COMPLIANCE WORLDWIDE INC.
TEST REPORT 378-16

In Accordance with the Requirements of

FCC PART 15.247, SUBPART C
INDUSTRY CANADA RSS-247, ISSUE 1

Low Power License-Exempt Radio Communication Devices
Intentional Radiators

Issued to

The Schawbel Corp.
2400 District Avenue, Ste. 150
Burlington, MA 01803

for the

Schawbel Heat Packs®
With
Pre-Approved Broadcom Bluetooth Module

FCC ID: ZAM-PAKL01
IC: 9559A-PAKL01

Report Issued on September 1, 2016

Tested by

Brian F. Breault

Reviewed by

Larry K. Stillings

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1. Scope

This test report certifies that the Schawbel Heat Packs® with pre-approved Broadcom Bluetooth module, as tested, meets the FCC Part 15.247, and Industry Canada RSS-247, Issue 1 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: The Schawbel Corp.
2.2. Model Number: Heat Packs®
2.3. Serial Number: N/A
2.4. EUT Description: Battery-operated warmer that can be used to bring the heat to your pocket, jacket, pants or hand muffs.
2.5. Power Source: Built-in 3.7 volt Li-ion custom rechargeable battery pack.
2.6. Hardware Rev.: Rev. B
2.7. Software Rev.: 1.41
2.8. EMC Modifications: None

3. Product Configuration

3.1. Operational Characteristics & Software

Operating Instructions:

The Schawbel Heat Packs® battery operated warmer BLE with pre-approved Broadcom Bluetooth module was configured with a customized serial port to facilitate setup for EMC measurements.

The LE Transmitter Test configures the device under test to send test packets at a fixed interval. External test equipment may be used to receive and analyze the reference packets.

The channel on which the device under test transmits the packets is passed as a parameter. BLE devices use 40 channels, each of which is 2 MHz wide. Channel 0 maps to 2402 MHz and Channel 39 maps to 2480 MHz.

The other two parameters specify the length of the test data and the data pattern to be used (see BLUETOOTH SPECIFICATION Version 4.1 [Vol 2], Section 7.8.29 for details).

Usage: mbt le_transmitter_test COMx <tx_channel> <data_length> <packet_payload> where:
tx_channel = transmit frequency minus 2402 divided by 2.
For example, if the transmit frequency is 2404 MHz then the tx_channel = (2404 – 2402) / 2 = 1.

The channel range is 1–40 (2402–2480 MHz).

data_length = 0–37

data_pattern = 0–7

0 = Pseudo-random bit sequence 9
1 = Pattern of alternating bits: 11110000
2 = Pattern of alternating bits: 10101010
3 = Pseudo-random bit sequence 15
4 = Pattern of all 1s
5 = Pattern of all 0s
6 = Pattern of alternating bits: 00001111
7 = Pattern of alternating bits: 0101

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3. Product Configuration (continued)

3.1. Operational Characteristics & Software (continued)

Operating Instructions (continued):

The example below starts the test and instructs the device to transmit packets on Channel 0 (2402 MHz), with a 10-byte payload of all ones (1s).

WICED-Smart-SDK\Tools\mbt\win32>mbt le_transmitter_test COM6 0 10 4
Sending HCI Command:
0000 < 01 1E 20 03 02 0A 04 >
Received HCI Event:
0000 < 04 0E 04 01 1E 20 00 >
Success

To terminate the transmission:

mbt le_test_end COM6

3.2 EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Voltage	Frq (Hz)	Description/Function
Schawbel	Heat Packs®	N/A	3.7 V	DC	Battery operated warmer
ThermaCell	KSA20B0500200VU	N/A	120 V	AC	5 volt, 2 Amp AC adapter

3.3. EUT Hardware/software/Firmware Revision Level

Manufacturer	Description	Hardware	Software	Firmware
N/A				

3.4. EUT Cables/Transducers

Manufacturer	Model/Part #	Length (m)	Shield Y/N	Description/Function
Not Listed	N/A	1	Y	USB to Micro USB cable

3.5. Support Equipment

Manufacturer	Model/Part # Options	Serial Number	Input Voltage	Input Frq.	Description/Function
Dell	Vostro	00196-120-140-982	19.5	DC	Laptop for downloading test parameters. Not connected during measurements.
Dell	AC/DC Adapter	CN-0KD8HY-48052-0AR-0404-A02	100-240	50/60	Dell Vostro Power Supply

3.6. Support Equipment Cables/Transducers

Manufacturer	Model/Part #	Length (m)	Shield Y/N	Description/Function
Generic	N/A	1	Y	USB to serial cable. For for downloading test parameters. Not connected during measurements.

3.7. Miscellaneous (e.g., consumables, test fixtures, etc.):

Manufacturer	Model/Part #	Qty	Description/Function
None			

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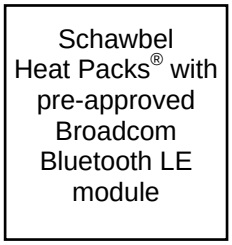
3. Product Configuration (continued)

3.8. Block Diagram:



4. Measurements Parameters

4.1 Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due	Interval
EMI Test Receiver, 9kHz - 7GHz [1]	Rohde & Schwarz	ESR7	101156	7/23/2017	2 Years
Spectrum Analyzer 20 Hz – 40 GHz [2]	Rohde & Schwarz	FSV40	100899	7/23/2017	2 Years
Spectrum Analyzer, 9 kHz to 40 GHz [3]	Rohde & Schwarz	FSVR40	100909	7/23/2017	2 Years
EMI Receiver	Hewlett Packard	8546A	3330A00115	6/4/2017	3 Years
Loop Antenna	EMCO	6512	9309-1139	9/23/2016	2 Years
Combilog Antenna, 30 MHz to 2 GHz	Com-Power	AC-220	25509	5/12/2018	2 Years
LISN 50 Ω 50 µH, 9 kHz to 30 MHz	EMCO	3825/2	9109-1860	7/23/2016	1 Year
Digital Barometer	Control Company	4195	ID236	10/8/2017	2 Years
Temperature Chamber	Associated Research	E-0029	N/A	N/A	---

[1] ESR7 Firmware revision: V2.26, Date installed: 08/15/2014 Previous V2.17, installed 6/11/2014.
[2] FSV40 Firmware revision: V2.30 SP4, Date installed: 05/04/2016 Previous V2.30 SP1, installed 10/22/2014.
[3] FSVR40 Firmware revision: V2.23, Date installed: 10/20/2014 Previous V1.63 SP1, installed 8/28/2013.

Manufacturer	Software Description	Title or Model #	Rev.	Report Sections
Compliance Worldwide	Test Report Generation Software	Test Report Generator	1.0	Not used for this product

4.2. Measurement & Equipment Setup

Test Dates:	July 28th 2016 – August 5th, 2016
Test Engineer:	Brian Breault
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 -75%RH):	35
Frequency Range:	30 kHz to 26 GHz
Measurement Distance:	3 Meters
EMI Receiver IF/Resolution Bandwidth:	100 kHz - 30 MHz to 1 GHz
	1 MHz - Above 1 GHz
EMI Receiver Average/Video Bandwidth:	300 kHz - 30 MHz to 1 GHz
	3 MHz - Above 1 GHz
Detector Functions:	Peak, Quasi-Peak & Average

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4. Measurements Parameters

4.3. Measurement Procedure

Testing was performed in accordance with the requirements detailed in ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices. In addition, FCC OET 558074, D01: DTS Measurement Guidance v03r05, April 8th, 2016 was referenced for the testing detailed in this report. All references to this document refer to this version.

Test measurements were made in accordance with FCC Part 15.247, ANSI C63.10-2013 and IC RSS-247 Annex A: Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz.

The test methods used to generate the data in this test report is in accordance with ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless

The device under test is capable of utilizing 40 channels. In accordance with ANSI C63.10, section 5.6, three channel frequencies were selected for measurement:

Channel	0	2402 MHz (Low)
Channel	19	2440 MHz (Middle)
Channel	39	2480 MHz (High)

During the measurement testing, the device under test was mounted on a polystyrene form to facilitate rotating the device through three orthogonal axes as required by ANSI C63.10-2013, section 5.10.1, for a hand held or body worn device. The three axes were defined as follows:

X-Axis	Horizontal with the micro-USB power connector facing toward the right. The front, labeled side was facing the antenna at 0º turntable azimuth.
Y-Axis	Vertical with the micro-USB power connector facing up. The front, labeled side was facing the antenna at 0º turntable azimuth.
Z-Axis	The labeled side facing up. The micro-USB power connector was facing away from the antenna at 0º turntable azimuth.

X-Axis

Y-Axis

Z-Axis

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4. Measurements Parameters

4.4. Measurement Uncertainty

The following uncertainties are expressed for an expansion/coverage factor of K=2.

RF Frequency	$\pm$ 1x10^{-8}
Radiated Emission of Transmitter	$\pm$ 4.55 dB
Radiated Emission of Receiver	$\pm$ 4.55 dB
Temperature	$\pm$ 0.91^{o} C
Humidity	$\pm$ 5%

5. Choice of Equipment for Test Suits

5.1 Choice of Model

This test report is based on the test sample supplied by the manufacturer and is reported by the manufacturer to be equivalent to the production units.

5.2 Presentation

This test sample was tested complete with all required ancillary equipment. Refer to Section 3 of this report for product equipment configuration.

5.3 Choice of Operating Frequencies

The Device under test, utilizes 40 channels. Refer to Section 4.3, paragraph four for the selected test frequencies.

5.4 Modes of Operation

The modulation mode for all tested frequencies was GFSK and the selected data rate was 1 Mbps.

The data rates and data patterns were selected to maximize the data output and duty cycle of the product.

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6. Measurement Summary

Test Requirement	FCC Rule Reference	IC Rule Reference	Test Report Section	Result
Antenna Requirement	15.203	RSS-GEN 7.1.2	7.1	Compliant
Minimum DTS (6 dB) Bandwidth	15.247 (a) (2)	RSS-247 5.2 (1)	7.2	Compliant
Bandwidth of Momentary Signals (99% Bandwidth)	N/A	RSS-GEN 4.6.1	7.3	N/A
Maximum Peak Conducted Output Power	15.247 (b) (1)	RSS-247 5.4 (4)	7.4	Compliant
Operation with directional antenna gains greater than 6 dBi	15.247 (b) (4)	RSS-GEN 7.1.2	7.5	Compliant
Transmitter Spurious Radiated Emissions	15.247 (d)	RSS-GEN 8.9	7.6	Compliant
Harmonic Emissions in the Restricted Bands of Operation	15.247 (d)	N/A	7.7	Compliant
Band Edge Measurements	15.247 (d)	RSS-247 5.5	7.8	Compliant
Peak Power Spectral Density	15.247(e)	RSS-247 5.2 (2)	7.9	Compliant
Conducted Emissions	15.207	RSS-GEN	7.10	Battery Operated Device
Public Exposure to Radio Frequency Energy Levels	15.247(i) 1.1307 (b) (1)	RSS-GEN 5.5 RSS-102	7.11	Compliant

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7. Measurement Data

7.1. Antenna Requirement (15.203, RSS-GEN 7.1.2)

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 device under test utilizes an internal, inaccessible antenna. The housing of the device under test is completely sealed.

7.2. Minimum DTS (6 dB) Bandwidth (15.247 (a) (2), RSS-247 5.2(1))

Requirement: 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.

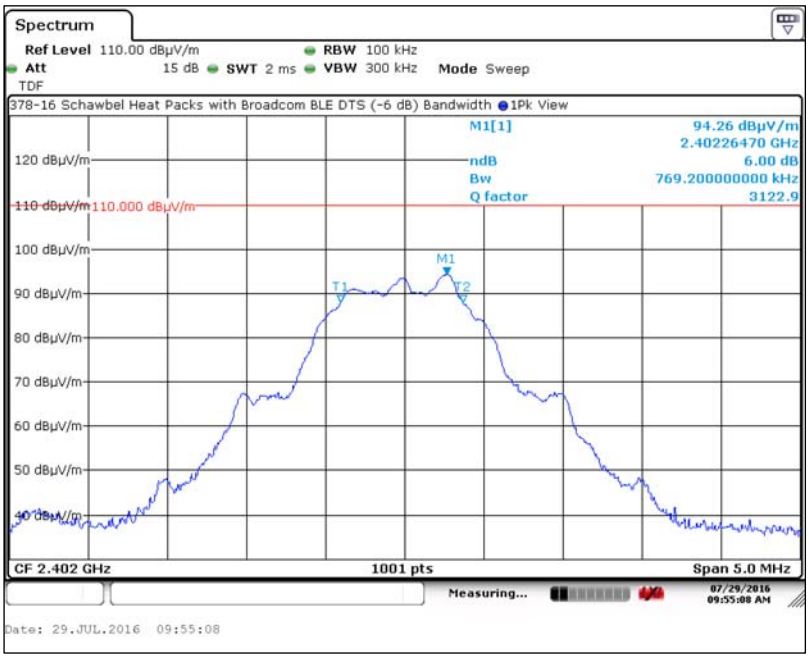
Procedure: Performed in accordance with FCC OET 558074 D01: DTS Measurement Guidance, Section 8.0: DTS bandwidth.

Conclusion: Compliant - The device under test meets the minimum 500 kHz 6 dB bandwidth requirement.

Measurement Results - Minimum 6 dB Bandwidth

Channel	Frequency (MHz)	-6 dB Bandwidth (kHz)	Min. -6 dB Bandwidth (kHz)	Result
Low	2402	769.2	>500	Compliant
Middle	2440	769.2	>500	Compliant
High	2480	764.2	>500	Compliant

7.2.1. -6 dB Bandwidth, Low Channel 0



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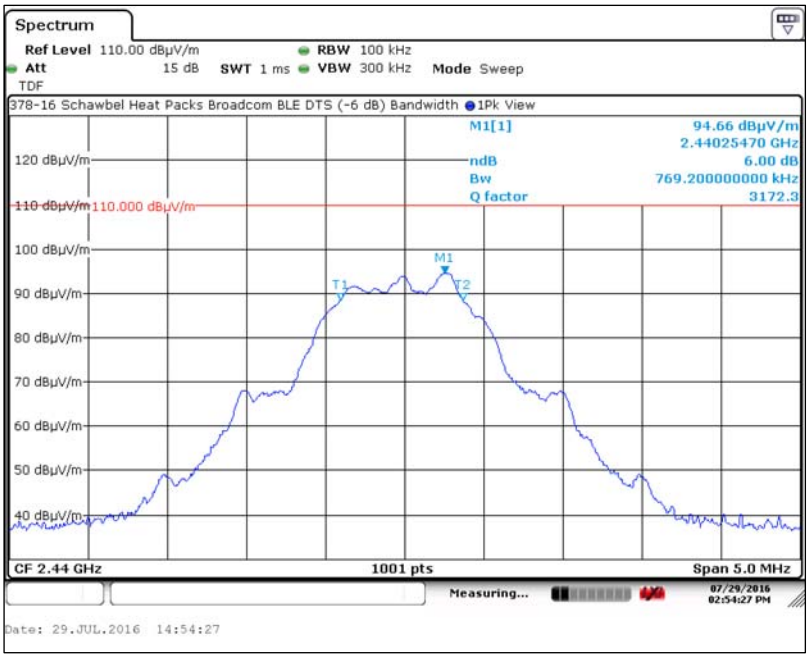
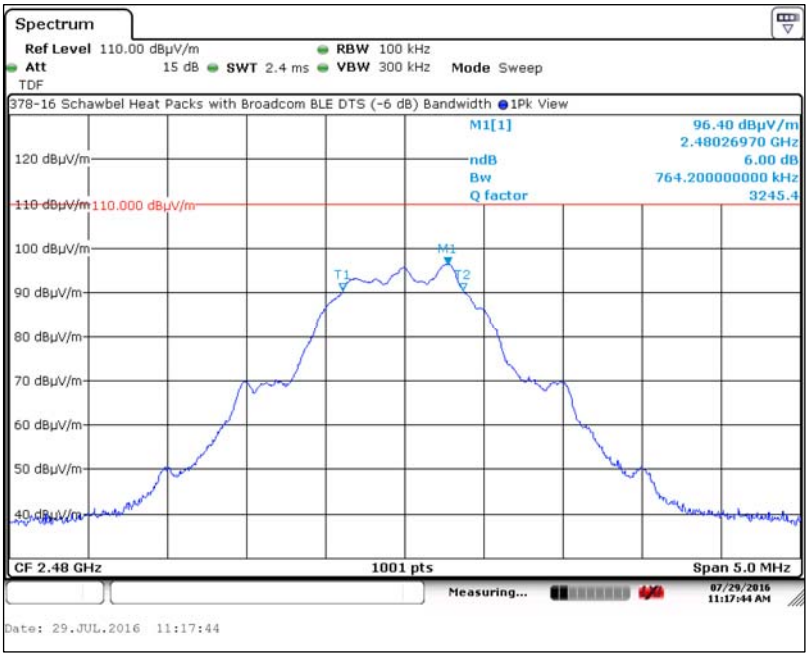
7. Measurement Data

7.2. Minimum DTS (6 dB) Bandwidth (15.247 (a) (2), RSS-247 5.2 (1)) (continued)

7.2.2. -6 dB Bandwidth, Middle Channel 19



7.2.3. -6 dB Bandwidth, High Channel 39



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7. Measurement Data (continued)

7.3. Bandwidth of Momentary Signals

Requirement: When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.
The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

Procedure: This test was performed utilizing the automated 99% bandwidth function of the spectrum analyzer.

Conclusion: Compliant - for informational purposes.

Measurement Results - 99% Bandwidth

Channel	Channel Frequency (MHz)	99% Power Bandwidth (MHz)
Low	2402	1.0939
Middle	2440	1.0939
High	2480	1.1438

7.3.1. 99% Bandwidth, Low Channel 0

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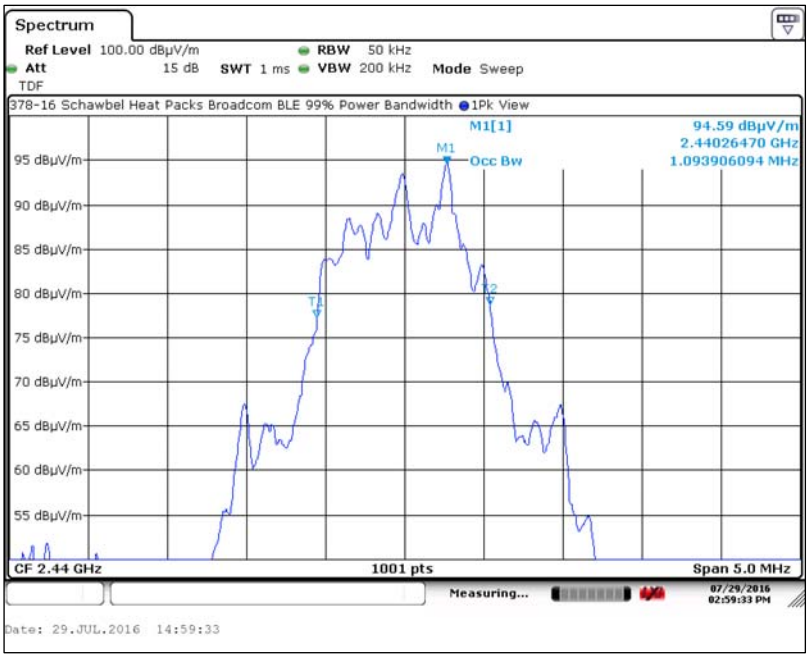
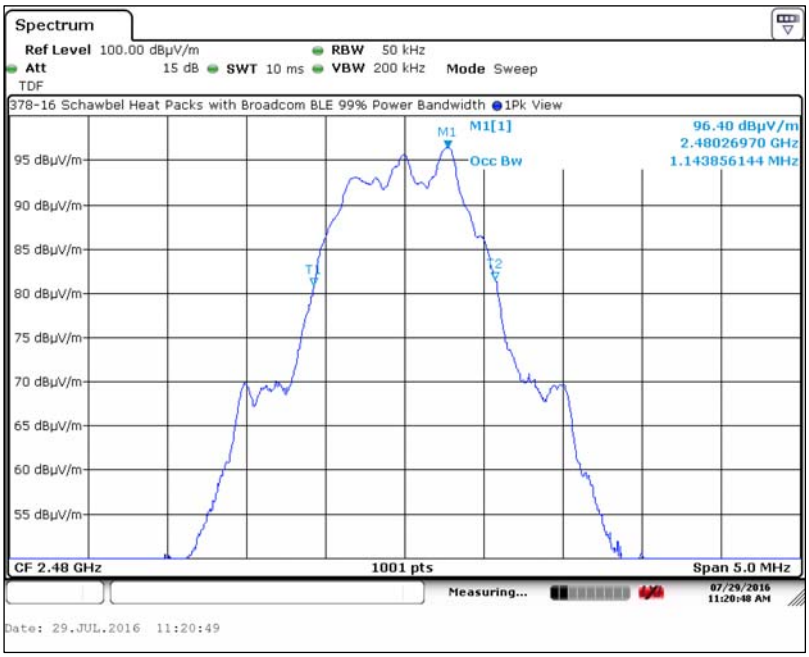
7. Measurement Data (continued)

7.3. Bandwidth of Momentary Signals

7.3.2. 99% Bandwidth, Middle Channel 19



7.3.3. 99% Bandwidth, High Channel 39



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7. Measurement Data (continued)

7.4. Maximum Peak Conducted Output Power (15.247 (b) (1), RSS-247 5.4 (4))

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.

Procedure: FCC OET 558074 D01: DTS Measurement Guidance, Section 9.1.1: Maximum peak conducted output power, RBW ≥ DTS bandwidth, was referenced for the maximum peak conducted output power measurements detailed in this section of this report.

Test Notes: The device under test does not have an accessible antenna port and therefore does not facilitate conducted power measurements. Radiated field strength measurements were made and converted to units of power using the following formula[1]:

$$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$$

EIRP = the equivalent isotropically radiated power in dBm.
E_{Meas} = the measured maximum field strength in dBµV/m.
d_{Meas} = the field strength measurement distance, in meters.

[1] Reference ANSI C63.10-2013, Section 9.5.: Equations to calculate EIRP

Conclusion: Compliant – the device under test meets the requirements of Fcc Part 15.247 (b)(1).

EIRP Measurement Results

Frequency	Peak Field Strength (E_{Meas})	Distance (d_{Meas})	Equivalent Isotropic Radiated Power (EIRP)		Output Power Limit	Result
(MHz)	(dBµV/m)	(Meters)	(dBm)	(mW)	(mW)	
2402	94.81	3.0	-0.35	0.923	1000.0	Compliant
2440	95.80	3.0	0.64	1.159	1000.0	Compliant
2480	96.89	3.0	1.73	1.490	1000.0	Compliant

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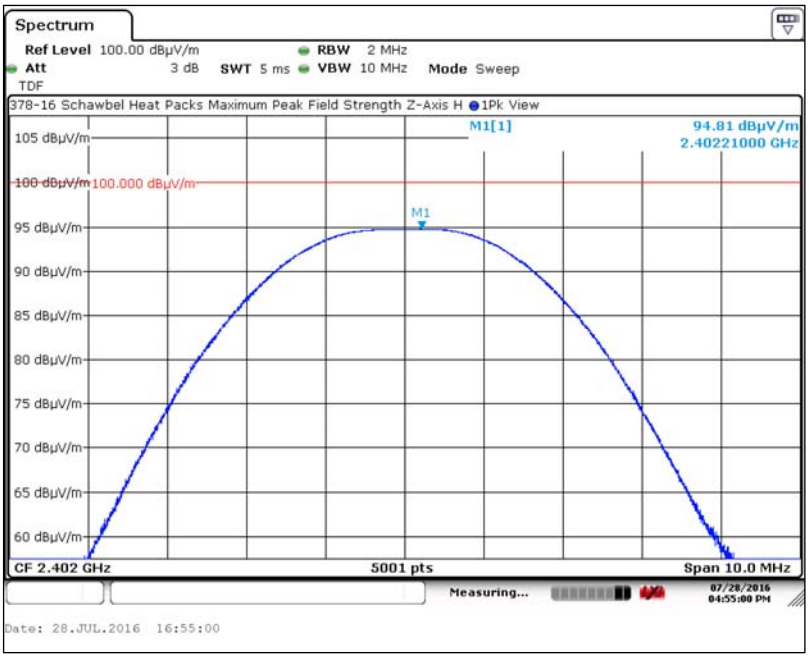
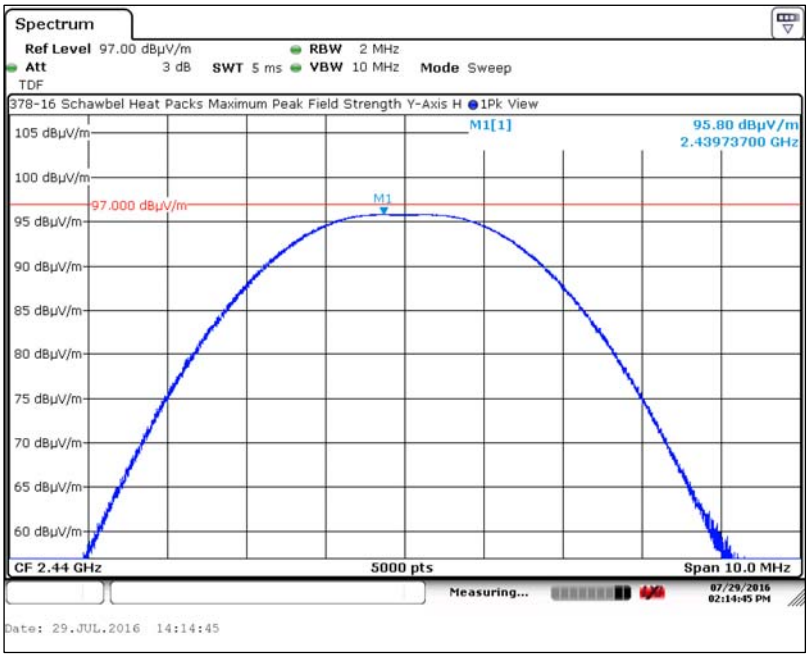
7. Measurement Data (continued)

7.4. Maximum Peak Conducted Output Power (15.247 (b) (3), RSS-247 5.4 (4)) (cont.)

7.4.1. Maximum Peak Field Strength, Low Channel 0



7.4.2. Maximum Peak Field Strength, Middle Channel 19



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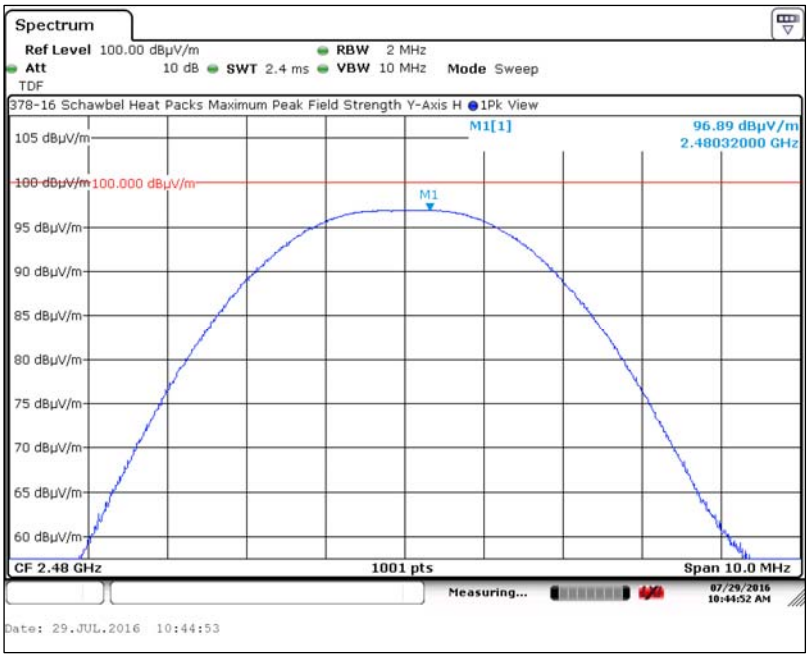
7. Measurement Data (continued)

7.4. Maximum Peak Conducted Output Power (15.247 (b) (3), RSS-247 5.4 (4)) (cont.)

7.4.3. Maximum Peak Field Strength, High Channel 39



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7. Measurement Data (continued)

7.5. Operation with Directional Antenna Gains Greater than 6 dBi (15.247 (b)(4))

Requirement: If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of FCC Part 15.247, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Conclusion: The antenna used with the device under test has a gain of approximately -1.5 dBi. Therefore Part 15.247, section (b)(4)) does not apply.

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7. Measurement Data (continued)

7.6. Transmitter Spurious Radiated Emissions (30 kHz to 26 GHz)

Requirement: (15.209) The Emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency Range (MHz)	Distance (Meters)	Limit (dBµV/m)
0.009 to 0.490	3	128.5 to 93.8
0.490 to 1.705	3	73.8 to 63.0
1.705 to 30	3	69.5
30 to 88	3	40.0
88 to 216	3	43.5
216 to 960	3	46.0
>960	3	54.0

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

Procedure: This test was performed in accordance with the procedure detailed in ANSI C63.10:2013, section 6.3: Radiated emissions testing—general requirements and FCC 47 CFR Part 15.209: Radiated Emission Limits; General Requirements.

Test measurements were made in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

Test Note: The measurements were performed with the device in three orthogonal positions in accordance with ANSI C63.10-2013, sections 5.10.1. Reference section 4.3 of this report for additional information.

Conclusion: The Emissions from the DUT did not exceed the FCC Part 15,209 field strength levels specified in the above table. Reference Appendix A for the transmitter spurious emission data.

Non-Harmonic Worst Case Measurements

Range	Frequency	Peak Field Strength	FCC 15.209 Limit	Margin	Result	Appendix A Reference
(MHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)		
0.03 to 0.15	0.030745	89.75	126.931	-37.18	Compliant	A1.1.5
0.15 to 30.0	0.503210	58.91	73.683	-14.77	Compliant	A2.2.1
30 to 1000	993.882000	30.17	54.000	-23.83	Compliant	A1.3.3
1000 to 2400	2399.860000	50.13	54.000	-3.87	Compliant	A1.4.1
2483.5 to 10000	9952.700000	47.38	54.000	-6.62	Compliant	A2.5.5
10000 to 18000	16858.600000	48.05	54.000	-5.95	Compliant	A1.6.1
18000 to 26000	24992.300000	45.93	54.000	-8.07	Compliant	A1.7.5

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7. Measurement Data (continued)

7.7. Harmonic Emissions in the Restricted Bands of Operation (15.247 (d))

Measurement Results – Worst Case Harmonic Emissions

Freq. (MHz)	Field Strength (dBµV/m)		Limit (dBµV/m)		Margin (dBµV/m)		Antenna Polarity (H/V)	Result
	Peak	Average	Peak	Average	Peak	Average		
4804.000	50.00	36.24	74.00	54.00	-24.00	-17.76	V	Compliant
4880.000	48.21	34.53	74.00	54.00	-25.79	-19.47	H	Compliant
4960.000	49.86	34.47	74.00	54.00	-24.14	-19.53	H	Compliant
7320.000	59.79	45.74	74.00	54.00	-14.21	-8.26	H	Compliant
7440.000	56.00	42.24	74.00	54.00	-18.00	-11.76	H	Compliant
12010.000	56.52	43.46	74.00	54.00	-17.48	-10.54	H	Compliant
12200.000	57.84	43.53	74.00	54.00	-16.16	-10.47	H	Compliant
12400.000	57.56	44.56	74.00	54.00	-16.44	-9.44	H	Compliant
19216.000	58.65	45.02	74.00	54.00	-15.35	-8.98	V	Compliant
19520.000	58.73	44.85	74.00	54.00	-15.27	-9.15	V	Compliant
19840.000	58.01	44.28	74.00	54.00	-15.99	-9.72	H	Compliant
22320.000	61.49	46.92	74.00	54.00	-12.51	-7.08	H	Compliant

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7. Measurement Data (continued)

7.8. Band Edge Measurements (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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

Procedures: Lower Band Edge - ANSI C63.10:2013, section 6.10.4: Authorized-band band-edge measurements (-20 dB delta relative method).

Upper Band Edge – ANSI C63.10:2013, section 6.10.5: Restricted-band band-edge measurements.

Conclusion: Compliant - The DUT meets the band edge requirements

Measurement Results

Lower Band Edge

Lowest Channel (MHz)	In-Band Peak Measurement (dBµV/m)		Band Edge Frequency (MHz)	Band Edge Measurement (dBµV/m)		Required Offset (dB)	Actual Offset (dB)	Result
	Peak	Average		Peak	Average			
2402	94.52	---	2400	39.90	---	>20	54.62	Compliant

Upper Band Edge

Highest Channel Frequency (MHz)	Field Strength (dBµV/m)		Band Edge Frequency (MHz)	Field Strength (dBµV/m)		FCC Part 15.209 Limit (dBµV/m)		Margin (dB)		Result
	Peak	Avg		Peak	Avg	Peak	Avg	Peak	Avg	
2480	96.34	---	2483.5	50.85	31.96	74.00	54.00	-23.15	-22.04	Compliant

Lower Restricted Band

Frequency (MHz)	Field Strength (dBµV/m)		FCC Part 15.209 Limit (dBµV/m)		Margin (dB)		Result
	Peak	Average	Peak	Average	Peak	Average	
2344.4860	46.9	---	74.00	54.00	-27.10	Note 1	Compliant

Note 1: The peak field strength was greater than 6 dB below the average limit.

Upper Restricted Band

Frequency (MHz)	Field Strength (dBµV/m)		FCC Part 15.209 Limit (dBµV/m)		Margin (dB)		Result
	Peak	Average	Peak	Average	Peak	Average	
2483.5367	53.3	31.84	74.00	54.00	-20.70	-22.16	Compliant

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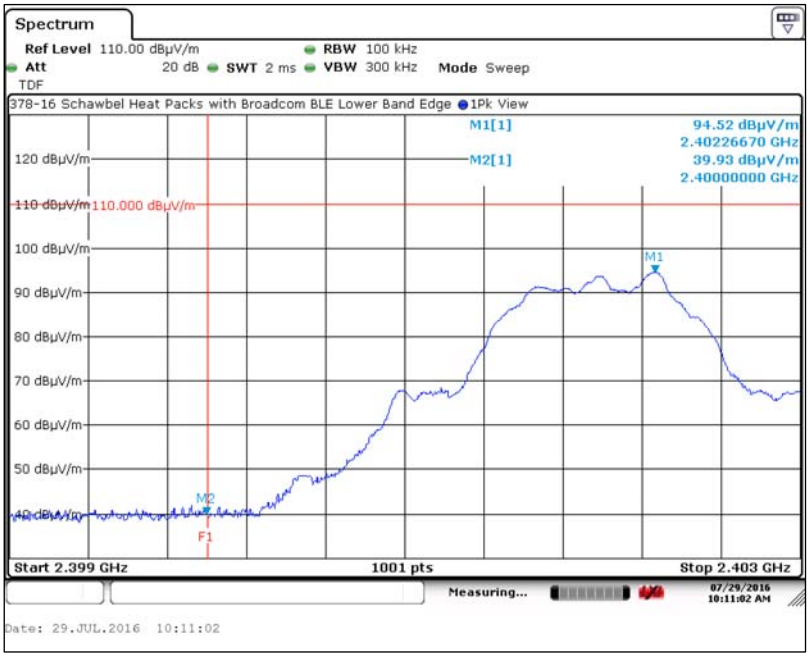
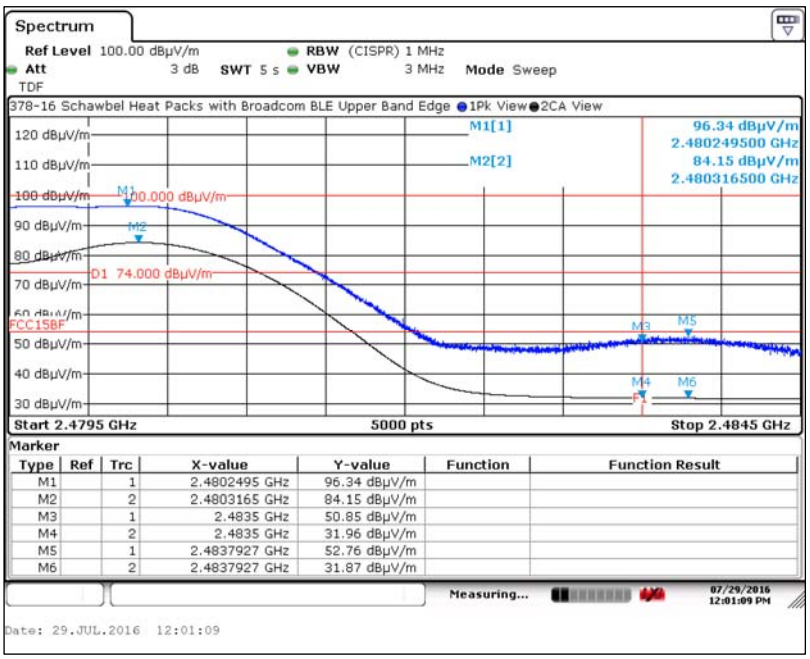
7. Measurement Data (continued)

7.8. Band Edge Measurements (15.247 d))

7.8.1. Lower Band Edge



7.8.2. Upper Band Edge



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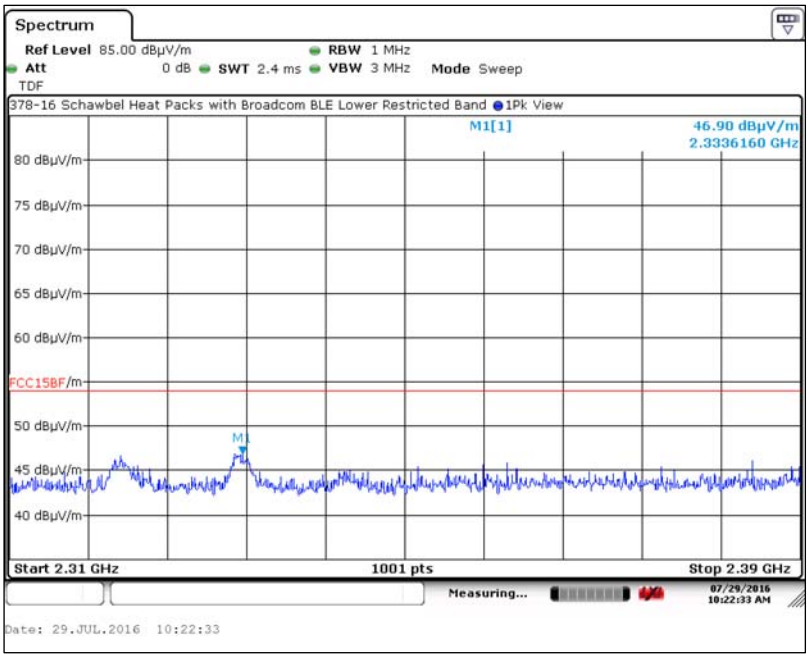
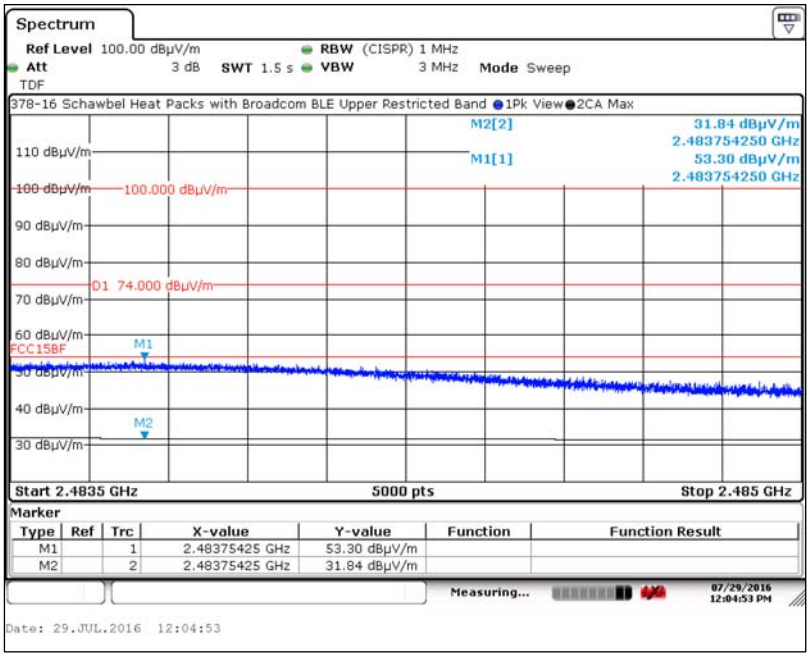
7. Measurement Data (continued)

7.8. Band Edge Measurements (15.247 d))

7.8.3. Lower Restricted Band



7.8.4. Upper Restricted Band



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7. Measurement Data (continued)

7.9. Peak Power Spectral Density (15.247(e), RSS-247 5.2 (2))

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.

Procedure: This measurement was performed in accordance with FCC OET 558074 D01: DTS Measurement Guidance Section 10.2: Method PKPSD (peak PSD).

Test Notes: The data presented in this test report represents the worst case receive antenna polarity and elevation and turntable position.

The method used to convert the field strength to power is detailed in the test notes in section 7.4 of this test report.

Channel 39 is an advertising channel. Channels 0 and 19 are not.

Conclusion: The DUT meets the Part 15.247(e) power spectral density requirement.

Measurement Results – Power Spectral Density

Channel Frequency	Measured Frequency	Peak Power Spectral Density	Distance	Peak Power Spectral Density		Output Power Limit	Result
(MHz)	(MHz)	(dBµV/m)	(Meters)	(dBm)	(mW)	(dBm)	
2402	2402.2637	85.89	3.0	-9.27	0.118	8.0	Compliant
2440	2440.2637	86.35	3.0	-8.81	0.132	8.0	Compliant
2480	2480.2697	87.78	3.0	-7.38	0.183	8.0	Compliant

7.9.1. Peak Power Spectral Density, Low Channel 0

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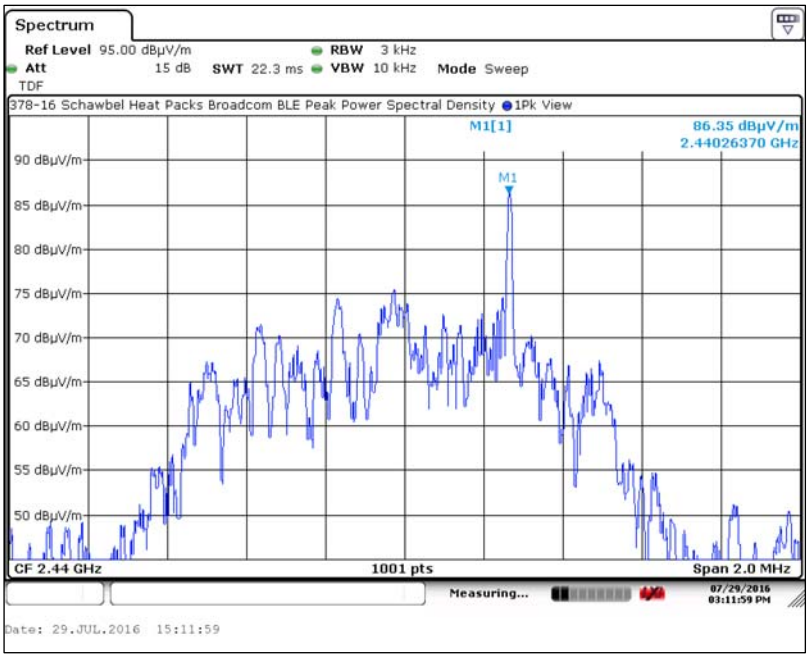
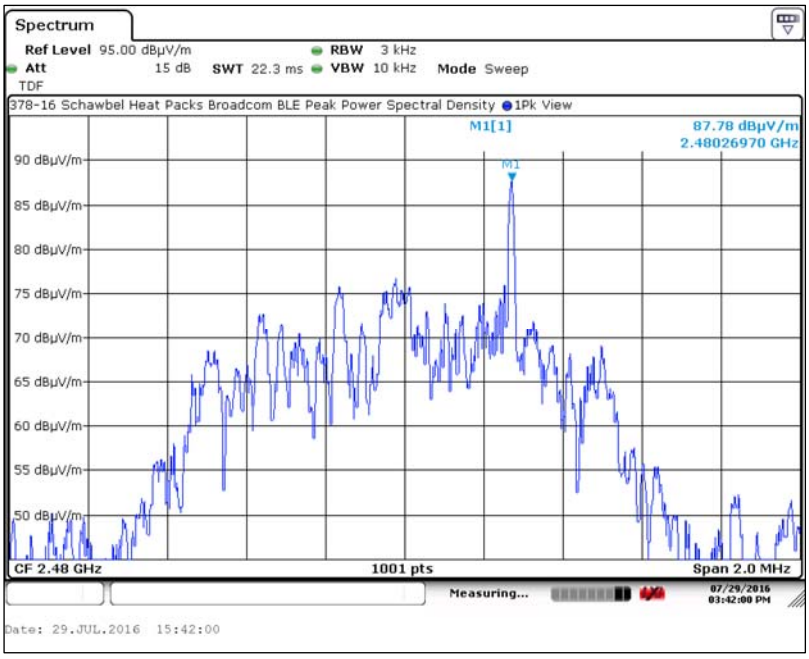
7. Measurement Data (continued)

7.9. Peak Power Spectral Density (15.247(e), RSS-247 5.2 (2)) (continued)

7.9.2. Peak Power Spectral Density, Middle Channel 19



7.9.2. Peak Power Spectral Density, High Channel 39



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7. Measurement Data (continued)

7.10. Conducted Emissions

Regulatory Limit: FCC Part 15.207

Frequency Range (MHz)	Limits (dBµV)	
	Quasi-Peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5.0	56	46
5.0 to 30.0	60	50
* Decreases with the logarithm of the frequency.		

Measurement Equipment Used to Perform Test

Device	Manufacturer	Model	Serial No.	Cal Due	Interval
LISN	EMCO	3850/2	9909-1079	7/23/2016	1 Year
EMI Receiver	Hewlett Packard	8546A	3330A00115	6/4/2017	3 Years

Manufacturer	Software Description	Title/Model #	Rev.
Compliance Worldwide	Test Report Generation Software	Test Report Generator	1.0

Measurement & Equipment Setup

Test Date:	7/21/2015
Test Engineer:	Cody Merry
Site Temperature (°C):	21
Relative Humidity (%RH):	37
Frequency Range:	0.15 MHz to 30 MHz
EMI Receiver IF Bandwidth:	9 kHz
EMI Receiver Avg Bandwidth:	30 kHz
Detector Functions:	Peak, Quasi-Peak & Average

Test Procedure

Test measurements were made in accordance with ANSI C63.10-2013, Section 6.2: Standard test method for ac power-line conducted emissions from unlicensed wireless devices

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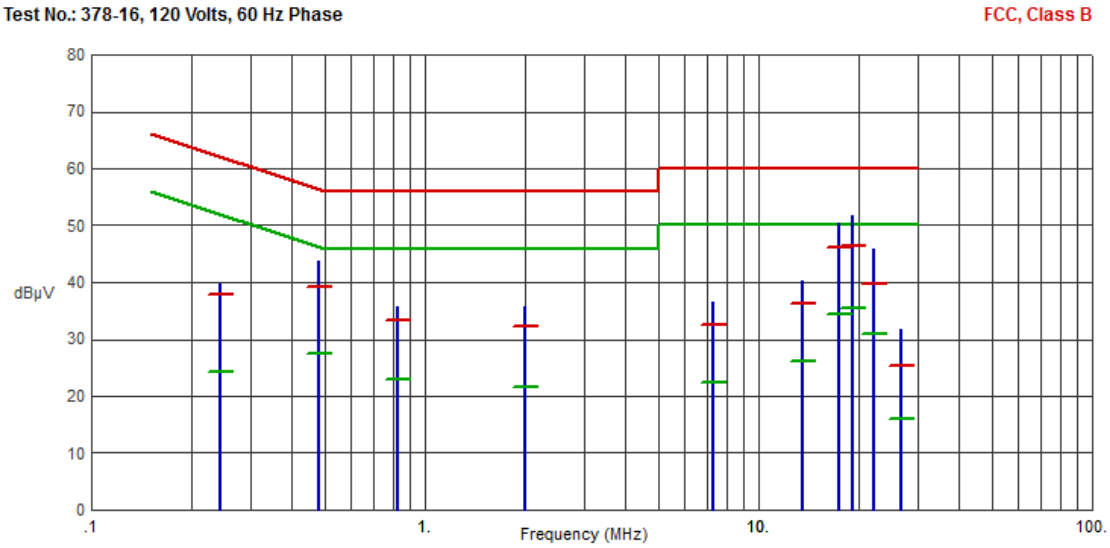
7. Measurement Data (continued)

7.10. Conducted Emissions

7.10.1. 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
.2428	39.62	37.95	62.00	-24.05	24.15	52.00	-27.85	
.4811	43.75	39.18	56.32	-17.14	27.40	46.32	-18.92	
.8269	35.64	33.41	56.00	-22.59	22.80	46.00	-23.20	
1.9891	35.79	32.26	56.00	-23.74	21.61	46.00	-24.39	
7.2896	36.57	32.54	60.00	-27.46	22.27	50.00	-27.73	
13.5312	40.20	36.36	60.00	-23.64	26.17	50.00	-23.83	
17.3885	50.39	46.08	60.00	-13.92	34.41	50.00	-15.59	
19.1824	51.61	46.38	60.00	-13.62	35.40	50.00	-14.60	
22.2417	45.78	39.84	60.00	-20.16	30.98	50.00	-19.02	
26.6839	31.79	25.32	60.00	-34.68	16.13	50.00	-33.87	

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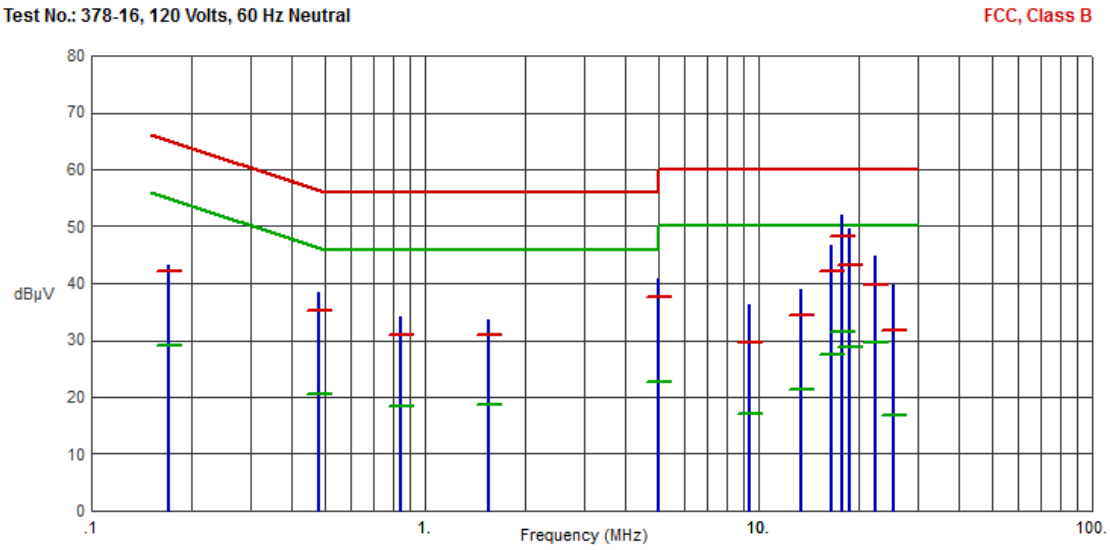
7. Measurement Data (continued)

7.10. Conducted Emissions

7.10.2. 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
.1712	43.24	42.08	64.90	-22.82	28.96	54.90	-25.94	
.4826	38.28	35.24	56.29	-21.05	20.42	46.29	-25.87	
.8445	34.08	30.94	56.00	-25.06	18.27	46.00	-27.73	
1.5593	33.53	31.05	56.00	-24.95	18.57	46.00	-27.43	
4.9894	40.77	37.54	56.00	-18.46	22.68	46.00	-23.32	
9.3969	36.34	29.60	60.00	-30.40	17.07	50.00	-32.93	
13.3723	38.94	34.35	60.00	-25.65	21.34	50.00	-28.66	
16.5027	46.66	42.09	60.00	-17.91	27.39	50.00	-22.61	
17.7196	52.11	48.35	60.00	-11.65	31.49	50.00	-18.51	
18.7142	49.67	43.27	60.00	-16.73	28.76	50.00	-21.24	
22.3095	44.68	39.85	60.00	-20.15	29.54	50.00	-20.46	
25.4940	39.75	31.64	60.00	-28.36	16.67	50.00	-33.33	

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7. Measurement Data (continued)

7.11. Public Exposure to Radio Frequency Energy Levels (15.247(i) (1.1307 (b)(1)) RSS-GEN, ISSUE 4 5.5, RSS 102)

7.11.1. 15.247(i) (1.1307 (b)(1) Requirements

Requirement: Portable devices are subject to radio frequency radiation exposure requirements.

For a 1-g SAR, the test exclusion result must be ≤ 3.0.

Test Notes: The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by the following formula:

$$\text{SAR Test Exclusion} = \frac{P_{MAX}}{d_{MIN}} \times \sqrt{f_{(GHz)}} \quad (1)$$

P_{MAX}	mW	Maximum power of channel, including tune-up tolerance
d_{MIN}	mm	Minimum test separation distance, mm (≤ 50 mm)
$f_{(GHz)}$	GHz	$f_{(GHz)}$ is the RF channel transmit frequency in GHz (>100 MHz and <6 GHz)

(1) FCC OET 447498 - Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

Conclusion: Compliant - The device under test meets the exclusion requirement detailed in FCC OET 447498.

Channel:			0	19	39
Input:	P_{MAX}[1]	(mW)	0.92	1.16	1.49
	d_{MIN}	(mm)	5.00	5.00	5.00
	$f_{(GHz)}$		2.402	2.440	2.480
Test Exclusion:			**0.29**	**0.36**	**0.47**
Limit Exemption:			**3.00**	**3.00**	**3.00**

[1] Taken from column 5 of the table in Section 7.4 of this test report.

7.11.2. RSS-102 Issue 5 Requirements

Requirement: SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1. Portable devices are subject to radio frequency radiation exposure requirements.

Test Notes: The limit was taken from Table 1 of RSS-102 Issue 5.

Frequency (MHz)	Separation Distance (mm)	Maximum Power (mW)	RSS-102 Limit (mW)	Result
2402	≤5	0.92	4.26	Compliant
2440	≤5	1.16	4.05	Compliant
2480	≤5	1.49	3.94	Compliant

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8. Test Setup Images

8.1. Radiated Emissions – Front View

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8. Test Setup Images

8.2. Radiated Emissions – Rear View Below 30 MHz

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8. Test Setup Images

8.3. Radiated Emissions – Rear View 30 MHz to 1 GHz

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8. Test Setup Images

8.4. Microwave Emissions – Front View

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8. Test Setup Images

8.5. Microwave Emissions – Rear View 1GHz to 18 GHz

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8. Test Setup Images

8.6. Microwave Emissions – Rear View Above 18 GHz

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8. Test Setup Images

8.7. Conducted Emissions – Front View

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8. Test Setup Images

8.8. Conducted Emissions – Rear View

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9. 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 with Federal Communications Commission (FCC) and Industry Canada standards. Through our American Association for Laboratory Accreditation (A2LA) ISO Guide 17025:2005 Accreditation our test sites are designated with the FCC (designation number **US1091**), Industry Canada (file number **IC 3023A-1)** and VCCI (Member number 3168) under registration number A-0208.

Compliance Worldwide is also designated as a Phase 1 CAB under APEC-MRA (US0132) for Australia/New Zealand AS/NZS CISPR 22, Chinese-Taipei (Taiwan) BSMI CNS 13438 and Korea (RRA) KN 11, KN 13, KN 14-1, KN 22, KN 32, KN 61000-6-3, KN 61000-6-4.

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. A second conducted emissions site is also located in the basement of the OATS site with a 2.3 x 2.5 meter ground plane and a 2.4 x 2.4 meter vertical wall.

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

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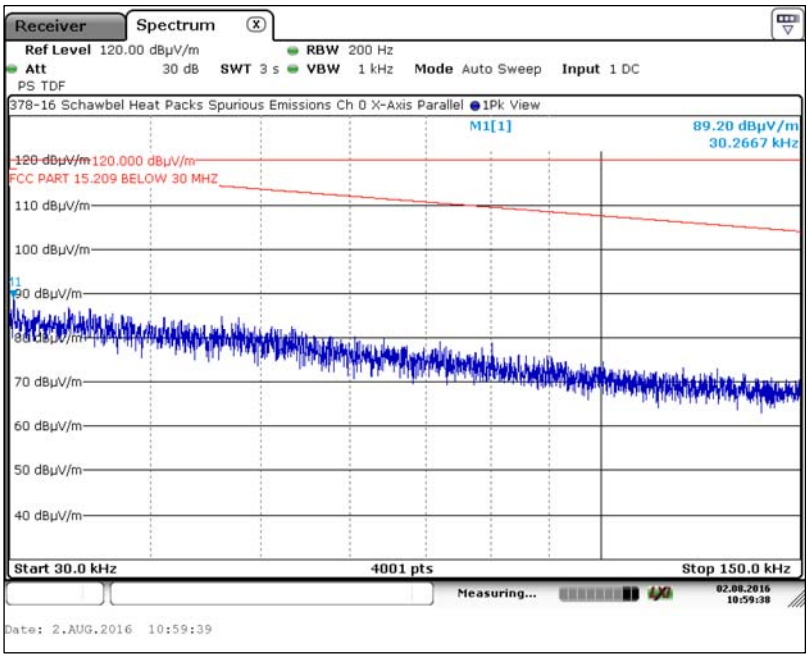
Appendix A

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

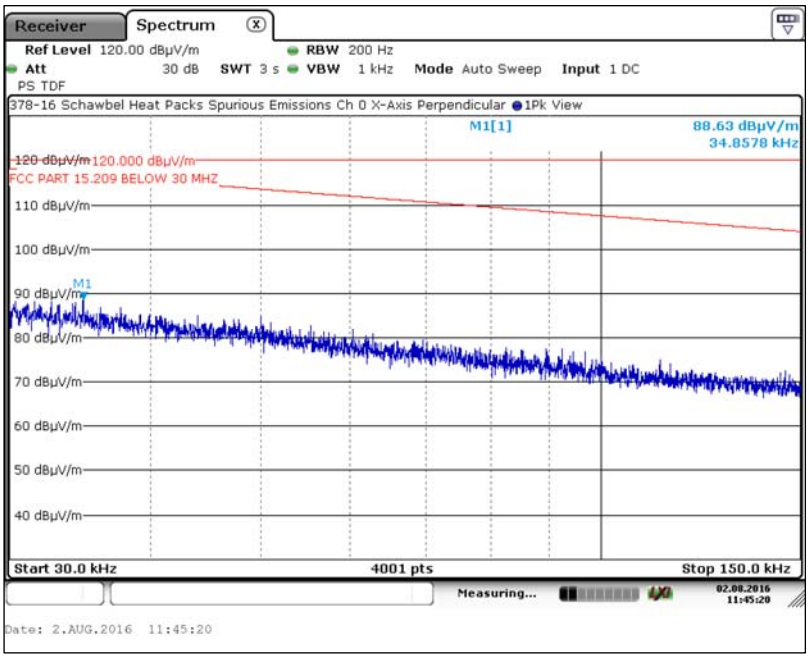
A1. Channel 0

A1.1. Measurement Results – Channel 0, 30 kHz to 150 kHz

A1.1.1. X-Axis, Parallel Antenna



A1.1.2. X-Axis, Perpendicular Antenna



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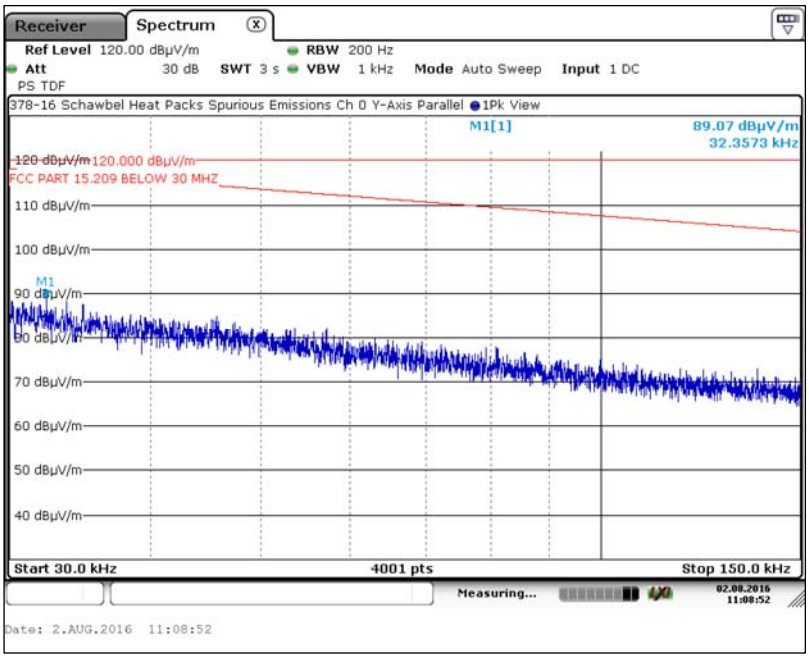
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

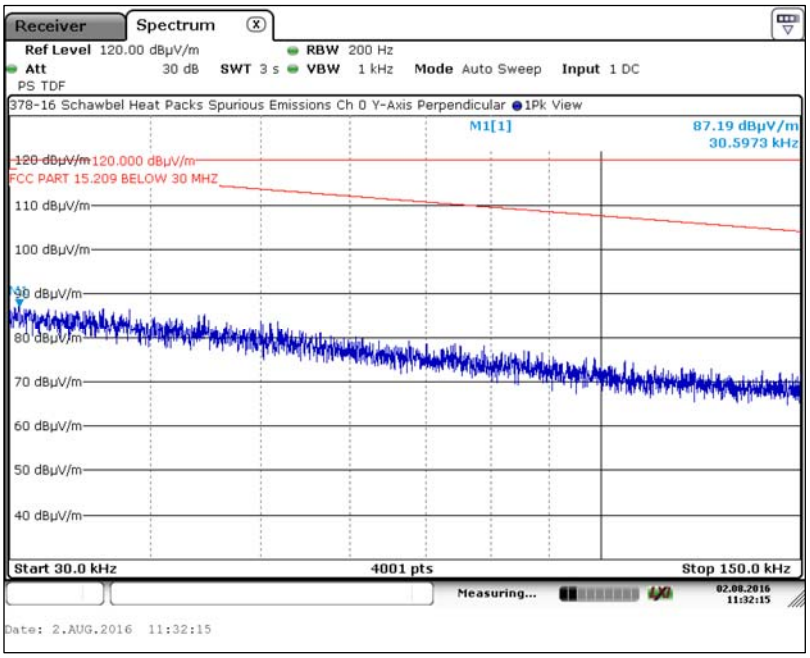
A1. Channel 0

A1. Measurement Results – Channel 0, 30 kHz to 150 kHz (continued)

A1.1.3. Y-Axis, Parallel Antenna



A1.1.4. Y-Axis, Perpendicular Antenna



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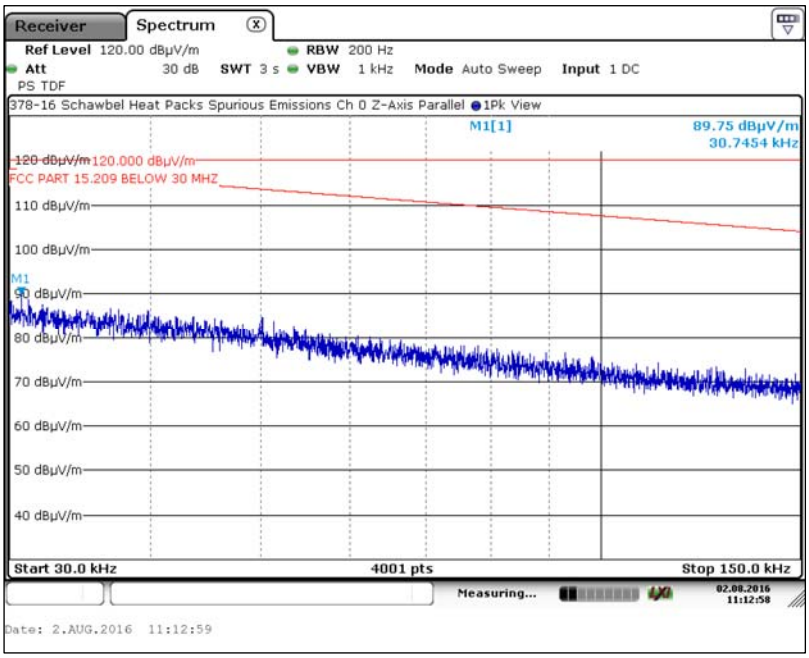
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

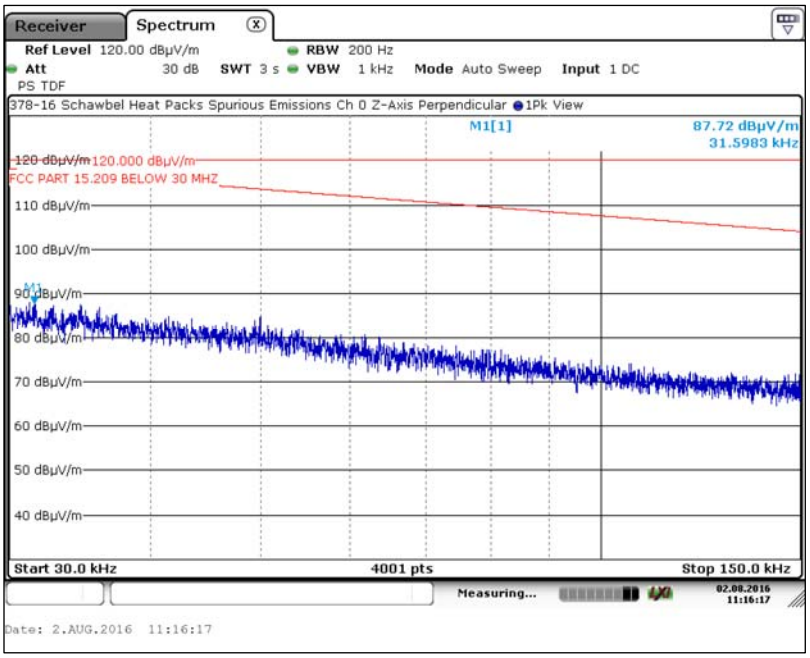
A1. Channel 0

A1.1. Measurement Results – Channel 0, 30 kHz to 150 kHz (continued)

A1.1.5. Z-Axis, Parallel Antenna



A1.1.6. Z-Axis, Perpendicular Antenna



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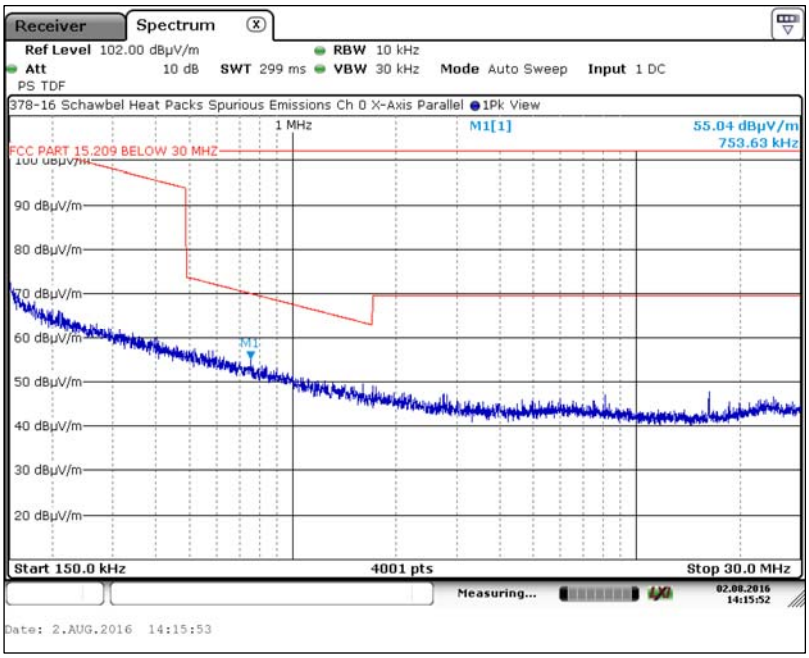
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

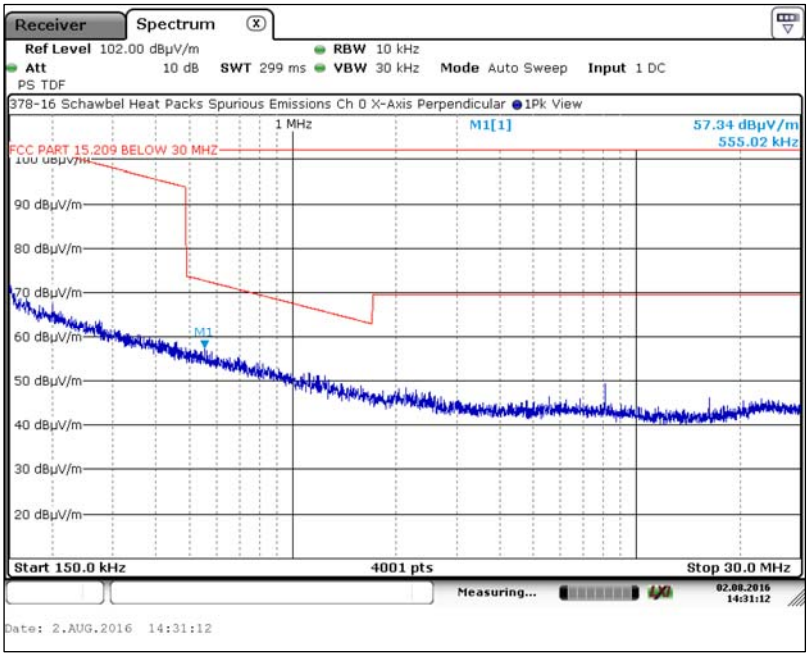
A1. Channel 0

A1.2. Measurement Results – Channel 0, 150 kHz to 30 MHz

A1.2.1. X-Axis, Parallel Antenna



A1.2.2. X-Axis, Perpendicular Antenna



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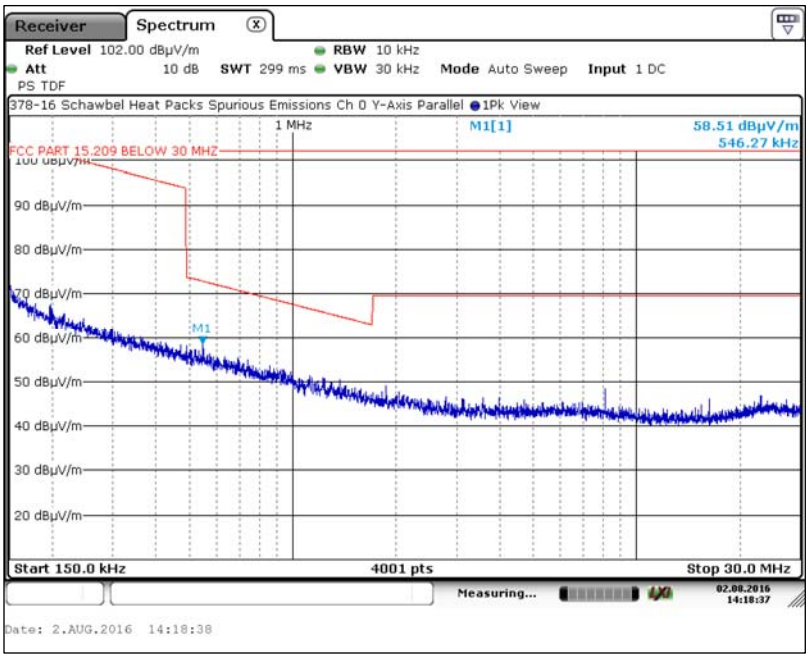
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

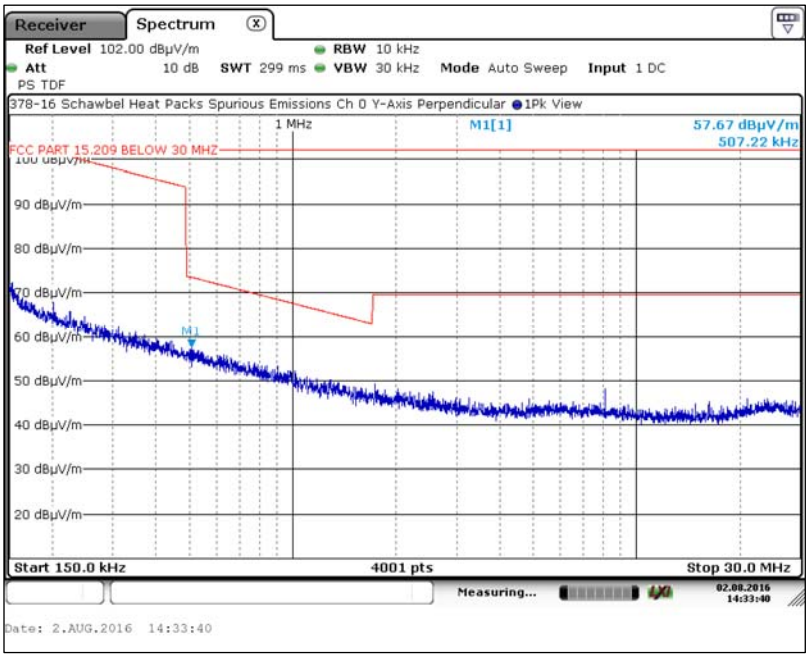
A1. Channel 0

A1. Measurement Results – Channel 0, 150 kHz to 30 MHz (continued)

A1.2.3. Y-Axis, Parallel Antenna



A1.2.4 Y-Axis, Perpendicular Antenna



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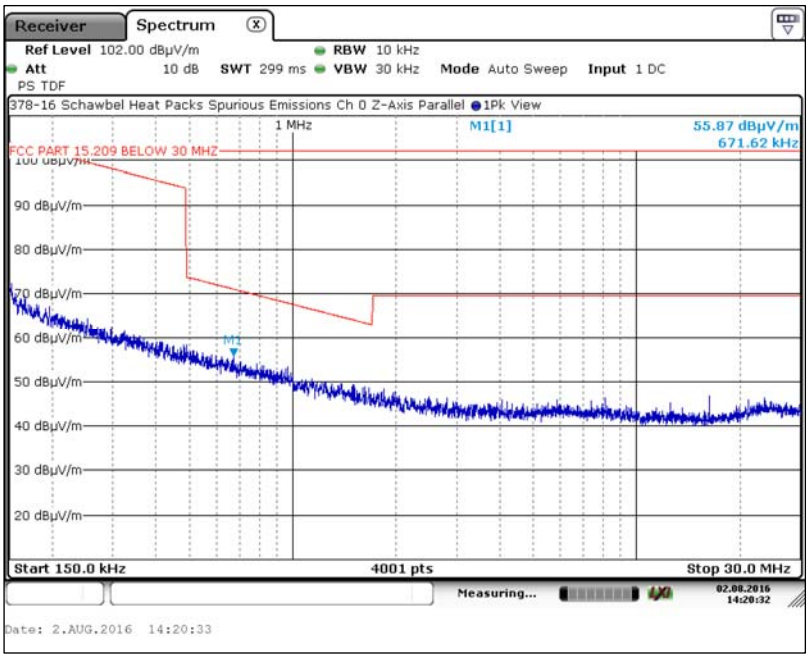
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

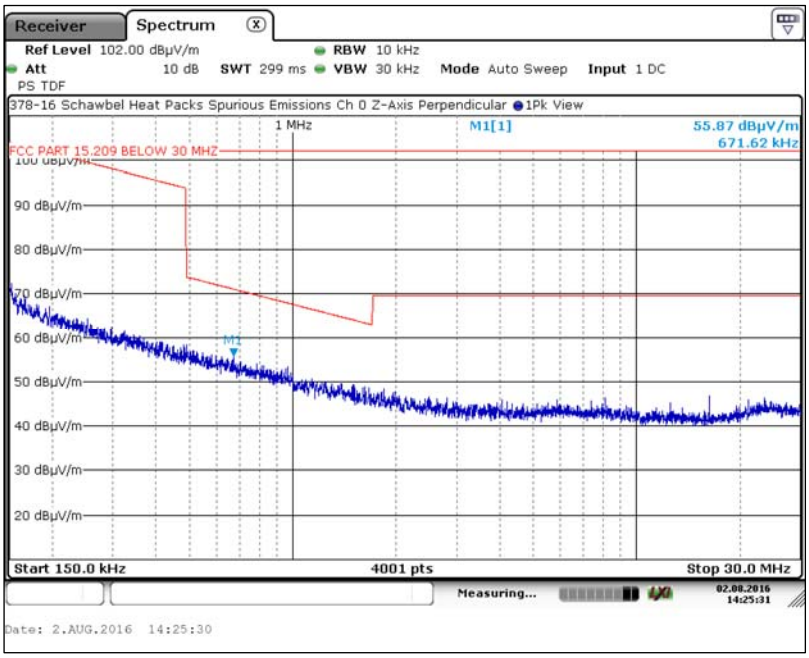
A1. Channel 0

A1.2. Measurement Results – Channel 0, 150 kHz to 30 MHz (continued)

A1.2.5. Z-Axis, Parallel Antenna



A1.2.6. Z-Axis, Perpendicular Antenna



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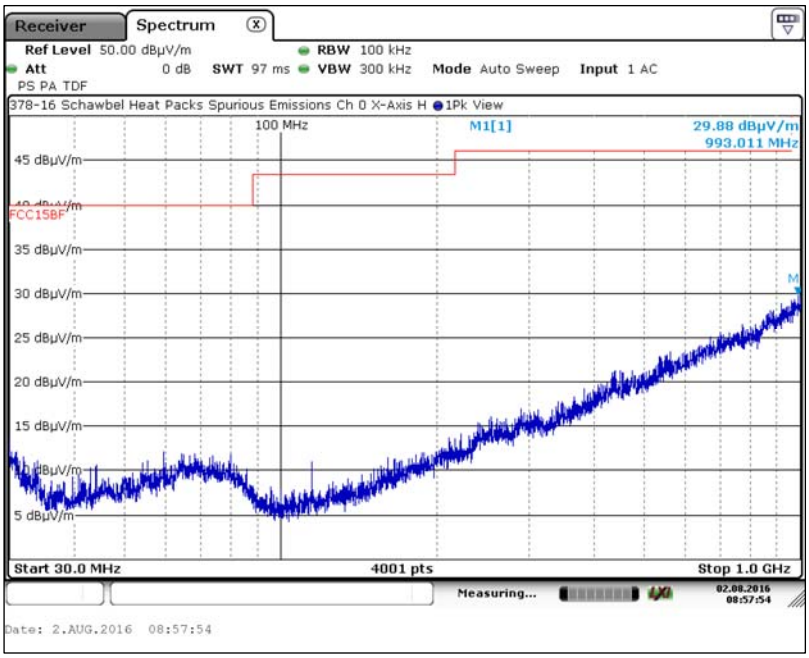
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

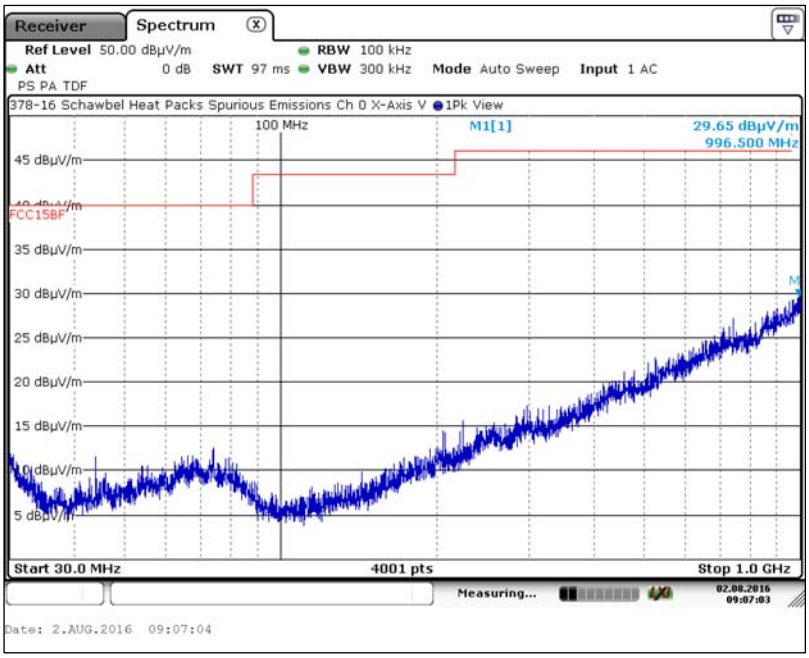
A1. Channel 0

A1.3. Measurement Results – Channel 0, 30 MHz to 1 GHz

A1.3.1. X-Axis, Horizontal Antenna



A1.3.2. X-Axis, Vertical Antenna



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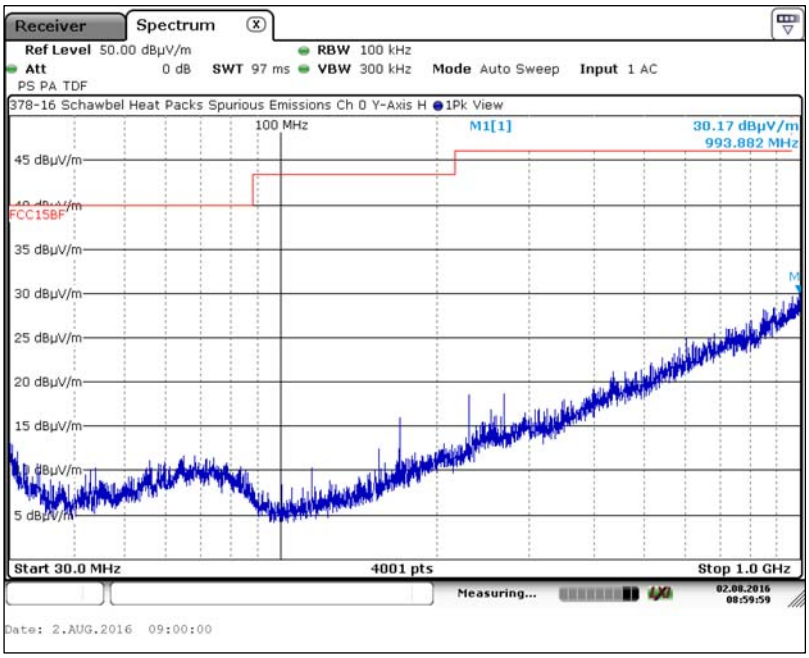
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

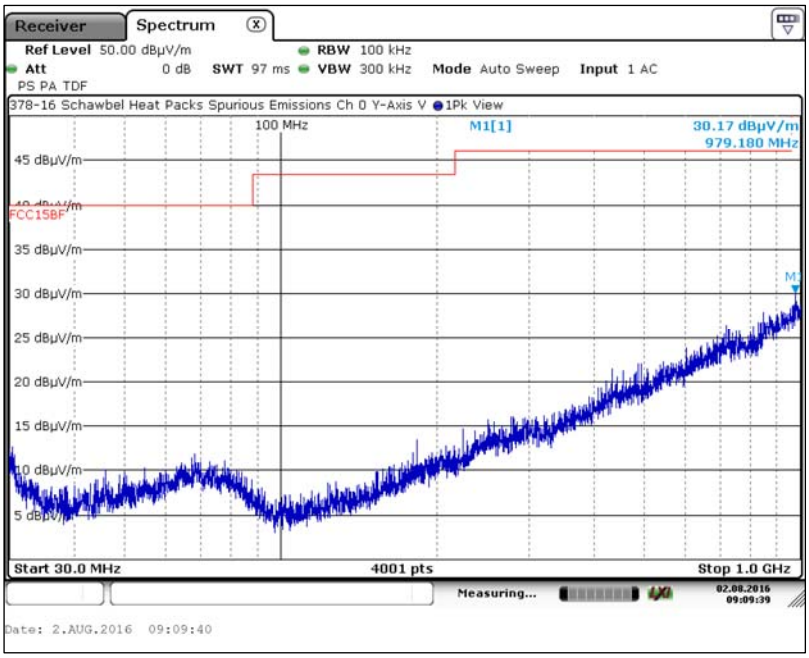
A1. Channel 0

A1.3. Measurement Results – Channel 0, 30 MHz to 1 GHz (continued)

A1.3.3. Y-Axis, Horizontal Antenna



A1.3.4. Y-Axis, Vertical Antenna



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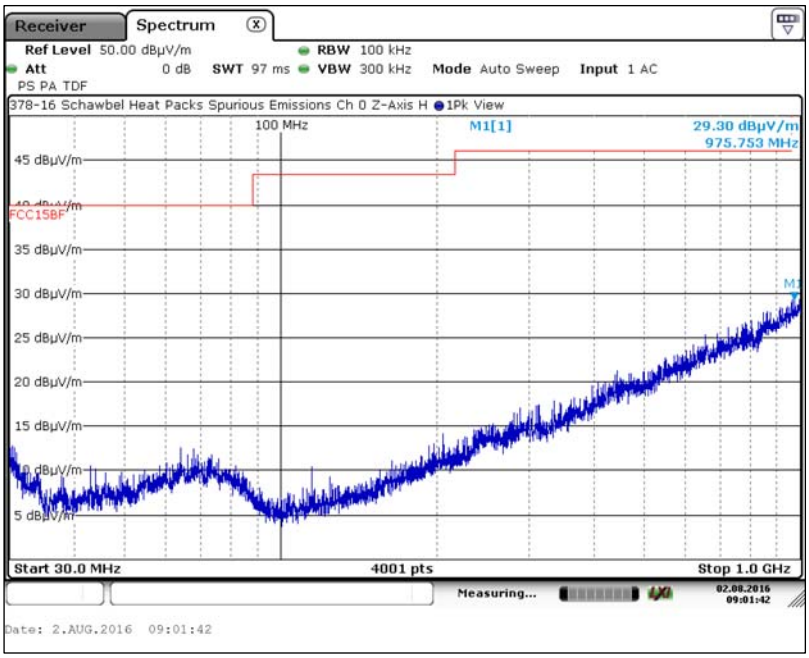
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

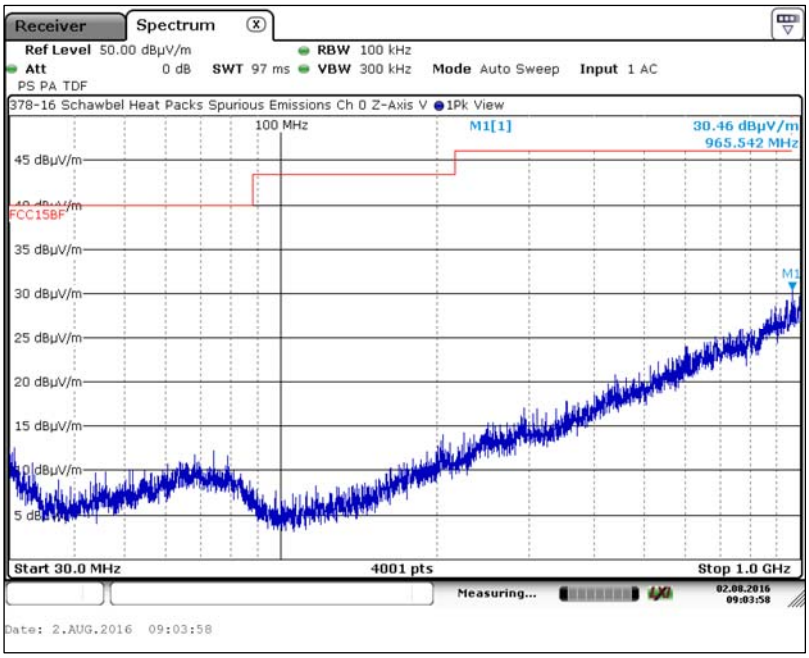
A1. Channel 0

A1.3. Measurement Results – Channel 0, 30 MHz to 1 GHz (continued)

A1.3.5. Z-Axis, Horizontal Antenna



A1.3.6. Z-Axis, Vertical Antenna



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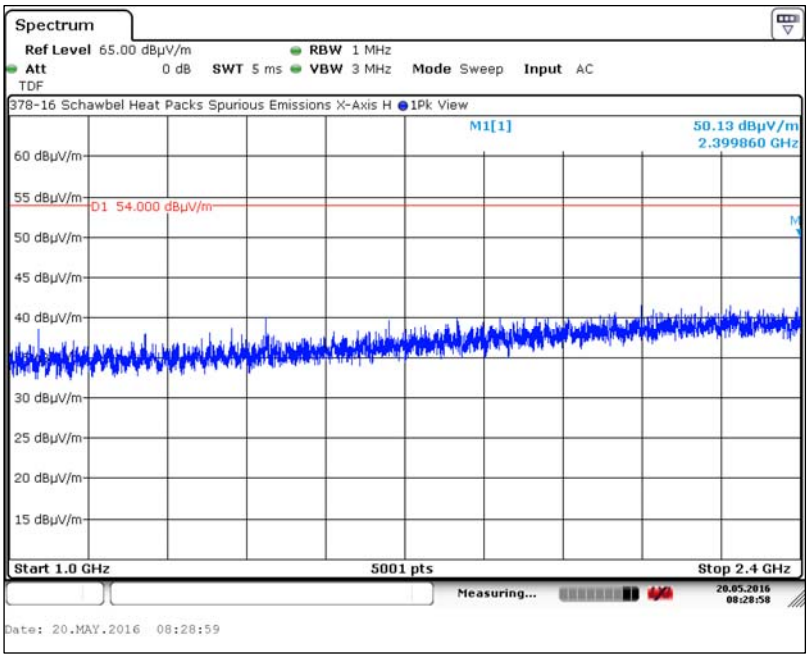
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

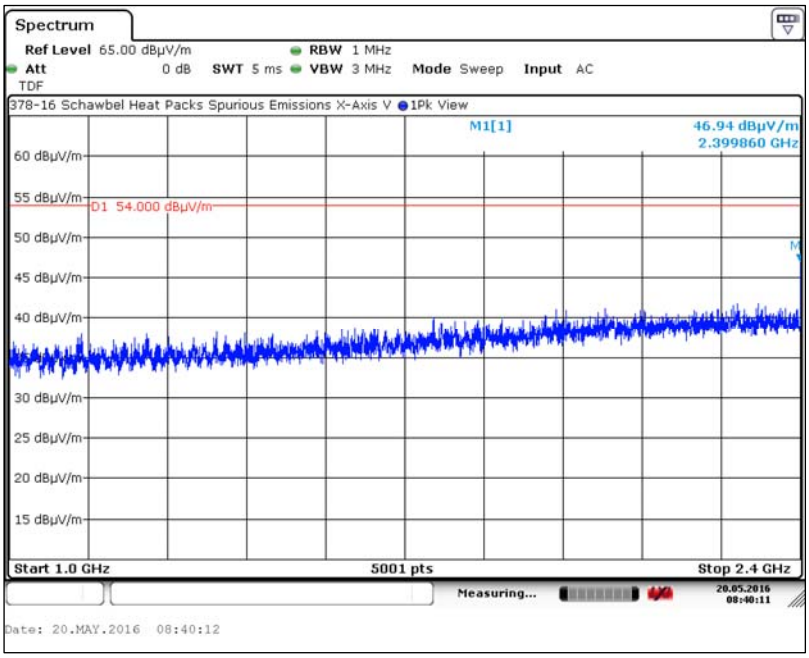
A1. Channel 0

A1.4. Measurement Results – Channel 0, 1 GHz to 2.4 GHz

A1.4.1. X-Axis, Horizontal Antenna



A1.4.2. X-Axis, Vertical Antenna



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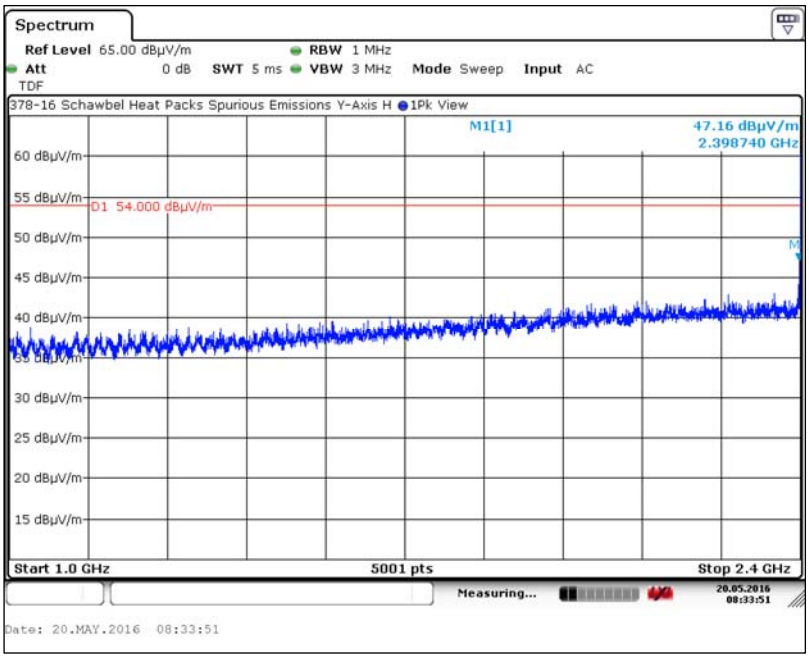
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

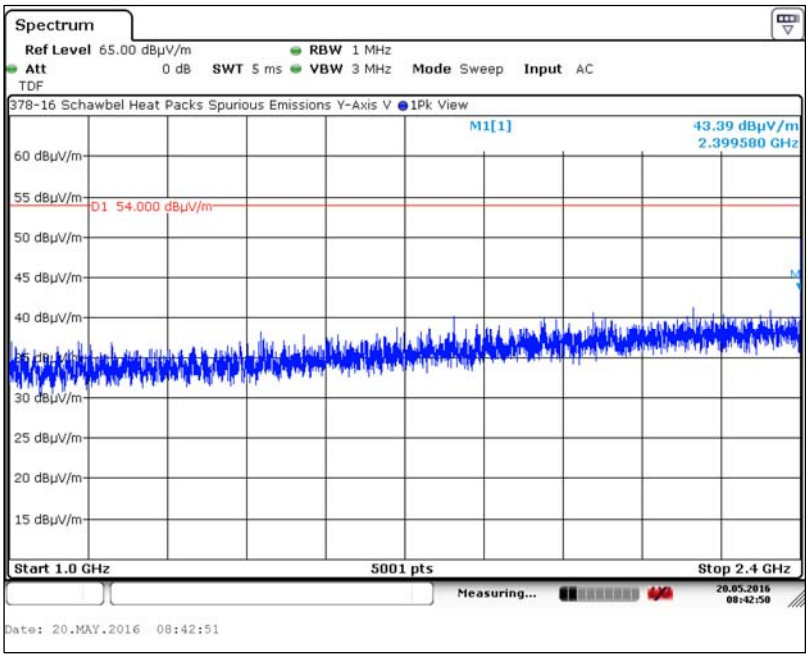
A1. Channel 0

A1.4. Measurement Results – Channel 0, 1 GHz to 2.4 GHz (continued)

A1.4.3. Y-Axis, Horizontal Antenna



A1.4.4. Y-Axis, Vertical Antenna



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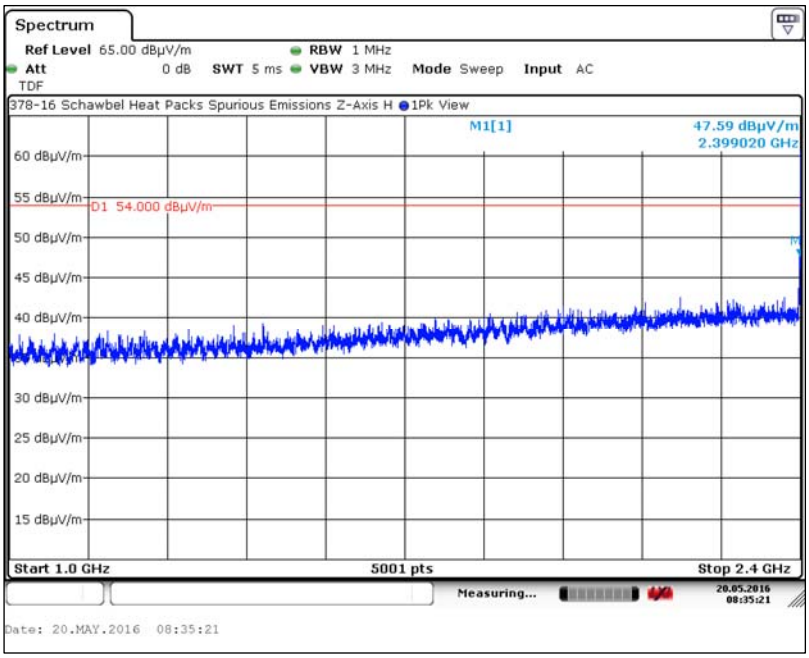
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

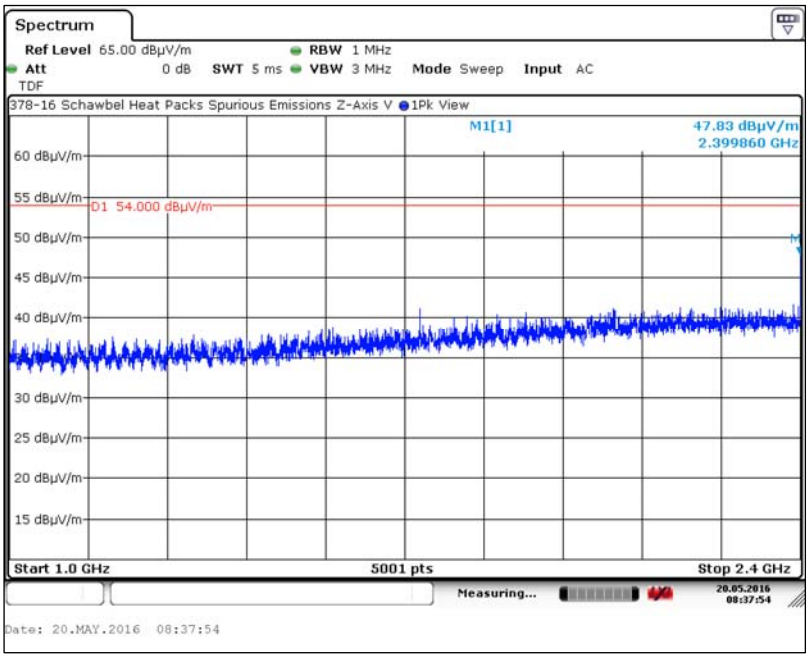
A1. Channel 0

A1.4. Measurement Results – Channel 0, 1 GHz to 2.4 GHz (continued)

A1.4.5. Z-Axis, Horizontal Antenna



A1.4.6. Z-Axis, Vertical Antenna



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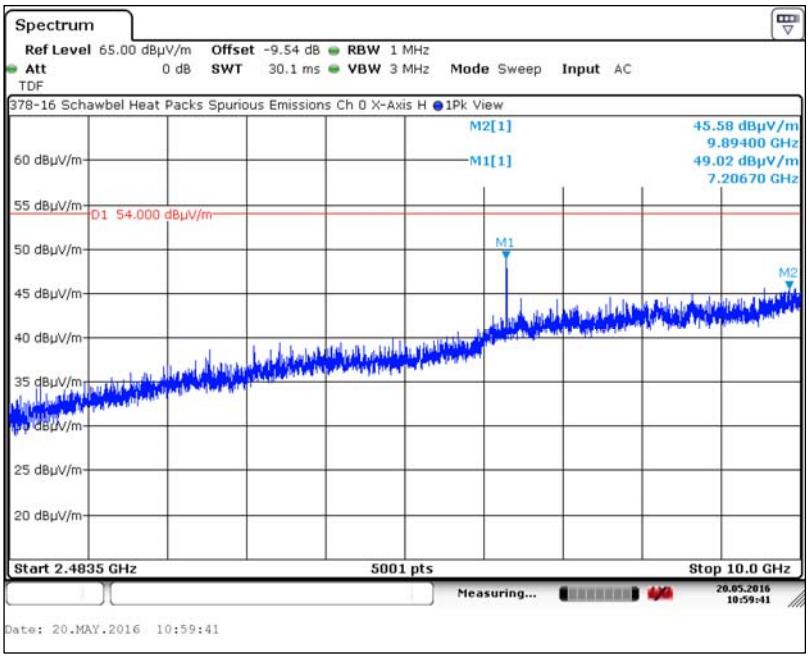
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

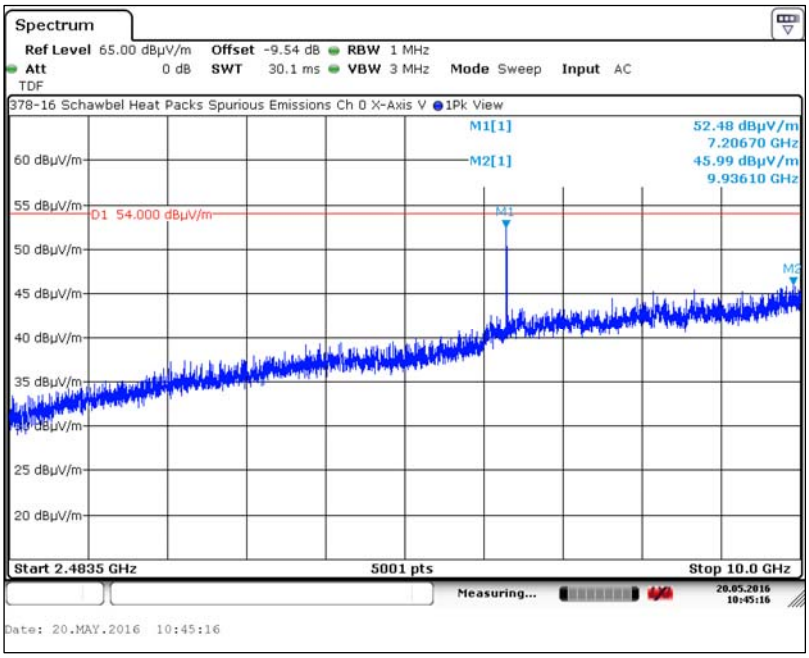
A1. Channel 0

A1.5. Measurement Results – Channel 0, 2.4835 GHz to 10 GHz

A1.5.1. X-Axis, Horizontal Antenna



A1.5.2. X-Axis, Vertical Antenna



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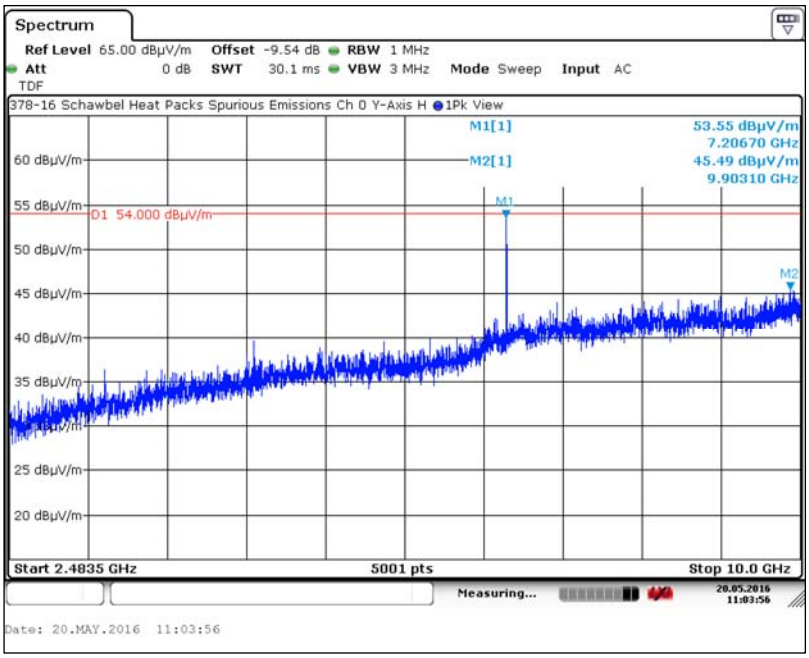
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

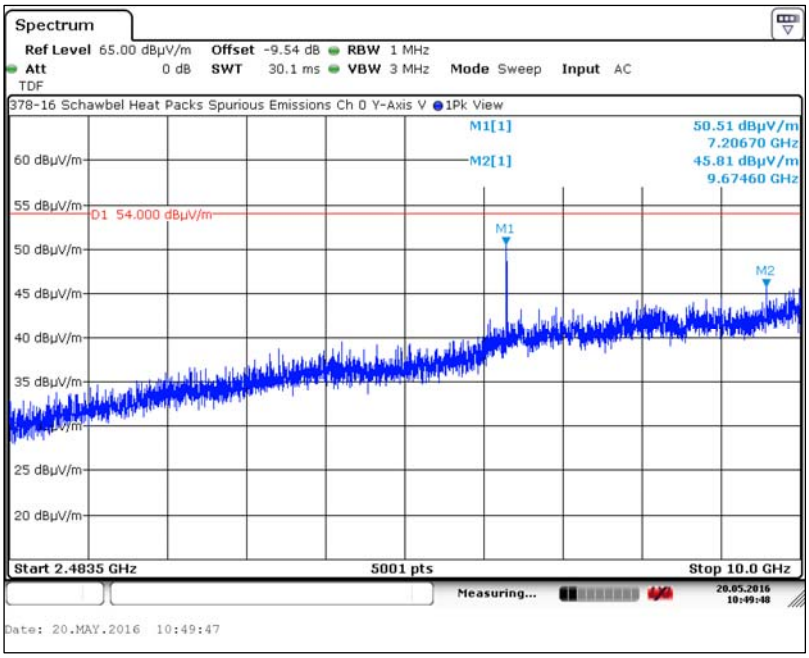
A1. Channel 0

A1.5. Measurement Results – Channel 0, 2.4835 GHz to 10 GHz (continued)

A1.5.3. Y-Axis, Horizontal Antenna



A1.5.4. Y-Axis, Vertical Antenna



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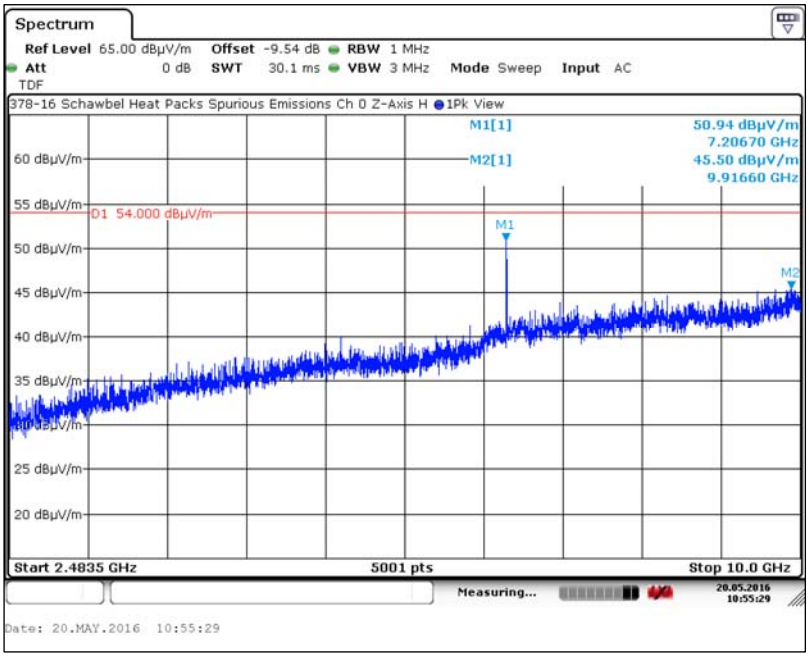
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

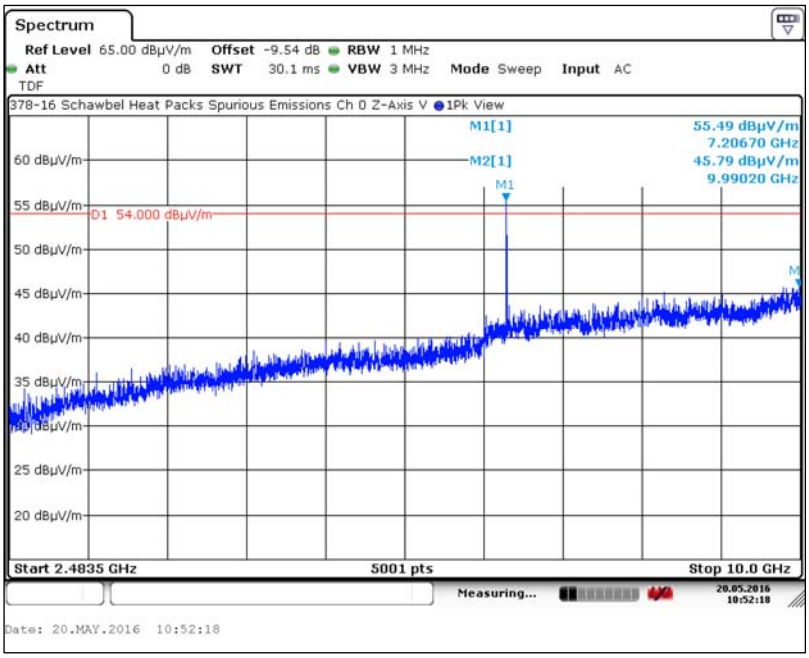
A1. Channel 0

A1.5. Measurement Results – Channel 0, 2.483.5 GHz to 10 GHz (continued)

A1.5.5. Z-Axis, Horizontal Antenna



A1.5.6. Z-Axis, Vertical Antenna



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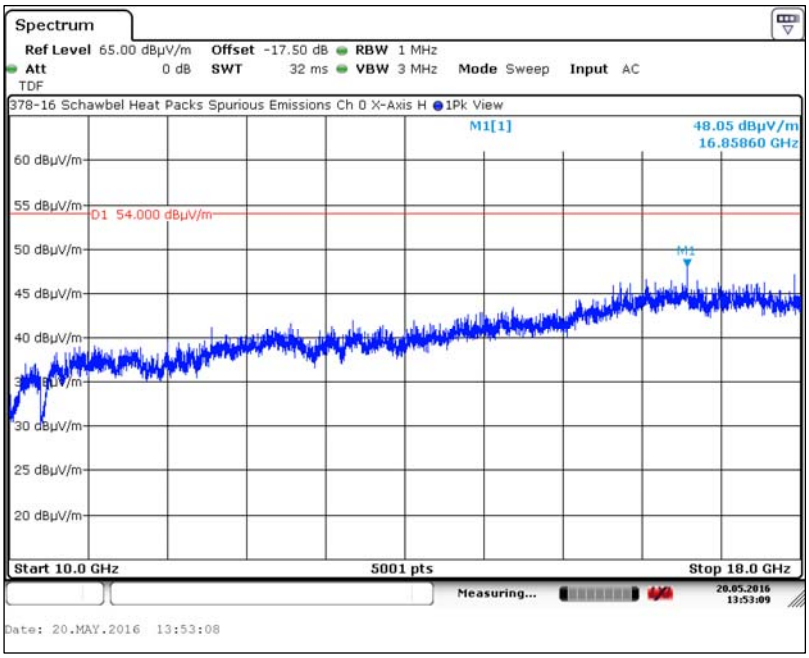
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

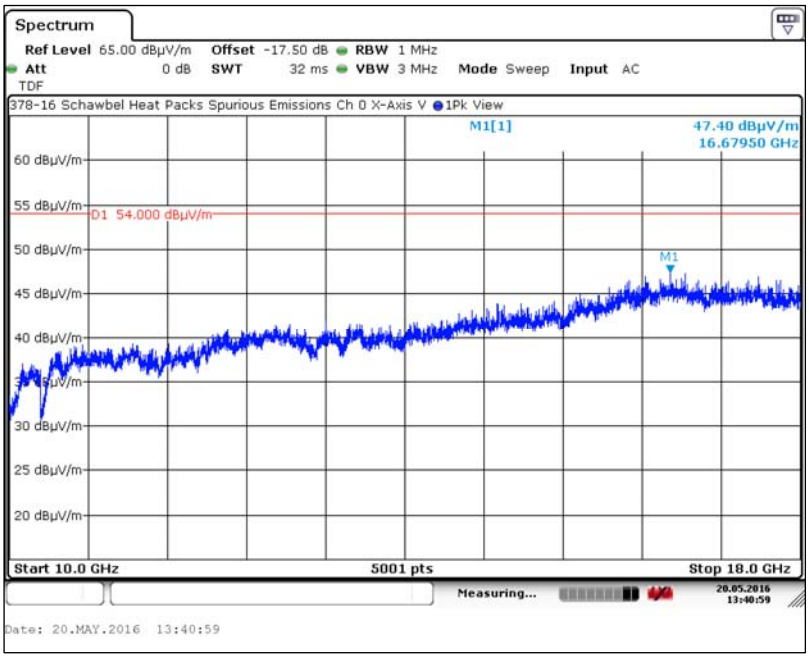
A1. Channel 0

A1.6. Measurement Results – Channel 0, 10 GHz to 18 GHz (continued)

A1.6.1. X-Axis, Horizontal Antenna



A1.6.2. X-Axis, Vertical Antenna



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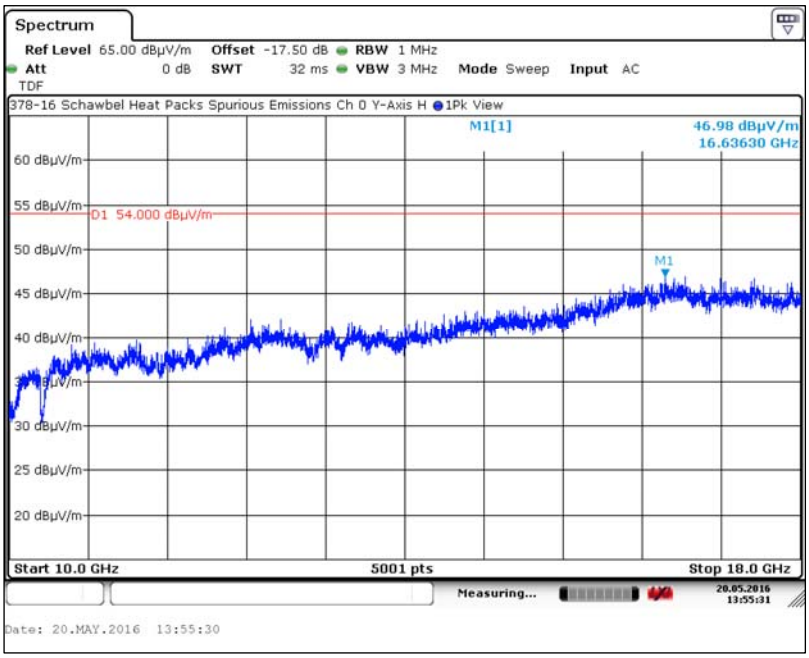
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

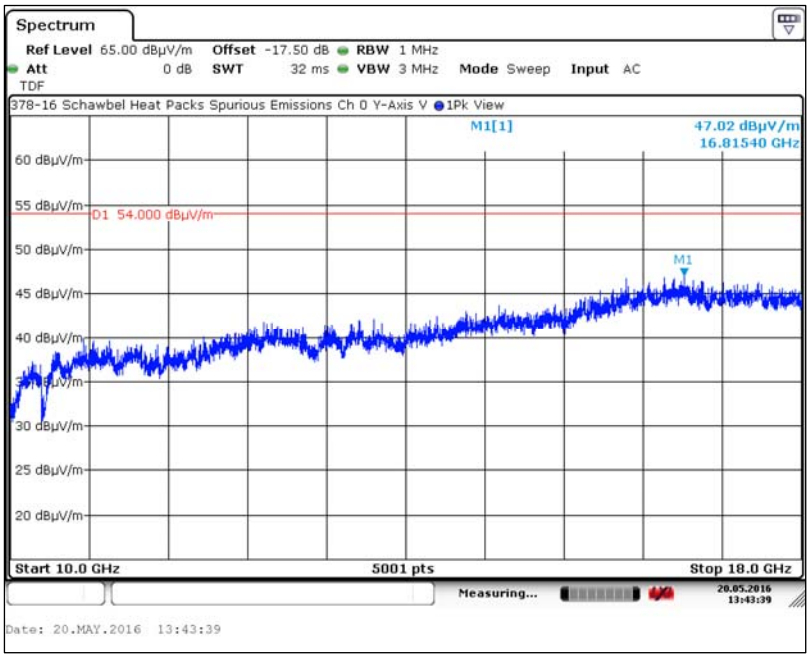
A1. Channel 0

A1.6. Measurement Results – Channel 0, 10 GHz to 18 GHz (continued)

A1.6.3. Y-Axis, Horizontal Antenna



A1.6.4. Y-Axis, Vertical Antenna



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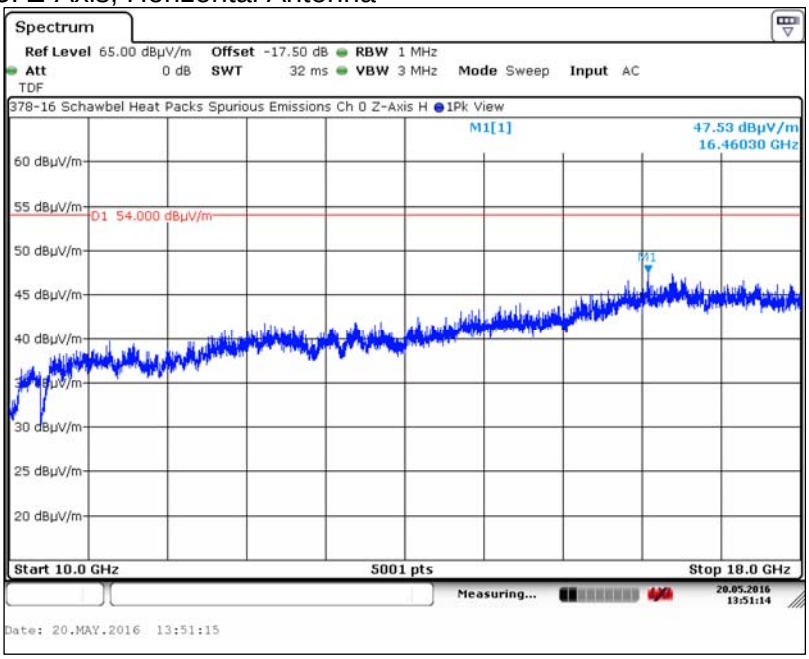
Appendix A (continued)

Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

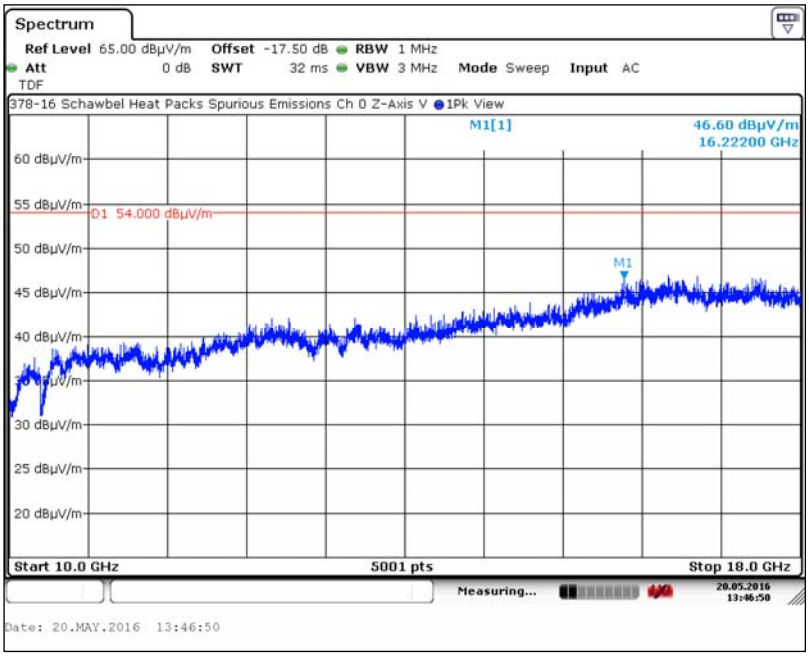
A1. Channel 0

A1.6. Measurement Results – Channel 0, 10 GHz to 18 GHz (continued)

A1.6.5. Z-Axis, Horizontal Antenna



A1.6.6. Z-Axis, Vertical Antenna



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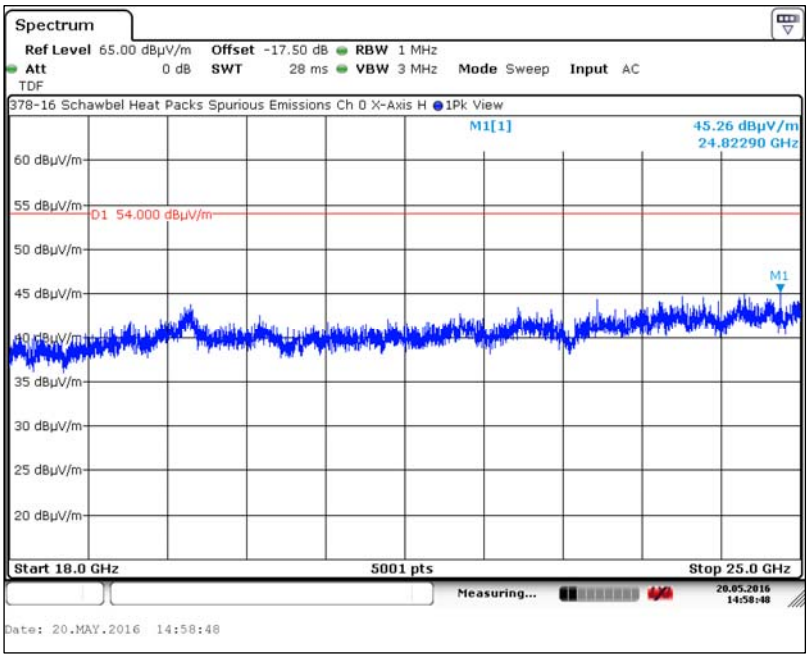
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

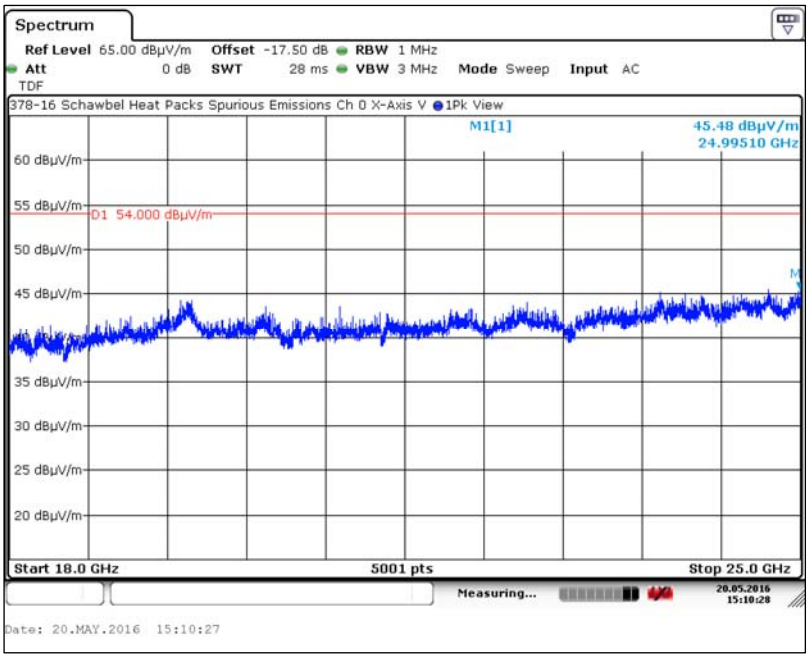
A1. Channel 0

A1.7. Measurement Results – Channel 0, 18 GHz to 25 GHz

A1.7.1. X-Axis, Horizontal Antenna



A1.7.2. X-Axis, Vertical Antenna



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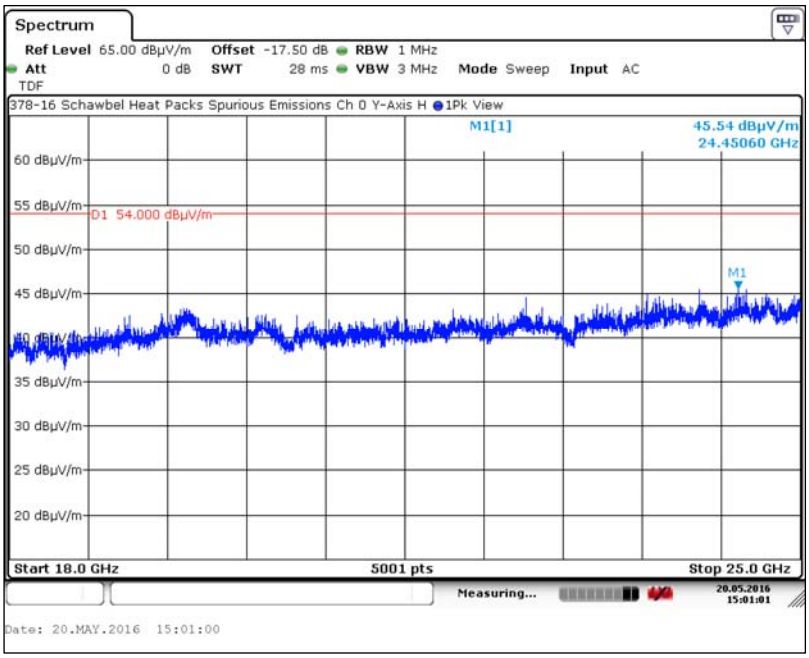
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

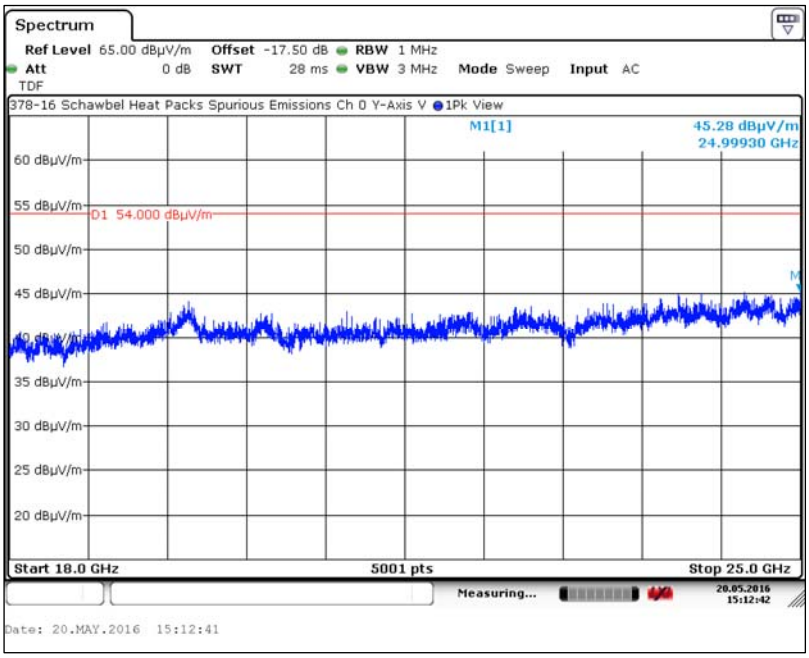
A1. Channel 0

A1.7. Measurement Results – Channel 0, 18 GHz to 25 GHz (continued)

A1.7.3. Y-Axis, Horizontal Antenna



A1.7.4. Y-Axis, Vertical Antenna



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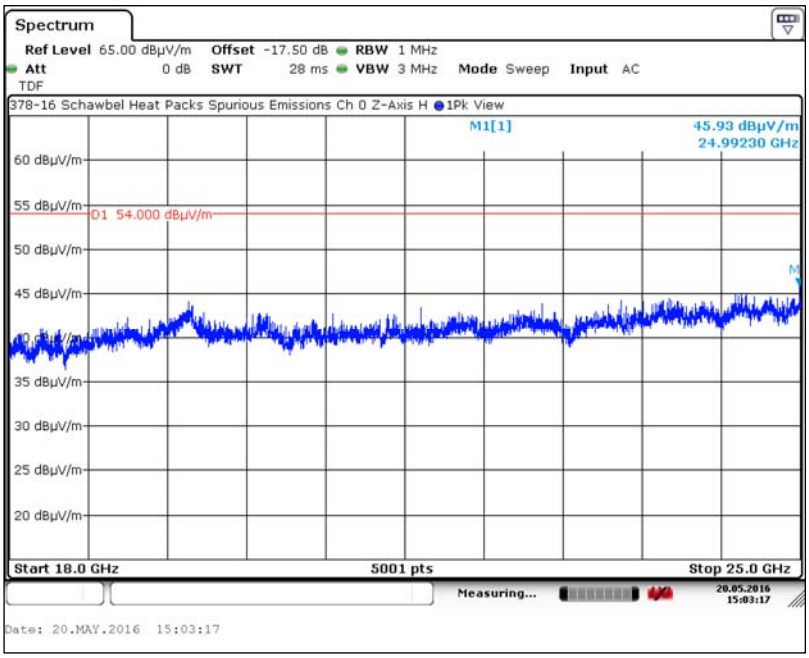
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN, ISSUE 4

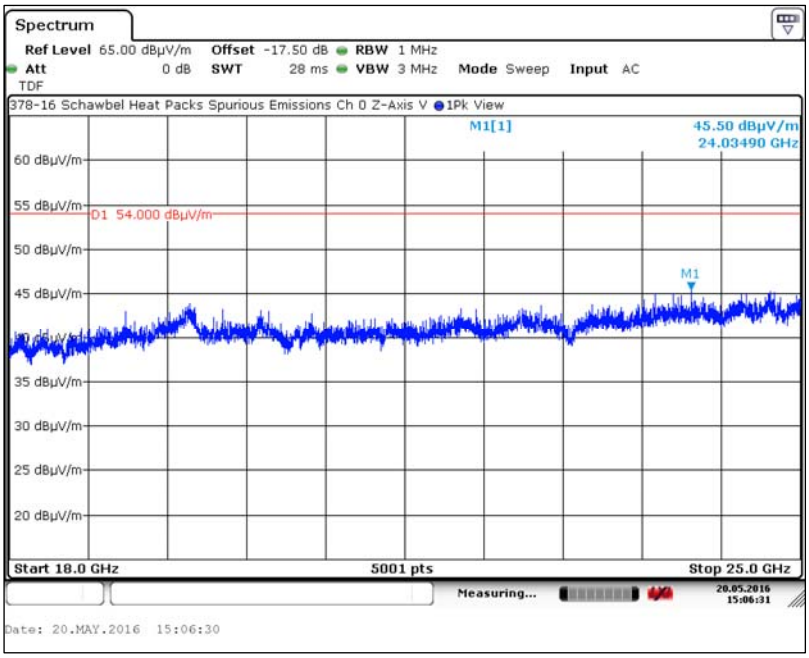
A1. Channel 0

A1.7. Measurement Results – Channel 0, 18 GHz to 25 GHz (continued)

A1.7.5. Z-Axis, Horizontal Antenna



A1.7.6. Z-Axis, Vertical Antenna



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