

EMC Integrity Test Report: ETRB10102_FCC_RevB

Applicant: FreeWave Technologies, Inc.
1880 S. Flatiron Court Suite F
Boulder, CO 80301

Equipment Under Test: GX-CP
(E.U.T.) 2.4-2.4835GHz FHSS Transceiver, 6-30VDC w/ CP board

In Accordance With: FCC Part 15.247
Frequency Hopping Spread Spectrum Transmitter

Tested By: EMC Integrity, Inc.
1736 Vista View Drive
Longmont, CO 80504

TESTED BY: Brian Annis **DATE:** 06-May-2011

APPROVED BY: Vincent Greb **DATE:** 06-May-2011

Number of Pages: 40

EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
FCC ID: KNY-715712152112	Test Report No.: ETRB10102_FCC_RevB

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Section 1. Summary of Test Results

Manufacturer: FreeWave Technologies, Inc.

Model No.: GX-CP

Serial No.: 244-1885

General: All measurements are traceable to national standards.

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 and RSS-GEN, Issue 3 for Frequency Hopping Spread Spectrum Systems. Radiated tests were conducted in accordance with ANSI C63.4-2003. Radiated emissions are made on a listed test site. A description of the test facility is on file with the FCC and Industry Canada.

- | | | | |
|-------------------------------------|----------------------------|-------------------------------------|---------------------|
| <input checked="" type="checkbox"/> | New Submission | <input type="checkbox"/> | Production Unit |
| <input type="checkbox"/> | Class II Permissive Change | <input checked="" type="checkbox"/> | Pre-Production Unit |

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.



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Summary Of Test Data

NAME OF TEST	PARA. NO.	RESULT
Channel Separation	FCC 15.247(a)(1)	Complies
Occupied Bandwidth	FCC 15.247(a)(1)	Complies
Maximum Peak Power Output	FCC 15.247(b)(1)	Complies
Channel Dwell Time	FCC 15.247(a)(1)(iii)	Complies
Number of Channels	FCC 15.247(a)(1)(iii)	Complies
Spurious Emissions (Antenna Conducted)	FCC 15.247(d)	Complies
Radiated Emissions (Restricted Bands)	FCC 15.247(d)	Complies
Powerline Conducted Emissions	FCC 15.207	Complies

Description of DUT:

2.4-2.4835GHz, 115K Over-the-Air Data Rate, frequency-hopping spread-spectrum wireless data transceiver, board level, 6-30 volts DC power input, RS-232/485/422. Max RF power output 500 mW. Modulation type is 2-level GFSK. Device was tested with two different antennas. Industrial usage: oil fields, agriculture, etc. Dimensions 127 L x 61 W x 15 H (mm), weight 53g.

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Section 3. Channel Separation & Occupied Bandwidth

NAME OF TEST: Channel Separation & Occupied Bandwidth	PARA. NO.: 15.247(a)(1)
TESTED BY: Brian Annis	DATE: 4 Jan 2011

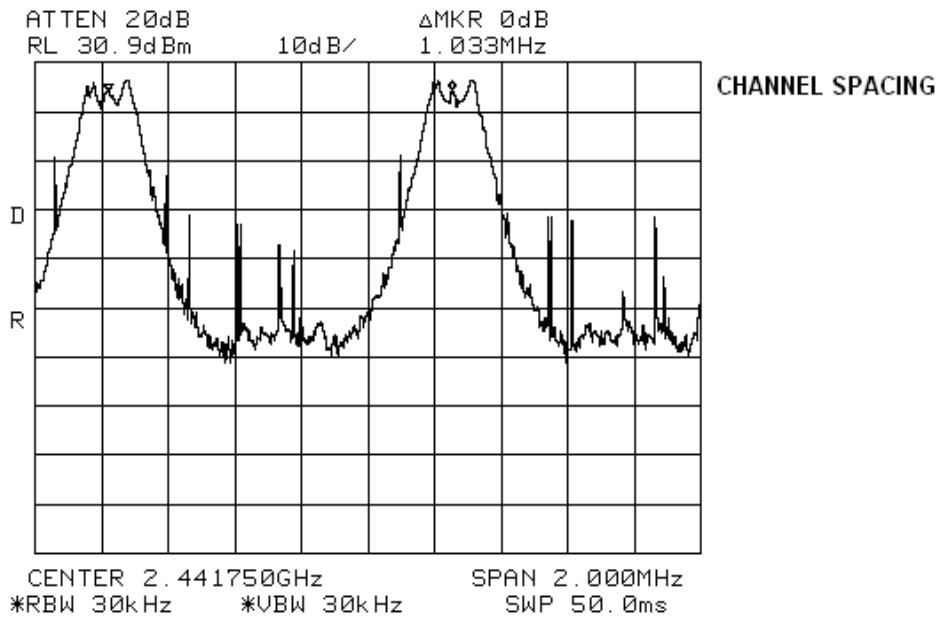
Test Results: Complies.

Measurement Data: See 20B BW plot
 Measured 20B bandwidth: 250 kHz
 Channel Separation 1 MHz

Test Conditions: 18 %RH
 22 °C

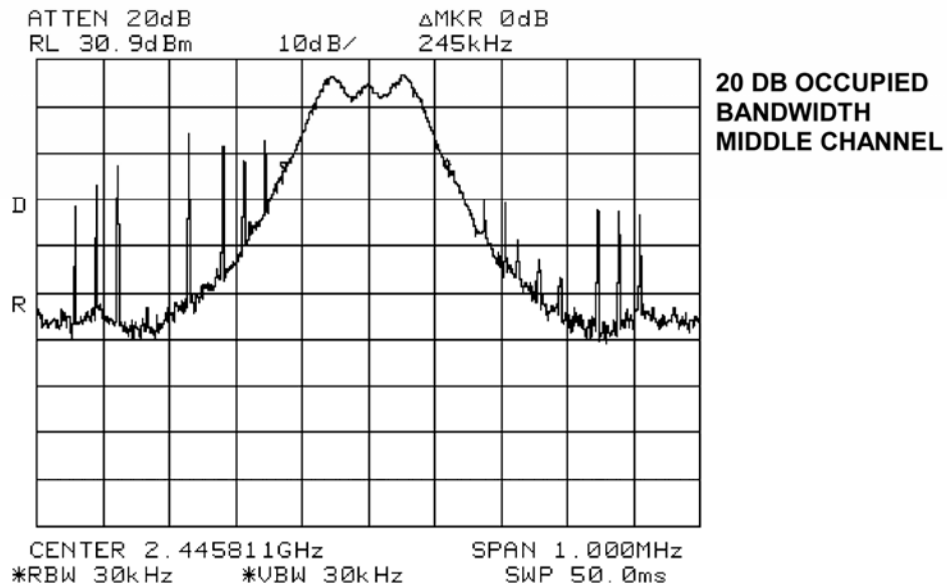
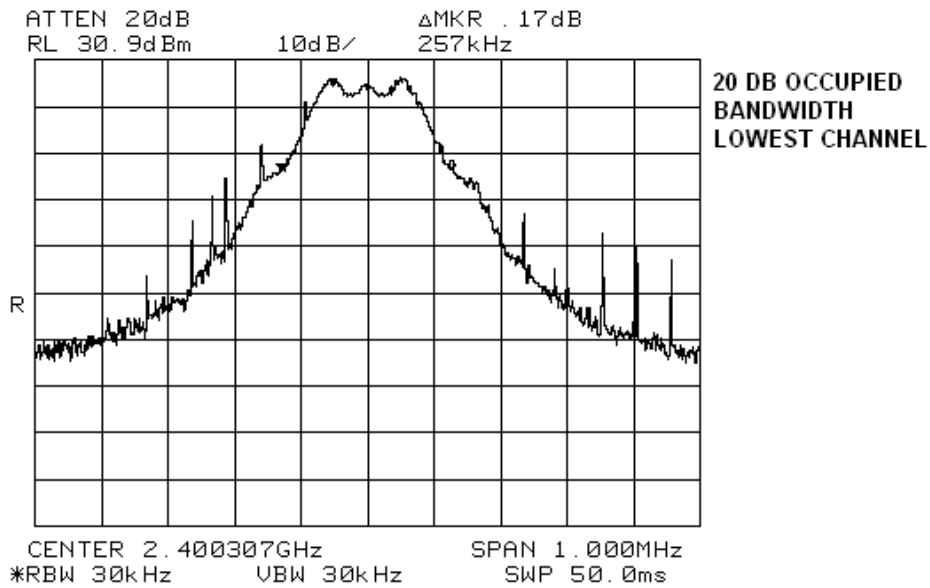
Measurement Uncertainty: +/-1x10⁻⁷ ppm

Test Equipment Used:
 1215, 20 dB atten



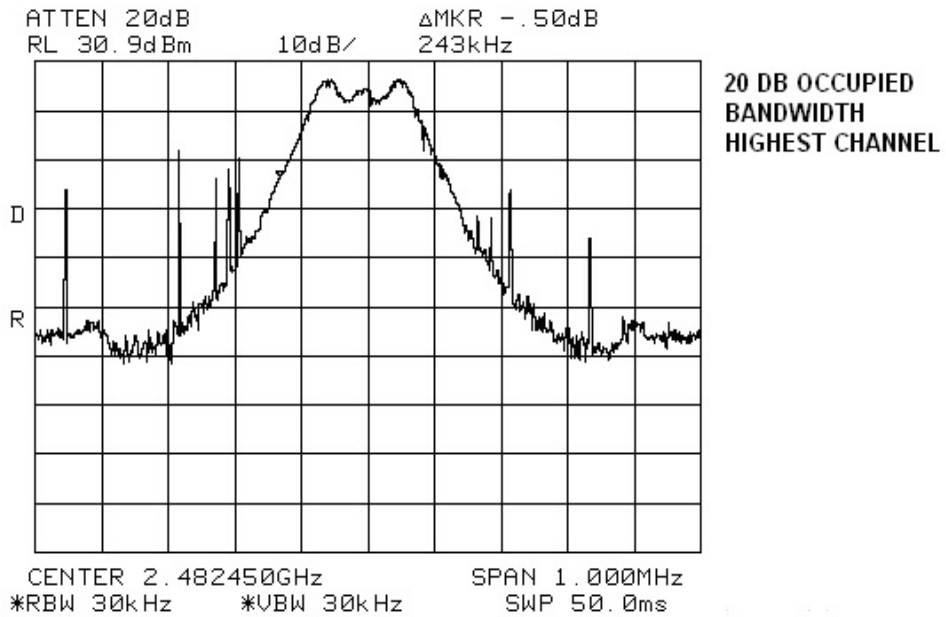
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Test Data – Occupied Bandwidth



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Test Data – Occupied Bandwidth



EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
FCC ID: KNY-715712152112	Test Report No.: ETRB10102_FCC_RevB

Section 4. Maximum Peak Output Power

NAME OF TEST: Maximum Peak Output power	PARA. NO.: 15.247(b)(1)
TESTED BY: Brian Annis	DATE: 06-May-2011

Test Results: Complies. Highest measured peak power was +27.00 dBm (500 mW)

Measurement Data: Refer to attached data

Test Conditions: 21 %RH
20 °C

Measurement Uncertainty: +/-1.7 dB

Test Equipment Used:
1215, 20 dB atten

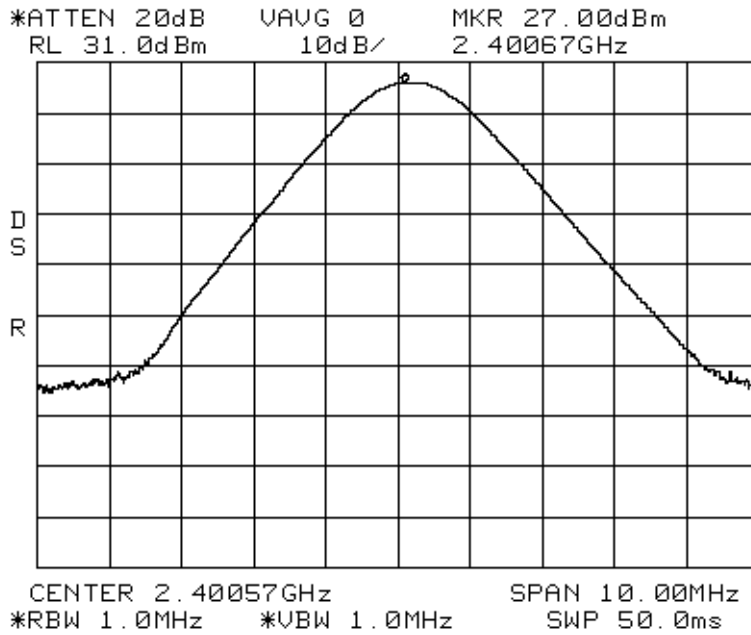
Notes:

The readings shown in the following spectrum analyzer screenshots have already been corrected for the losses in the interconnecting cable and attenuator, and reflect the true measured output power at the antenna terminals of the transmitter.

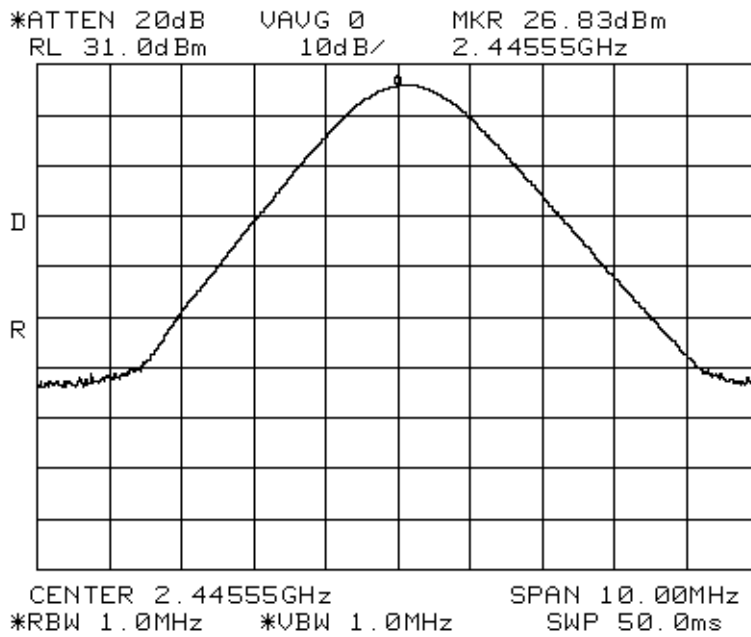
- This device was tested at +/- 15% input power per 15.31(e), with no variation in output power.
- The device was tested on three channels per 15.31(m).

EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
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Test Data – Peak Power



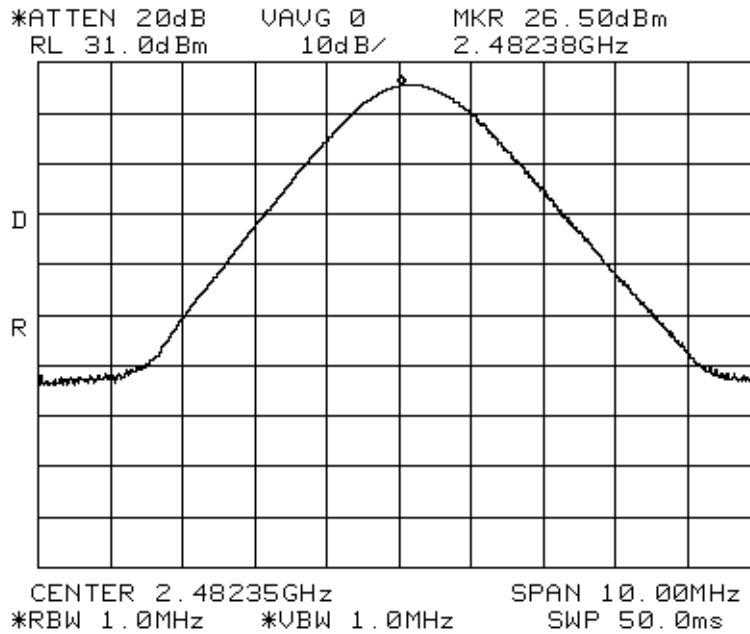
Peak Power
Lowest Freq



Peak Power
Middle Freq

EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
FCC ID: KNY-715712152112	Test Report No.: ETRB10102_FCC_RevB

Test Data – Peak Power



Peak Power
Highest Freq

EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
FCC ID: KNY-715712152112	Test Report No.: ETRB10102_FCC_RevB

Section 5. Channel Dwell Time

NAME OF TEST: Channel Dwell Time	PARA. NO.: 15.247(a)(1)(iii)
TESTED BY: Brian Annis	DATE: 4 Jan 2011

Test Results: Complies.

Measurement Data: Refer to attached data

Test Conditions: 18 %RH
22 °C

Measurement Uncertainty: +/-1.7 dB

Test Equipment Used:
1215, 20 dB atten

EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
FCC ID: KNY-715712152112	Test Report No.: ETRB10102_FCC_RevB

Section 6. Number of Channels

NAME OF TEST: Number of Channels	PARA. NO.: 15.247(a)(1)(iii)
TESTED BY: Brian Annis	DATE: 5 Jan 2011

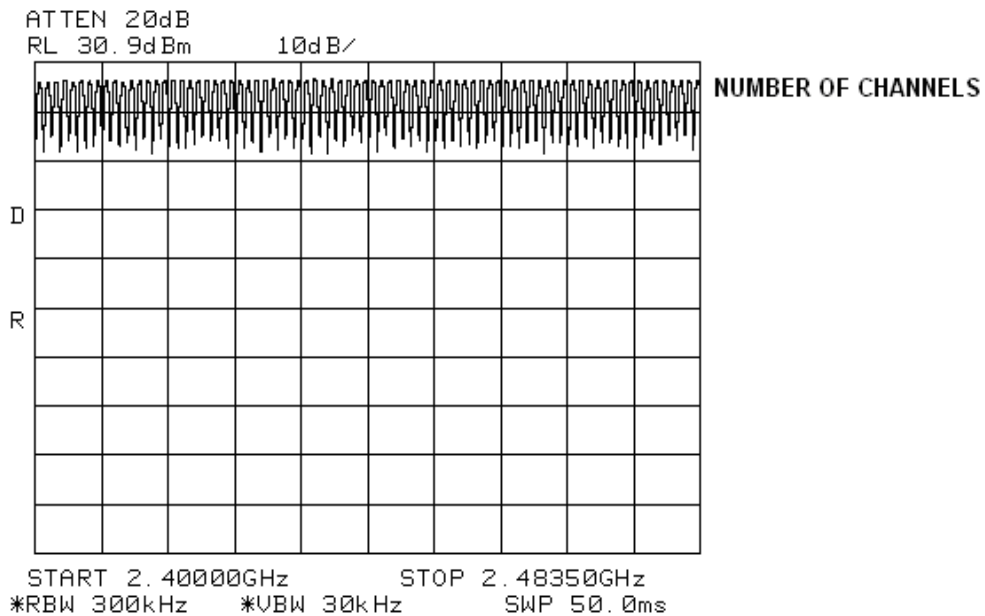
Test Results: Complies.

Measurement Data: 80 channels

Test Conditions: 17 %RH
22 °C

Measurement Uncertainty: +/-1.7 dB

Test Equipment Used:
1215, 20 dB atten



EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
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Section 7. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions at Antenna Terminals	PARA. NO.: 15.247 (d)
TESTED BY: Brian Annis	DATE: 31 Jan 2011

Test Results: Complies.

Measurement Data: See attached plots.

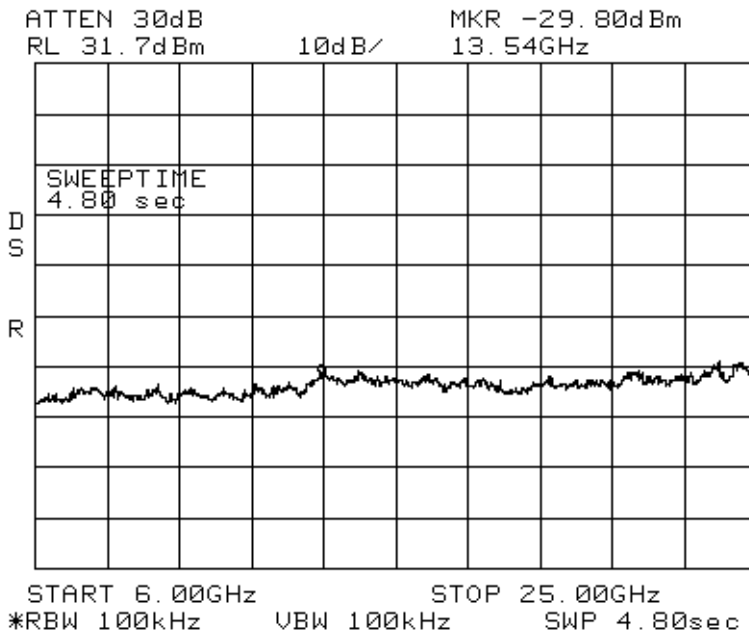
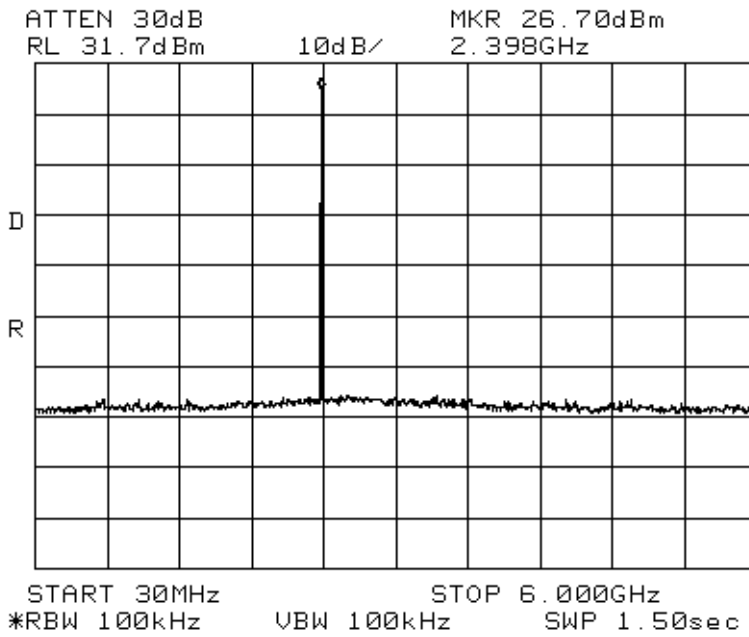
Test Conditions: 18 %RH
22 °C

Measurement Uncertainty: +/-1.7 dB

Test Equipment Used:
1215, 20 dB atten

EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
FCC ID: KNY-715712152112	Test Report No.: ETRB10102_FCC_RevB

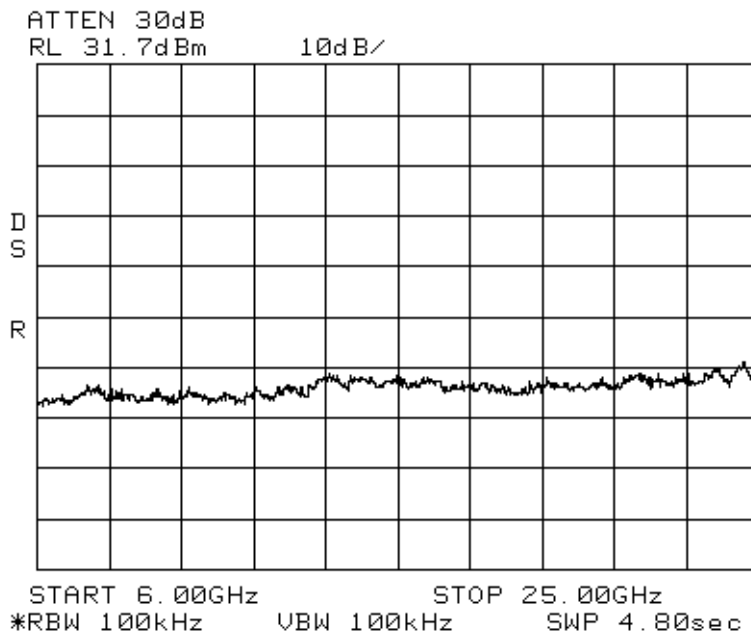
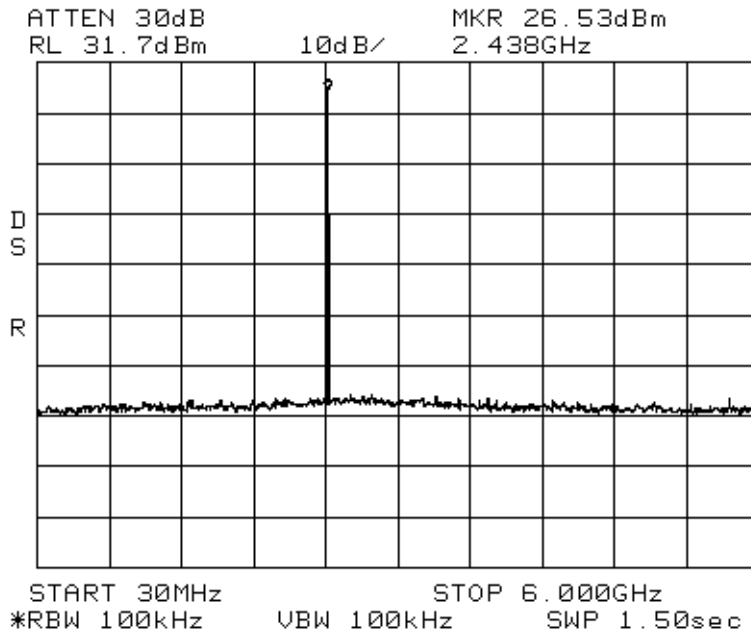
Test Data – Spurious Emissions at Antenna Terminals
Low Channel Spurs



EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
FCC ID: KNY-715712152112	Test Report No.: ETRB10102_FCC_RevB

Test Data – Spurious Emissions at Antenna Terminals

Mid Channel



EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
FCC ID: KNY-715712152112	Test Report No.: ETRB10102_FCC_RevB

Section 8. Radiated Emissions (Restricted Band)

NAME OF TEST: Radiated Emissions (Restricted Band)	PARA. NO.: 15.247(d)
TESTED BY: Kevin Johnson	DATE: 28 Jan 2011

Test Results: Complies.

Measurement Data: See attached data

Test Conditions: 18 %RH
21 °C

Measurement Uncertainty: +/-5.01 dB

Test Equipment Used: 1208, 1219, 1232, 1233, 1234, 1238, 1238, 1239, 1266, 1342, 1343, 1344, 1345, 1030, 1139, 1276, 1246

Notes:

- Antenna #1 is a WaveLink Model# PRO2400-4 Yagi, and antenna #2 is a MaxRad Model# MUF24005 Omni antenna
- Test distance is 10 meters for ≤ 1 GHz, 3 meters for > 1 GHz
- The device was tested from 30 MHz to the tenth harmonic of the highest fundamental frequency (25 GHz) per 15.33. No emissions were observed above 13 GHz.
- The device was tested on three channels per 15.31(m)
- Duty cycle was 100%

Detectors and Bandwidths used:

PRESCAN = Peak detector, RBW is 1MHz, VBW is 3 MHz

PK = Peak Measurement: RBW is 1 MHz, VBW is 3 MHz (used for freqs > 1 GHz)

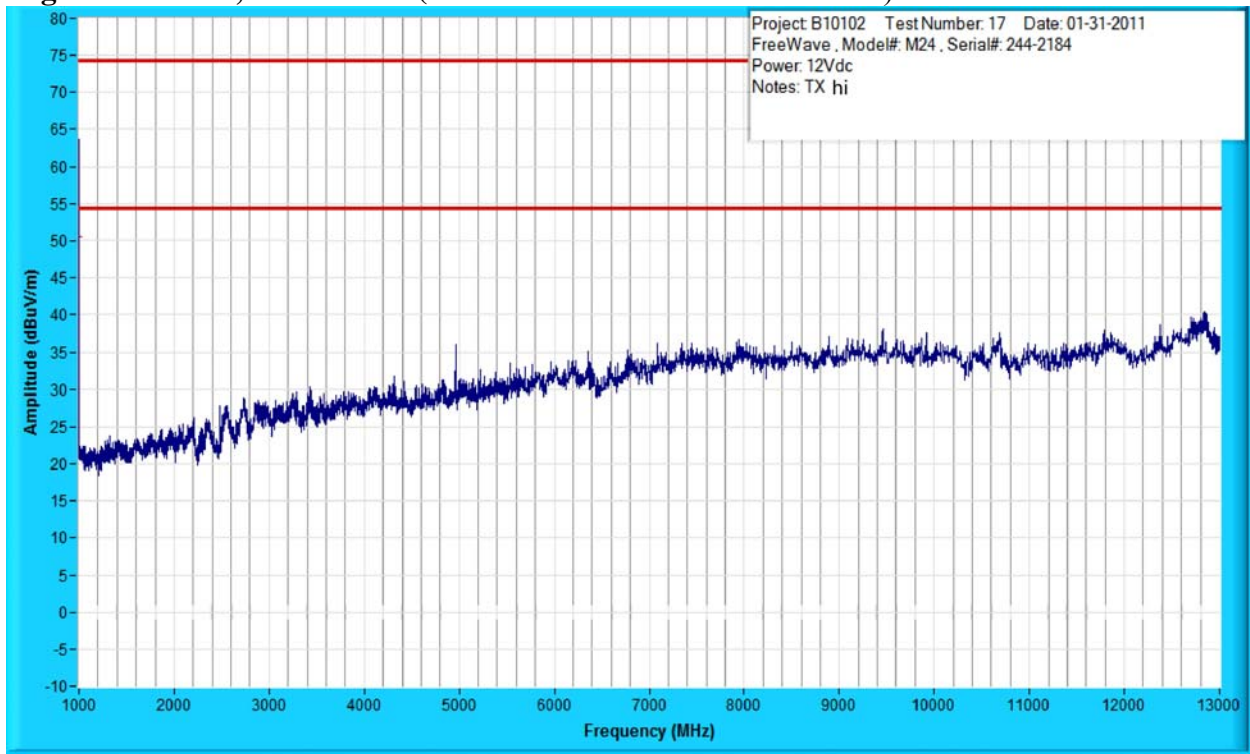
QP = Quasi-Peak Measurement: RBW is 120kHz, VBW is 3 MHz, and QP Detection is ENABLED (used for freqs ≤ 1 GHz)

AV = Video Average Measurement: RBW is 1 MHz, VBW is 10 Hz (used for freqs > 1 GHz)

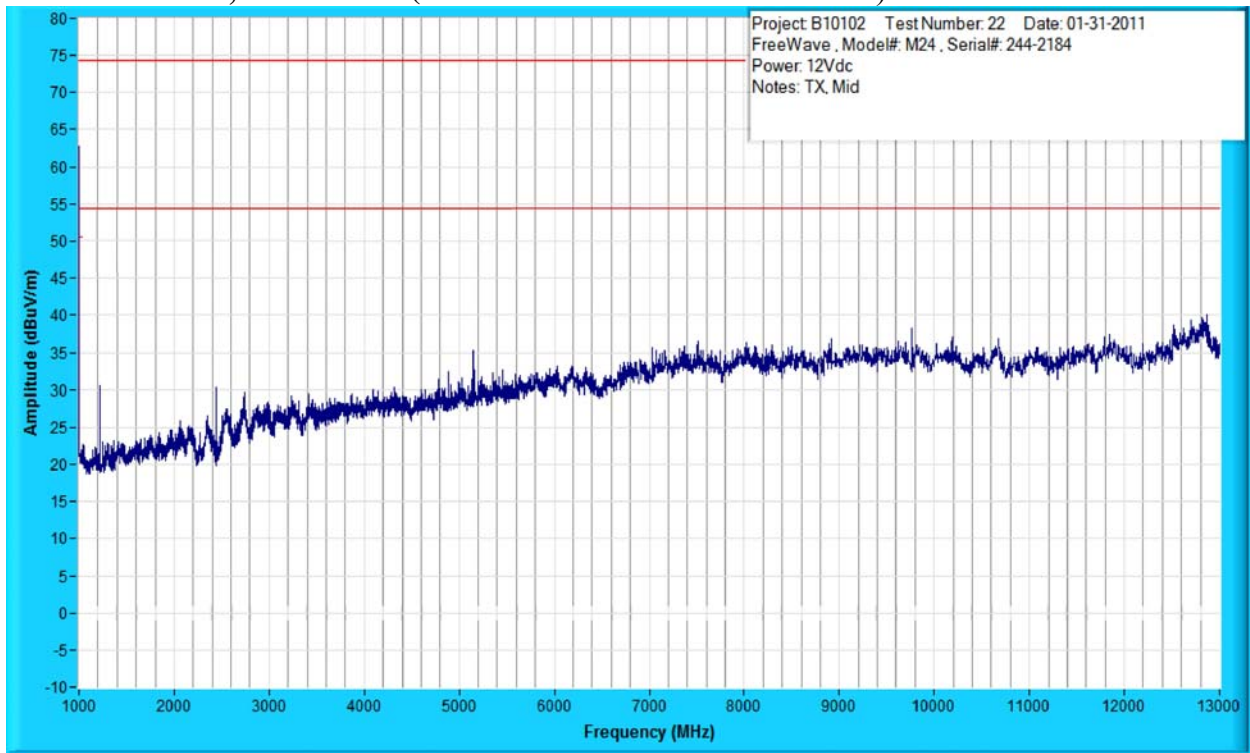
The graphs on the following pages are the Prescan results. Prescan bandwidths are wider than those used for the final QP (RBW=120kHz) or Avg (VBW=10Hz) readings. These Prescan graphs represent signals that are higher (or equal to) the levels that would be measured with a QP or Average detector. If these peak-detected Prescan results (using wider bandwidths) are compliant, then the QP and Avg results will be as well (and likely would exhibit even larger margins). The dual limit lines on the 1-13 GHz graphs represent the Peak and Average-detected limits.

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Highest Channel, Antenna #2 (MaxRad Model# MUF24005 Omni)

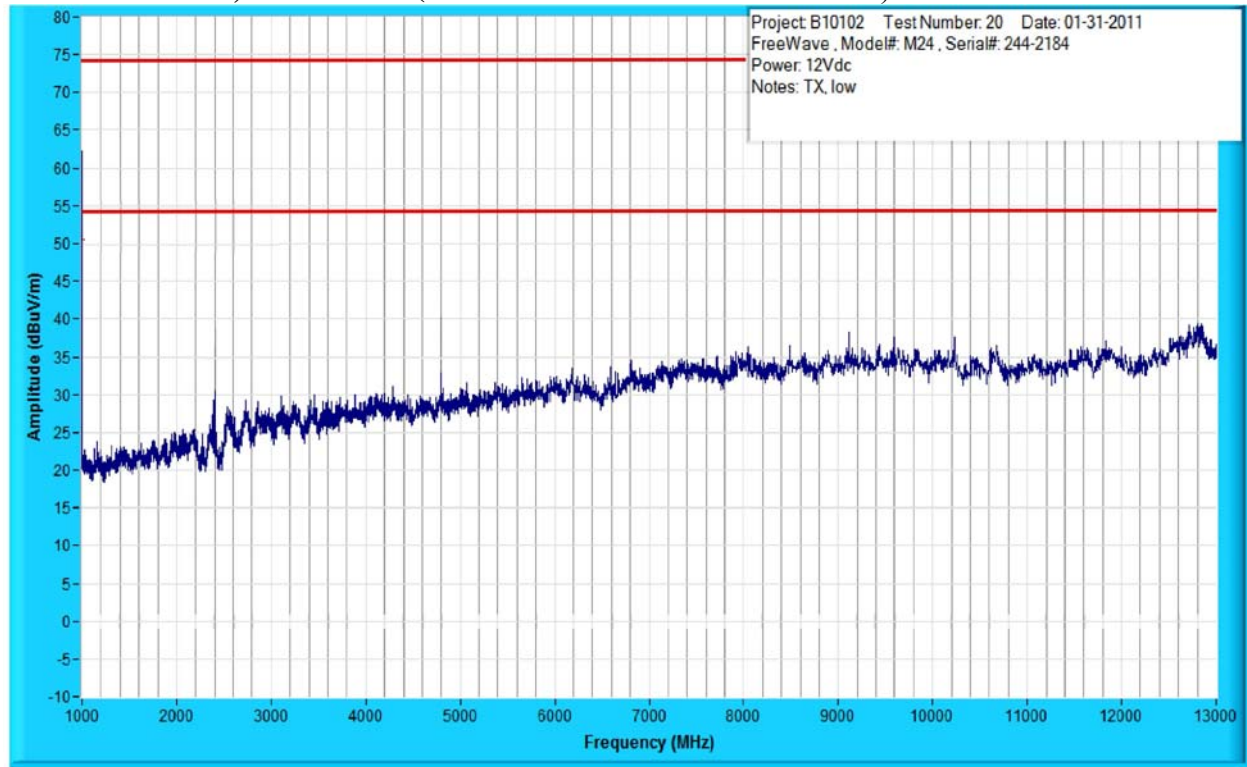


Middle Channel, Antenna #2 (MaxRad Model# MUF24005 Omni)

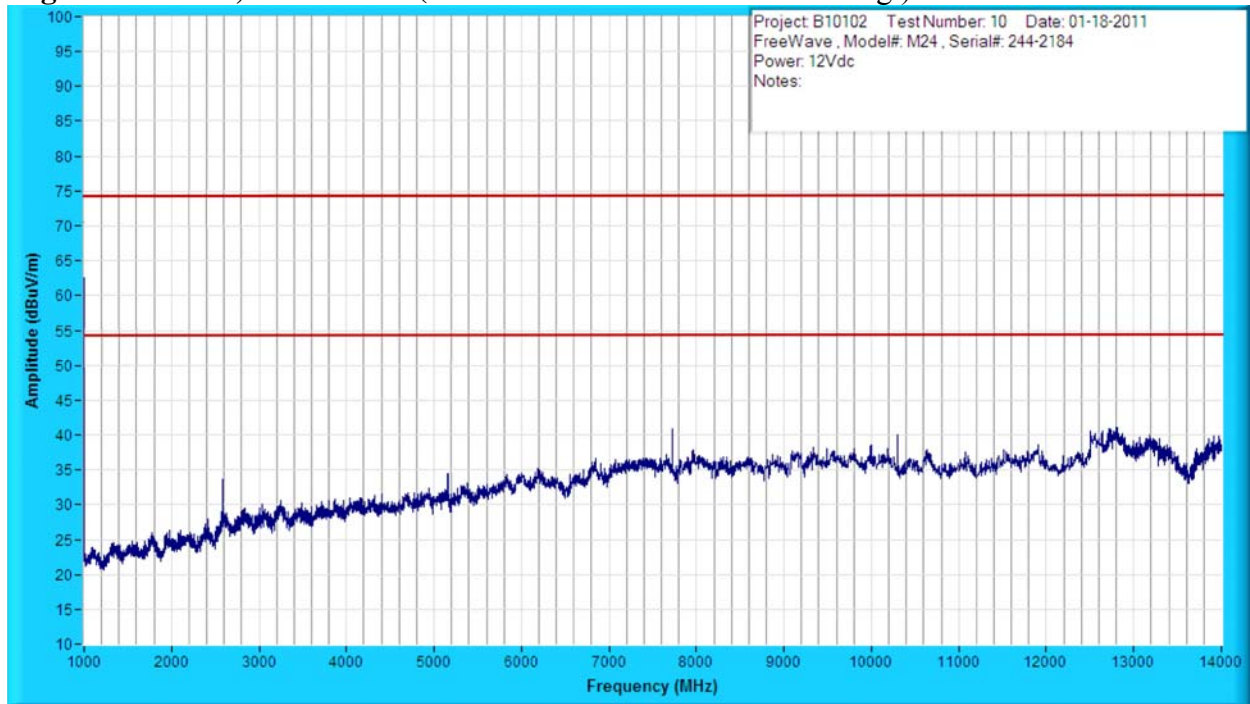


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EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
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Lowest Channel, Antenna #2 (MaxRad Model# MUF24005 Omni)

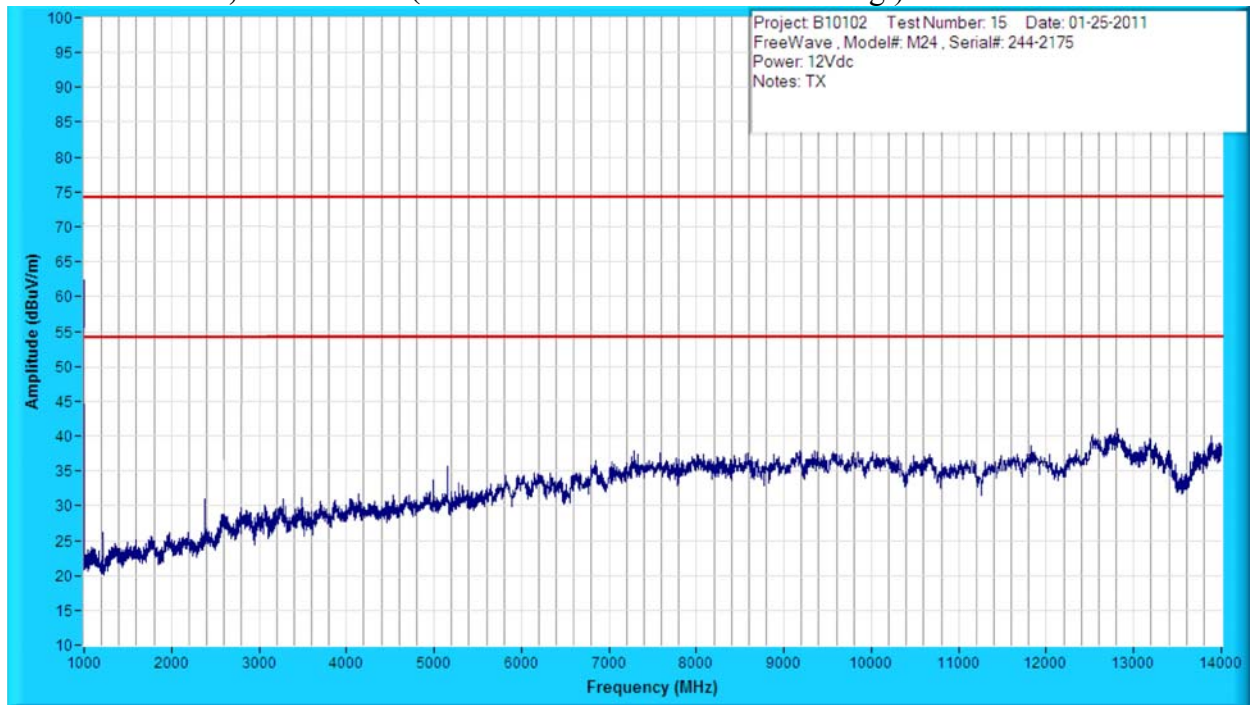


Highest Channel, Antenna #1 (WaveLink Model# PRO2400-4 Yagi)

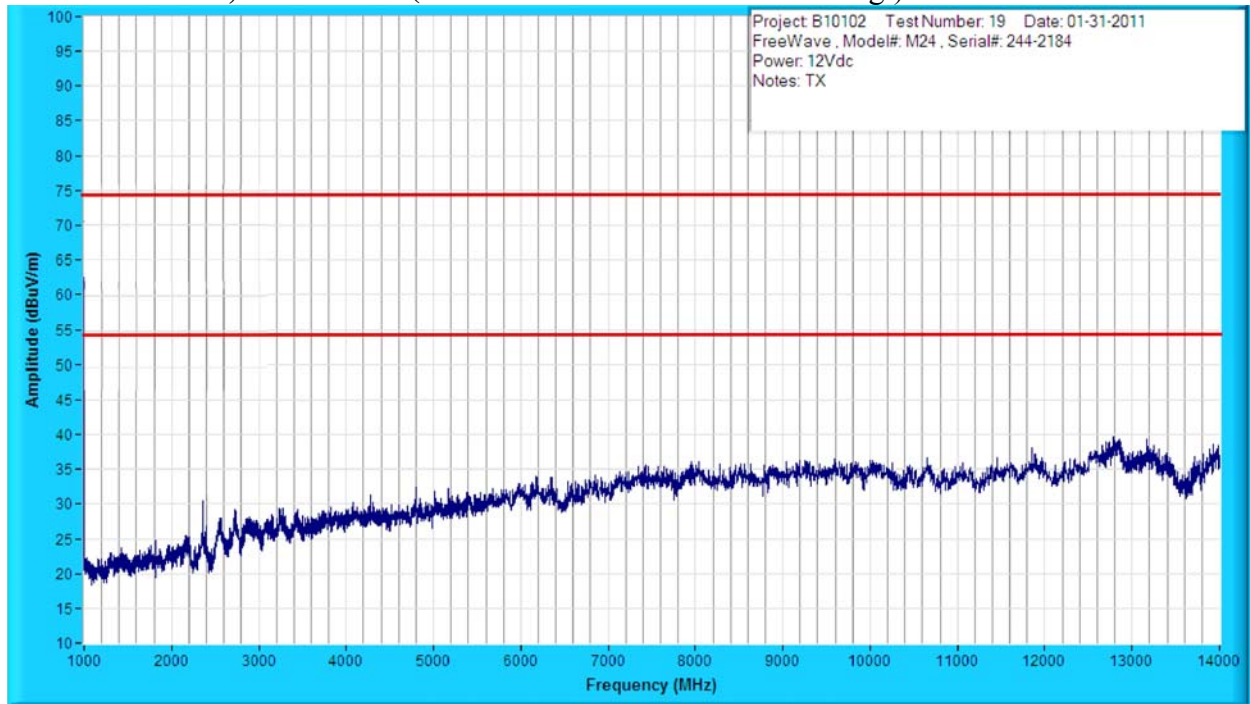


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EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
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Middle Channel, Antenna #1 (WaveLink Model# PRO2400-4 Yagi)

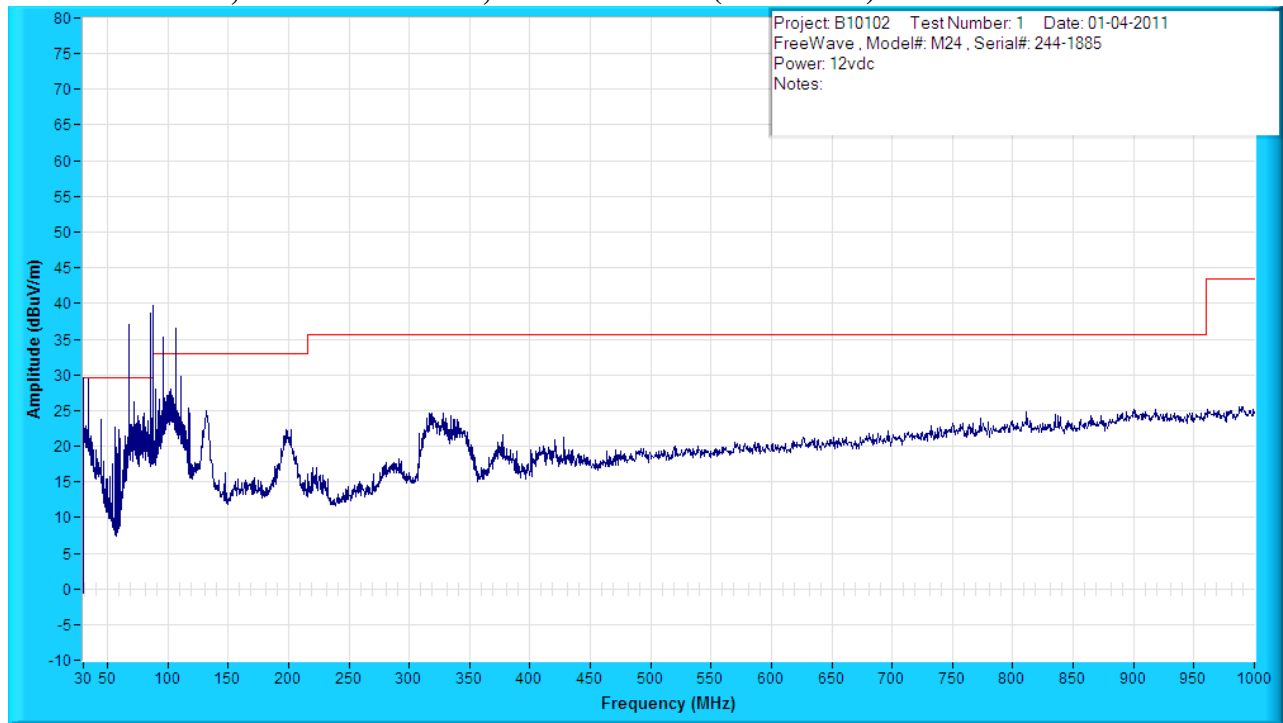


Lowest Channel, Antenna #1 (WaveLink Model# PRO2400-4 Yagi)



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Middle Channel, transceiver mode, 30 – 1000 MHz (worst-case)



Type	Frequency (MHz)	Level (dBUV)	Transducer (dB/m)	Gain / Loss (dB)	Final (dBUV/m)	Azm(deg)/Pol/Hgt(m)	Margin: FCC Class B QP (dB)	Margin: FCC Class B AV (dB)
QP	87.520	42.9	7.7	-29.2	21.4	72/V-Pole/4.00	8.1	-
QP	106.479	32.2	11.9	-29.1	15.1	221/H-Pole/1.50	18.0	-
QP	68.198	44.2	8.1	-29.4	22.9	180/V-Pole/2.86	6.6	-
QP	102.332	42.0	10.9	-29.1	23.8	20/V-Pole/4.00	9.2	-
QP	197.234	34.7	12.7	-28.7	18.7	103/V-Pole/1.00	14.3	-
QP	71.884	45.5	8.2	-29.4	24.3	134/V-Pole/2.41	5.3	-

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Section 9. Powerline Conducted Emissions

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207
TESTED BY: Kevin Johnson	DATE: 7 Jan 2011

Test Results: Complies.

Measurement Data: See data tables & plots below

Test Conditions: 19 %RH
21 °C

Measurement Uncertainty: +/- 3.04 dB

Test Equipment Used:

1342, 1194, 1343, 1201, 1344, 1213, 1345

Standard test voltage = 120 Vac / 60 Hz

Power Supply Info

Manufacturer: CUI, Inc.

Part number: 41-12-500

Description: +12VDC power supply, 500mA max

This power supply is not sold with the EUT – it is only an off-the-shelf device used for the purposes of testing. EUT is typically battery-powered in the field.

Detectors and Bandwidths used:

PRESCAN = Peak Measurement: RBW is 10 kHz, VBW is 30 kHz

QP = Quasi-Peak Measurement: RBW is 9 kHz, VBW is 30 kHz, and QP Detection is ENABLED

AV = Video Average Measurement: RBW is 10 kHz, VBW is 10 Hz

.The limit lines on the following graphs represent the Average and Quasi-Peak limits.

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Test Data – Powerline Conducted Emissions

Line 1: Quasi Peak, Average Data

Type	Frequency (MHz)	Level (dBuV)	Transducer (dB)	Gain / Loss (dB)	Final (dBuV)	Test Point	Margin: EN55022 Class B AV (dB)	Margin: EN55022 Class B QP (dB)
AV	0.160	21.9	3.8	10.1	35.9	Line 1	19.87	-
QP	0.160	22.6	3.8	10.1	36.5	Line 1	-	29.24
AV	0.195	16.9	3.5	10.1	30.5	Line 1	24.27	-
QP	0.195	23.6	3.5	10.1	37.1	Line 1	-	27.62
AV	0.370	13.5	1.8	10.1	25.4	Line 1	24.36	-
QP	0.370	22.8	1.8	10.1	34.7	Line 1	-	25.06
AV	0.561	18.2	1.5	10.2	29.8	Line 1	16.16	-
QP	0.561	21.5	1.5	10.2	33.1	Line 1	-	22.86
AV	0.583	18.7	1.4	10.2	30.3	Line 1	15.68	-
QP	0.583	21.6	1.4	10.2	33.3	Line 1	-	22.74
AV	0.727	22.3	1.4	10.2	33.9	Line 1	12.05	-
QP	0.727	23.8	1.4	10.2	35.4	Line 1	-	20.59

Neutral: Quasi Peak, Average Data

Type	Frequency (MHz)	Level (dBuV)	Transducer (dB)	Gain / Loss (dB)	Final (dBuV)	Test Point	Margin: EN55022 Class B AV (dB)	Margin: EN55022 Class B QP (dB)
AV	0.192	24.4	3.5	10.1	37.9	Neutral	16.87	-
QP	0.192	26.4	3.5	10.1	40.0	Neutral	-	24.77
AV	0.212	24.2	3.1	10.1	37.4	Neutral	16.84	-
QP	0.212	24.1	3.1	10.1	37.3	Neutral	-	26.95
AV	0.266	18.8	2.1	10.1	30.9	Neutral	21.77	-
QP	0.266	21.1	2.1	10.1	33.3	Neutral	-	29.39
AV	0.325	10.2	1.9	10.1	22.2	Neutral	28.75	-
QP	0.325	20.1	1.9	10.1	32.1	Neutral	-	28.85
AV	0.374	20.6	1.8	10.1	32.4	Neutral	17.21	-
QP	0.374	22.5	1.8	10.1	34.3	Neutral	-	25.28
AV	0.649	5.3	1.5	10.2	17.0	Neutral	29.00	-
QP	0.649	15.4	1.5	10.2	27.1	Neutral	-	28.88

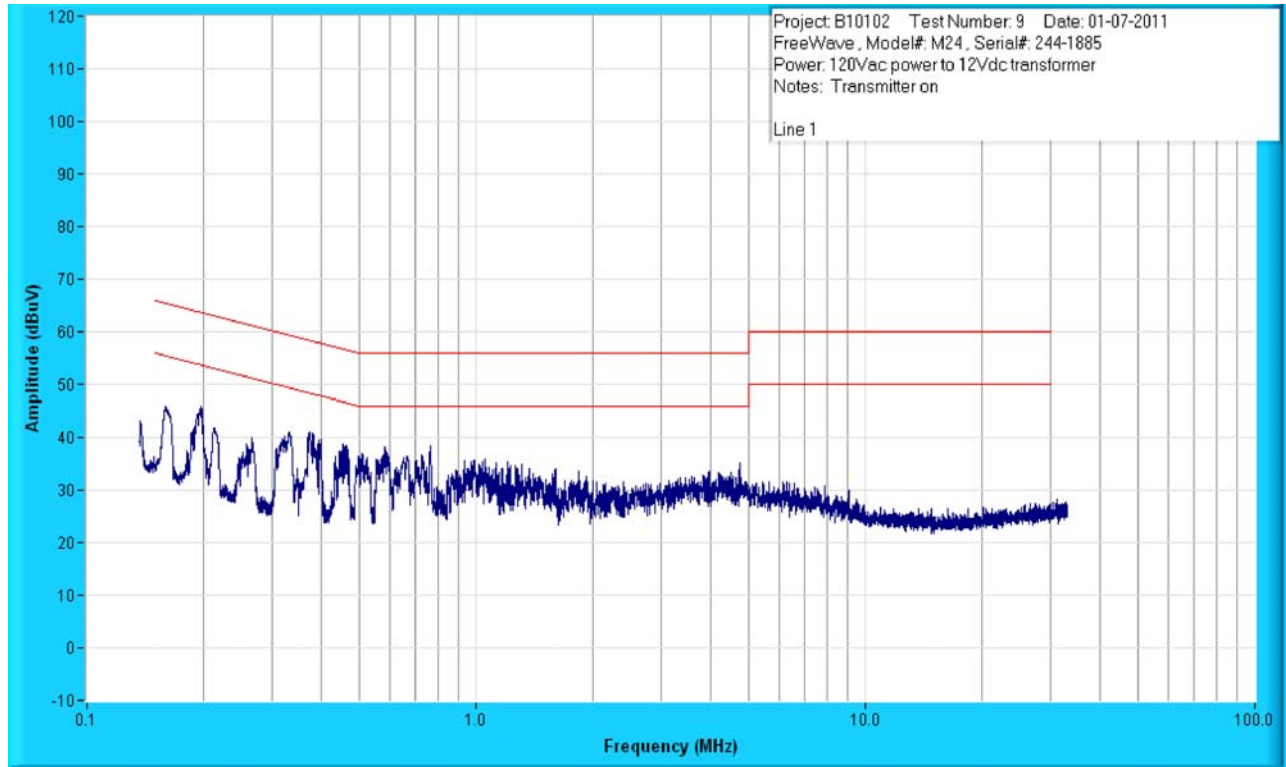
The highest emission measured was on **Line 1** at **0.727 MHz**, which was **12.05 dB** below the limit.

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Test Data – Powerline Conducted Emissions

Line

Peak-Detected Prescan Data



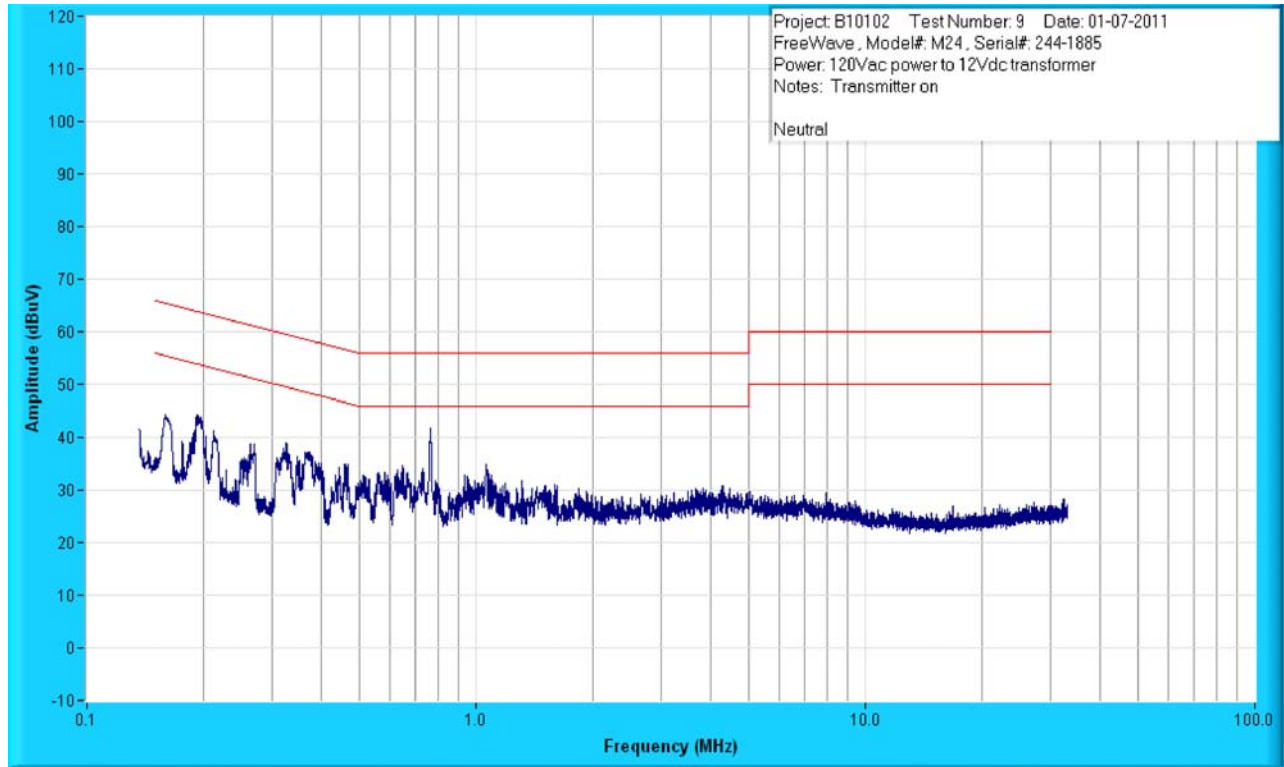
Conducted Emissions Prescan, Line 1, 0.150MHz to 30MHz, Peak Measurements

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Test Data – Powerline Conducted Emissions

Neutral

Peak-Detected Prescan Data



Conducted Emissions Prescan, Neutral, 0.150MHz to 30MHz, Peak Measurements

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Section 10. Test Equipment List

ID Number	Manufacturer	Model #	Serial #	Description	Cal Date	Cal Due
1208	Extech	115715	252868	Hygro-Thermometer	06/23/2010	06/23/2011
1219	Mini-Circuits	ZKL-2	062905	Preamp, 10 - 2000 MHz, 30 dB	03/19/2010	03/19/2011
1232	Sunol Sciences	JB1	A071605-2	Bilog Antenna, 30 MHz to 2.0 GHz	08/13/2010	08/13/2011
1233	Sunol Sciences	SC104V	110305-1	Positioning Controller	NA	NA
1234	CIR Enterprises	10m Chamber	001	10m Radiated Emissions Semi-Anechoic Chamber	10/18/2009	02/18/2011
1238	Sunol Sciences	TWR95-4	110305-3	Antenna Mast	NA	NA
1239	Sunol Sciences	FM2522VS	110305-2	Turn Table, 2.5m Diameter	NA	NA
1266	California Instruments	MX15-1	57961	AC Power Source, 0 - 300 VAC / 16 - 819 Hz / 15kVA	NA	NA
1342	Hewlett Packard	85650A	2412A00392	Quasi-Peak Adapter	03/04/2010	03/04/2011
1343	Hewlett Packard	8566B	2403A08410	Spectrum Analyzer Display	03/03/2010	03/03/2011
1344	Hewlett Packard	8566B	2611A02676	Spectrum Analyzer with 2403A08410	03/03/2010	03/03/2011
1345	Hewlett Packard	85685A	2901A0865	RF Preselector	03/03/2010	03/03/2011
1030	EMCO	3115	9906-5816	Double-ridged Horn (1 - 18 GHz)	03/22/2010	03/22/2011
1139	Wiltron	68369B	675016	Synthesized Signal Generator, 10 MHz - 40 GHz	05/14/2010	05/14/2011
1197	EMCO	3116	00040962	DRG Horn 18-40 GHz	08/23/2010	09/23/2011
1253	Narda West	1840N506	010-100	18 to 40 GHz Preamplifier, 40dB Gain Nominal	02/11/2010	02/11/2011
1276	Narda	DBL-0218N308	037-038	1GHz to 18GHz Preamplifier, 60dB gain nominal	04/15/2010	04/15/2011
1215	Hewlett Packard	8564E	3943A01645	9kHz-40GHz Portable Spectrum Analyzer	10/08/2010	10/08/2011
1194	Solar	9252-50-R-24-BNC	042012	LISN	04/06/2010	04/06/2011
1201	Agilent Technology	11947A	3107A03807	Transient Limiter, 9 kHz to 200 MHz	01/18/2010	01/18/2011
1213	Solar	7930-100	885210	High Pass Filter, fc: 100kHz, -100dB @ 33kHz	04/07/2010	04/07/2011
---	Mini-Circuits	BW-S20W5+	---	20 dB SMA Atten, 5W, 18 GHz	NA	NA
1246	Micro-Tronics	BRM50701	038	2.4 GHz Notch Filter SMA	NA	NA

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EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
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ANNEX A - TEST DETAILS

EMC Integrity, Inc.	FCC PART 15.247
EUT: Freewave GX-CP	Frequency Hopping Spread Spectrum
FCC ID: KNY-715712152112	Test Report No.: ETRB10102_FCC_RevB

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207
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Minimum Standard: §15.207 Conducted limits.

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 mH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Conducted Emission (MHz)	Limit (dBmV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current systems containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 mV within the frequency band 535-1705 kHz, as measured using a 50 mH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits as provided in §15.205 and §§15.209, 15.221, 15.223, 15.225 or 15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

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NAME OF TEST: Channel Separation, Occupied Bandwidth PARA. NO.: 15.247(a)(1)

Minimum Standard: per §15.247(a)(1)
Frequency hopping and digitally modulated intentional radiators may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Method Of Measurement:

The spectrum analyzer is set as follows:

RBW = VBW = 30 kHz.
Span: Sufficient to display 20 dB bandwidth
LOG dB/div.: 10 dB
Sweep: Auto

For Occupied Bandwidth test, tuning range is > 10 MHz so 3 channels are tested (top, middle, bottom)

For Channel Separation test, one channel is tested (middle)

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NAME OF TEST: Maximum Peak Output Power **PARA. NO.: 15.247(b)(1)**

Minimum Standard: The maximum peak output power shall not exceed 1 watt.

Direct Measurement Method For Detachable Antennas:

If the antenna is detachable, a peak power meter is used to measure the power output with the transmitter operating into a 50 ohm load.

The RBW of the spectrum analyzer shall be set to a value greater than the measured 6 dB occupied bandwidth of the E.U.T.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

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NAME OF TEST: Spurious Emissions (antenna conducted)	PARA. NO.: 15.247(d)
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Minimum Standard:

(d) 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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) (see Section 15.205(c)).

The spectrum is searched up to the 10th harmonic of the highest frequency generated or used in the EUT.

Method Of Measurement:

Spurious Emissions

RBW: 100 kHz
 VBW: 100 kHz
 Sweep: Auto

Lower and Upper Band Edge Measurements

RBW: At least 1% of span/div.
 VBW: >=RBW
 Span: As necessary to display any spurious signals at band edge.
 Sweep: Auto
 Spectrum Analyzer Center Frequency: 2.4000 (lower) and 2.4835 (upper)
 Marker: Peak of fundamental emission
 Marker Δ: Peak of highest spurious level outside band edge (if it exists) or the reading at band edge

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NAME OF TEST: Radiated Emissions (Restricted Bands) PARA. NO.: 15.247(d)

Minimum Standard:

(d) 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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) (see Section 15.205(c)).

Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (µV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC

15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41	1718		

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

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NAME OF TEST: Channel Dwell Time	PARA. NO.: 15.247(a)(1)(iii)
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Minimum Standard:

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Method Of Measurement:

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

- Span = zero span, centered on a hopping channel
- RBW = 1 MHz (Note: Channel is only 250 kHz wide; used 3 kHz RBW)
- VBW \geq RBW
- Sweep = as necessary to capture the entire dwell time per hopping channel
- Detector function = peak
- Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (data rate, modulation format, etc.), repeat this test for each variation. An oscilloscope may be used instead of a spectrum analyzer. The EUT shall show compliance with the appropriate regulatory limit for the number of hopping channels. A plot of the data shall be included in the test report.

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NAME OF TEST: Number of Channels	PARA. NO.: 15.247(a)(1)(iii)
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Minimum Standard:

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

Method Of Measurement:

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

- Span = the frequency band of operation
- RBW \geq 1 % of the span
- VBW \geq RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize

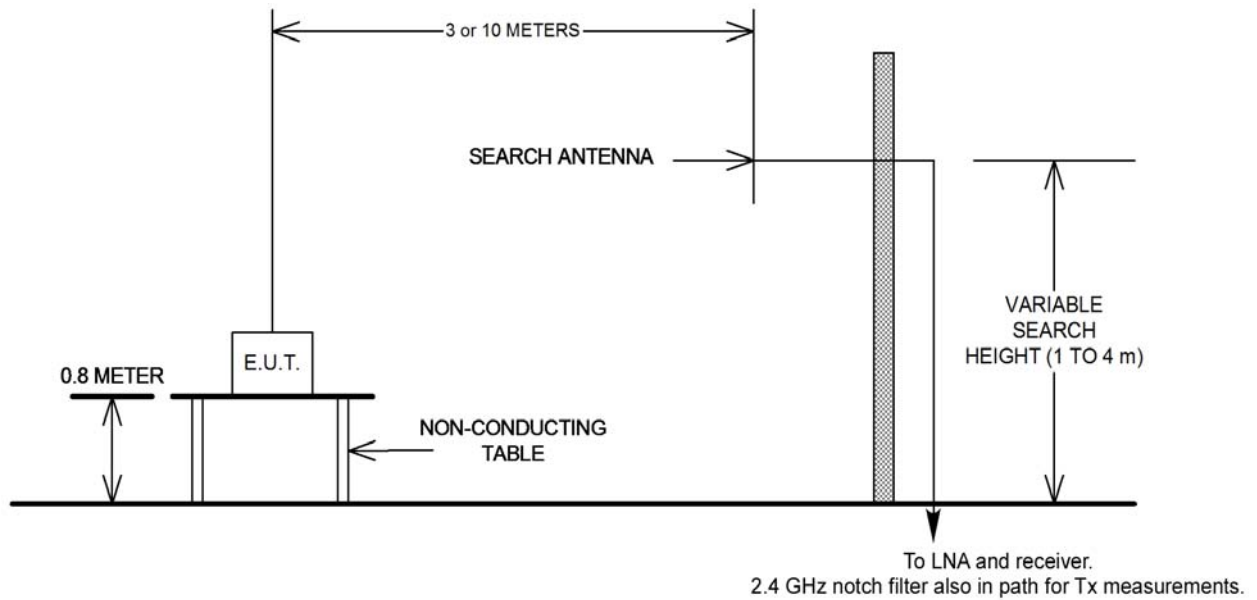
It may prove necessary to break the span up into sub-ranges, to clearly show all of the hopping frequencies. The EUT shall show compliance with the appropriate regulatory limit for the number of hopping channels. A plot of the data shall be included in the test report.

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ANNEX B - TEST DIAGRAMS

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Test Site for Radiated Emissions



Conducted Emissions



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Peak Power At Antenna Terminals
Occupied Bandwidth
Peak Power Spectral Density
Spurious Emissions (antenna conducted)
Channel Dwell Time
Number of Channels

