Nemko-CCL, Inc.

1940 West Alexander Street
Salt Lake City, UT 84119
801-972-6146

Test Report

Certification

Test Of: EPIC 3 RI & EPIC 3 TA

IC: 6453A-201141

Test Specifications:

RSS-Gen Issue 4 (November 2014)
RSS-247 Issue 1 (May 2015)

Test Report Serial No.: 285363-4.1

Applicant:
Scott Safety
4320 Goldmine Road
Monroe, NC 28110
U.S.A

Dates of Test: May 11 – 13, 2015

Report Issue Date: June 22, 2015

Accredited Testing Laboratory By:

NVLAP Lab Code 100272-0

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Nemko-CCL, Inc. to document compliance of the device described below with the requirements of RSS-Gen Issue 4 (November 2014) and RSS-247 Issue 1 (May 2015). This report may be reproduced in full. Partial reproduction may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

- Applicant: Scott Safety
- Manufacturer: Scott Safety
- Brand Name: Scott Safety
- Model Number: EPIC 3 RI and EPIC 3 TA
- IC: 6453A-201141

On this 22nd day June 2015, I, individually and for Nemko-CCL, Inc., certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has recognized that the Nemko-CCL, Inc. EMC testing facilities are in good standing, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

Nemko-CCL, Inc.

Tested by: Norman P. Hansen
Test Technician

Reviewed by: Mark M. Feil
EMC Engineer

Revision History		
Revision	Description	Date
1	Original Report Release	June 22, 2015
2	Plots section 6.2.7 have markers to show peak. Table of A1.1 show calibration information for equipment.	August 24, 2015

TABLE OF CONTENTS

PAGE

SECTION 1.0 CLIENT INFORMATION

1.1 Applicant:

Company Name: Scott Safety
4320 Goldmine Road
Monroe, NC 28110
U.S.A

Contact Name: Klaus Wilkens
Title: Senior Certification Engineer

1.2 Manufacturer:

Company Name: Scott Safety
4320 Goldmine Road
Monroe, NC 28110
U.S.A

Contact Name: Klaus Wilkens
Title: Senior Certification Engineer

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of EUT:

Brand Name:	Scott Safety
Model Number:	EPIC 3 RI and EPIC 3 TA
Hardware Version:	R06
Serial Number:	None
Dimensions:	10 cm x 6.8 cm x 5.0 cm

2.2 Description of EUT:

The EPIC 3 RI is SCBA mask mounted voice amplifier with Bluetooth wireless interface, 2.4 GHz proprietary transceiver, microphone, and internal speakers. The EPIC 3 RI proprietary 2.4 GHz transceiver uses an inverted F antenna with a maximum gain of -4.95 dBi that is soldered to the PCB. 74 channels, starting at 2401.9 MHz and ending at 2474.9 MHz, spaced every 1 MHz are used. The transceiver uses FSK modulation. The EPIC 3 RI is powered by 3 AAA batteries. The Bluetooth module is a Blugiga module carrying IC# 5132A-BGTWT32AE.

The EPIC 3 TA and EPIC 3 RI are identical and differ only in the software support of the transceivers.

This report covers the circuitry of the devices subject to RSS-247. The circuitry of the device subject to ICES-003 was found to be compliant and is covered in Nemko-CCL, Inc. report 285363-2.

2.3 EUT and Support Equipment:

The IC numbers for all the EUT and support equipment used during the test are listed below:

Brand Name Model Number Serial Number	IC Number or Compliance	Description	Name of Interface Ports / Interface Cables
BN: Scott Safety MN: EPIC 3 RI (Note 1) SN: None	6453A-201141 and contains 5132A-BGTWT32AE	SCBA mounted communication device	See Section 2.4
BN: Scott Safety MN: EPIC 3 TA (Note 1) SN: None	6453A-201141 and contains 5132A-BGTWT32AE	SCBA mounted communication device	See Section 2.4

Note: (1) EUT

2.4 Interface Ports on EUT:

There are no interface ports on the EUT.

2.5 Modification Incorporated/Special Accessories on EUT:

The following modifications were made to the EUT by the Client during testing to comply with the specification. This report is not complete without an accompanying signed attestation, that the product will have all of the documented modifications incorporated into the product when manufactured and placed on the market.

1. The power setting was reduced from +20 to +16 for all channels. +16 will be set as the maximum power setting in firmware and will not be user accessible.

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES

3.1 Test Specification:

Title:	RSS-Gen Issue 4 (November 2014) RSS-247 Issue 1 (May 2015)
Purpose of Test:	The tests were performed to demonstrate initial compliance.

3.2 Requirements:

3.2.1 RSS-Gen 6.6 Occupied Bandwidth

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously. The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

3.2.2 RSS-Gen Section 8.3 Transmitter Antenna

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level.9 When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

3.2.3 RSS-Gen Section 8.8 AC Power Lines Conducted Emission Limits for Licence-Exempt Radio Apparatus

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in Table 3.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 3 below. The more stringent limit applies at the frequency range boundaries.

The conducted emissions shall be measured in accordance with the reference publication mentioned in Section 3.

Table 3 – AC Power Line conducted Emissions Limits

Frequency (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average**
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

*The level decreases linearly with the logarithm of the frequency.
**A linear average detector is required.

3.2.4 RSS-Gen 8.10 Restricted Frequency Bands

Restricted bands, identified in Table 6, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

(a) Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 6 except for apparatus complying under RSS-287;
(b) Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and
(c) Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

3.2.5 RSS-247 5.1 Frequency Hopping Systems (FHSs)

FHSs employ a spread spectrum technology in which the carrier is modulated with coded information in a conventional manner, causing a conventional spreading of the radio frequency (RF) energy around the carrier frequency. The carrier frequency is not fixed, but changes at fixed intervals under the direction of a coded sequence.

FHSs are not required to employ all available hopping frequencies during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the requirements in this section in case the transmitter is presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of frequency hopping equipment and must distribute its transmissions over the minimum number of hopping channels specified in this section.

Incorporation of intelligence into an FHS that enables it to recognize other users of the band and to avoid occupied frequencies is permitted provided that the FHS does it individually and independently chooses or adapts its hopset. The coordination of FHSs in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

The following applies to FHSs in each of the three bands:

(1) The bandwidth of a frequency hopping channel is the -20 dB emission bandwidth, measured with the hopping stopped. The system's radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The hopset shall be such that the near-term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset, whereas the long-term distribution appears evenly distributed.

(2) FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the -20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(3) For FHSs in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

(4) FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

(5) FHSs operating in the band 5725-5850 MHz shall use at least 75 hopping channels. The maximum 20 dB bandwidth of the hopping channel shall be 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30-second period.

3.2.6 RSS-247 5.2 Digital Transmission Systems (DTSs)

DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz[1]:

(1) The minimum 6 dB bandwidth shall be 500 kHz.

(2) The transmitter power spectral density conducted from the transmitter 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 Section 5.4(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

3.2.7 RSS-247 5.3 Hybrid Systems

Hybrid systems employ a combination of both frequency hopping and digital transmission techniques and shall comply with the following:

(1) With the digital transmission operation of the hybrid system turned off, the frequency hopping operation shall have an average time of occupancy on any frequency not exceeding 0.4 seconds within a duration in seconds equal to the number of hopping frequencies multiplied by 0.4.

(2) With the frequency hopping turned off, the digital transmission operation shall comply with the power spectral density requirements for digital modulation systems set out in of Section 5.2(2) above or Section 6.2.4 for hybrid devices operating in the band 5725-5850 MHz.

3.2.8 RSS-247 5.4 Transmitter Output Power and Equivalent Isotropically Radiated Power (E.I.R.P.) Requirements

(1) For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

(2) For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

(3) For FHSs operating in the band 5725-5850 MHz, the maximum peak conducted output power shall not exceed 1 W, and the e.i.r.p. shall not exceed 4 W (see Section 5.4(5) for exceptions).

(4) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling 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 transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

(5) Fixed point-to-point systems in the bands 2400-2483.5 MHz and 5725-5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems,[2] omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W.

(6) Transmitters may operate in the band 2400-2483.5 MHz, employing antenna systems that emit multiple directional beams simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers, provided that the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams, but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device (i.e. the sum of the power supplied to all antennas, antenna elements, staves, etc., and summed across all carriers or frequency channels) shall not exceed the applicable output power limit specified in sections 5.4(2) and 5.4(4). However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the applicable power limit specified in sections 5.4(2) and 5.4(4). If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the applicable limit specified in sections 5.4(2) and 5.4(4). In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the applicable limit specified in sections 5.4(2) and 5.4(4) by more than 8 dB.

(iv) Transmitters that transmit a single directional beam shall operate under the provisions of sections 5.4(2), 5.4(4) and 5.4(5).

3.2.9 RSS-247 5.5 Unwanted Emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

[1] DTSs operating in the band 5725-5850 MHz shall meet the requirements of Section 6 of this document.
[2] However, remote stations of point-to-multipoint systems shall be permitted to operate at an e.i.r.p. greater than 4 W under the same conditions as for point-to-point systems.

3.3 Test Procedure:

The testing was performed according to the procedures in RSS-Gen Issue 4, RSS-247 Issue 1, and ANSI C63.10-2013. Testing was performed at Nemko-CCL, Inc.'s Wanship open area test site #2, located at 29145 Old Lincoln Highway, Wanship, UT. This site has been registered with Industry Canada, and was accepted under Industry Canada Assigned Code 2041A-2 effective until January 19, 2018.

Nemko-CCL, Inc. is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Lab Code: 100272-0, which is effective until September 30, 2015.

SECTION 4.0 OPERATION OF EUT DURING TESTING

4.1 Operating Environment:

Power Supply: 4.5 Vdc from 3 – AAA batteries

4.2 Operating Modes:

The transmitter was tested on 3 orthogonal axes while in a constant transmit mode at the upper, middle, and lower channels. New batteries used in testing. The worst-case radiated spurious emissions were seen with the EUT placed vertically on the test table. See Photograph 1 of Appendix 2.

4.3 EUT Exercise Software:

Test firmware, Rev 1, was used to exercise the transmitter for testing.

SECTION 5.0 SUMMARY OF TEST RESULTS

5.1 RSS-Gen and RSS-247

The EUT was subjected to each of the tests shown in the summary table below.

5.1.1 Summary of Tests:

Reference	Requirement	Frequency Range (MHz)	Result
RSS-Gen 6.6	99% Occupied Bandwidth	2400 – 2483.5	Complied
RSS-Gen 8.3	Transmitter Antenna	N/A	Complied
RSS-Gen 8.8	AC Power Line Conducted Emissions Limits	0.15 – 30	Not Applicable (Note 1)
RSS-Gen 8.10	Emissions Falling Within Restricted Frequency Bands	0.009 - 24835	Complied
RSS-247 – 5.1	20 dB Bandwidth for FHSs	2400 – 2483.5	Not Applicable
RSS-247 – 5.1	Channel Separation for FHSs	2400 – 2483.5	Not Applicable
RSS-247 – 5.1	Channel Time of Occupancy for FHSs	2400 – 2483.5	Not Applicable
RSS-247 – 5.2	6 dB Bandwidth for DTSs	2400 – 2483.5	Complied
RSS-247 – 5.2	3 kHz Power Spectral Density for DTSs	2400 – 2483.5	Complied
RSS-247 – 5.3	Channel Time of Occupancy for Hybrid Systems	2400 – 2483.5	Not Applicable
RSS-247 – 5.3	3 kHz Power Spectral Density for Hybrid Systems	2400 – 2483.5	Not Applicable
RSS-247 – 5.4	Transmitter Output Power and E.I.R.P.	2400 – 2483.5	Complied
RSS-247 – 5.5	Unwanted Emissions	0.009 - 24835	Complied
Note 1: The EUT is battery powered with no provision for connection to the AC mains or a device that connects to the AC mains; therefore, this test is not applicable.			

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

SECTION 6.0 MEASUREMENTS AND RESULTS

6.1 General Comments:

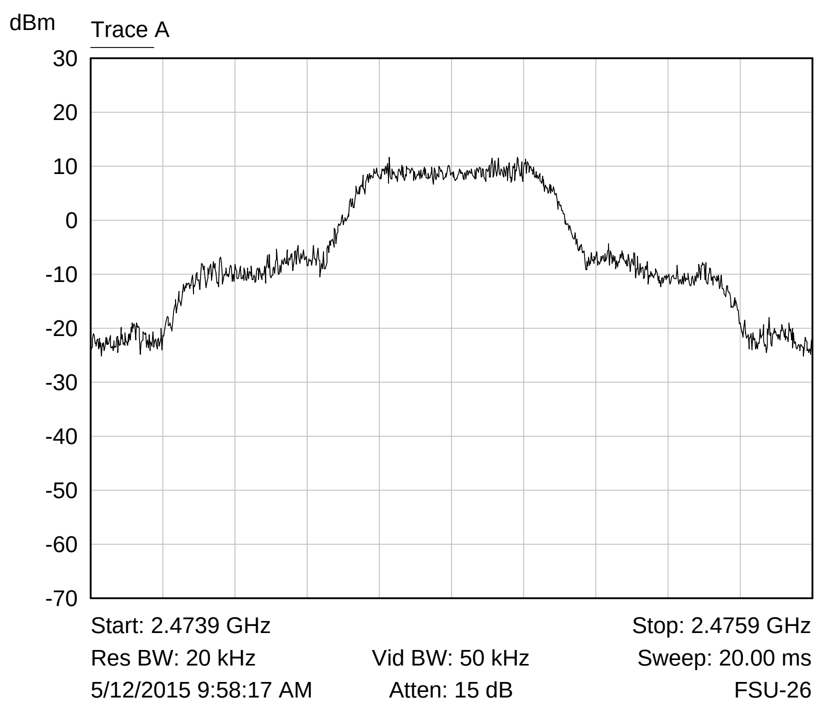
This section contains the test results and determinations only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Appendix 1 of this report.

6.2 Test Results:

6.2.1 RSS-Gen 6.6 Occupied Bandwidth

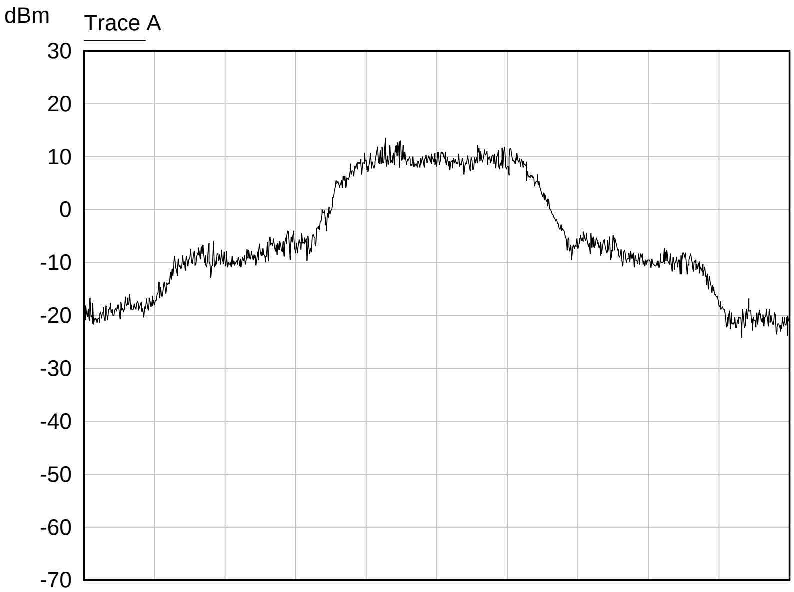
The 99% emission bandwidth was measured with the Rohde & Schwartz FSU26 using Industry Canada procedures. The 99% emission bandwidths are shown below.

Frequency (MHz)	Emission 99% bandwidth (MHz)
2401.9	1.10
2437.9	1.12
2474.9	1.10



Trace A

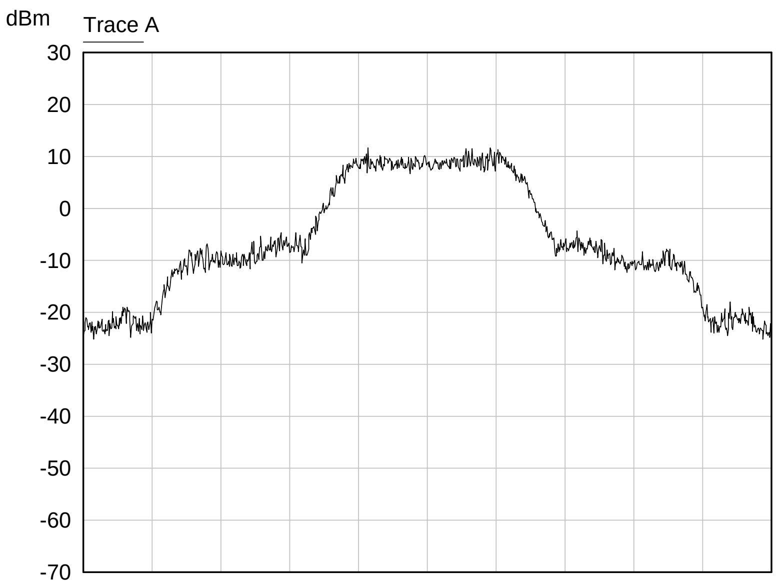
Measurement Parameter	Value
Occupied Power Bandwidth	1.10 MHz



Start: 2.4369 GHz Stop: 2.4389 GHz
Res BW: 20 kHz Vid BW: 50 kHz Sweep: 20.00 ms
5/12/2015 10:41:05 AM Atten: 15 dB FSU-26

Trace A

Measurement Parameter	Value
Occupied Power Bandwidth	1.12 MHz



Start: 2.4739 GHz Stop: 2.4759 GHz
Res BW: 20 kHz Vid BW: 50 kHz Sweep: 20.00 ms
5/12/2015 9:58:17 AM Atten: 15 dB FSU-26

Trace A

Measurement Parameter	Value
Occupied Power Bandwidth	1.10 MHz

6.2.2 RSS-Gen 8.3 Transmitter Antenna

The EUT uses an inverted F antenna that is soldered to the PCB. See Photograph 16 of Appendix 2.

6.2.3 RSS-Gen 8.10 Emissions Falling Within Restricted Frequency Bands

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any radiated emissions in the restricted bands. Shown below are plots with the EUT tuned to the upper and lower channels in the different modes of operation. These demonstrate compliance with the provisions of this section at the band edges. The tables show measurements of any emission that fell into the restricted bands of RSS-Gen Table 1. The tables show the worst-case emission measured. The emissions in the restricted bands must meet the limits specified in RSS-Gen Table 5. The tabular data shows the emission in the restricted bands.

AVERAGE FACTOR

There was no average factor applied.

Transmitting at the Lowest Frequency (2401.9 MHz)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4803.8	Peak	Vertical	16.1	38.9	55.0	74.0	-19.0
4803.8	Average	Vertical	10.1	38.9	49.0	54.0	-5.0
4803.8	Peak	Horizontal	10.0	38.9	48.9	74.0	-25.1
4803.8	Average	Horizontal	3.7	38.9	42.6	54.0	-11.4
7205.7	Peak	Vertical	10.6	43.3	53.9	74.0	-20.1
7205.7	Average	Vertical	0.6	43.3	43.9	54.0	-10.1
7205.7	Peak	Horizontal	7.3	43.3	50.6	74.0	-23.4
7205.7	Average	Horizontal	-1.9	43.3	41.4	54.0	-12.6
12009.5	Peak	Vertical	-3.0	49.1	46.1	74.0	-27.9
12009.5	Average	Vertical	-9.1	49.1	40.0	54.0	-14.0
12009.5	Peak	Horizontal	-2.9	49.1	46.2	74.0	-27.8
12009.5	Average	Horizontal	-10.5	49.1	38.6	54.0	-15.4

Transmitting at the Middle Frequency (2437.9 MHz)

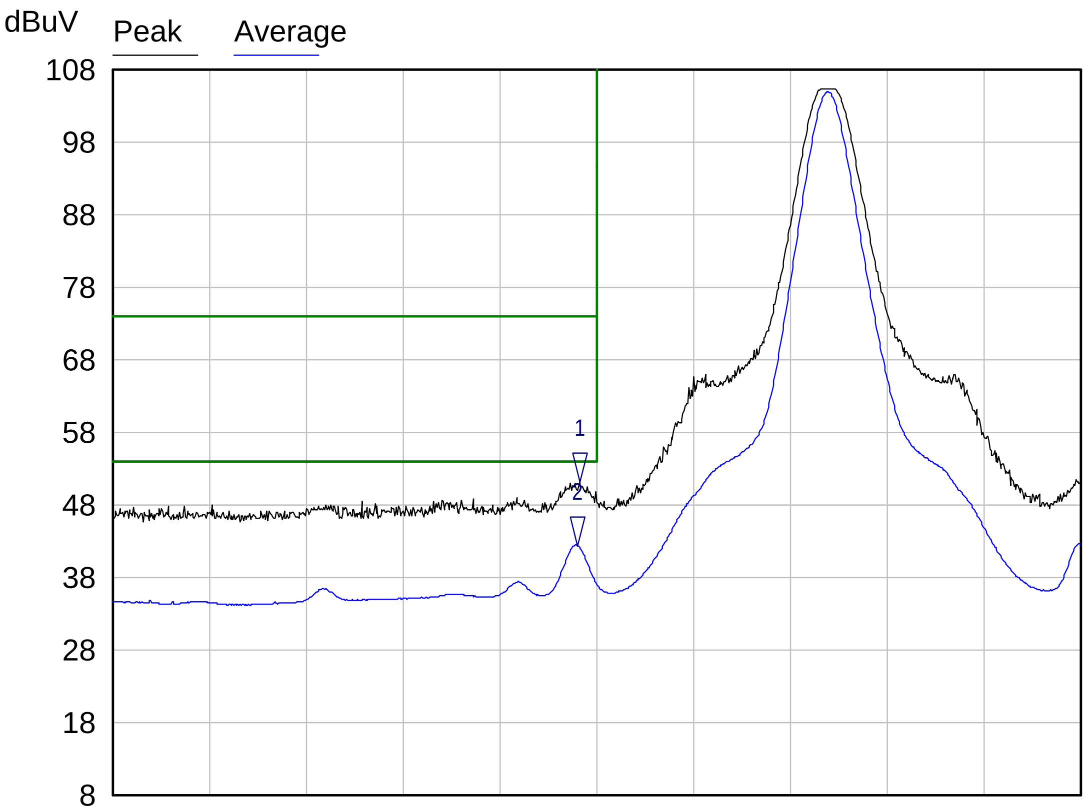
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4875.8	Peak	Vertical	15.0	39.2	54.2	74.0	-19.8
4875.8	Average	Vertical	9.0	39.2	48.2	54.0	-5.8
4875.8	Peak	Horizontal	10.1	39.2	49.3	74.0	-24.7
4875.8	Average	Horizontal	3.9	39.2	43.1	54.0	-10.9
7313.7	Peak	Vertical	6.9	43.7	50.6	74.0	-23.4
7313.7	Average	Vertical	-3.5	43.7	40.2	54.0	-13.8
7313.7	Peak	Horizontal	7.7	43.7	51.4	74.0	-22.6
7313.7	Average	Horizontal	-1.6	43.7	42.1	54.0	-11.9
12189.5	Peak	Vertical	-2.8	49.1	46.3	74.0	-27.7
12189.5	Average	Vertical	-9.7	49.1	39.4	54.0	-14.6
12189.5	Peak	Horizontal	-3.1	49.1	46.0	74.0	-28.0
12189.5	Average	Horizontal	-10.2	49.1	38.9	54.0	-15.1

Transmitting at the Highest Frequency (2474.9 MHz)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4949.8	Peak	Vertical	15.2	39.3	54.5	74.0	-19.5
4949.8	Average	Vertical	9.3	39.3	48.6	54.0	-5.4
4949.8	Peak	Horizontal	11.2	39.3	50.5	74.0	-23.5
4949.8	Average	Horizontal	4.9	39.3	44.2	54.0	-9.8
7424.7	Peak	Vertical	6.4	44.0	50.4	74.0	-23.6
7424.7	Average	Vertical	-3.1	44.0	40.9	54.0	-13.1
7424.7	Peak	Horizontal	5.0	44.0	49.0	74.0	-25.0
7424.7	Average	Horizontal	-4.7	44.0	39.3	54.0	-14.7
12374.5	Peak	Vertical	-3.4	49.1	45.7	74.0	-28.3
12374.5	Average	Vertical	-10.9	49.1	38.2	54.0	-15.8
12374.5	Peak	Horizontal	-3.8	49.1	45.3	74.0	-28.7
12374.5	Average	Horizontal	-11.0	49.1	38.1	54.0	-15.9

No other emissions were seen in the restricted bands.

Radiated Lower Band Edge Plot

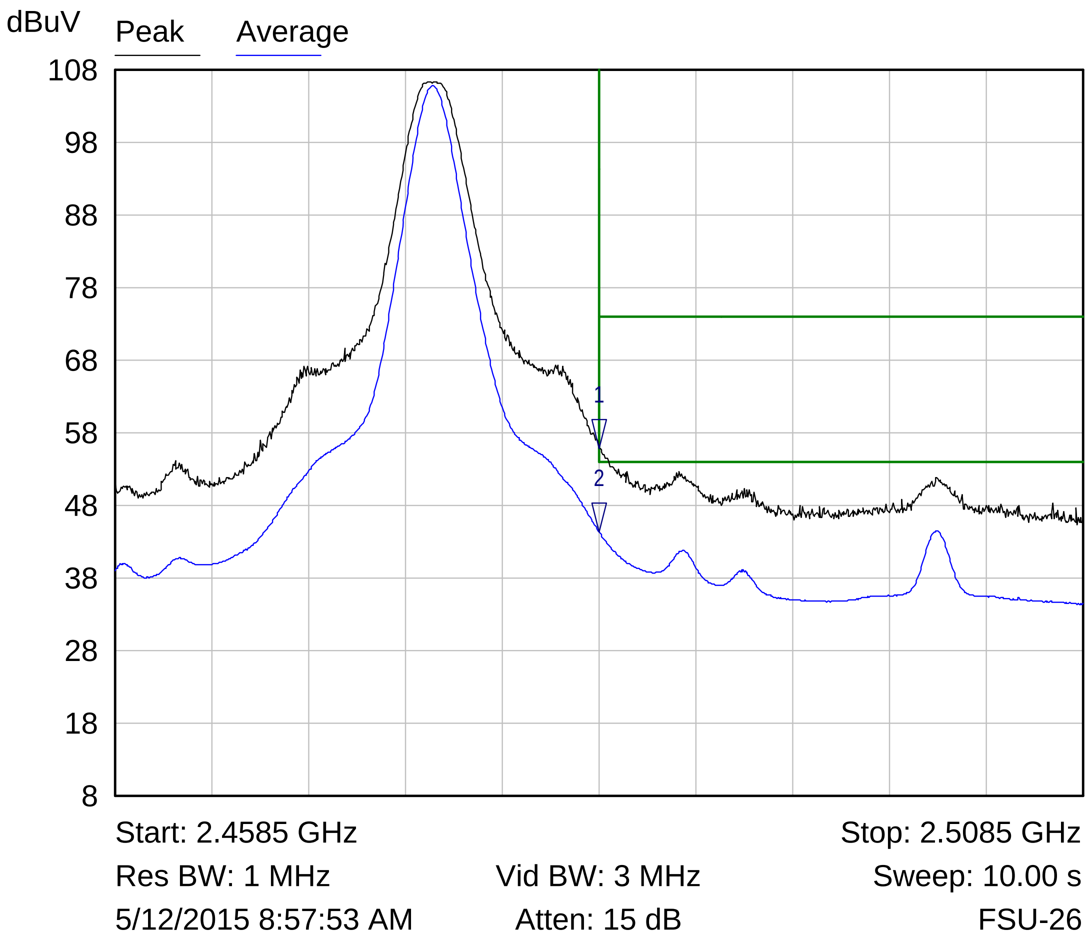


Start: 2.3650 GHz Stop: 2.4150 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 10.00 s
5/12/2015 9:07:04 AM Atten: 15 dB FSU-26

Mkr	Trace	X-Axis	Value	Notes
1 ∇	Peak	2.3891 GHz	51.11 dBuV	
2 ∇	Average	2.3890 GHz	42.41 dBuV	

power setting +16, EUT placed vertical, receive antenna horizontal

Radiated Upper Band Edge Plot



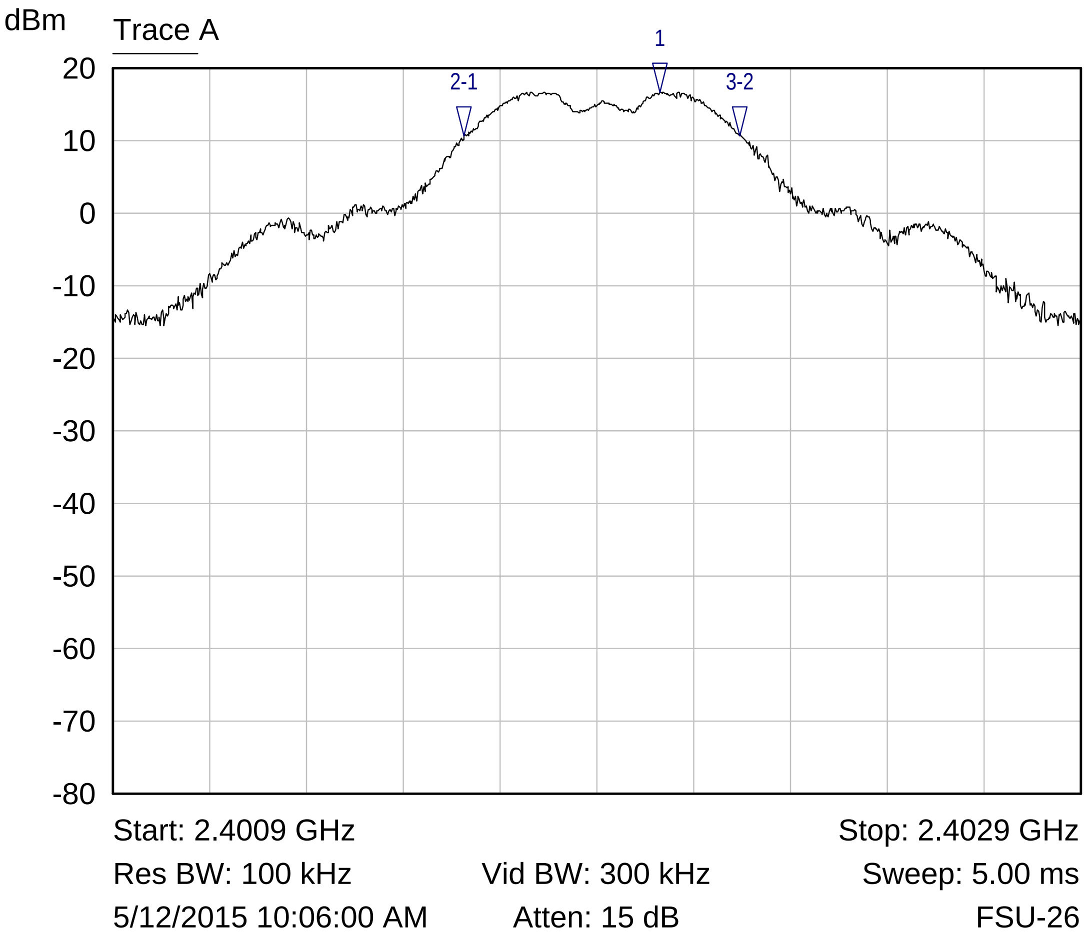
Mkr	Trace	X-Axis	Value	Notes
1 ∇	Peak	2.4835 GHz	55.77 dBuV	
2 ∇	Average	2.4835 GHz	44.35 dBuV	

power setting +16, EUT placed vertical, receive antenna horizontal

6.2.4 RSS-247 – 5.2 Minimum 6dB Bandwidth

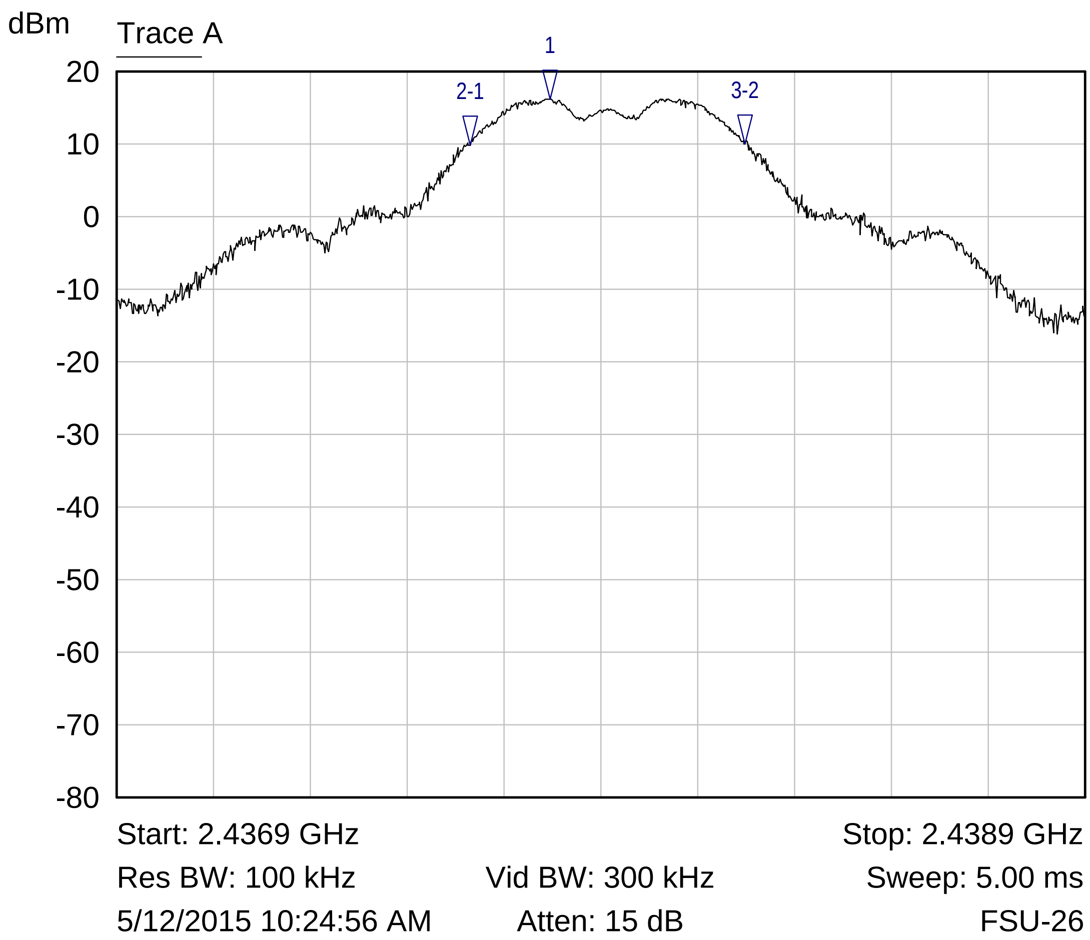
The minimum 6 dB bandwidth of the channel shall be 500 kHz.

Lowest Channel 6 dB Bandwidth



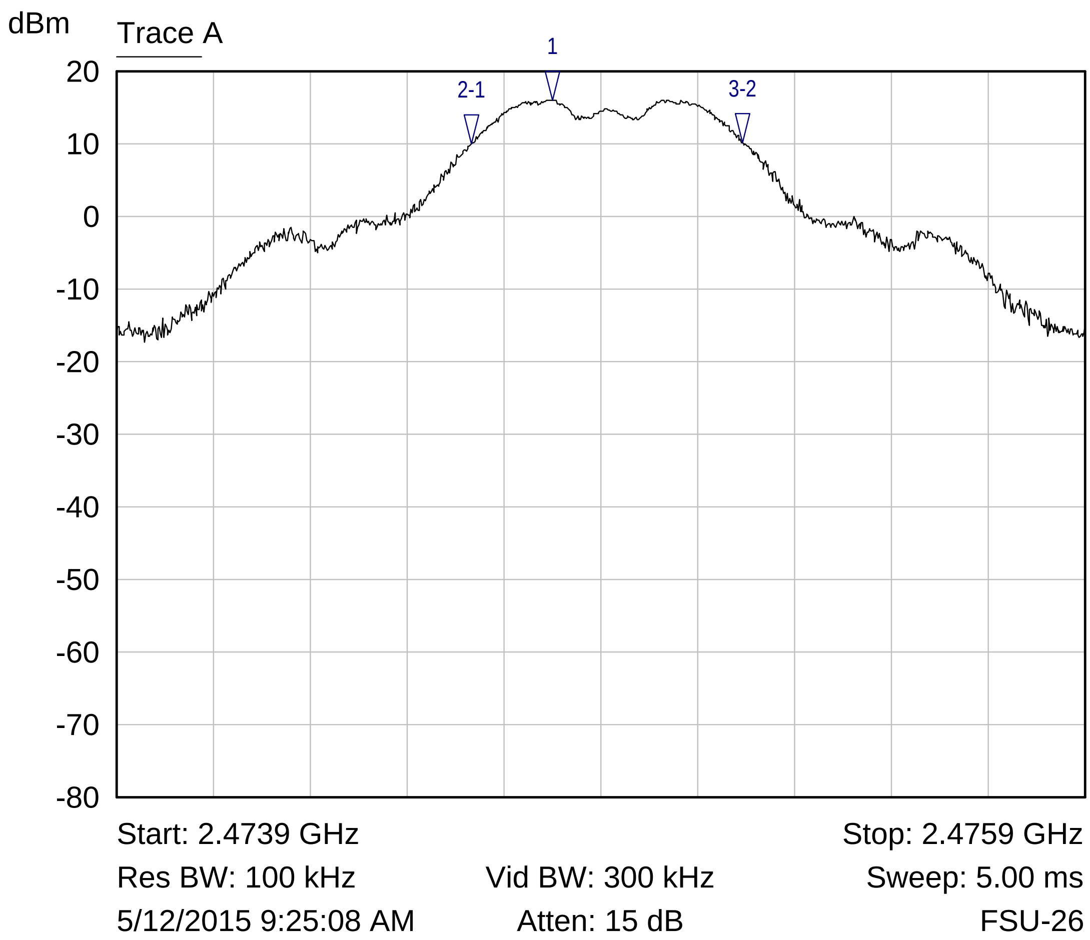
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4020 GHz	16.67 dBm	
2-1 ▽	Trace A	-404.0000 kHz	-5.94 dB	
3-2 ▽	Trace A	568.0000 kHz	-0.09 dB	

Middle Channel 6 dB Bandwidth



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4378 GHz	16.21 dBm	
2-1 ▽	Trace A	-164.0000 kHz	-6.32 dB	
3-2 ▽	Trace A	568.0000 kHz	0.08 dB	

Highest Channel 6 dB Bandwidth



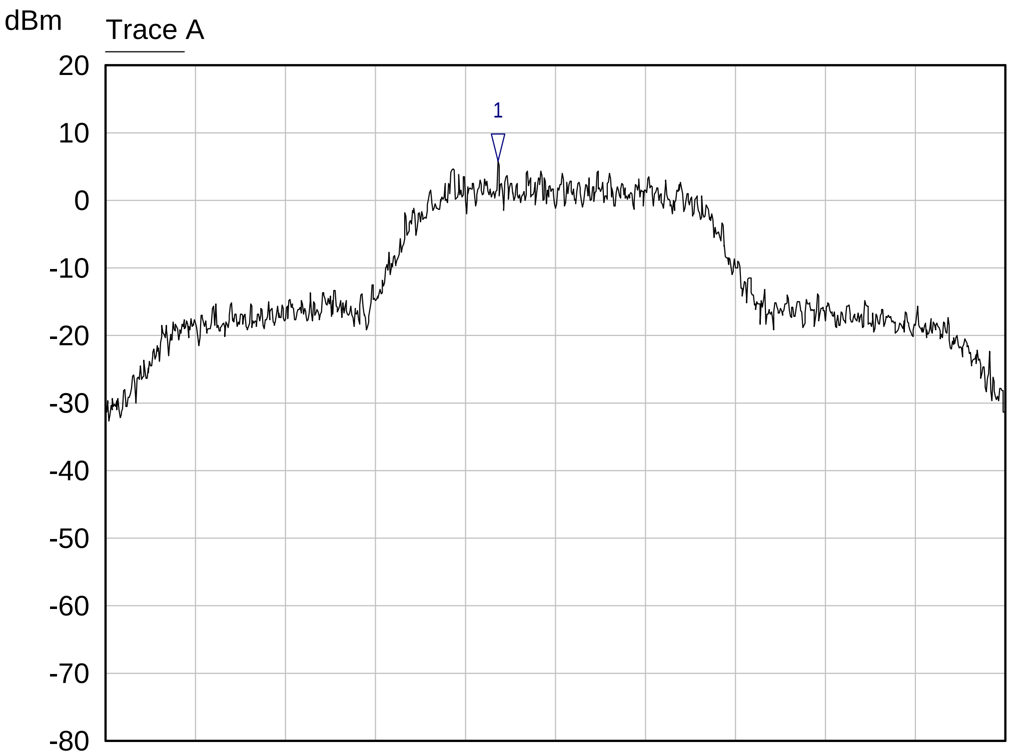
Mkr	Trace	X-Axis	Value	Notes
1 ∇	Trace A	2.4748 GHz	16.07 dBm	
2-1 ∇	Trace A	-168.0000 kHz	-5.99 dB	
3-2 ∇	Trace A	560.0000 kHz	0.09 dB	

6.2.5 RSS-247 – 5.2 3 kHz Power Spectral Density

The peak 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 The result of this testing is shown in the plots and summarized in the table below.

Frequency (MHz)	Measurement (dBm)
2401.9	5.90
2437.9	5.40
2474.9	3.79

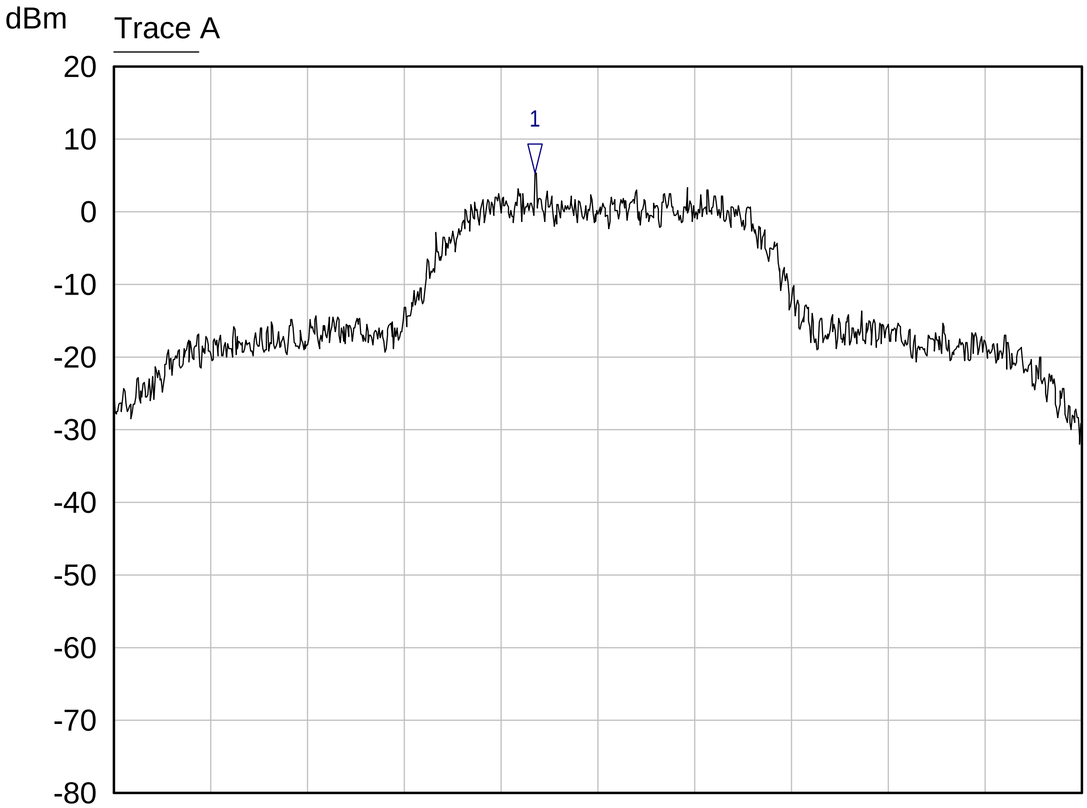
Lowest Channel 3 kHz PSD Plot



Start: 2.4011 GHz Stop: 2.4027 GHz
Res BW: 3 kHz Vid BW: 10 kHz Sweep: 190.00 ms
5/12/2015 10:08:42 AM Atten: 15 dB FSU-26

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4018 GHz	5.90 dBm	

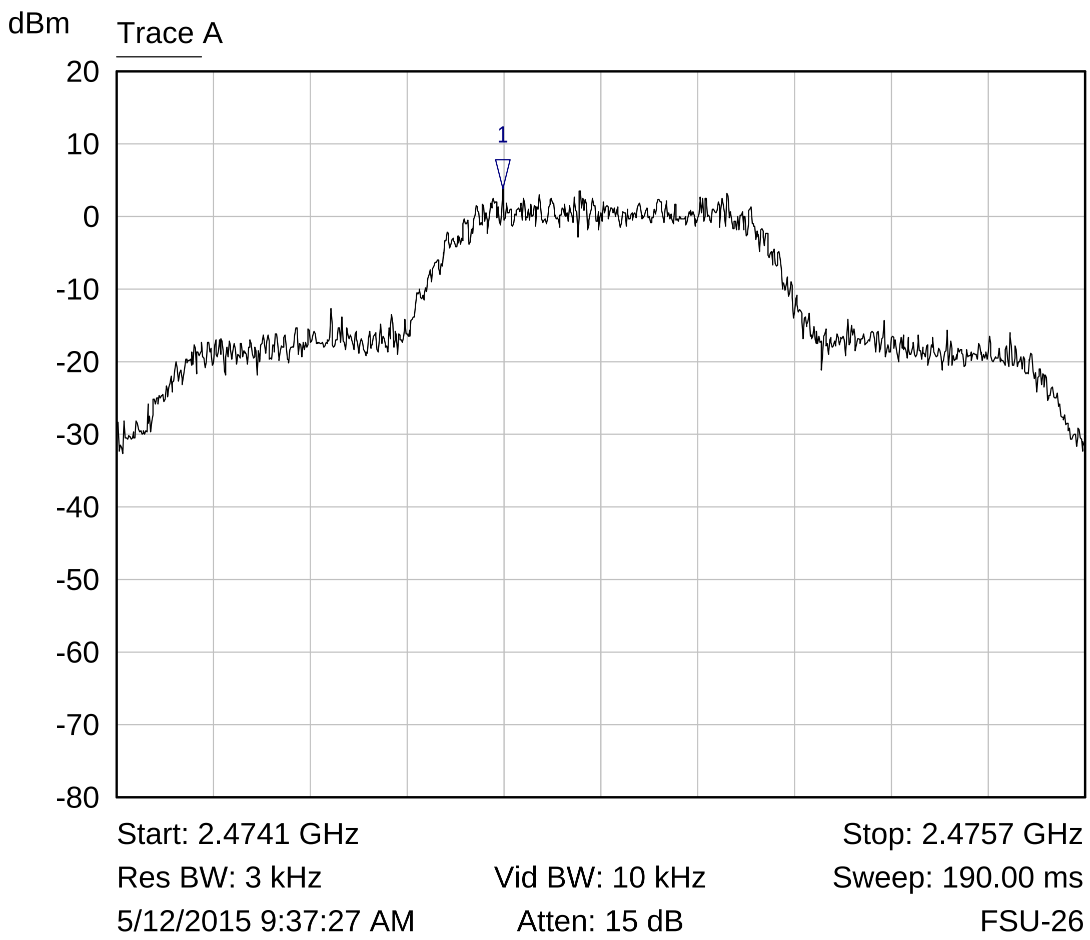
Middle Channel 3 kHz PSD Plot



Start: 2.4371 GHz Stop: 2.4387 GHz
Res BW: 3 kHz Vid BW: 10 kHz Sweep: 190.00 ms
5/12/2015 10:42:43 AM Atten: 15 dB FSU-26

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4378 GHz	5.40 dBm	

Highest Channel 3 kHz PSD Plot



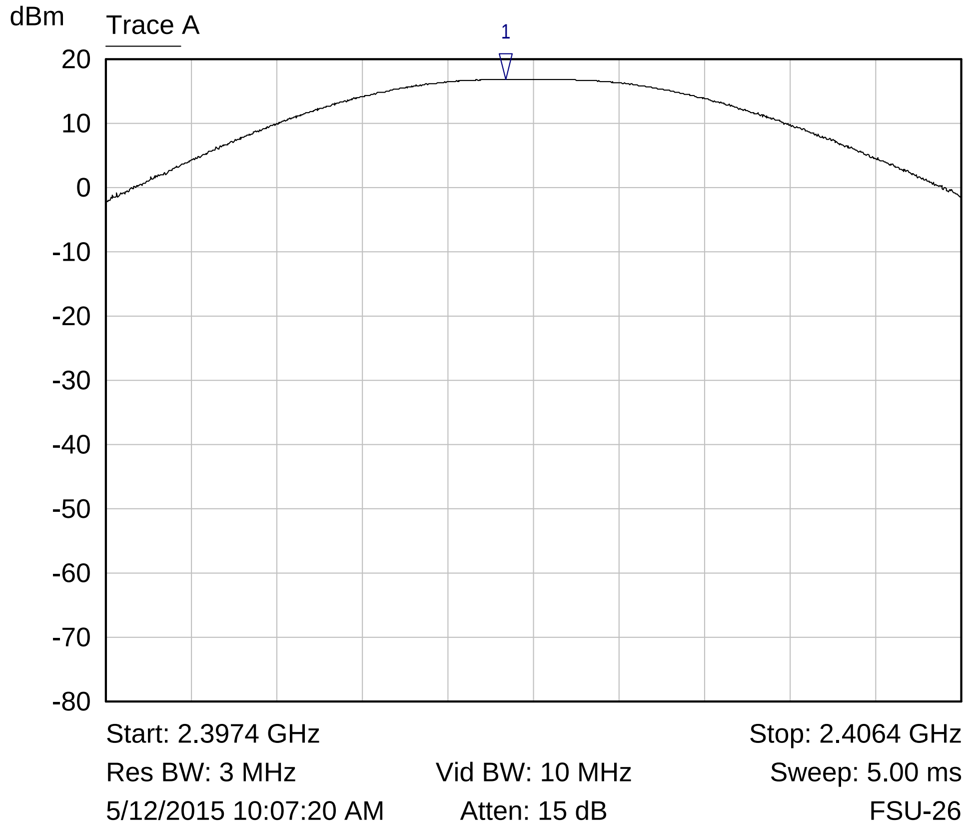
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4747 GHz	3.79 dBm	

6.2.6 RSS-247 – 5.4 Transmitter Output Power and E.I.R.P.

The maximum peak conducted output power limit is 1.0 Watt. The E.I.R.P. must not exceed 4.0 Watts.

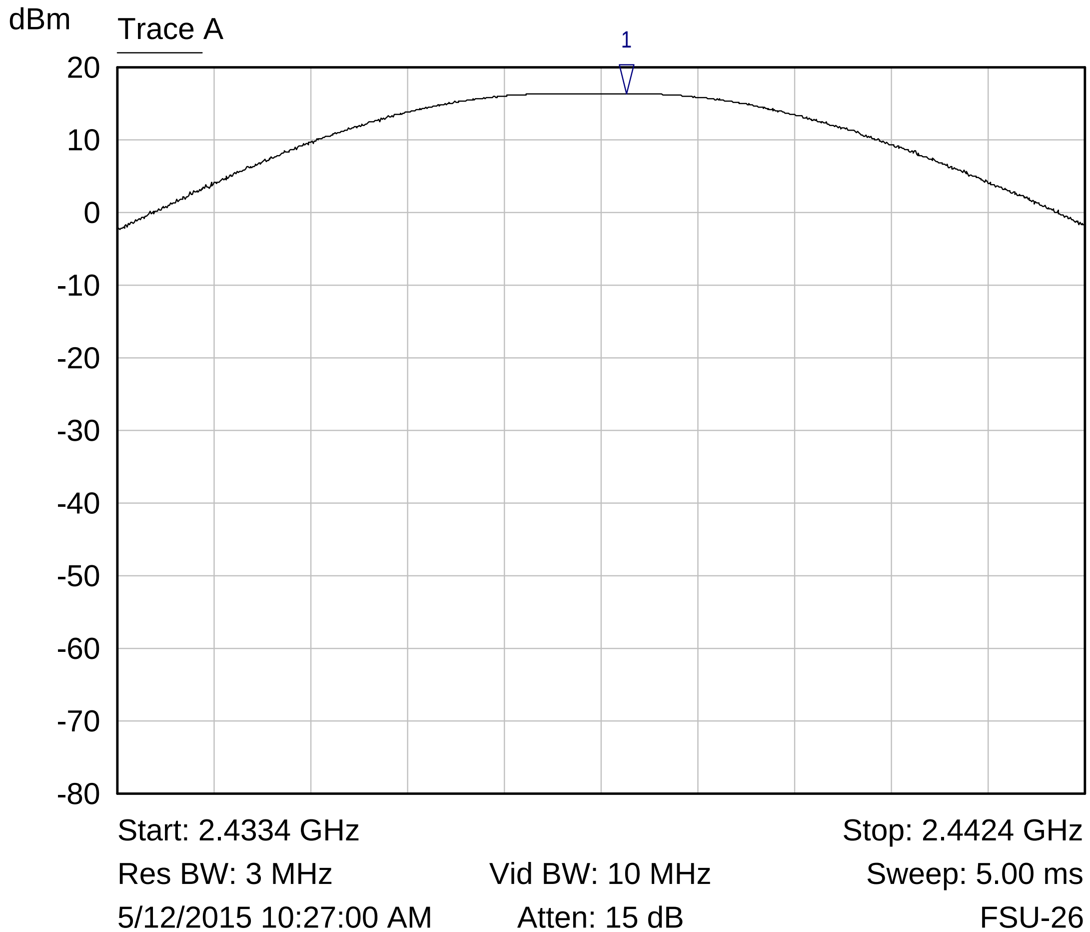
Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (mW)	Measured Field Strength (dBμV/m)	E.I.R.P (Watts)
2401.9	16.83	48.2	105.4	0.0104
2437.9	16.40	43.7	105.8	0.0114
2474.9	16.02	40.0	106.3	0.0128

Lowest Channel Output Power Plot



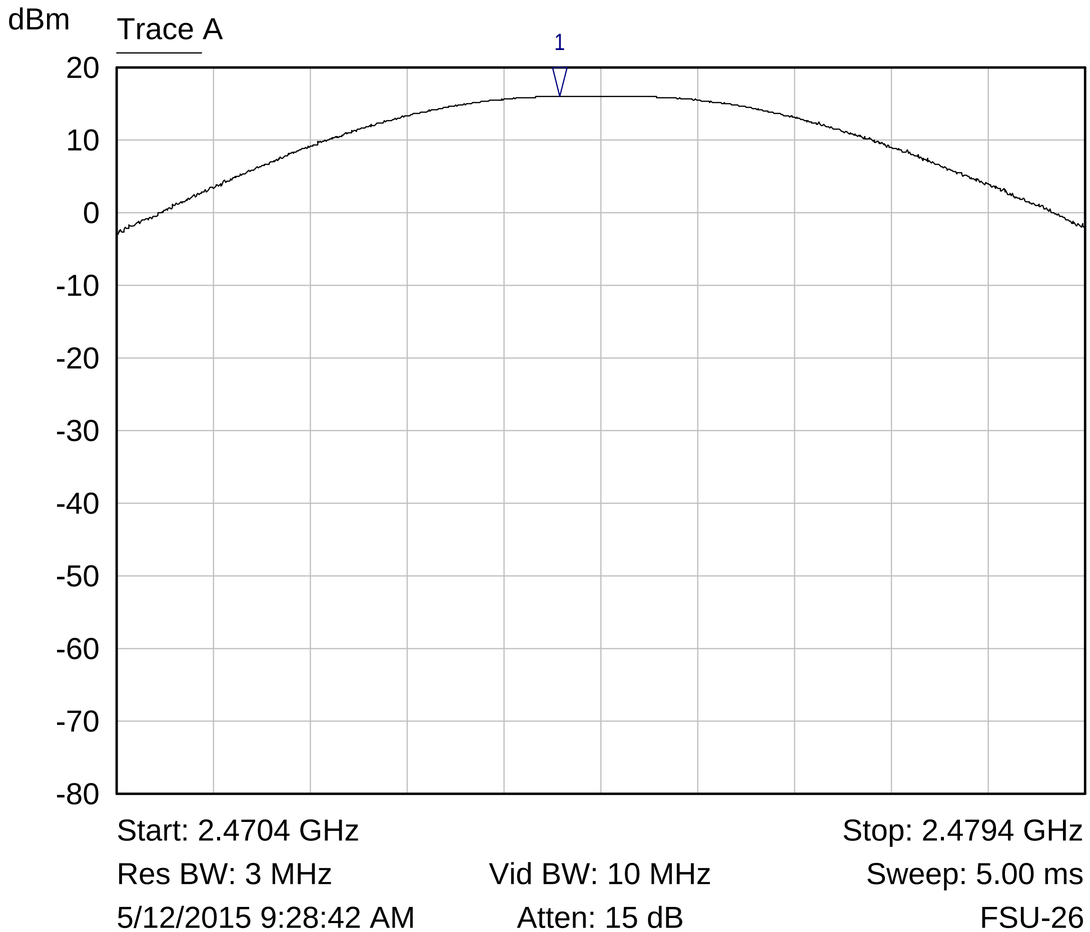
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4016 GHz	16.83 dBm	

Middle Channel Output Power Plot



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4381 GHz	16.40 dBm	

Highest Channel Output Power Plot



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4745 GHz	16.02 dBm	

6.2.7 RSS-247 – 5.5 Unwanted Emissions

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The tables show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency, and upper frequency. Shown below are plots with the EUT tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section at the band edges.

The emissions must be attenuated 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW. The highest level measured using a 100 kHz RBW was 16.74 dBm; therefore, the criteria is 16.74 – 20 = -3.3 dBm.

Transmitting on the Lowest Channel (2401.9 MHz)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4803.8	-33.3	-3.3	-30.0
7205.7	-20.6	-3.3	-17.3
9607.6	-46.4	-3.3	-43.1
12009.5	-47.2	-3.3	-43.9
14411.4	-64.8	-3.3	-61.5
16813.3	-61.9	-3.3	-58.6
19215.2	-64.8	-3.3	-61.5
21617.1	-65.2	-3.3	-61.9
24090.0	-64.1	-3.3	-60.8

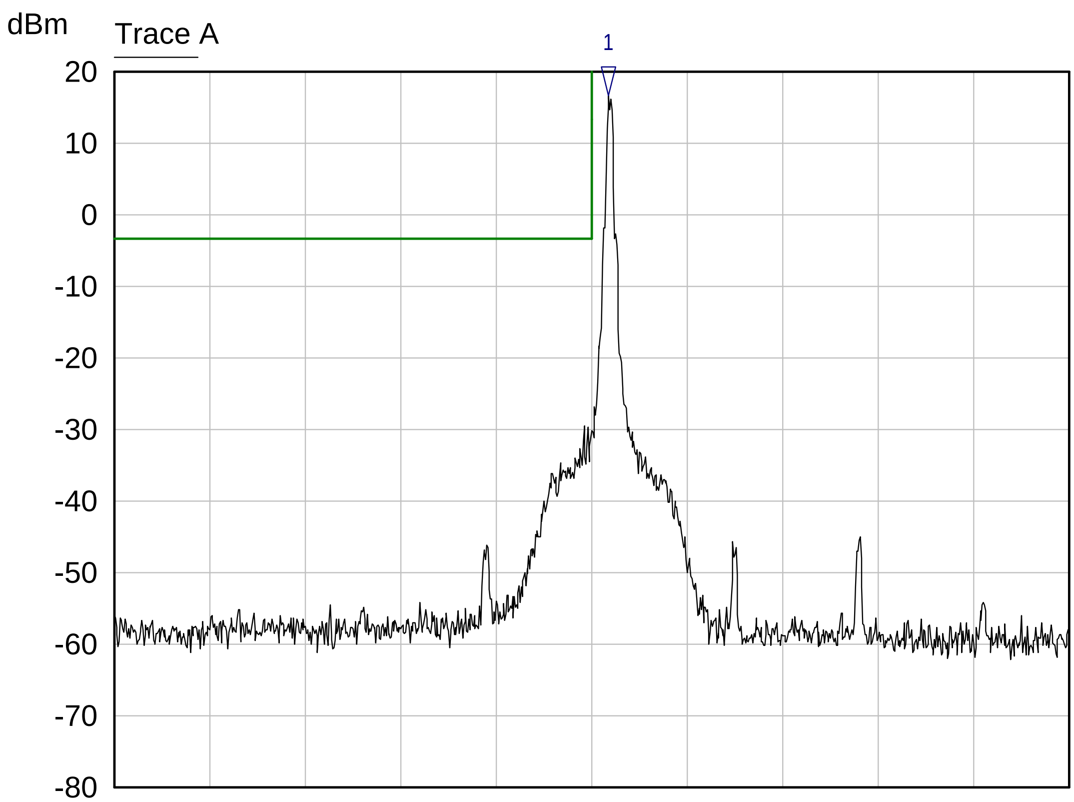
Transmitting on the Middle Channel (2437.9 MHz)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4875.8	-28.3	-3.3	-25.0
7313.7	-24.1	-3.3	-20.8
9751.6	-46.7	-3.3	-43.4
12189.5	-48.3	-3.3	-45.0
14627.4	-60.1	-3.3	-56.8
17665.3	-58.8	-3.3	-55.5
19503.2	-62.4	-3.3	-59.1
21941.1	-65.1	-3.3	-61.8
24379.0	-64.1	-3.3	-60.8

Transmitting on the Highest Channel (2474.9 MHz)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4949.8	-32.4	-3.3	-29.1
7424.7	-28.7	-3.3	-25.4
9899.6	-46.3	-3.3	-43.0
12374.5	-49.7	-3.3	-46.4
14849.4	-64.3	-3.3	-61.0
17324.3	-64.7	-3.3	-61.4
19799.2	-64.4	-3.3	-61.1
22274.1	-64.9	-3.3	-61.6
24749.0	-64.0	-3.3	-60.7

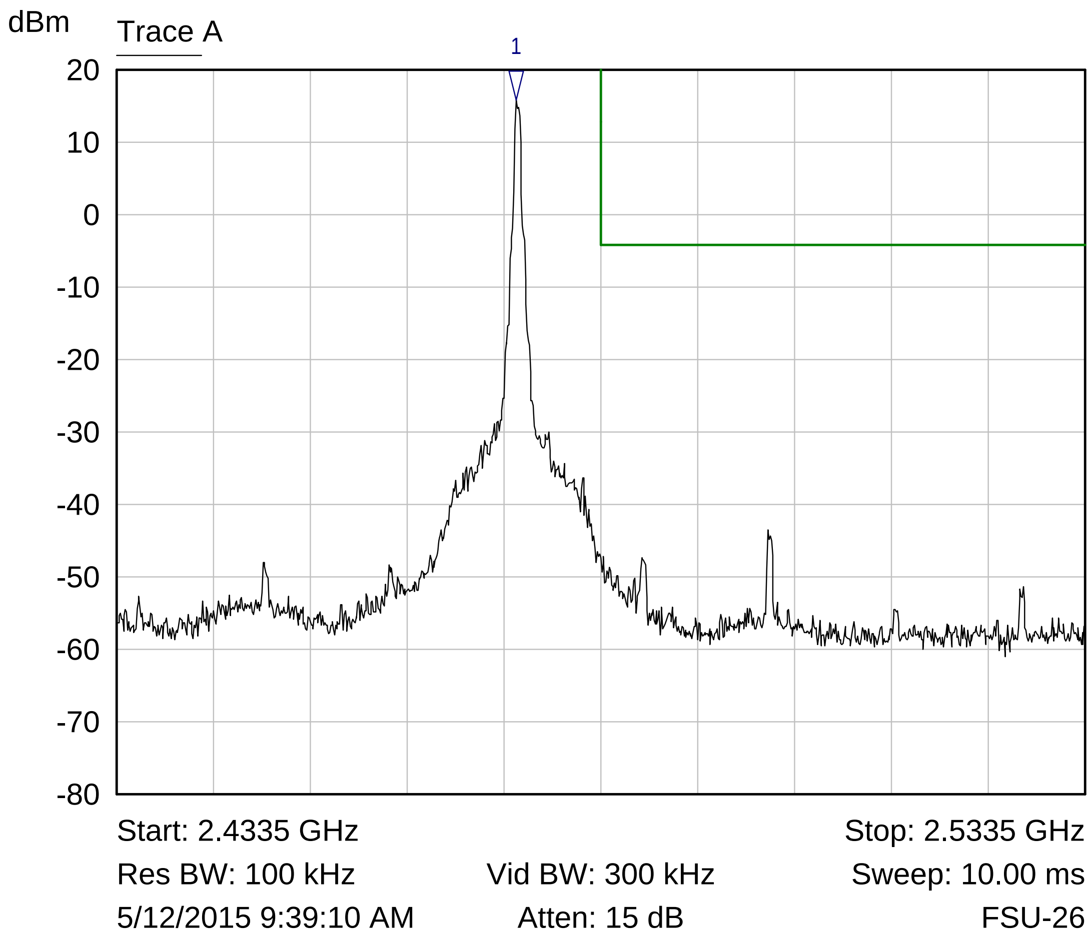
Lower Band Edge Plot



Start: 2.3500 GHz | Stop: 2.4500 GHz
Res BW: 100 kHz | Vid BW: 300 kHz | Sweep: 10.00 ms
5/12/2015 10:10:57 AM | Atten: 15 dB | FSU-26

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4018 GHz	16.74 dBm	

Upper Band Edge Plot



Mkr	Trace	X-Axis	Value	Notes
1 ∇	Trace A	2.4748 GHz	15.91 dBm	

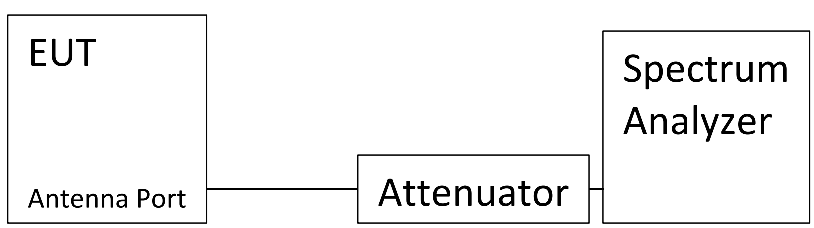
APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

A1.1 Direct Connection at the Antenna Port Tests

Type of Equipment	Manufacturer	Model Number	Barcode Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer	Hewlett Packard	8566B	1407	01/26/2015	01/26/2016
Quasi-Peak Detector	Hewlett Packard	85650A	1130	06/27/2014	06/27/2015
Spectrum Analyzer/Receiver	Rohde & Schwarz	FSU26	1557	03/16/2015	03/16/2016
Low Loss Cable (1 dB)	N/A	N/A	N/A	12/23/2014	12/23/2015

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.10-2013 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Test Configuration Block Diagram



A1.2 RSS-Gen Radiated Spurious Emissions in the Restricted Bands

The radiated emissions from the intentional radiator were measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings.

A loop antenna was used to measure emissions below 30 MHz. Emission readings more than 20 dB below the limit at any frequency may not be listed in the reported data. For frequencies between 9 kHz and 30 MHz, or the lowest frequency generated or used in the device greater than 9 kHz, and less than 30 MHz, the spectrum analyzer resolution bandwidth was set to 9 kHz and the video bandwidth was set to 30 kHz. For average measurements, the spectrum analyzer average detector was used.

For frequencies above 30 MHz, an amplifier and preamplifier were used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency ranges. For peak emissions above 1000 MHz the spectrum analyzer’s resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz. For average measurements above 1000 MHz the spectrum analyzer’s resolution bandwidth was set to 1 MHz and the average detector of the analyzer was used.

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz and a Double Ridge Guide Horn antenna was used to measure the frequency range of 1 GHz to 18 GHz and a standard gain horn antenna was used at frequencies above 18 GHz at a distance of 3 meters and/or 1 meter from the EUT. The readings obtained by the antenna are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

The configuration of the intentional radiator was varied to find the maximum radiated emission. The intentional radiator was connected to the peripherals listed in Section 2.4 via the interconnecting cables listed in Section 2.5. These interconnecting cables were manipulated manually by a technician to obtain worst case radiated emissions. The intentional radiator was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there are multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

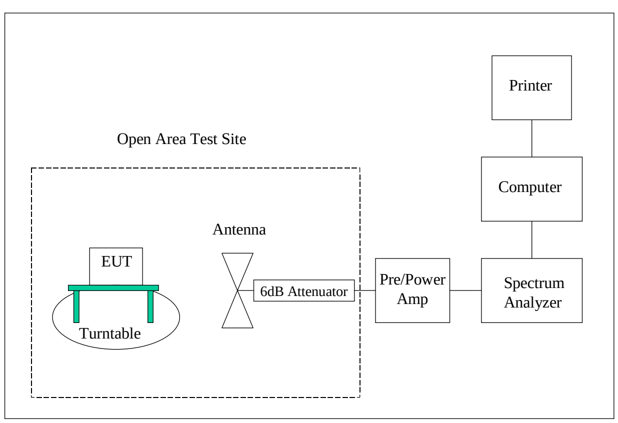
Desktop intentional radiators are measured on a non-conducting table 80 centimeters above the ground plane. The table is placed on a turntable which is level with the ground plane. The turntable has slip rings, which supply AC power to the intentional radiator. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

For radiated emission testing at 30 MHz or above that is performed at distances closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

Type of Equipment	Manufacturer	Model Number	Barcode Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer/Receiver	Rohde & Schwarz	FSU26	1557	01/26/2015	01/26/2016
Spectrum Analyzer	Hewlett Packard	8566B	1407	06/27/2014	06/27/2015
Quasi-Peak Detector	Hewlett Packard	85650A	1130	03/16/2015	03/16/2016
Loop Antenna	EMCO	6502	176	03/17/2015	03/17/2017
Biconilog Antenna	EMCO	3142	713	10/22/2014	10/22/2016
Double Ridged Guide Antenna	EMCO	3115	735	03/17/2015	03/17/2017
Pyramidal Standard Gain Horn	EMC Test System	3160-09	1052	04/10/2009	ICO
High Frequency Amplifier	Miteq	AFS4-00102650-35-10P-4	1299	12/23/2014	12/23/2015
20’ High Frequency Cable	Microcoax	UFB197C-1-3120-000000	1297	12/23/2014	12/23/2015
3 Meter Radiated Emissions Cable Wanship Site #2	Microcoax	UFB205A-0-4700-000000	1295	12/23/2014	12/23/2015
Pre/Power-Amplifier	Hewlett Packard	8447F	762	09/05/2014	09/05/2015
6 dB Attenuator	Hewlett Packard	8491A	1103	12/23/2014	12/23/2015

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.10-2013 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Radiated Emissions Test Setup



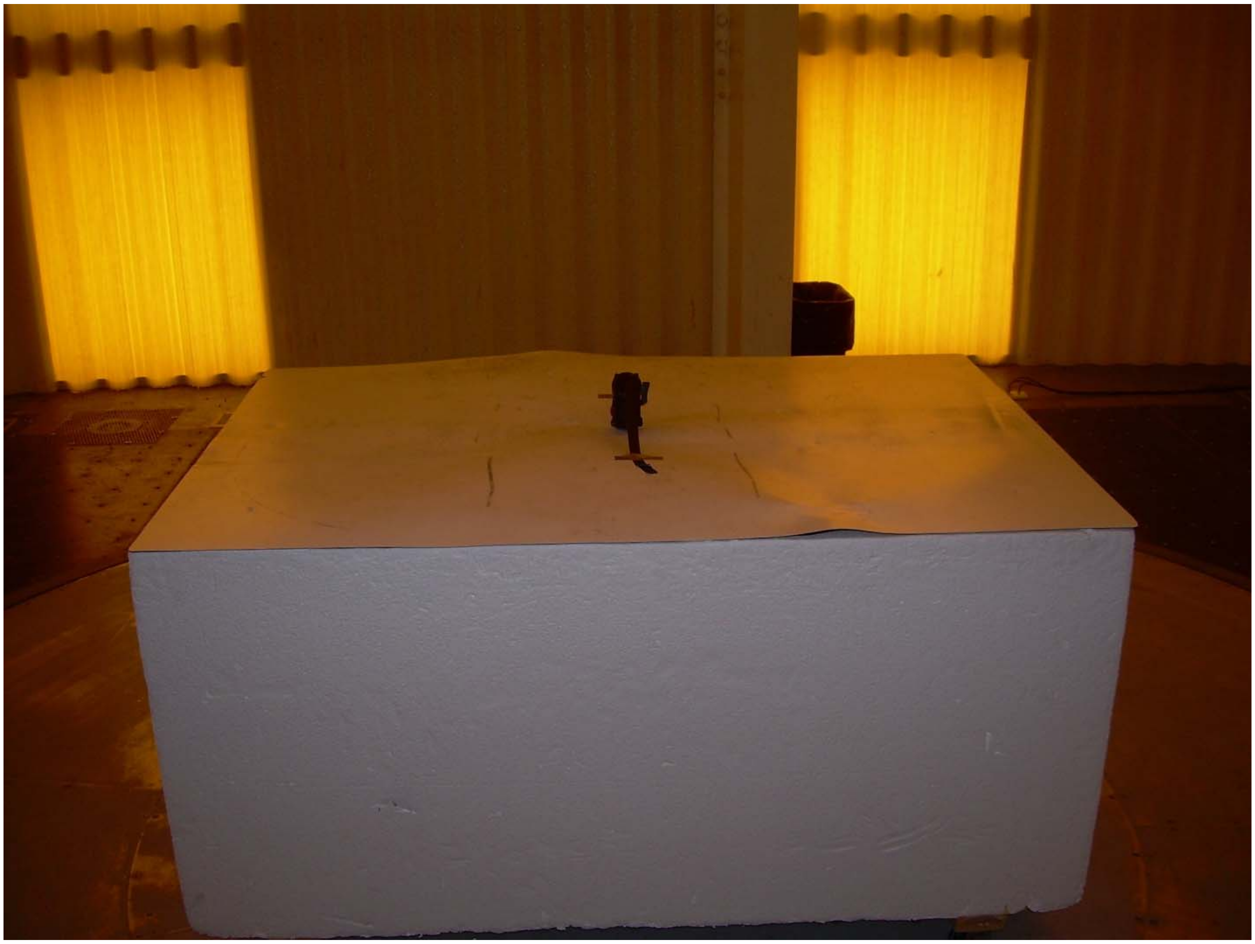
A1.3 Measurement Uncertainty

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

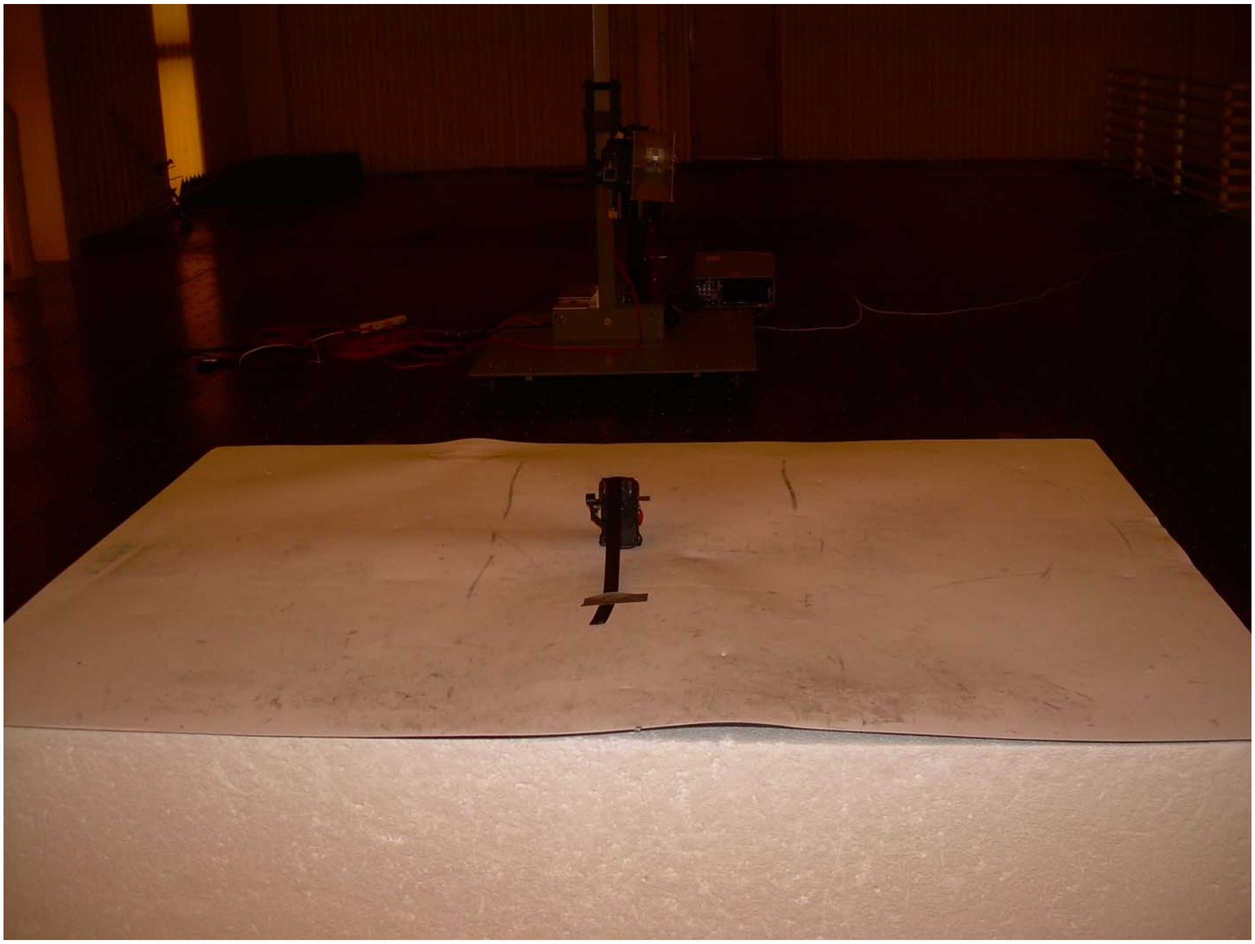
Test name	**Measurement uncertainty, dB**
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

APPENDIX 2 PHOTOGRAPHS

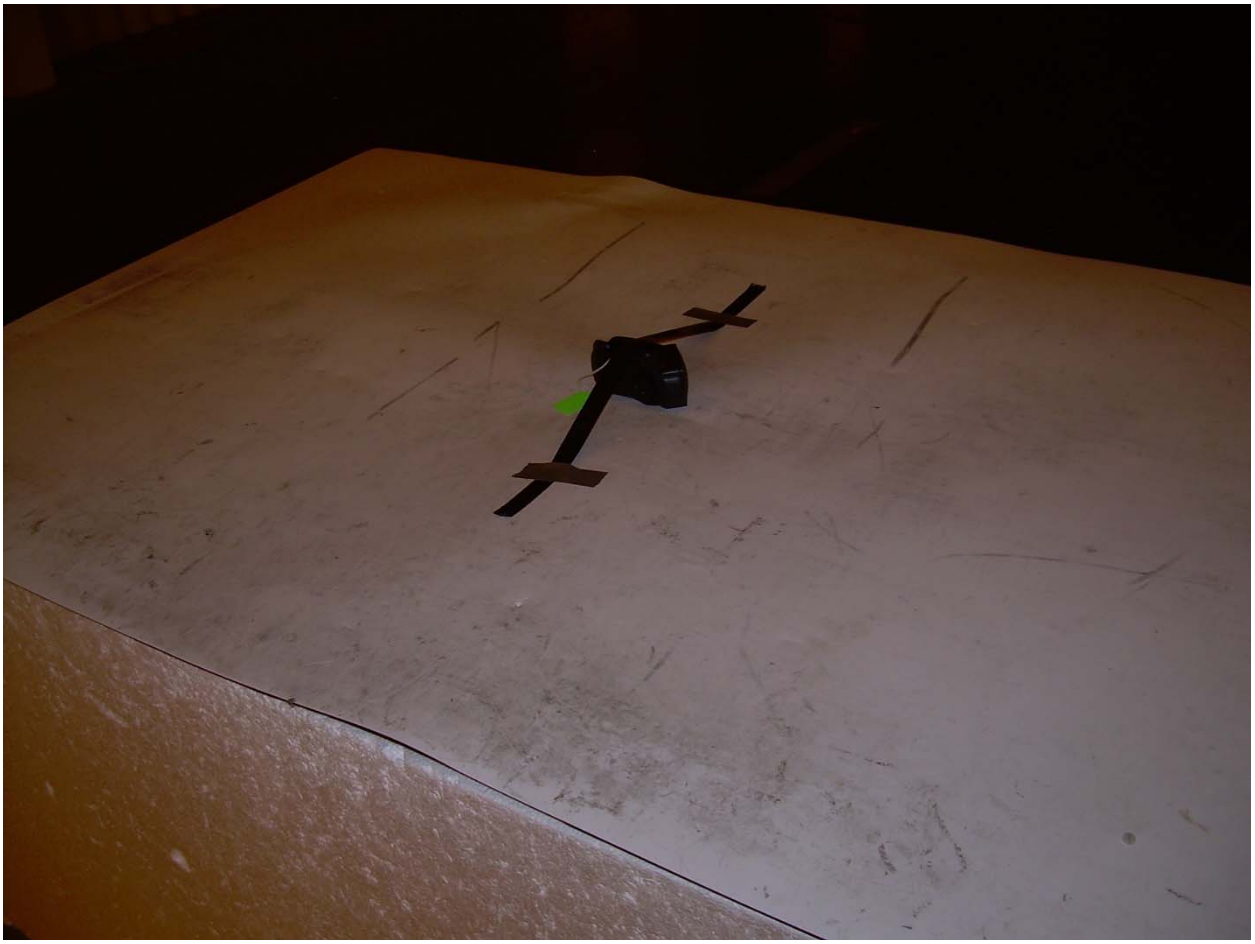
Photograph 1 – Front View Radiated Spurious Emission Test Setup – Vertical Placement



Photograph 2 – Back View Radiated Spurious Emission Test Setup – Vertical Placement



Photograph 3 – Radiated Spurious Emission Test Setup – On Edge Placement



Photograph 4 – Radiated Spurious Emission Test Setup – Horizontal Placement

Photograph 5 – Front View of the EUT

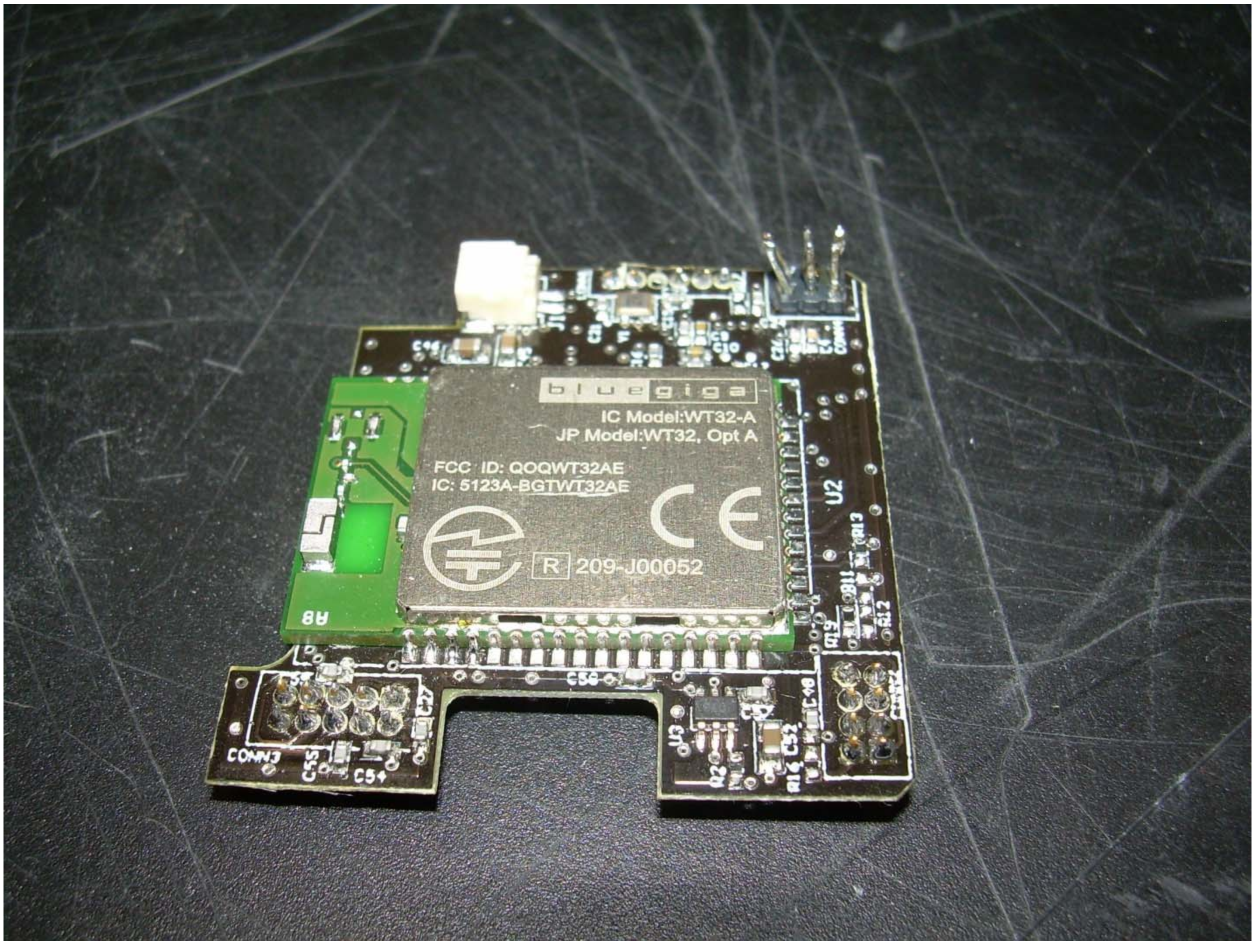
Photograph 6 – Back View of the EUT

Photograph 7 – Side View of the EUT

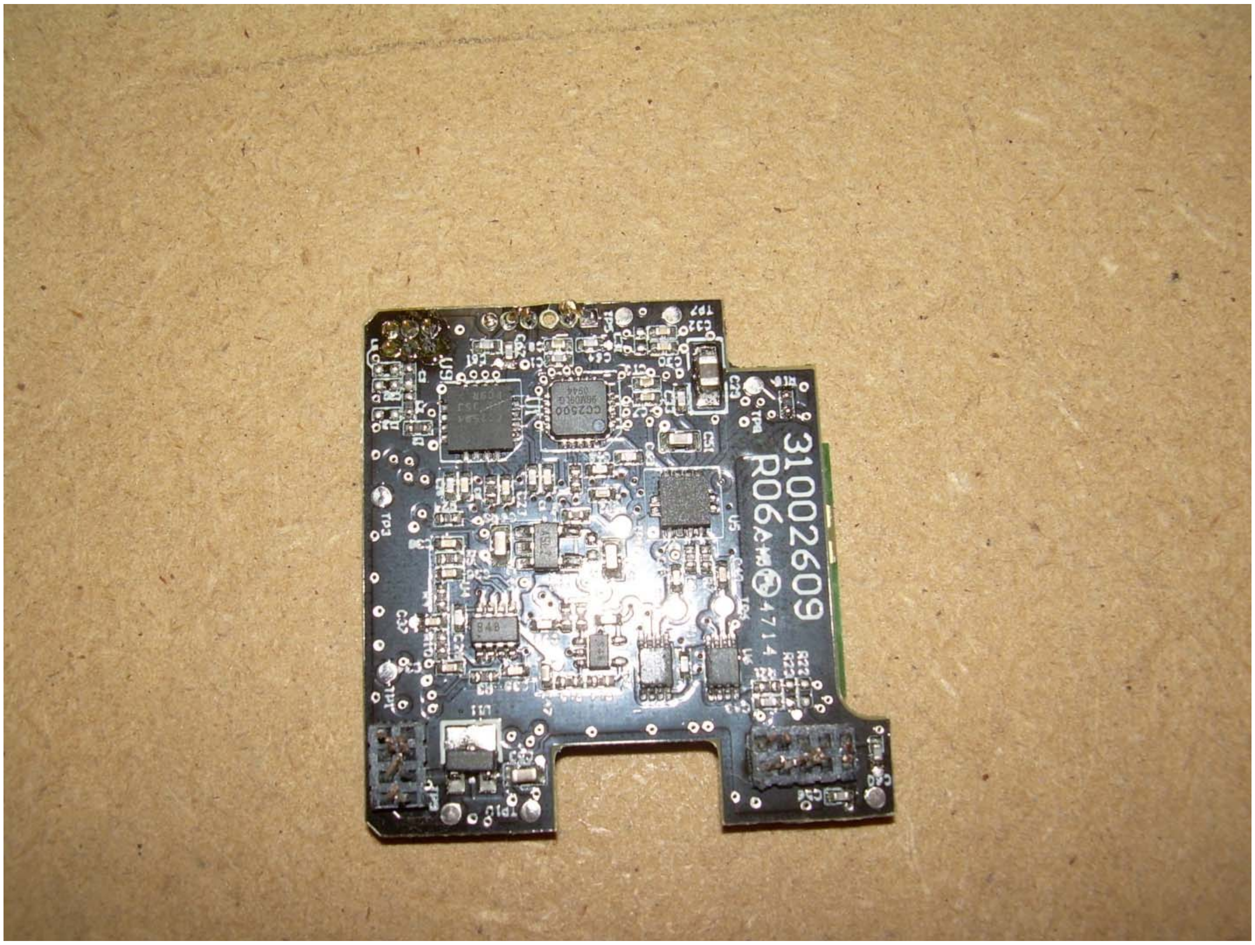
Photograph 8 – Side View of the EUT

Photograph 9 – View of the Housing with Microphone and Speaker

Photograph 10 – View of the RF PCB with Bluegiga Module

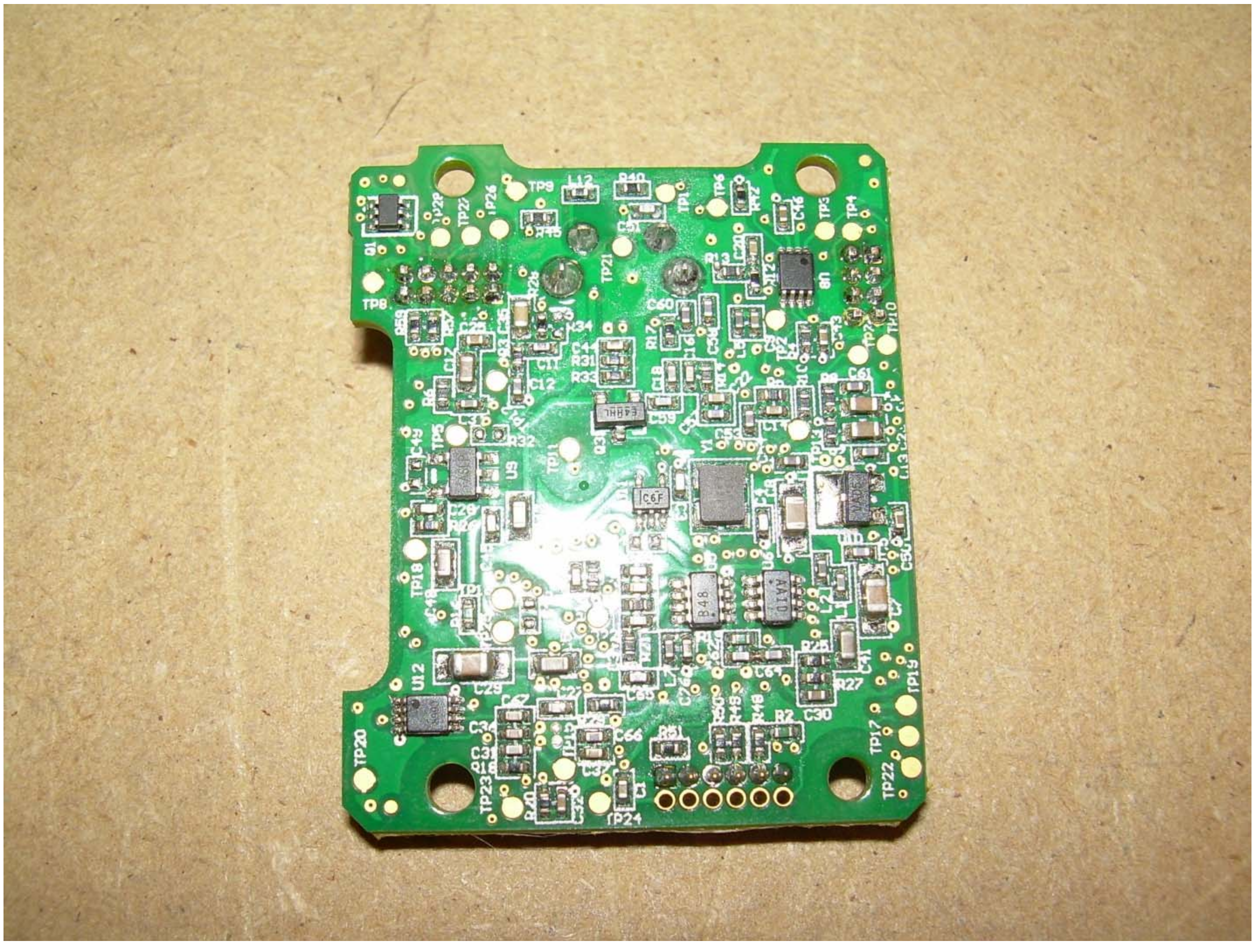


Photograph 11 – Bottom View of the RF PCB



Photograph 12 – Top View of the Audio PCB

Photograph 13 – Bottom View of the Audio PCB



Photograph 14 – View of the 2.4 GHz Transceiver Antenna