COMPLIANCE WORLDWIDE INC.
TEST REPORT 102-10

In Accordance with the Requirements of

Federal Communications Commission Part 15.247, Subpart C
Industry Canada RSS 210, Issue 7, Annex 8

Low Power License-Exempt Radio Communication Devices
Intentional Radiators

Issued to

Realtime Technologies Ltd.
Shimmer Research
485 Massachusetts Avenue, Suite 300
Cambridge, MA, 02139-4018

for the

Span SR1
incorporating the
SR7 module

FCC ID: X2W-SR7-1
IC: 8838A-SR71

Report Issued on January 22, 2010

Tested by

Brian F. Breault

Reviewed by

Larry K. Stillings

Table of Contents

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1. Scope

This test report certifies that the Realtime Technologies, Shimmer Research Division, Span SR1 incorporating the SR7 module, as tested, meets the FCC Part 15, Subpart C and Industry Canada RSS 210 requirements. The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated and a retest may be required.

2. Product Details

2.1. Manufacturer: Realtime Technologies, Shimmer Research Division

2.2. Model Number: Span SR1 incorporating the SR7 module

2.3. Serial Number: N/A

2.4. Description: Span is a USB-plug in peripheral used to enable commercial computing devices to communicate with wireless devices utilizing the low power IEEE 802.15.4 physical layer. Span is fully encased in plastic with a removable connector cover in the flash drive form factor (72x18x7mm). The top side of Span is clearly marked with Shimmer Research branding; The reverse side of Span has an area for stickers indicating serial number and agency approvals. Span integrates a microcontroller, the SR7 which is a 2.4 GHz IEEE 802.15.4 radio module, 48 bit digital serial number, dual channel USB UART, power regulation and has three status indicators:

Blue: Host communication Active
Orange: Firmware Update Active
Green: Application Defined

Span's feature set can support a variety of communication stacks using a combination of the host-PC and embedded processing resources. One UART channel is for host communication allowing communication speeds up to 230kbps. The second channel for embedded processor firmware update and reset.

2.5. Power Source: +5 VDC (USB Dongle)

2.6. Hardware Rev.: 2

2.7. Software Rev.: SEP2007 Compiled for Span on JAN2010

2.8. EMC Modifications: None

3. Product Configuration

3.1. Support Equipment

Device	Manufacturer	Model	Serial No.	Comment
Laptop PC	Toshiba	Satellite A105	X6208961Q	Used to program the DUT firmware and as the host for conducted emissions.
USB (+5V) Power Supply	LG	STA-U12WR	RA8X0072567	Used to powering the DUT during tests

3.2. Cables

Cable Type	Length	Shield	From	To
Generic USB Extension	2 Meters	Yes	Laptop PC or USB Power Supply	DUT

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3. Product Configuration

3.3. Operational Characteristics & Software

Windows Bootstrap Loader, a utility supplied by Shimmer, was used to program the firmware in the device under test. This utility set the transmit frequency and forced the unit to provide a near constant output. Once the firmware has been programmed, the unit under test would run continuously in standalone mode provided +5 volts DC (USB voltage) was supplied.

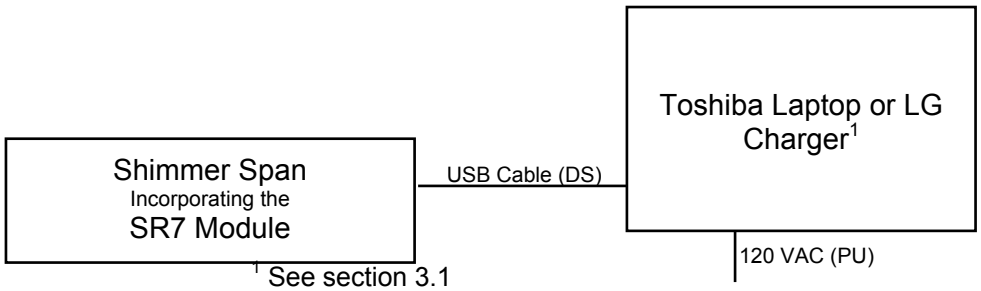
Notes: The FTDI driver must be resident in the PC in order to run the Windows Bootstrap Loader. Use CDM20600.exe to install this driver, if necessary.

Reference Section 4.4 for the required test channels.

Software Instructions

1. Plug the Shimmer SPAN into one of the PC's USB Ports.
2. Click on bsl430.exe (Windows Bootstrap Loader program).
3. Check the box "Select by file name."
4. Press the Search button (Binoculars).
5. Select one of the 16 Intel HEX files; "radiostress_chXX.ihex." XX represents the channel number (11 to 26).
6. Press the Program button. A Command Window will temporarily appear on the PC screen and an amber light on the DUT will blink during the download. The download process takes about 15 seconds.
7. Once the download has concluded, the DUT can be unplugged from the USB port.

3.4. Block Diagram



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4. Measurements Parameters

4.1. Measurement Equipment Used to Perform Tests

Device	Manufacturer	Model No.	Serial No.	Cal Due
Spectrum Analyzer	Agilent	E4407B	MY4510449	7/09/2010
Microwave Preamp	Hewlett Packard	8449B	3008A01323	9/22/2010
Bilog Antenna	Com-Power	AC-220	25509	8/6/2010
Horn Antenna	Electro-Metrics	EM-6961	6337	7/22/2010
Horn Antenna	Com-Power	AH-826	081051	4/16/2010
2.4GHz Band Reject Filter	Micro-Tronics	BRM50702	14	12/1/2010

4.2. Measurement & Equipment Setup

Test Dates:	1/12/2010 – 1/15/2010
Test Engineer:	Brian Breault
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 -75%RH):	31
Frequency Range:	30 MHz to 24.8 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	100 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz
EMI Receiver Average Bandwidth:	300 kHz - 30 MHz to 1 GHz 3 MHz - Above 1 GHz
Detector Function:	Peak, Quasi-Peak & Average

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4. Measurements Parameters (continued)

4.3. Measurement Procedure

The measurements detailed in this test report are based on the requirements in FCC Part 15, Section 15.247: Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz.

The test methods used to generate the data is this test report are in accordance with ANSI C63.4: 2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

Radiated emissions limits are based on the requirements detailed in FCC Part 15, Section 15.209: Radiated emission limits, general requirements. Conducted emissions limits are based on the requirements detailed in FCC Part 15, Section 15.207: Conducted Limits.

In accordance with ANSI C63.4-2003, Section 13.1.4.1 c, the DUT was rotated through three orthogonal axes to determine which attitude produced the highest emissions relative to the limit. The attitude that produced the highest emissions relative to the limit was used in making final radiated emission measurements.

4.4. Choice of Operating Frequencies

The Shimmer SPAN employs 16 (ZigBee channels 11 to 26) channels in the 2400 MHz to 2483.5 MHz frequency band. In accordance with ANSI C63.4, Section 13.1.1, three channels are detailed in this test report:

- Low Channel – 2405 MHz (channel 11)
- Middle Channel – 2445 MHz (channel 19)
- High Channel – 2480 MHz (channel 26)

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5. Measurement Summary

Test Requirement	FCC Part 15.247 Reference	Test Report Section	Result	Comment
Antenna Requirement	15.203	6.1	Compliant	
Minimum 6 dB Bandwidth 99% Bandwidth	15.247 (a)	6.2	Compliant	
Maximum Peak Conducted Output Power	15.247 (b) (3)	6.3	Compliant	
Operation with directional antenna gains greater than 6 dBi	15.247 (b) (4)	NA	Compliant	The DUT utilizes a TDK ANT8030-01 antenna with 2 dBi gain.
Lower and Upper Band Edge	15.247 (d)	6.4	Compliant	
Spurious Radiated Emissions	15.247 (d)	6.5	Compliant	
Spurious Radiated Emissions (> GHz) - Harmonic Measurements	15.247 (d)	6.6	Compliant	
Power Spectral Density	15.247(e)	6.7	Compliant	
Conducted Emissions	FCC Part 15	6.8	Compliant	
Public Exposure to Radio Frequency Energy Levels	1.1307 (b) (1)	6.9	Compliant	

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6. Measurement Data

6.1. Antenna Requirement (Section 15.203)

Requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

Status: The unit under test employs an internal PCB mounted antenna which is non-user accessible.

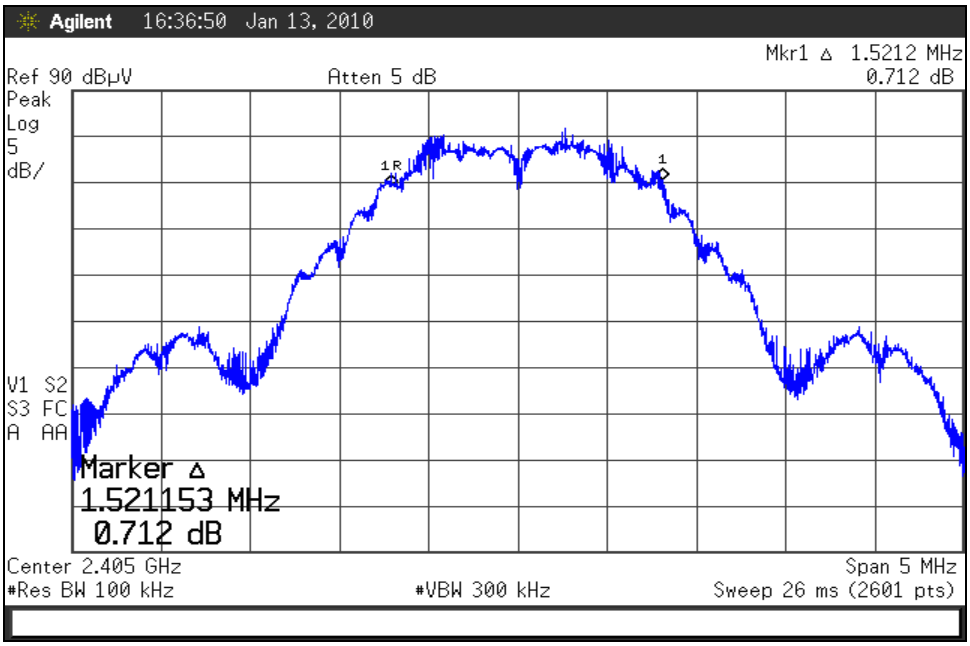
6.2. Minimum 6 dB Bandwidth (Section 15.247 (a))

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

Note: In addition to the minimum 6 dB bandwidth measurements, 99% power bandwidth measurements are also provided.

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum 6 dB Bandwidth (MHz)	Result
Low	2405	1.5212	.500	Compliant
Mid	2445	1.6019	.500	Compliant
High	2480	1.5865	.500	Compliant

6.2.1. 6 dB Bandwidth – Low Channel



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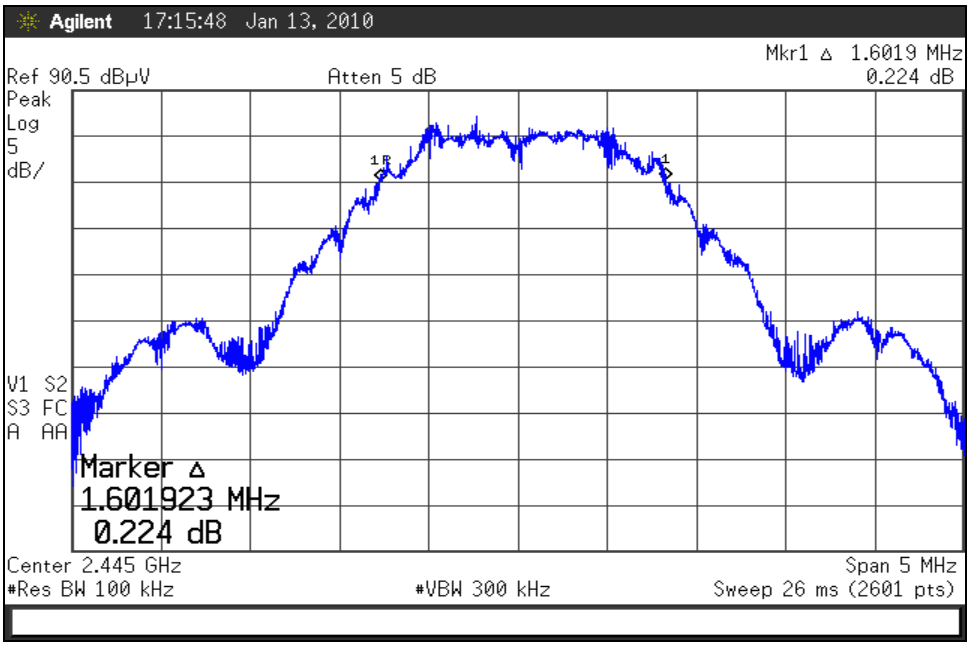
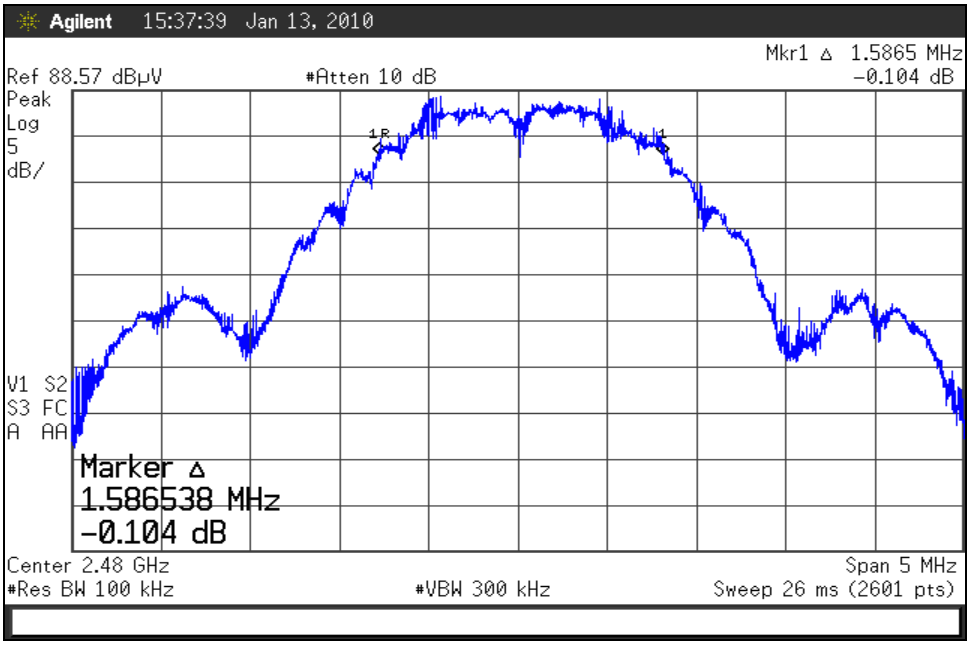
6. Measurement Data (continued)

6.2. Minimum 6 dB Bandwidth (Section 15.247 (a))

6.2.2. 6 dB Bandwidth – Middle Channel



6.2.3. 6 dB Bandwidth – High Channel



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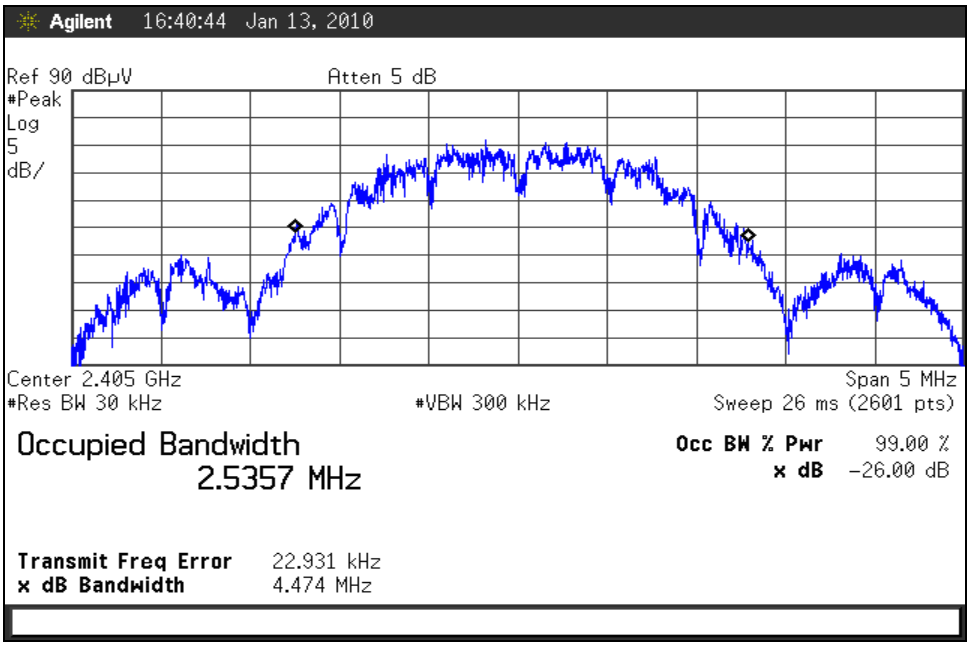
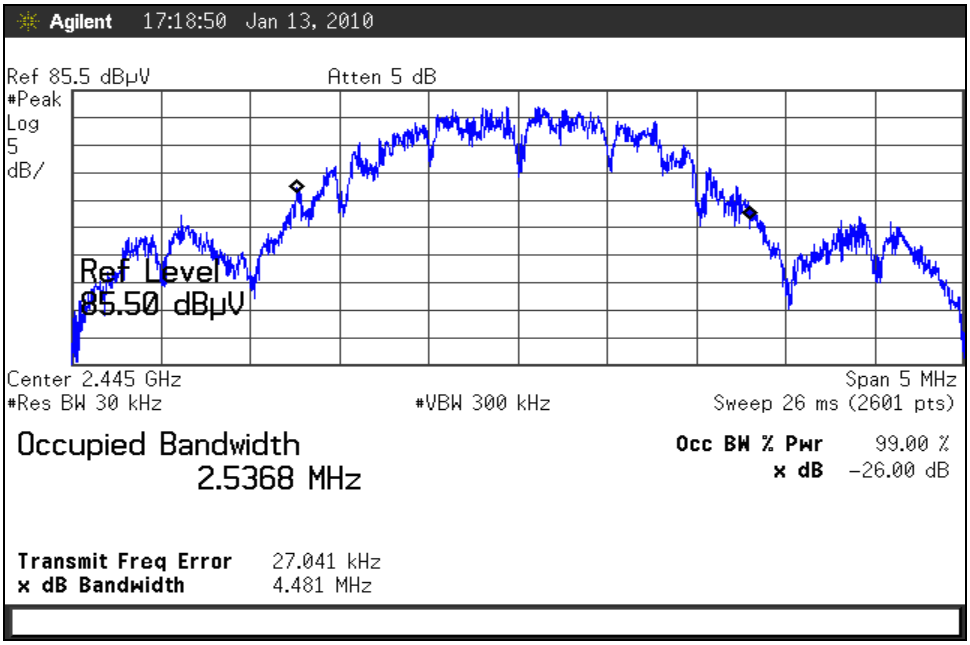
6. Measurement Data (continued)

6.2. Minimum 6 dB Bandwidth (Section 15.247 (a))

6.2.4. 99% Power Bandwidth – Low Channel



6.2.5. 99% Power Bandwidth – Middle Channel



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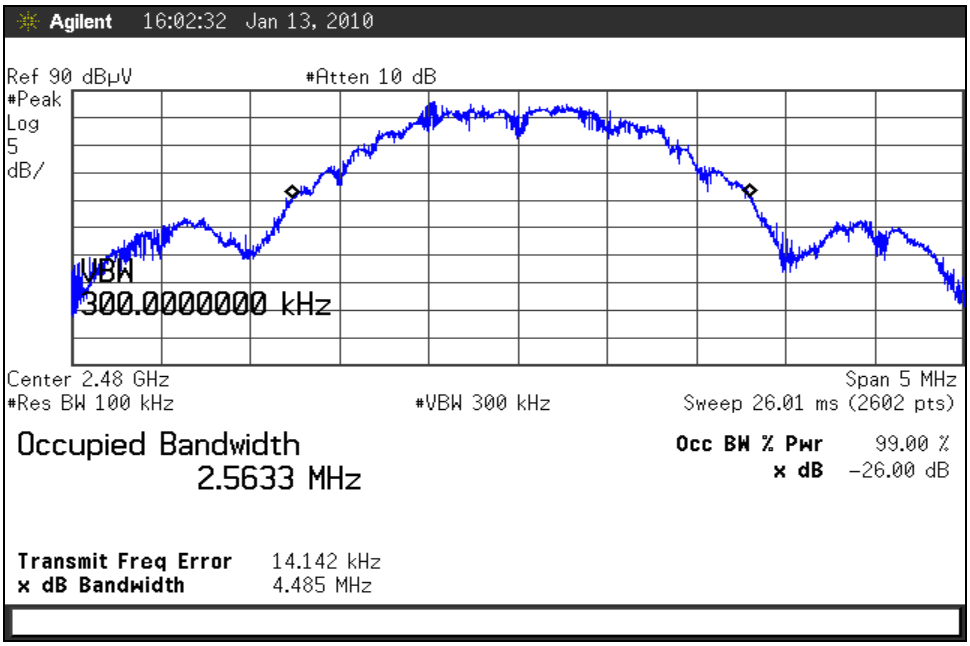
6. Measurement Data (continued)

6.2. Minimum 6 dB Bandwidth (Section 15.247 (a))

6.2.6. 99% Power Bandwidth – High Channel



6.3. Maximum Peak Conducted Output Power (Section 15.247 (b)(3))

Requirement: The maximum peak conducted output power of the intentional radiator shall not exceed the following: For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

Note: The device under test is configured with a non-removable PCB antenna. The maximum peak conducted output power was derived according to the procedure outlined in KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems: Alternative Test Procedures. Refer to page 6 of the DTS Attachment.

https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?switch=P&id=21124

https://fjallfoss.fcc.gov/oetcf/report_detail.cfm?report_url=/kdb/GetAttachment.html?id=20422

From this publication, the following formula was used to convert the field strength measurements to maximum peak conducted output power:

$$P = \frac{(E \times d)^2}{(30 \times G)}$$

P = the power in Watts.
E = the measured maximum field in V/m
d = the distance in meters of the field strength measurement
G = the numeric gain of the transmitting antenna over an isotropic radiator.

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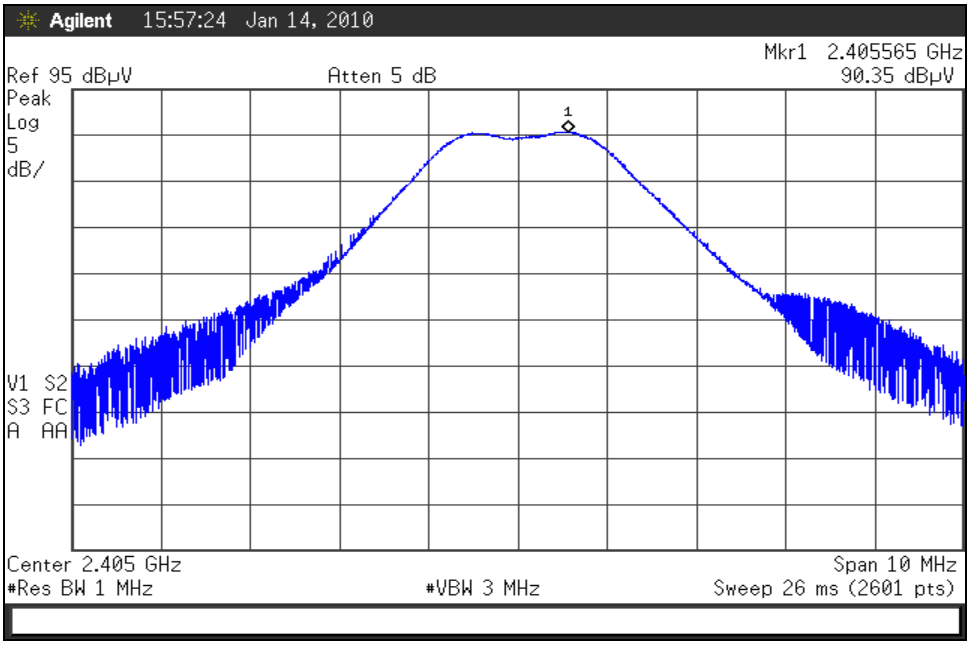
6. Measurement Data (continued)

6.3. Maximum Peak Conducted Output Power (Section 15.247 (b)(3)) (continued)

Channel	Frequency	Peak Field Strength	Distance	Antenna Gain[1]	Measured Output Power	Output Power Limit	Result
	(MHz)	(dBµV/m)	(m)	(dBi)	(mW)	(mW)	
Low	2405	90.35	3.0	2.0	0.2051735	1000	Compliant
Middle	2445	91.04	3.0	2.0	0.2405034	1000	Compliant
High	2480	92.00	3.0	2.0	0.3000000	1000	Compliant

[1] Taken from the antenna manufacture's data guide (TDK ANT8030-01).

6.3.1. Peak Field Strength – Low Channel



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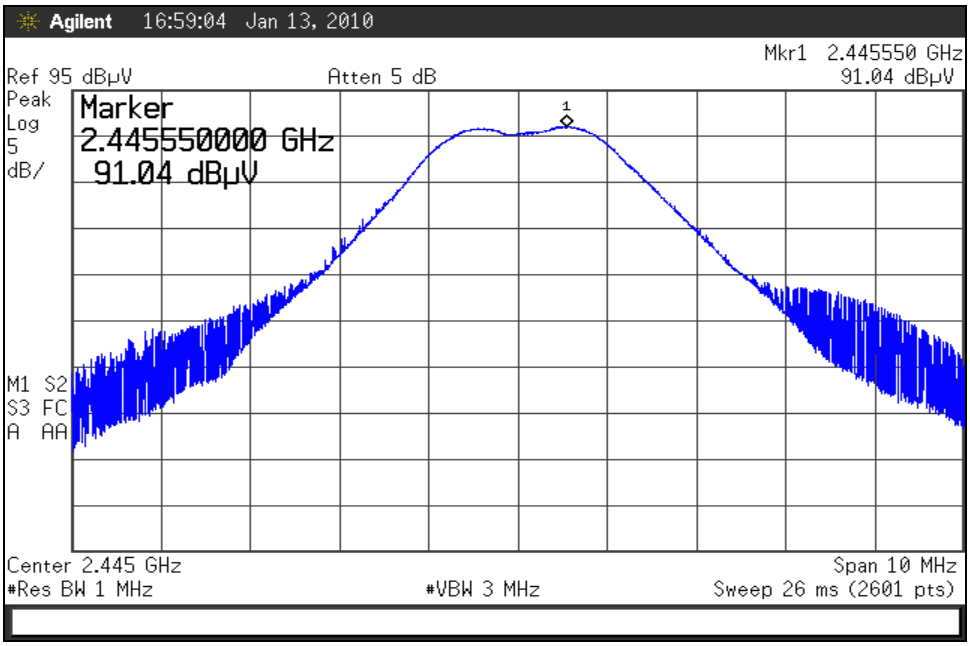
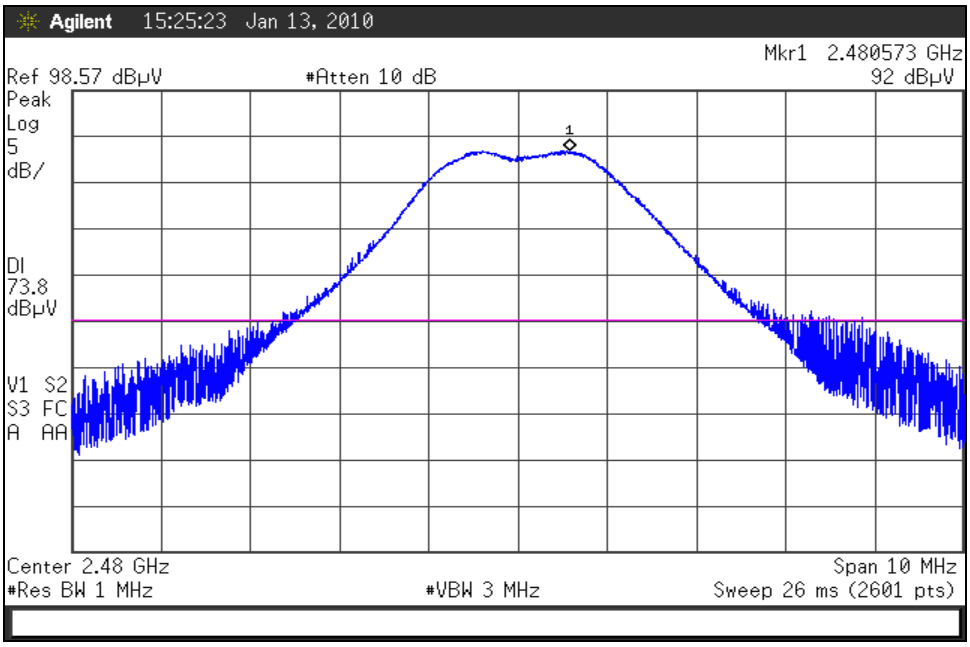
6. Measurement Data (continued)

6.3. Maximum Peak Conducted Output Power (Section 15.247 (b)(3)) (continued)

6.3.2. Peak Field Strength – Middle Channel



6.3.3. Peak Field Strength – High Channel



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6. Measurement Data (continued)

6.4. Lower and Upper Band Edge (Section 15.247 (d))

Requirement: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Lower Band Edge

Lowest Channel	Field Strength (dBµV/m)		Band Edge Frequency	Field Strength (dBµV/m)		15.209 Limit (dB)	Margin >20 dB	Result
(MHz)	Peak	Average	(MHz)	Peak	Average	Average		
2405	84.87	---	2400	46.36	---	NA	-38.5	Compliant

Upper Band Edge

Highest Channel	Field Strength (dBµV/m)		Band Edge Frequency	Field Strength (dBµV/m)		15.209 Limit (dB)	Margin (dB)	Result
(MHz)	Peak	Average	(MHz)	Peak	Average	Average		
2480	86.82	---	2483.5	55.82	49.7	54	-4.22	Compliant

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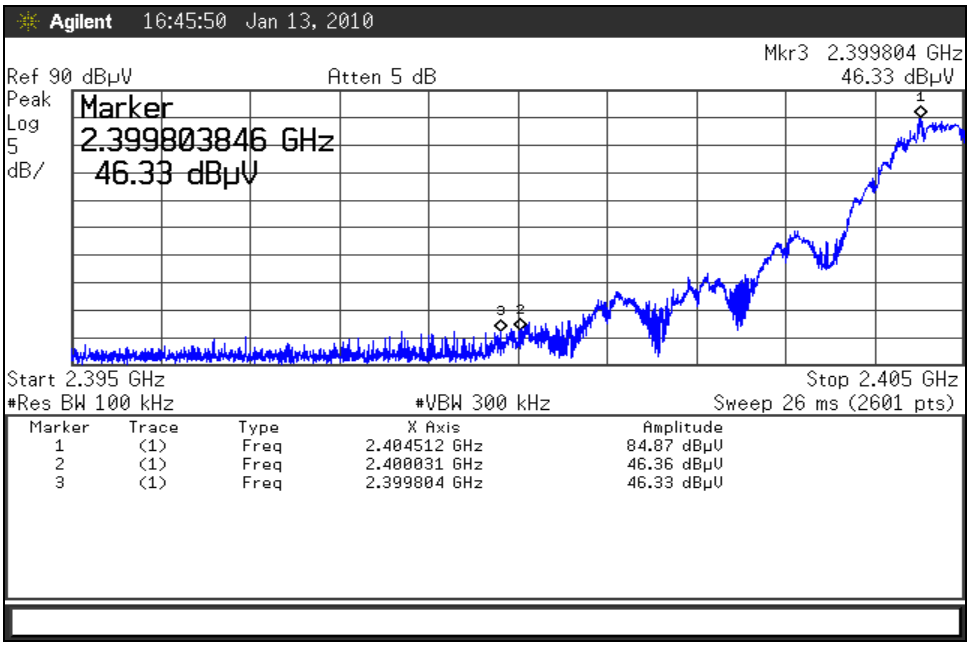
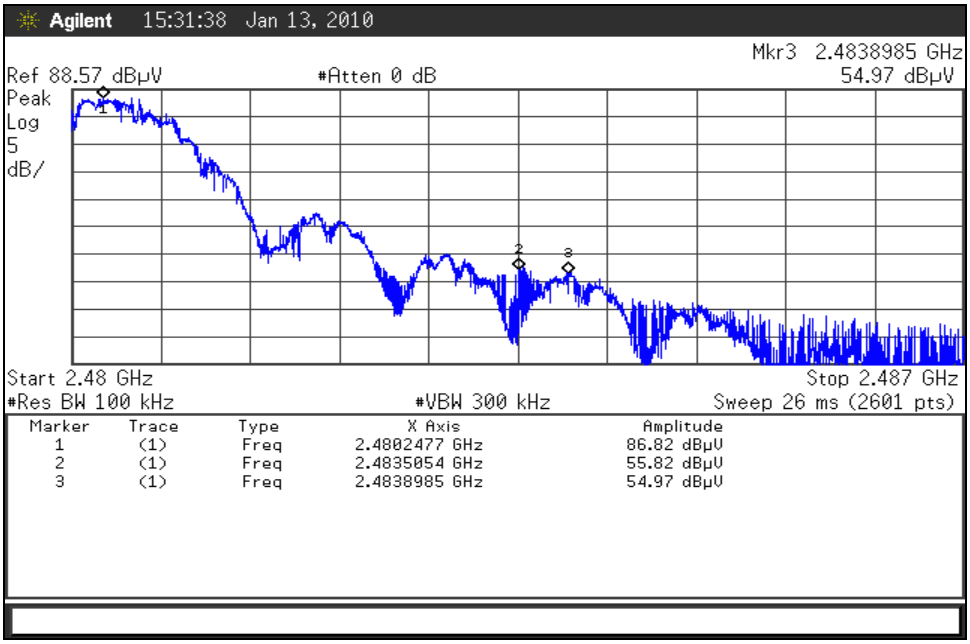
6. Measurement Data (continued)

6.4. Lower and Upper Band Edge (Section 15.247 (d)) (continued)

6.4.1. Lower Band Edge



6.4.2. Upper Band Edge



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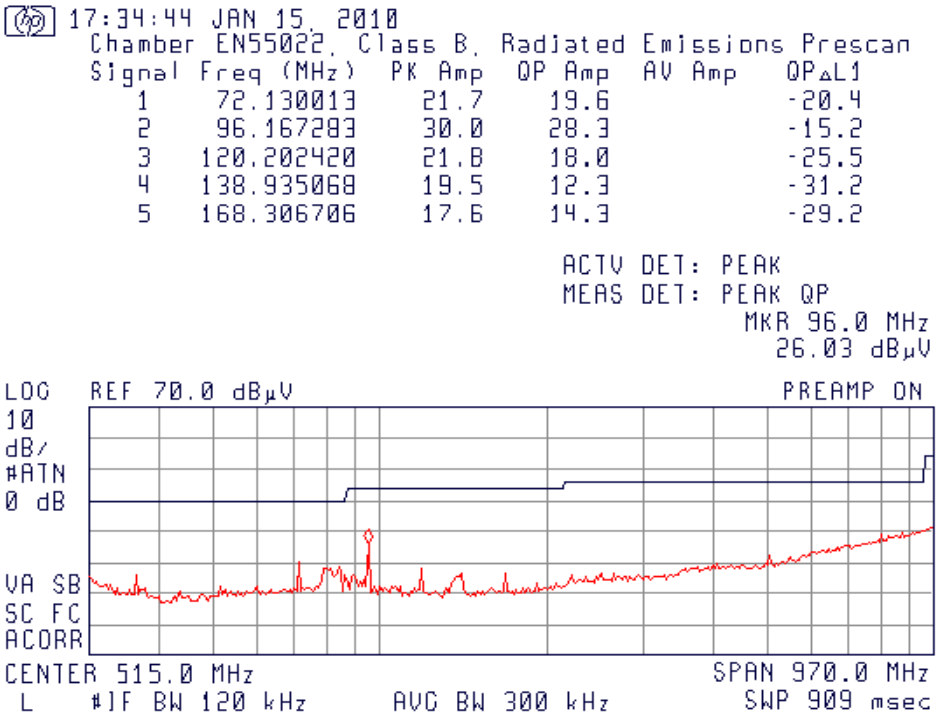
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (30 MHz to 40 GHz)

6.5.1. Regulatory Limit: FCC Part 209, Quasi-Peak

Frequency Range (MHz)	Distance (Meters)	Limit (dBµV/m)
30 to 88	3	40.0
88 to 216	3	43.5
216 to 960	3	46.0
>960	3	54.0

6.5.2. Test Results, 30 MHz to 1 GHz



6.5.3. Test Results, Above 1 GHz

There were no measurable emissions other than the emissions tabled in Section 6.6.

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6. Measurement Data (continued)

6.6. Spurious Radiated Emissions (Harmonic Emissions)

Frequency (MHz)	Avg (dBµV/m)[1]	Limit (dB)	Margin (dB)	Pol (H/V)	Ht (cm)	TT Pos (Deg)	Notes	Results
4810.00	24.10	54	-29.90	V	100	355	Low Channel	Compliant
7215.00	25.53	54	-28.47	V	100	0	Low Channel	Compliant
9620.00	26.33	54	-27.67	V	100	0	Low Channel	Compliant
12025.00	26.33	54	-27.67	V	100	0	Low Channel	Compliant
14430.00	27.69	54	-26.31	H	100	0	Low Channel	Compliant
16835.00	29.21	54	-24.79	V	100	0	Low Channel	Compliant
19240.00	30.63	54	-23.37	H	100	0	Low Channel	Compliant
21645.00	31.79	54	-22.21	H	100	0	Low Channel	Compliant
24050.00	37.50	54	-16.50	H	100	0	Low Channel	Compliant
4890.00	24.31	54	-29.69	H	100	35	Middle Channel	Compliant
7335.00	25.76	54	-28.24	H	100	0	Middle Channel	Compliant
9780.00	26.15	54	-27.85	H	100	0	Middle Channel	Compliant
12225.00	26.47	54	-27.53	H	100	0	Middle Channel	Compliant
14670.00	28.20	54	-25.80	V	100	0	Middle Channel	Compliant
17115.00	29.40	54	-24.60	H	100	0	Middle Channel	Compliant
19560.00	30.78	54	-23.22	H	100	0	Middle Channel	Compliant
22005.00	33.28	54	-20.72	V	100	0	Middle Channel	Compliant
24450.00	37.41	54	-16.59	V	100	0	Middle Channel	Compliant
4960.00	24.13	54	-29.87	H	119	45	High Channel	Compliant
7440.00	25.06	54	-28.94	H	100	0	High Channel	Compliant
9920.00	27.40	54	-26.60	V	100	0	High Channel	Compliant
12400.00	26.02	54	-27.98	H	100	0	High Channel	Compliant
14880.00	28.04	54	-25.96	V	100	0	High Channel	Compliant
17360.00	29.18	54	-24.82	V	100	0	High Channel	Compliant
19840.00	30.99	54	-23.01	H	100	0	High Channel	Compliant
22320.00	33.51	54	-20.49	H	100	0	High Channel	Compliant
24800.00	36.53	54	-17.47	H	100	0	High Channel	Compliant

[1] All correction factors are stored in the spectrum analyzer and applied to this column entry.

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6. Measurement Data (continued)

6.7. Power Spectral Density

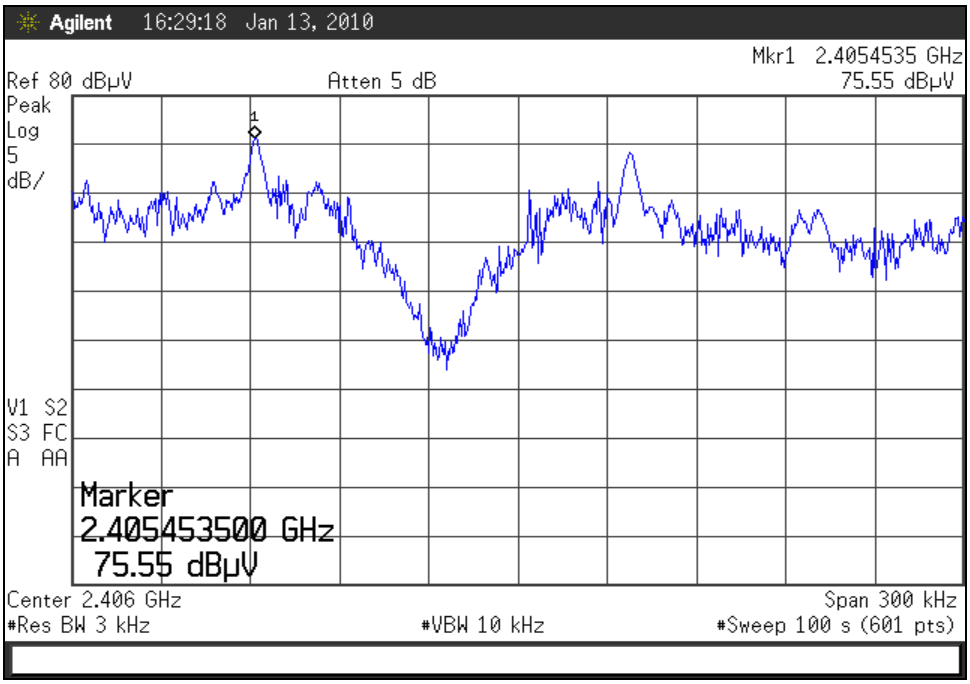
Requirement: For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Note: Refer to Section 6.3: Maximum Peak Conducted Output Power for the method used to determine the power spectral density.

Channel	Freq.	Measured Frequency	Meas. PSD	Dist.	Antenna Gain[1]	Measured Output Power	Output Power Limit	Result
	(MHz)	(MHz)	(dBµV/m)	(m)	(dBi)	(dBm)	(dBm)	
Low	2405	2405.4535	75.55	3.0	2.0	-21.68	8	Compliant
Middle	2445	2405.4540	77.31	3.0	2.0	-19.92	8	Compliant
High	2480	2480.4545	78.32	3.0	2.0	-18.91	8	Compliant

[1] Taken from the antenna manufacture's data guide (TDK ANT8030-01).

6.7.1. Power Spectral Density – Low Channel



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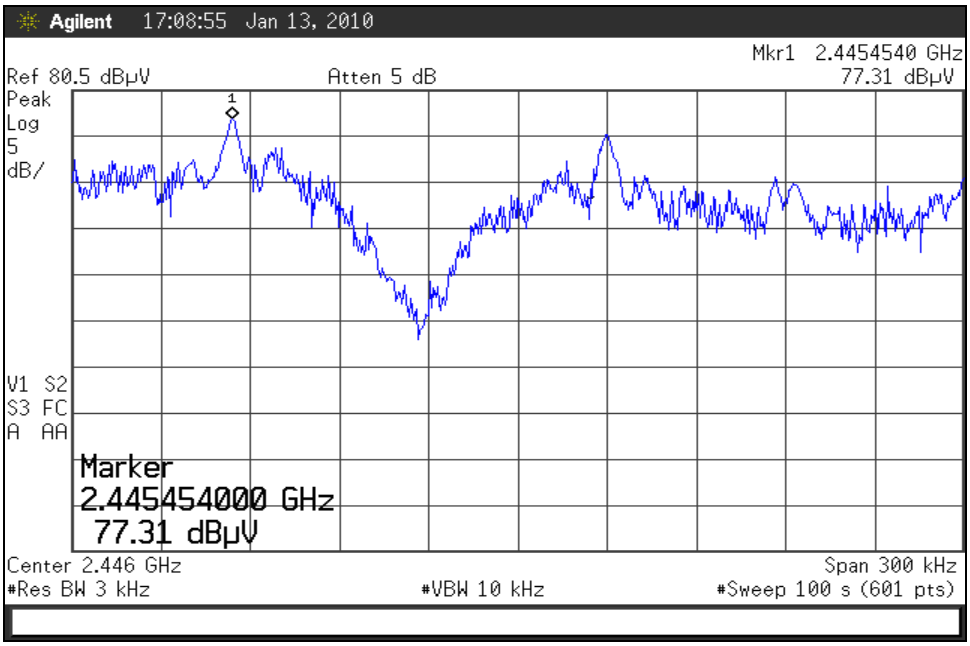
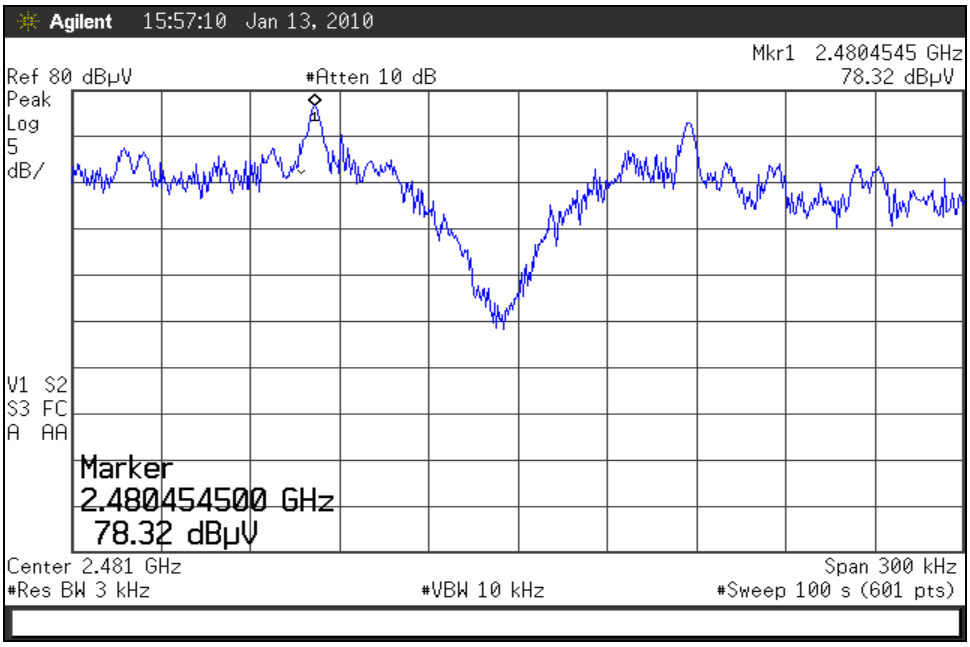
6. Measurement Data (continued)

6.7. Power Spectral Density

6.7.2. Power Spectral Density – Middle Channel



6.7.3. Power Spectral Density – High Channel



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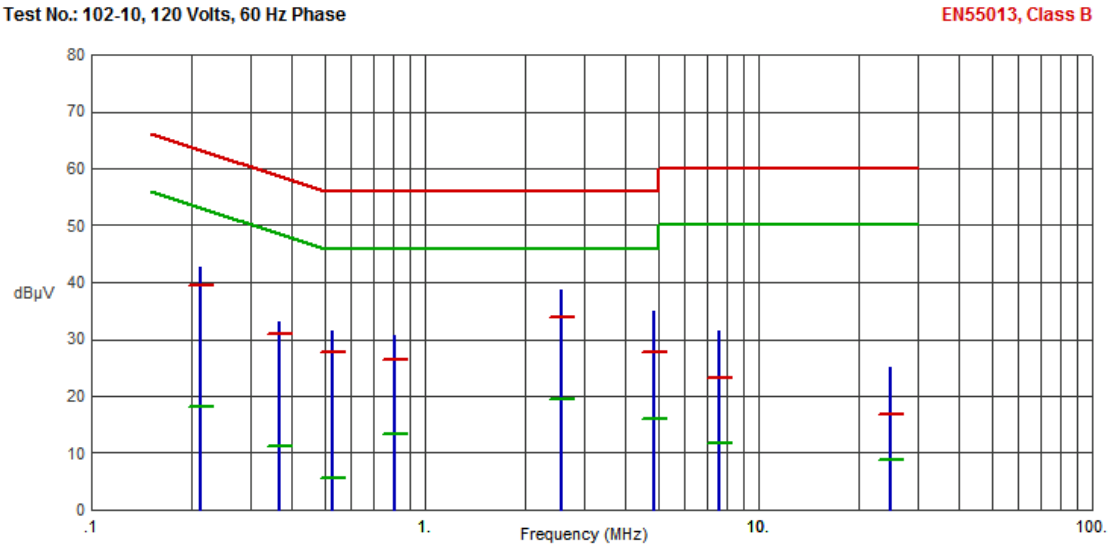
6. Measurement Data (continued)

6.8. Conducted Emissions

6.8.1. 120 Volts, 60 Hz, Phase



Frequency (MHz)	Pk Amp (dBµV)	QP Amp (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Avg Amp (dBµV)	Avg Limit (dBµV)	Avg Margin (dB)	Comments
.2132	42.69	39.48	63.08	-23.60	18.04	53.08	-35.04	
.3671	33.17	30.89	58.57	-27.68	11.07	48.57	-37.50	
.5272	31.35	27.74	56.00	-28.26	5.60	46.00	-40.40	
.8081	30.77	26.51	56.00	-29.49	13.23	46.00	-32.77	
2.5651	38.72	33.88	56.00	-22.12	19.59	46.00	-26.41	
4.8796	34.88	27.86	56.00	-28.14	16.10	46.00	-29.90	
7.6542	31.36	23.07	60.00	-36.93	11.71	50.00	-38.29	
24.9622	24.96	16.90	60.00	-43.10	8.72	50.00	-41.28	

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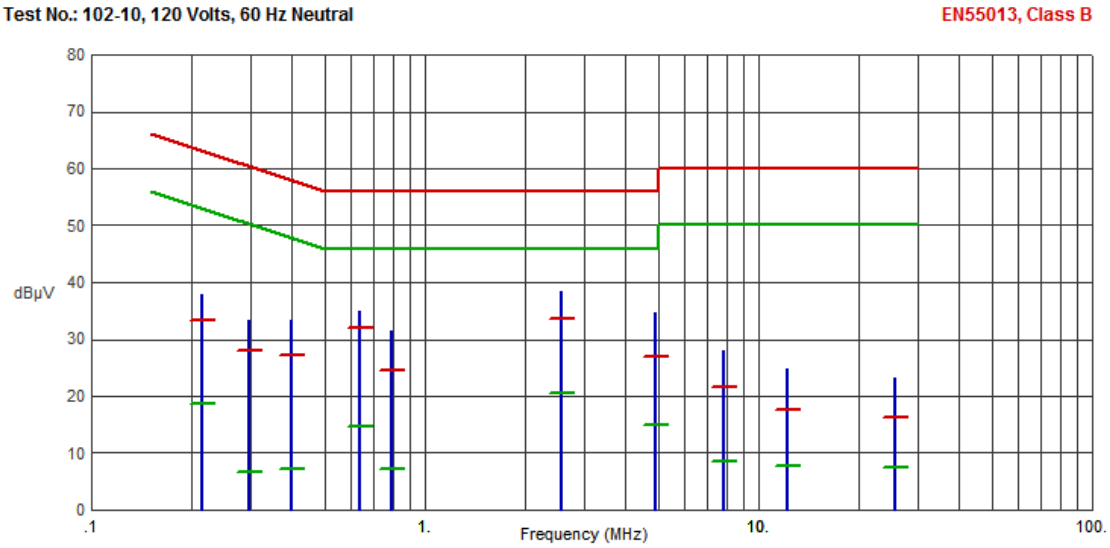
6. Measurement Data (continued)

6.8. Conducted Emissions

6.8.2. 120 Volts, 60 Hz, Neutral



Frequency (MHz)	Pk Amp (dBµV)	QP Amp (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Avg Amp (dBµV)	Avg Limit (dBµV)	Avg Margin (dB)	Comments
.2153	37.80	33.43	63.00	-29.57	18.76	53.00	-34.24	
.2971	33.28	27.93	60.32	-32.39	6.76	50.32	-43.56	
.3999	33.27	27.07	57.86	-30.79	7.18	47.86	-40.68	
.6346	34.85	31.98	56.00	-24.02	14.57	46.00	-31.43	
.7928	31.52	24.51	56.00	-31.49	7.27	46.00	-38.73	
2.5677	38.35	33.63	56.00	-22.37	20.57	46.00	-25.43	
4.9052	34.62	26.88	56.00	-29.12	14.85	46.00	-31.15	
7.8533	28.12	21.65	60.00	-38.35	8.60	50.00	-41.40	
12.1620	24.91	17.71	60.00	-42.29	7.62	50.00	-42.38	
25.6811	23.20	16.31	60.00	-43.69	7.58	50.00	-42.42	

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6. Measurement Data (continued)

6.9. Public Exposure to Radio Frequency Energy Levels (15.247(i) (1.1307 (b)(1)) RSS-GEN 5.5, RSS 102

Channel	Freq.	MPE Distance (cm)	DUT Output Power (dBm)	DUT Antenna Gain (dBi)	Power Density		Limit (mW/cm2)	Result
					(mW/cm2)	(W/m2)		
		(1)	(2)	(3)	(4)		(5)	
Low	2405	20.0	-6.88	2.00	0.0000647	0.0006469	1	Compliant
Middle	2445	20.0	-6.19	2.00	0.0000758	0.0007583	1	Compliant
High	2480	20.0	-5.23	2.00	0.0000946	0.0009459	1	Compliant

$$PD = \frac{OP + AG}{(4 \times \pi \times d^2)}$$

PD = Power Density (mW/cm2)
OP = DUT Output Power (dBm)
AG = DUT Antenna Gain (dBi)
d = MPE Distance (cm)

1. Reference CFR 2.1093(b): For purposes of this section, a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.
2. Sections 6.2 of this test report.
3. Antenna manufacturer's data sheet.
4. Power density is calculated from field strength measurement and antenna gain.
5. Reference CFR 1.1310, Table 1: Limits for Maximum Permissible Exposure (MPE), Section (B): Limits for General Population/Uncontrolled Exposure.

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7. Test Site Description

Compliance Worldwide is located at 357 Main Street in Sandown, New Hampshire. The test sites at Compliance Worldwide are used for conducted and radiated emissions testing in accordance with Federal Communications Commission (FCC) and Industry Canada standards. A description of the test sites is on file with the FCC (registration number **96392**) and Industry Canada (file number **IC 3023A-1)**.

The radiated emissions test site is a 3 and 10 meter enclosed open area test site (OATS). Personnel, support equipment and test equipment are located in the basement beneath the OATS ground plane.

The conducted emissions site is part of a 16' x 20' x 12' ferrite tile chamber and uses one of the walls for the vertical ground plane required by EN 55022.

Both sites are designed to test products or systems 1.5 meter W x 1.5 meter L x 2.0 meter H, floor standing or table top.

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