Electromagnetic Compatibility Test Report

Tests Performed on an Ultra Electronics USSI

Lapel Microphone with Integrated Team Radio, Model 90088A

Radiometrics Document RP-6721

ACCREDITED
TESTING CERT #1495.01

Product Detail: FCC ID: LFFSPCC IC: 6253A-SPCC Equipment type: 2.4 GHz and 900 MHz Digital transmission system.
Test Standards: US CFR Title 47, Chapter I, FCC Part 15 Subpart C FCC Part 15 CFR Title 47: 2008 Industry Canada RSS-210, Issue 7: 2007 as required for Category I Equipment This report concerns: Original Grant for Certification FCC Part 15.247

Tests Performed For:	*Test Facility:*
Ultra Electronics UnderSea Sensor Systems, Inc. 4758 E. Park 30 Dr. Columbia City, IN 46725	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446

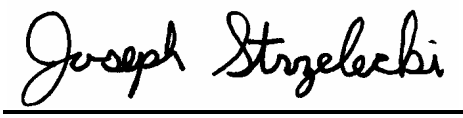
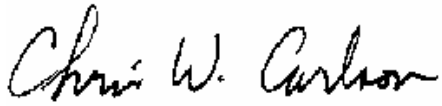
Test Date(s): (Month-Day-Year)
April 2 to 16, 2010

Document RP-6721 Revisions:

Rev.	Issue Date	Affected Pages	Revised By
0	April 26, 2010		
1	April 27, 2010	1	Joseph Strzelecki

Table of Contents

1 ADMINISTRATIVE DATA

Equipment Under Test: An Ultra Electronics UnderSea Sensor Systems, Inc., LM Transmitter Model: 90088A Serial Number: none This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) March 31, 2010	*Test Date(s): (Month-Day-Year)* April 2 to 16, 2010
Test Report Written By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* The tests were not witnessed by Ultra Electronics USSI
Radiometrics' Personnel Responsible for Test:  Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Report Approved By*  Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is an LM Transmitter, Model 90088A, manufactured by Ultra Electronics USSI. The detailed test results are presented in a separate section. The following is a summary of the test results.

900 MHz Test Results

Environmental Phenomena	Frequency Range	FCC Section	RSS-210 Section	Test Result
6 dB Bandwidth Test;	902-928 MHz	15.247 a	A8.1 (4)	Pass
20 dB Bandwidth Test;	902-928 MHz	15.247 a	A8.1 (4)	Pass
Peak Output Power	902-928 MHz	15.247 b	A8.1 (1)	Pass
Band-edge Compliance of RF Conducted Emissions	902-928 MHz	15.247 d	A8.4 (2)	Pass
Spurious RF Conducted Emissions	30 MHz to 25 GHz	15.247 d	A8.5	Pass
Spurious Radiated Emissions	30 MHz to 25 GHz	15.247 d	A8.5	Pass
Power Spectral Density	2400 to 2483 MHz	15.247 e	A8.2 (1)	Pass
Conducted Emissions, AC Mains	0.15 - 30 MHz	15.207	7.2.2 of RSS-Gen	Pass
Radiated Emissions (Unintential Radiation Receive mode)	30 MHz to 5 GHz	15.109	Table 2	Pass

2.4 GHz Test Results

Environmental Phenomena	Frequency Range	FCC Section	RSS-210 Section	Test Result
6 dB Bandwidth Test;	2400 to 2483 MHz	15.247 a	A8.1 (4)	Pass
20 dB Bandwidth Test;	2400 to 2483 MHz	15.247 a	A8.1 (4)	Pass

Environmental Phenomena	Frequency Range	FCC Section	RSS-210 Section	Test Result
Peak Output Power	2400 to 2483 MHz	15.247 b	A8.1 (1)	Pass
Band-edge Compliance of RF Conducted Emissions	2400 to 2483 MHz	15.247 d	A8.4 (2)	Pass
Spurious RF Conducted Emissions	30 MHz to 25 GHz	15.247 d	A8.5	Pass
Spurious Radiated Emissions	30 MHz to 25 GHz	15.247 d	A8.5	Pass
Power Spectral Density	2400 to 2483 MHz	15.247 e	A8.2 (1)	Pass
Conducted Emissions, AC Mains	0.15 - 30 MHz	15.207	7.2.2 of RSS-Gen	Pass
Radiated Emissions (Unintential Radiation Receive mode)	30 MHz to 12.5 GHz	15.109	Table 2	Pass

2.1 RF Exposure Compliance Requirements

Since the power output is 12.3 mW for the 900 MHz radio and 0.6 mW for the 2.4 GHz Radio, The EUT meets the FCC requirement for RF exposure. There are no power level adjustments and the antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a Transmitter, Model 90088A, manufactured by Ultra Electronics USSI. The EUT was in good working condition during the tests, with no known defects.

The EUT is an accessory lapel speaker/microphone for use by “first responders,” ie: firefighters and HazMat personnel, who would wear a full-face mask in the execution of their duties. The product includes an 802.15.4 radio at 2400 MHz to provide full duplex audio link to a microphone and speaker in the user’s mask. The device also includes a 900 MHz transceiver for short-haul push-to-talk operation. This gives the user the ability to communicate amongst his teammates without need of a tactical radio.

3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The 900 MHz antenna is a half wave monopole. The antenna has a reverse polarity connector type that is not readily available to the general public. Therefore it meets the 15.203 Requirements.

The 2.4 GHz antenna is permanently attached to the PCB via a trace on the circuit board. The antenna is internal to the EUT and it is not readily available to be modified by the end user. Therefore it meets the 15.203 Requirement

3.2 Related Submittals

Ultra Electronics USSI is not submitting any other products simultaneously for equipment authorization related to the EUT.

4 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations.

The EUT was tested as a stand-alone device. Power was supplied with a new batteries.

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	LM Transmitter	E	Ultra Electronics UnderSea Sensor Systems, Inc.	90088A	none

* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2008	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-2003	2003	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-210 Issue 7	2007	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment
IC RSS-Gen Issue 2	2007	General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)
FCC DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
FCC 558074	2005	Measurement of Digital Transmission Systems Operating under Section 15.247

The test procedures used are in accordance with the FCC 558074, Industry Canada RSS-212 and ANSI document C63.4-2003, "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2005 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber A: Is an anechoic chamber that measures 24' L X 12' W X 12' H. The walls and ceiling are fully lined with ferrite absorber tiles. The floor has a 10' x 10' section of ferrite absorber tiles located in the center. Panashield of Rowayton, Connecticut manufactured the chamber. The enclosure is NAMAS certified.

Chamber E: Is a custom made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC3124A-1.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification. The results relate only to the EUT listed herein. Any modifications made to the EUT subsequent to the indicated test date will invalidate the data and void this certification.

9 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	02/11/10
AMP-20	Avantek	Pre-amplifier	SF8-0652	15221	8-18GHz	12 Mo	02/11/10
AMP-22	Anritsu	Pre-amplifier	MH648A	M23969	0.1-1200MHz	12 Mo.	02/11/10

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	10/22/08
ANT-44	Impossible Machine	Super Log Antenna	SL-20M2G	1002	20-2000MHz	24 Mo.	11/25/09
ANT-53	EMCO	Loop Antenna	6507	1453	1 kHz-30 MHz	12 Mo	11/04/09
LSN-01	Electrometrics	50 uH LISN	FCC/VDE 50/2	1001	0.01-30MHz	24 Mo.	06/01/09
PRE-01	Hewlett Packard	Preselector	85685A	2510A00143	20 Hz-2GHz	12 Mo.	01/11/10
REC-03	Anritsu	Spectrum Analyzer	MS2601B	MT94589	0.01-2200MHz	12 Mo.	03/15/10
REC-07	Anritsu	Spectrum Analyzer	MS2601A	MT53067	0.01-2200MHz	12 Mo.	04/06/10
REC-08	Hewlett Packard	Spectrum Analyzer	8566B	2648A13481 2209A01436	30Hz-22GHz	12 Mo.	08/21/09
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	12 Mo.	04/01/10

Note: All calibrated equipment is subject to periodic checks.

10 TEST SECTIONS

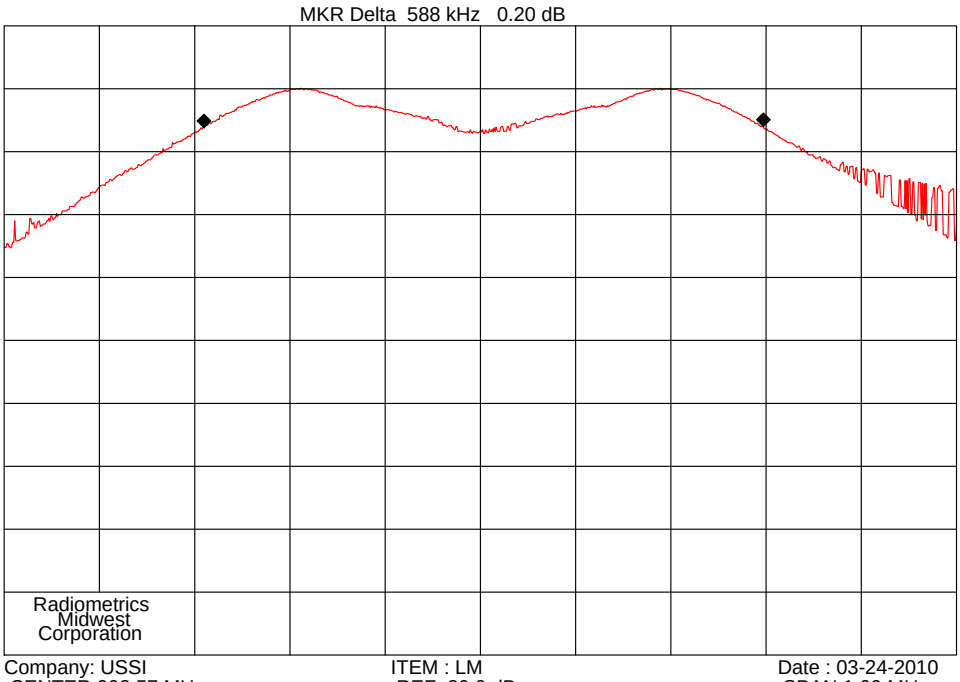
10.1 Occupied Bandwidth

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize.

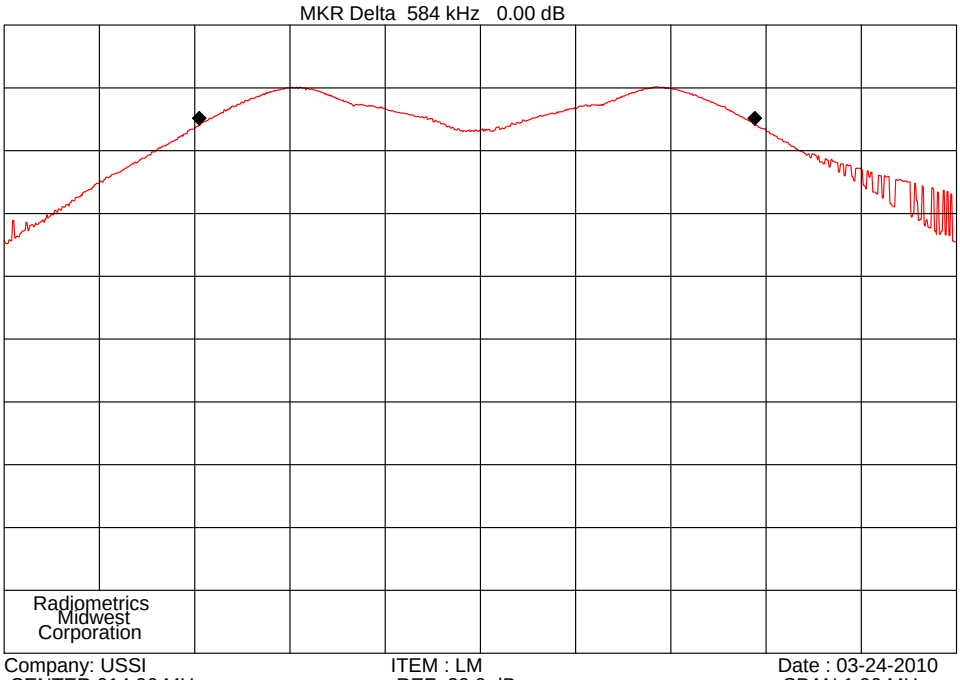
The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

Channel MHz	6 dB EBW MHz	20 dB EBW MHz (Canada)
902.6	0.588	0.585
914.95	0.584	0.597
927.34	0.583	0.585
2405	1.570	2.690
2440	1.595	2.670
2480	1.605	2.670

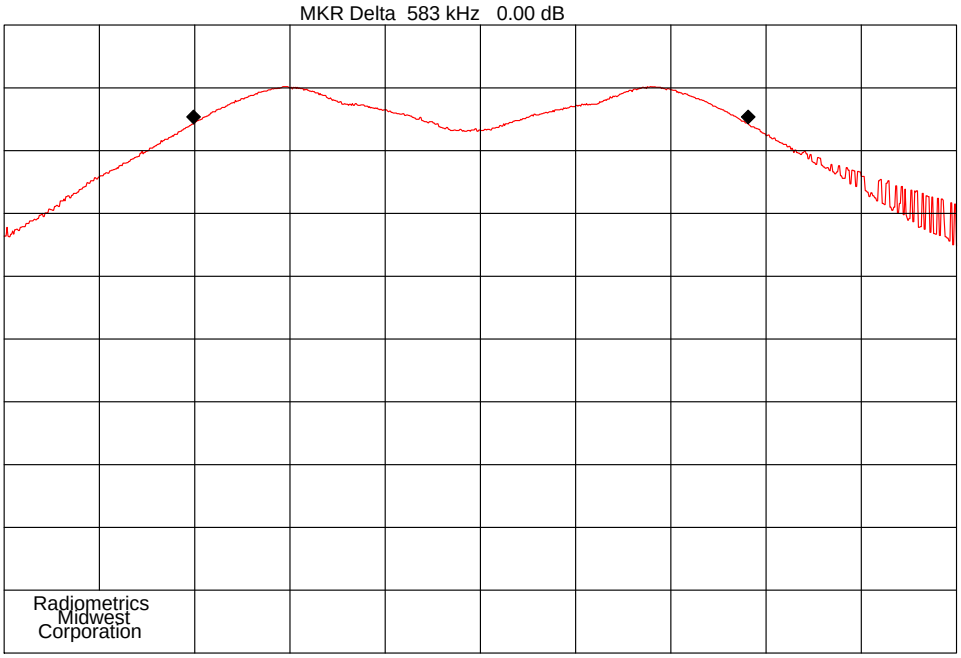
10.1.1 900 MHz Results



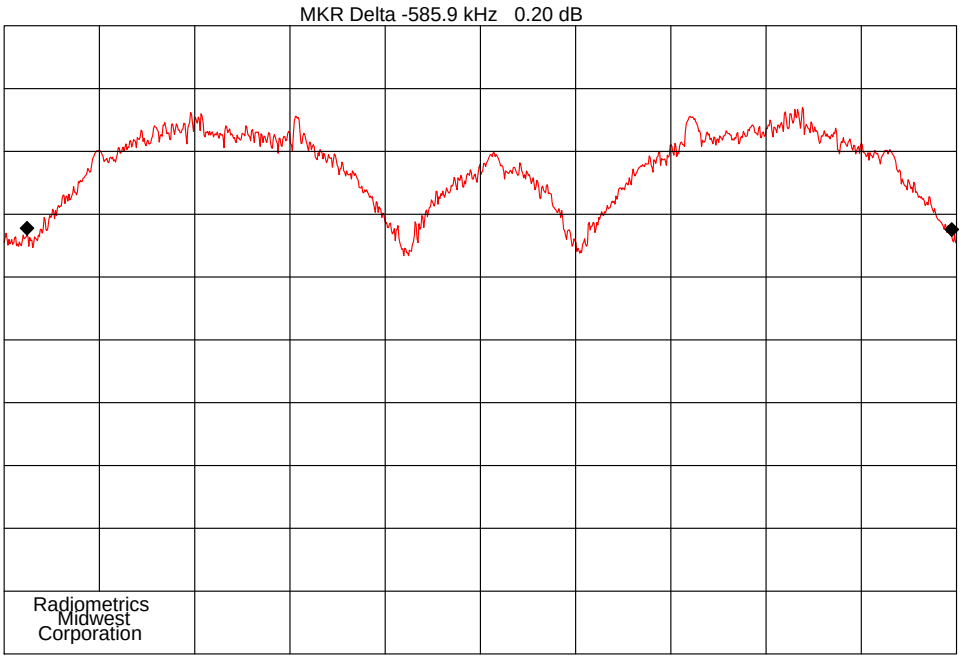
Company: USSI
CENTER 902.57 MHz
RES BW 100 kHz
10 dB/
ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 11:36
Date : 03-24-2010
SPAN 1.00 MHz
ATTEN 30 dB
SWP 20.0 msec
Notes: Occupied Bandwidth, Lowest Channel



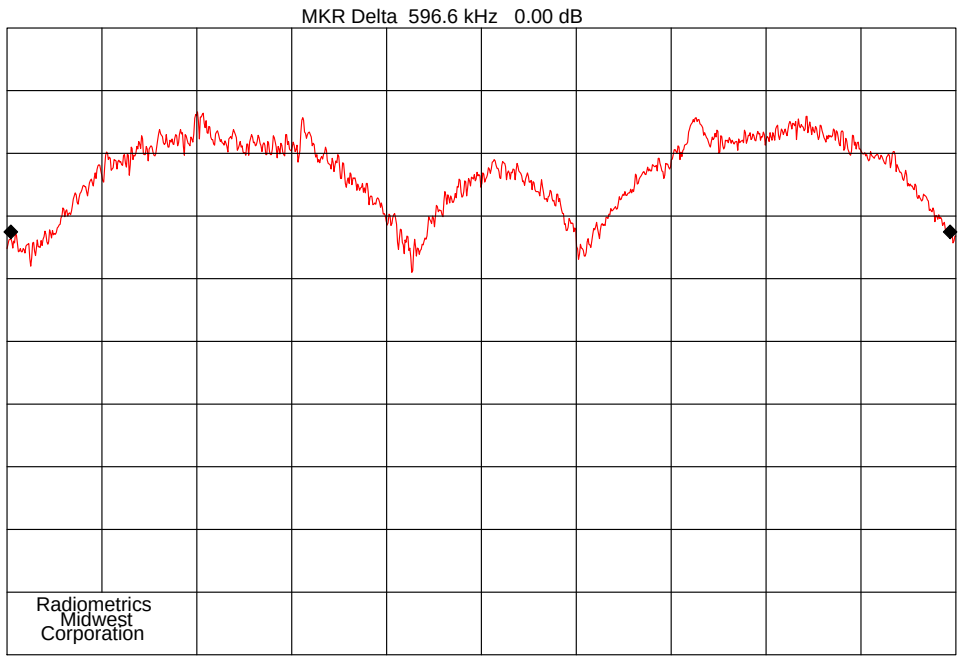
Company: USSI
CENTER 914.96 MHz
RES BW 100 kHz
10 dB/
ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 11:34
Date : 03-24-2010
SPAN 1.00 MHz
ATTEN 30 dB
SWP 20.0 msec
Notes: Occupied Bandwidth, Middle Channel



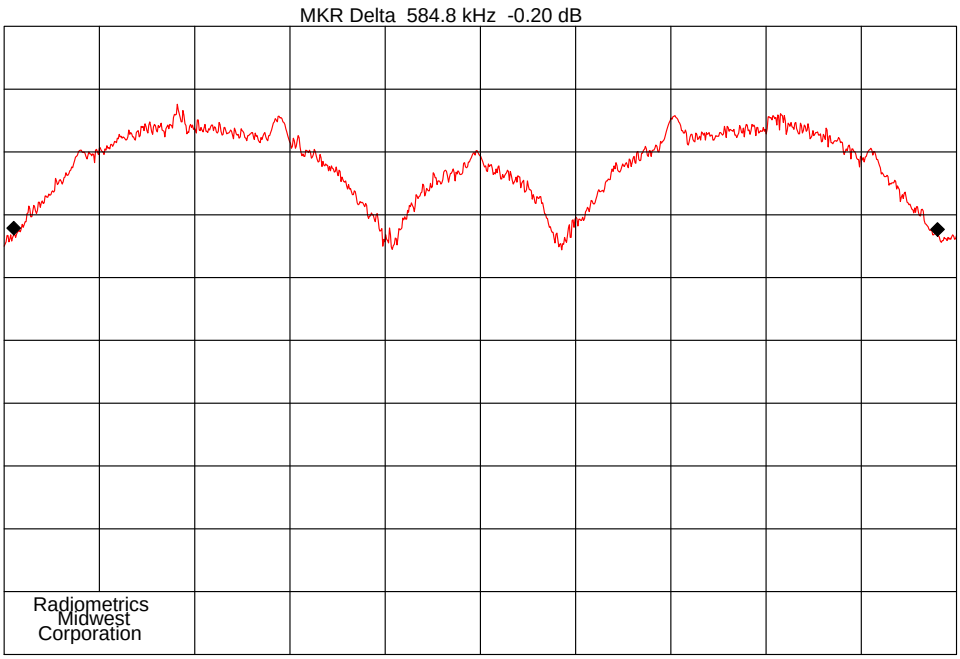
Company: USSI
CENTER 927.34 MHz
RES BW 100 kHz
10 dB/
ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 11:33
Date : 03-24-2010
SPAN 1.00 MHz
ATTEN 30 dB
SWP 20.0 msec
Notes: Occupied Bandwidth Test, Highest Channel



Company: USSI
CENTER 902.576 MHz
RES BW 10 kHz
10 dB/
ITEM : LM
REF 20.0 dBm
VBW 30 kHz
Time: 11:40
Date : 03-24-2010
SPAN 603 kHz
ATTEN 30 dB
SWP 30.0 msec
Notes: 20 dB Bandwidth Test, Lowest Channel

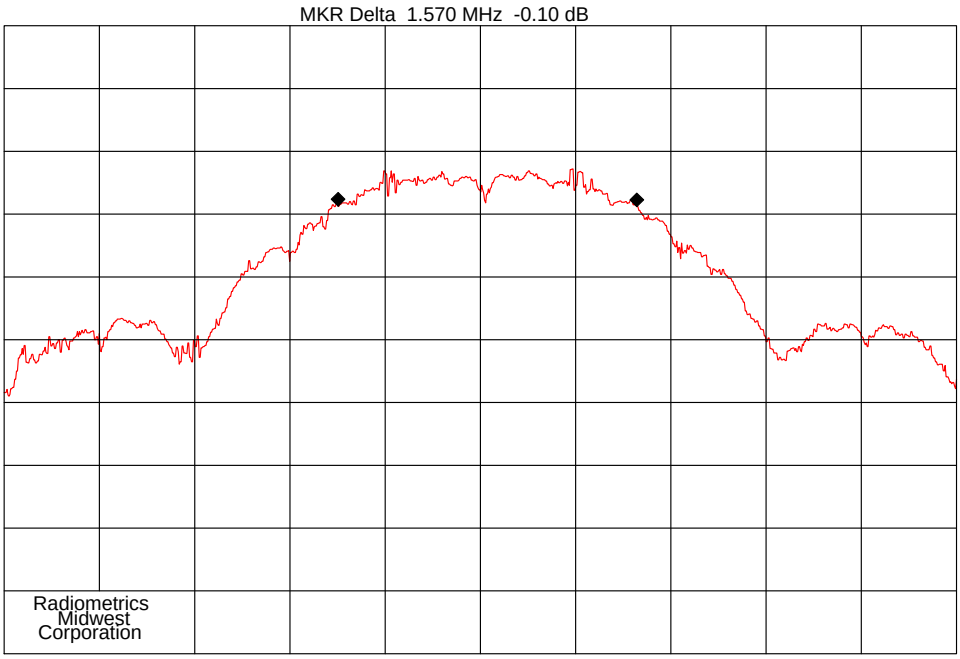


Company: USSI
CENTER 914.950 MHz
RES BW 10 kHz
10 dB/
ITEM : LM
REF 20.0 dBm
VBW 30 kHz
Time: 11:43
Date : 03-24-2010
SPAN 602 kHz
ATTEN 30 dB
SWP 30.0 msec
Notes: 20 dB Bandwidth Test, Mid Channel

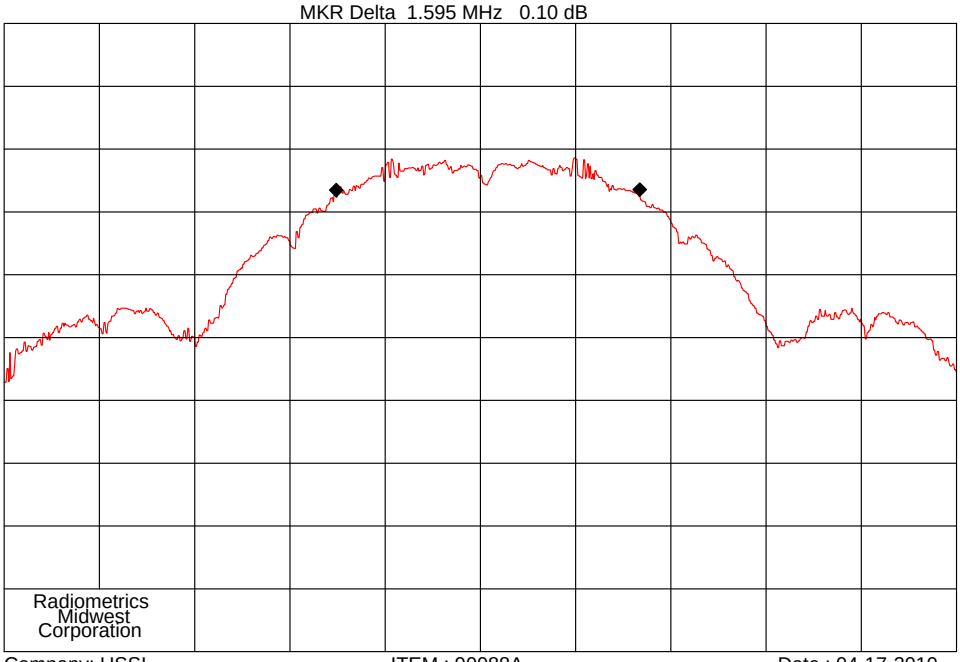


Company: USSI
CENTER 927.342 MHz
RES BW 10 kHz
10 dB/
ITEM : LM
REF 20.0 dBm
VBW 30 kHz
Time: 11:46
Date : 03-24-2010
SPAN 602 kHz
ATTEN 30 dB
SWP 30.0 msec
Notes: 20 dB Bandwidth Test, Highest Channel

10.1.2 2.4 GHz Results

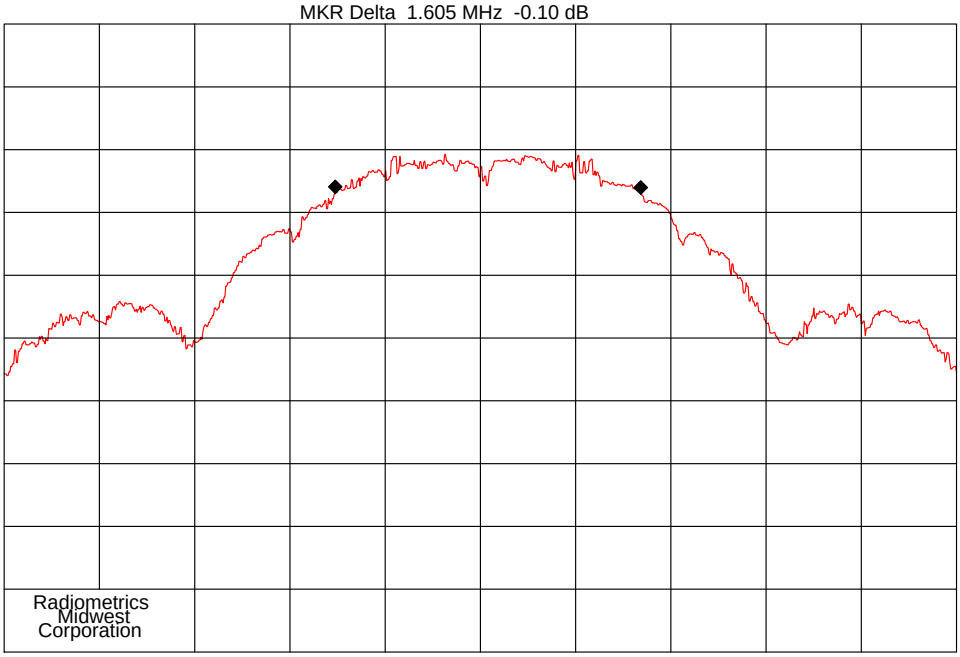


Company: USSI
CENTER 2.405 00 GHz
RES BW 100 kHz
10 dB/
ITEM : 90088A
REF -10.0 dBm
VBW 300 kHz
Time: 12:27
Date : 04-17-2010
SPAN 5.00 MHz
ATTEN 10 dB
SWP 20.0 msec
Notes: 6 dB Occupied Bandwidth, Lowest Channel



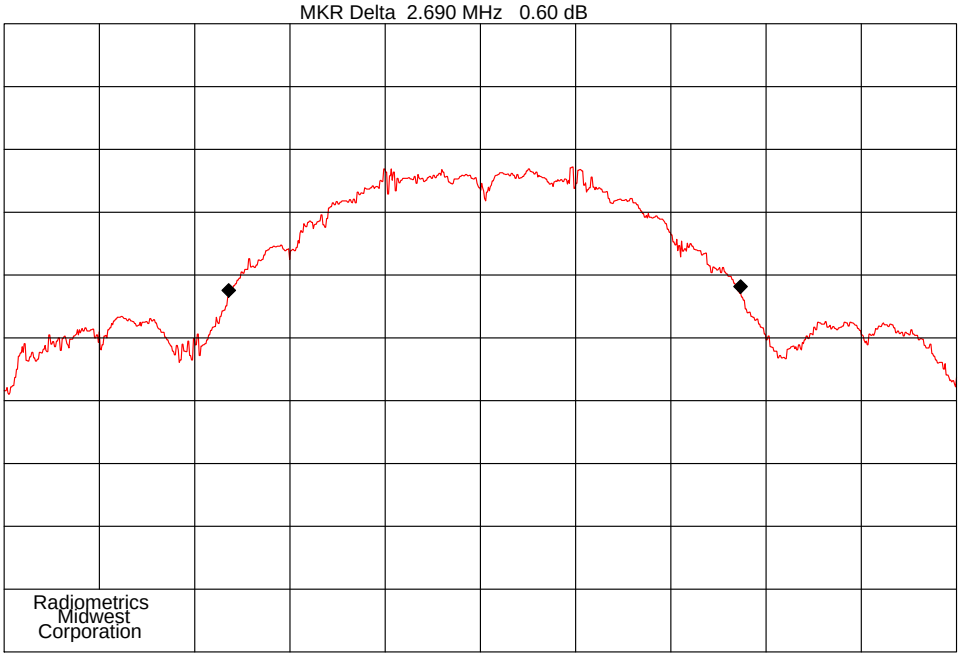
Company: USSI
CENTER 2.440 00 GHz
RES BW 100 kHz
10 dB/
ITEM : 90088A
REF -10.0 dBm
VBW 300 kHz
Time: 12:29
Date : 04-17-2010
SPAN 5.00 MHz
ATTEN 10 dB
SWP 20.0 msec
Notes: 6 dB Occupied Bandwidth, Mid Channel

MKR Delta 1.605 MHz -0.10 dB

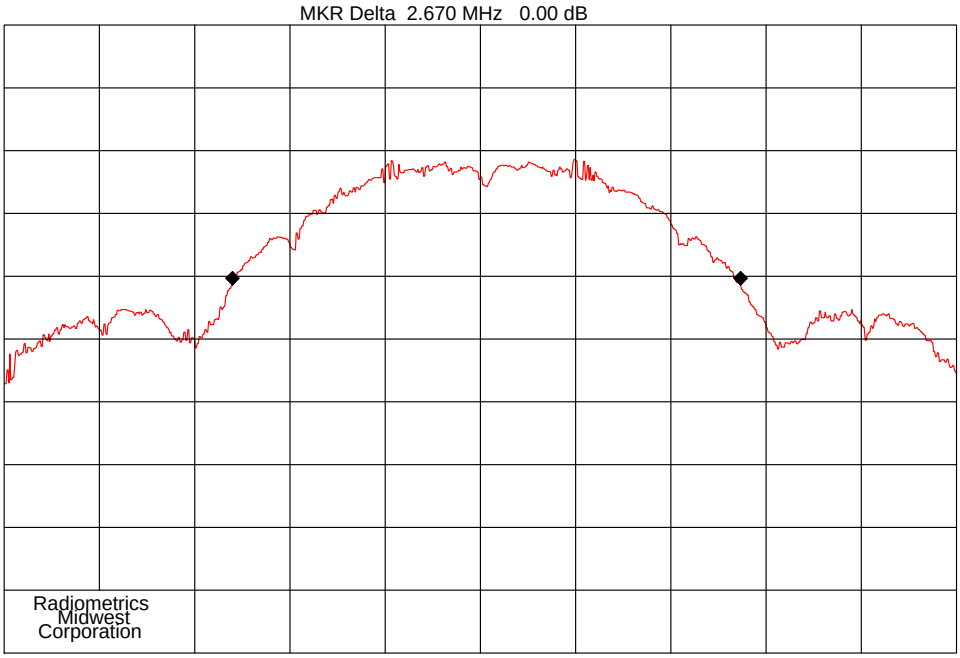


Company: USSI
CENTER 2.480 00 GHz
RES BW 100 kHz
10 dB/
ITEM : 90088A
REF -10.0 dBm
VBW 300 kHz
Time: 12:24
Date : 04-17-2010
SPAN 5.00 MHz
ATTEN 10 dB
SWP 20.0 msec
Notes: 6 dB Occupied Bandwidth, Highest Channel

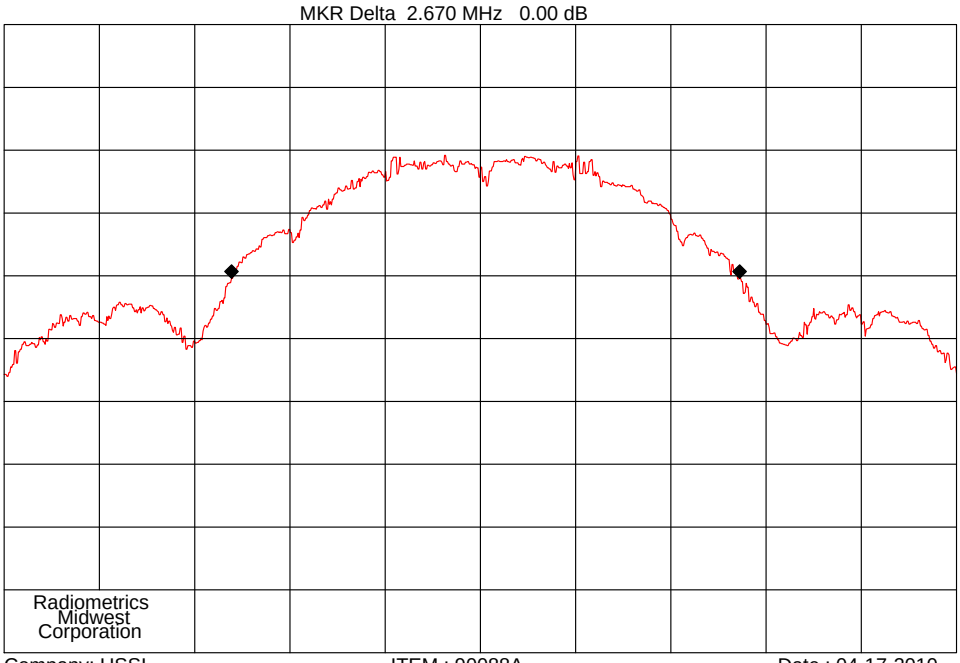
MKR Delta 2.690 MHz 0.60 dB



Company: USSI
CENTER 2.405 00 GHz
RES BW 100 kHz
10 dB/
ITEM : 90088A
REF -10.0 dBm
VBW 300 kHz
Time: 12:27
Date : 04-17-2010
SPAN 5.00 MHz
ATTEN 10 dB
SWP 20.0 msec
Notes: 20dB Occupied Bandwidth, Lowest Channel



Company: USSI
CENTER 2.440 00 GHz
RES BW 100 kHz
10 dB/
ITEM : 90088A
REF -10.0 dBm
VBW 300 kHz
Time: 12:29
Date : 04-17-2010
SPAN 5.00 MHz
ATTEN 10 dB
SWP 20.0 msec
Notes: 20dB Occupied Bandwidth, Mid Channel



Company: USSI
CENTER 2.480 00 GHz
RES BW 100 kHz
10 dB/
ITEM : 90088A
REF -10.0 dBm
VBW 300 kHz
Time: 12:25
Date : 04-17-2010
SPAN 5.00 MHz
ATTEN 10 dB
SWP 20.0 msec
Notes: 20dB Occupied Bandwidth, Highest Channel

10.2 Peak Output Power

10.2.1 900 MHz Results

The EUT antenna port on the 900 MHz Radio was connected to the spectrum analyzer via a low loss coaxial cable. The power output option 2; Method #3 from FCC rules 558074 was used for this test. The spectrum analyzer was set to the following settings:

Span = 2 MHz; RBW = 3 MHz; VBW = 3 MHz; Sweep = auto
Detector function = peak; Trace = max hold

The trace was allowed to stabilize. The marker-to-peak function was used to measure the peak of the emission. The indicated level is the peak output power. The BW correction factor is 10*Log(BW). Note 30 dBm = 1 watt. Since the gain of the antenna is always less than 6 dB, the limit is not reduced.

Frequency (MHz)	Reading (dBm)	Cable Loss (dB)	Total Power (dBm)		Limit (dBm)
			dBm	Watts	
902.6	10.7	0.2	10.9	0.0123	30
914.95	10.6	0.2	10.8	0.01202	30
927.35	10.6	0.2	10.8	0.01202	30

Judgment: Pass by 19.1 dB

10.2.2 2.4 GHz Results

Since antenna conducted tests cannot be performed on the EUT at 2.4 GHz, radiated tests were performed to show compliance with this requirement. The FCC procedures from power output option 2, Method #3 were used. The transmitter's peak power was calculated using the following equation:

P = (E x d)^2 / (30)

Where: E = the measured maximum peak field strength in V/m.
d = Distance in meters from which the field strength was measured. (3 meters)
P = The EUT power in watts

The Field Strength was measured using the procedures described in section 10.9, with the exception of the resolution and video bandwidths. The spectrum analyzer was set to the following settings:

Span = 3 MHz ; RBW = 3 MHz (> the 20 dB bandwidth of the emission being measured)
VBW = 3 MHz; Sweep = auto; Detector function = peak; Trace = max hold

Since the gain of the antenna is always less than 6dB, the limit is not reduced.

MHz	dBuV/m Peak	Watts	V/m	Test Dist meters	Peak EUT dBm
2405	91.8	0.000454	0.039	3	-3.4
2440	93.0	0.000599	0.045	3	-2.2
2480	91.2	0.000395	0.036	3	-4.0

Judgment: Pass by 32.2 dB

10.3 Power Spectral Density

10.3.1 900 MHz Results

PSD option 1 was used for this test on the 900 MHz Radio. No external attenuator was used. The spectrum analyzer was set to the following settings:
Span = 500 kHz RBW = 3 kHz; VBW = 10 kHz
Sweep = 167 seconds; Detector Function = Peak

Frequency (MHz)	Reading dBm	Cable Loss (dB)	3 kHz Spectral Density (dBm)	Limit (dBm)
902.6	3.3	0.2	3.5	8.0
914.95	2.5	0.2	2.7	8.0
927.35	2.7	0.2	2.9	8.0

Judgment: Pass by 4.5 dB

10.3.2 2.4 GHz Results

Since antenna conducted tests cannot be performed on the EUT at 2.4 GHz, radiated tests were performed to show compliance with this requirement. The FCC procedures from PSD option 1 was used. The power spectral density was measured as follows.

The field strength was measured using the procedures described in section 10.9, with the following exceptions: The analyzer was tuned to the highest point of the maximized fundamental emission. Using this peak level, the transmitter's power spectral density was calculated using the following equation:

P = (E x d)^2 / (30 x G)

Where: E = the measured maximum peak field strength in V/m, using the bandwiths in this section.
G = The numeric gain of the transmitting antenna over an isotropic radiator.
d = Distance in meters from which the field strength was measured. (3 meters)
P = The EUT power in watts

Span = 500 kHz ; RBW = 3 kHz ; VBW = 10 kHz; Sweep = 167 Seconds
Detector function = Peak

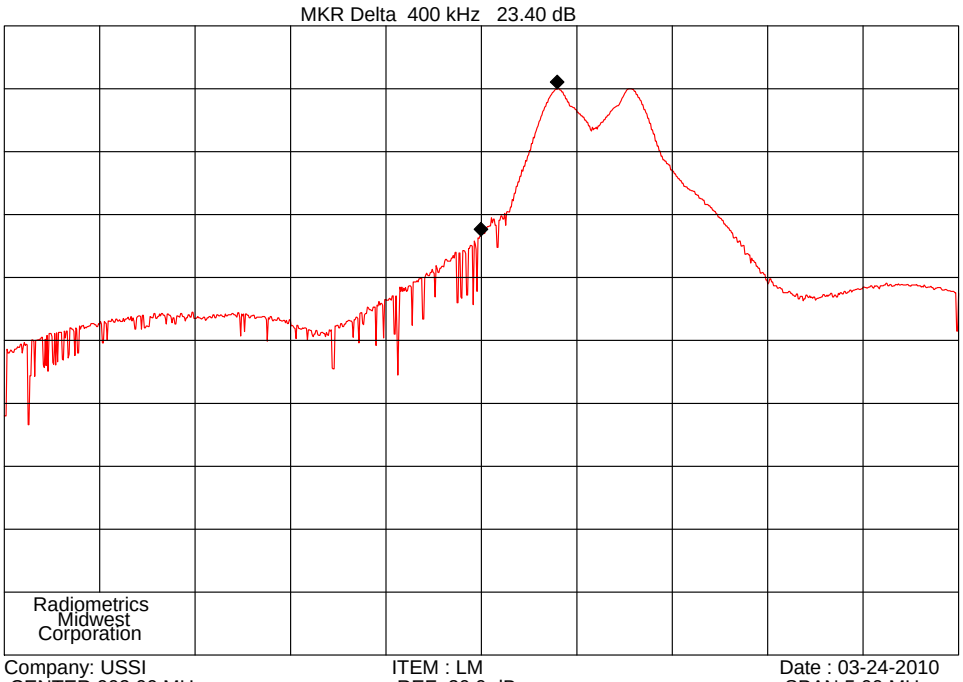
Freq	3kHz PSD Field Strength		Test Distance	3 kHz Spectral Density from EUT		Limit
MHz	dBuV/m	V/m	Meters	Watts	dBm	dBm
2405	82.2	0.012882	3	5E-05	-13.0	8
2440	82.8	0.013804	3	5.7E-05	-12.4	8
2480	80.9	0.011092	3	3.7E-05	-14.3	8

Overall Test result: Pass by 20.4 dB

10.4 Band-edge Compliance of RF Conducted Emissions

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation at the band-edge, with the EUT set to the lowest frequency. The trace was allowed to stabilize.

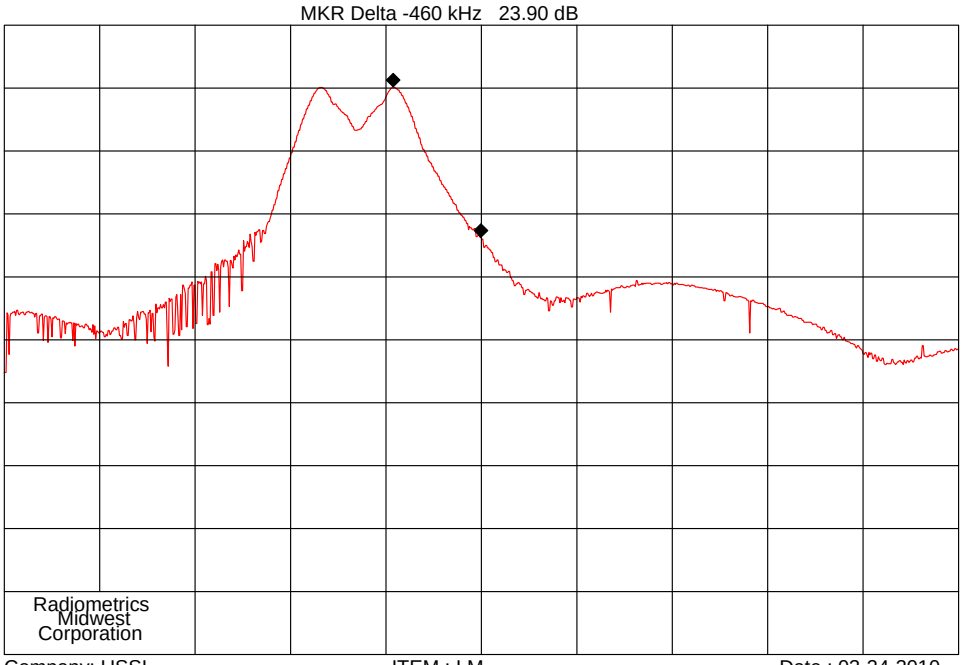
10.4.1 900 MHz Results



Company: USSI
CENTER 902.00 MHz
RES BW 100 kHz
10 dB/
Notes: Lower Band Edge,

ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 10:29

Date : 03-24-2010
SPAN 5.00 MHz
ATTEN 30 dB
SWP 20.0 msec



Company: USSI
CENTER 928.00 MHz
RES BW 100 kHz
10 dB/
Notes: Upper Band Edge Test,

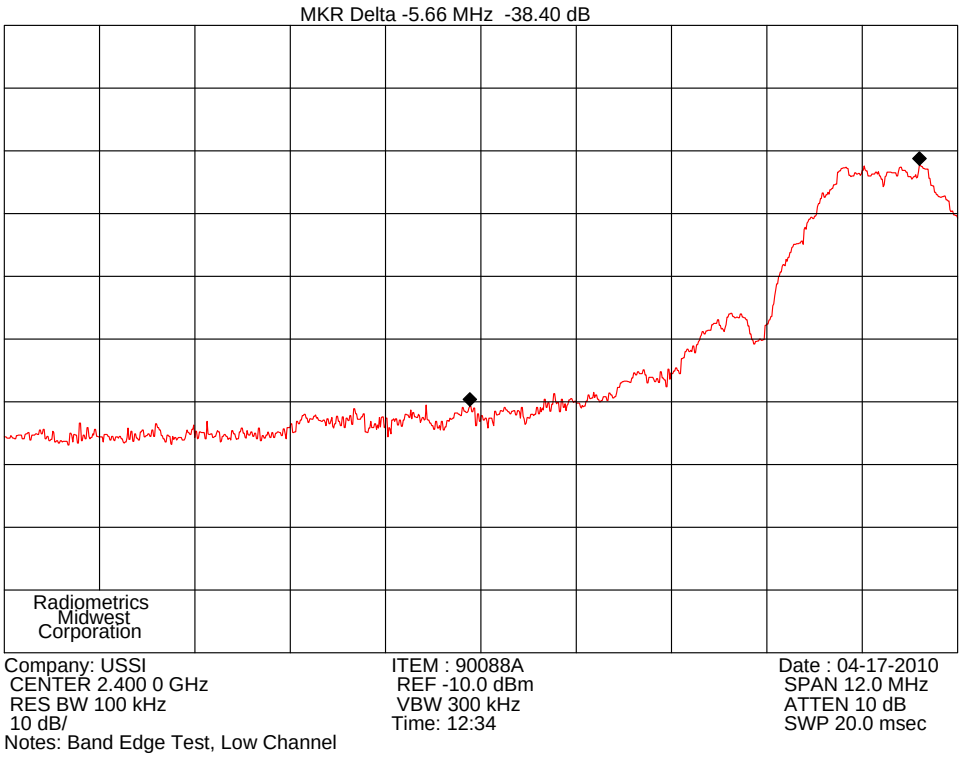
ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 11:02

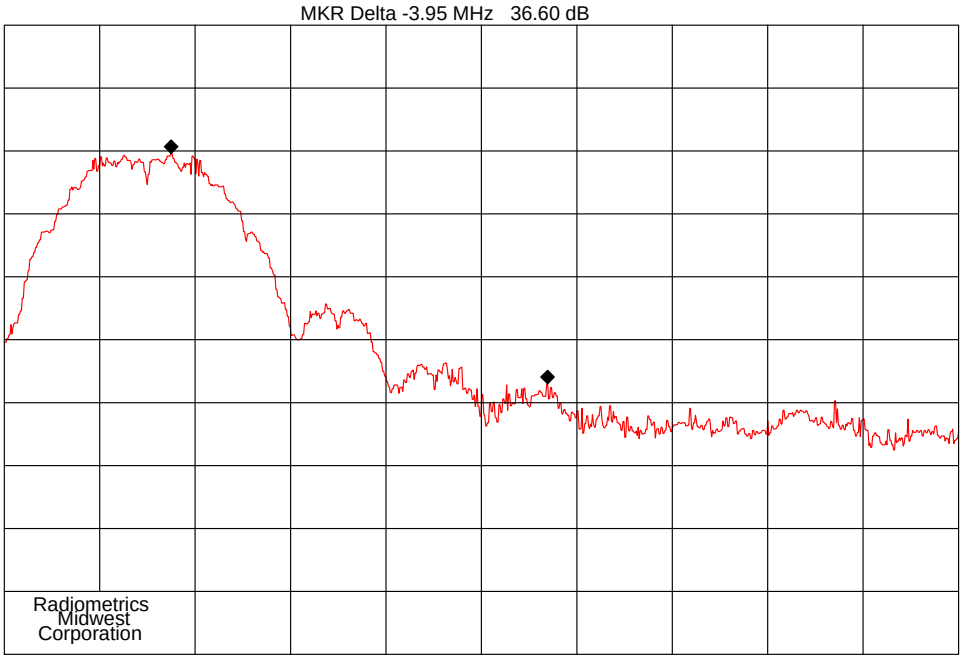
Date : 03-24-2010
SPAN 5.00 MHz
ATTEN 30 dB
SWP 20.0 msec

Channel	Band Edge in dB	Minimum Allowed dB
903 Lower Band edge	23.4	20
927 Upper Band edge	23.9	20

Judgment: Pass by 3.4 dB

10.4.2 2.4 GHz Results





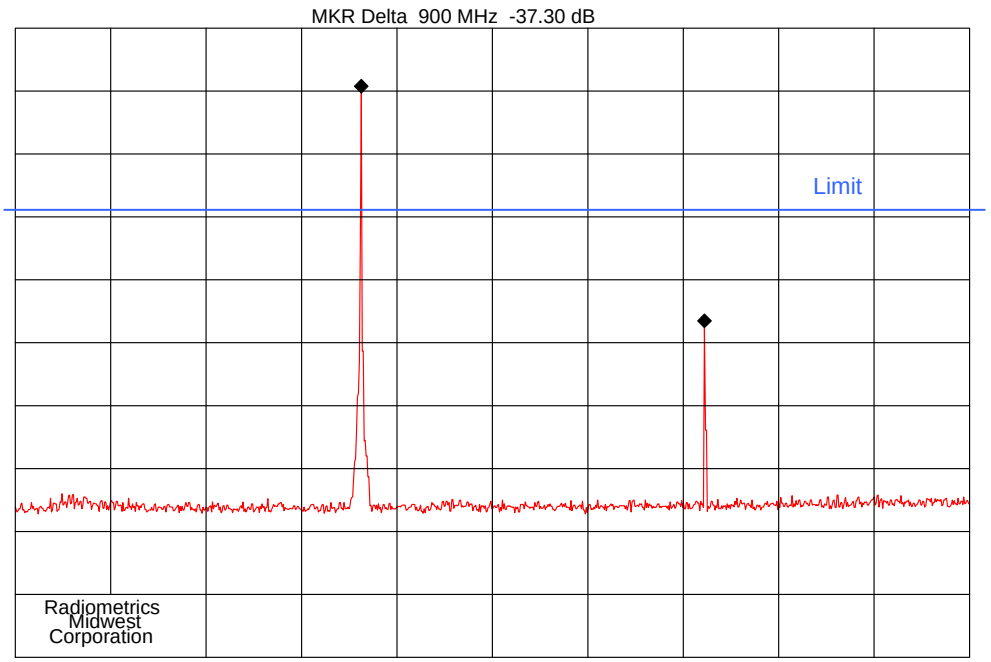
Channel	Band Edge in dB	Minimum Allowed dB
2405 Lower Band edge	38.4	20
2480 Upper Band edge	36.6	20

Judgment: Pass by 16.6 dB

10.5 Spurious RF Conducted Emissions

10.5.1 900 MHz Results

The spectrum analyzer was set to the MAX HOLD mode to record all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic. The trace was allowed to stabilize. The first two plots were made while stepping through three frequencies (Low middle and high). Each frequency was on for 30 seconds.

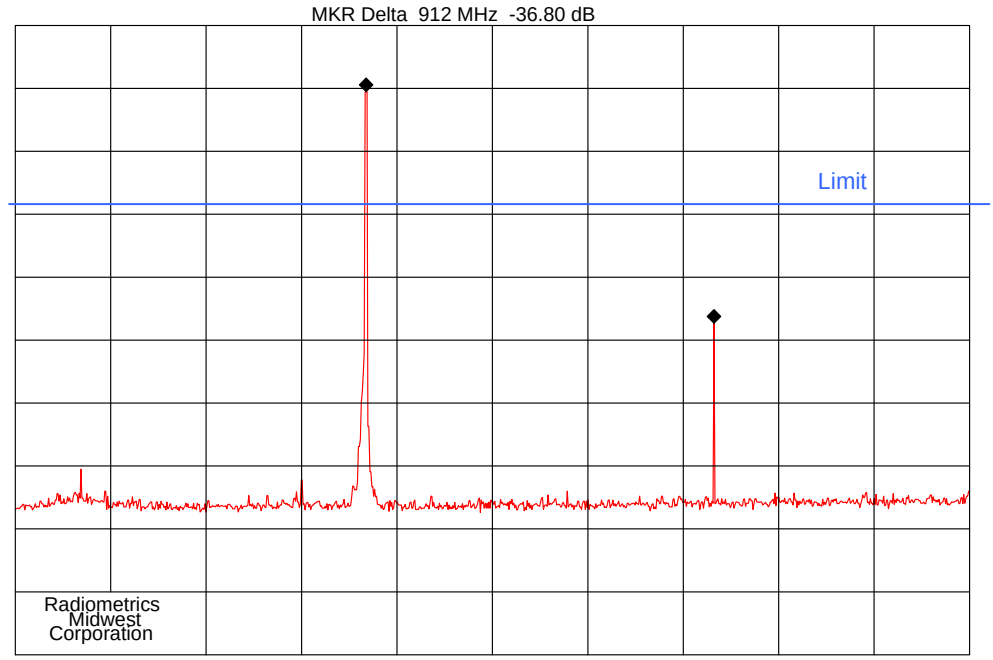


Company: USSI
START 1 MHz
RES BW 100 kHz
10 dB/

ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 12:13

Date : 03-24-2010
STOP 2.50 GHz
ATTEN 30 dB
SWP 750 msec

Notes: Antenna Conducted Test, Low Channel

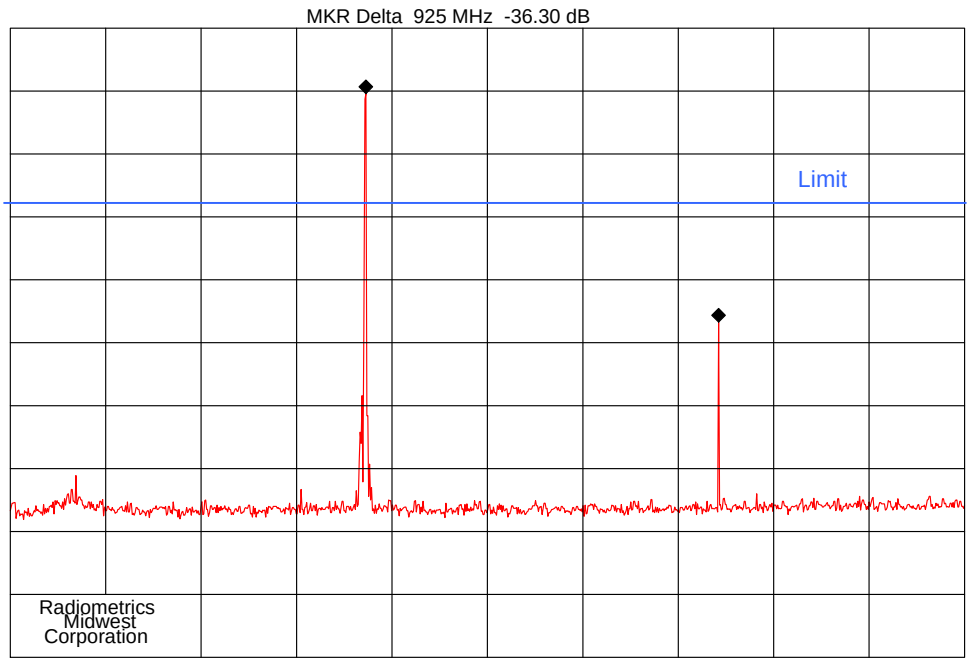


Company: USSI
START 1 MHz
RES BW 100 kHz
10 dB/

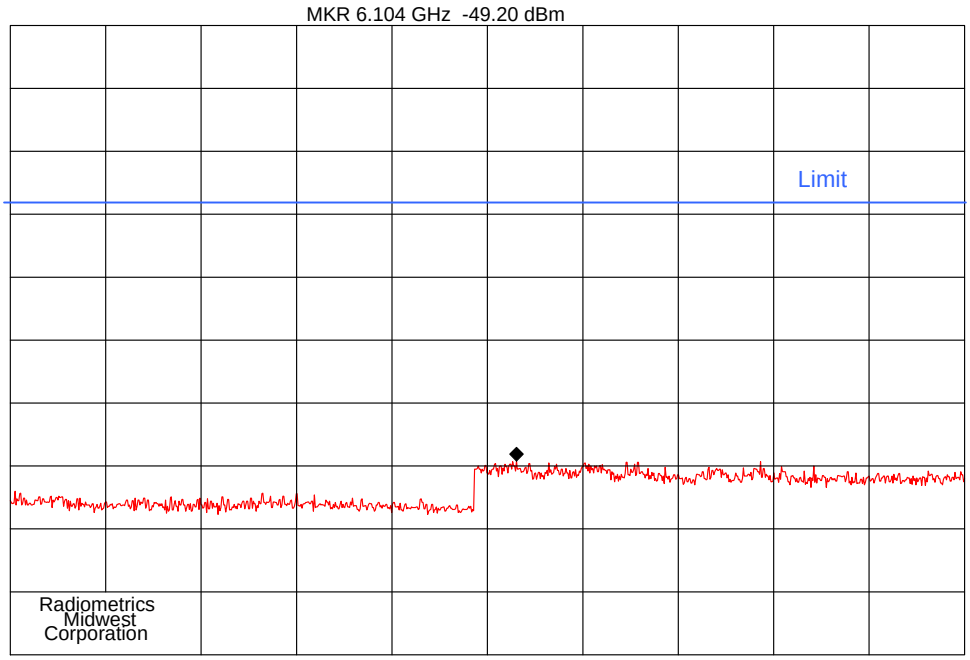
ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 12:15

Date : 03-24-2010
STOP 2.50 GHz
ATTEN 30 dB
SWP 750 msec

Notes: Antenna Conducted Test, Mid Channel

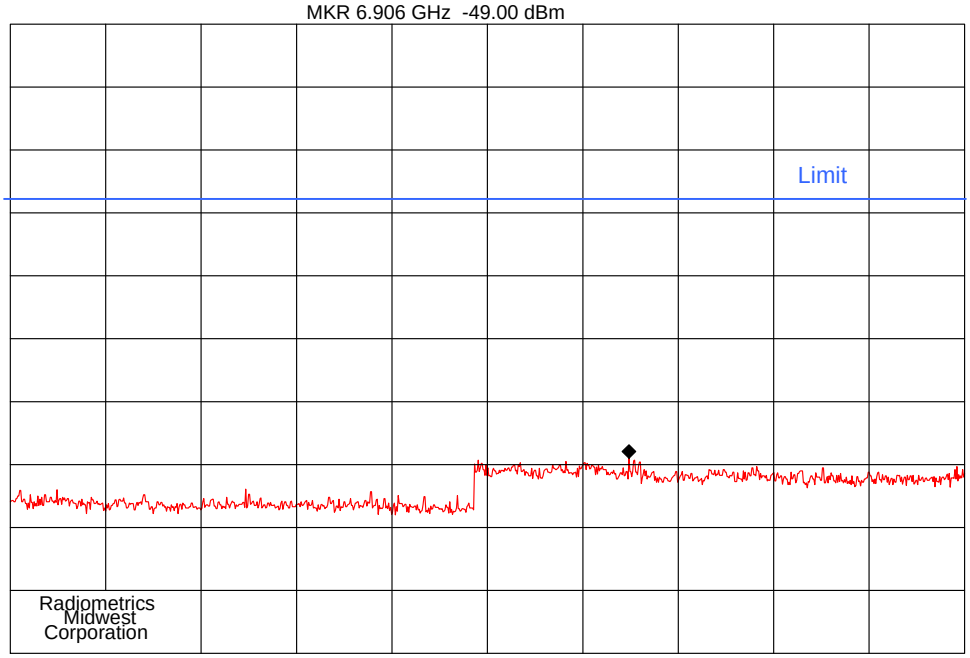


Company: USSI
START 1 MHz
RES BW 100 kHz
10 dB/
ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 12:16
Date : 03-24-2010
STOP 2.50 GHz
ATTEN 30 dB
SWP 750 msec
Notes: Antenna Conducted Test, High Channel



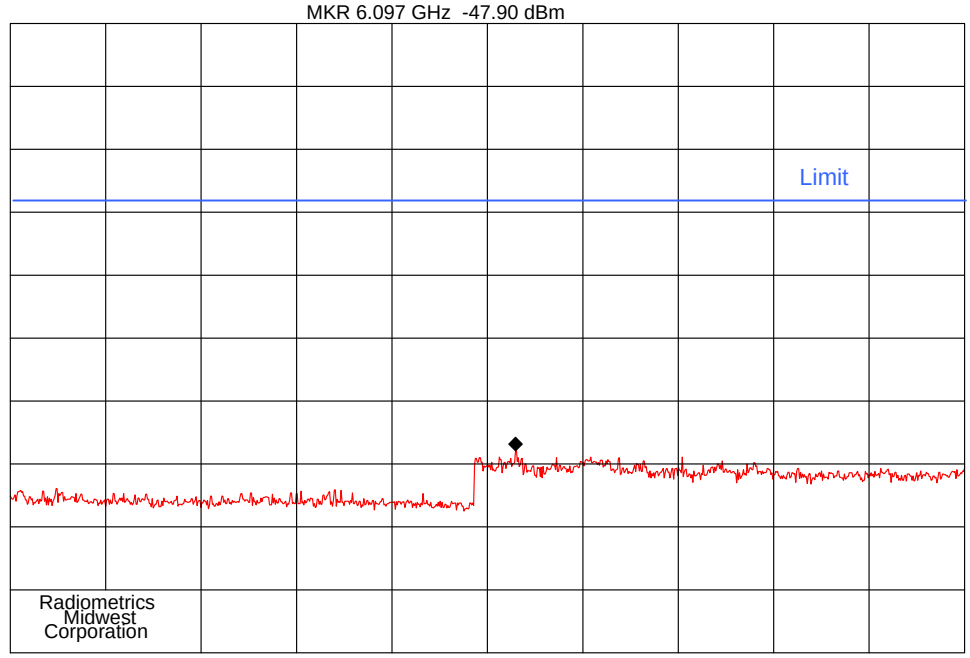
Company: USSI
START 2.50 GHz
RES BW 100 kHz
10 dB/
ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 12:19
Date : 03-24-2010
STOP 9.30 GHz
ATTEN 30 dB
SWP 2.04 sec
Notes: Antenna Conducted Test, Low Channel

MKR 6.906 GHz -49.00 dBm



Company: USSI
START 2.50 GHz
RES BW 100 kHz
10 dB/
ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 12:18
Date : 03-24-2010
STOP 9.30 GHz
ATTEN 30 dB
SWP 2.04 sec
Notes: Antenna Conducted Test, Mid Channel

MKR 6.097 GHz -47.90 dBm

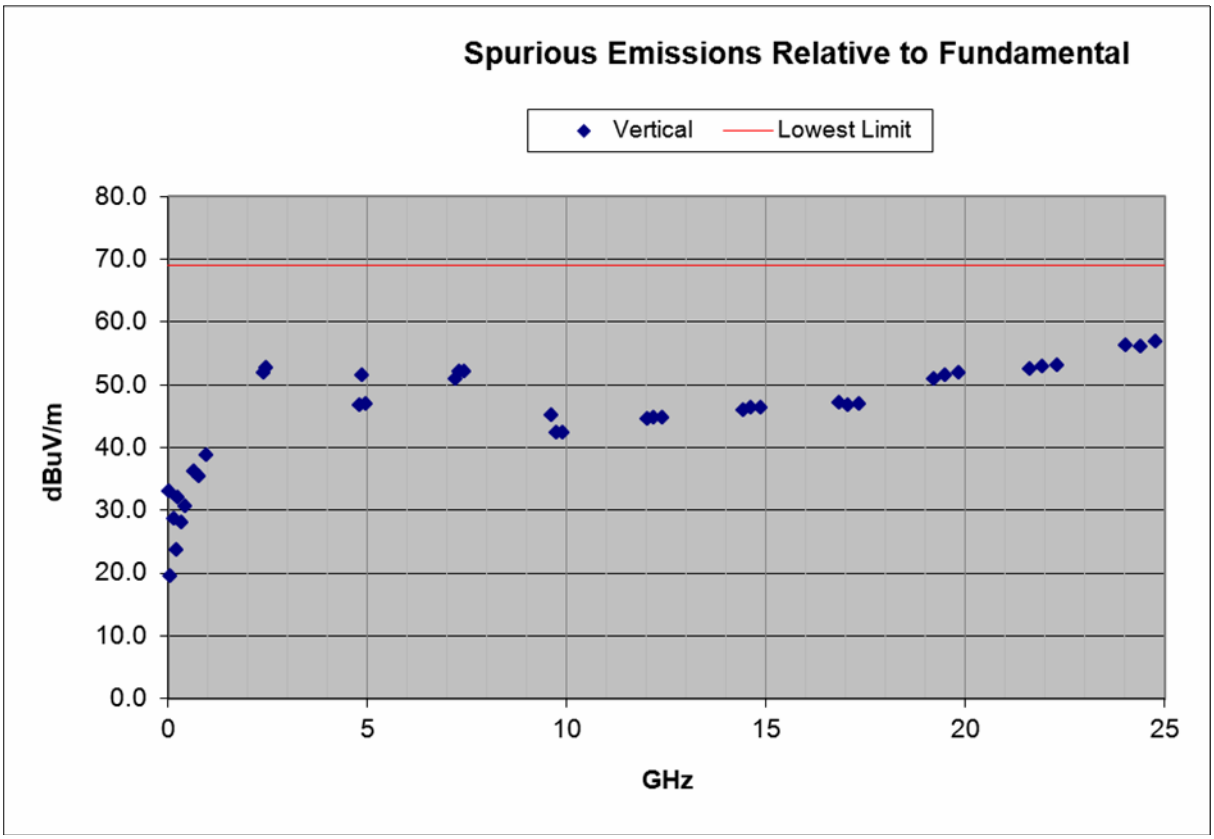


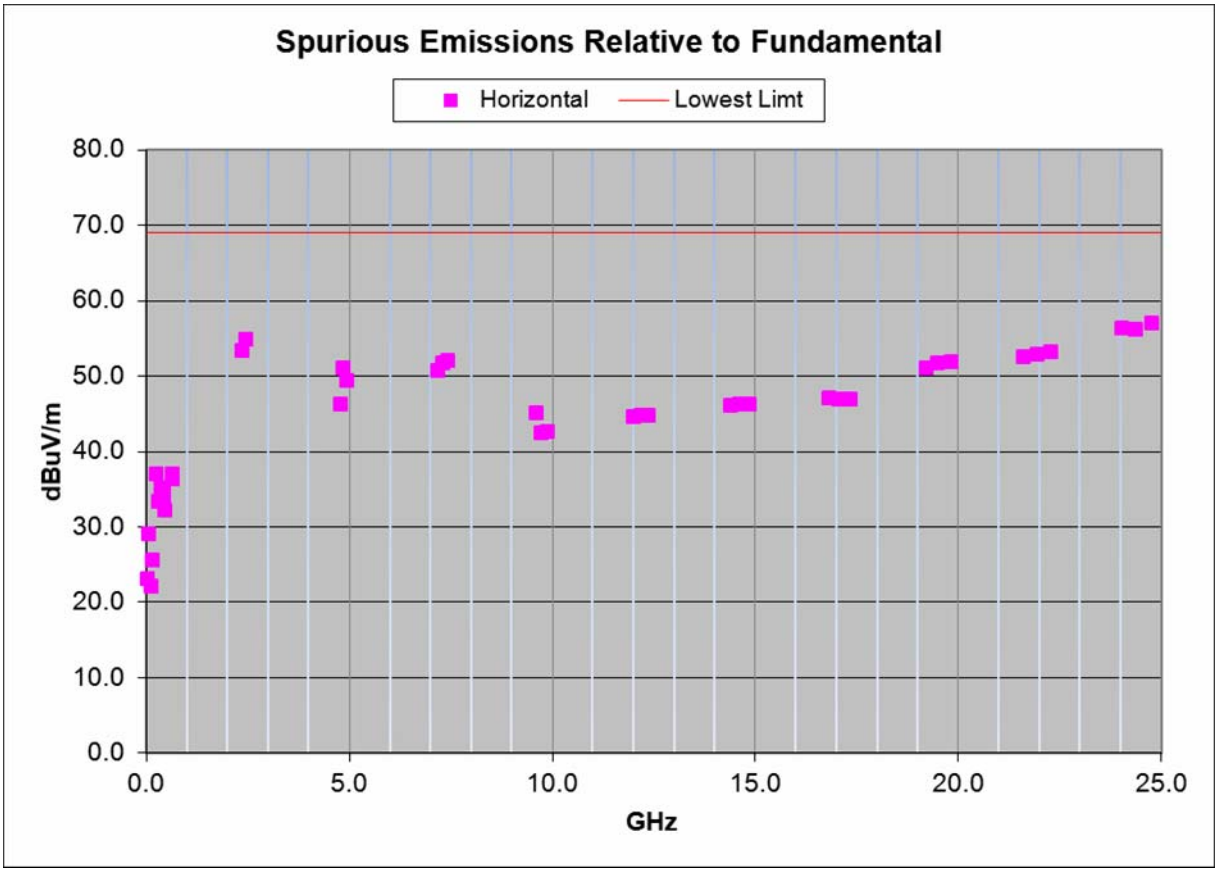
Company: USSI
START 2.50 GHz
RES BW 100 kHz
10 dB/
ITEM : LM
REF 20.0 dBm
VBW 300 kHz
Time: 12:17
Date : 03-24-2010
STOP 9.30 GHz
ATTEN 30 dB
SWP 2.04 sec
Notes: Antenna Conducted Test, High Channel

10.5.2 2.4 GHz Results

Since antenna conducted tests cannot be performed on the EUT at 2.4 GHz, radiated tests were performed to show compliance with this requirement.

The EUT was tested in continous mode and peak readings were made from the lowest frequency generated in the EUT up through the 10th harmonic. The limit is 20 dB lower than the peak of the lowest fundamental. The data is shown graphically.





Judgement: Pass by 12.2 dB

10.6 Spurious Radiated Emissions

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 1000 MHz, an Anritsu spectrum analyzer was used. For tests from 1 to 25 GHz, an HP 8566 spectrum analyzer was used. For tests from 1 to 10 GHz, a high pass filter was used to reduce the fundamental emission. A harmonic mixer was used from 18 to 25 GHz. Figure 4 herein lists the details of the test equipment used during radiated emissions tests. In addition, a high pass filter was used to reduce the fundamental emission. The was device was rotated through three orthogonal axis as per 13.1.4.1 of ANSI C63.4 during the prescans and during final radiated tests.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 25000 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

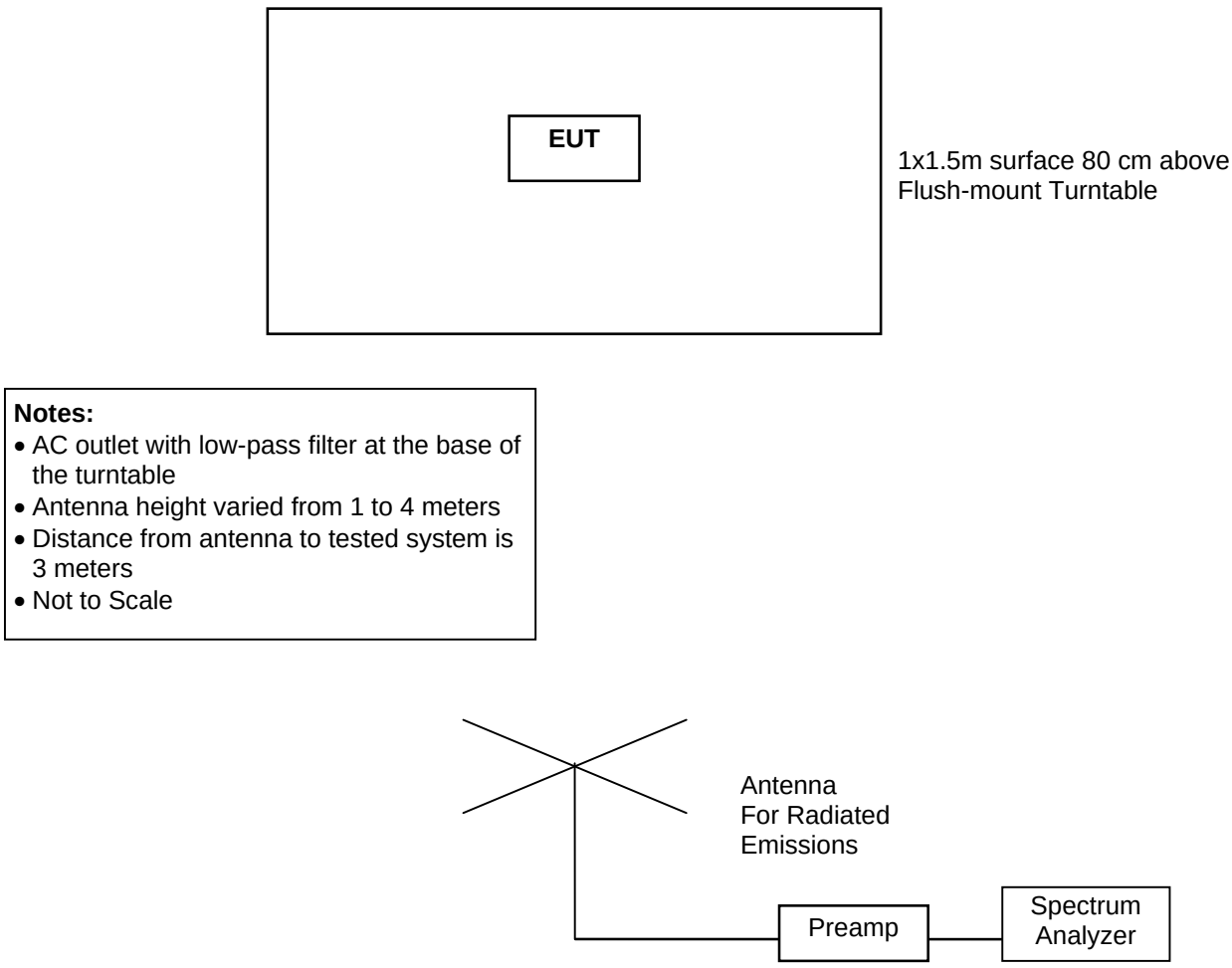
10.6.1 Radiated Emissions Field Strength Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF – AG + HPF

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
HPF = High pass Filter Loss

Figure 1. Drawing of Radiated Emissions Setup



10.6.2 Spurious Radiated Emissions Test Results

The following spectrum analyzer settings were used.

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
A Video Bandwidth of 10 Hz was used for Average measurements above 1 GHz.

10.6.3 900 MHz Results

hrm #	Tx Freq MHz	Spectrum Analyzer Reading in dBuV				Corr. Fact dB	Emission Freq MHz	Field Strength				Margin Under Limit
		Vertical Polarization		Horizontal Polarization				EUT		Limit		
		Peak	Ave	Peak	Ave			dBuV/m				
2	902.6	38.4	25.2	40.9	26.3	33.8	1805.2	74.7	60.1	94	74	13.9
3	902.6	43.8	33.8	41.2	36	4	2707.8	47.8	40	74	54	14
4	902.6	37.5	27.9	37.9	26.2	6.4	3610.4	44.3	34.3	74	54	19.7
5	902.6	36.5	24.6	36.6	25	8.8	4513	45.4	33.8	74	54	20.2
6	902.6	36.5	24.8	35.9	24.6	9.9	5415.6	46.4	34.7	74	54	19.3
7	902.6	35.5	25.4	39	24	10.6	6318.2	49.6	36	94	74	38
8	902.6	39.9	24	38.4	23.8	12.1	7220.8	52	36.1	74	54	17.9
9	902.6	40.6	26.1	39.8	24	15.5	8123.4	56.1	41.6	74	54	12.4
10	902.6	38.4	25	37.8	25	19.6	9026	58	44.6	74	54	9.4
2	915.0	38	26	37.6	31.7	32.6	1830	70.6	64.3	94	74	9.7
3	915.0	43.5	35.1	41.1	33.7	3.7	2745	47.2	38.8	74	54	15.2
4	915.0	40.2	26.1	37.8	26.1	6.6	3660	46.8	32.7	74	54	21.3
5	915.0	36.4	24.8	36.5	24	8.9	4575	45.4	33.7	74	54	20.3
6	915.0	35.3	24	35.5	24.8	10	5490	45.5	34.8	94	74	39.2
7	915.0	40.3	24.3	40	24	10.3	6405	50.6	34.6	94	74	39.4
8	915.0	38.7	24.7	40.3	24.1	12.9	7320	53.2	37.6	74	54	16.4
9	915.0	38.4	23.5	39	24	15.7	8235	54.7	39.7	74	54	14.3
10	915.0	37.5	25	38.3	25	19.5	9150	57.8	44.5	74	54	9.5
2	927.4	38.4	27.9	39.7	32	31.3	1854.8	71	63.3	94	74	10.7
3	927.4	44.9	37.1	41.2	35.8	3.6	2782.2	48.5	40.7	74	54	13.3
4	927.4	37.9	29	37.9	26	6.8	3709.6	44.7	35.8	74	54	18.2
5	927.4	35.9	24.6	36.9	24.6	8.8	4637	45.7	33.4	74	54	20.6
6	927.4	36.1	24	35.3	24	10.2	5564.4	46.3	34.2	94	74	39.8
7	927.4	39.6	25.1	40	25.6	10.2	6491.8	50.2	35.8	94	74	38.2
8	927.4	39.8	23.8	38.6	23.8	13.7	7419.2	53.5	37.5	74	54	16.5
9	927.4	38	24.7	37.6	24.3	16.3	8346.6	54.3	41	74	54	13
10	927.4	38.4	25	38.8	25	19.8	9274	58.6	44.8	74	54	9.2
Column numbers (see below for explanations)												
1	2	3	4	5	6	7	8	9	10	11	12	13

Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer in dBuV (Highest of three First Axis Rotations)
Column #4. Average Reading based on peak reading reduced by the Duty cylce correction. (Highest of three First Axis Rotations)
Column #5. Same as Column #3 except Horizontal Receive antenna
Column #6. Same as Column #4 except Horizontal Receive antenna
Column #7. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #8. Frequency of Tested Emission
Column #9. Highest peak field strength at listed frequency.
Column #10. Highest Average field strength at listed frequency.

Column #11. Peak Limit.
Column #12. Average Limit.
Column #13. The margin is the worst case margin in dB under the peak or average limits for that row.

Spurrious Emissions Below 1 GHz

Manufacturer	USSI	Specification	FCC Part 15.247 & RSS-210
Model	90088A	Test Date	April 14, 2010
Serial Number	none	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; BC = Biconical (ANT-3); LP = Log-Periodic (ANT-6); HN = Horn (ANT-13) P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain – Duty Cycle Factor + HP Filter Loss		

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
63.6	30.9	P	9.5	H/44	-17.5	22.9	40.0	17.1
93.6	37.8	P	8.3	H/44	-17.1	29.0	43.5	14.5
140.8	27.7	P	11.0	H/44	-16.8	21.9	43.5	21.6
190.4	32.3	P	9.5	H/44	-16.3	25.5	43.5	18.0
260.3	40.0	P	12.7	H/44	-15.9	36.8	46.0	9.2
340.4	34.2	P	14.4	H/44	-15.4	33.2	46.0	12.8
389.1	35.2	P	15.1	H/44	-15.3	35.0	46.0	11.0
444.6	34.1	P	15.9	H/44	-15.0	35.0	46.0	11.0
458.6	31.7	P	16.7	H/44	-15.0	33.4	46.0	12.6
491.0	29.6	P	17.3	H/44	-14.8	32.1	46.0	13.9
662.9	29.7	Q	19.9	H/44	-13.4	36.2	46.0	9.8
683.0	30.7	Q	19.3	H/44	-13.2	36.8	46.0	9.2
30.8	34.5	P	16.4	V/44	-18.0	32.9	40.0	7.1
77.2	30.0	P	6.8	V/44	-17.3	19.5	40.0	20.5
152.8	35.0	P	10.1	V/44	-16.6	28.5	43.5	15.0
222.8	28.2	P	11.6	V/44	-16.1	23.7	46.0	22.3
260.3	35.1	P	12.7	V/44	-15.9	31.9	46.0	14.1
340.4	28.9	P	14.4	V/44	-15.4	27.9	46.0	18.1
430.0	28.6	P	17.0	V/44	-15.0	30.6	46.0	15.4
654.0	30.7	P	18.9	V/44	-13.4	36.2	46.0	9.8
792.0	27.6	P	20.2	V/44	-12.4	35.4	46.0	10.6
981.0	27.8	P	22.0	V/44	-11.0	38.8	54.0	15.2

Judgment: Pass by 7.1 dB

10.6.4 2.4 GHz Results

hrm #	Tx Freq MHz	Spectrum Analyzer Reading in dBuV				Corr. Fact dB	Emission Freq MHz	Field Strength				Margin Under Limit
		Vertical Polarization		Horizontal Polarization				EUT		Limit		
		Peak	Ave	Peak	Ave			dBuV/m				
1	2405	86.4	81.8	87.8	83.2	4	2405	91.8	87.2	125	125	33.2
BE	2405	48	43.4	49.4	44.8	3.9	2400	53.3	48.7	74	54	5.3
2	2405	34.5	29.9	34.1	29.5	12.1	4810	46.6	42	74	54	12.0
3	2405	35.1	30.5	34.8	30.2	15.8	7215	50.9	46.3	74	54	7.7
4	2405	33	28.4	33	28.4	12	9620	45	40.4	74	54	13.6
1	2440	88.9	84.3	85.7	81.1	4.1	2440	93	88.4	125	125	32.0
2	2440	39	34.4	38.5	33.9	12.4	4880	51.4	46.8	74	54	7.2
3	2440	36.2	31.6	35.6	31.0	15.9	7320	52.1	47.5	74	54	6.5
4	2440	33	28.4	33	28.4	9.3	9760	42.3	37.7	74	54	16.3
1	2480	84.8	80.2	86.9	82.3	4.3	2480	91.2	86.6	125	125	33.8
BE	2480	48.2	43.6	50.3	45.7	4.4	2483.5	54.7	50.1	74	54	3.9
2	2480	34.5	29.9	36.8	32.2	12.4	4960	49.2	44.6	74	54	9.4
3	2480	35.5	30.9	35.4	30.8	16.5	7440	52	47.4	74	54	6.6
4	2480	33	28.4	33	28.4	9.4	9920	42.4	37.8	74	54	16.2
Column numbers (see below for explanations)												
1	2	3	4	5	6	7	8	9	10	11	12	13

Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer in dBuV (Highest of three First Axis Rotations)
Column #4. Average Reading based on peak reading reduced by the Duty cylce correction. (Highest of three First Axis Rotations)
Column #5. Same as Column #3 except Horizontal Receive antenna
Column #6. Same as Column #4 except Horizontal Receive antenna
Column #7. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #8. Frequency of Tested Emission
Column #9. Highest peak field strength at listed frequency.
Column #10. Highest Average field strength at listed frequency.
Column #11. Peak Limit.
Column #12. Average Limit.
Column #13. The margin is the worst case margin in dB under the peak or average limits for that row.

Spurrious Emissions Below 1 GHz

Freq. MHz	Meter Reading dBuV	Antenna		Corr. Factors dB	Field Strength dBuV/m		Margin Under Limit dB
		Factor dB	Pol/ Type		EUT	Limit	
76.8	29.0 P	6.9	H/25	-28.8	7.1	40.0	32.9
150.8	30.2 P	11.0	H/25	-28.8	12.4	43.5	31.1
180.4	42.0 P	9.3	H/25	-28.7	22.6	43.5	20.9

Freq. MHz	Meter Reading dBuV	Antenna Factor dB	Antenna Pol/ Type	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
216.4	35.7 P	12.3	H/44	-28.8	19.2	46.0	26.8
263.7	42.3 P	13.5	H/44	-28.6	27.2	46.0	18.8
323.6	44.5 P	14.1	H/44	-28.6	30.0	46.0	16.0
397.5	36.8 P	15.3	H/44	-28.5	23.6	46.0	22.4
487.1	34.5 P	17.2	H/44	-27.8	23.9	46.0	22.1
591.0	37.7 P	18.7	H/44	-27.4	29.0	46.0	17.0
643.0	34.3 P	19.3	H/44	-27.5	26.1	46.0	19.9
694.0	35.5 P	19.9	H/44	-27.3	28.1	46.0	17.9
850.0	40.3 P	21.0	H/44	-26.8	34.5	46.0	11.5
954.0	36.2 P	22.9	H/44	-27.3	31.8	46.0	14.2
32.4	37.2 P	18.1	V/44	-28.9	26.4	40.0	13.6
69.6	37.6 P	7.6	V/44	-28.8	16.4	40.0	23.6
100.8	31.5 P	10.6	V/44	-28.8	13.3	43.5	30.2
178.8	34.0 P	9.3	V/44	-28.8	14.5	43.5	29.0
205.6	36.0 P	10.4	V/44	-28.7	17.7	43.5	25.8
271.0	33.5 P	13.1	V/44	-28.7	17.9	46.0	28.1
330.9	34.7 P	14.1	V/44	-28.6	20.2	46.0	25.8
346.0	47.7 P	14.3	V/44	-28.7	33.3	46.0	12.7
400.3	37.0 P	15.2	V/44	-28.5	23.7	46.0	22.3
455.8	38.3 P	16.9	V/44	-28.1	27.1	46.0	18.9
239.0	30.4 P	12.6	V/44	-28.7	14.3	46.0	31.7
286.1	31.6 P	13.1	V/44	-28.8	15.9	46.0	30.1
327.5	34.2 P	14.1	V/44	-28.6	19.7	46.0	26.3
370.1	39.3 P	15.0	V/44	-28.4	25.9	46.0	20.1
436.2	30.2 P	15.7	V/44	-28.0	17.9	46.0	28.1
486.0	31.9 P	17.4	V/44	-27.8	21.5	46.0	24.5

Judgment: Passed by 3.9 dB overall

10.7 Unintentional Emissions (Receive Mode)

Manufacturer	USSI	Specification	FCC Part 15.247 & RSS-210
Model	90088A	Test Date	April 14, 2010
Serial Number	none	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; BC = Biconical (ANT-3); LP = Log-Periodic (ANT-6); HN = Horn (ANT-13) P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain – Duty Cycle Factor + HP Filter Loss		

10.7.1 900 MHz & 2.4 GHz Results

This is the results with the EUT in the receive mode for both the 900 MHz and the 2.4 GHz radios.

Freq. MHz	Meter Reading dBuV	Antenna Factor dB	Antenna Pol/ Type	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
78.4	25.3 P	7.1	V/44	-28.8	3.6	40.0	36.4
144.8	26.2 P	11.7	V/44	-28.8	9.1	43.5	34.4
271.5	25.6 P	13.1	V/44	-28.7	10.0	46.0	36.0
382.4	27.2 P	15.4	V/44	-28.4	14.2	46.0	31.8
451.8	30.9 P	16.6	V/44	-28.1	19.4	46.0	26.6
624.0	26.6 P	18.7	V/44	-27.3	18.0	46.0	28.0
767.0	26.0 P	21.0	V/44	-27.3	19.7	46.0	26.3
938.0	29.1 P	22.5	V/44	-27.0	24.6	46.0	21.4
70.4	33.0 P	7.5	H/44	-28.8	11.7	40.0	28.3
122.8	25.7 P	15.6	H/44	-28.7	12.6	43.5	30.9
212.0	25.4 P	11.5	H/44	-28.8	8.1	43.5	35.4
281.6	26.0 P	13.0	H/44	-28.8	10.2	46.0	35.8
358.3	25.7 P	14.7	H/44	-28.5	11.9	46.0	34.1
449.6	26.5 P	16.5	H/44	-28.1	14.9	46.0	31.1
612.0	24.5 P	18.9	H/44	-27.2	16.2	46.0	29.8
788.0	26.2 P	21.5	H/44	-27.1	20.6	46.0	25.4
862.0	27.7 P	21.5	H/44	-26.6	22.6	46.0	23.4
938.0	29.1 P	22.5	H/44	-27.0	24.6	46.0	21.4

Judgment: Passed by 21.4 dB overall