RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

Limited Modular Approval Certification Application Report
FCC Part 15.249 & Industry Canada RSS-210

Test Lab:	Applicant:
Rhein Tech Laboratories, Inc. 360 Herndon Parkway Suite 1400 Herndon, VA 20170 E-Mail: atcbinfo@rheintech.com Tel: 703-689-0368 Fax: 703-689-2056 www.rheintech.com	Fleetwood Group Inc. P.O. Box 1259 Holland, MI 49422 Contact: Emil Ureel Tel: 616-820-8271 Fax: 616-820-8300

FCC ID: **IC:**	FBRL240D 1859A-L240D	**Test Report Date:**	August 5, 2012
Platform:	N/A	**RTL Work Order #:**	2012234
Model:	L240D	**RTL Quote #:**	QRTL12-234
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:	DXT – Part 15 Low Power Transceiver		
FCC Rule Part(s)/ Guidance:	15.249: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHZ, and 24.0-24.25 GHz, October 1, 2009		
Industry Canada:	RSS-210 Issue 8: License-Exempt Radio Apparatus (All Frequency Bands): Category I Equipment		
Digital Interface Information:	Digital Interface was found to be compliant		

Frequency Range (MHz)	Output Power (W)	Frequency Tolerance	Emission Designator
2401 – 2475	N/A	N/A	664KFXD

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, RSS-210, and ANSI C63.4.

Signature: 

Date: August 5, 2012

Typed/Printed Name: Desmond A. Fraser

Position: President

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANSI-ASQ National Accreditation Board/ACLASS. Refer to certificate and scope of accreditation AT-1445.

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1 General Information

1.1 Scope

This is an original certification application request for Limited Modular Approval.

Applicable Standards:

- FCC Part 15.249: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz
- Industry Canada RSS-210: Low Power License-Exempt Communications Devices

1.2 Description of EUT

Equipment Under Test	Transceiver
Model	L240D
Power Supply	3VDC, CR1220a, cell or super-capacitor
Modulation Type	GFSK
Frequency Range	2401 – 2475 MHz
Antenna Connector Type	PCB Trace type
Antenna Type	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 certification application for Limited Modular Approval for Fleetwood Group, Inc., Model: L240D, FCC ID: FBRL240D, IC: 1859A-L240D.

1.5 Modifications

No modifications were made to the equipment during testing in order to achieve compliance with these standards.

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 a low, mid, and high power. 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. Four power levels were available for testing.

2.3 Test Result Summary

Table 2-2: Test Result Summary – FCC Part 15, Subpart C (Section 15.249)

Standard	Test	Pass/Fail or N/A
FCC 15.207	AC Power Conducted Emissions	N/A
FCC 15.209	Radiated Emissions	Pass
FCC 15.249(a)	Field Strength of Fundamental and Harmonics	Pass
RSS-Gen	20 dB Bandwidth	Pass

2.4 Test System Details

The test samples were received on August 2, 2012. 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
Transceiver	Fleetwood Group, Inc.	L240D	L2	FBRL240D	N/A	20366
Transceiver with SMA Connector	Fleetwood Group, Inc	L240D	L1	FBRL240D	N/A	20367

2.5 Configuration of Tested System

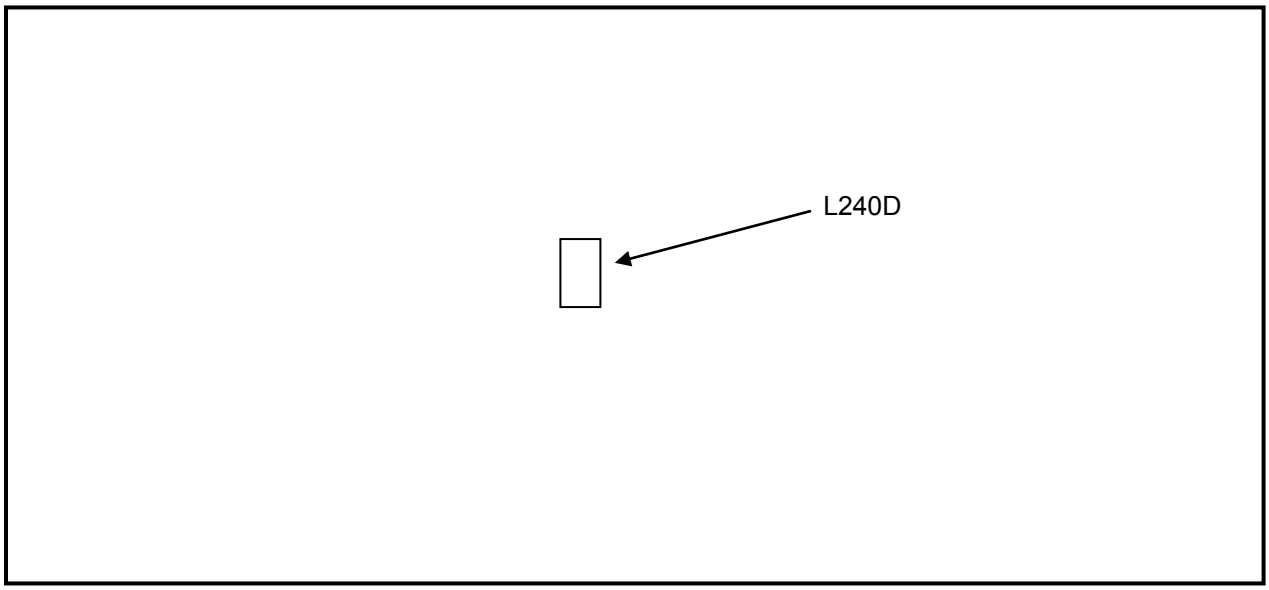


Figure 2-1: Configuration of System Under Test

3 Duty Cycle Calculation - FCC §15.35(c), RSS-Gen §4.3

A standard transmission consists of a 190.7 µs data packet with a 2.981 ms transmission period. Therefore, the maximum aggregate on time within a transmission period of 100 ms is 20log(0.1907/2.981) or -23.7 dB.

Duty cycle = 20Log(on time/(on time + off time)) = 20log(0.1907/2.981) = -23.9 dB

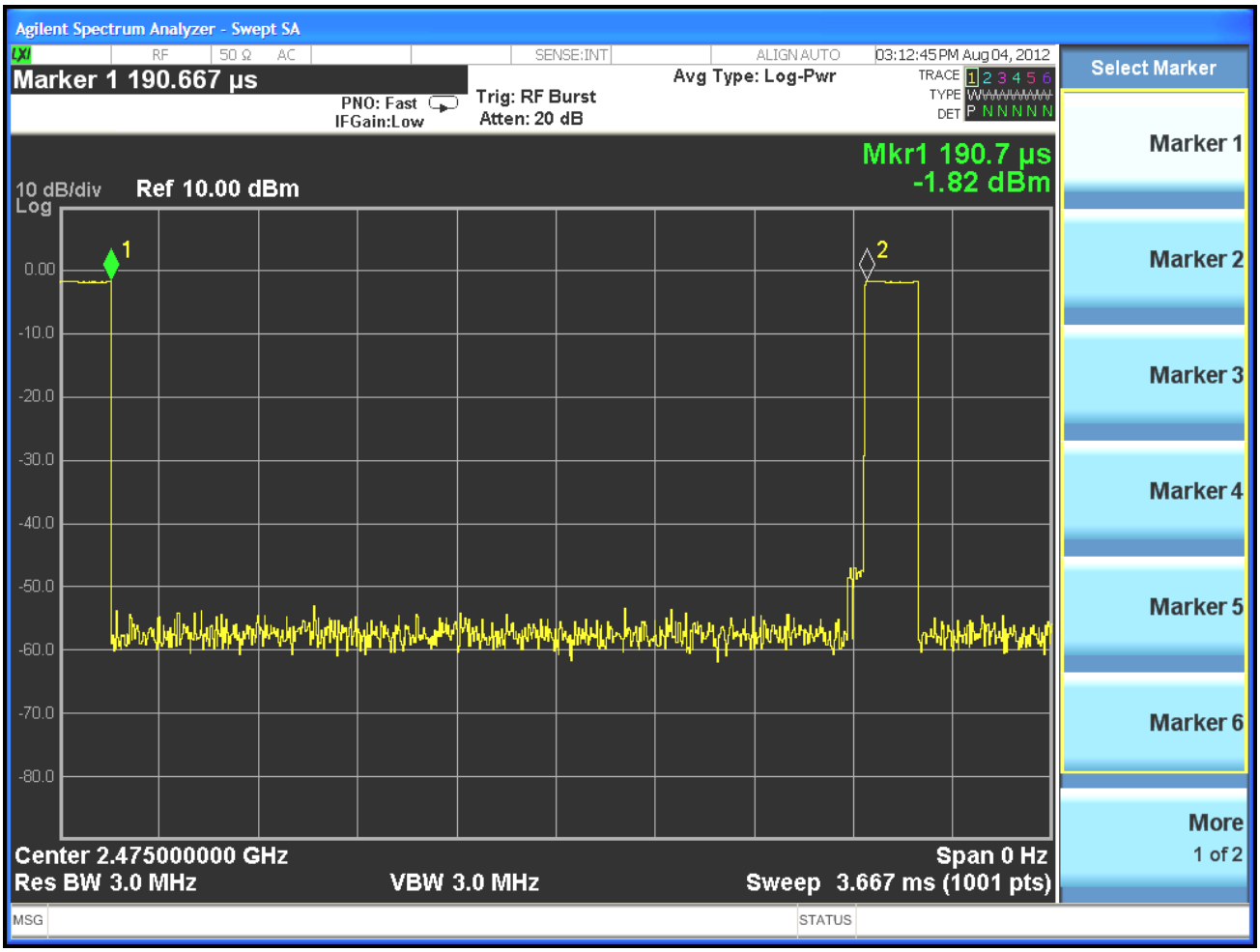
Or, on time in 100ms = 0.1907 x 34 pulses = 6.4838 ms and 20 log(6.4838/100) = -23.8 dB

The duty cycle correction is 23.8 dB.

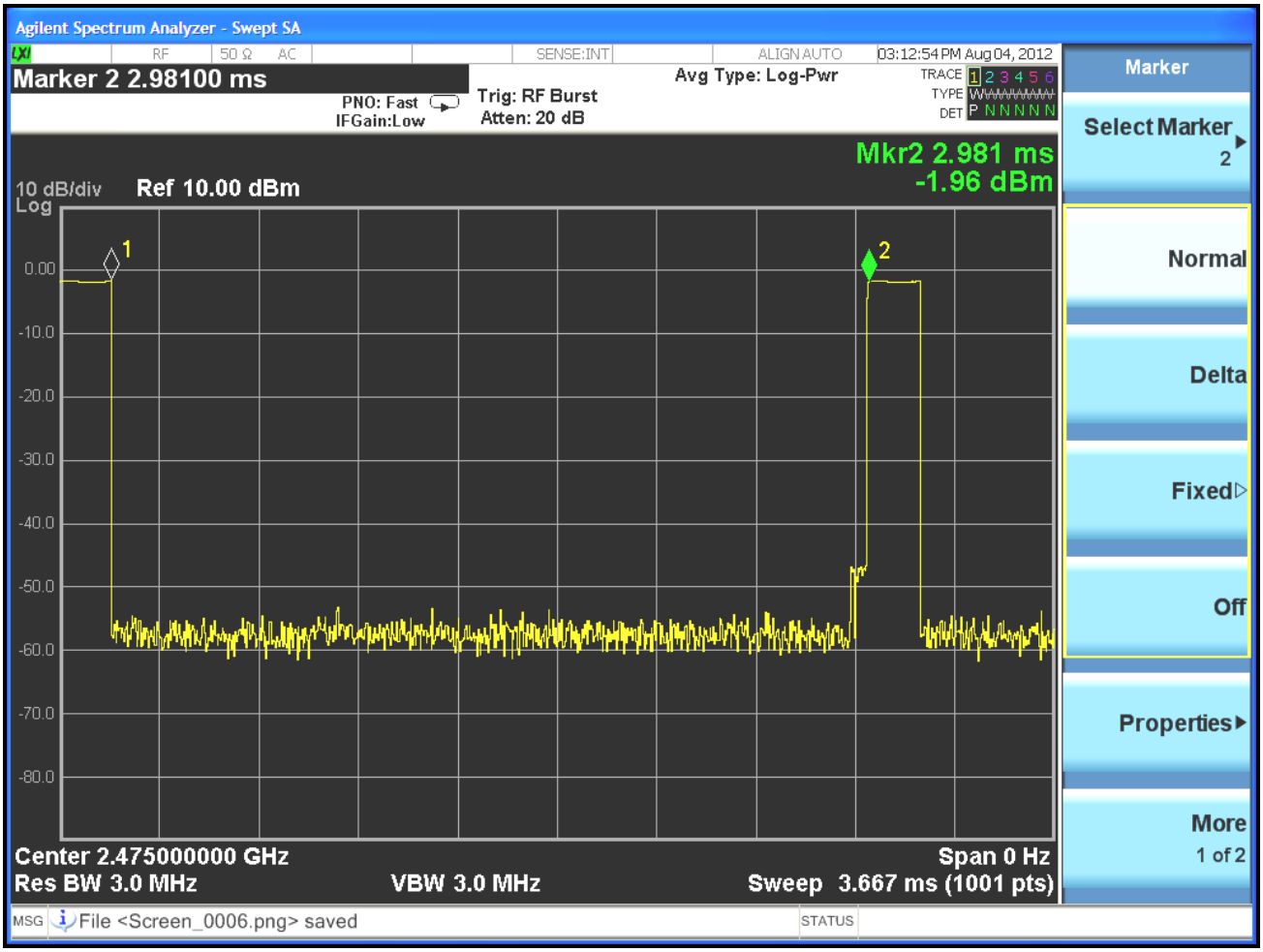
Table 3-1: Duty Cycle Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	3/13/13

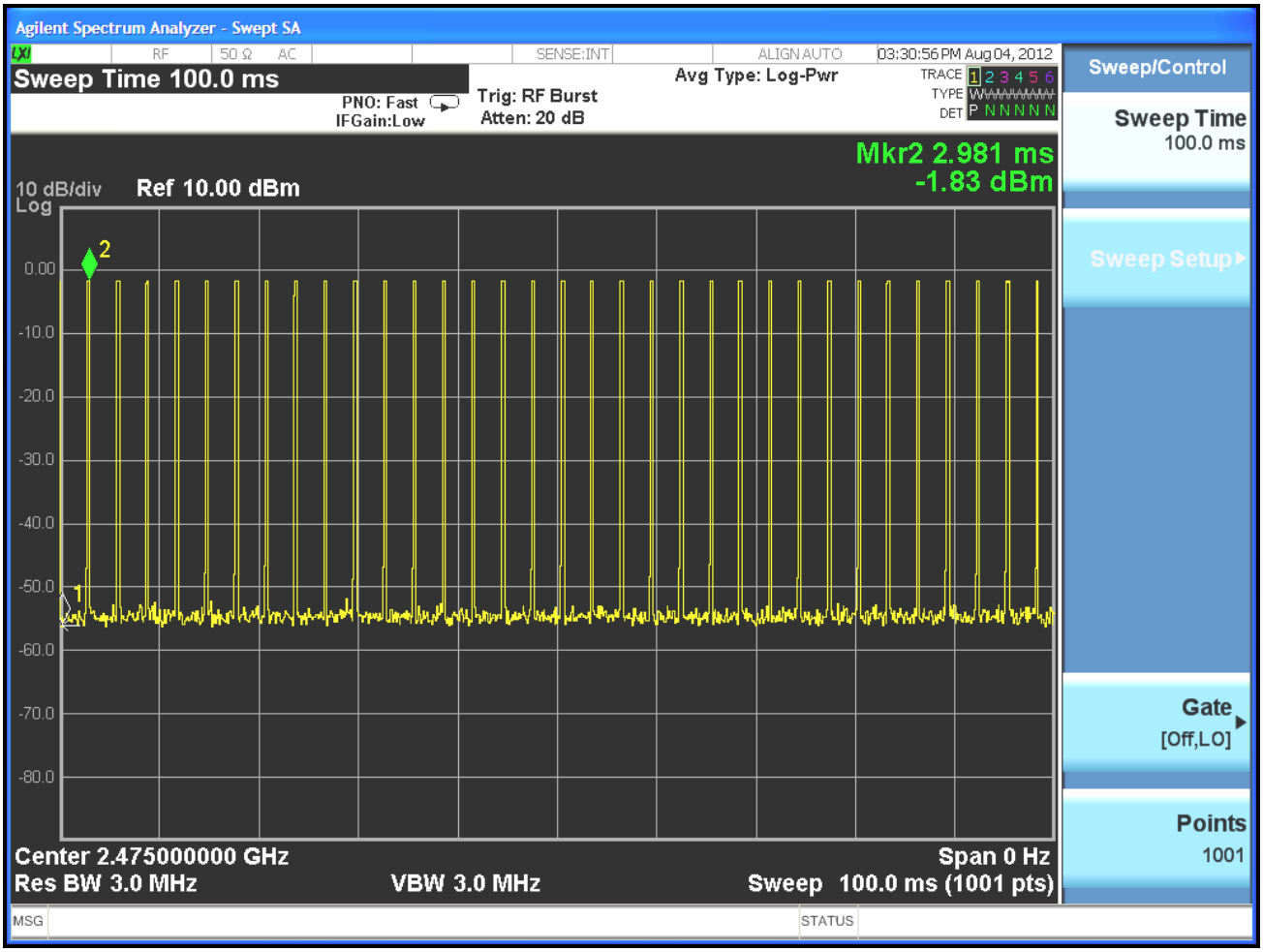
Plot 3-1: Duty Cycle On Time; 190.7 µs



Plot 3-2: Duty Cycle On Time + Off Time; 2.981 ms



Plot 3-3: Number of Pulses in 100 ms (34)



Test Personnel:

Daniel W. Baltzell		August 4, 2012
Test Engineer	Signature	Date of Test

4 Radiated Emissions – FCC §15.209, §15.249(a); RSS-210 §A2.9; RSS-Gen

4.1 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.

4.2 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 4-1: 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	10/1/12
900932	Hewlett Packard	8449B OPT H02	Preamplifier 1-26.5 GHz	3008A00505	7/14/13
900905	Rhein Tech Laboratories	PR-1040	OATS 1 Preamplifier 40dB (30 MHz–2 GHz)	1006	7/14/13
900878	Rhein Tech Laboratories	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	10/14/12
901236	IW Microwave Products	KPS-1503-360-KPS	High Frequency RF Cables	36"	7/8/13
901242	Rhein Tech Laboratories	WRT-000-0003	Wood rotating table	N/A	Not Required
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 kHz–6.5 GHz)	3325A00159	8/17/12
900914	Hewlett Packard	8546OA	RF Filter Section (100 kHz-6.5 GHz)	3330A00107	8/17/12
900772	EMCO	3161-02	Horn Antenna (2-4 GHz)	9804-1044	4/19/14
900321	EMCO	3161-03	Horn Antenna (4.0-8.2 GHz)	9508-1020	4/19/14
900323	EMCO	3160-07	Horn Antenna (8.2-12.4 GHz)	9605-1054	4/19/14
900356	EMCO	3160-08	Horn Antenna (12.4-18 GHz)	9607-1044	4/19/14
900325	EMCO	3160-9	Horn Antenna (18-26.5 GHz)	9605-1051	4/19/14
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	3/13/13
900724	Antenna Research Associates, Inc.	LPB-2520	BiLog Antenna (25-1000 MHz)	1037	4/19/14

4.3 Radiated Emissions Test Results

Table 4-2: Radiated Emissions Test Data

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV/m) (1 MHz RBW/ VBW)	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Calculated Average (dBuV/m) (-23.8 dB)	Average Limit (dBuV/m)	Average Margin (dB)
2401.0	86.0	11.2	97.2	114.0	-16.8	73.4	94.0	-20.6
2437.0	87.4	11.2	98.6	114.0	-15.4	74.8	94.0	-19.2
2475.0	86.6	11.2	97.8	114.0	-16.2	74.0	94.0	-20.0

** testing performed at 3m*

4.4 Radiated Emissions Harmonics/Spurious Test Data

Table 4-3: Radiated Emissions Harmonics/Spurious - 2401 MHz

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV/m) (1 MHz RBW/VBW) 1m	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Calculated Average (dBuV/m) (-23.8 dB)	Average Limit (dBuV/m)	Average Margin (dB)
4802.0	40.6	13.9	54.5	74.0	-19.5	30.7	54.0	-23.3
7203.0	35.6	13.1	48.7	74.0	-25.3	24.9	54.0	-29.1
9604.0	39.6	18.3	57.9	74.0	-16.1	34.1	54.0	-19.9
12005.0	33.4	18.1	51.5	74.0	-22.5	27.7	54.0	-26.3

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

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV/m) (1 MHz RBW/VBW) 1m	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Calculated Average (dBuV/m) (-23.8 dB)	Average Limit (dBuV/m)	Average Margin (dB)
4874.0	40.8	13.9	54.7	74.0	-19.3	30.9	54.0	-23.1
7311.0	34.5	13.0	47.5	74.0	-26.5	23.7	54.0	-30.3
9748.0	38.0	18.2	56.2	74.0	-17.8	32.4	54.0	-21.6
12185.0	33.5	18.0	51.5	74.0	-22.5	27.7	54.0	-26.3

Table 4-5: Radiated Emissions Harmonics/Spurious - 2475 MHz

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV/m) (1 MHz RBW/VBW) 1m	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Calculated Average (dBuV/m) (-23.8 dB)	Average Limit (dBuV/m)	Average Margin (dB)
4950.0	39.4	14.0	53.4	74.0	-20.6	29.6	54.0	-24.4
7425.0	33.9	12.9	46.8	74.0	-27.2	23.0	54.0	-31.0
9900.0	37.5	18.1	55.6	74.0	-18.4	31.8	54.0	-22.2
12375.0	34.4	18.1	52.5	74.0	-21.5	28.7	54.0	-25.3

4.5 Radiated Emissions Digital Test Data

Table 4-6: Digital Radiated Emissions Test Data

Temperature: 91°F Humidity: 68%										
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)	Pass/ Fail
32.299	Qp	V	0	1.0	34.6	-11.6	23.0	40.0	-17.0	Pass
48.444	Qp	H	0	1.0	38.5	-19.5	19.0	40.0	-21.0	Pass
64.589	Qp	H	0	1.0	38.8	-22.8	16.0	40.0	-24.0	Pass
80.734	Qp	V	0	1.0	35.2	-21.0	14.2	40.0	-25.8	Pass
96.879	Qp	V	0	1.0	39.8	-18.1	21.7	43.5	-21.8	Pass
113.024	Qp	H	0	1.0	33.6	-15.9	17.7	43.5	-25.8	Pass
161.459	Qp	H	0	1.0	33.0	-18.0	15.0	43.5	-28.5	Pass
226.039	Qp	V	0	1.0	33.8	-18.2	15.6	46.0	-30.4	Pass
323.120	Qp	V	0	1.0	32.6	-12.9	19.7	46.0	-26.3	Pass

Test Personnel:

Daniel W. Baltzell		August 3-4, 2012
Test Engineer	Signature	Dates of Test

5 AC Conducted Emissions - FCC §15.207; RSS-Gen §7.2.4: Conducted Limits

No Conducted tests are required since the device is powered solely by a 3 VDC “CR1220a” size cell.

6 20 dB Bandwidth – IC RSS-Gen

6.1 20 dB Bandwidth Test Procedure

The minimum 20 dB bandwidths per RSS-Gen were measured using a 50-ohm spectrum analyzer. The modulated carrier was adjusted on the analyzer so that it was displayed entirely on the spectrum analyzer. The sweep time was auto and allowed through several sweeps with the max hold function used in peak detector mode. The resolution bandwidth was set to 100 kHz, and the video bandwidth set to 1 MHz. The table below contains the bandwidth measurement results.

Table 6-1: 20 dB Bandwidth Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	3/13/13

6.2 20 dB Modulated Bandwidth Test Data

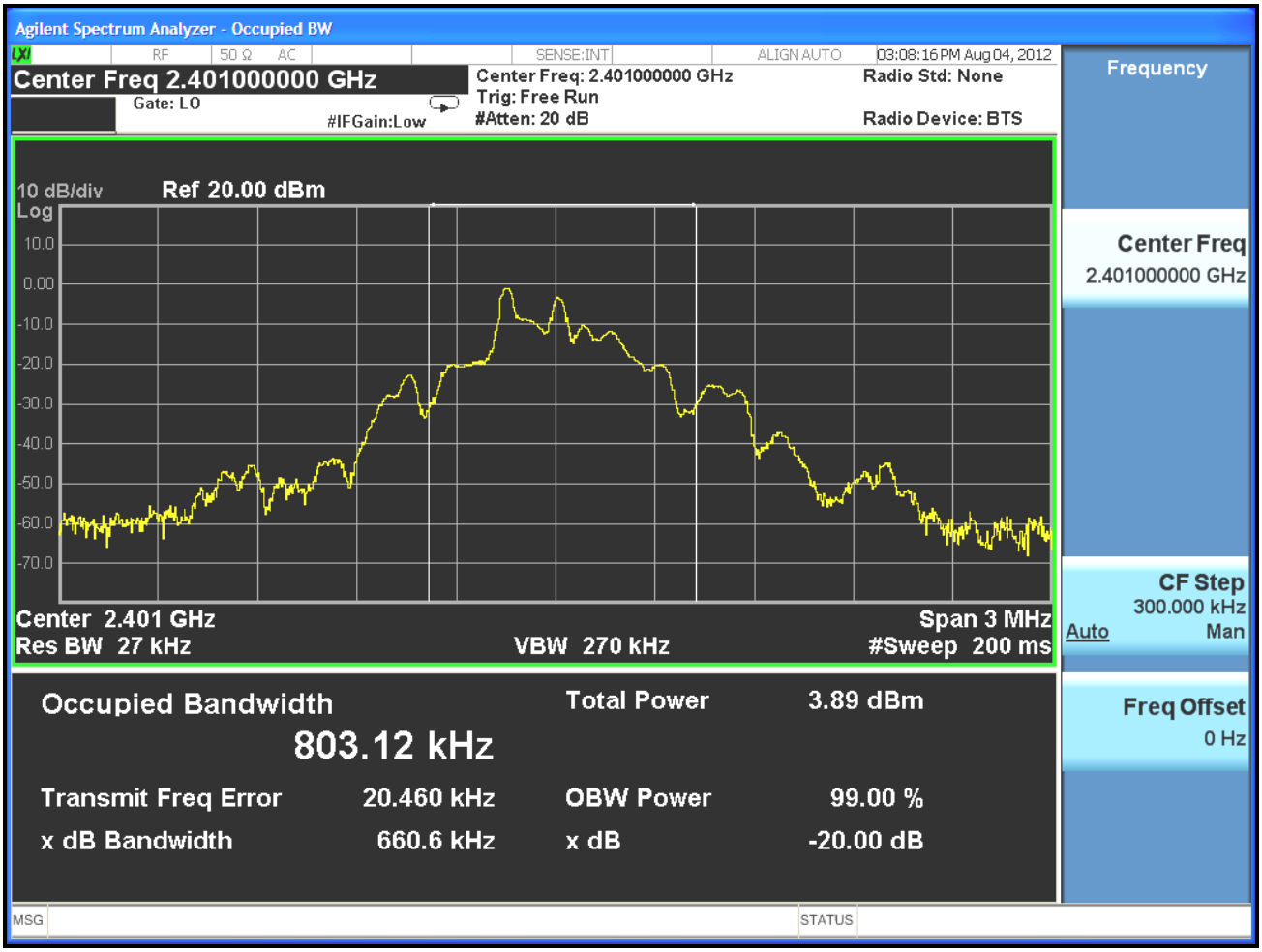
Table 6-2: 20 dB Modulated Bandwidth Test Data

Minimum 20 dB bandwidths

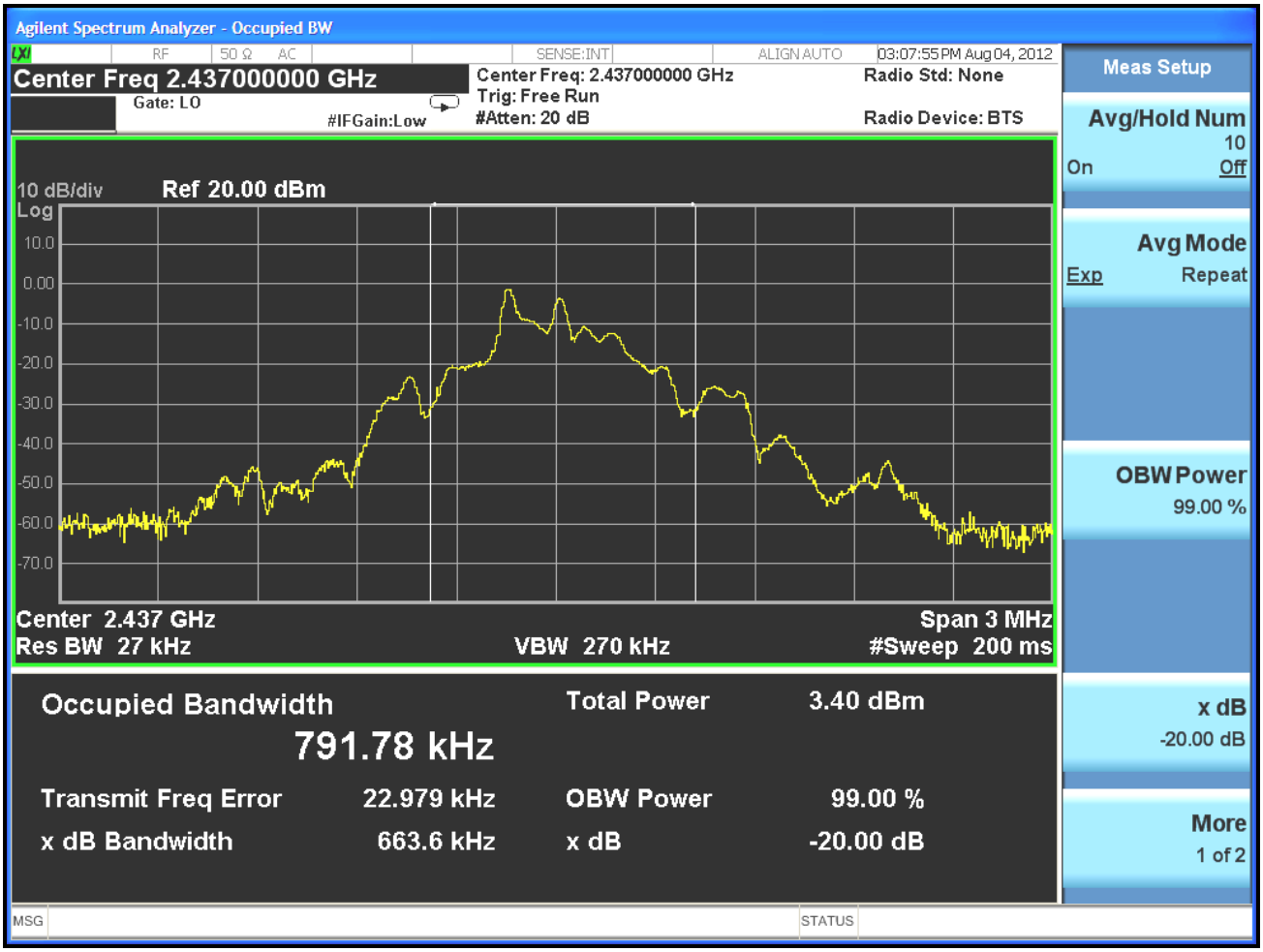
Channel	20 dB Bandwidth (kHz)
1	660.6
37	663.6
75	662.6

6.3 20 dB Bandwidth Plots

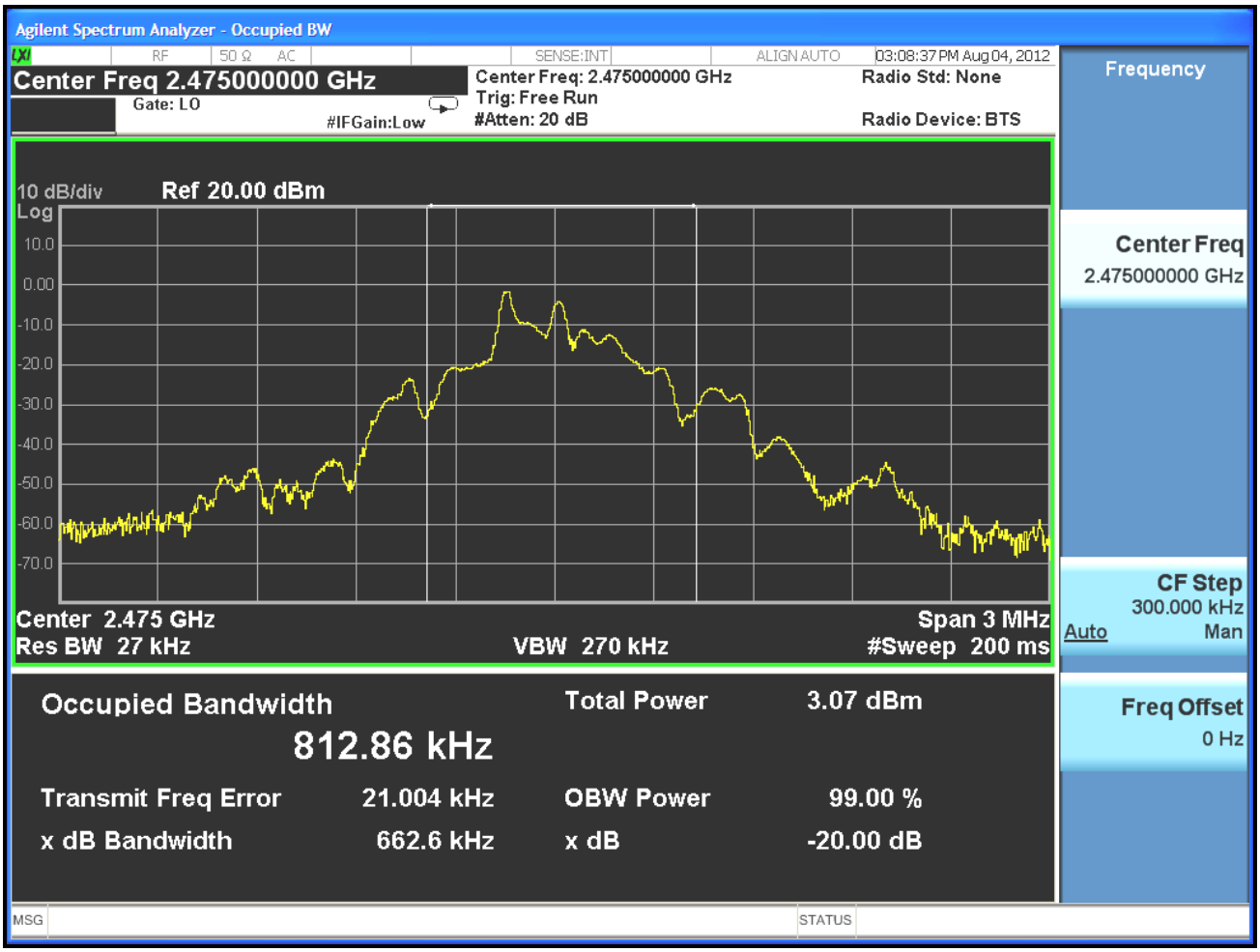
Plot 6-1: 20 dB Bandwidth; 2401 MHz



Plot 6-2: 20 dB Bandwidth; 2437 MHz



Plot 6-3: 20 dB Bandwidth; 2475 MHz



Test Personnel:

Daniel W. Baltzell		August 4, 2012
Test Engineer	Signature	Date of Test

7 Conclusion

The data in this measurement report shows that the EUT as tested, Fleetwood Group, Inc., Model: L240D, FCC ID: FBRL240D, IC: 1859A-L240D, complies with all the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations, and IC RSS-210 and RSS-Gen for limited modular approval.