Testing Tomorrow's Technology

Application for

US Code Title 47, Part 2, Subpart J, Section 2.947, Certification
Per
Part 15, Subpart C, for Intentional Radiators, Section 15.249, Intentional Radiator Operating within the Band 2400 MHz to 2483.5 MHz.

And

US Code Title 47, Part 2, Subpart J, Section 2.902, Verification
Per
Part 15, Subpart B, for Unintentional Radiators, section 15.101, 15.107 and 15.109

For the

Hubbell Power Systems, Inc

Model:
Three Phase Programmable Resettable Sectionalizer

Manufactured by

Hubbell Power Systems, Inc

UST Project: 13-0072
Test Date(s): March 18-21, 2013
Issue Date: March 22, 2013

3505 Francis Circle Alpharetta, GA 30004
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I certify that I am authorized to sign for the test facility and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: 

Name: Alan Ghasiani

Title: Consulting Engineer - President

Date: March 22, 2013

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MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: Hubbell Power Systems, Inc

MODEL(S): Three Phase Programmable Resettable Sectionalizer
FCC ID: SKL-3PHPRS

DATE: March 22, 2013

This report concerns (check one): Original grant_X
Class II change_____

Equipment type: Intentional Radiator Operating within the bands 2400-2483.5 MHz

Deferred grant requested per 47 CFR 0.457(d) (1) (ii)? yes_____ No_X

If yes, defer until:_____
date

__N.A.__ agrees to notify the Commission by__N.A.__
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

SUMMARY OF TEST REQUIREMENTS

FCC Requirement	Title	Disposition
15.205	Restricted Bands	Pass
15.207	Intentional Radiator Power Line Conducted Emissions	Pass
15.209	Intentional Radiator Radiated Emissions	Pass
15.249(a)	Fundamental Field Strength	Pass
15.107	Unintentional Radiator Power Line Conducted Emissions	Pass
15.109	Unintentional Radiator Radiated Emissions	Pass

N/A = Not applicable for this unit.

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1 General Information

1.1 Purpose of this Report

This report is prepared as a means of presenting test data to be used by a Telecom Certification Body in determination of whether this product is permitted for unlicensed dissemination to the general public according to the FCC Rules and Regulations for RF Devices Intentional Radiators.

1.2 Product Description

The Equipment Under Test (EUT) is the Hubbell Power Systems' Sectionalizer. The EUT is an ISM band transceiver operating in the 2400-2483.5 MHz frequency band. Per 47 CFR Part 15.31(m) the EUT was evaluated at the low, middle and high channels for operation in this band. Test data for these channels is provided herein.

The Three Phase Programmable Resettable Sectionalizer (PRS) consists of 3 electrically and mechanically identical units that are placed in Cutout Mountings on three phase distribution level electricity lines. These devices are placed downstream of a Three Phase Gang Operated Recloser. The Three Phase PRS counts the number of times the upstream recloser opens and closes. If the recloser opens a number equal to the programmed "Count" of the Three Phase PRS and current greater than the programmed "Minimum Actuating Current" is flowing in at least one of the phases of the line, the unit installed in that phase will communicate to the units placed on the other 2 phases using the Nordic nrF24L01+ radio modules. Upon receiving the signal from the unit seeing the fault, all 3 units will drop out of the Cutout Mountings synchronously thus isolating all 3 phases of the downstream load.

1.3 Related Submittal(s)/Grant(s)

1.3.1 The EUT is subject to the following FCC authorizations:

a) Certification under section 15.249 as a transmitter.
b) Verification under section 15.101 as a digital device and receiver.

1.3.2 Certification of the Transmitter

The EUT employs digital modulation, but is not being certified under CFR 15.247 because the field strength of the fundamental and its harmonics are within the limits specified in 47 CFR 15.249. Therefore the EUT is instead being presented under the requirements of CFR 15.249. The EUT will operate within the frequency band of 2400 MHz to 2483.5 MHz.

1.3.3 Verification of the Digital apparatus

The Verification requirement shares many common report elements with the Certification report. Therefore, though this report is mostly intended to provide data for the Certification process, the Verification authorization report (part 15.107 and 109) for the EUT is included herein.

2 Tests and Measurements

2.1 Configuration of Tested System

The sample was set up and tested per ANSI C63.4, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Frequency Range of 9 kHz to 40 GHz (2003). Conducted and radiated emissions data were taken with the EMC test receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. A Block diagram of the tested system is shown in Figure 1. A listing of the EUT and its test peripherals is found in Table 1 below. Test configuration photographs for spurious and fundamental emissions measurements are in the attached appendices.

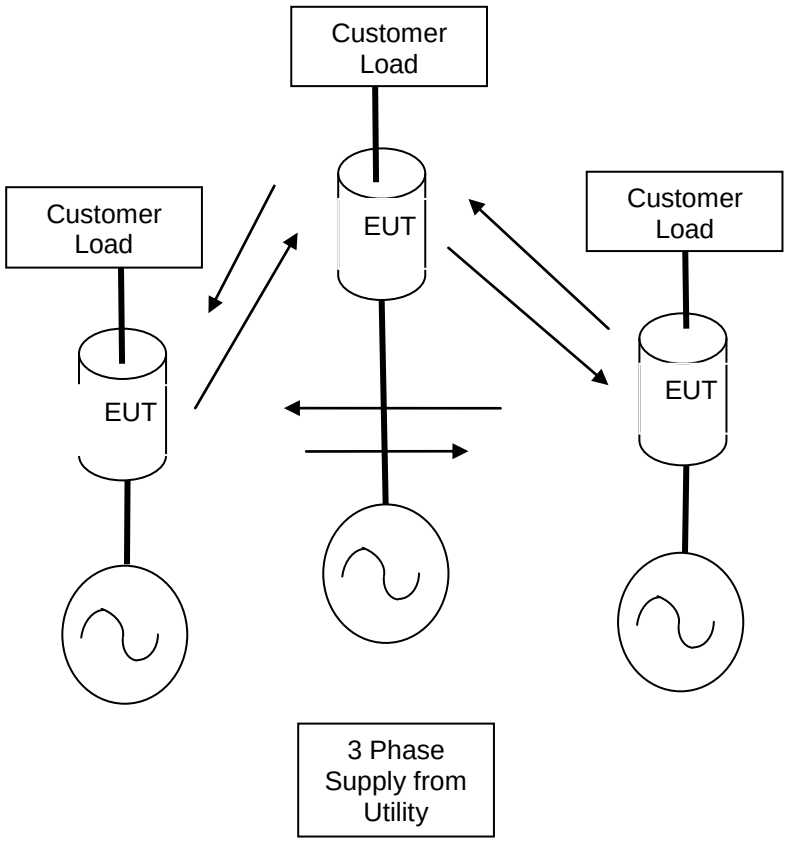


Figure 1. Test Configuration

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
SECTIONALIZER (EUT) Hubbell Power Systems, Inc.	Three Phase Programmable Resettable Sectionalizer	Engineering Sample	SKL-3PHPRS	NA

2.2 EUT Characterization

The sample used for testing was received by US Tech on March 19, 2013 in good operating condition.

2.3 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and registered with the FCC under site registration number 186022. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 2982A-1.

2.4 Test Equipment

Table 2 describes test equipment used to evaluate this product.

Table 2. Test Instruments used for Evaluation

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2648A13875	11/21/2012
SPECTRUM ANALYZER	E4407B	Agilent	US41442935	10/29/2012
RF PREAMP	8447D	HEWLETT-PACKARD	2944A06291	11/29/2012
LOOP ANTENNA	SAS-200/562	AH Systems	142	08/08/11 2 yrs
BICONICAL ANTENNA	3110B	EMCO	9307-1708	07/02/2012
LOG PERIODIC	3146	EMCO	3110-3236	06/05/2012
LISN (x 2) 9247-50-TS-50-N	9247	Solar Electronics	955824 & 955826	03/01/2013
HORN ANTENNA	3115	EMCO	9107-3723	08/10/2011 2 yrs
PREAMP	8449B	HEWLETT-PACKARD	3008A00480	04/12/2012
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A
Power Supply	MS-2A	Megger	20119010010	N/A

Note: The calibration interval of the above test instruments is 12 months unless stated otherwise, and all calibrations are traceable to NIST/USA.

2.5 Modifications to EUT

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15, Subpart B, Class A Limits for the receiver and digital portion of the EUT or the Subpart C, Transmitter requirements.

2.6 Measurement Standards (CFR 15.31)

Intentional and unintentional radiators are to use the methods of ANSI C63.4 – 2003. Measurements were made on an Open Area Test Site (OATS) wherever possible. For battery powered equipment, ne
w (or fully charged) batteries are used. Section 15.31(m) indicates that if the EUT System operates over the 2400 MHz to 2483.5 MHz ISM band, measurements must be made near the bottom of the band (around 2400 MHz for example) and in the middle of the band (2440 MHz) as well as near the top of the band (2483.5 MHz).

2.7 Frequency Range of Radiated Measurements (CFR 15.33)

The frequency range is detailed below for intentional and unintentional radiators.

2.7.1 Frequency Range for Intentional Radiators

The spectrum was investigated from the lowest RF signal generated without going below 9 kHz to the 10^{th} harmonic of the highest fundamental transmitter frequency.

2.7.2 Frequency Range for Unintentional Radiators

The spectrum was investigated from the lowest RF signal generated without going below the lowest frequency for which an emissions limit is specified (30 MHz) to the 5^{th} harmonic of the highest fundamental frequency of the digital device (12.5 GHz maximum).

2.7.3 Measurement Detector Function and Bandwidth (CFR 15.35)

On any frequency below 1000 MHz, the limits shown are based upon measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths. On frequencies above 1000 MHz, the radiation limits are based upon the use of measuring instrumentation employing an average detector function.

When average detector measurements are specified for use, including emission measurements below 1000 MHz, there is also a corresponding limit for Peak detector measurements having a limit of 20 dB above the corresponding average limit unless a different peak emission limit is specified. Measurements above 1000 MHz utilize a minimum resolution bandwidth of 1 MHz.

When radiated emissions limits are expressed in terms of the average value of the emission and pulsed operation is employed, the measurement field strength is determined by averaging over one complete pulse train (Duty Cycle) including blanking intervals for pulse trains up to 0.1 second in duration. The exact method of calculating the average field strength is included in paragraph 2.11 of this report. Refer to Figures 2 and 3 for duty cycle measurement data.

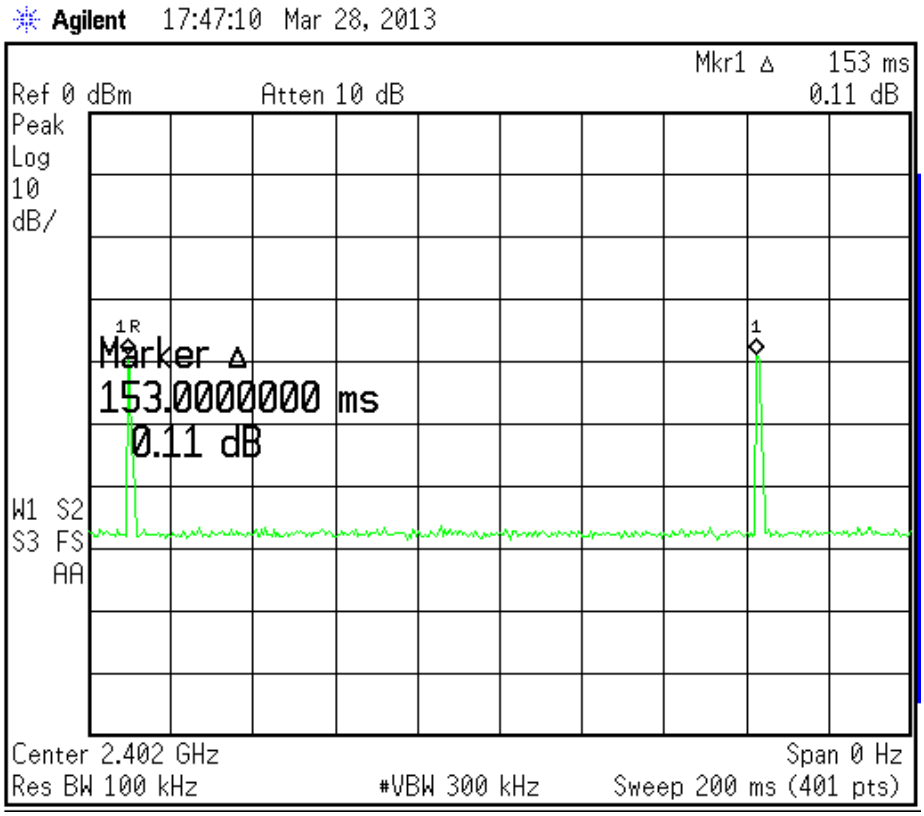


Figure 2. Duty Cycle Measurement 1 – Cycle Time

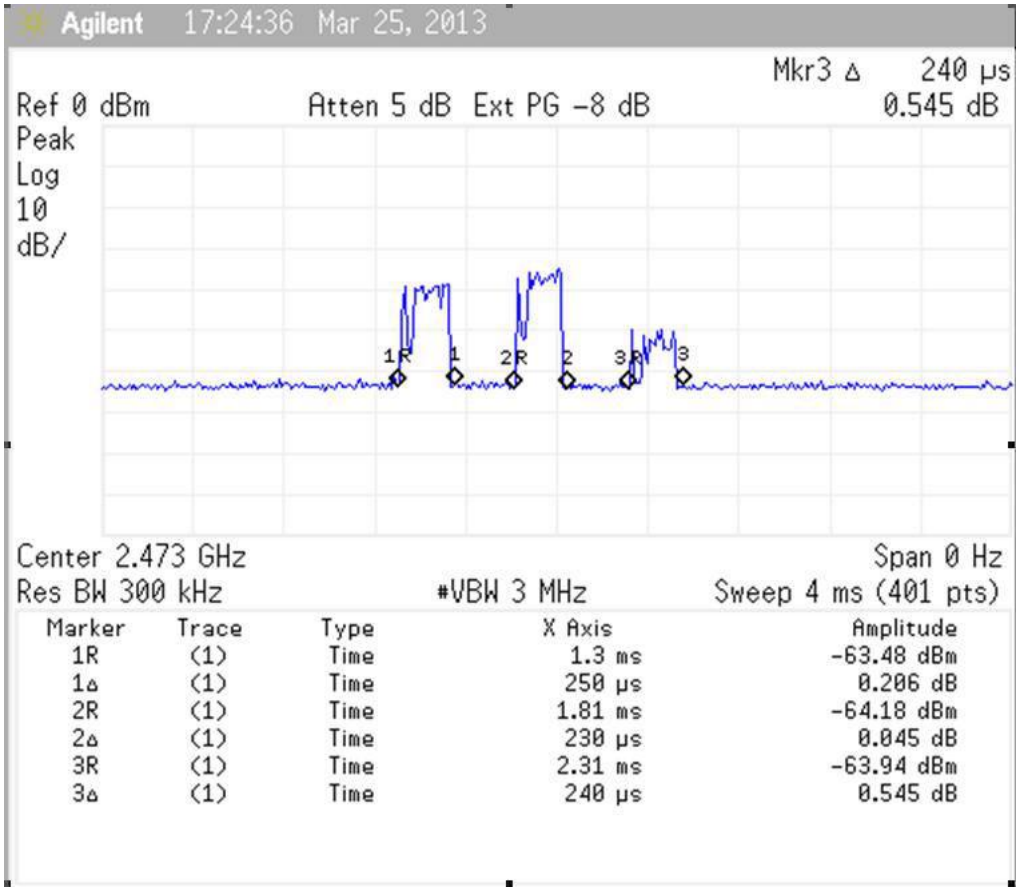


Figure 3. Duty Cycle Measurement 2 – Transmitter ON

Transmit Time = 1Δ + 2Δ + 3Δ = 250µS +230µS + 240 µS = 720µS

Duty Cycle = 20 Log (Transmitter On/(Cycle Time-Transmitter on)) = -46.5 dB

The Duty Cycle applied in this test report is -20 dB.

2.8 Antenna Requirement (CFR 15.203)

The EUT has an internal radiator; there are no external antenna ports.

Table 3. Allowed Antenna(s)

MANUFACTURER	TYPE OF ANTENNA	MODEL	REPORT REFERENCE	GAIN) (dB_i)	TYPE OF CONNECTOR
Hubbell Power Systems, Inc.	Dipole Antenna	Engineering Sample	Antenna	-12.687	Solder Bare Wire

2.9 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207)

During testing the EUT is powered by a 30 amp/ 60Hz power supply.

2.10 Intentional Radiator, Radiated Emissions (CFR 15.249 (a), (e))

The EUT was placed into a continuous transmit mode of operation. A preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the product and to obtain the worse case result the EUT tested in all X, Y and Z axis. Radiated measurements below 30 MHz were tested with a RBW = 9 kHz; emissions below 1 GHz were tested with a RBW = 120 kHz and radiated measurements above 1 GHz were measured using a RBW =1 MHz VBW = 3 MHz.

Test data is found in Tables 4 and 5.

2.11 Restricted Bands of Operation (CFR 15.205)

Only radiated harmonics and other spurious signals can be permitted to fall into the restricted bands of 15.205. All signals found in paragraph 2.7 above shall be examined for this requirement. Limits are based upon the limits of paragraph 15.209. Above 1 GHz, the limits are for Average value. See Tables 4 and 5 below for peak and Average measurements. According to CFR 15.35, the peak limits can exceed the average limits by 20 dB.

Table 4. Peak Fundamental and Harmonics, (CFR15.249 (a))

Peak Radiated Fundamental and Harmonics Emissions							
Test By:	**Test:** Fundamental and Harmonics CFR 15.249 (a)			**Client:** Hubbell Power Systems, Inc.			
JCW	**Project:** 13-0072		**Class: A**	**Model: SECTIONALIZER**			
Frequency (MHz)	**Test Data (dBuV)**	**DF+FL***	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Peak Limits (dBuV/m)**	**Distance / Polarity (Meters)**	**Margin (dB)**
Low Channel 2402MHz							
2402.02	47.38		22.29	69.67	94.0	1.0m./V	24.3
Mid Channel 2443MHz							
2443.03	45.04		22.25	67.29	94.0	1.0m./V	26.7
High Channel 2480							
2480.03	45.25		22.43	67.68	94.0	1.0m./V	26.3

All other emissions were at least 20 dB below the applicable limit. There were no appreciable harmonics.

SAMPLE CALCULATION: at 2402.02 MHz, = 47.38 dBuV + (22.29) dB/m = 69.67 dBuV/m @ 1m

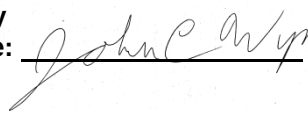
Test Date: March 20, 2013
Tested by
Signature: _____ **Name: John C. Wynn**

Table 5. Fund and Harmonics Average limits, (CFR 15.35(b), 15.249(a))

Average Radiated Fundamental and Harmonics Emissions							
Test By:	**Test:** Fundamental and Harmonics CFR 15.249 (a)			**Client:** Hubbell Power Systems, Inc.			
JCW	**Project:** 13-0072		**Class: A**	**Model: SECTIONALIZER**			
Frequency (MHz)	**Test Data (dBuV)**	**DF+FL***	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Peak Limits (dBuV/m)**	**Distance / Polarity (Meters)**	**Margin (dB)**
Low Channel 2402MHz							
2402.02	42.91		22.29	65.20	74.0	1.0m./V	8.8
Mid Channel 2443MHz							
2443.03	42.66		22.25	64.91	74.0	26.7	9.1
High Channel 2480							
2480.03	42.80		22.43	65.23	74.0	1.0m./V	8.8

All other emissions were at least 20 dB below the applicable limit. There were no appreciable harmonics.

SAMPLE CALCULATION: at 2402.02 MHz = 42.91 dBuV + 22.29 = 65.20 dBuV/m

Test Date: March 20, 2013
Tested by
Signature:  **Name: John C. Wynn**

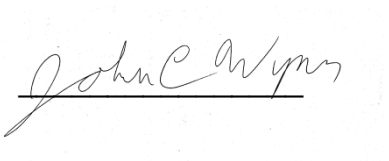
2.13 20 dB Bandwidth Measurement per CFR 15.249

The EUT antenna port was connected to a spectrum analyzer having 50 Ω input impedance. Measurements were performed similar to the method of FCC, KDB Publication No. 558074 for a bandwidth of 20 dB. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in the table below and figures below.

Table 6. 20 dB Bandwidth

Frequency (MHz)	20 dB Bandwidth (MHz)
2402.00	0.3750
2443.00	0.3475
2480.00	0.3573

Test Date: March 21, 2013

Tested By
Signature:  Name: John C. Wynn

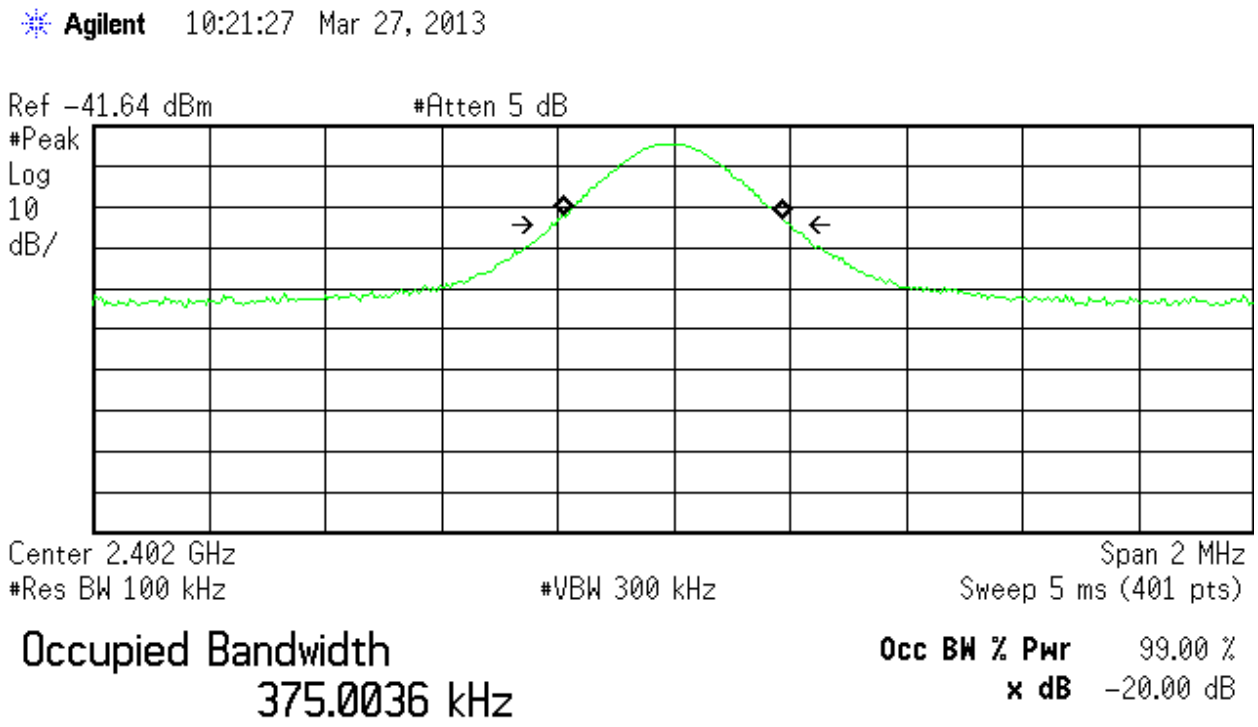


Figure 4. Low Ch 20 dB Bandwidth

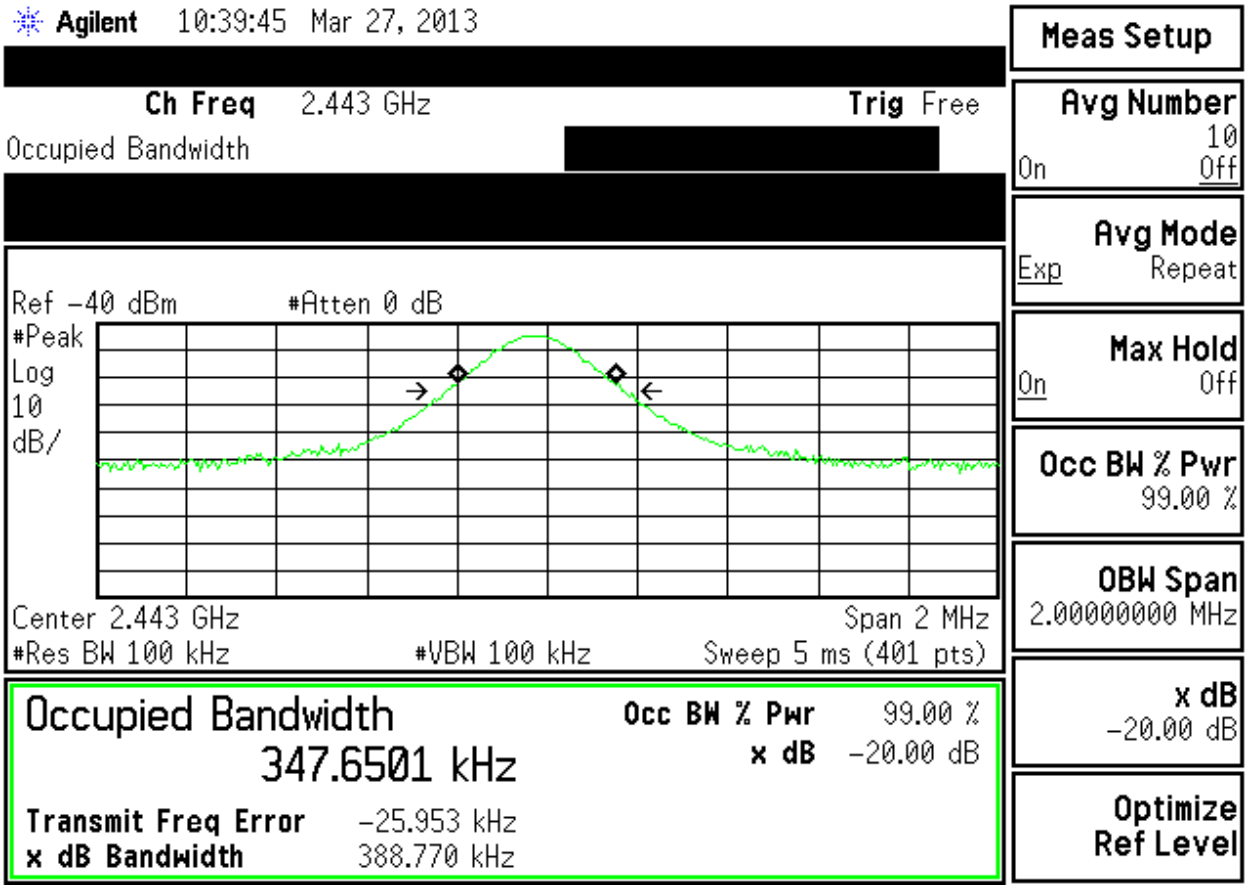


Figure 5. Mid Ch 20 dB Bandwidth

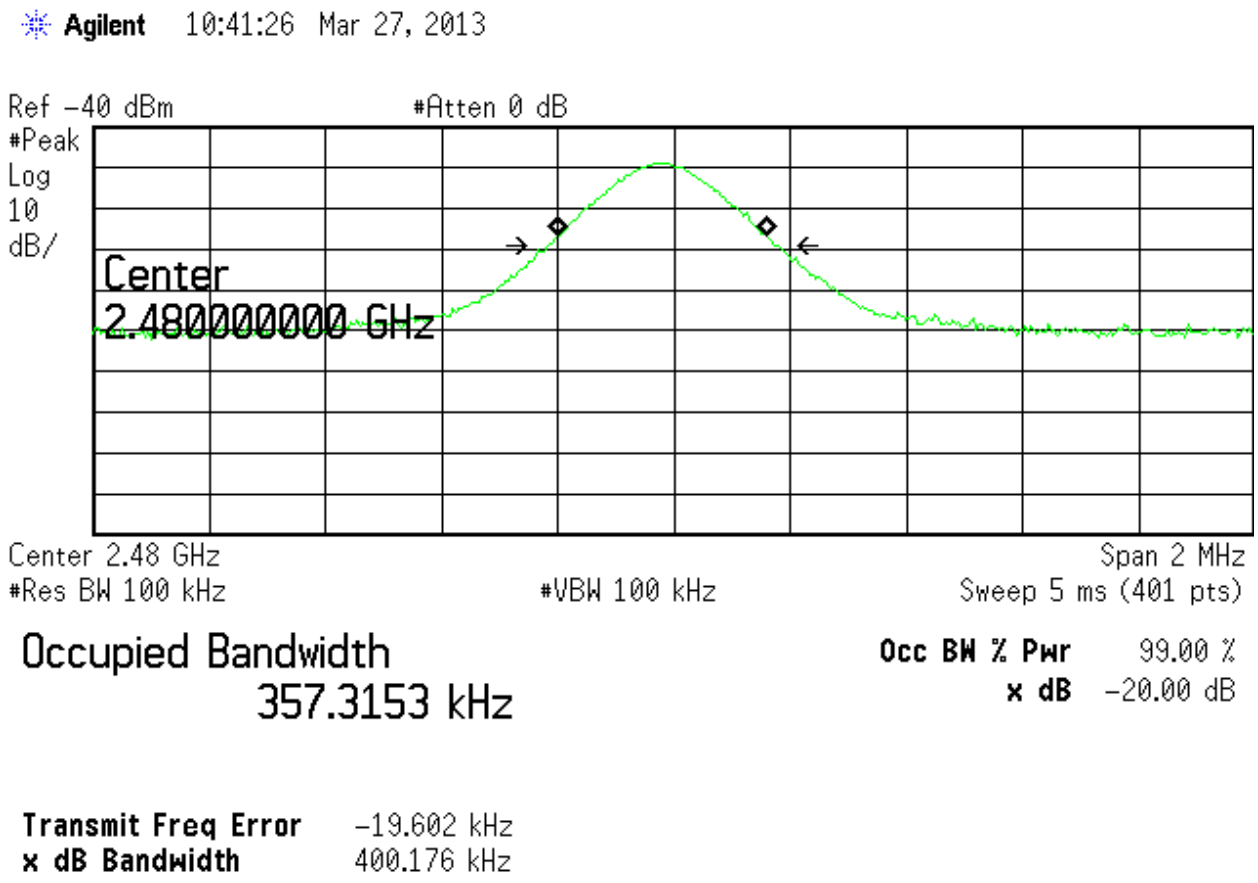


Figure 6. High Ch 20 dB Bandwidth

2.12 Band Edge Measurements (CFR15.249(d))

Band Edge measurements were made at a Low Channel and High Channel peak at highest EUT related emission outside the upper and lower occupied bandwidth. A measurement was made of the fundamental and the emission was measured using a quasi peak setting. A Resolution Bandwidth of > 1% of the emission bandwidth was used. This procedure was repeated for the high channel. The limits were derived as described in the following sections.

2.12.1 High Band Edge

Above 2483.5 MHz the limit per section 15.249(d) is 20 dB below the fundamental or the value expressed by CFR 15.209 (54 dBuV/m) whichever is the lesser attenuation. The High Channel fundamental recorded in Table 4 is 67.68 dBuV/m: 67.68 dBuV – 50.51dB = 17.17 dBuV ; Passing Margin= 54dBuV – 17.17 dBuV) = 36.83 dB

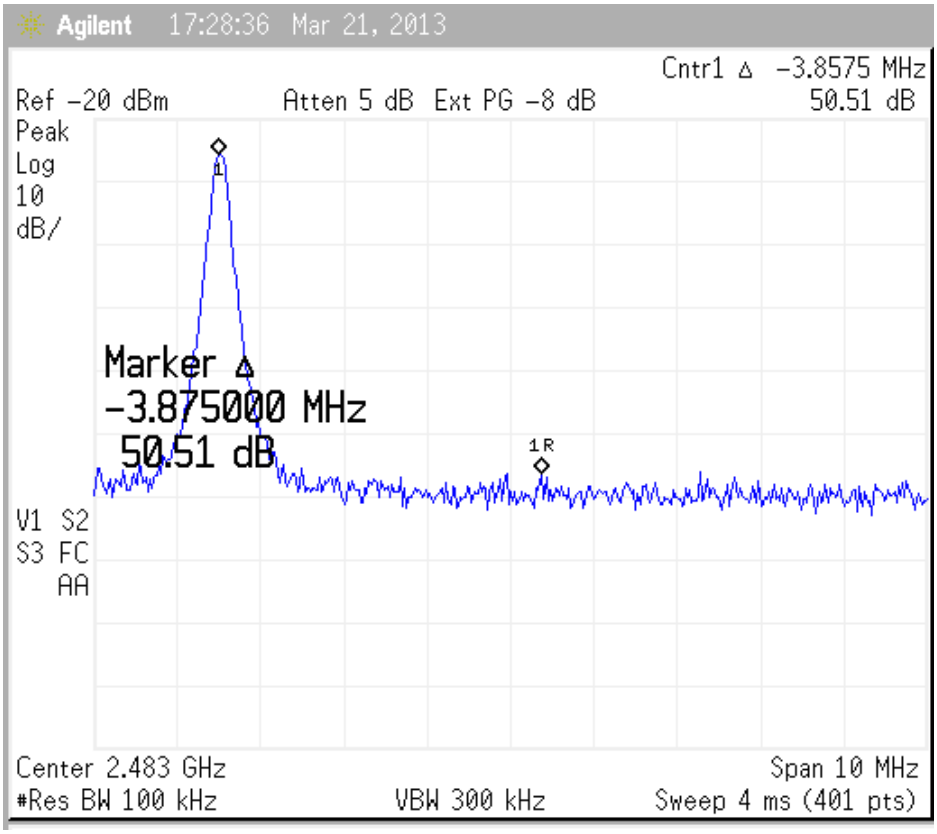


Figure 7. Radiated Band Edge – High Channel Delta

2.12.2 Low Band Edge

The low channel fundamental recorded in Table 4 is 69.67 dBuV/m
69.67 dBuV – 41.43 dB = 28.24 dBuV; Passing Margin= 54 – 28.24 = 25.76 dB

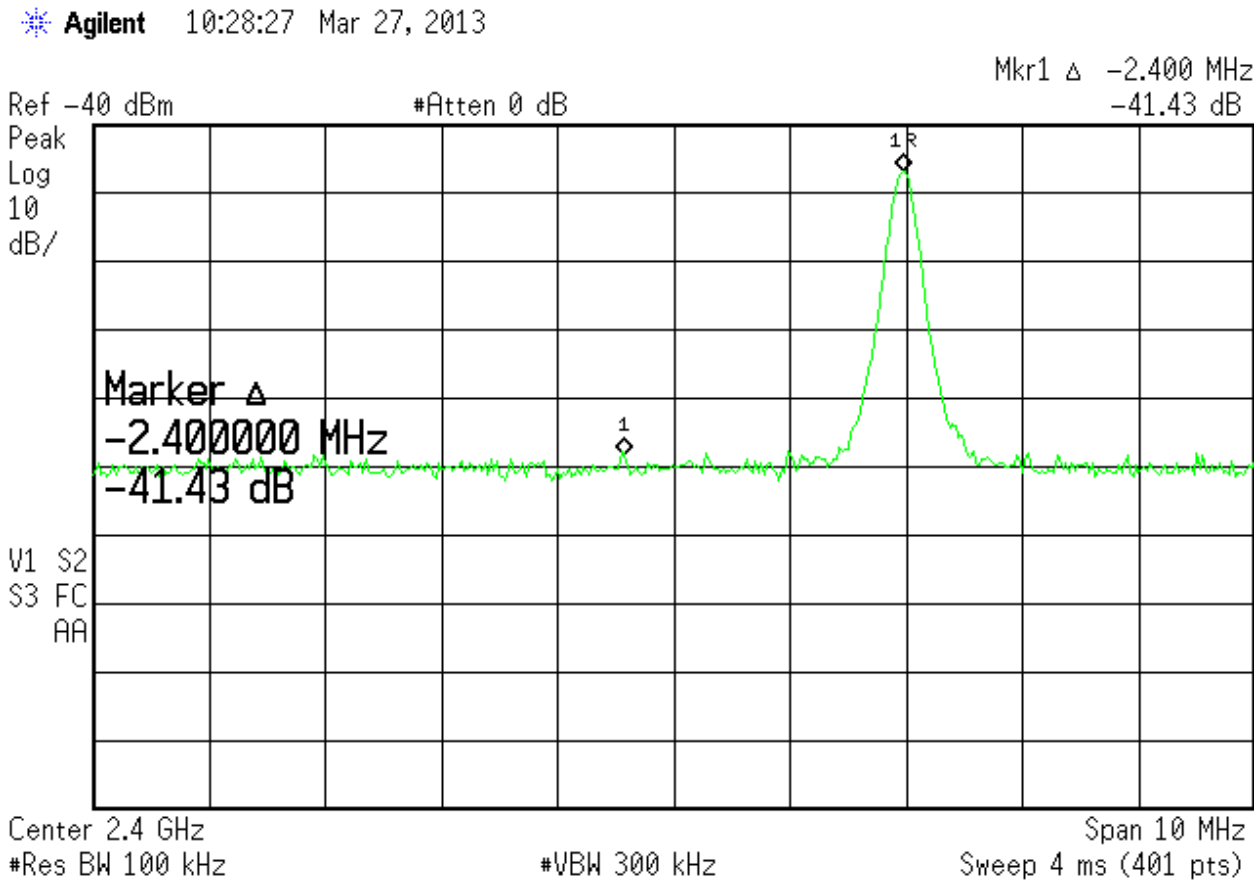


Figure 8. Radiated Band Edge – Low Channel Delta

2.13 Power Conducted Emissions (CFR 15.107, 15.207)

The unit was set up and measured for conducted power line emissions. The measurement setup and test procedures were in accordance with ANSI C63.4, paragraph 7. The EUT is connected to the power lines through the ac adaptor. This configuration is used to test and show compliance to CFR 15.207/CFR15.107 for power line conducted emissions.

Measurements were made over the 150 kHz to 30 MHz frequency range for the unit. The measurement receiver was connected to the RF (receiver) Port on the LISN and each power lead was individually measured. Test results are shown in the following Table for the unit.

Table 7. Power line Conducted Emissions Data, Class B

Power Line Conducted Emissions						
Test By: JCW	**Test:** FCC Power Line Conducted Emissions 150 KHz – 30 MHz			**Client:** Hubbell Power Systems, Inc.		
	Project: 13-0072	Sect. 15.107/15.207 Class: B		**Model:** SECTIONALIZER		
Frequency (MHz)	**Test Data (dBuV)**	**IL+CL-PA (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector PK or QP**
30 AMPS, 60 Hz Phase						
0.1518	50.01	1.45	51.46	65.9*	14.4	**QP**
0.1518	15.83	1.45	17.28	55.9	38.6	**AVG**
0.5000	41.02	0.51	41.53	56.0*	14.5	**QP**
0.5000	10.80	0.51	11.31	46.0	34.7	**AVG**
1.0900	46.80	0.46	47.26	56.0*	8.7	**PK**
1.0900	9.49	0.46	9.95	46.0	36.1	**AVG**
5.0450	22.50	0.66	23.16	50.0	26.8	**PK**
15.4300	23.20	1.02	24.22	50.0	25.8	**PK**
26.9600	21.90	1.26	23.16	50.0	26.8	**PK**
30 AMPS, 60 Hz Neutral						
0.1500	51.56	1.42	52.98	66.0*	13.0	**QP**
0.1500	13.98	1.42	15.40	56.0	40.6	**AVG**
0.5175	41.60	0.47	42.07	56.0*	13.9	**QP**
0.5175	9.57	0.47	10.04	46.0	36.0	**AVG**
1.0700	49.96	0.42	50.38	56.0*	5.6	**PK**
1.0700	9.30	0.42	9.72	46.0	36.3	**AVG**
9.5600	22.80	0.87	23.67	50.0	26.3	**PK**
19.2600	22.40	1.04	23.44	50.0	26.6	**PK**
24.3900	21.80	1.18	22.98	50.0	27.0	**PK**

Tested from 150 kHz to 30 MHz

SAMPLE CALCULATIONS: At 0.1518 MHz, 50.01 dBuV + 1.45 dB = 51.46 dBuV
***Quasi-Peak limits were used.**

Test Date: March 18, 2013

Tested by Signature: John C Wynn **Name: John C. Wynn**

2.14 Radiated Emissions (CFR 15.109, 15.209)

Radiated emissions within the band 9 KHz to 30 MHz and 30 MHz to 12.5 GHz were measured with a spectrum analyzer via a pre-amplifier by connecting the spectrum analyzer to a receiving antenna spaced three (3) meters from the EUT. The spectrum analyzer was set for a 50 Ω input impedance with the VBW set to ≥ the RBW bandwidth. The antenna was raised and lowered over a span of 4 meters in order to maximize the signal coming from the EUT. Similarly, the turntable was rotated through 360 degrees in the same maximizing effort. Also the EUT was scanned for a maximum radiated power when placed in each of the three mutually exclusive orthogonal planes.

Radiated emissions within the band of 9 kHz to 30 MHz were investigated using a calibrated Loop Antenna and per the requirements of ANSI C63.4:2003. The resolution bandwidth was set to 9 kHz, the video bandwidth was set to three times the resolution bandwidth.

For measurements above 30 MHz the measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth.

All measured signals were at least 6 db below the specification limit. The results of the measurements are reported in the tables below.

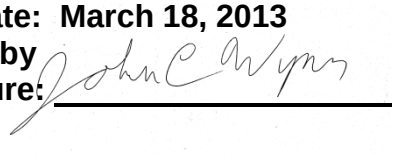
Table 8. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109, 15.209)

Peak Radiated Emissions, Digital Device and Receiver							
Test By: JCW	**Test:** Radiated Emissions- 150 kHz to 12.5 GHz				**Client:** Hubbell Power Systems, Inc.		
	Project: 13-0072	**Requirement** 15.109/15.209, Class: B			**Model:** SECTIONALIZER		
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Distance / Polarity (meters)**	**Margin (dB)**	**Detector PK / QP**
3000.00	46.59	-12.17	34.42	54.0	3m/Vert.	19.6	**PK**
3050.00	45.94	-11.66	34.28	54.0	3m/Hor.	19.7	**PK**
1204.00	43.15	-18.57	24.58	54.0	3m/Hor.	29.4	**PK**
1198.85	43.18	-18.82	24.36	54.0	3m/Vert.	29.6	**PK**
763.129	29.00	-11.32	17.68	46.0	3m/Hor.	28.3	**PK**
803.766	38.90	-11.58	27.32	46.0	3m/Vert.	18.7	**PK**

Tested from 150 kHz to 12.5 GHz.

No other emissions found more than 20 dB from the limit.
All measurements were made at 3 meters and extrapolated back to 10 meters using a -10.5dB factor.

SAMPLE CALCULATION:
RESULTS at 3000.0 MHz, = 46.59 dBuV + (-12.17) dB = 34.42 dBuV/m

Test Date: March 18, 2013
Tested by
Signature:  **Name: John C. Wynn**

2.15 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.15.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.8 dB.

The data listed in this test report does have sufficient margin to negate the effects of uncertainty. Therefore, the EUT unconditionally meets this requirement.

2.15.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.3 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±2.45 dB.

The data listed in this test report does have sufficient margin to negate the effects of uncertainty. Therefore, the EUT unconditionally meets this requirement.