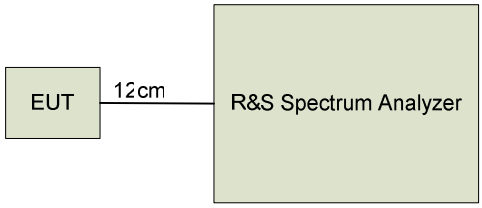
The minimum 6dB bandwidth shall be at least 500 kHz.

7.3 Test Setup

This is a conducted measurement. The EUT is configured in TXM mode.

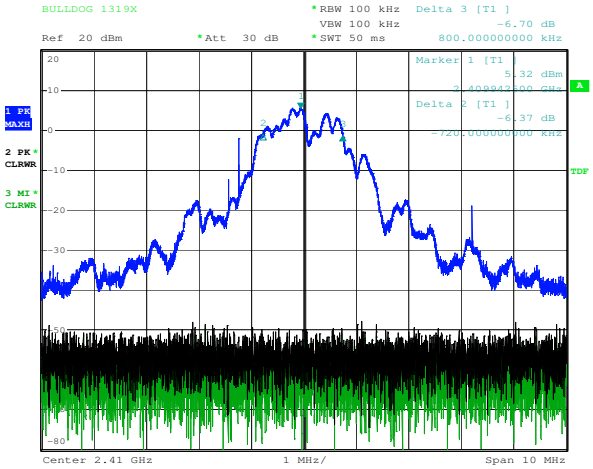
This test was performed on channels 1, 7 and 15.

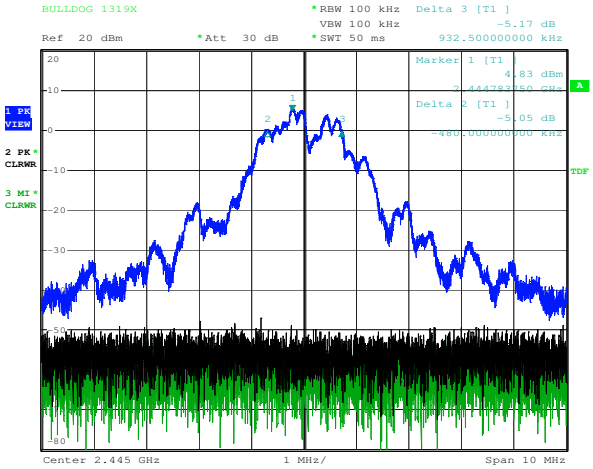
7.3.1 Test Setup Block Diagram

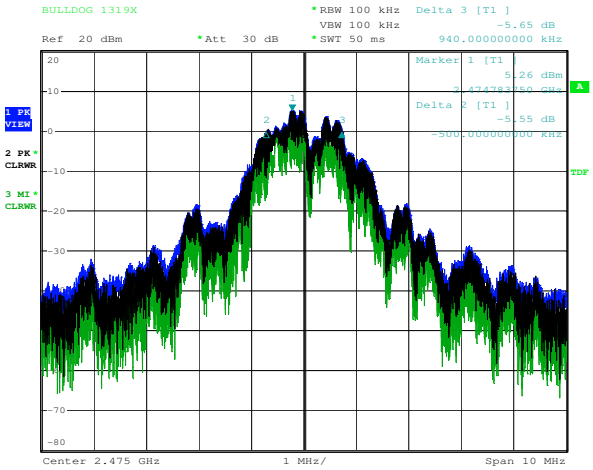


7.4 Test Results

6 dB Occupied Bandwidth







	Delta Low (kHz)	Delta High (kHz)	Occupied Bandwidth (kHz)	Result
CH 1	720	800	**1520.00**	PASS
Ch 7	480	932.5	**1412.50**	PASS
Ch 15	500	940	**1440.00**	PASS

8.0 Power Spectral Density

8.1 Test Standard

FCC CFR 47, Part 15, Subpart B 15.247e

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

8.2 Test Limits

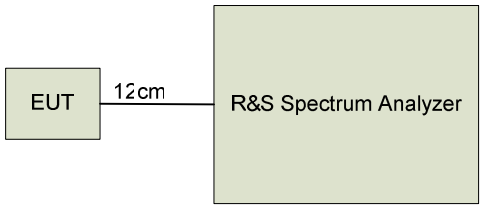
The transmitted power density shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.3 Test Setup

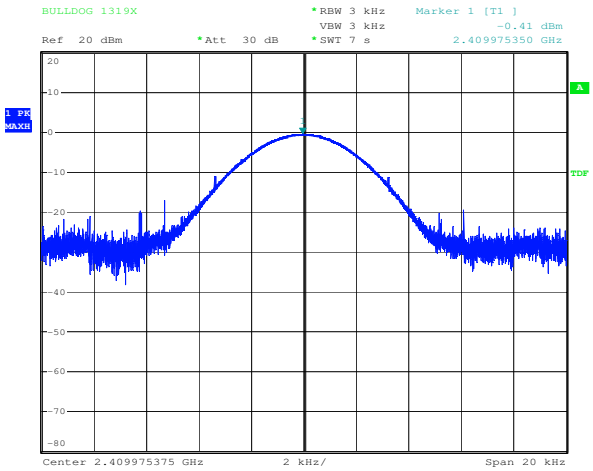
This is a conducted measurement. The EUT is configured in TXM mode on the channel under investigation.

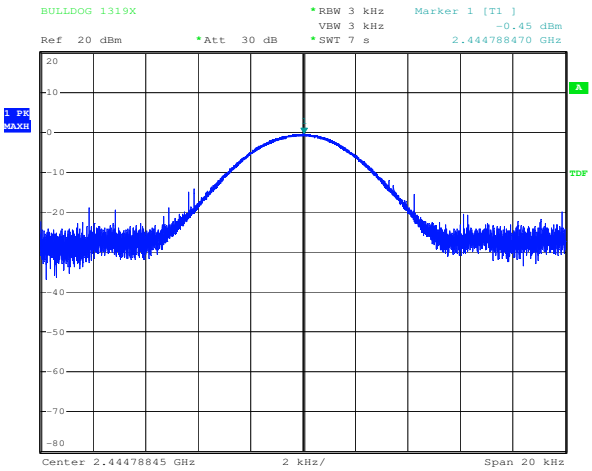
This test was performed on channels 1, 7 and 15.

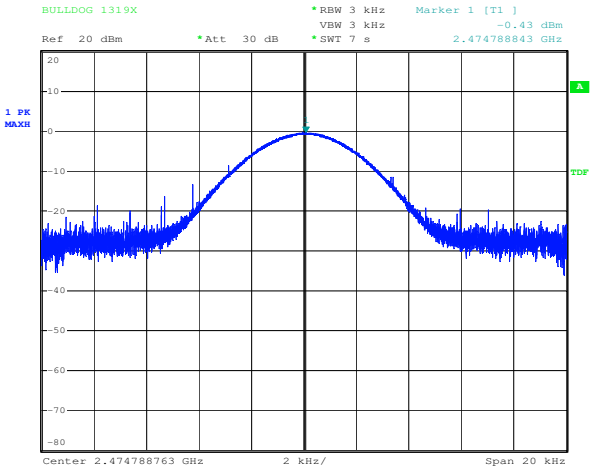
8.3.1 Test Setup Block Diagram



8.4 Test Results 15.247







Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
2409.975	-0.41	+8	PASS
2444.788	-0.45	+8	PASS
2474.789	-0.43	+8	PASS

Frequency span in the above plots is 20 kHz

9.0 RF Exposure Evaluation

FCC 1.1310 states the criteria listed in the table below shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter. Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, ``Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation."

Frequency Range (MHZ)	Electric Field Strength (V/m)	Magnetic Field Strength (A/M)	Power Density (mW/cm^2)	Average Time
(A) Limits for Occupational/Control Exposures				
300-1500	--	--	F/300	6
1500-100,000	--	--	5	6
(B) Limits for General Population/Uncontrolled Exposures				
300-1500	--	--	F/1500	6
1500-100,000	--	--	1	30

9.1 Fries Formula

Fries transmission formula: $Pd = (P_{out}*G)/(4*\pi*r^2)$ Where

Pd = power density in mW/cm^2
P_{out} = output power to antenna in mW.
G = gain of antenna in the direction of interest relative to an isotropic radiator.
R = the distance between the observation point and the center of the radiator in cm.

Pd is the limit of MPE, $1mW/cm^2$. If we know the maximum gain of the antenna and the total power input to the antenna we can calculate the distance r where the MPE limit is reached.

9.2 EUT Operating Condition

The maximum antenna gain is 9 dBi as stated by the manufacturer.

9.3 RF exposure evaluation distance calculation

EUT with 9 dBi antenna

Chan	Freq (MHz)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Antenna Gain (dBi)	r (cm)
1	2409	8.51	7	9	1.0
6	2444	8.39	7	9	1.0
11	2474	8.35	7	9	1.0

As shown above, the minimum distance where the MPE limit is reached is **1** cm for the EUT.

10.0 Test Photos

Radiated Emissions Test Setup

Conducted Emissions Test Setup