Engineering and Testing for EMC and Safety Compliance

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Limited Modular Approval Certification Application Report
FCC Part 15.247 & Industry Canada RSS-210

Test Lab:	Applicant:
Rhein Tech Laboratories, Inc. Tel: 703-689-0368 360 Herndon Parkway Fax: 703-689-2056 Suite 1400 Herndon, VA 20170 E-Mail: atcbinfo@rheintech.com http://www.rheintech.com	Fleetwood Group, Inc. Tel: 616-820-8271 11832 James Street Fax: 616-820-8300 Holland, MI 49424 Contact: Will Buehler

FCC ID/ IC:	FBRKG3EI/ 1859A-KG3EI	**Test Report Date:**	May 6, 2009
Platform:	N/A	**RTL Work Order #:**	2009149
Model:	KG3EI	**RTL Quote #:**	QRTL09-130A
American National Standard Institute:	ANSI C63.4-2003: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
FCC Classification:	DSS – Part 15 Spread Spectrum Transmitter		
FCC Rule Part(s)/Guidance:	FCC Rules Part 15.247: Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System (10-01-08), DA 00-705		
Industry Canada:	RSS-210 Issue 7: Low Power License-Exempt Communications Devices		
Digital Interface Information:	Digital Interface was found to be compliant		

Frequency Range (MHz)	Output Power* (W)	Frequency Tolerance	Emission Designator
2401–2475	0.002	N/A	561KFXD

** power is peak EIRP*

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15, Industry Canada RSS-210, and ANSI C63.4.

Signature: _____ Date: May 6, 2009

Typed/Printed Name: Desmond A. Fraser Position: President

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1 General Information

1.1 Scope

This is an original limited modular approval certification application test report.

Applicable Standards:

- FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.
- Industry Canada RSS-210: Low Power License-Exempt Communications Devices

1.2 Description of EUT

Equipment Under Test	Keypad transmitter module
Model	KG3EI
Power Supply	Battery - 2 AA batteries (3 VDC)
Modulation Type	FHSS
Frequency Range	2401 – 2475 MHz
Antenna Connector Type	Internal
Antenna Types	Internal

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4-2003).

1.4 Related Submittal(s)/Grant(s)

This is an original limited modular approval application for Fleetwood Group, Inc., Model Name: KG3EI, FCC ID: FBRKG3EI, IC: 1859A-KG3EI.

1.5 Modifications

None.

2 Test Information

2.1 Description of Test Modes

In accordance with FCC 15.31(m), and because the EUT utilizes an operating band greater than 10 MHz, the following frequencies were tested:

Table 2-1: Channels Tested

Channel	Frequency
Low	2401
Middle	2437
High	2475

2.2 Exercising the EUT

The EUT was supplied with test firmware programmed with a high, mid, and low channel for testing, as well as in an original configuration for hopping mode. The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The EUT was provided with software to continuously transmit during testing. The carrier was also checked to verify that information was being transmitted. There were no deviations from the test standard(s) and/or methods. The test results reported relate only to the item tested.

2.3 Test Result Summary

Table 2-2: Test Result Summary – FCC Part 15, Subpart C (Section 15.247)

Standard	Test	Pass/Fail or N/A
FCC 15.207	AC Power Conducted Emissions	N/A
FCC 15.209	Radiated Emissions	Pass
FCC 15.247(b)	Maximum Peak Power Output	Pass
FCC 15.247(d)	Antenna Conducted Spurious Emissions	Pass
FCC 15.247(d)	Band Edge Measurement	Pass
FCC 15.247(a)(1)	Carrier Frequency Separation	Pass
FCC 15.247(a)(1)(ii)	20 dB Bandwidth	Pass
FCC 15.247(a)(1)(iii)	Hopping Characteristics	Pass
FCC 15.247(a)(1)(iii)	Average Time of Occupancy	Pass

2.4 Test System Details

The test samples were received on March 19 and 27, 2009. The FCC identifiers for all applicable equipment, plus descriptions of all cables used in the tested system, are identified in the following table.

Table 2-3: Equipment Under Test

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
Keypad Transmitter Module	Fleetwood Group Inc.	KG3EI	F2	FBRKG3EI	N/A	18883
Keypad Transmitter Module	Fleetwood Group Inc.	KG3EI	F1	FBRKG3EI	N/A	18884

2.5 Configuration of Tested System

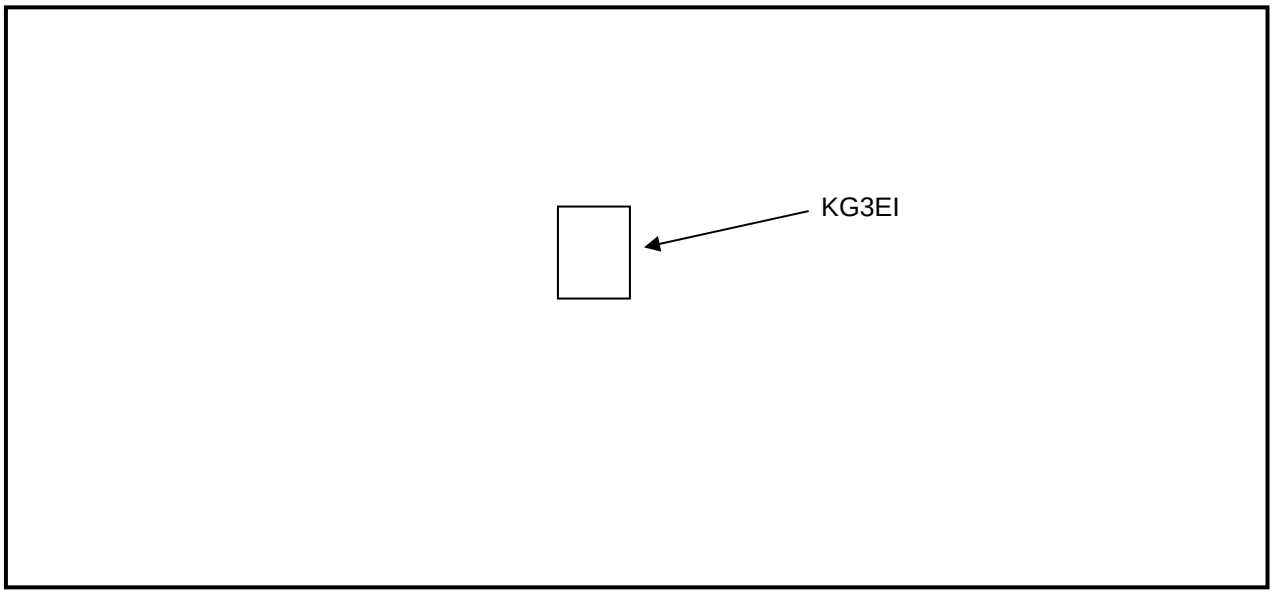


Figure 2-1: Configuration of System Under Test

3 Peak Output Power – FCC §15.247(b)(1); RSS-Gen §4.8

3.1 Power Output Test Procedure

A radiated power measurement of the EUT was taken using an Agilent 4448A spectrum analyzer.

Table 3-1: Power Output Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900878	Rhein Tech Laboratories, Inc.	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required
901516	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	10/17/09
901517	Insulated Wire Inc.	KPS-1503-360-KPS	RF cable 36"	NA	10/17/09
901242	Rhein Tech Laboratories, Inc.	WRT-000-0003	Wood rotating table	N/A	Not Required
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	7/31/09
900772	EMCO	3161-02	Horn Antenna (2-4 GHz)	9804-1044	6/14/10

3.2 Power Output Test Data

Table 3-2: Power Output Test Data

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Site Correction Factor (dB/m)	EIRP Power (dBuV/m)	EIRP Power (mW)
2401	72.2	25.5	97.7	1.8
2437	71.4	25.6	97.0	1.5
2475	70.9	25.7	96.6	1.4

Test Personnel:

Daniel W. Baltzell		March 27, 2009
EMC Test Engineer	Signature	Date of Test

4 Band-Edge Compliance of RF Conducted Emissions – FCC §15.247(d); RSS-210 §2.2

4.1 Band Edge Test Procedure

The EUT was connected to the spectrum analyzer through suitable attenuation. The span was set wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The spectrum analyzer was set to the following:

RBW > = 1% of the span
VBW > = RBW
Sweep = auto
Detector function = peak
Trace = max hold

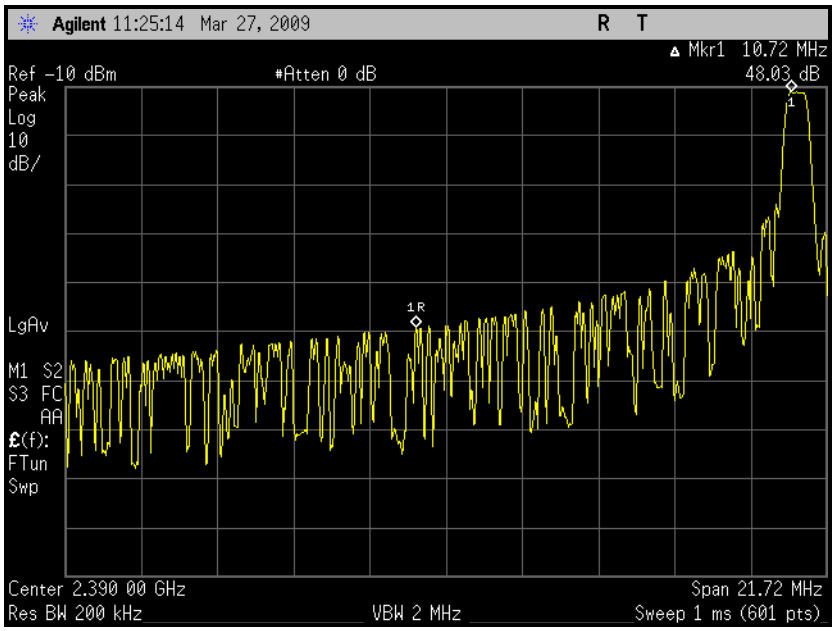
The trace was allowed to stabilize. The marker was set on the emission at the band edge. The marker-delta was used to show the delta between the maximum in-band emission and the emission at the band edge, and was compared to the 20 dBc requirement of 15.247(d) (when using peak emissions). This measurement was taken in both fixed frequency and hopping modes.

Table 4-1: Band Edge Test Equipment

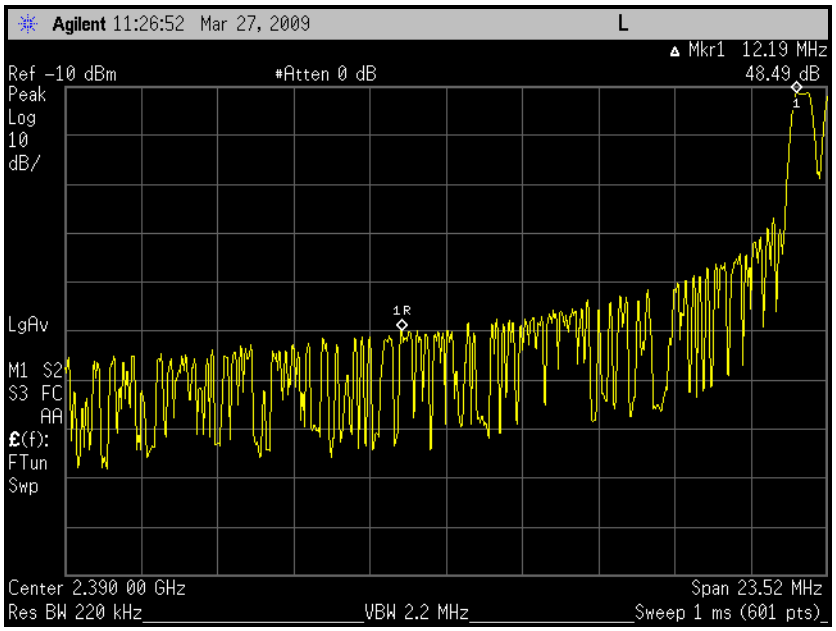
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer (3 Hz–50 GHz)	US440203416	7/31/09

4.2 Test Results

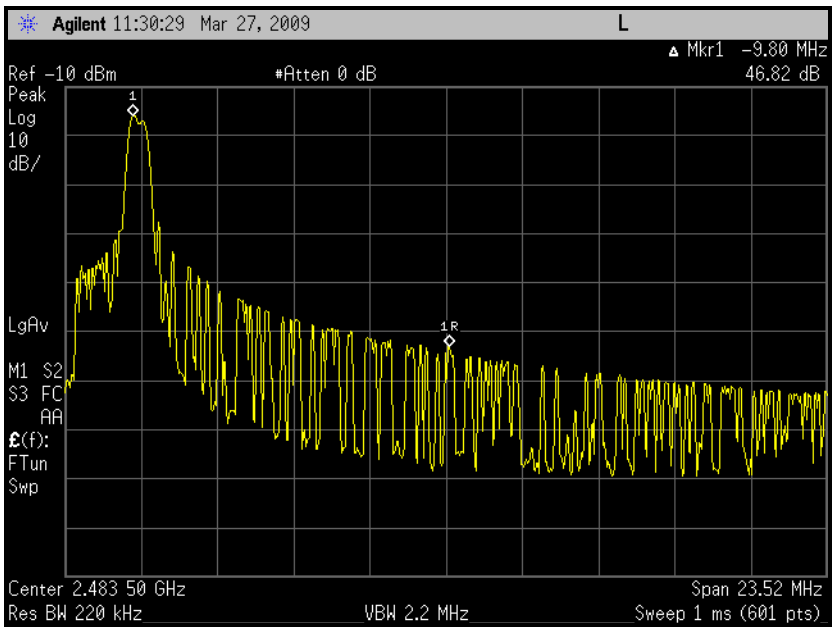
Plot 4-1: Lower Band Edge TX Frequency; 2401 MHz – Fixed Frequency



Plot 4-2: Lower Band Edge TX Frequency; 2401 MHz – Hopping



Plot 4-3: Upper Band Edge TX Frequency; 2475 MHz – Fixed Frequency



Plot 4-4: Upper Band Edge TX Frequency; 2475 MHz – Hopping

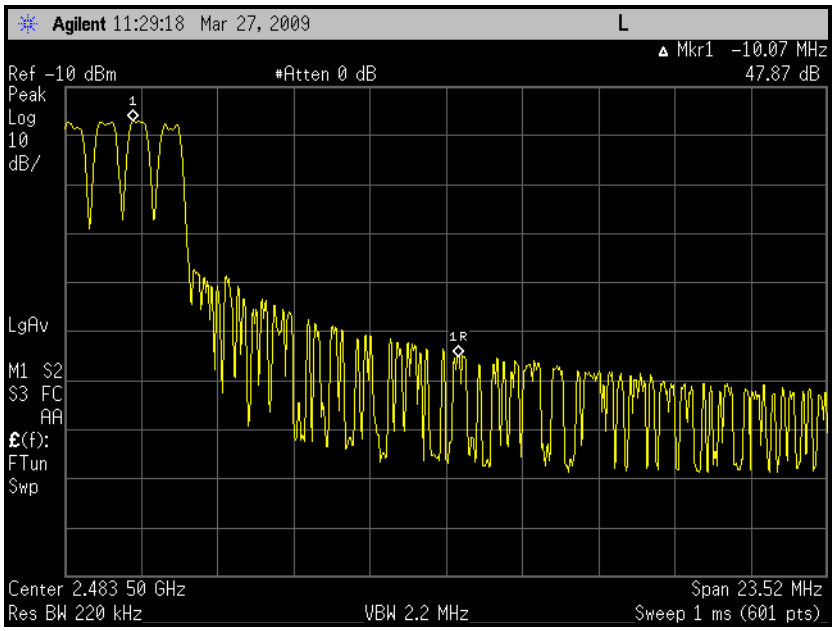


Table 4-2: Radiated Band Edge Emissions

Emission Frequency (MHz)	Peak (dBuV/m) (1 MHz RBW/ VBW)	Average (dBuV/m) (1 MHz RBW/ 10 Hz VBW)	Delta (from above plots)	Average Limit (dBuV/m)	Average Margin (dB)
2401.0	97.7	77.7	48.0	54.0	-24.3
2475.0	96.6	76.6	46.8	54.0	-24.2

Test Personnel:

Dan Baltzell		March 27, 2009
EMC Test Engineer	Signature	Date of Tests

5 20 dB Bandwidth – FCC §15.247(a)(1)(ii); IC RSS-210 §A1.1.3

5.1 20 dB Bandwidth Test Procedure

The minimum 20 dB bandwidths per RSS-210 were measured using a 50 ohm spectrum analyzer. The carrier was adjusted on the analyzer so that it was displayed entirely on the spectrum analyzer. The sweep time was set to 1 second and allowed through several sweeps with the max hold function used in peak detector mode. The resolution bandwidth was set to 30 kHz, and the video bandwidth set at 300 kHz. The minimum 20 dB bandwidths were measured using the spectrum analyzer delta marker set 20 dB down from the peak of the carrier. The table below contains the bandwidth measurement results.

Table 5-1: 20 dB Bandwidth Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer (3 Hz–50 GHz)	US440203416	7/31/09

5.2 20 dB Modulated Bandwidth Test Data

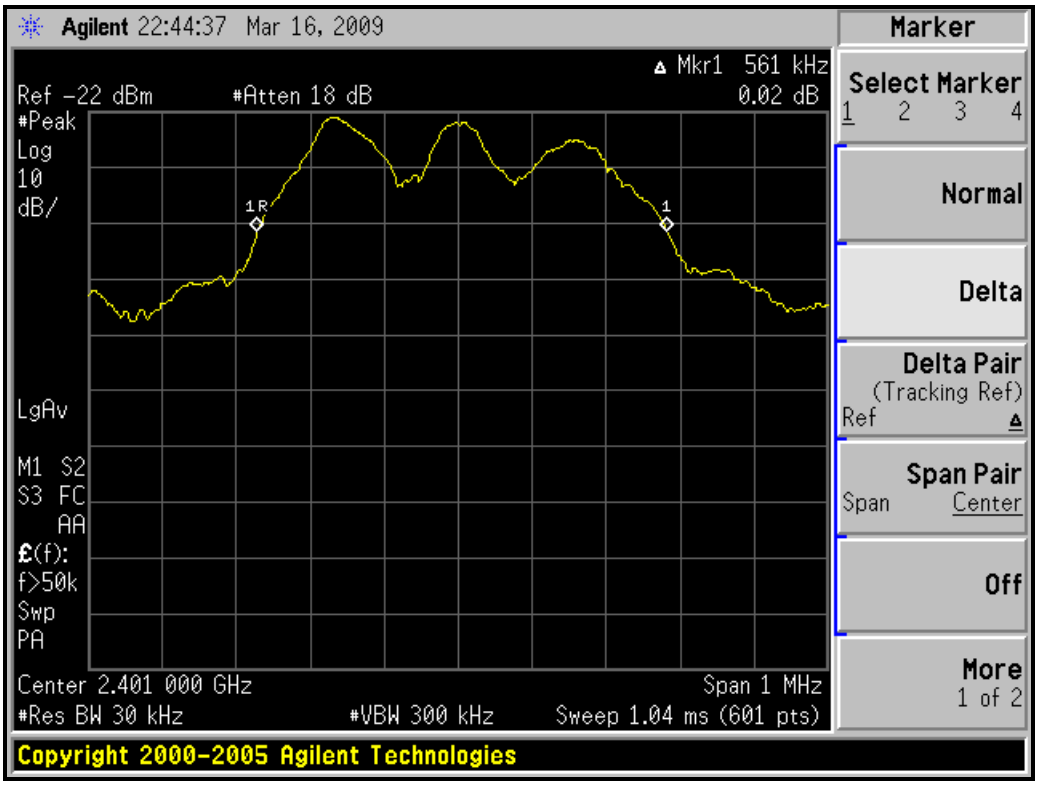
Table 5-2: 20 dB Modulated Bandwidth Test Data

Minimum 20 dB Bandwidth

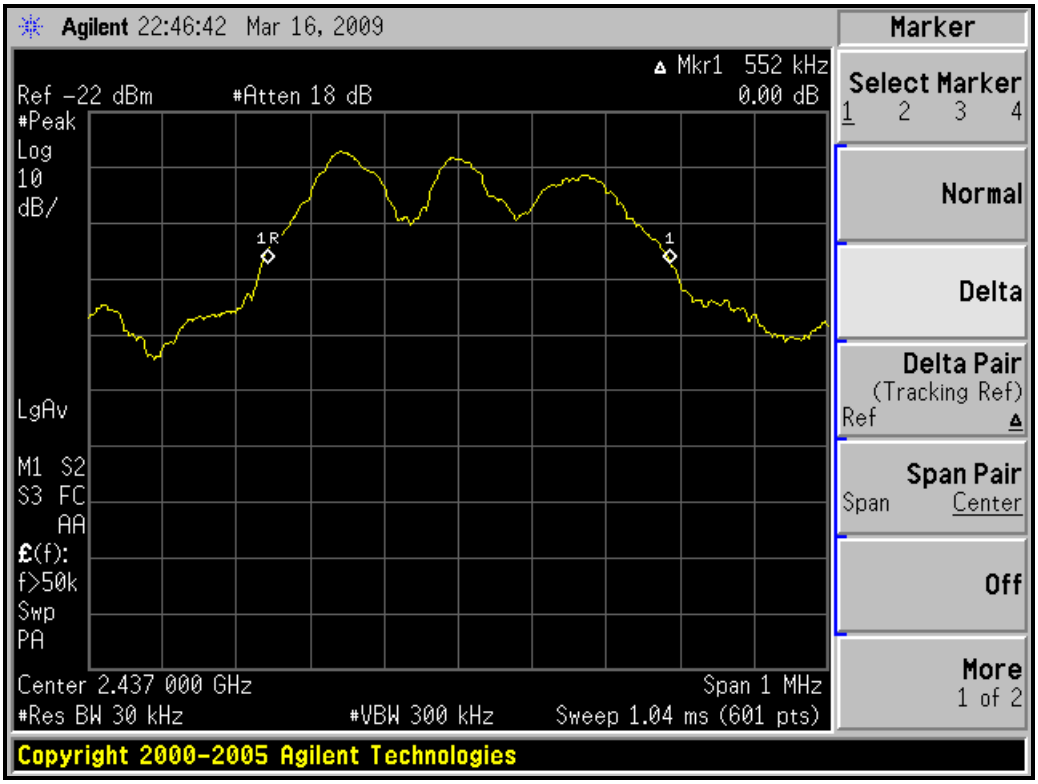
Frequency (MHz)	20 dB Bandwidth (kHz)
2401	561 kHz
2437	552 kHz
2475	558 kHz

5.3 20 dB Bandwidth Plots

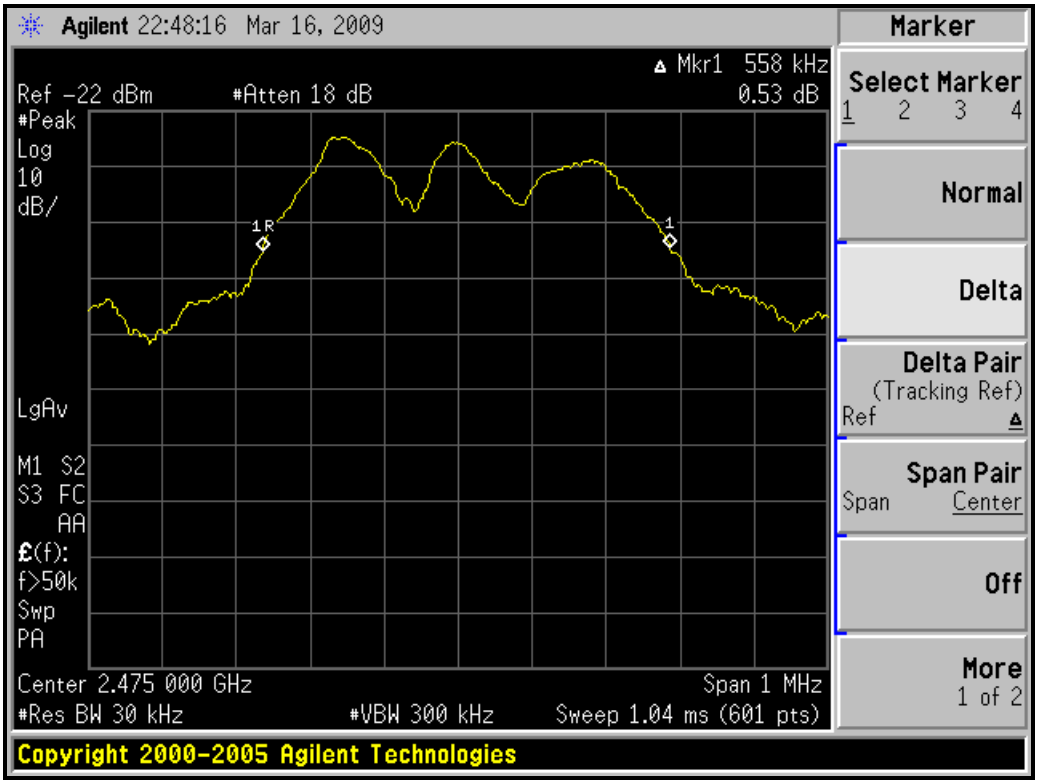
Plot 5-1: 20 dB Bandwidth - 2401 MHz



Plot 5-2: 20 dB Bandwidth - 2437 MHz



Plot 5-3: 20 dB Bandwidth - 2475 MHz



Test Personnel:

Richard B. McMurray, P.E.	Richard B. McMurray	March 19, 2009
EMC Test Engineer	Signature	Date of Test

6 Carrier Frequency Separation - §15.247(a)(1)

6.1 Carrier Frequency Separation Test Procedure

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.

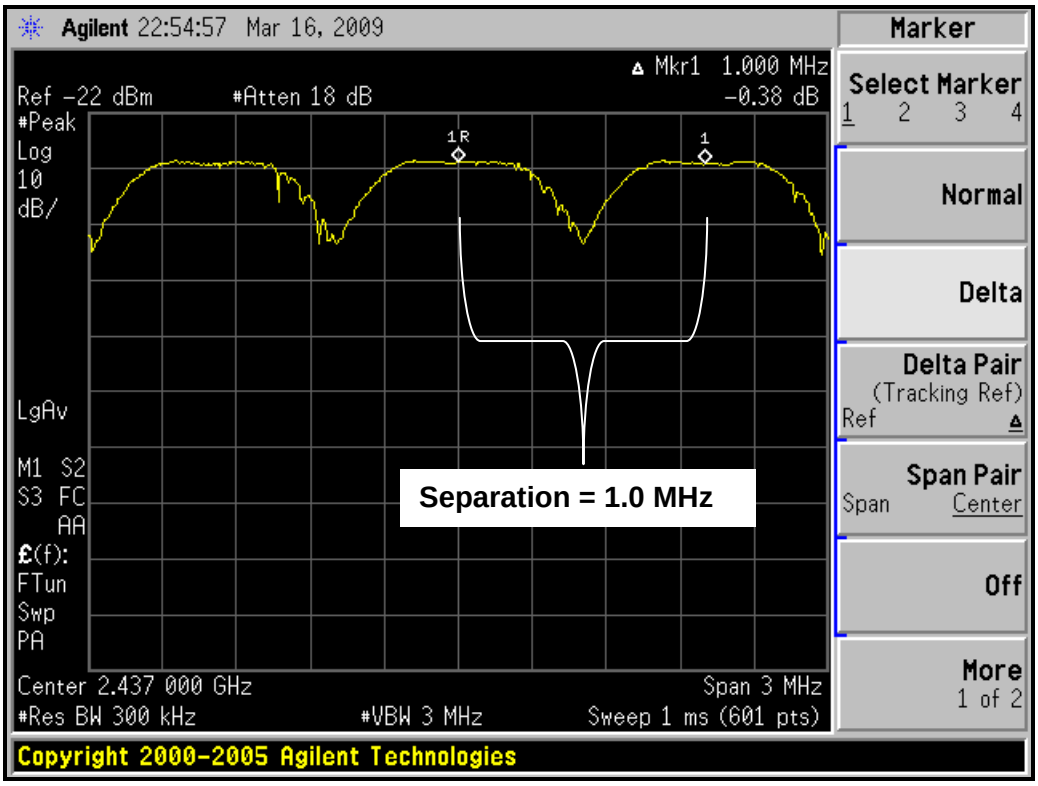
Measured frequency separation = 1.0 MHz

Table 6-1: Carrier Frequency Separation Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer (3 Hz–50 GHz)	US440203416	7/31/09

6.2 Carrier Frequency Separation Test Data

Plot 6-1: Carrier Frequency Separation



Test Personnel:

Richard B. McMurray, P.E.	Richard B. McMurray	March 19, 2009
EMC Test Engineer	Signature	Date of Test

7 Hopping Characteristics – FCC §15.247(a)(1)(iii); IC RSS-210 §A8.1

7.1 Hopping Characteristics Test Procedure

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.

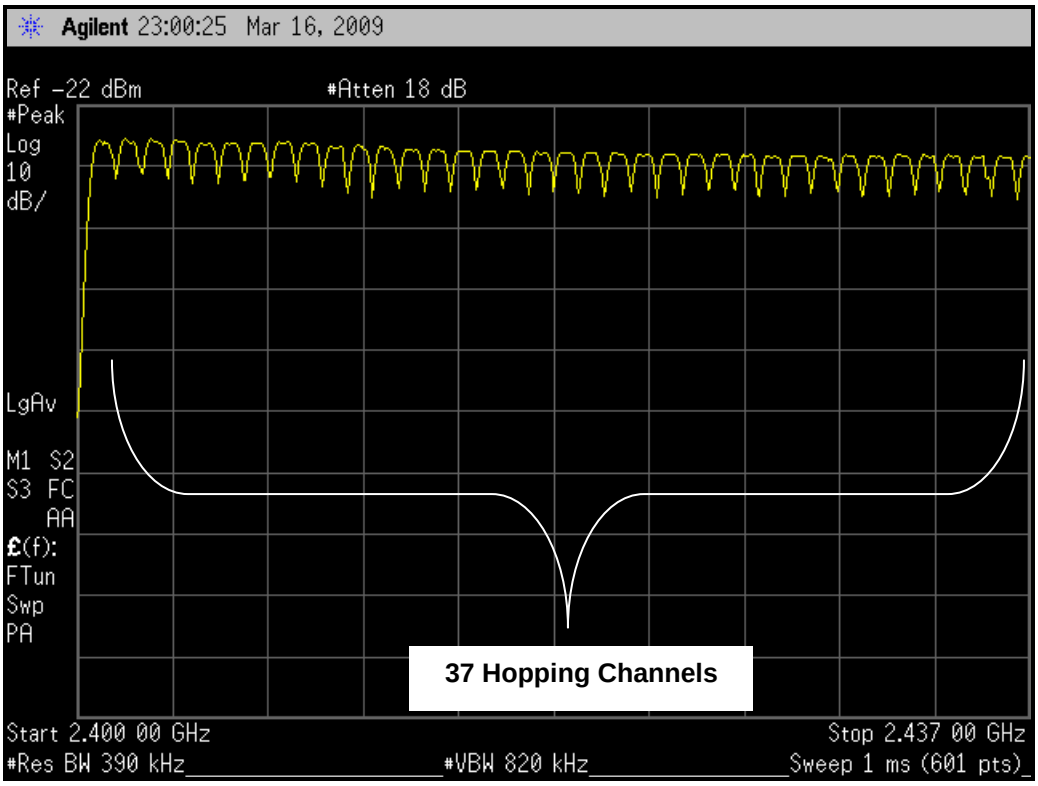
Table 7-1: Hopping Characteristics Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer (3 Hz–50 GHz)	US440203416	7/31/09

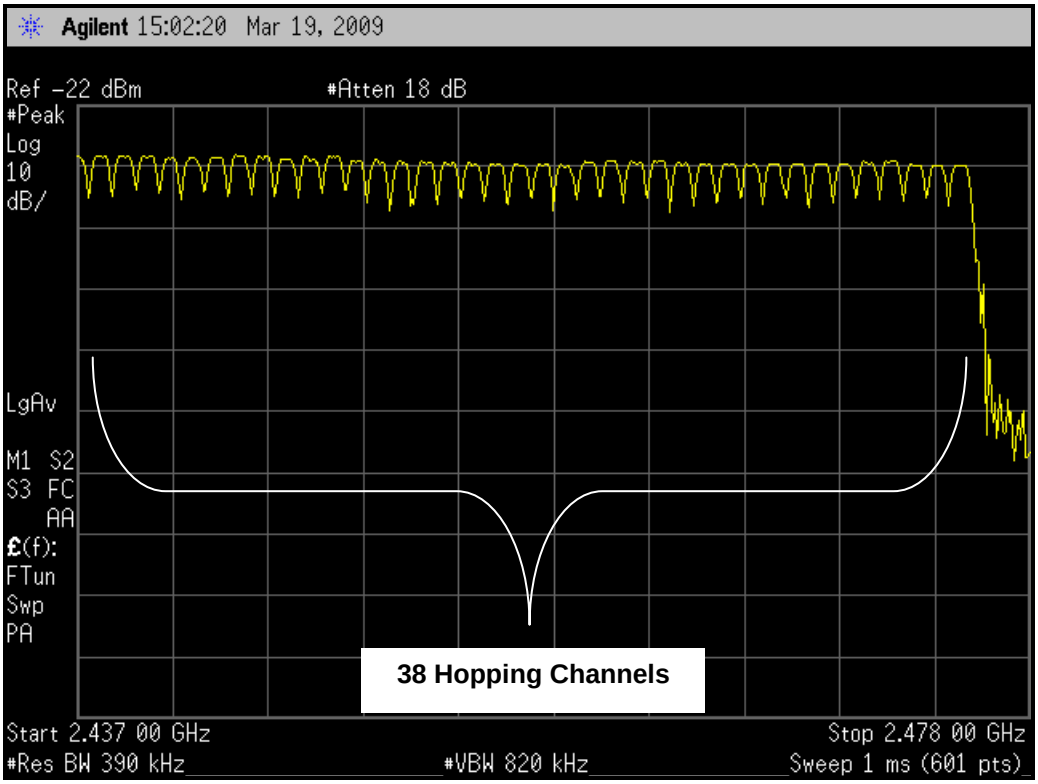
7.2 Number of Hopping Frequencies

Measured number of hopping frequencies = 37 + 38 = 75

Plot 7-1: Number of Hopping Frequencies (2401-2437 MHz)



Plot 7-2: Number of Hopping Frequencies (2437-2478 MHz)



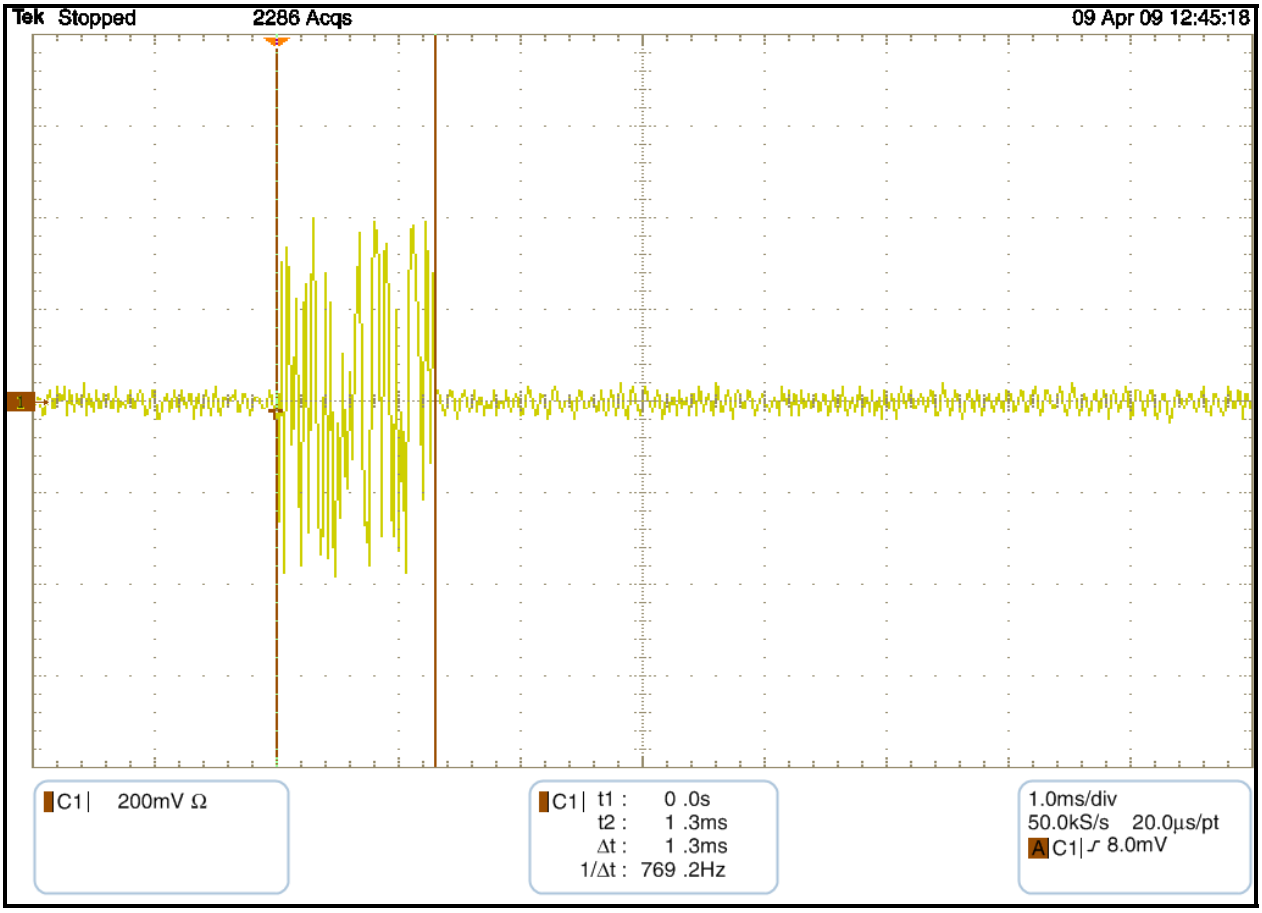
7.3 Average Time of Occupancy

A plot was taken from a scope of the pulse and measured to be 1.3 ms. The sweep was then set to single sweep for 30 seconds on a spectrum analyzer at zero span.

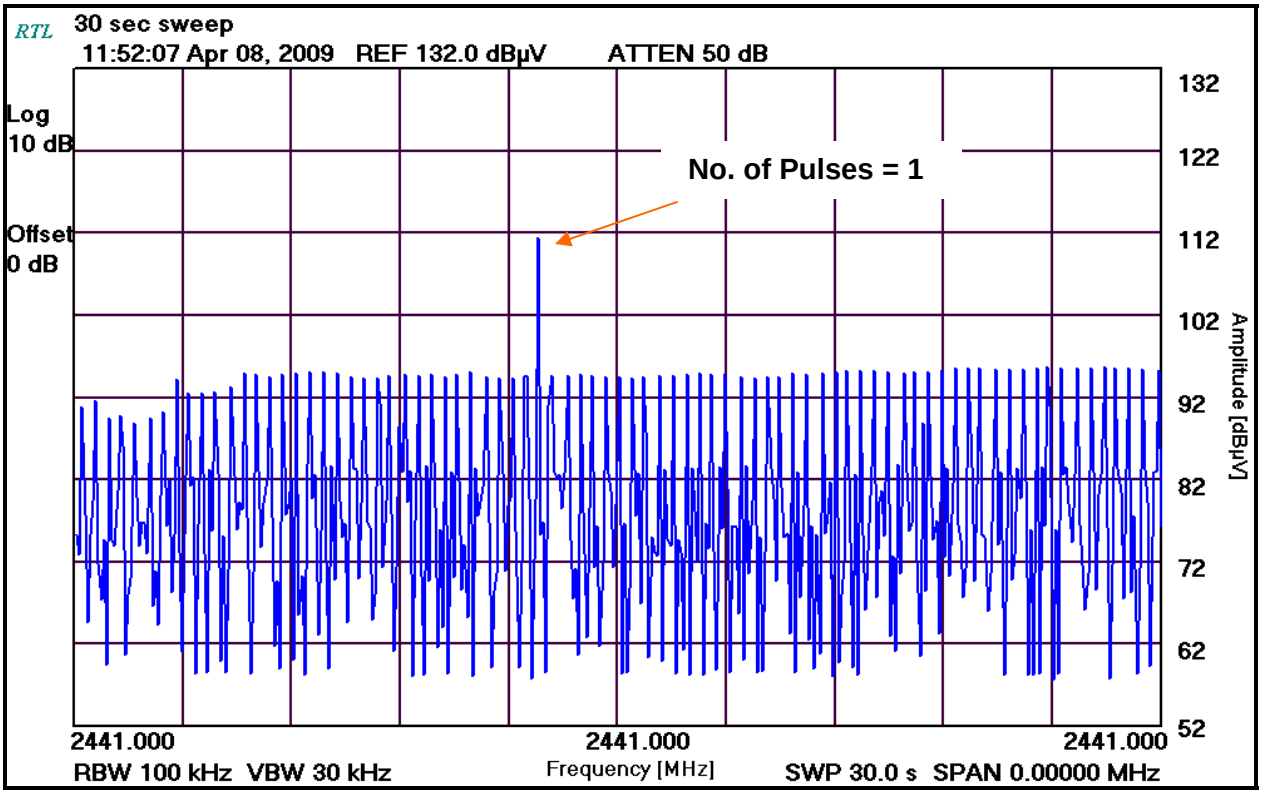
The number of pulses in 30 s was 1. Therefore, the number of pulses in a period of 0.4 seconds X 75 hopping channels (30 s) would be 1 pulse.

The average time of occupancy in the above period (30 s) is equal to 1 pulses X 1.3 ms = 1.3 ms, which meets the limit as defined by 15.247(a)(1)(iii) of 0.4 seconds.

Plot 7-3: Time of Occupancy (Dwell Time)



Plot 7-4: Time of Occupancy (Dwell Time 30 Second Sweep)



Test Personnel:

Dan Baltzell	Daniel W. Baltzell	March 19, April 8-9, 2009
EMC Test Engineer	Signature	Dates of Tests

8 Radiated Emissions - §15.209; RSS-210 §A1.1.2

8.1 Limits of Radiated Emissions Measurement

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009-0.490	2400/f (kHz)	300
0.490-1.705	2400/f (kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

As shown in 15.35(b), for frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any circumstances of modulation.

8.2 Radiated Emissions Measurement Test Procedure

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to ensure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane. The spectrum was examined from 9 kHz to the 10^{th} harmonic of the highest fundamental transmitter frequency (24.8 GHz).

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30 and 1000 MHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1000 MHz, emissions are measured using the average detector function with a minimum resolution bandwidth of 1 MHz. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Table 8-1: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900151	Rohde and Schwarz	HFH2-Z2	Loop Antenna (9 kHz-30 MHz)	827525/019	09/15/09
901365	MITEQ	JS4-00102600-41-5P	Amplifier, 0.1-26 GHz, 30dB gain	N/A	3/4/10
900878	Rhein Tech Laboratories, Inc.	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required
901516	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	10/17/09
901517	Insulated Wire Inc.	KPS-1503-360-KPS	RF cable 36"	NA	10/17/09
901242	Rhein Tech Laboratories, Inc.	WRT-000-0003	Wood rotating table	N/A	Not Required
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	7/31/09
900791	Chase	CBL6111B	Bilog antenna (30 MHz–2000 MHz)	N/A	12/12/10
900321	EMCO	3161-03	Horn Antennas (4–8 GHz)	9508-1020	6/14/10
900323	EMCO	3160-07	Horn Antennas (8.2–12 GHz)	9605-1054	6/14/10
900356	EMCO	3160-08	Horn Antennas (12.4–18 GHz)	9607-1044	6/14/10
901218	EMCO	3160-09	Horn Antenna (18-26 GHz)	960281-003	6/19/10
900772	EMCO	3161-02	Horn Antenna (2-4 GHz)	9804-1044	6/14/10

8.3 Radiated Emissions Test Results

8.3.1 Radiated Emissions Digital/Receiver Test Data

Table 8-2: Digital/Receiver Radiated Emissions Test Data

Temperature: 76.1°F Humidity: 24%									
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
99.650	Qp	V	0	1	54.7	-23.7	31.0	43.5	-12.5
139.700	Qp	V	0	1	48.5	-23.5	25.0	43.5	-18.5
211.000	Qp	V	0	1	45.2	-21.9	23.3	43.5	-20.2
329.800	Qp	V	0	1	38.5	-18.3	20.2	46.0	-25.8
505.000	Qp	V	0	1	32.6	-14.5	18.1	46.0	-27.9
621.080	Qp	V	0	1	41.1	-13.1	28.0	46.0	-18.0
1373.100	Pk	V	25	1	28.3	-6.4	21.9	54.0	-32.1
1394.242	Pk	V	0	1	28.2	-6.3	21.9	54.0	-32.1
1415.433	Pk	V	30	1	29.4	-6.0	23.4	54.0	-30.6

8.3.2 Radiated Emissions Harmonics/Spurious Test Data

Table 8-3: Radiated Emissions Harmonics/Spurious - 2401 MHz

Fundamental amplitude = 77.7 dBuV/m average

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ VBW)	Average Analyzer Reading (dBuV) (Peak -20 dB duty cycle)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4802.0	59.8	39.8	4.9	44.7	54.0	-9.3
7203.0	40.5	20.5	5.7	26.2	57.7	-31.5
9604.0	41.8	21.8	13.5	35.3	57.7	-22.4
12005.0	39.6	19.6	15.2	34.8	54.0	-19.2
14406.0	39.6	19.6	19.6	39.2	57.7	-18.5
16807.0	38.7	18.7	22.2	40.9	57.7	-16.8

Table 8-4: Radiated Emissions Harmonics/Spurious - 2437 MHz

Fundamental amplitude = 77.0 dBuV/m average

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ VBW)	Average Analyzer Reading (dBuV) (Peak -20 dB duty cycle)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4874.0	56.3	36.3	4.6	40.9	54.0	-13.1
7311.0	42.7	22.7	5.9	28.6	57.0	-28.4
9748.0	39.0	19.0	15.1	34.1	57.0	-22.9
12185.0	40.8	20.8	14.7	35.5	54.0	-18.5
14622.0	38.6	18.6	20.1	38.7	57.0	-18.3
17059.0	39.4	19.4	22.4	41.8	57.0	-15.2

Table 8-5: Radiated Emissions Harmonics/Spurious - 2475 MHz

Fundamental amplitude = 76.6 dBuV/m average

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ VBW)	Average Analyzer Reading (dBuV) (Peak -20 dB duty cycle)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4950.0	58.3	38.3	3.9	42.2	54.0	-11.8
7425.0	42.4	22.4	7.2	29.6	56.6	-27.0
9900.0	40.0	20.0	13.9	33.9	56.6	-22.7
12375.0	37.9	17.9	14.6	32.5	54.0	-21.5
14850.0	39.7	19.7	19.3	39.0	56.6	-17.6
17325.0	40.4	20.4	22.9	43.3	56.6	-13.3

Table 8-6: Radiated Emissions Harmonics/Spurious Hopping Mode

Fundamental amplitude = 76.6 dBuV/m average

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ VBW)	Average Analyzer Reading (dBuV) (Peak -20 dB duty cycle)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4816.0	63.8	43.8	4.9	48.7	54.0	-5.3
7245.0	45.7	25.7	5.8	31.5	56.6	-25.1
9860.5	38.6	18.6	14.4	33.0	56.6	-23.6
12161.2	37.5	17.5	14.5	32.0	54.0	-22.0
14740.0	38.4	18.4	19.6	38.0	56.6	-18.6
17204.0	38.6	18.6	23.3	41.9	56.6	-14.7

Test Personnel:

Daniel W. Baltzell		March 27-28, 2009
Test Engineer	Signature	Date Of Test

9 Conclusion

The data in this measurement report shows that the EUT as tested, Fleetwood Group, Inc., Model: KG3EI, FCC ID: FBRKG3EI, IC: 1859A-KG3EI, complies with all the applicable requirements of Parts 2 and 15, and Public Notice DA 00-705, of the FCC Rules and Regulations, and Industry Canada RSS-210 and RSS-Gen, for limited modular approval.