166 South Carter, Genoa City, WI 53128

Company: BTR Controls, Inc.
Model Tested: 11-115-0000 & 11-115-0001
Report Number: 18663
DLS Project: 5025

Code of Federal Regulations 47 Part 15 – Radio Frequency Devices

Subpart C – Intentional Radiators
Section 15.249
Operation within the bands 902 - 928 MHz,
2400 - 2483.5 MHz, 5725 - 5875 MHz,
and 24.0 - 24.25 GHz
and

Subpart C – Intentional Radiators
Section 15.207
Conducted Emissions

THE FOLLOWING **MEETS** THE ABOVE TEST SPECIFICATION

Formal Name:	SeyWave RF Module
Kind of Equipment:	Wireless Communication Device
Frequency Range:	2402 MHz to 2481 MHz
Test Configuration:	Stand-alone for single modular approval
Model Number(s):	11-115-0000 & 11-115-0001
Model(s) Tested:	11-115-0000 & 11-115-0001
Serial Number(s):	10000 & 10001
Date of Tests:	January 7th, 8th, & 29th, 2013
Test Conducted For:	BTR Controls, Inc. 1570 Todd farm Drive Elgin, IL 60123 USA

NOTICE: "This test report relates only to the items tested and must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government". Please see the "Description of Test Sample" page listed inside of this report.

166 South Carter, Genoa City, WI 53128

Company: BTR Controls, Inc.
Model Tested: 11-115-0000 & 11-115-0001
Report Number: 18663
DLS Project: 5025

SIGNATURE PAGE

Tested By:

Craig Brandt
Test Engineer

Reviewed By:

William Stumpf
OATS Manager

Approved By:

Brian Mattson
General Manager

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United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 100276-0

D.L.S. Electronic Systems, Inc.
Wheeling, IL

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2012-10-01 through 2013-09-30
Effective dates

DEPARTMENT OF COMMERCE * UNITED STATES OF AMERICA *

For the National Institute of Standards and Technology

NVLAP-01C (REV. 2009-01-28)

1.0 Summary of Test Report

It was determined that the BTR Controls, Inc. SeyWave RF Module, complies with the requirements of CFR 47 Part 15 Subpart C Section 15.249, and Subpart C Section 15.207.

Subpart C Section 15.249, and Subpart C Section 15.207 Applicable Technical Requirements Tested:

Section	Description	Procedure	Note	Compliant?
15.249(a)	Field Strength of Fundamental Frequency & Spurious Emissions	ANSI C63.10-2009 Sections 6.5 & 6.6	1, 2	Yes
15.205, 15.209, 15.35	Radiated Band-Edge	ANSI C63.10-2009 Sections 6.6 & 6.9.3	1	Yes
15.215(c)	20 dB Emission Bandwidth	ANSI C63.10-2009 Section 6.9.1	3	NA
15.35(c)	Duty Cycle Correction	ANSI C63.10-2009 Section 7.5	3	NA
15.207	AC Line Conducted Emissions	ANSI C63.10-2009 Section 6.2	4	Yes

Note 1: EUT tested at a distance of 3 meters in three orthogonal planes.
Note 2: EUT tested at a distance of 1 meter in three orthogonal planes above 18 GHz.
Note 3: Informative.
Note 4: AC Line Conducted Emissions tested with an off-the-shelf AC power adapter.

2.0 Introduction

On January 7th, 8th & 29th, 2013, the SeyWave RF Module, as provided by BTR Controls, Inc. was tested to the requirements of CFR 47 Part 15 Subpart C Section 15.249, and Subpart C Section 15.207. To meet these requirements, the procedures contained within this report were performed by personnel of D.L.S Electronic Systems, Inc.

3.0 Facilities

D.L.S. Electronic Systems, Inc. is a full service EMC/Safety Testing Laboratory accredited to ISO 17025. NVLAP Certificate and Scope can be viewed at http://www.dlsemc.com/certificate. Our facilities are registered with the FCC, Industry Canada, and VCCI.

Wisconsin Test Facility:
D.L.S. Electronic Systems, Inc.
166 S. Carter Street
Genoa City, Wisconsin 53128

Wheeling Test Facility:
D.L.S. Electronic Systems, Inc.
1250 Peterson Drive
Wheeling, IL 60090

4.0 Description of Test Sample

Description:

This is a 2.4 GHz RF module. The test samples consist of the RF module and a host board. The host board only provides power and screw terminal connections to the RF module, along with a RS485 port for debugging.

Type of Equipment / Frequency Range:

RF Module operating on 79 channels / 2402 MHz to 2481 MHz

Physical Dimensions of Equipment Under Test:

Length: 3 in. x Width: 1 in. x Height: 2 in.

Power Source:

2.4 - 5.25 VDC / 120V, 60Hz from power supply

Internal Frequencies:

16 MHz, 0.032768 MHz

Transmit / Receive Frequencies Used For Test Purpose:

2402 MHz, 2440 MHz, 2481 MHz

4.0 Description of Test Sample (continued)

Type of Modulation(s) / Antenna Type:

GFSK / SMT Ceramic, External RP-SMA Whip

Description of Circuit Board(s) / Part Number:

SeyWave RF Module	11-115-0000 Rev D
SeyWave RF Module EXT An	11-115-0001 Rev A
Microprocessor Model Number	PIC18F24K20

5.0 Test Equipment

A list of the equipment used can be found in the table below. All primary equipment was calibrated against known reference standards with a verified traceable path to NIST.

D.L.S. Wisconsin – Site 3 - Test Equipment:

30 – 1000 MHz

Description	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Date	Cal Due Dates
Receiver	Rohde & Schwarz	ESI 40	837808/005	20 Hz – 40 GHz	7-23-12	7-23-13
Antenna	EMCO	3104C	97014785	20 MHz – 200 MHz	8-22-12	8-22-14
Antenna	EMCO	3146	97024895	200 MHz – 1 GHz	9-6-12	9-6-14

AC LINE CONDUCTED TEST (Screen Room)

Description	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Date	Cal Due Dates
Receiver	Rohde & Schwarz	ESI 40	837808/005	20 Hz – 40 GHz	7-23-12	7-23-13
LISN	Solar	9252-50-R-24-BNC	961019	9 kHz – 30 MHz	5-24-12	5-24-13
Filter- High-Pass	SOLAR	7930-120	090702	120 kHz – 30 MHz	1-7-13	1-7-14
Limiter	Electro-Metrics	EM-7600	706	9 kHz – 30 MHz	1-7-13	1-7-14

Test Equipment continued:

1-18 GHz

Description	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Date	Cal Due Dates
Preamp	Planar	PTB-60-120-5R0-10-115VAC-S	PL3291	1GHz-20GHz	8-13-12	8-13-13
Horn Antenna	EMCO	3115	9903-5731	1-18GHz	6-29-11	6-29-13
Filter- High-Pass	Q-Microwave	100462	2	4.2GHz-18GHz	5-18-12	5-18-13

18-26 GHz

Description	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Date	Cal Due Dates
Preamp	Miteq	AMF-8B-180265-40-10P-H/S	438727	18GHz-26GHz	8-13-12	8-13-13
Horn Antenna	EMCO	3116	2549	18 – 40GHz	9-6-12	9-6-14
Filter- High-Pass	Planar	CL22500-9000-CD-SS	PF1230/0728	18GHz-26GHz	8-13-12	8-13-13

6.0 Test Arrangements

Radiated Arrangement:

All emission tests were performed at D.L.S. Electronic Systems, Inc. and set up according to ANSI C63.10-2009 unless otherwise noted. Description of procedures and measurements can be found in Appendix B – Measurement Data. See Appendix A for additional photos of the test set up.

Unless otherwise noted, the bandwidth of the measuring receiver / analyzer used during testing is shown below.

Frequency Range	Bandwidth (-6 dB)
10 to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz
30 MHz to 1 GHz	120 kHz
Above 1 GHz	1 MHz

7.0 Test Conditions

Temperature and Humidity:

68°F at 24% RH

8.0 Modifications Made To EUT For Compliance

None noted at time of test.

9.0 Additional Descriptions

Test Software used to control transmit and receive.
Continuous transmit.
Low, Mid, and High channels.
Model 11-115-0000: Tested in three orthogonal axis of rotation.
Model 11-115-0001: Tested in three orthogonal axis of rotation.

10.0 Results

Measurements were performed in accordance with ANSI C63.10-2009. Graphical and tabular data can be found in Annex B at the end of this report.

11.0 Conclusion

The Seywave RF Module as provided by BTR Controls, Inc., tested on January 7th, 8th, & 29th, 2013 **meets** the requirements of CFR 47 Part 15 Subpart C Section 15.249, and Subpart C Section 15.207.

Appendix A – Test Photos

Photo Information and Test Setup:

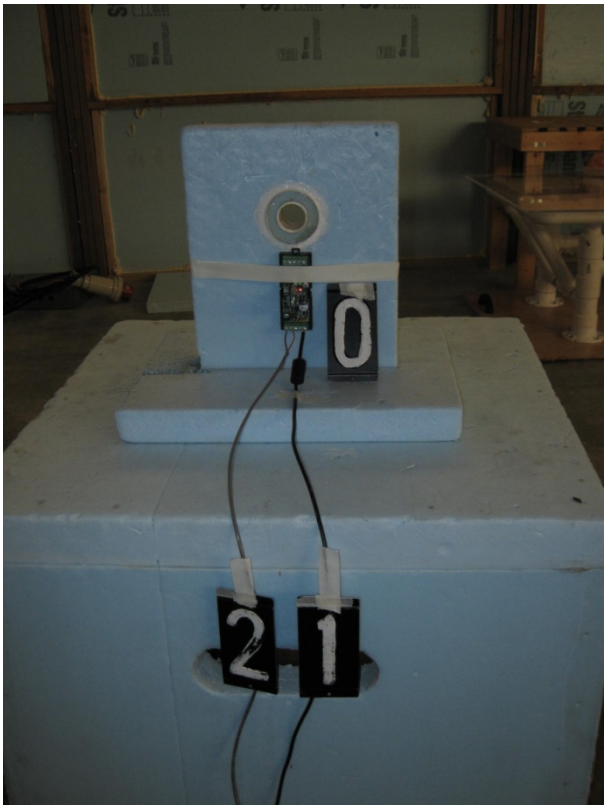
Item 0: Model 11-115-0000 or 11-115-0001, as noted
Item 1: Cord from power supply (no manufacturer listed): Model TH-363A
Item 2: Unshielded Cable used for programming test modes, 1.2 m long with plastic shells

Radiated Front - Below 1 GHz (Model 11-115-0000)

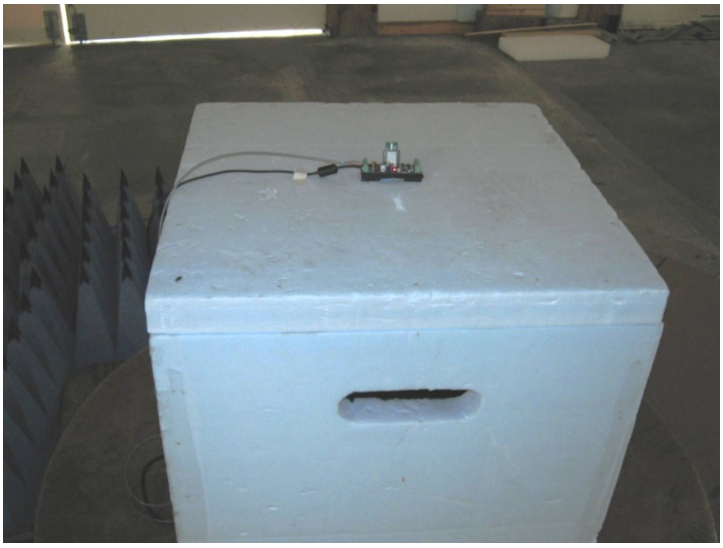
Radiated Back - Below 1 GHz (Model 11-115-0000)

Appendix A

Radiated - Position 1
(Model 11-115-0000)



Radiated - Position 2
(Model 11-115-0000)



Appendix A

Radiated - Position 3
(Model 11-115-0000)

Radiated - Above 1 GHz
(Model 11-115-0000)

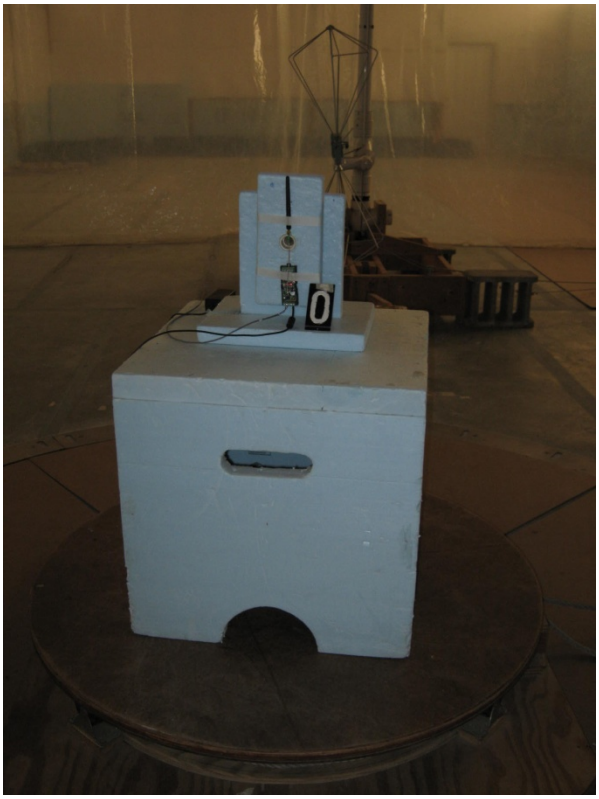
Appendix A

AC Line Conducted - Front
(Model 11-115-0000)

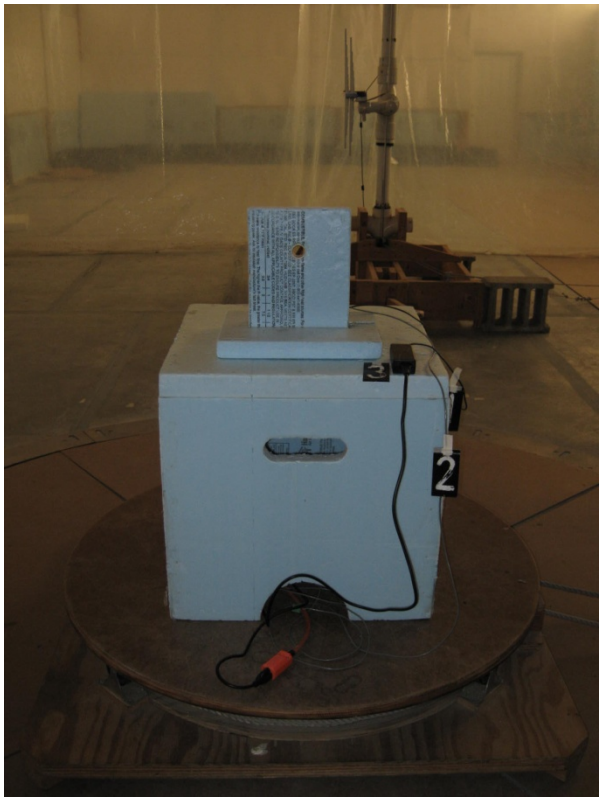
AC Line Conducted - Back
(Model 11-115-0000)

Appendix A

Radiated Front - Below 1 GHz
(Model 11-115-0001)

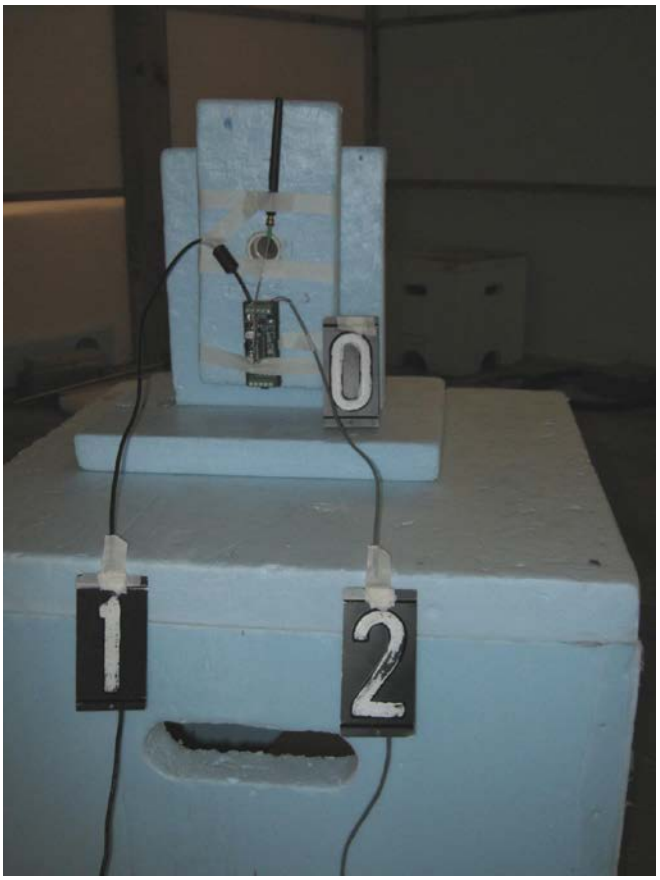


Radiated Back - Below 1 GHz
(Model 11-115-0001)

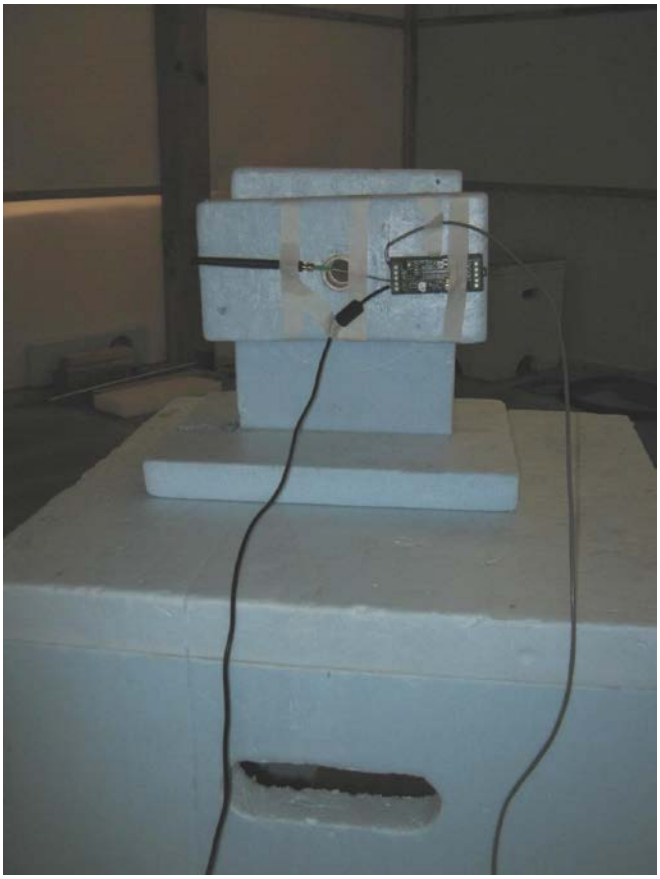


Appendix A

Radiated - Position 1
(Model 11-115-0001)



Radiated - Position 2
(Model 11-115-0001)



Appendix A

Radiated - Position 3
(Model 11-115-0001)

Radiated - Above 1 GHz
(Model 11-115-0001)

Appendix A

AC Line Conducted - Front
(Model 11-115-0001)

AC Line Conducted - Back
(Model 11-115-0001)

Appendix B – Measurement Data

1.0 Field Strength of Fundamental and Spurious emissions

Rule Part: Section 15.249(a) including 15.209(a)

Test Procedure: ANSI C63.10-2009 Sections 6.5 & 6.6

Limits:

Fundamental Frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
2400 – 2483.5 MHz	50	500

Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960	500

Results: Compliant

Sample Equations:

Total Level = Level + Antenna Factor + System Loss
Final Corrected = Total Level - Duty Cycle Correction
Margin = Limit - Final Corrected

Notes:

Tested at a 3 meter distance 30 MHz to 18 GHz
Tested at a 1 meter distance 18 GHz to 26 GHz
All other emissions at least 20 dB below the limit
Compliance is shown by measurement with a peak detector and applying a duty cycle corrected value to the average limit (see above equations).

FCC Part 15.249 & 15.205

Electric Field Strength

EUT: SeyWave RF Module, Model: 11-115-0000 & 11-115-0001
Manufacturer: BTR Controls
Operating Condition: 68 deg. F; 24% R.H.
Test Site: DLS O.F. Site 3
Operator: Craig B
Test Specification: Spurious; Low, Mid, High channels
Comment: Continuous Transmit
Date: 01-08-2013

TEXT: "Horz 3 meters"

Short Description: Test Set-up

Test Set-up: EUT Measured at 3 Meters with HORIZONTAL Antenna Polarization

Equations: Total Level(dBµV/m) = Level(dBµV) + System Loss(dB) + Antenna Factor(dBµV/m)

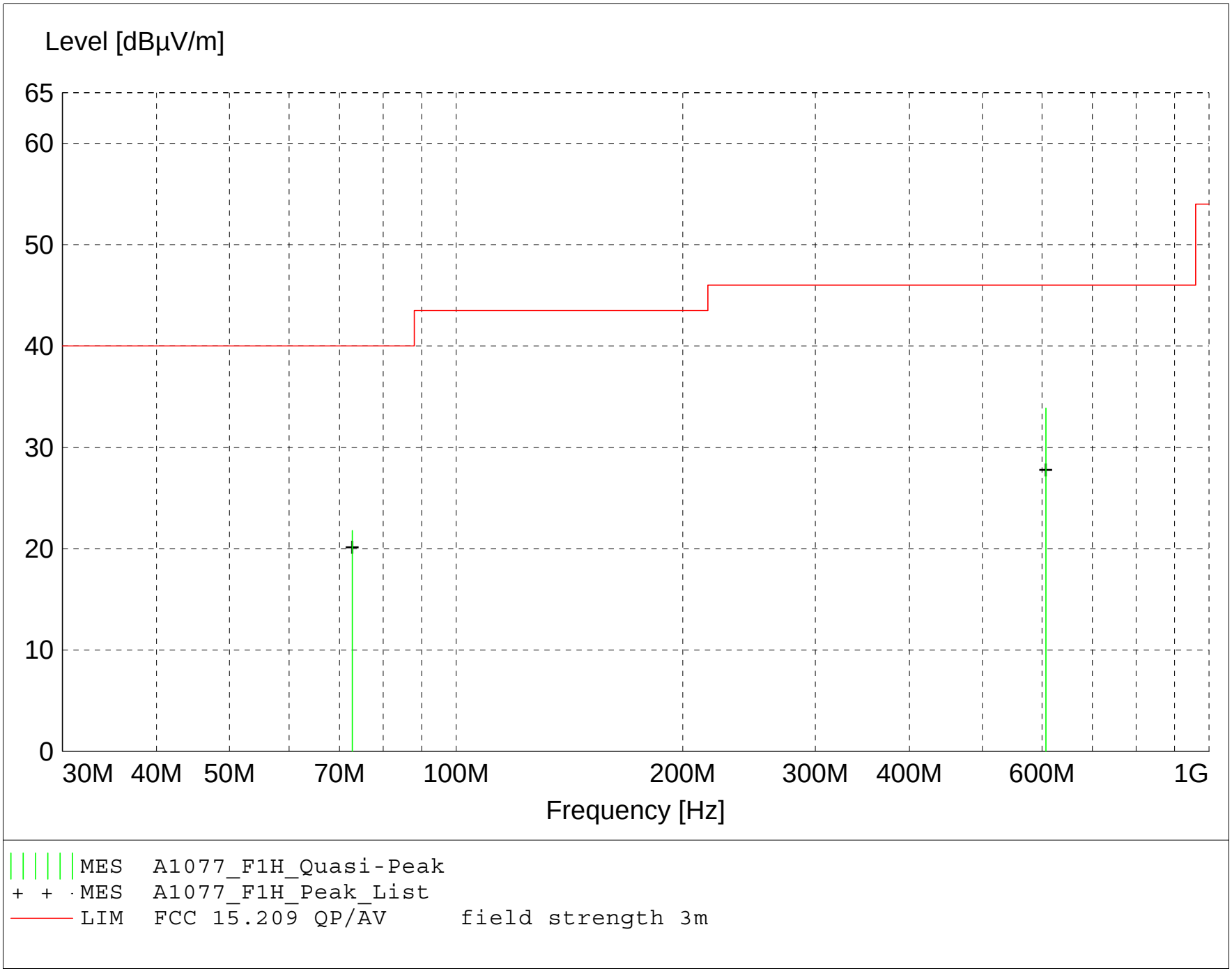
Margin(dB) = Limit(dBµV/m) - Total Level(dBµV/m)

Graph Markers: + Frequency marker (Level of marker not related to final level)

| Final maximized level using Quasi-Peak detector

X Final maximized level using Average dector

Final maximized level using Peak detector


Level [dBµV/m]
65
60
50
40
30
20
10
0
30M
40M
50M
70M
100M
200M
300M
400M
600M
1G
Frequency [Hz]
MES A1077_F1H_Quasi-Peak
MES A1077_F1H_Peak_List
LIM FCC 15.209 QP/AV field strength 3m

MEASUREMENT RESULT: "A1077_F1H_Final"

1/8/2013 11:24AM

Frequency	Level	Antenna Factor	System Loss	Total Level	Limit	Margin	Height Ant.	EuT Angle	Final Detector	Comment
MHz	dBµV	dBµV/m	dB	dBµV/m	dBµV/m	dB	m	deg		
607.260000	8.94	19.29	5.6	33.9	46.0	12.1	1.80	180	QUASI-PEAK	noise floor
72.790000	13.25	6.64	1.9	21.8	40.0	18.2	2.70	300	QUASI-PEAK	broadband

FCC Part 15.249 & 15.205

Electric Field Strength

EUT: SeyWave RF Module, Model: 11-115-0000 & 11-115-0001
Manufacturer: BTR Controls
Operating Condition: 68 deg. F; 24% R.H.
Test Site: DLS O.F. Site 3
Operator: Craig B
Test Specification: Spurious; Low, Mid, High channels
Comment: Continuous Transmit
Date: 01-08-2013

TEXT: "Vert 3 meters"

Short Description: Test Set-up

Test Set-up: EUT Measured at 3 Meters with VERTICAL Antenna Polarization

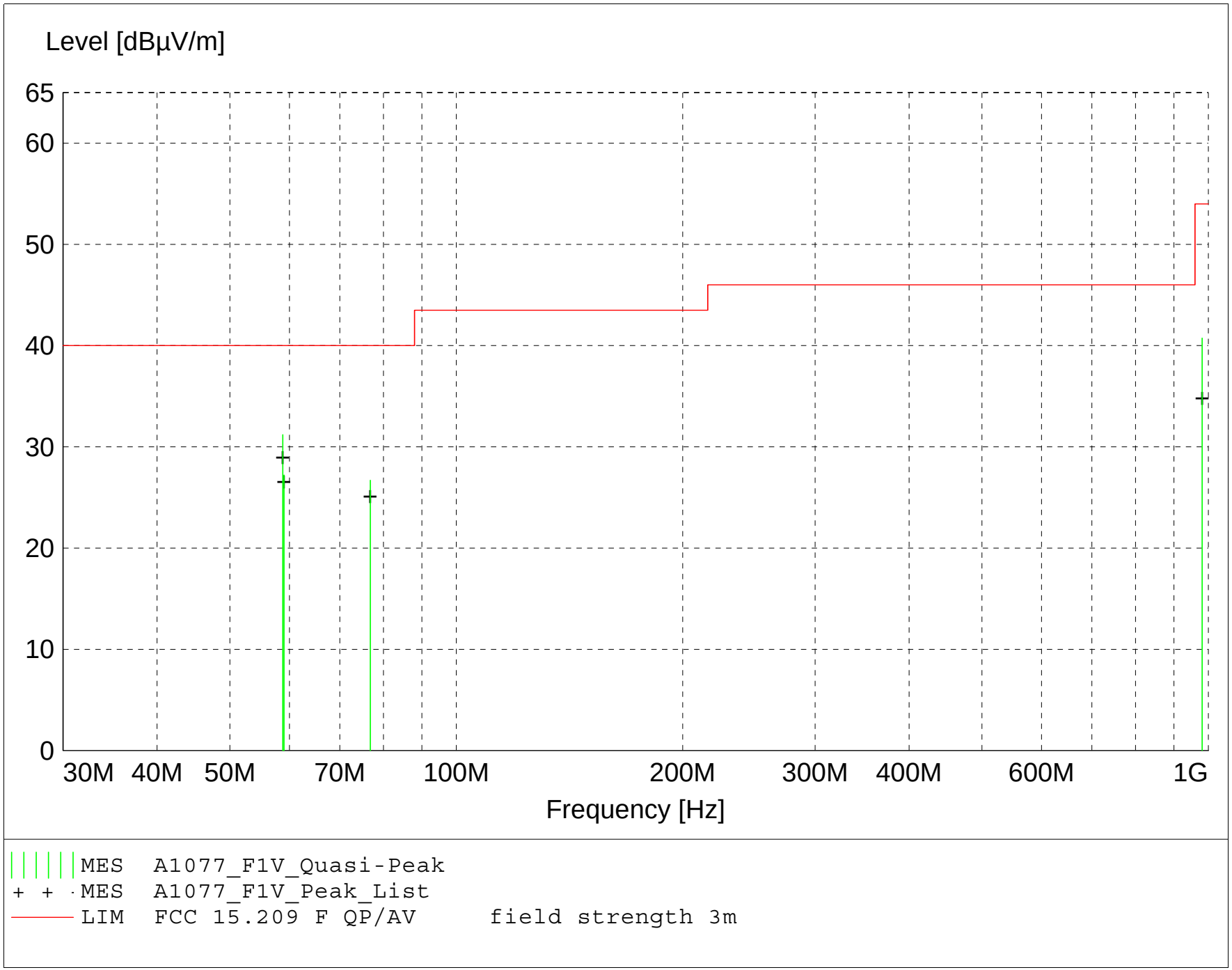
Sample Equations:

Total Level(dBµV/m)	= Level(dBµV)	+ System Loss(dB)	+ Antenna Factor(dBµV/m)
24.6	= 35.51	+ (-22.1)	+ 11.20

Margin(dB)	= Limit(dBµV/m)	- Total Level(dBµV/m)
15.4	= 40	- 24.6

Graph Markers:

+	Frequency marker (Level of marker not related to final level)
|	Final maximized level using Quasi-Peak detector
X	Final maximized level using Average dector
#	Final maximized level using Peak detector


Level [dBµV/m]
65
60
50
40
30
20
10
0
30M
40M
50M
70M
100M
200M
300M
400M
600M
1G
Frequency [Hz]
MES A1077_F1V_Quasi-Peak
MES A1077_F1V_Peak_List
LIM FCC 15.209 F QP/AV field strength 3m

MEASUREMENT RESULT: "A1077_F1V_Final"

1/8/2013 11:30AM

Frequency	Level	Antenna Factor	System Loss	Total Level	Limit	Margin	Height Ant.	EuT Angle	Final Detector	Comment
MHz	dBµV	dBµV/m	dB	dBµV/m	dBµV/m	dB	m	deg		
58.800000	19.03	10.44	1.7	31.2	40.0	8.8	1.00	20	QUASI-PEAK	broadband
59.025000	15.09	10.40	1.7	27.2	40.0	12.8	1.00	315	QUASI-PEAK	broadband
981.190000	9.09	24.30	7.3	40.7	54.0	13.3	1.00	0	QUASI-PEAK	noise floor
76.855000	18.64	6.10	2.0	26.7	40.0	13.3	1.00	340	QUASI-PEAK	broadband

Radiated Fundamental and Spurious Emissions – 1 GHz to 26 GHz

1 GHz to 18 GHz Tested at a 3 Meter Distance

18 GHz to 26 GHz Tested at a 1 Meter Distance

EUT: SeyWave RF Module, Model: 11-115-0000
Manufacturer: BTR Controls, Inc.
Operating Condition: 68 deg F; 23% R.H.
Test Site: Site 3
Operator: Craig B
Test Specification: FCC Part 15.249 and Part 15.205
Comment: Transmit at Low channel: 2.402 GHz
Date: 01-07-2013 and 01-29-2013
Notes: All measurements with Peak detector.
All other emissions are more than 20 dB under the limit.

Frequency (GHz)	Measurement Type	Antenna Polarization	Level (dBuV)	Antenna Factor (dB/m)	System Loss (dB)	Duty Cycle Correction (dB)	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	EUT Angle (deg)	Comment
2.402	Max Peak	Vert	60.60	28.70	0.7	0	90.0	114	24.0	1.3	315	Fundamental
2.402	Average	Vert	60.60	28.70	0.7	-26.76	63.2	94	30.8	1.3	315	Fundamental
2.402	Max Peak	Horz	62.90	28.70	0.7	0	92.3	114	21.7	1.8	90	Fundamental
2.402	Average	Horz	62.90	28.70	0.7	-26.76	65.5	94	28.5	1.8	90	Fundamental
7.206	Max Peak	Vert	90.26	36.04	-56.8	0	69.5	74	4.5	1.5	330	3rd Harmonic
7.206	Average	Vert	90.26	36.04	-56.8	-26.76	42.7	54	11.3	1.5	330	3rd Harmonic
7.206	Max Peak	Horz	89.86	36.04	-56.8	0	69.1	74	4.9	2.1	90	3rd Harmonic
7.206	Average	Horz	89.86	36.04	-56.8	-26.76	42.3	54	11.7	2.1	90	3rd Harmonic
9.608	Max Peak	Vert	73.63	37.87	-56.4	0	55.1	74	18.9	1.4	0	4th Harmonic
9.608	Average	Vert	73.63	37.87	-56.4	-26.76	28.3	54	25.7	1.4	0	4th Harmonic
9.608	Max Peak	Horz	73.63	37.87	-56.4	0	55.1	74	18.9	1.8	45	4th Harmonic
9.608	Average	Horz	73.63	37.87	-56.4	-26.76	28.3	54	25.7	1.8	45	4th Harmonic

Radiated Fundamental and Spurious Emissions – 1 GHz to 26 GHz

1 GHz to 18 GHz Tested at a 3 Meter Distance

18 GHz to 26 GHz Tested at a 1 Meter Distance

EUT: SeyWave RF Module, Model: 11-115-0000
Manufacturer: BTR Controls, Inc.
Operating Condition: 68 deg F; 23% R.H.
Test Site: Site 3
Operator: Craig B
Test Specification: FCC Part 15.249 and Part 15.205
Comment: Transmit at Mid channel: 2.440 GHz
Date: 01-07-2013 and 01-29-2013
Notes: All measurements with Peak detector.
All other emissions are more than 20 dB under the limit.

Frequency (GHz)	Measurement Type	Antenna Polarization	Level (dBuV)	Antenna Factor (dB/m)	System Loss (dB)	Duty Cycle Correction (dB)	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	EUT Angle (deg)	Comment
2.440	Max Peak	Vert	61.81	28.79	0.7	0	91.3	114	22.7	1.2	225	Fundamental
2.440	Average	Vert	61.81	28.79	0.7	-26.76	64.5	94	29.5	1.2	225	Fundamental
2.440	Max Peak	Horz	62.01	28.79	0.7	0	91.5	114	22.5	1.8	90	Fundamental
2.440	Average	Horz	62.01	28.79	0.7	-26.76	64.7	94	29.3	1.8	90	Fundamental
7.320	Max Peak	Vert	89.87	36.63	-56.8	0	69.7	74	4.3	2.0	315	3rd Harmonic
7.320	Average	Vert	89.87	36.63	-56.8	-26.76	42.9	54	11.1	2.0	315	3rd Harmonic
7.320	Max Peak	Horz	89.57	36.63	-56.8	0	69.4	74	4.6	1.9	285	3rd Harmonic
7.320	Average	Horz	89.57	36.63	-56.8	-26.76	42.6	54	11.4	1.9	285	3rd Harmonic
9.760	Max Peak	Vert	77.19	38.11	-56.8	0	58.5	74	15.5	1.7	0	4th Harmonic
9.760	Average	Vert	77.19	38.11	-56.8	-26.76	31.7	54	22.3	1.7	0	4th Harmonic
9.760	Max Peak	Horz	77.29	38.11	-56.8	0	58.6	74	15.4	1.9	75	4th Harmonic
9.760	Average	Horz	77.29	38.11	-56.8	-26.76	31.8	54	22.2	1.9	75	4th Harmonic

Radiated Fundamental and Spurious Emissions – 1 GHz to 26 GHz

1 GHz to 18 GHz Tested at a 3 Meter Distance

18 GHz to 26 GHz Tested at a 1 Meter Distance

EUT: SeyWave RF Module, Model: 11-115-0000
Manufacturer: BTR Controls, Inc.
Operating Condition: 68 deg F; 23% R.H.
Test Site: Site 3
Operator: Craig B
Test Specification: FCC Part 15.249 and Part 15.205
Comment: Transmit at High channel: 2.481 GHz
Date: 01-07-2013 and 1-29-2013
Notes: All measurements with Peak detector.
All other emissions are more than 20 dB under the limit.

Frequency (GHz)	Measurement Type	Antenna Polarization	Level (dBuV)	Antenna Factor (dB/m)	System Loss (dB)	Duty Cycle Correction (dB)	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	EUT Angle (deg)	Comment
2.481	Max Peak	Vert	60.72	28.88	0.7	0	90.3	114	23.7	1.2	225	Fundamental
2.481	Average	Vert	60.72	28.88	0.7	-26.76	63.5	94	30.5	1.2	225	Fundamental
2.481	Max Peak	Horz	61.22	28.88	0.7	0	90.8	114	23.2	1.8	45	Fundamental
2.481	Average	Horz	61.22	28.88	0.7	-26.76	64.0	94	30.0	1.8	45	Fundamental
7.443	Max Peak	Vert	83.48	36.72	-56.6	0	63.6	74	10.4	2.0	315	3rd Harmonic
7.443	Average	Vert	83.48	36.72	-56.6	-26.76	36.8	54	17.2	2.0	315	3rd Harmonic
7.443	Max Peak	Horz	82.28	36.72	-56.6	0	62.4	74	11.6	1.4	110	3rd Harmonic
7.443	Average	Horz	82.28	36.72	-56.6	-26.76	35.6	54	18.4	1.4	110	3rd Harmonic
9.924	Max Peak	Vert	77.00	38.40	-56.5	0	58.9	74	15.1	2.0	0	4th Harmonic
9.924	Average	Vert	77.00	38.40	-56.5	-26.76	32.1	54	21.9	2.0	0	4th Harmonic
9.924	Max Peak	Horz	77.20	38.40	-56.5	0	59.1	74	14.9	1.4	85	4th Harmonic
9.924	Average	Horz	77.20	38.40	-56.5	-26.76	32.3	54	21.7	1.4	85	4th Harmonic

Radiated Fundamental and Spurious Emissions – 1 GHz to 26 GHz
1 GHz to 18 GHz Tested at a 3 Meter Distance
18 GHz to 26 GHz Tested at a 1 Meter Distance

EUT: SeyWave RF Module, Model: 11-115-0001
Manufacturer: BTR Controls, Inc.
Operating Condition: 68 deg F; 23% R.H.
Test Site: Site 3
Operator: Craig B
Test Specification: FCC Part 15.249 and Part 15.205
Comment: Transmit at Low channel: 2.402 GHz
Date: 01-07-2013
Notes: All measurements with Peak detector.
All other emissions are more than 20 dB under the limit.

Frequency (GHz)	Measurement Type	Antenna Polarization	Level (dBuV)	Antenna Factor (dB/m)	System Loss (dB)	Duty Cycle Correction (dB)	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	EUT Angle (deg)	Comment
2.402	Max Peak	Vert	67.10	28.70	0.7	0	96.5	114	17.5	1.7	210	Fundamental
2.402	Average	Vert	67.10	28.70	0.7	-26.76	69.7	94	24.3	1.7	210	Fundamental
2.402	Max Peak	Horz	69.30	28.70	0.7	0	98.7	114	15.3	1.5	350	Fundamental
2.402	Average	Horz	69.30	28.70	0.7	-26.76	71.9	94	22.1	1.5	350	Fundamental
7.206	Max Peak	Vert	84.56	36.04	-56.8	0	63.8	74	10.2	1.5	90	3rd Harmonic
7.206	Average	Vert	84.56	36.04	-56.8	-26.76	37.0	54	17.0	1.5	90	3rd Harmonic
7.206	Max Peak	Horz	84.56	36.04	-56.8	0	63.8	74	10.2	1.0	225	3rd Harmonic
7.206	Average	Horz	84.56	36.04	-56.8	-26.76	37.0	54	17.0	1.0	225	3rd Harmonic

Radiated Fundamental and Spurious Emissions – 1 GHz to 26 GHz

1 GHz to 18 GHz Tested at a 3 Meter Distance

18 GHz to 26 GHz Tested at a 1 Meter Distance

EUT: SeyWave RF Module, Model: 11-115-0001
Manufacturer: BTR Controls, Inc.
Operating Condition: 68 deg F; 23% R.H.
Test Site: Site 3
Operator: Craig B
Test Specification: FCC Part 15.249 and Part 15.205
Comment: Transmit at Mid channel: 2.440 GHz
Date: 01-07-2013
Notes: All measurements with Peak detector.
All other emissions are more than 20 dB under the limit.

Frequency (GHz)	Measurement Type	Antenna Polarization	Level (dBuV)	Antenna Factor (dB/m)	System Loss (dB)	Duty Cycle Correction (dB)	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	EUT Angle (deg)	Comment
2.440	Max Peak	Vert	66.61	28.79	0.7	0	96.1	114	17.9	1.4	90	Fundamental
2.440	Average	Vert	66.61	28.79	0.7	-26.76	69.3	94	24.7	1.4	90	Fundamental
2.440	Max Peak	Horz	67.81	28.79	0.7	0	97.3	114	16.7	1.8	0	Fundamental
2.440	Average	Horz	67.81	28.79	0.7	-26.76	70.5	94	23.5	1.8	0	Fundamental
7.320	Max Peak	Vert	80.57	36.63	-56.8	0	60.4	74	13.6	1.3	90	3rd Harmonic
7.320	Average	Vert	80.57	36.63	-56.8	-26.76	33.6	54	20.4	1.3	90	3rd Harmonic
7.320	Max Peak	Horz	79.57	36.63	-56.8	0	59.4	74	14.6	1.2	300	3rd Harmonic
7.320	Average	Horz	79.57	36.63	-56.8	-26.76	32.6	54	21.4	1.2	300	3rd Harmonic

Radiated Fundamental and Spurious Emissions – 1 GHz to 26 GHz

1 GHz to 18 GHz Tested at a 3 Meter Distance

18 GHz to 26 GHz Tested at a 1 Meter Distance

EUT: SeyWave RF Module, Model: 11-115-0001
Manufacturer: BTR Controls, Inc.
Operating Condition: 68 deg F; 23% R.H.
Test Site: Site 3
Operator: Craig B
Test Specification: FCC Part 15.249 and Part 15.205
Comment: Transmit at High channel: 2.481 GHz
Date: 01-07-2013
Notes: All measurements with Peak detector.
All other emissions are more than 20 dB under the limit.

Frequency (GHz)	Measurement Type	Antenna Polarization	Level (dBuV)	Antenna Factor (dB/m)	System Loss (dB)	Duty Cycle Correction (dB)	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	EUT Angle (deg)	Comment
2.481	Max Peak	Vert	64.52	28.88	0.7	0	94.1	114	19.9	1.4	135	Fundamental
2.481	Average	Vert	64.52	28.88	0.7	-26.76	67.3	94	26.7	1.4	135	Fundamental
2.481	Max Peak	Horz	66.12	28.88	0.7	0	95.7	114	18.3	1.5	350	Fundamental
2.481	Average	Horz	66.12	28.88	0.7	-26.76	68.9	94	25.1	1.5	350	Fundamental
7.443	Max Peak	Vert	76.18	36.72	-56.6	0	56.3	74	17.7	2.1	0	3rd Harmonic
7.443	Average	Vert	76.18	36.72	-56.6	-26.76	29.5	54	24.5	2.1	0	3rd Harmonic
7.443	Max Peak	Horz	79.18	36.72	-56.6	0	59.3	74	14.7	2.1	40	3rd Harmonic
7.443	Average	Horz	79.18	36.72	-56.6	-26.76	32.5	54	21.5	2.1	40	3rd Harmonic

Appendix B

2.0 Radiated Band Edge

Rule Part: Section 15.249 including 15.205, 15.209, and 15.35

Test Procedure: ANSI C63.10-2009 Section 6.9.3
Marker-delta method for band-edge measurements

Limits:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
Above 960	500	3

Results: Compliant

Notes:

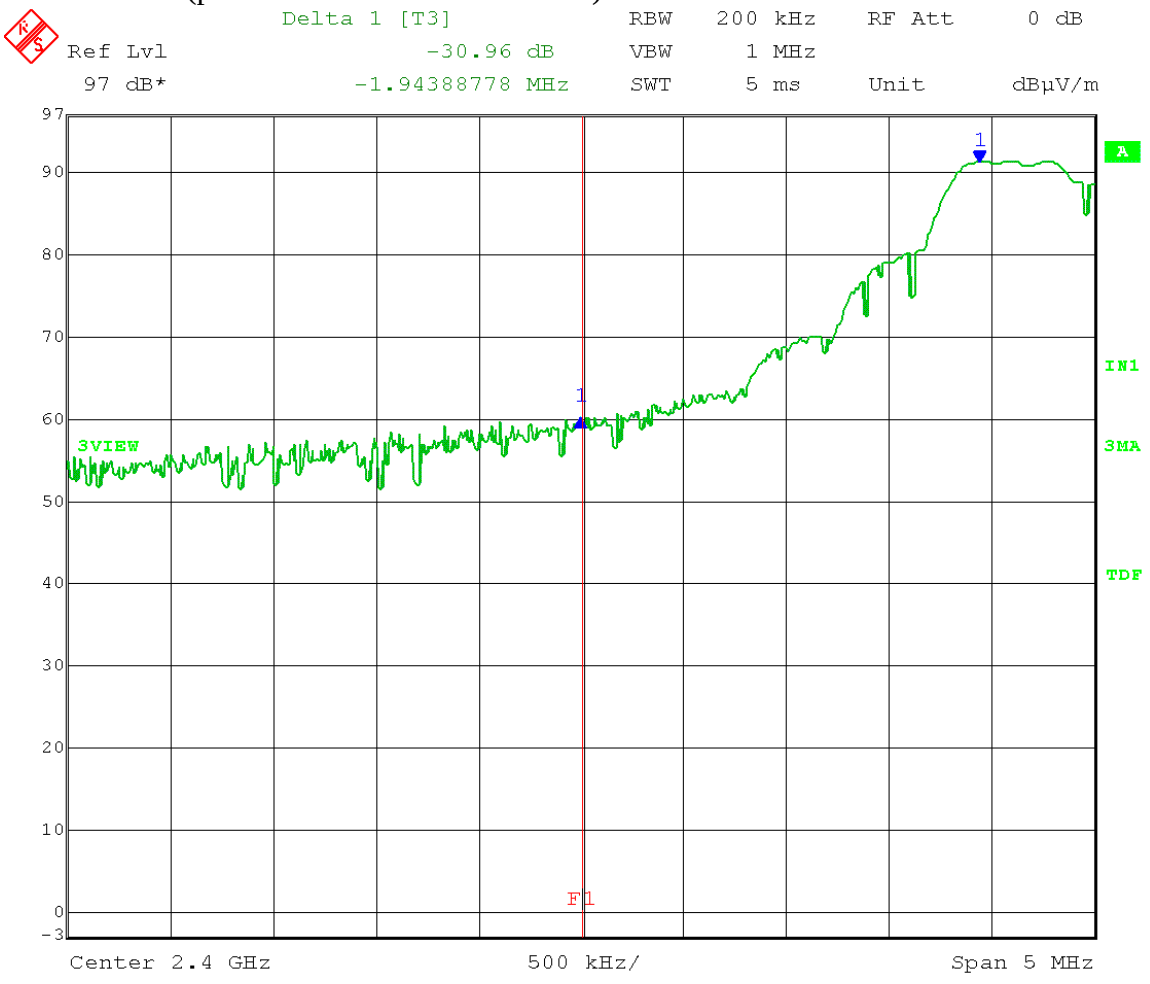
Band edge compliance was determined by measuring the field strength of the fundamental emission, and then measuring the field strength delta between the peak in-band emission and the emission level at the band-edge frequency. The EUT was transmitting a modulated signal at its maximum power level.

Test Date: 01-29-2013
Company: BTR Controls, Inc.
EUT: SeyWave RF Module, Model: 11-115-0000
Test: Band-Edge Measurement - Radiated
Operator: Craig B
Comment:

Low Channel: Transmit = 2.402 GHz

Peak Limit: 74 dBµV/m at 3 meters
Average Limit: 54 dBµV/m at 3 meters
Band-Edge Frequency = 2.4 GHz

Peak detector: Horizontal (worst-case):
Field strength of fundamental = 92.3 dBµV/m at 3 meters
Marker-Delta (per ANSI C63.10 section 6.9.3) = -30.96 dB



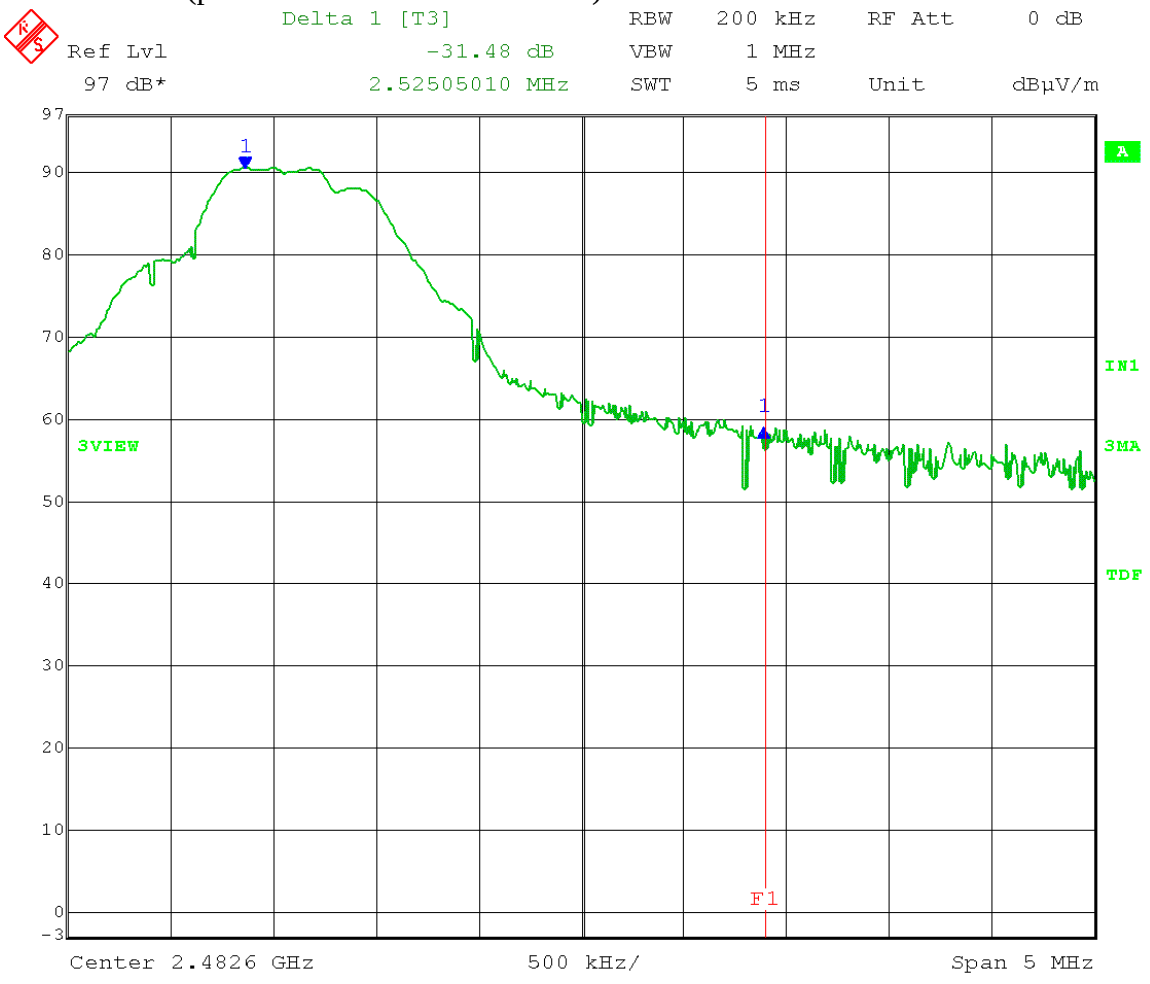
Peak level = 92.3 – 30.96 = 61.34
Margin Peak = 74 – 61.34 = 12.66 dB.
Average level = 61.34 – 26.76 dB (duty cycle correction) = 34.58
Margin Average = 54 – 34.58 = 19.42 dB

Test Date: 01-29-2013
Company: BTR Controls, Inc.
EUT: SeyWave RF Module, Model: 11-115-0000
Test: Band-Edge Measurement - Radiated
Operator: Craig B
Comment:

High Channel: Transmit = 2.481 GHz

Peak Limit: 74 dBµV/m at 3 meters
Average Limit: 54 dBµV/m at 3 meters
Band-Edge Frequency = 2.4835 GHz

Peak detector: Horizontal (worst-case):
Field strength of fundamental = 90.8 dBµV/m at 3 meters
Marker-Delta (per ANSI C63.10 section 6.9.3) = -31.48 dB



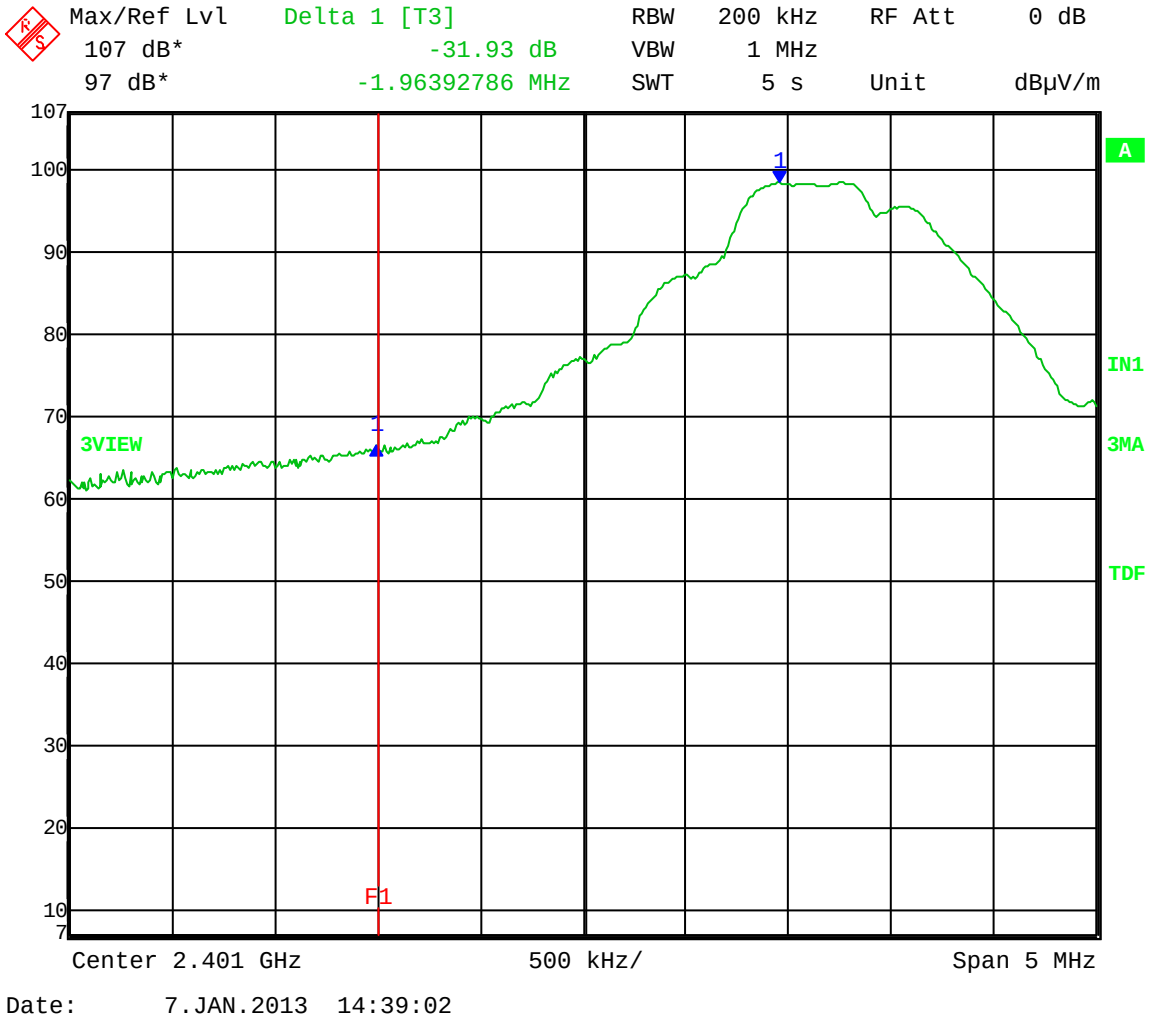
Peak level = 90.8 – 31.48 = 59.32
Margin Peak = 74 – 59.32 = 14.68 dB.
Average level = 59.32 – 26.76 dB (duty cycle correction) = 32.56
Margin Average = 54 – 32.56 = 21.44 dB

Test Date: 01-07-2013
Company: BTR Controls, Inc.
EUT: SeyWave RF Module, Model: 11-115-0001
Test: Band-Edge Measurement - Radiated
Operator: Craig B
Comment:

Low Channel: Transmit = 2.402 GHz

Peak Limit: 74 dBµV/m at 3 meters
Average Limit: 54 dBµV/m at 3 meters
Band-Edge Frequency = 2.4 GHz

Peak detector: Horizontal (worst-case):
Field strength of fundamental = 98.7 dBµV/m at 3 meters
Marker-Delta (per ANSI C63.10 section 6.9.3) = -31.93 dB



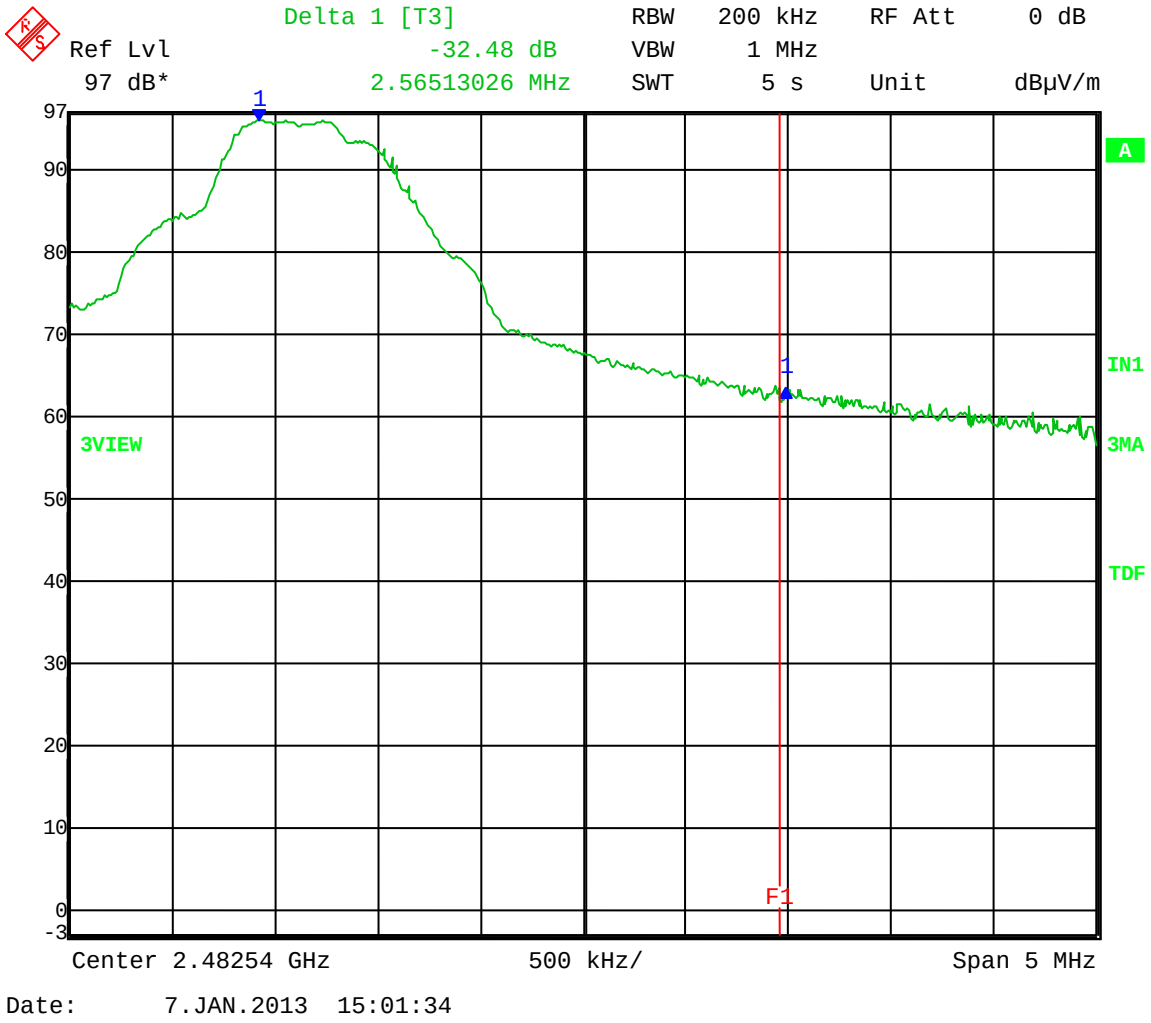
Peak level = 98.7 – 31.93 = 66.77
Margin Peak = 74 – 66.77 = 7.23 dB.
Average level = 66.77 – 26.76 dB (duty cycle correction) = 40.01
Margin Average = 54 – 40.01 = 13.99 dB

Test Date: 01-07-2013
Company: BTR Controls, Inc.
EUT: SeyWave RF Module, Model: 11-115-0001
Test: Band-Edge Measurement - Radiated
Operator: Craig B
Comment:

High Channel: Transmit = 2.481 GHz

Peak Limit: 74 dBµV/m at 3 meters
Average Limit: 54 dBµV/m at 3 meters
Band-Edge Frequency = 2.4835 GHz

Peak detector: Horizontal (worst-case):
Field strength of fundamental = 95.7 dBµV/m at 3 meters
Marker-Delta (per ANSI C63.10 section 6.9.3) = -32.48 dB



Peak level = 95.7 – 32.48 = 63.22
Margin Peak = 74 – 63.22 = 10.78 dB.
Average level = 63.22 – 26.76 dB (duty cycle correction) = 36.46
Margin Average = 54 – 36.46 = 17.54 dB

Appendix B

3.0 20 dB Emission Bandwidth

Rule Part: Section 15.215(c)

Test Procedure: ANSI C63.10-2009 Section 6.9.1

Limits: Not Applicable

Results: 20 dB Bandwidth = 1 MHz

Sample Equations:

None

Notes:

The resolution bandwidth of the spectrum analyzer was set to a value within 1% to 5% of the emission bandwidth.

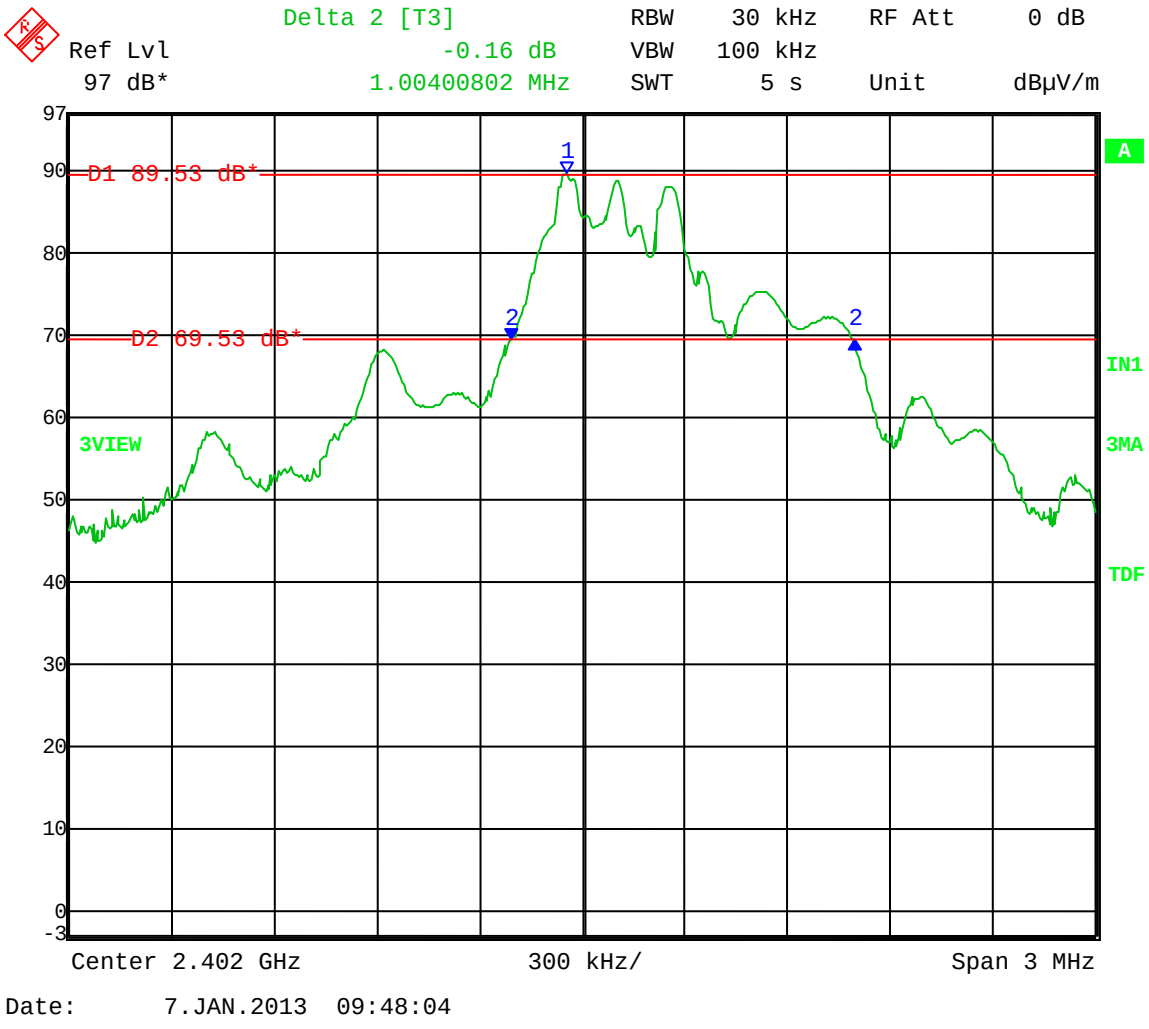
Appendix B

3.0 20 dB Emission Bandwidth

Test Date: 01-07-2013
Company: BTR Controls
EUT: SeyWave RF Module, Model: 11-115-0000 & 11-115-0001
Test: Emission Bandwidth (20 dB) - Radiated
Operator: Craig B

Comment: Low Channel: Frequency – 2.402 GHz

20 dB Emission Bandwidth = 1.00 MHz



Appendix B

4.0 Duty Cycle Correction

Rule Part: Section 15.35(c)

Test Procedure: ANSI C63.10-2009 Section 7.5

Limits: Not Applicable

Results: Duty Cycle Correction: 26.76 dB

Sample Equations:

Total ON time in 100 ms = 11 pulses at 0.417 ms = 4.59 ms
Duty Cycle correction = 20 Log(4.59/100) = -26.76 dB

Notes: None

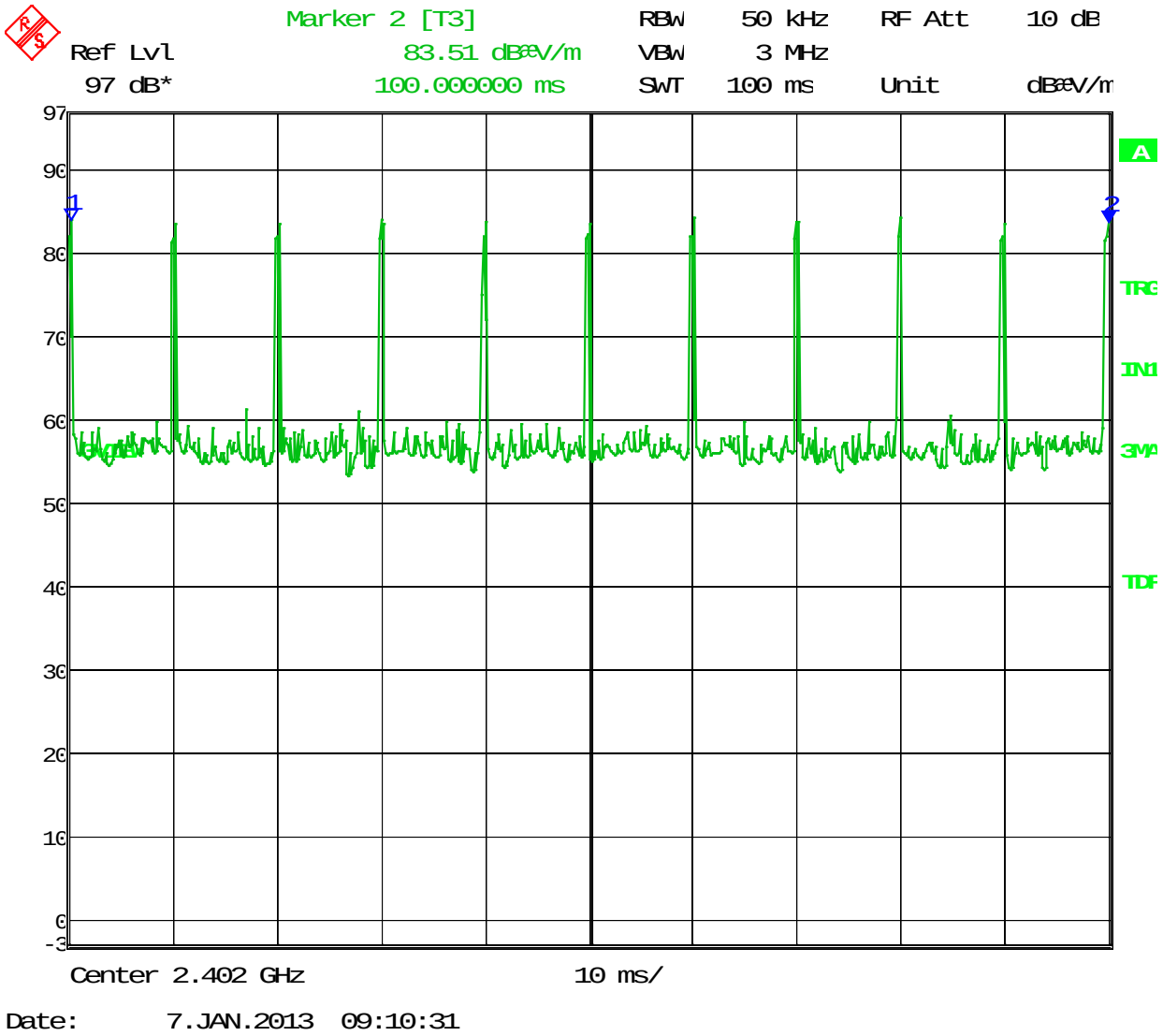
Appendix B

4.0 Duty Cycle Correction Factor

Test Date: 01-07-2013
Company: BTR Controls, Inc.
EUT: SeyWave RF Module, Model: 11-115-0000 & 11-115-0001
Test: Duty Cycle – maximum possible using special test software
Operator: Craig B

Comment: Total ON time in 100 ms = 11 pulses at 0.417 ms = 4.59 ms
Duty Cycle correction = 20 Log(4.59/100) = -26.76 dB

Number of pulses during 100 ms:



166 South Carter, Genoa City, WI 53128

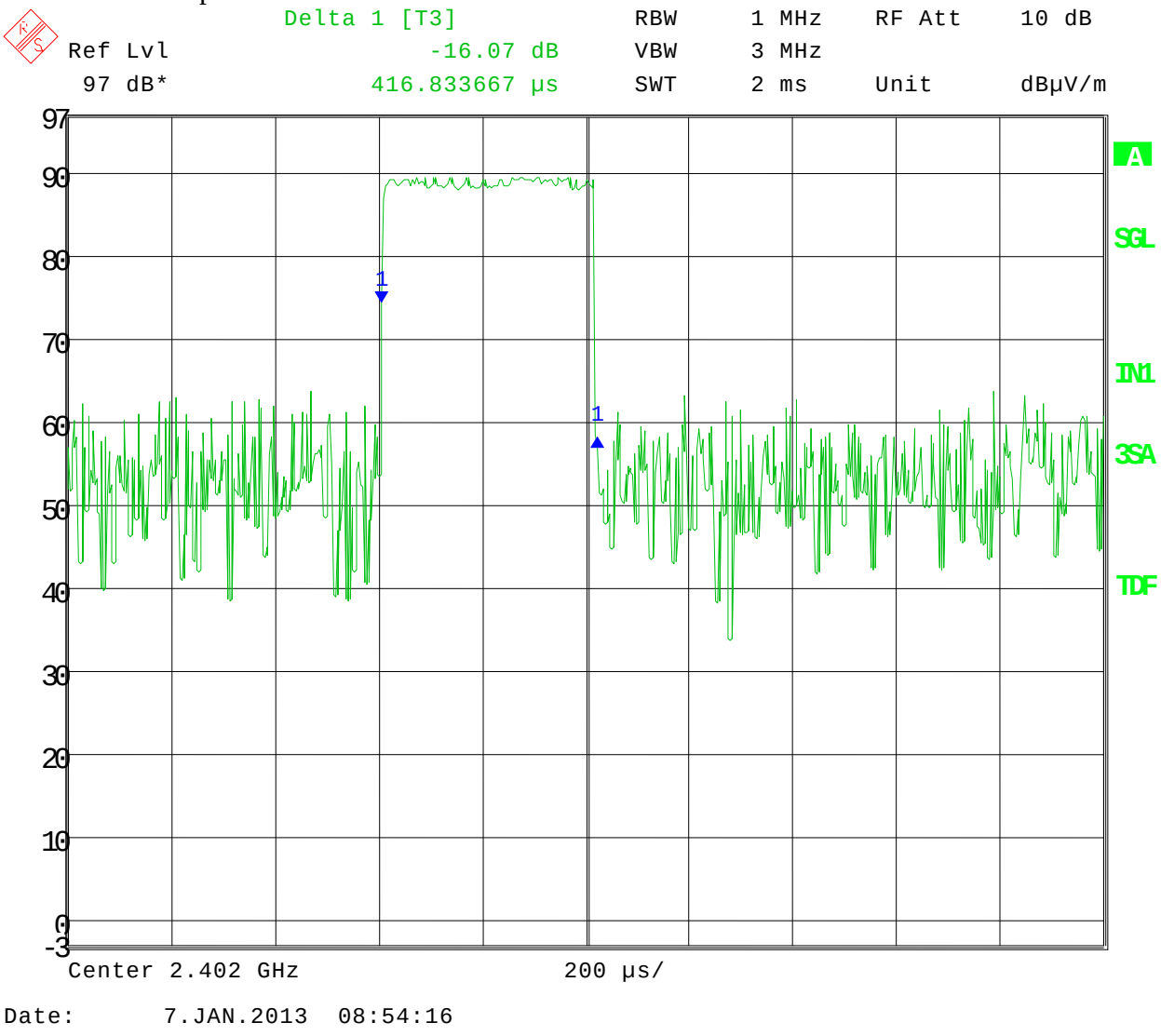
Company: BTR Controls, Inc.
Model Tested: 11-115-0000 & 11-115-0001
Report Number: 18663
DLS Project: 5025

Appendix B

Test Date: 01-07-2013
Company: BTR Controls, Inc.
EUT: SeyWave RF Module, Model: 11-115-0000 & 11-115-0001
Test: Duty Cycle – maximum possible using special test software
Operator: Craig B

Comment: Totol ON time in 100 ms = 11 pulses at 0.417 ms = 4.59 ms
Duty Cycle correction = 20 Log(4.59/100) = -26.76 dB

Duration of one pulse:



Appendix B

5.0 AC Line Conducted Emissions

Rule Part: FCC Part 15.207

Test Procedure: ANSI C63.10-2009
Section 6.2

Limit: FCC Part 15.207(a)

Results: Compliant

Notes: This was an AC Conducted emissions measurement.
The EUT was powered from an AC Adapter with an input of 120 VAC 60 Hz.

FCC Part 15.207

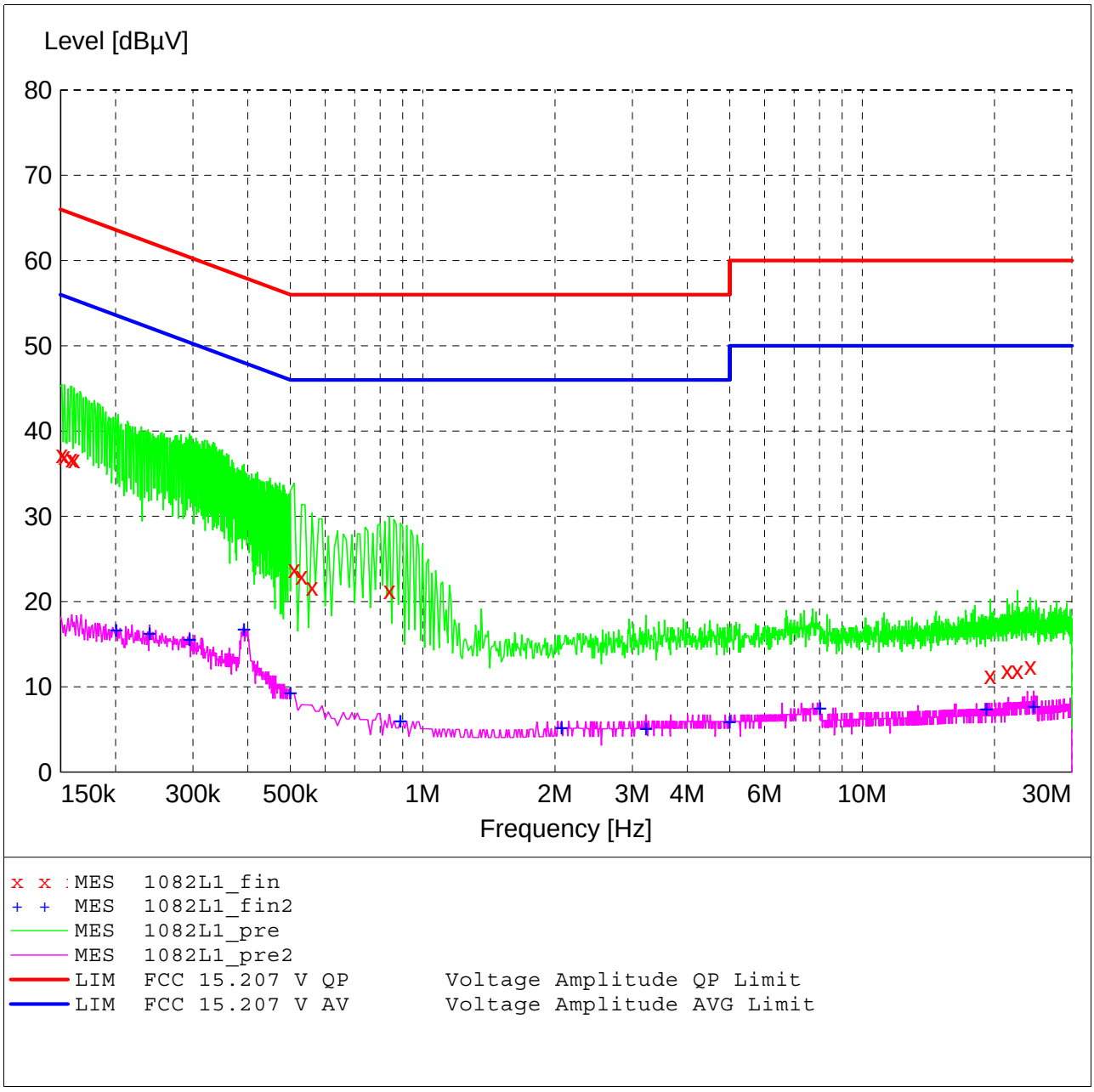
Voltage Mains Test

```
EUT:                  Model 11-115-0000
Manufacturer:         BTR Controls
Operating Condition:  72 deg. F,  23%  R.H.
Test Site:            DLS O.F. Screen Room
Operator:             Craig B
Test Specification:   120 V  60 Hz; O.E.M. Model AD-0950 power supply
Comment:              Line 1
                      Date:  01-08-2013
```

SCAN TABLE: "Line Cond SR Final"

Short Description: Line Conducted Emissions

Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	4.0 kHz	QuasiPeak CISPR AV	5.0 s	9 kHz	LISN DLS#128



MEASUREMENT RESULT: "1082L1_fin"

1/8/2013 12:51PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector
0.151000	37.20	13.6	66	28.7	QP
0.153000	37.10	13.6	66	28.7	QP
0.159000	36.80	13.4	66	28.7	QP
0.161000	36.70	13.3	65	28.7	QP
0.510000	23.80	11.2	56	32.2	QP
0.530000	23.00	11.2	56	33.0	QP
0.560000	21.70	11.1	56	34.3	QP
0.840000	21.30	10.8	56	34.7	QP
19.550000	11.40	11.4	60	48.6	QP
21.380000	11.90	11.4	60	48.1	QP
22.565000	11.90	11.5	60	48.1	QP
24.155000	12.40	11.5	60	47.6	QP

MEASUREMENT RESULT: "1082L1_fin2"

1/8/2013 12:51PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector
0.201000	16.60	12.7	54	37.0	CAV
0.239000	16.20	12.2	52	35.9	CAV
0.295000	15.50	11.8	50	34.9	CAV
0.392000	16.70	11.4	48	31.3	CAV
0.500000	9.20	11.2	46	36.8	CAV
0.890000	6.00	10.7	46	40.0	CAV
2.070000	5.20	10.7	46	40.8	CAV
3.220000	5.10	10.7	46	40.9	CAV
5.000000	5.90	10.7	46	40.1	CAV
8.015000	7.50	10.8	50	42.5	CAV
19.160000	7.40	11.4	50	42.6	CAV
24.560000	7.60	11.6	50	42.4	CAV

FCC Part 15.207

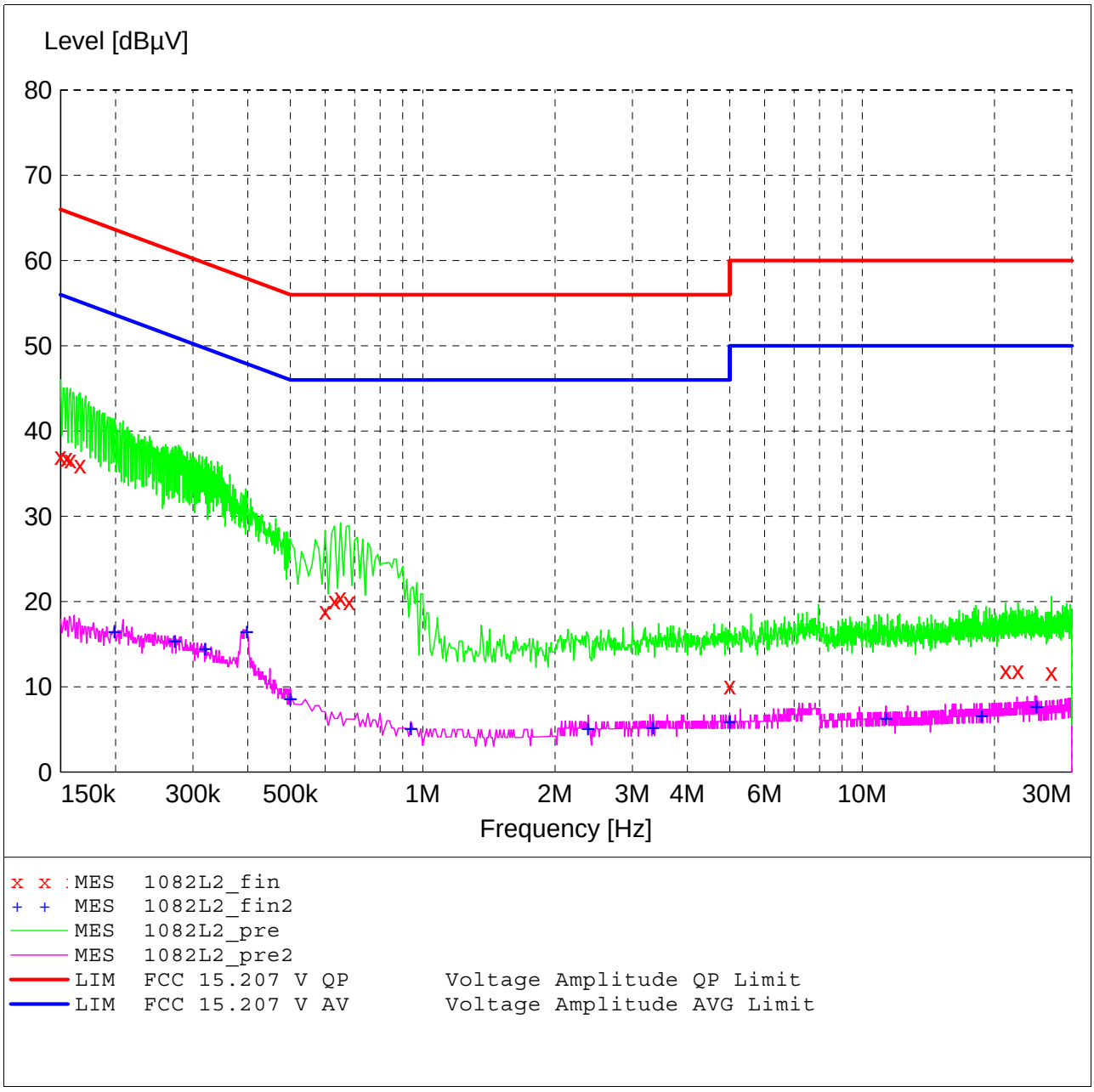
Voltage Mains Test

```
EUT:                  Model 11-115-0000
Manufacturer:         BTR Controls
Operating Condition:  72 deg. F,  23%  R.H.
Test Site:            DLS O.F. Screen Room
Operator:             Craig B
Test Specification:   120 V  60 Hz; O.E.M. Model AD-0950 power supply
Comment:              Line 2
                      Date:  01-08-2013
```

SCAN TABLE: "Line Cond SR Final"

Short Description: Line Conducted Emissions

Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	4.0 kHz	QuasiPeak CISPR AV	5.0 s	9 kHz	LISN DLS#128



MEASUREMENT RESULT: "1082L2_fin"

1/8/2013 12:57PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector
0.150000	37.10	13.6	66	28.9	QP
0.155000	36.90	13.5	66	28.8	QP
0.158000	36.70	13.4	66	28.9	QP
0.166000	36.00	13.2	65	29.2	QP
0.600000	18.90	11.1	56	37.1	QP
0.630000	20.10	11.0	56	35.9	QP
0.650000	20.50	11.0	56	35.5	QP
0.680000	20.00	11.0	56	36.0	QP
5.000000	10.20	10.7	56	45.8	QP
21.230000	11.90	11.4	60	48.1	QP
22.625000	11.90	11.5	60	48.1	QP
26.945000	11.70	11.7	60	48.3	QP

MEASUREMENT RESULT: "1082L2_fin2"

1/8/2013 12:57PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector
0.199000	16.40	12.7	54	37.3	CAV
0.273000	15.30	11.9	51	35.7	CAV
0.320000	14.40	11.7	50	35.3	CAV
0.398000	16.40	11.4	48	31.5	CAV
0.500000	8.60	11.2	46	37.4	CAV
0.940000	5.10	10.7	46	40.9	CAV
2.380000	5.10	10.7	46	40.9	CAV
3.340000	5.20	10.7	46	40.8	CAV
5.000000	5.90	10.7	46	40.1	CAV
11.345000	6.30	11.0	50	43.7	CAV
18.710000	6.60	11.3	50	43.4	CAV
24.950000	7.60	11.6	50	42.4	CAV

FCC Part 15.207

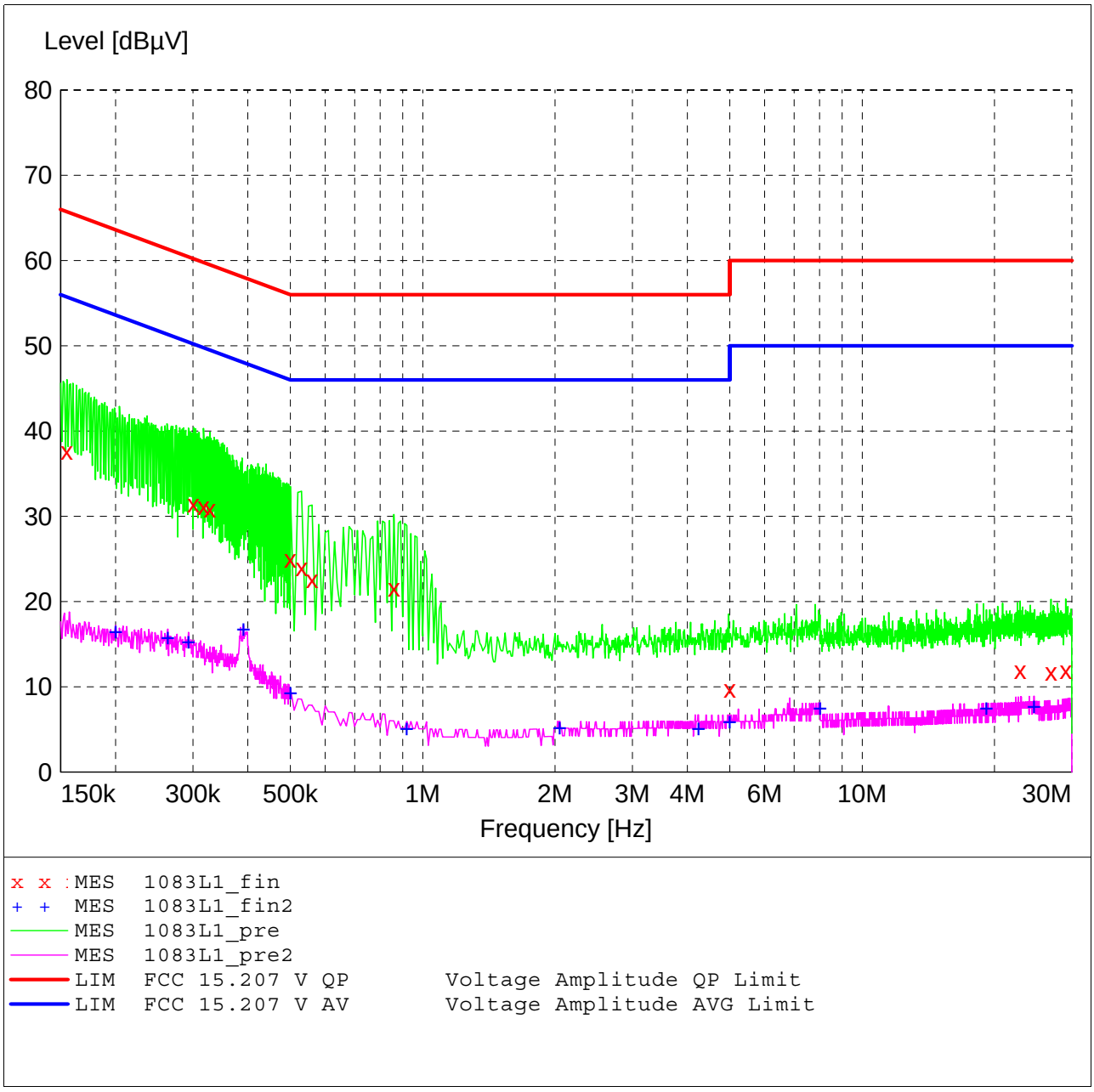
Voltage Mains Test

EUT:	Model 11-115-0001
Manufacturer:	BTR Controls
Operating Condition:	72 deg. F, 23% R.H.
Test Site:	DLS O.F. Screen Room
Operator:	Craig B
Test Specification:	120 V 60 Hz; O.E.M. Model AD-0950 power supply
Comment:	Line 1
	Date: 01-08-2013

SCAN TABLE: "Line Cond SR Final"

Short Description: Line Conducted Emissions

Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	4.0 kHz	QuasiPeak CISPR AV	5.0 s	9 kHz	LISN DLS#128



MEASUREMENT RESULT: "1083L1_fin"

1/8/2013 1:08PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector
0.155000	37.60	13.5	66	28.1	QP
0.301000	31.50	11.8	60	28.7	QP
0.317000	31.20	11.7	60	28.6	QP
0.328000	30.90	11.6	60	28.6	QP
0.500000	25.00	11.2	56	31.0	QP
0.530000	24.00	11.2	56	32.0	QP
0.560000	22.60	11.1	56	33.4	QP
0.860000	21.60	10.7	56	34.4	QP
5.000000	9.70	10.7	56	46.3	QP
22.880000	11.90	11.5	60	48.1	QP
26.885000	11.70	11.7	60	48.3	QP
29.060000	11.90	11.9	60	48.1	QP

MEASUREMENT RESULT: "1083L1_fin2"

1/8/2013 1:08PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector
0.200000	16.40	12.7	54	37.2	CAV
0.263000	15.70	12.0	51	35.6	CAV
0.293000	15.20	11.9	50	35.2	CAV
0.391000	16.70	11.4	48	31.3	CAV
0.500000	9.20	11.2	46	36.8	CAV
0.920000	5.10	10.7	46	40.9	CAV
2.050000	5.20	10.7	46	40.8	CAV
4.240000	5.10	10.7	46	40.9	CAV
5.000000	5.90	10.7	46	40.1	CAV
8.015000	7.50	10.8	50	42.5	CAV
19.160000	7.40	11.4	50	42.6	CAV
24.605000	7.60	11.6	50	42.4	CAV

FCC Part 15.207

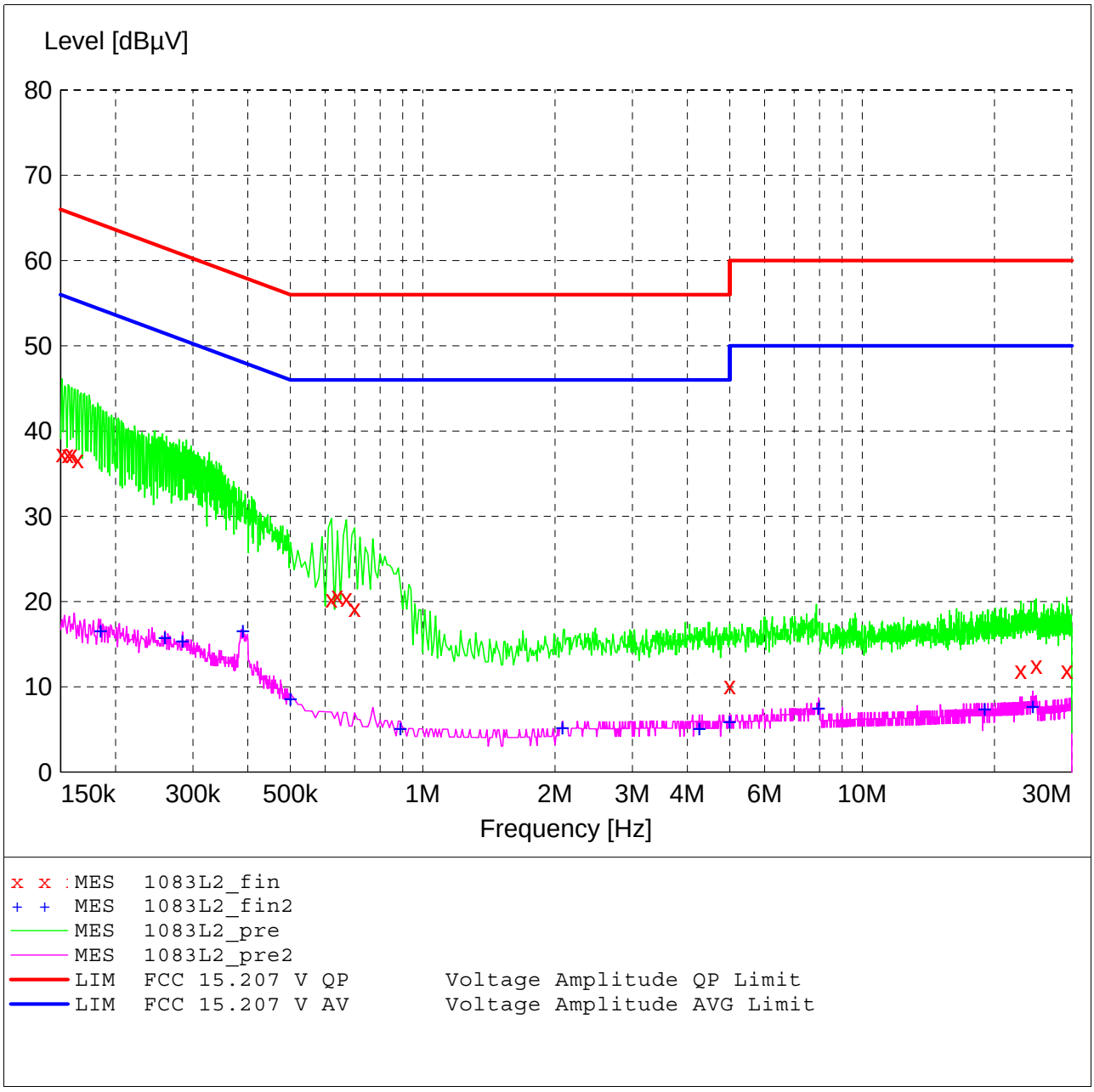
Voltage Mains Test

```
EUT:                  Model 11-115-0001
Manufacturer:         BTR Controls
Operating Condition:  72 deg. F,  23%  R.H.
Test Site:            DLS O.F. Screen Room
Operator:             Craig B
Test Specification:   120 V  60 Hz; O.E.M. Model AD-0950 power supply
Comment:              Line 2
                      Date:  01-08-2013
```

SCAN TABLE: "Line Cond SR Final"

Short Description: Line Conducted Emissions

Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	4.0 kHz	QuasiPeak CISPR AV	5.0 s	9 kHz	LISN DLS#128



MEASUREMENT RESULT: "1083L2_fin"

1/8/2013 1:14PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector
0.151000	37.40	13.6	66	28.5	QP
0.156000	37.30	13.5	66	28.4	QP
0.159000	37.30	13.4	66	28.2	QP
0.164000	36.70	13.2	65	28.6	QP
0.620000	20.30	11.0	56	35.7	QP
0.640000	20.70	11.0	56	35.3	QP
0.670000	20.40	11.0	56	35.6	QP
0.700000	19.20	10.9	56	36.8	QP
5.000000	10.20	10.7	56	45.8	QP
22.955000	11.90	11.5	60	48.1	QP
24.905000	12.50	11.6	60	47.5	QP
29.225000	11.90	11.9	60	48.1	QP

MEASUREMENT RESULT: "1083L2_fin2"

1/8/2013 1:14PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector
0.185000	16.50	12.9	54	37.8	CAV
0.259000	15.70	12.0	52	35.8	CAV
0.284000	15.30	11.9	51	35.4	CAV
0.390000	16.50	11.4	48	31.6	CAV
0.500000	8.60	11.2	46	37.4	CAV
0.890000	5.10	10.7	46	40.9	CAV
2.080000	5.20	10.7	46	40.8	CAV
4.260000	5.10	10.7	46	40.9	CAV
5.000000	5.90	10.7	46	40.1	CAV
7.955000	7.50	10.8	50	42.5	CAV
18.995000	7.40	11.3	50	42.6	CAV
24.440000	7.60	11.5	50	42.4	CAV

166 South Carter, Genoa City, WI 53128

Company: BTR Controls, Inc.
Model Tested: 11-115-0000 & 11-115-0001
Report Number: 18663
DLS Project: 5025

END OF REPORT

Revision #	Date	Comments	By
1.0	01-18-2013	Preliminary Release	JS
1.1	01-29-2013	Added data & photo from 3rd position of model -0000	JS