EMISSIONS TEST REPORT

Report Number: 3131338DAL-001
Project Number: 3131338

Testing performed on the

Zigbee Transceiver

Model: Z7 Console
FCC ID: U5P ILUVMYZ7
To

FCC Part 15 Subpart C 15.247
Industry Canada's RSS-210 Issue 6 September 2005, Annex 8
FCC Part 15 Subpart B and ICES-003 Issue 4 February 2004

For

International Safety Instruments, Inc.

Test Performed by:
Intertek – ETL SEMKO
420 N Dorothy Drive,
Richardson, TX 75081 USA

Test Authorized by:
International Safety Instruments, Inc.
922 Hurricane Shoals Rd.
Lawrenceville, GA – 30043 USA

Prepared by: _____ Date: 09/19/07
Sudesh Kamble, Team Leader

Reviewed by: _____ Date: 9/21/07

Intertek Testing Services NA, Inc.
420 N Dorothy Drive, Richardson, TX – 75081 USA
Telephone: 1-972-238-5591 Fax: 1-972-238-1860 Web: www.intertek-etlsemko.com

Table of Content

1 Job Description

1.1 Client Information

This EUT has been tested at the request of:

Company:	International Safety Instruments, Inc. 922 Hurricane Shoals Rd. Lawrenceville, GA – 30043 USA
Contact:	Mr. John Baker
Telephone:	770-962-2552
Fax:	770-963-2797

1.2 Equipment Under Test

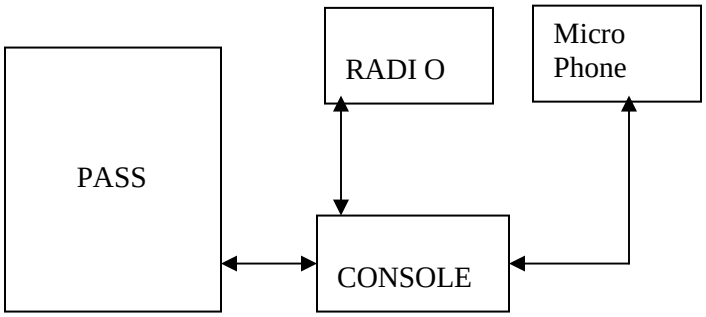
Equipment Type:	Zigbee Transceiver
Model Number(s):	Z7 Console (see section 1.4.3 for individual items)
Serial number(s):	Prototype sample tested
Manufacturer:	International Safety Instruments, Inc. 922 Hurricane Shoals Rd. Lawrenceville, GA – 30043 USA
EUT receive date:	August 31, 2007
EUT received condition:	Prototype
Test start date:	September 4, 2007
Test end date:	September 11, 2007

1.3 Test Plan Reference

Tested according to the standards listed, ANSI C63.4:2003, and RSS-Gen Issue 2 June 2007; KDB 558074 and RSS-210 Issue 7 June 2007

1.4 Test Configuration

1.4.1 Block Diagram



1.4.2 Cables:

Cables						
Cable Id #	Description	Length	Shielding	Ferrites	Connection	
					From	To
Microph one	Audio connection”	29’	Yes	No	PASS Device	Face Mask Microphone
Radio	PASS to Radio connection	7’ 6”	Yes	No	PASS	Radio
Pass	Pass to Console	1’ 7”	Yes	No	Console	PASS Device

1.4.3 Support Equipment & Equipment Under Test:

Description	Manufacturer	Model Number	Serial Number
MTS2000 Talkie Fm Radio	Motorola	H01UCH6PW1BN FCC ID: AZ489FT5747	466AYE0472
Microphone	ISI	025165 Rev B	15935050

:

1.5 Mode(s) of Operation:

The Device was activated from a fresh AA batteries. The EUT was continuously transmitting on low, mid, and high channels and was manipulated in three orthogonal axes. The EUT does not have an antenna port. The antenna is integrated in the device.

1.6 Floor Standing Equipment:

Applicable:__ __ Not Applicable:__X_

1.7 Modifications Required for Compliance:

No modifications required.

2 Test Summary

TEST STANDARD	RESULTS	
FCC Part 15 Subpart C 15.247, Industry Canada's RSS-210 Issue 6 September 2005 Annex 8, FCC Part 15 Subpart B, and Industry Canada's ICES-003 Issue 4 February 2004		
SUB-TEST	**TEST PARAMETER**	**COMMENT**
Maximum Peak Conducted Output Power and Human RF Exposure FCC 15.247(b)(3-5), RSS-210 A8.4, RSS-102 4.3	The output power of the Radio Module must not exceed 1 Watt (30 dBm) and 36 dBm EIRP. The human RF Exposure limit is 1 mW/cm^2.	Pass
Occupied Bandwidth FCC 15.247(a)(2), RSS-210 A8.2	The 6 dB bandwidth of the Radio Module must be at least 500 kHz.	Pass
Antenna Port Conducted Spurious Emissions FCC 15.209, 15.247(d), RSS-210 A8.5	The spurious emissions of the Radio Module must be attenuated below the level of the fundamental by at least 20 dBc.	Not Applicable Integral Antenna
Radiated Spurious Emissions FCC 15.205, 15.209, 15.247(d), 15.109, RSS-210 2.2, 2.7, A8.5, ICES-003	The spurious emissions of the Radio Module must be attenuated below the level of the fundamental by at least 20 dBc. Emissions which fall in the restricted bands must meet the general limits of 15.209 and RSS-210 2.7 Table 2. The spurious emissions of the BEP must not exceed the limits of 15.109 Class B and ICES-003 Class B.	Pass
Peak Power Spectral Density FCC 15.247(e), RSS-210 A8.2	The peak power spectral density of the Radio Module must not exceed 8 dBm / 3 kHz.	Pass
Band Edge Compliance FCC 15.215, RSS-210 2.1, A8.5	The fundamental frequency of the Radio Module must stay within the assigned frequency band.	Pass
AC Line-Conducted Emissions FCC 15.207, 15.107, RSS-Gen 7.2.2, ICES-003	The AC line-conducted emissions of the Radio Module must not exceed the limits of 15.207 and RSS-Gen 7.2.2 Table 2. The AC line-conducted emissions of the BEP must not exceed the limits of 15.107 Class A and ICES-003 Class A.	Not Applicable Battery powered Device

Notes: The Mini Tag was tested as a Class A digital device to FCC Part 15 Subpart B and ICES-003; Intentional transmission was tested as a transmitter to the requirements of FCC Part 15 Subpart C 15.247 and RSS-210 Annex 8. Channels selected for test were:
Channel 11: 2405 MHz,
Channel 17: 2435 MHz,
Channel 26: 2480 MHz

3 REVISION SUMMARY

The following changes have been made to this Report:

Date	Project No.	Project Handler	Page(s)	Item	Description of change

4 Sample Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

RA = 52.0 dBµV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBµV/m

Level in µV/m = [10(32 dBµV/m)/20] = 39.8 µV/m

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBµV
RF = Reading from receiver in dBµV
LF = LISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBµV to µV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in µV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBµV
$UF = 10^{(48.1\ dB\mu V / 20)}$ = 254 µV/m

4.1 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.
The expanded uncertainty (k = 2)[1] for radiated emissions from 30 to 1000 MHz has been determined to be:

±3.1 dB at 3m

The expanded uncertainty (k = 2) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be:

±1.74 dB

[1] k=2 represents 95% Confidence Level.

5 Site Description

Test Site(s): 1

The test facility is located at 420 N Dorothy Drive, Richardson, TX - 75081

The FCC site registration number for this site is 10157.
The Industry Canada file no. is IC 6018.
.
Measurements are conducted with a quasi-peak detector instrument in the frequency range of 30 MHz to 1000 MHz. The measuring receiver meets the requirements of Section One of CISPR 16/ ANSI 63.4 and the measuring antenna correlates to a balanced dipole.
Measurements of the radiated field are made with the antenna located at a distance of 10 meters from the EUT. If the field-strength measurements at 10m cannot be made because of high ambient noise level or for other reasons, measurements of Class B equipment may be made at a closer distance, for example 3m. An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance for determining compliance.
The antenna is adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.
The antenna-to-EUT azimuth is varied during the measurement to find the maximum field-strength readings.
The antenna-to-EUT polarization (horizontal and vertical) is varied during the measurements to find the maximum field-strength readings.
The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.
Equipment setup for radiated disturbance tests followed the guidelines of CISPR 16 and ANSI 63.4.

6 Test Results

6.1 Test: Transmitter Output Power and EIRP, and Human RF Exposure

Test Standard: FCC 15.247(b)(3-5), RSS-210 A8.4, RSS-102 4.3

Test Results: Pass

Test Environment:

Environmental Conditions During Testing:	Humidity (% Rh):	47	Pressure (mbar):	996	Ambient (°C):	26.5
Pretest Verification Performed	N/A		Equipment under Test:		Z7 Console	

Maximum Test Parameters: The output power of the Radio Module must not exceed 1 Watt (30 dBm) and 36 dBm EIRP. The human RF Exposure limit is 1 mW/cm^2.

Test Equipment Used:

Equip. ID	Description	Manufacturer	Model	Serial Number	Cal Date	Cal Due
77	EMI Receiver	R & S	ES17	100044	12/29/06	12/29/07
192	Handheld Manometer	Omega	HHP-102F	19.99/29.0 PSIA	03/03/07	03/03/08
260	Humidity Temperature	Extech	445580	17-260	12/01/06	12/01/07
30	DMM	Fluke	8060A	6191012	02/08/07	02/08/08
82	Bi-ConiLog Antenna	Schaffner	CBL6112B	2726	06/24/07	06/24/08
128	RF Cable	Custom made	#1	none	07/26/07	07/26/08
131	RF Cable	Custom made	#4	none	07/26/07	07/26/08
271	Horn Antenna	A H Systems	SAS-571	787	02/24/07	02/24/08
101	EMI Receiver	Agilent	E7405A	US40240235	12/20/06	12/20/07

Test Results:

Notes: The cable loss and antenna factor were compensated for in the spectrum analyzer. The field strength obtained at 3 meters distance was converted to EIRP using the equations of DA-00-705A1. A 100 kHz bandwidth and RMS detector were used with a 50 MHz span in order to have 500 discrete non-overlapping values for integration. Since the antenna is integral, conducted output power compliance cannot be demonstrated.

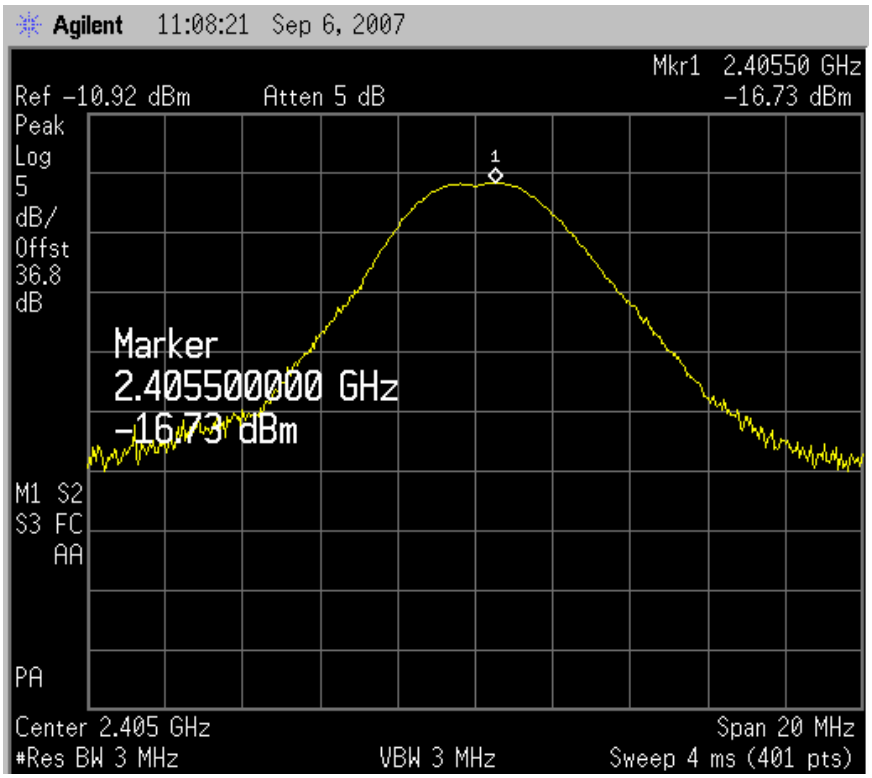
As referenced in RSS-102 2.5, the EUT is exempt from SAR evaluation because the output power is less than 20 mW and RF evaluation because the operating frequency is above 1.5 GHz and the EIRP does not exceed 5 watts. The FCC human RF exposure limit is 1 mW/cm^2. The power density S generated by some value of EIRP at a given distance d is related by the equation:

$$S=EIRP / (4\pi d^2)$$

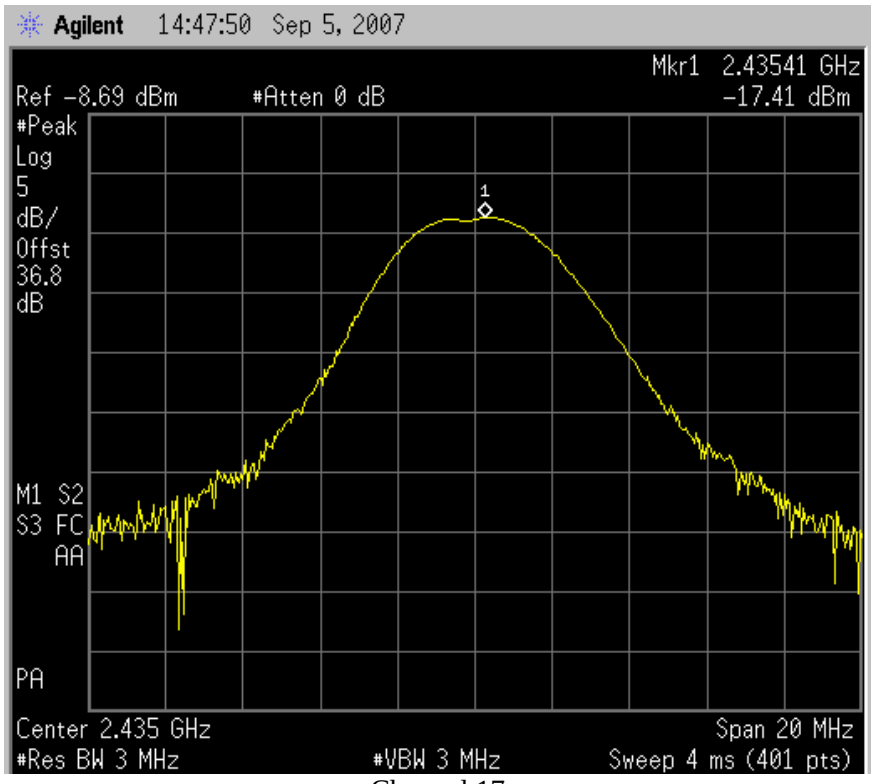
The distance, given a maximum EIRP of -14.58 dBm (0.0348 mW) at which the radiated power density of the EUT is equal to the human RF exposure limit is 0.0526 cm from the antenna. Note that the EUT is exempt from FCC SAR evaluation because the output power is less than 25 mW.

Antenna	Type	Model	Connector	Gain
Integral Antenna	N/A	N/A	N/A	N/A

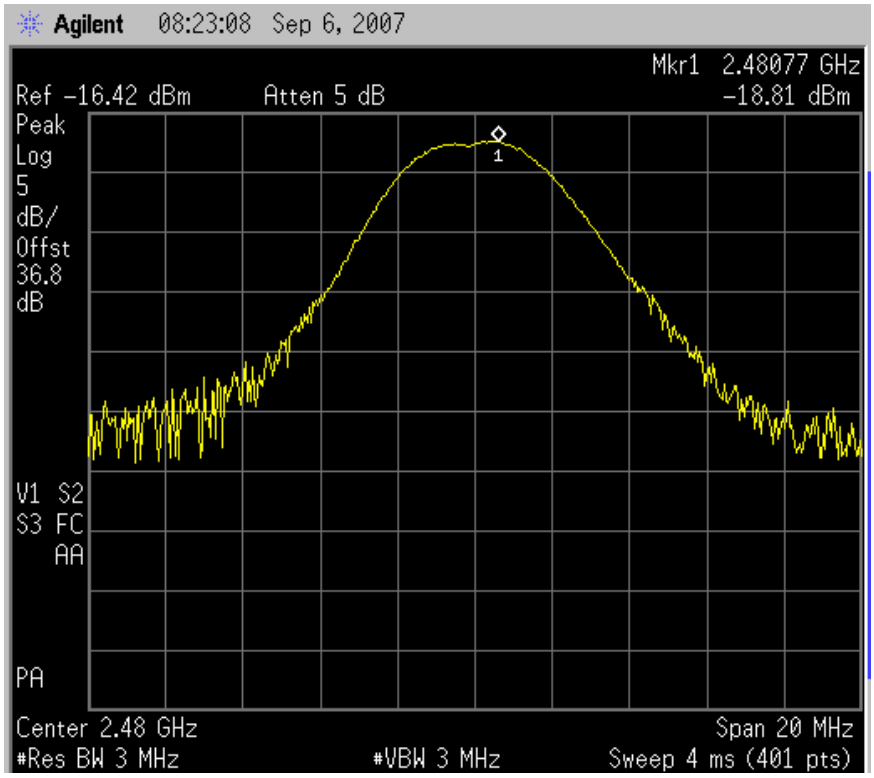
Pol	Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	EIRP (dBm)	EIRP Limit (dBm)
V	11	2405	-18.16	30.0	-16.01	36.0
V	17	2435	-19.84	30.0	-17.69	36.0
V	26	2480	-19.66	30.0	-17.51	36.0
H	11	2405	-16.73	30.0	-14.58	36.0
H	17	2435	-16.86	30.0	-14.71	36.0
H	26	2480	-18.81	30.0	-16.66	36.0



Channel 11



Channel 17



Channel 26

6.2 Test: Occupied Bandwidth

Test Standard: FCC 15.247(a)(2), RSS-210 A8.2

Test Results: Pass

Test Environment:

Environmental Conditions During Testing:	Humidity (%Rh):	49	Pressure (mbar):	997	Ambient (°C):	25.9
Pretest Verification Performed	N/A		Equipment under Test:		Z7 Console	

Maximum Test Parameters: The 6 dB bandwidth of the Radio Module must be at least 500 kHz.
Test Equipment Used:

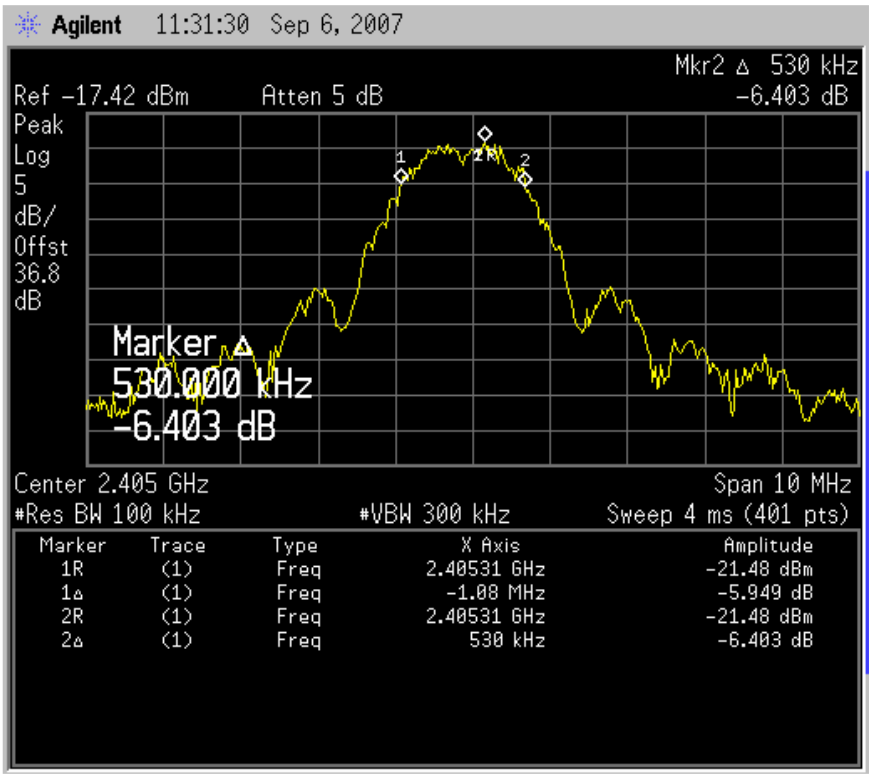
Equip. ID	Description	Manufacturer	Model	Serial Number	Cal Date	Cal Due
77	EMI Receiver	R & S	ES17	100044	12/29/06	12/29/07
192	Handheld Manometer	Omega	HHP-102F	19.99/29.0 PSIA	03/03/07	03/03/08
260	Humidity Temperature	Extech	445580	17-260	12/01/06	12/01/07
30	DMM	Fluke	8060A	6191012	02/08/07	02/08/08
82	Bi-ConiLog Antenna	Schaffner	CBL6112B	2726	06/24/07	06/24/08
128	RF Cable	Custom made	#1	none	07/26/07	07/26/08
131	RF Cable	Custom made	#4	none	07/26/07	07/26/08
271	Horn Antenna	A H Systems	SAS-571	787	02/24/07	02/24/08
101	EMI Receiver	Agilent	E7405A	US40240235	12/20/06	12/20/07

Test Results:
Notes: There is no limit on the 20 dB bandwidth; it is simply included for informational purposes. The 20 dB bandwidth is referenced to the actual RF output power.

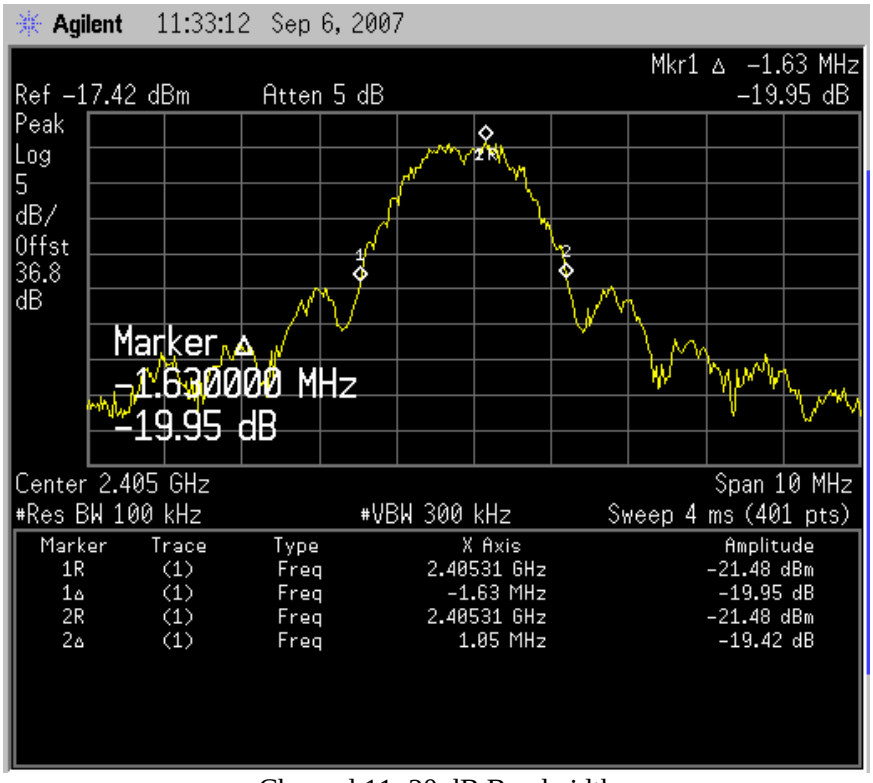
Channel	Frequency	6 dB Bandwidth
11	2405 MHz	1.61 MHz
17	2435 MHz	1.65 MHz
26	2480 MHz	1.63 MHz

Channel	Frequency	20 dB Bandwidth
11	2405 MHz	2.68 MHz
17	2435 MHz	2.78 MHz
26	2480 MHz	2.75 MHz

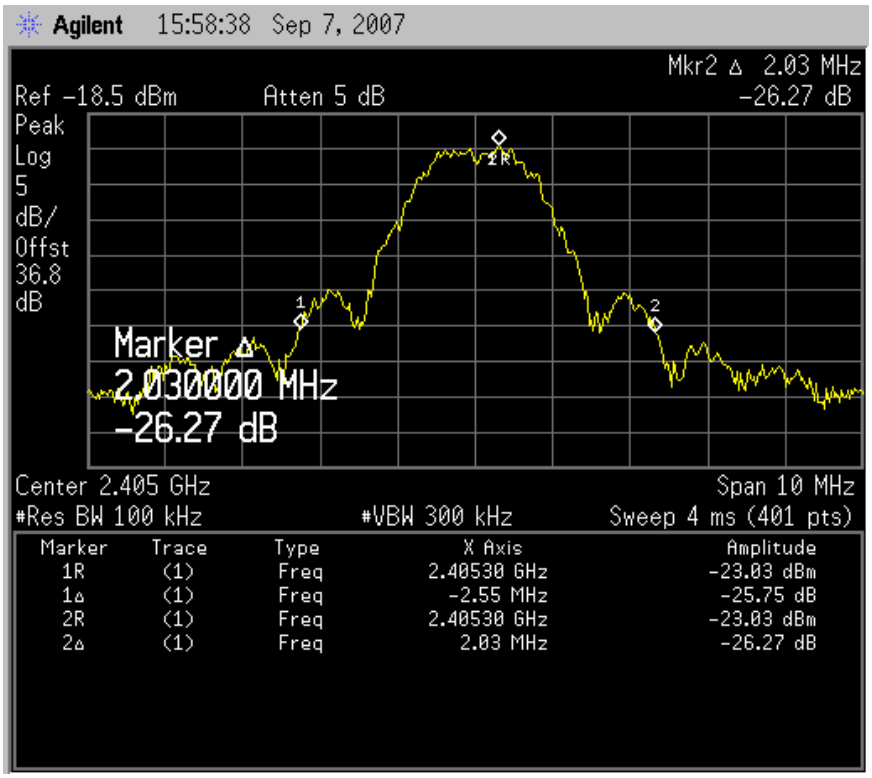
Channel	Frequency	26 dB Bandwidth
11	2405 MHz	4.58 MHz
17	2435 MHz	4.53 MHz
26	2480 MHz	4.56 MHz



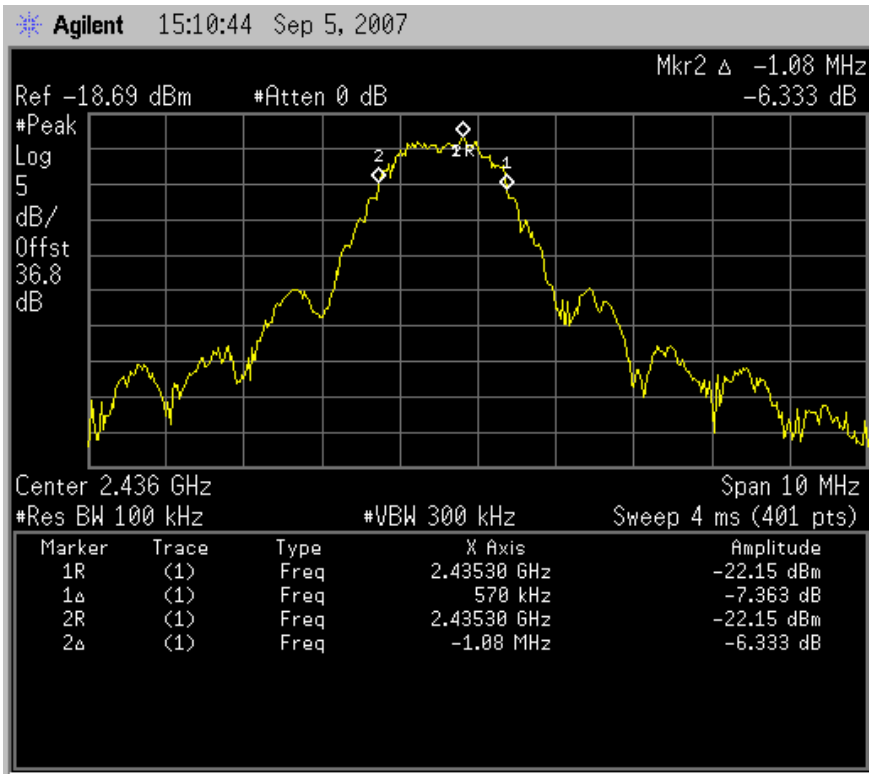
Channel 11: 6dB Bandwidth



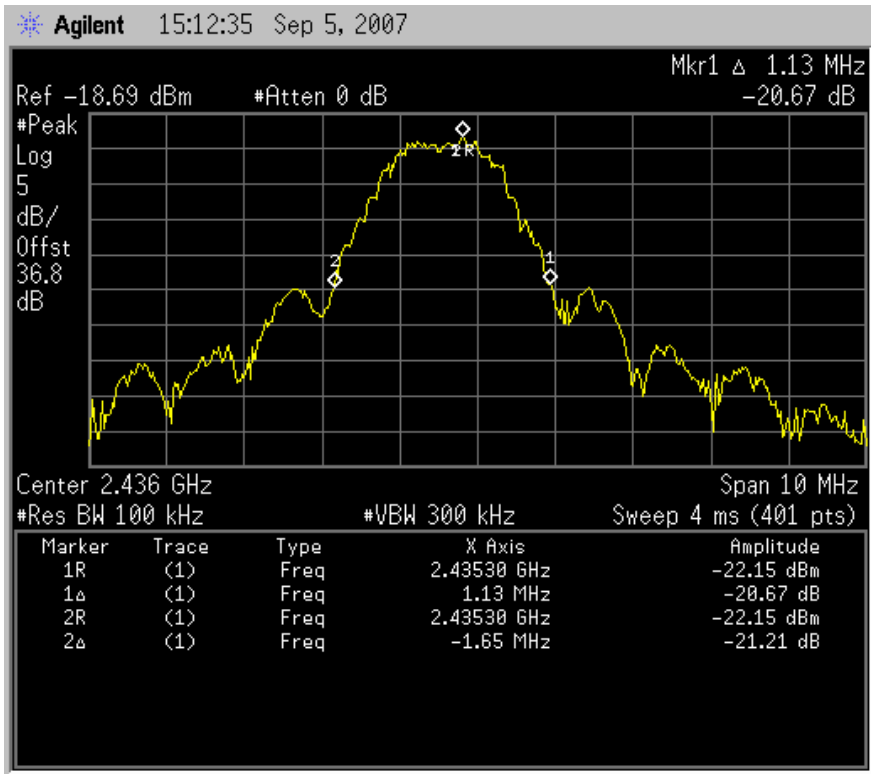
Channel 11: 20 dB Bandwidth



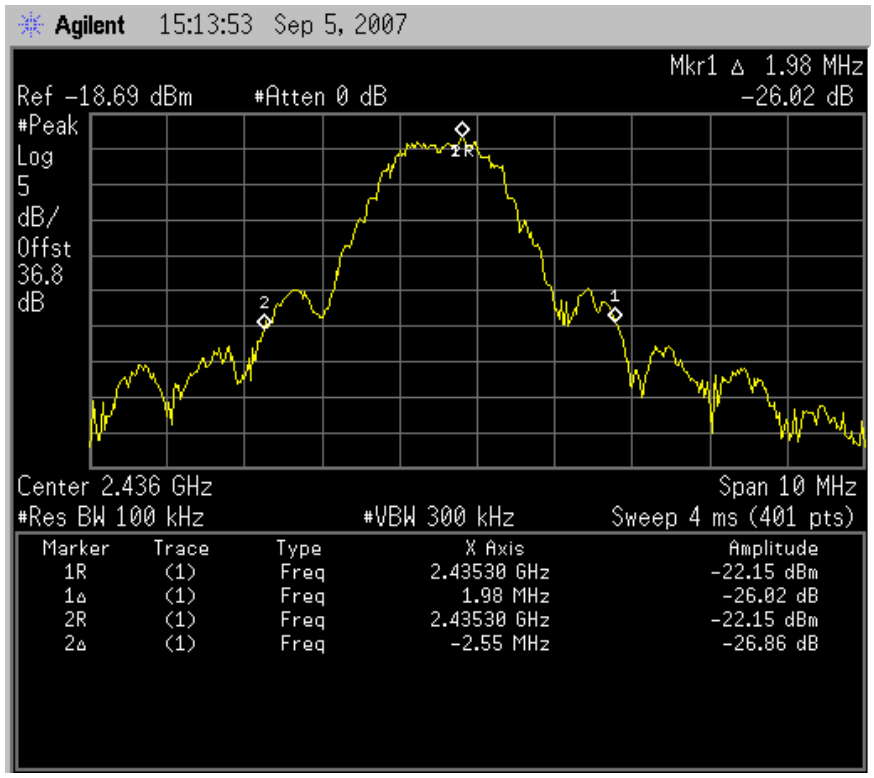
Channel 11: 26 dB Bandwidth



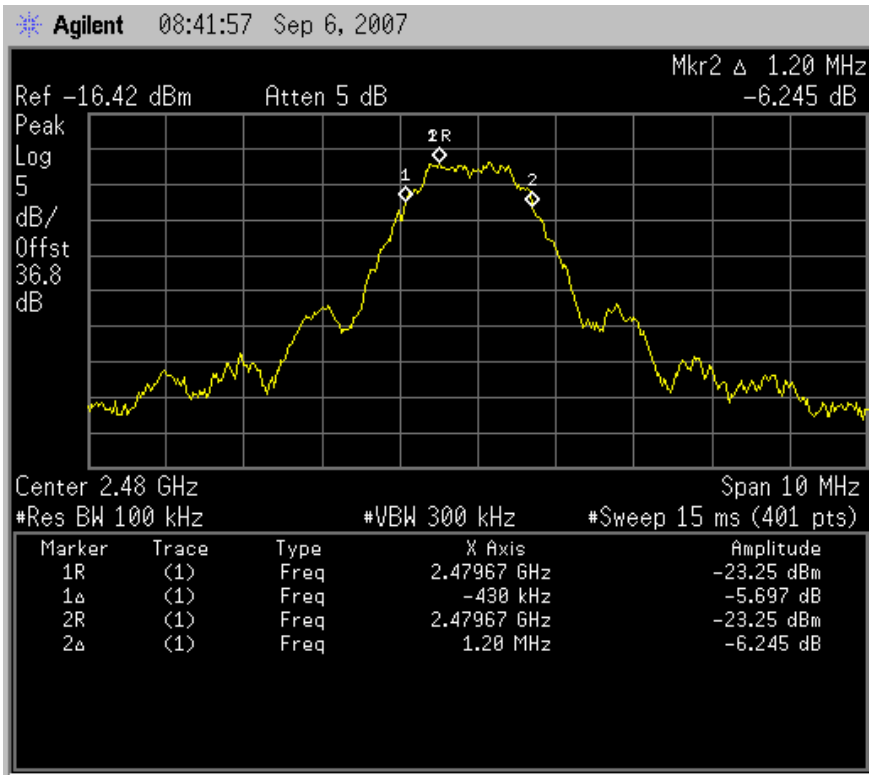
Channel 17: 6 dB Bandwidth



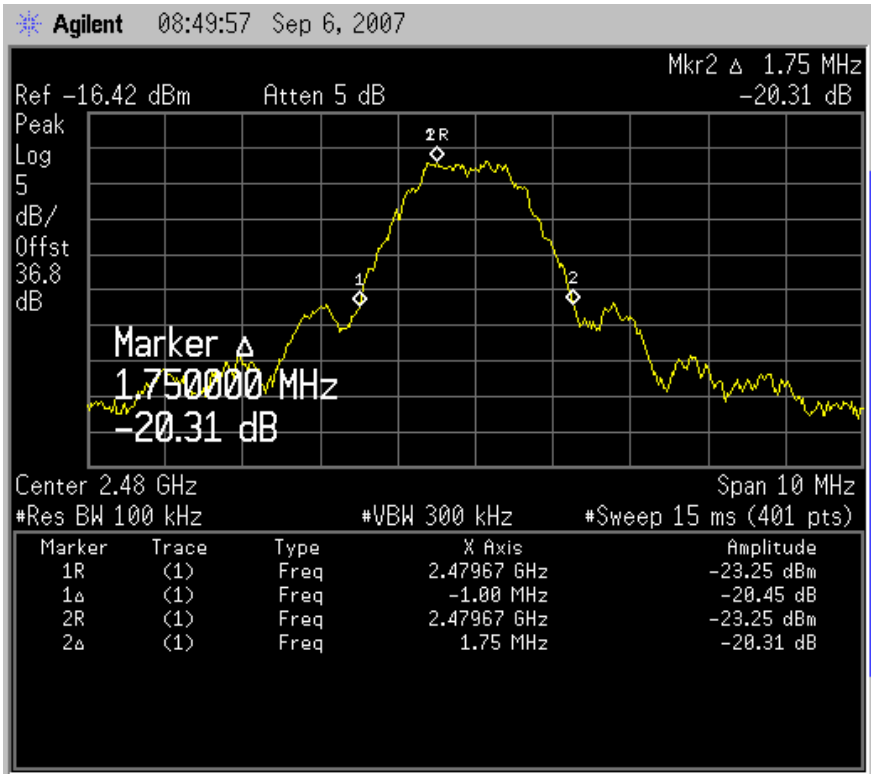
Channel 17: 20 dB Bandwidth



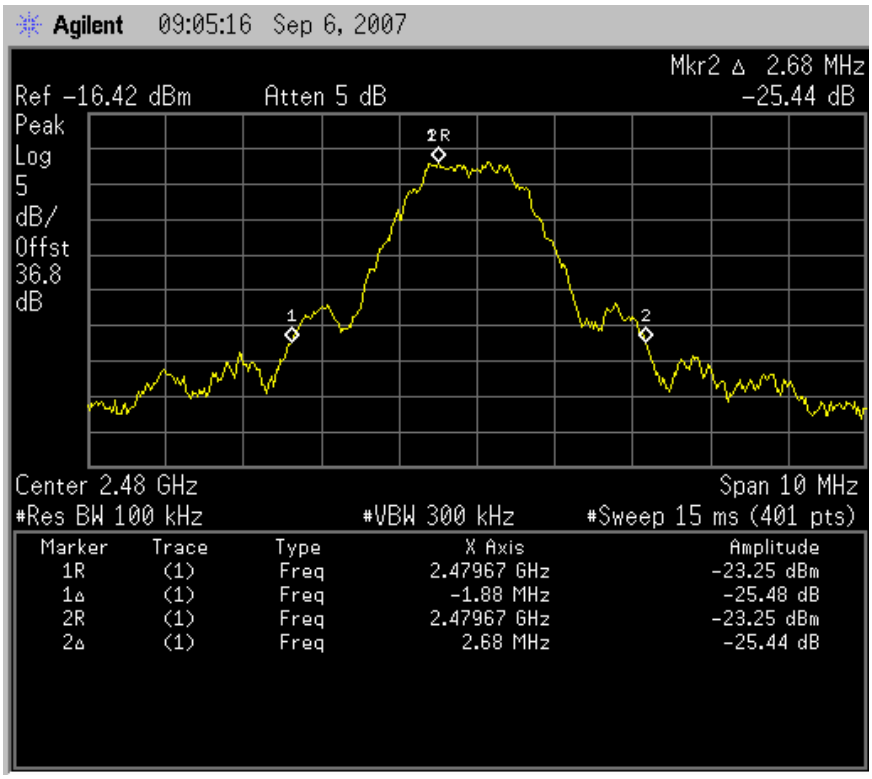
Channel 17: 26 dB Bandwidth



Channel 26: 6 dB Bandwidth



Channel 26: 20 dB Bandwidth



Channel 26: 26 dB Bandwidth

6.3 Test: Radiated Spurious Emissions

Test Standard: FCC 15.205, 15.209, 15.247(d), 15.109, RSS-210 2.2, 2.7, A8.5, ICES-003

Test Results: Pass

Test Environment:

Environmental Conditions During Testing:	Humidity (%Rh):	See Tables	Pressure (mbar):	See Tables	Ambient (°C):	See Tables
Pretest Verification Performed	N/A		Equipment under Test:		Z7 Console	

Maximum Test Parameters: The spurious emissions of the Radio Module must be attenuated below the level of the fundamental by at least 20 dBc. Emissions which fall in the restricted bands must meet the general limits of 15.209 and RSS-210 2.7 Table 2. The spurious emissions of the EUT must not exceed the limits of 15.109 Class B and ICES-003 Class B

Test Equipment Used:

Equip. ID	Description	Manufacturer	Model	Serial Number	Cal Date	Cal Due
77	EMI Receiver	R & S	ES17	100044	12/29/06	12/29/07
192	Handheld Manometer	Omega	HHP-102F	19.99/29.0 PSIA	03/03/07	03/03/08
260	Humidity Temperature	Extech	445580	17-260	12/01/06	12/01/07
30	DMM	Fluke	8060A	6191012	02/08/07	02/08/08
82	Bi-ConiLog Antenna	Schaffner	CBL6112B	2726	06/24/07	06/24/08
128	RF Cable	Custom made	#1	none	07/26/07	07/26/08
131	RF Cable	Custom made	#4	none	07/26/07	07/26/08
271	Horn Antenna	A H Systems	SAS-571	787	02/24/07	02/24/08
101	EMI Receiver	Agilent	E7405A	US40240235	12/20/06	12/20/07
222	Pre-Amp	Miteq	AMF-4D-001180-24-10P	1020106	08/01/06	08/01/07
129	RF Cable	Custom made	#2	None	07/26/07	07/26/08

Test Results:

Notes: Above 1 GHz, the emissions shown compare the peak values with the average limits in order to demonstrate overall compliance. The range up to 26 GHz was investigated using the SHF equipment listed in the tables, but only the emissions shown were observed. In cases where no emissions were observed, the noise floor was verified to be under the limit.
Notes: The Device was tested as a Class B digital device to FCC Part 15 Subpart B and ICES-003, Intentional transmission was tested as a transmitter to the requirements of FCC Part 15 Subpart C 15.247 and RSS-210 Annex 8. Channels selected for test were:
Channel 11: 2405 MHz,
Channel 17: 2435 MHz,
Channel 26: 2480 MHz

Standard: FCC 15.109 / ICES-003
Test: Radiated Emissions
Frequency Range: 30 MHz to 1000 MHz
Limits: Class B
Measurement Distance: 3 meters
EUT Configuration: Tested with continuous trans-receive mode.

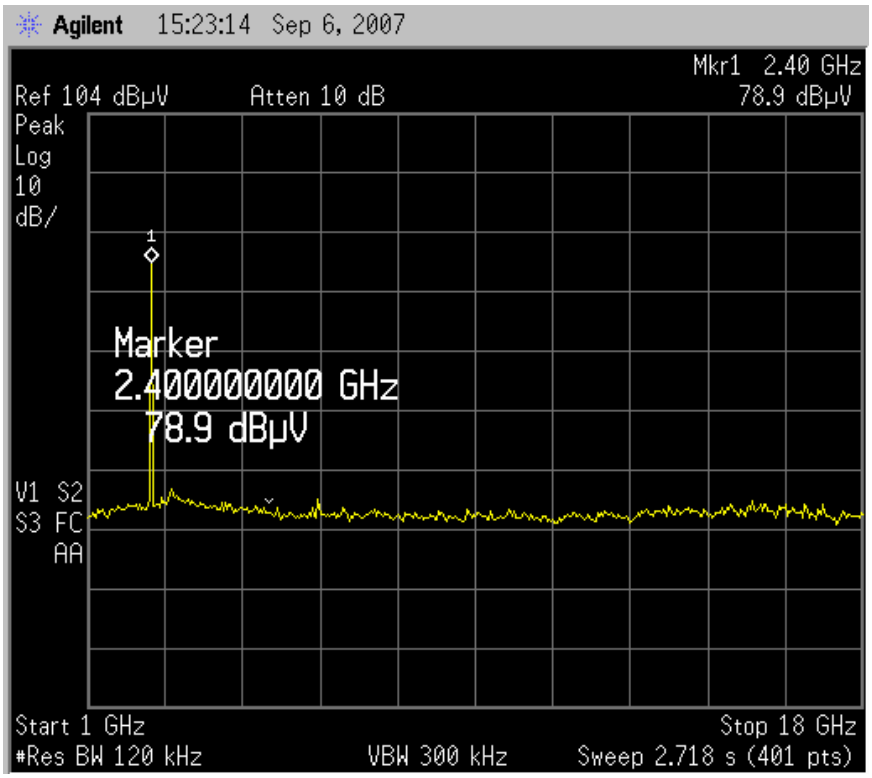
Measurement Uncertainty: 3.1 dB
Temperature: 26.7 ˚C
Relative Humidity: 49 %Rh
Atmospheric Pressure: 997 mbar

Radiated Disturbance

Polarity	Frequency	Ant	Azimuth	QP	LIMIT	Margin
H	974.544	345.00	219.00	34.67	47.46	-12.79
H	945.241	306.00	210.00	34.19	47.46	-13.27
H	283.665	354.00	110.00	21.89	47.46	-25.57
H	123.137	306.00	212.00	20.31	40.46	-20.15
H	30.475	226.00	22.00	26.29	40.46	-14.17
V	783.159	227.00	113.00	32.76	47.46	-14.70
V	842.799	272.00	337.00	34.08	47.46	-13.38
V	870.271	169.00	313.00	34.42	47.46	-13.04
V	881.688	178.00	223.00	34.46	47.46	-13.00
V	905.779	365.00	142.00	34.73	47.46	-12.73
V	931.541	323.00	161.00	35.15	47.46	-12.31
V	954.397	118.00	121.00	35.62	47.46	-11.84
V	974.482	299.00	226.00	35.78	47.46	-11.68
V	983.668	139.00	342.00	35.93	47.46	-11.53
V	994.211	217.00	281.00	36.09	47.46	-11.37

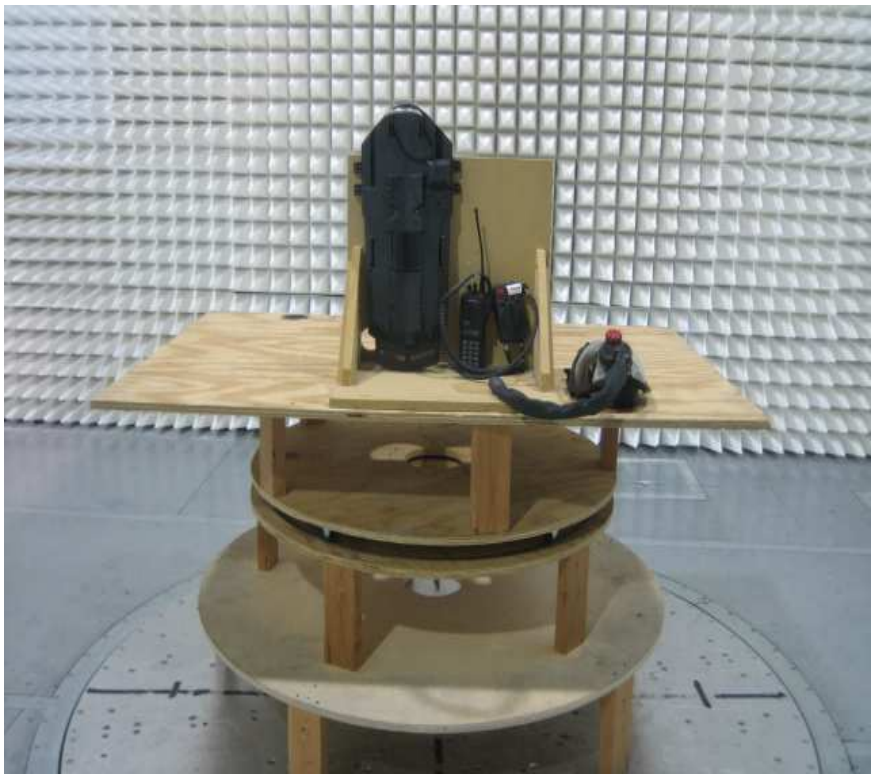
Polarity	Frequency GHz	Ant Height cm	Azimuth deg.	Peak dBuV/m	LIMIT dBuV/m	Margin dB
V	2.40545	100	34	88.84	---	---
V	2.43448	148	331	87.16	---	---
V	2.48050	143	232	87.34	---	---
H	2.40545	134	-10	90.27	---	---
H	2.43448	103	331	89.59	---	---
H	2.48050	152	262	88.19	---	---

Polarity	Frequency GHz	Ant Height cm	Azimuth deg.	AVG dBuV/m	LIMIT dBuV/m	Margin dB
V	4.86896	121	330	50.893	54.00	-3.107
V	4.96100	142	302	50.230	54.00	-3.77
V	7.21635	122	331	45.134	54.00	-8.866
V	7.30344	105	336	44.484	54.00	-9.516
V	7.44150	143	10	43.804	54.00	-10.196
H	4.86896	111	243	50.631	54.00	-3.369
H	4.96100	100	184	49.799	54.00	-4.201
H	7.21635	104	201	44.919	54.00	-9.081
H	7.30344	110	200	43.590	54.00	-10.41
H	7.44150	107	209	42.822	54.00	-11.178


Agilent 15:23:14 Sep 6, 2007
Mkr1 2.40 GHz
78.9 dBµV
Ref 104 dBµV
Atten 10 dB
Peak
Log
10
dB/
Marker
2.400000000 GHz
78.9 dBµV
V1 S2
S3 FC
AA
Start 1 GHz
Stop 18 GHz
#Res BW 120 kHz
VBW 300 kHz
Sweep 2.718 s (401 pts)

Pre-Scan

6.3.1 Setup Photos



Test Results: Pass

6.4 Test: Peak Power Spectral Density

Test Standard: FCC 15.247(e)(2), RSS-210 A8.2

Test Environment:

Environmental Conditions During Testing:	Humidity (%Rh):	48	Pressure (mbar):	996	Ambient (°C):	26.8
Pretest Verification Performed	N/A		Equipment under Test:		**Z7 Console**	

Maximum Test Parameters: The peak power spectral density of the Radio Module must not exceed 8 dBm / 3 kHz.

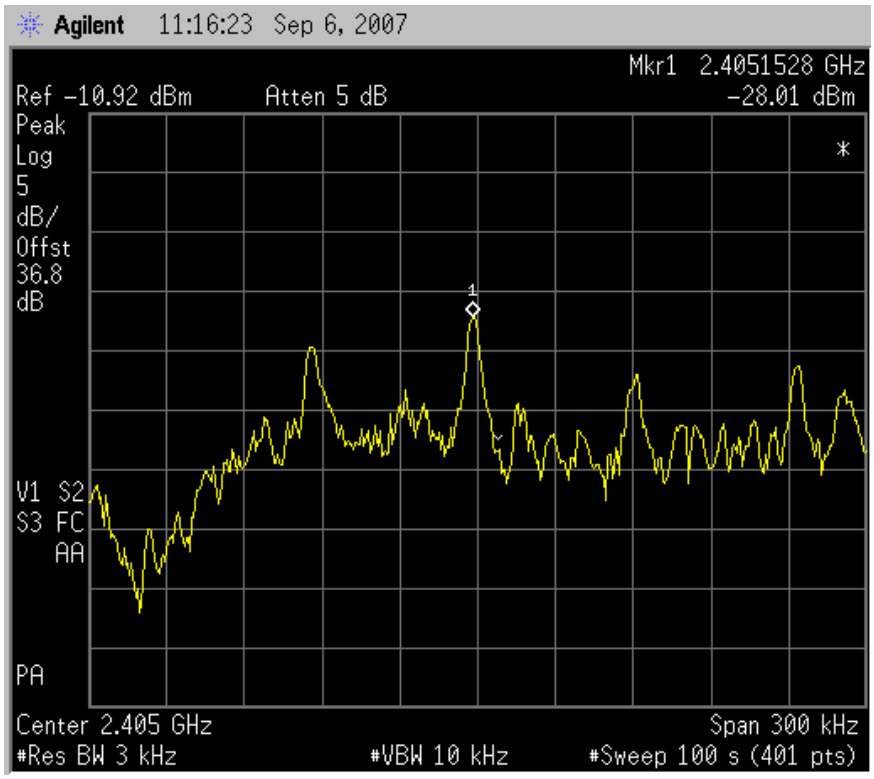
Test Equipment Used:

Equip. ID	Description	Manufacturer	Model	Serial Number	Cal Date	Cal Due
77	EMI Receiver	R & S	ES17	100044	12/29/06	12/29/07
192	Handheld Manometer	Omega	HHP-102F	19.99/29.0 PSIA	03/03/07	03/03/08
260	Humidity Temperature	Extech	445580	17-260	12/01/06	12/01/07
30	DMM	Fluke	8060A	6191012	02/08/07	02/08/08
82	Bi-ConiLog Antenna	Schaffner	CBL6112B	2726	06/24/07	06/24/08
128	RF Cable	Custom made	#1	none	07/26/07	07/26/08
131	RF Cable	Custom made	#4	none	07/26/07	07/26/08
271	Horn Antenna	A H Systems	SAS-571	787	02/24/07	02/24/08
101	EMI Receiver	Agilent	E7405A	US40240235	12/20/06	12/20/07
222	Pre-Amp	Miteq	AMF-4D-001180-24-10P	1020106	08/01/06	08/01/07

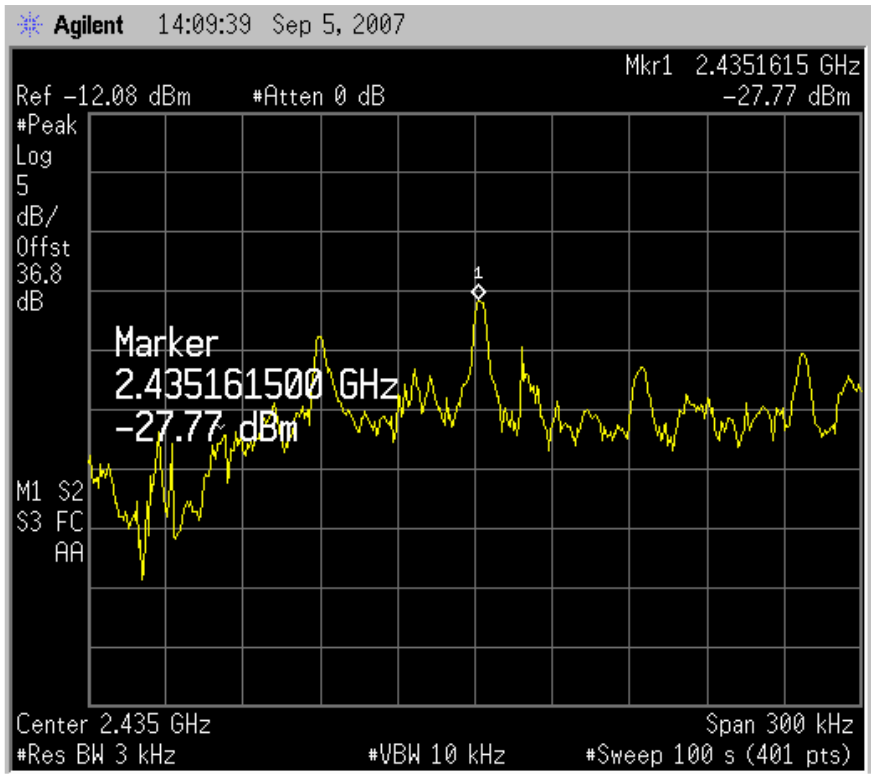
Test Results: Pass

Notes: The cable loss was compensated for in the spectrum analyzer.

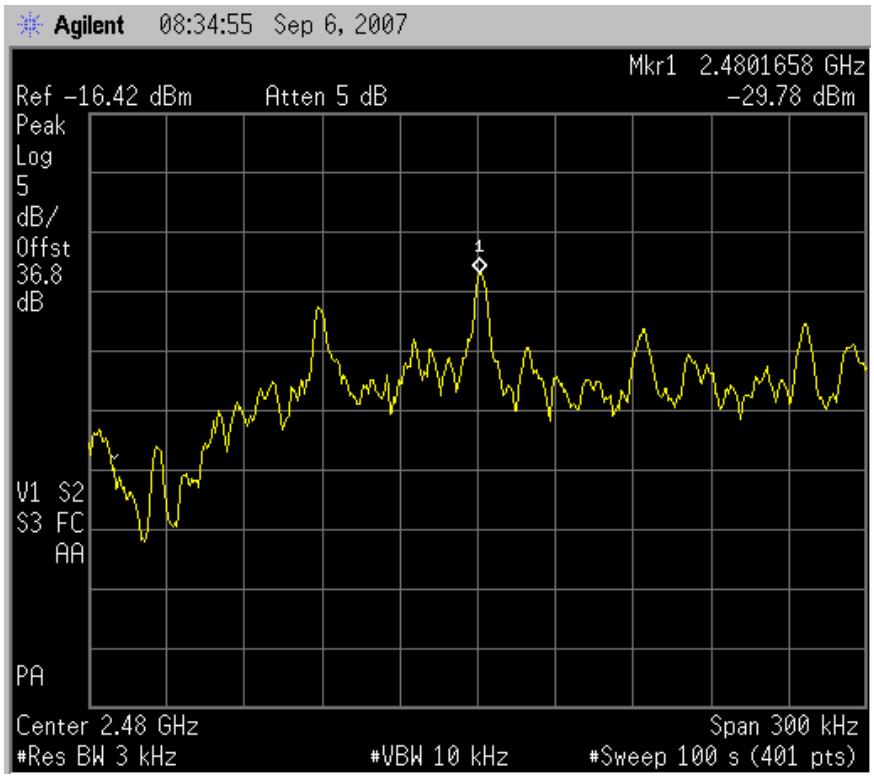
Channel	Frequency	Peak Power Spectral Density
11	2405 MHz	-28.01 dBm
17	2435 MHz	-27.77 dBm
26	2480 MHz	-29.78 dBm



Channel 11 Peak Power Spectral Density



Channel 17 Peak Power Spectral Density



Channel 26 Peak Power Spectral Density

Test Results: Pass

6.5 Test: Band Edge Compliance

Test Standard: FCC 15.215, RSS-210 2.1, A8.5

Test Environment:

Environmental Conditions During Testing:	Humidity (%Rh):	48	Pressure (mbar):	996	Ambient (°C):	26.8
Pretest Verification Performed	N/A		Equipment under Test:		**Z7 Console**	

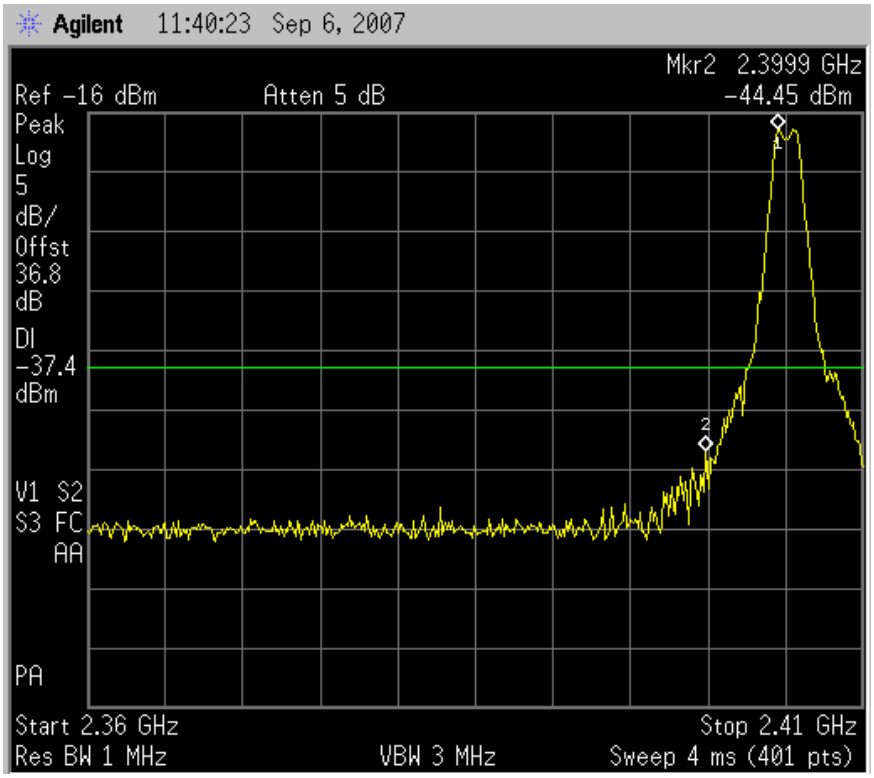
Maximum Test Parameters: The fundamental frequency of the Radio Module must stay within the assigned frequency band. The emissions beyond band edges must be at least 20 dB below the fundamental and shall meet the requirements of FCC 15.209 limits for out of band emissions.

Test Equipment Used:

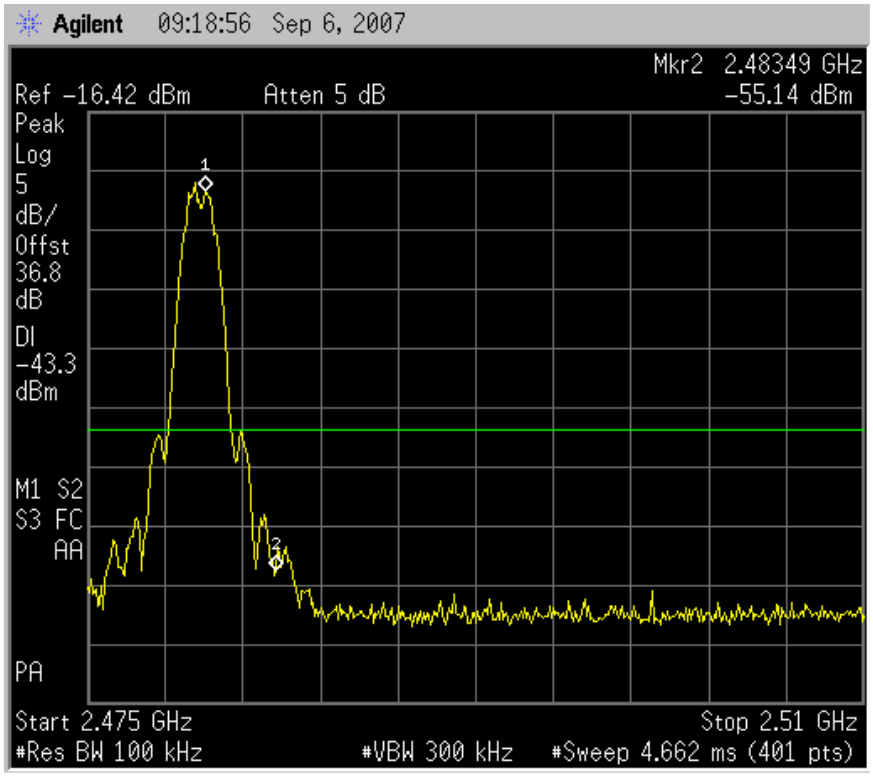
Equip. ID	Description	Manufacturer	Model	Serial Number	Cal Date	Cal Due
77	EMI Receiver	R & S	ES17	100044	12/29/06	12/29/07
192	Handheld Manometer	Omega	HHP-102F	19.99/29.0 PSIA	03/03/07	03/03/08
260	Humidity Temperature	Extech	445580	17-260	12/01/06	12/01/07
30	DMM	Fluke	8060A	6191012	02/08/07	02/08/08
82	Bi-ConiLog Antenna	Schaffner	CBL6112B	2726	06/24/07	06/24/08
128	RF Cable	Custom made	#1	none	07/26/07	07/26/08
131	RF Cable	Custom made	#4	none	07/26/07	07/26/08
271	Horn Antenna	A H Systems	SAS-571	787	02/24/07	02/24/08
101	EMI Receiver	Agilent	E7405A	US40240235	12/20/06	12/20/07
222	Pre-Amp	Miteq	AMF-4D-001180-24-10P	1020106	08/01/06	08/01/07

Test Results:

Notes: The cable/Antenna loss was compensated for in the spectrum analyzer. A 100 kHz bandwidth and peak detector was used, and a marker was placed at the peak fundamental level. A marker was placed at the band edge at the highest signal outside the band edge.
The display line shows the level 20 dB below the fundamental in the following graphs.



Channel 11: Low Band Edge Compliance



Channel 26: High Band Edge Compliance