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FCC PART 15.Subpart H White Spaces System

PART 1 TEST REPORT

Fixed TVBD Device

Applicant	REDLINE COMMUNICATIONS, INC.
Address	302 TOWN CENTRE BLVD. SUITE 100 MARKHAM, ONTARIO L3R 0E8 CANADA
FCC ID	QC8-RDL3000RMF
Model Number	RDL-3000-RMF (Antenna: Redline, ALP-SB-60055-01 Antenna Log-P Directional 470-698MHz 11dBi 48in(122cm) 55deg vpol & hpol - 2x2 MIMO cross-polarized configuration)
Product Description	White Space Fixed TVBD
Date Sample Received	02/01/2013
Date Tested	02/04/2013
Tested By	Sushant Kadimdivan
Approved By	Mario de Aranzeta
Report Number	R\Redline_QC8\208AUT13\208AUT13TestReport.doc
Test Results	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.



Testing Certificate #0955-01

TABLE OF CONTENT

GENERAL REMARKS 3

GENERAL INFORMATION 4

EMC EQUIPMENT LIST 6

TEST PROCEDURES 7

§15.207 & §15.709(C)(5) POWER LINE CONDUCTED INTERFERENCE 8

§15.209 RADIATION INTERFERENCE 11

§15.709(A) POWER LIMITS FIXED TVBD 15

§15.709(A)(3)(I) TRANSMITTER POWER CONTROL FIXED TVBD 19

§15.709(C)(1) EMISSION LIMITS AT THE BAND EDGE FOR TVBDS 20

§15.709(C)(4) EMISSION IN THE BAND OF 602-620MHZ LIMITS FOR TVBDS 28

PRODUCT PHOTOS 38

GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

The test results relate only to the items tested.

Summary

The device under test does:

- fulfill the general approval requirements as identified in this test report
- not fulfill the general approval requirements as identified in this test report

Attestations

The scope of this document is to report the results of the Fixed TVBD Part 1 Radio Frequency Certification Tests. There are three (3) components of the White Spaces technology;

- **TV Band devices (Fixed TVBD for Certification).**
- **TV Bands Database**
- **TV Band System, Made up of Fixed TVBD's database, and layer of interaction between the devices and the databases.**

To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025: 2005 requirements.



Testing Certificate # 0955-01

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669

Authorized Signatory Name:



Compliance Engineer/ Lab. Supervisor

Date: March 22, 2013

APPLICANT. REDLINE COMMUNICATIONS, INC.
FCC ID: QC8-RDL3000RMF
REPORT: R\Redline_QC8\208AUT13\208AUT13TestReport.doc

GENERAL INFORMATION

DUT Description

General:

The RDL-3000-RMF UHF 2x2 MIMO broadband radio provides high capacity, long range communications links. Operating in the 470-698MHz band, the RDL-3000-RMF is configured via firmware options and electronic product keys. It can be upgraded later without having to replace any hardware. Powered by Redline's innovative next generation Orthogonal Frequency Division Multiplexing (OFDM) technology, the RDL-3000-RMF radio uses a proprietary OFDM protocol derived from the IEEE 802.11a standard. It implements powerful hardware accelerators and MIMO technology that achieves the highest throughput, lowest latency, and the greatest line-of-sight (LOS) and non-line-of-sight (NLOS) range in the industry, even in the most challenging urban and industrial environments. It supports a full range of Quality of Service (QoS) controls to enable premium access services for voice, data, and video services. Its industry leading capacity also supports the maximum number of video cameras with the highest video quality. With AES-128 encryption standard or optionally AES-256 encryption and X.509 certificate based authentication, the RDL-3000-RMF delivers unparalleled security.

DUT Specification

Applicable Standard	Part 15 Subpart H TV Band White Space Fixed Device		
DUT Description	Transceiver – Single preferred channel		
FCC ID	QC8-RDL3000RMF		
Application:	High capacity, long range communications links		
Operating Frequency	473-695MHz		
Number of channels	TV channels #14 through #35 and #39 through #51		
Transmit Power(dBm):	+18dBm RMS per RF channel (ch #35 and #39 limited to +16dBm max)		
DUT Power Source	<input type="checkbox"/> 110–120Vac/50– 60Hz		
	<input checked="" type="checkbox"/> DC 48V nominal via POE injector, <0.4A CINCON TR60A-POE-L		
	<input type="checkbox"/> Battery Operated Exclusively		
Test Item	<input type="checkbox"/> Prototype	<input type="checkbox"/> Pre-Production	<input checked="" type="checkbox"/> Production
Type of Equipment	<input checked="" type="checkbox"/> Fixed - WGF	<input type="checkbox"/> Mobile – WG1	<input type="checkbox"/> Portable – WG2
	<input type="checkbox"/> Fixed - WSF	<input type="checkbox"/> Mobile – WS1	<input type="checkbox"/> Portable – WS2
Antenna Connector	50 ohm N type connector x2. Product has 2 RF ports. Timco has confirmed that both ports are identical.		
Antenna	Redline, ALP-SB-60055-01 Antenna Log-P Directional 470-698MHz 11dBi 48in(122cm) 55deg Vpol & Hpol - 2x2 MIMO cross-polarized configuration		
Network Port	RJ 45		
Serial Port	NA		
Indicators	<input type="checkbox"/> Power Indicator		

APPLICANT. REDLINE COMMUNICATIONS, INC.

FCC ID: QC8-RDL3000RMF

REPORT: R\Redline_QC8\208AUT13\208AUT13TestReport.doc

	<input type="checkbox"/> Alarm Indicator
	<input type="checkbox"/> Transmit Indicator

Test Facility	Timco Engineering Inc. 849 NW State Road 45 Newberry, FL 32669 USA.
Test Conditions	Temperature: 26°C Relative humidity: 50%
Test Exercise	The DUT was placed in manual mode allowing for power and frequency adjustments while in a continuous transmit mode of operation.

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	10/28/11	10/28/13
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	10/28/11	10/28/13
Antenna: Biconnical	Eaton	94455-1	1096	05/04/11	05/04/13
Antenna: Log-Periodic	Electro-Metrics	LPA-25	1122	05/04/11	05/04/13
Signal Generator	HP	8640B	2308A21464	02/23/12	02/23/14
Hygro-Thermometer	Extech	445703	0602	06/15/11	06/15/13
Digital Multimeter	Fluke	77	35053830	09/09/11	09/09/13
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	10/28/11	10/28/13
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	10/28/11	10/28/13
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	03/24/12	03/24/14
Spectrum Analyzer	R&S	ESIB40	100274	3/16/12	3/16/14
Antenna: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	12/07/11	12/07/13
Antenna: Passive Loop	EMC Test Systems	EMCO 6512	9706-1211	06/14/12	06/14/14

TEST PROCEDURES

RF Test: Certification Test Procedures for TV Band (White Spaces) Devices Authorized under Subpart H of the Part 15 Rules, 416721 DO1 White Space Test Procedures v02.

FCC KDB 662911 D02 MIMO with Cross Polarized Antenna v01

Radiated tests were performed with one port connected to horizontally polarized antenna and the second port connected to vertically polarized antenna.

Conducted tests were performed on one port with the other port terminated in 50 OHMS.

Power Line Conducted Interference: The procedure used was ANSI C63.4-2009 using a 50uH LISN. Both lines were observed. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed. The spectrum was scanned from 0.15 to 30 MHz.

Radiation Interference: ANSI C63.4-2009 using a spectrum analyzer, a preselector, a quasi-peak adapter, and an appropriate antenna. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was 100 kHz with an appropriate sweep speed and the video bandwidth was 300 kHz up to 1 GHz and 1 MHz with a video BW of 3 MHz above 1 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. The antenna was placed in both the horizontal and vertical planes and the worse case emissions were reported. The spectrum was searched to at least the tenth (10) harmonic of the fundamental.

Formula Of Conversion Factors: The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dBµV) to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

Example:

Freq (MHz)	Meter Reading	+ ACF	+ CL = FS
33	20 dBµV	+ 10.36 dB	+ 0.5 = 30.86 dBµV/m @ 3m

Occupied Bandwidth: A small sample of the transmitter output was fed into the spectrum analyzer and the attached plot was printed. The vertical scale is set to -10 dBm per division.

Power Output: The RF power output was measured at the antenna feed point using a spectrum analyzer

Antenna Conducted Emissions: The RBW=100 kHz, VBW=300 kHz and the span set to 10 MHz and the spectrum was scanned from 30 MHz to the 10th Harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz and the span to 50 MHz.

ANSI C63.4-2009 10.1 Measurement Procedures: The DUT was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The DUT was placed in the center of the table (1.5m side). The table used for radiated measurements is capable of continuous rotation.

When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes. Emissions attenuated more than 20 dB below the permissible value are not reported.

APPLICANT. REDLINE COMMUNICATIONS, INC.
 FCC ID: QC8-RDL3000RMF
 REPORT: R\Redline_QC8\208AUT13\208AUT13TestReport.doc

§15.203 Antenna Requirements:

Requirement: A UNIQUE connector or the antenna must be permanently attached.

The device will be professionally installed. It is not a consumer device.

§15.207 & §15.709(c)(5) POWER LINE CONDUCTED INTERFERENCE

Rules Part No.: Part 15.207

Requirements:

Frequency (MHz)	Quasi Peak Limits (dBµV)	Average Limits (dBµV)
0.15 – 0.5	66 – 56 *	56 – 46 *
0.5 – 5.0	56	46
5.0 – 30	60	50
* Decrease with logarithm of frequency		

Test Data: The following plots represent the emissions read for power line conducted. Both lines were observed. The device was put in transmit mode.

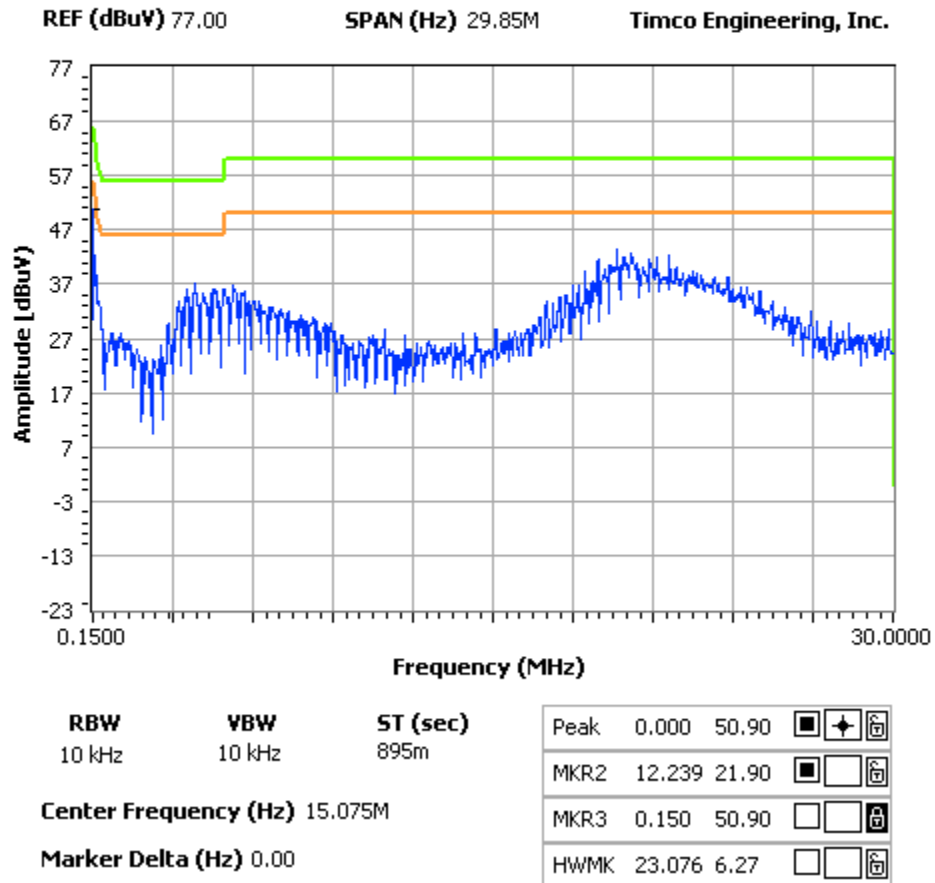
POWERLINE CONDUCTED PLOTS

Peak Detector, Line 1

NOTES:

REDLINE CINCON TR60A-POE-L
LINE 1

FCC 15.107 Mask Class B



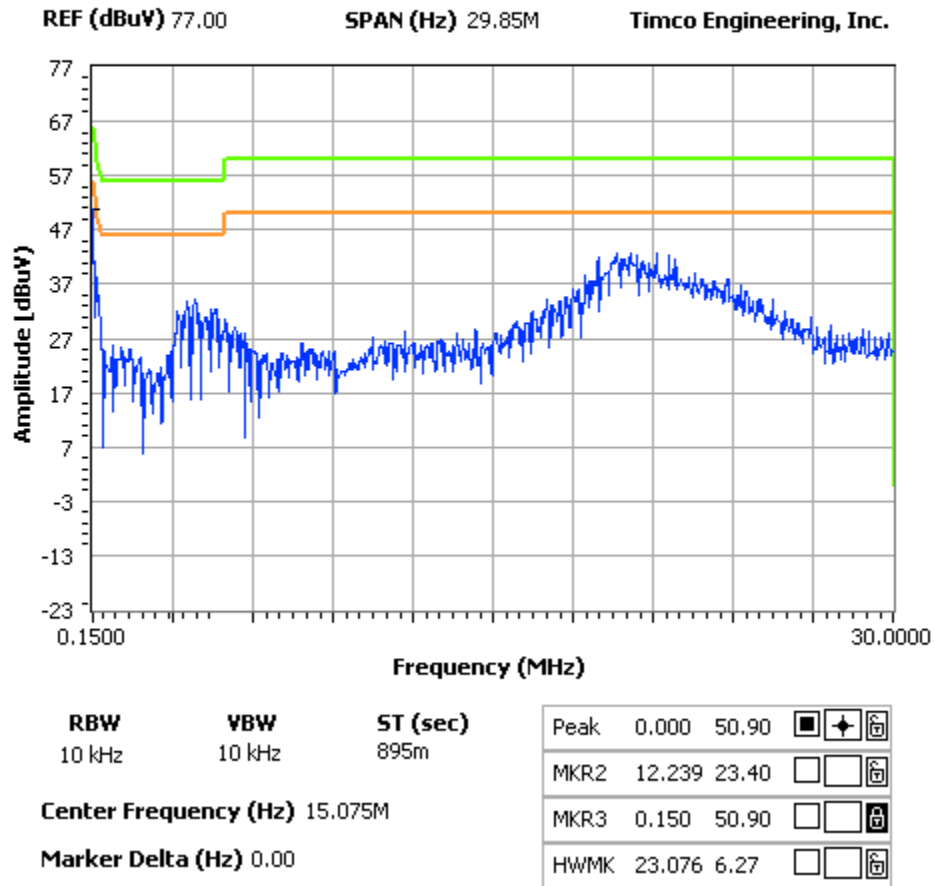
POWERLINE CONDUCTED PLOTS

Peak Detector, Line 2

NOTES:

REDLINE CINCON TR60A-POE-L
LINE 2

FCC 15.107 Mask Class B



§15.209 RADIATION INTERFERENCE

Rules Part No.: 15.709(c)(3) Emission Limits for TVBD's, 15.209

Requirements:

Frequency	Limits
Part 15.209	
9 to 490 kHz	2400/F (kHz) μ V/m @ 300 meters
490 to 1705 kHz	24000/F (kHz) μ V/m @ 30 meters
1705 kHz to 30 MHz	29.54 dB μ V/m @ 30 meters
30 – 88	40.0 dB μ V/m @ 3 meters
80 – 216	43.5 dB μ V/m @ 3 meters
216 – 960	46.0 dB μ V/m @ 3 meters
Above 960	54.0 dB μ V/m @ 3 meters

Emissions were checked from the lowest frequency generated or 9 kHz through to the 10th harmonic.

The whitespace TVBD must meet CLASS B requirements.

Test Data: All values are peak unless noted.
 Items mark with an * designate a frequency in a restricted band.
 Measurement Distance is 3m.

Unintentional Radiated Emissions

Emission Frequency MHz	Meter Reading dBμV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBμV/m	Margin dB
34.00	13.7	V	0.41	13.6	27.7	12.3
32.20	9.8	H	0.41	13.60	23.81	16.19
64.90	14.6	V	0.55	5.74	20.89	19.11
69.6	13.8	V	0.55	5.74	20.09	19.91
113.00	10.4	V	0.66	10.14	21.20	22.30
675.20	15.7	H	1.68	21.60	38.98	7.02
675.20	17.5	V	1.68	21.60	40.78	5.22
699.20	14.5	V	1.70	21.80	38.00	8.00
724.00	17.1	H	1.75	21.82	40.67	5.33
724.00	20.4	V	1.75	21.82	43.97	2.03
748.80	14.1	V	1.80	21.90	37.80	8.20
774.40	7.8	V	1.85	22.04	31.69	14.31
798.40	12.3	V	1.90	22.10	36.30	9.70
824.00	10.4	V	1.91	22.56	34.87	11.13

Note: The transmitter on the product was turned off using control software.

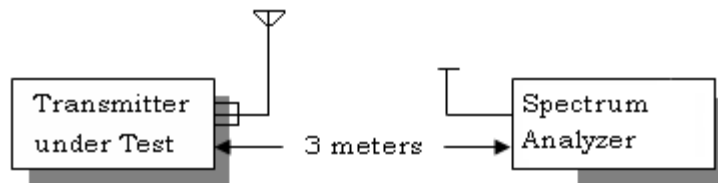
Intentional Radiated Emissions

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBμV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBμV/m	Margin dB
473.0	32.00	24.1	V	0.41	13.60	38.11	1.89
473.0	32.20	19.6	H	0.41	13.60	33.61	6.31
473.0	64.90	14.6	V	0.55	5.74	20.89	19.11
473.0	113.00	10.4	V	0.66	10.14	21.20	22.30
473.0	360.10	13.9	V	1.16	15.10	30.16	15.84
473.0	725.00	20.8	V	1.75	21.80	44.35	1.65
473.0	945.20	14.0	H	2.02	24.15	40.17	5.83
473.0	946.40	9.1	V	2.02	24.16	35.28	10.72
473.0	1,417.00	14.7	V	2.43	28.48	45.61	8.39(AVG)
473.0	1,417.00	25.8	V	2.43	28.48	56.71	-2.71
473.0	2,360.00	7.8	V	3.15	32.32	43.27	10.73
473.0	2,814.00	10.9	V	3.47	32.85	47.22	6.78
587.0	1,173.00	11.9	V	2.24	27.85	41.99	12.01(AVG)
587.0	1,173.00	25.8	V	2.24	27.85	55.89	-1.89
587.0	1,761.00	13.5	V	2.71	30.21	46.42	7.58(AVG)
587.0	1,761.00	24.8	V	2.71	30.21	57.72	-3.72
587.0	2,347.00	11.0	V	3.14	32.29	46.43	7.57
587.0	2,933.00	13.9	H	3.55	32.95	50.40	3.60
587.0	2,933.00	16.7	V	3.55	32.95	53.20	0.80
695.0	1,388.00	13.3	H	2.41	28.41	44.12	9.88
695.0	1,388.00	13.9	V	2.41	28.41	44.72	9.28
695.0	2,084.00	13.8	V	2.96	31.77	48.53	5.47(AVG)
695.0	2,084.00	25.7	V	2.96	31.77	60.43	-6.43
695.0	2,085.00	7.2	H	2.96	31.77	41.93	12.07(AVG)
695.0	2,085.00	19.5	H	2.96	31.77	54.23	-0.23
695.0	2,779.00	12.9	V	3.45	32.82	49.17	4.83
695.0	2,780.00	10.6	H	3.45	32.82	46.87	7.13

Measurements are in peak detector mode unless marked otherwise.

Measurements above 1000 MHz that fail with peak detector were re-measured using average detector.

Method of Measuring Radiated Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was ANSI standard C63.4-2009 & the FCC/OET Guidance on Measurements for Spread Spectrum Systems – KDB 558074 dated March 23, 2005.

§15.709(a) Power Limits Fixed TVBD

Test Procedure: 15.709(a)(2), 15.709(a)(5)(ii),
416721 D01 Whitespace Procedures v02

Requirements: 15.709(a)(2), 15.709(a)(5)(ii)
LIMIT ADJUSTMENT FOR ANTENNA GAIN OVER 6 DBi = 5 dB
LIMIT ADJUSTMENT FOR CROSS POLARIZED MIMO = 3 dB

Final Fixed Power limit (6MHz) = 30 – 8 = 22 dBm
Final Fixed PSD limit (100kHz) = 12.6 – 8 = 4.6 dBm

Conducted measurement Limits (Fixed Devices)		
Antenna gain (dBi)	6MHZ power (dBm)	PSD 100 kHz (dBm)
≤6	30	12.6
11	22	4.6

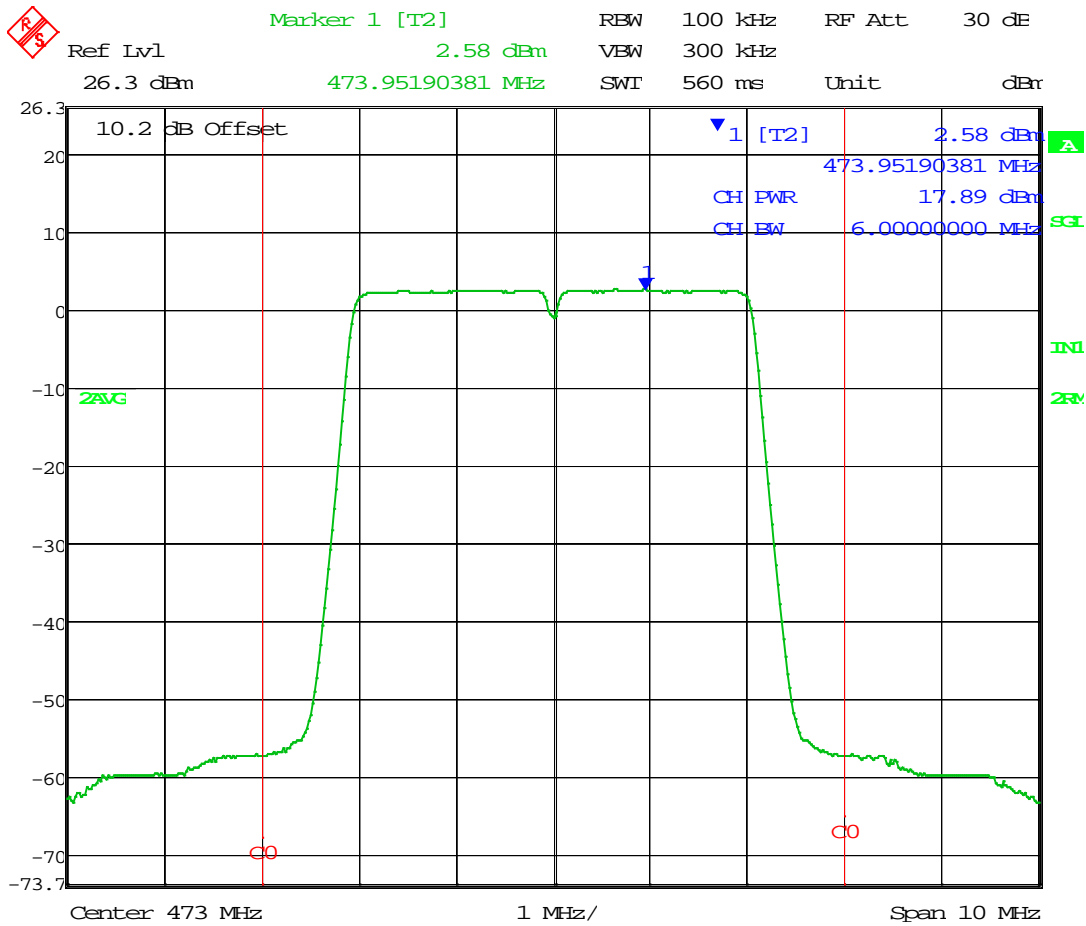
Test Data:

Refer next page.

CONDUCTED RESULTS:

○ **Test Results #1 Low of the Band:**

Channel Frequency: 473 MHz
 Measured Channel Power: (Conducted) 17.89 dBm
 Highest in-band PSD: (Conducted) 2.58 dBm

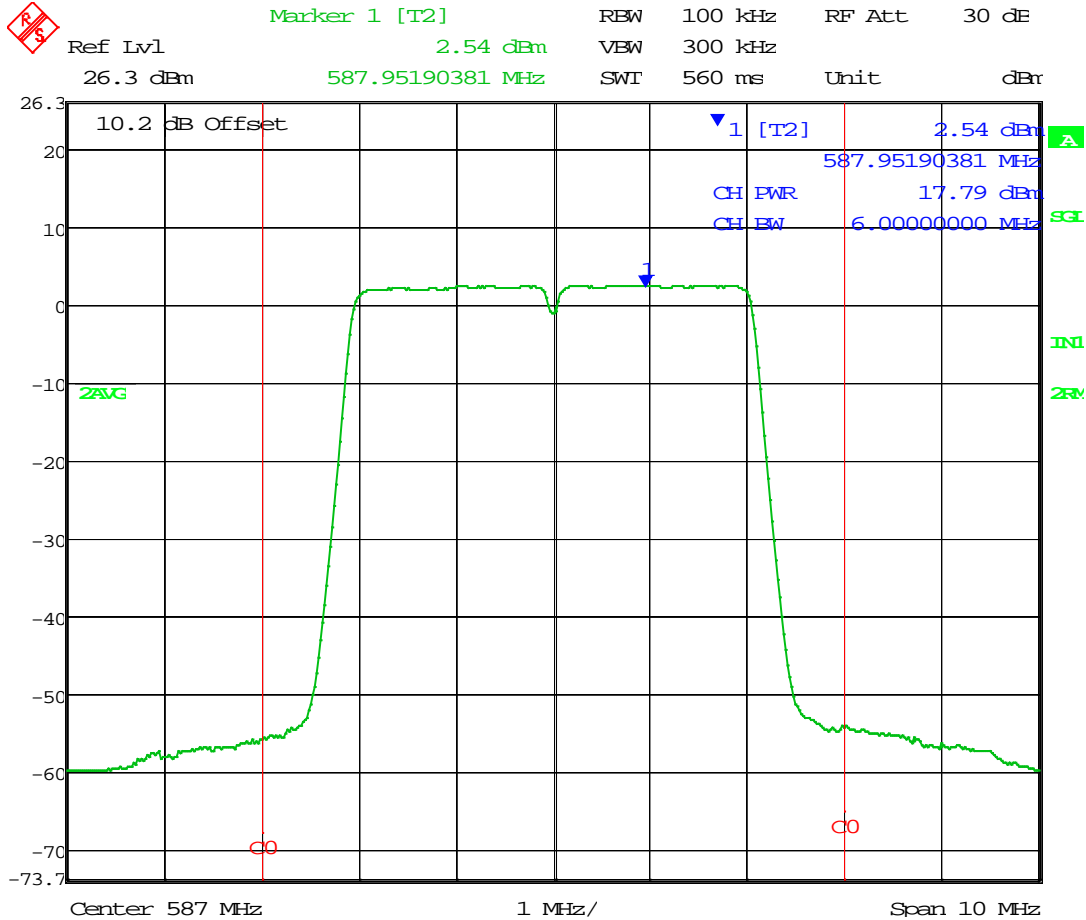


Date: 4.FEB.2013 11:45:01

Results: PASS

Test Results #2 Middle of the Band:

Channel Frequency: 587 MHz
 Measured Channel Power: (Conducted) 17.79 dBm
 Highest in-band PSD: (Conducted) 2.54 dBm



Date: 4.FEB.2013 11:47:19

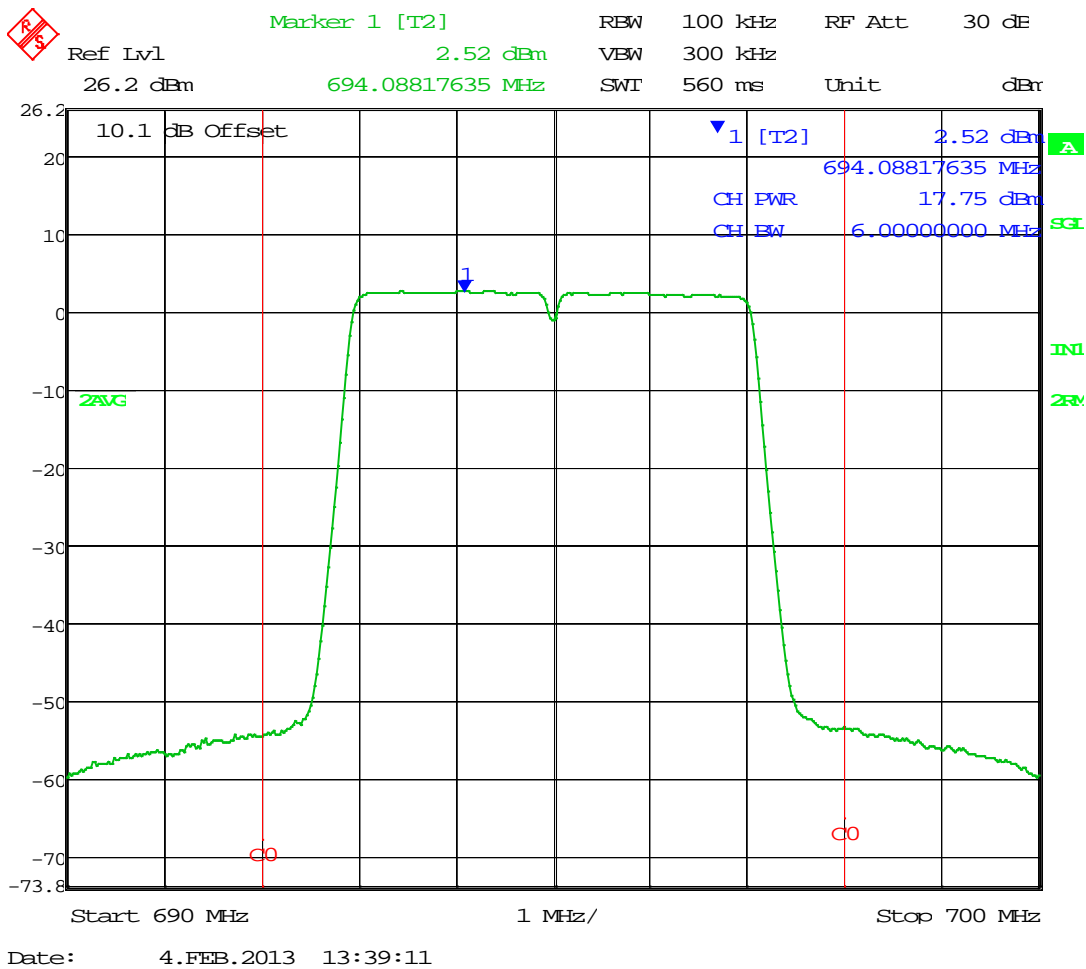
Results: PASS

○ **Test Results #3 High End of the Band:**

Channel Frequency: 695 MHz

Measured Channel Power: (Conducted) 17.75 dBm

Highest in-band PSD: (Conducted) 2.52 dBm



Results: PASS

§15.709(a)(3)(i) Transmitter Power Control Fixed TVBD

The power setting for the product under test was set (to 18 dBm) using the manufacturer's test tool software.

§15.709(c)(1) Emission Limits at the band edge for TVBDs

Requirement: 15.709 (c) (ii), 15.709(c)(2) Emission Limits for TVBDs

LIMIT ADJUSTMENT FOR ANTENNA GAIN OVER 6 DBi = 5 dB

LIMIT ADJUSTMENT FOR CROSS POLARIZED MIMO = 3 dB

Final Fixed device Limit = -50.8 dBm

Conducted measurement Limits (Fixed Devices)	
Antenna gain (dBi)	Adjacent Channel (dBm)
≤6	-42.8
13	-50.8

Test Data:

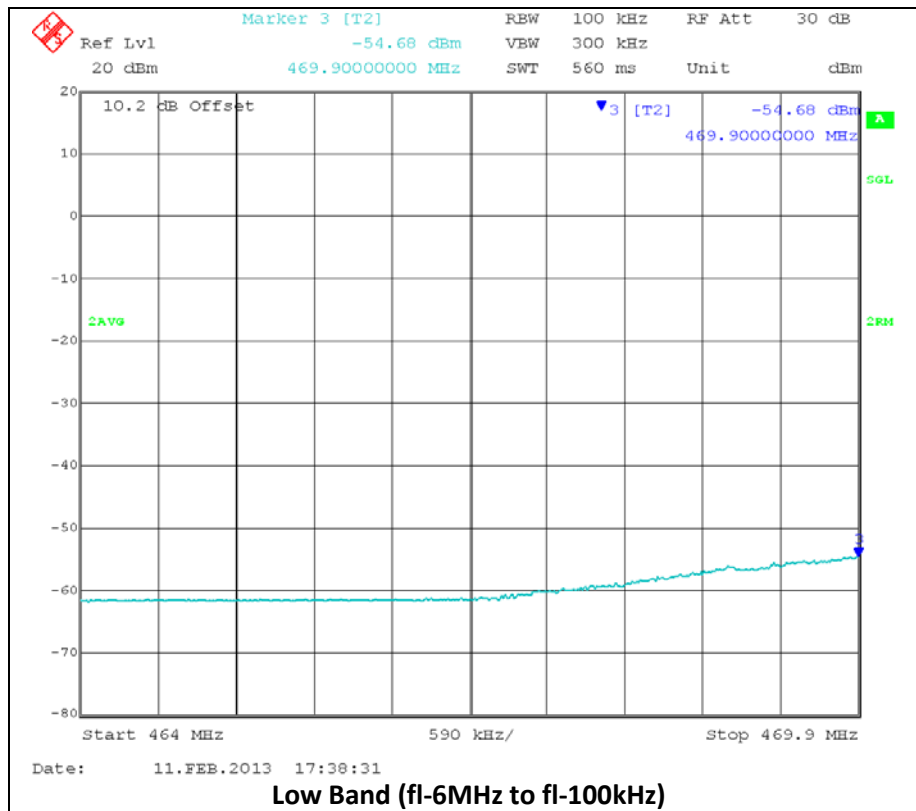
Conducted measurements:

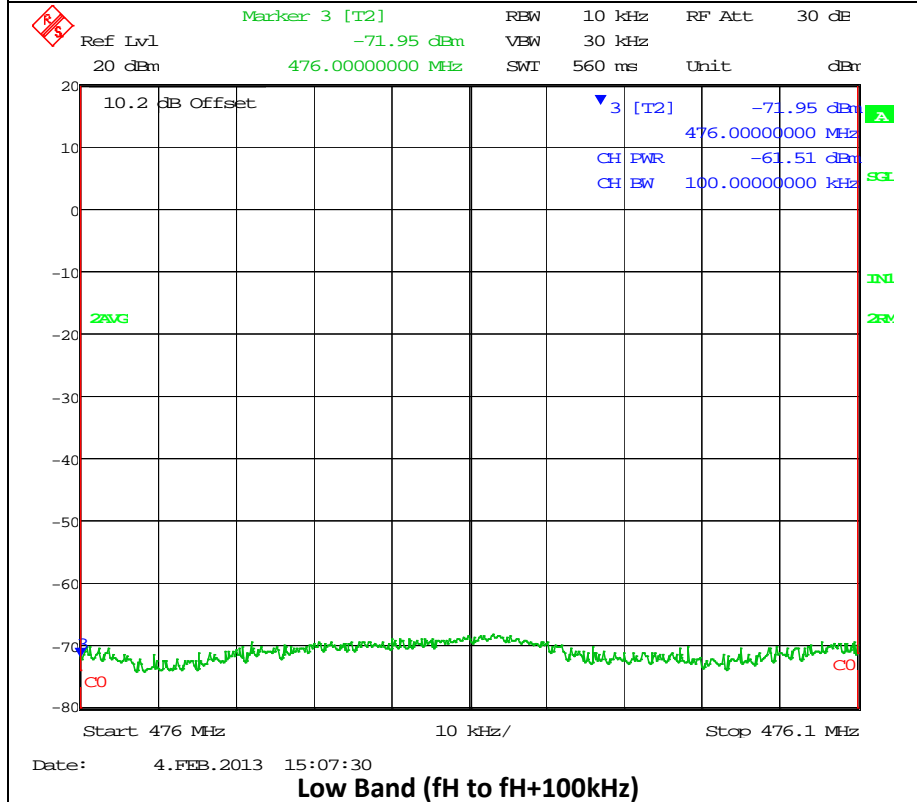
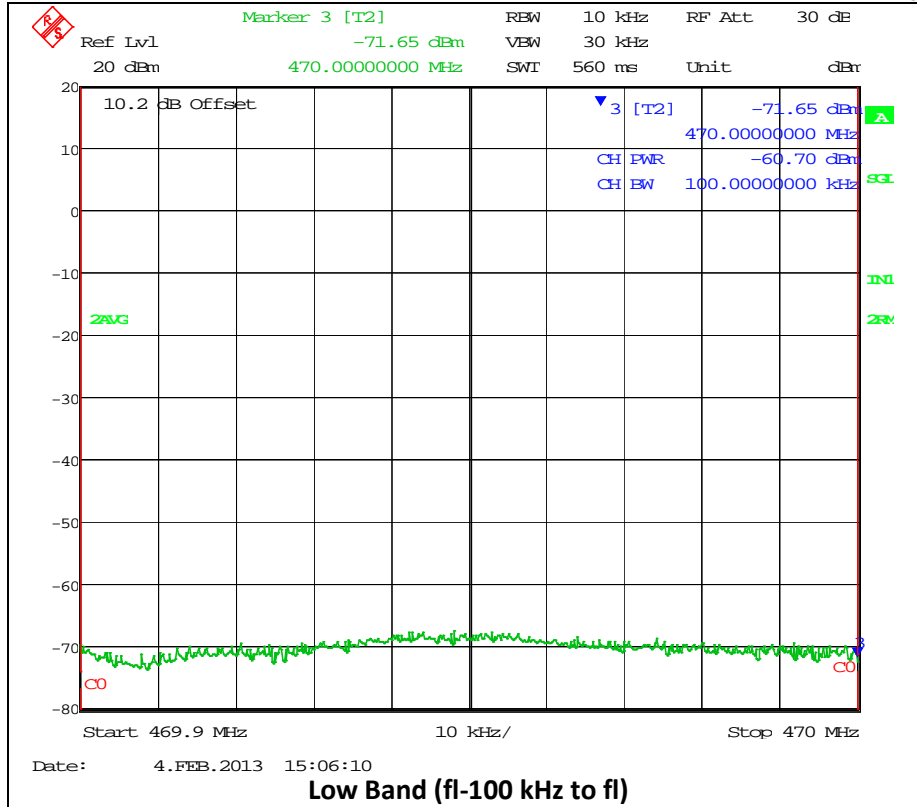
Ch	Center (MHz)	fL-6 MHz to fL-100 kHz (dBm)	fL-100 kHz to fL (dBm)
14	473	-54.68	-60.70
33	587	-55.46	-60.36
51	695	-53.98	-58.06

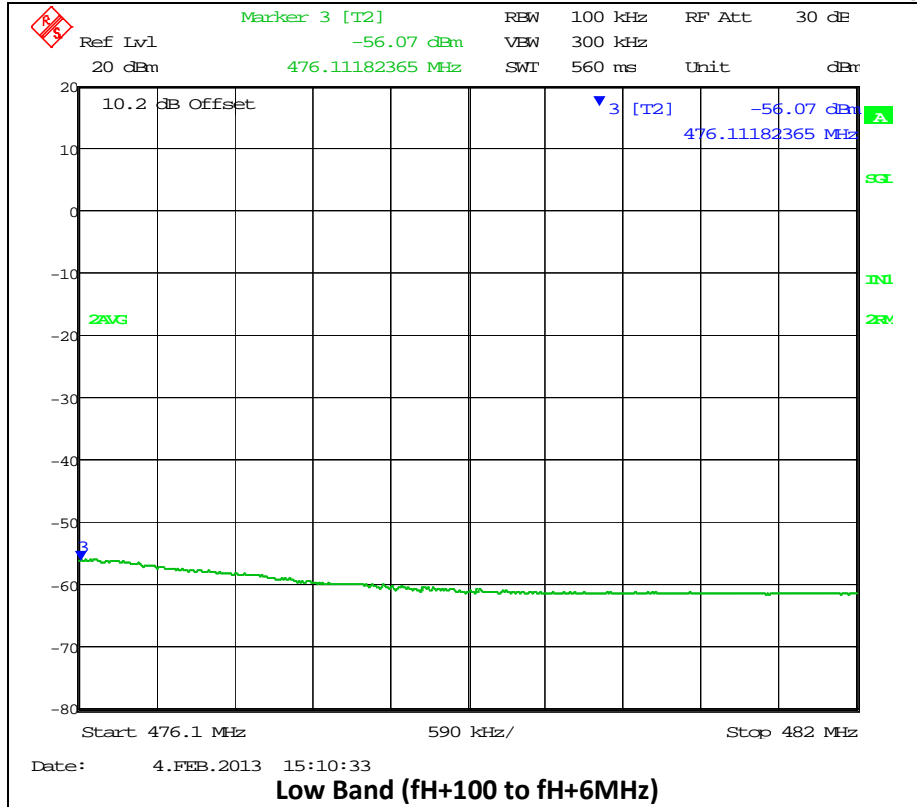
Ch	Center (MHz)	fH to fH+100 kHz (dBm)	fH+100kHz to fH+6 MHz (dBm)
14	473	-61.6	-56.07
33	587	-58.12	-54.03
51	695	-57.06	-53.05

Conducted Plots

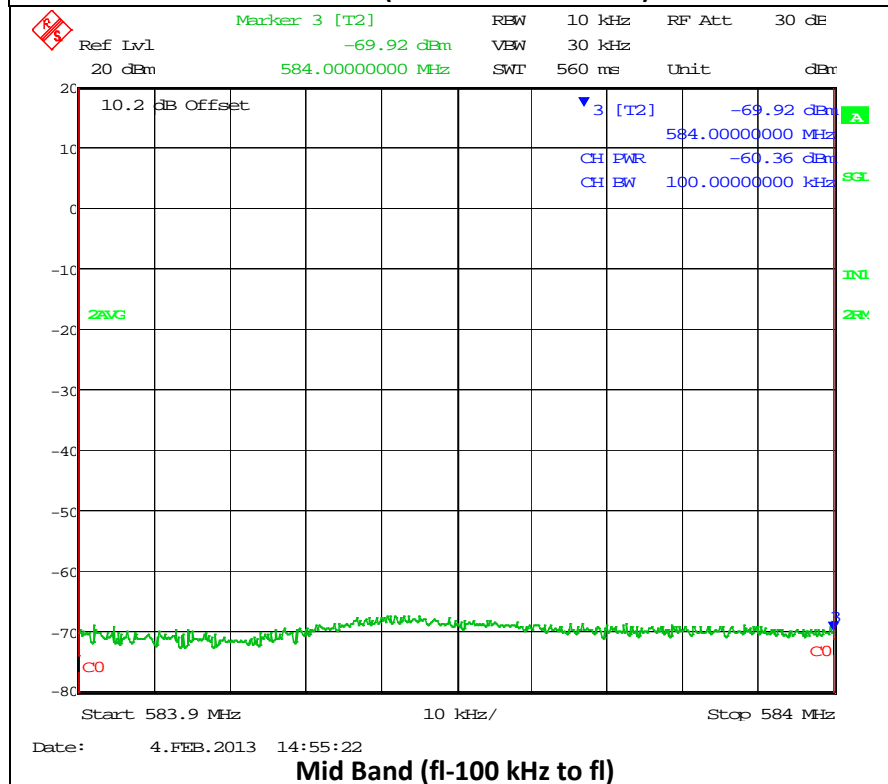
○ **Test Results #1 Low of the Band:**



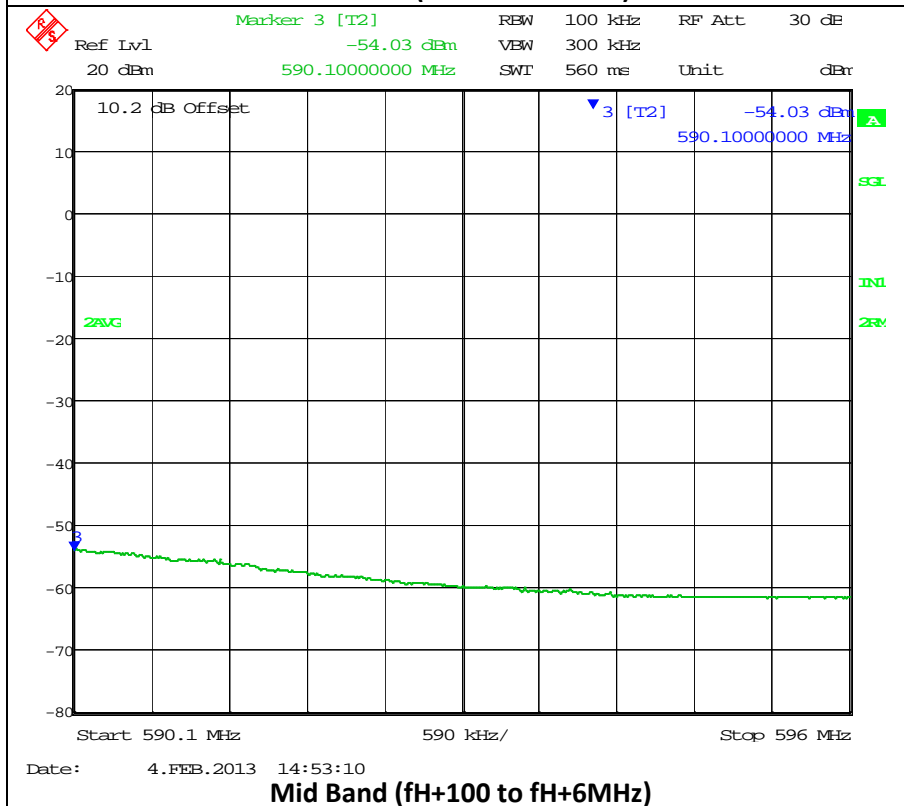
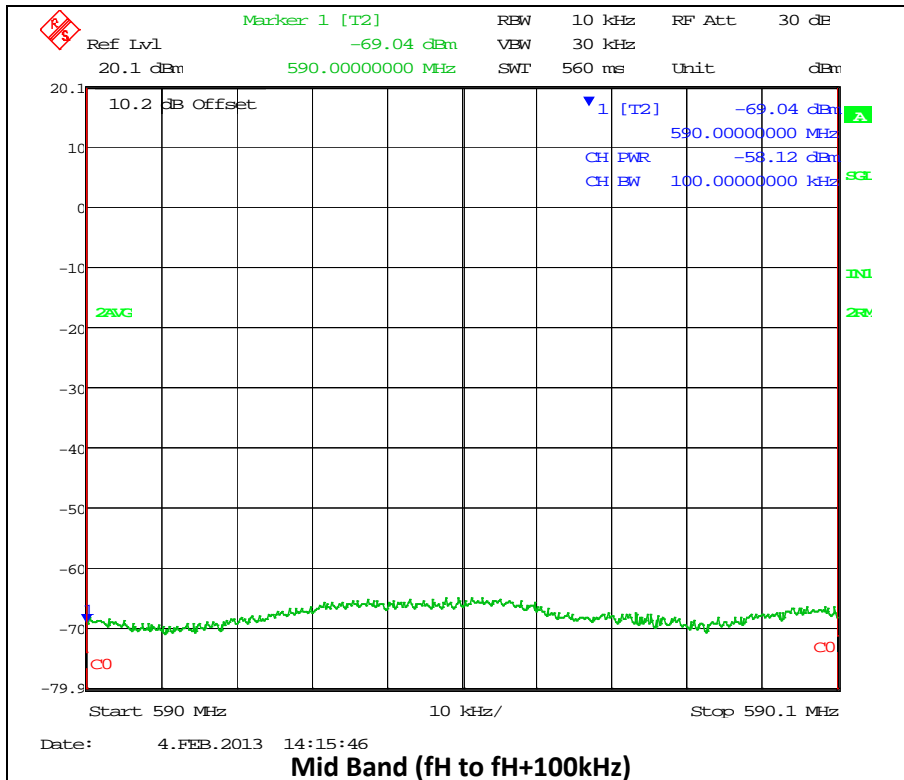




○ Test Results #2 Mid of the Band:

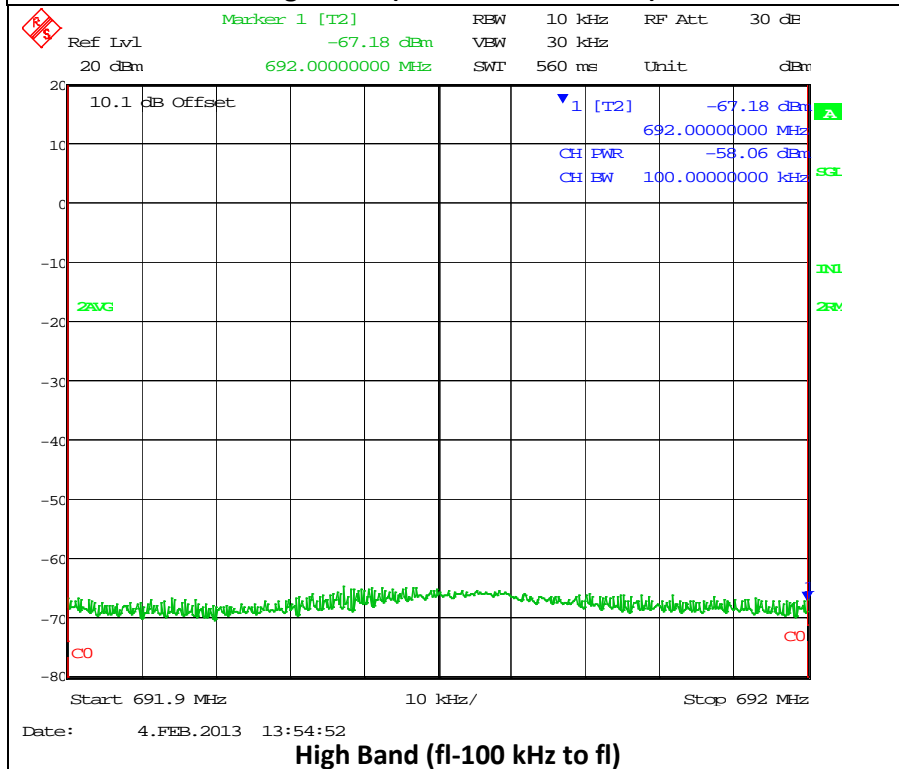
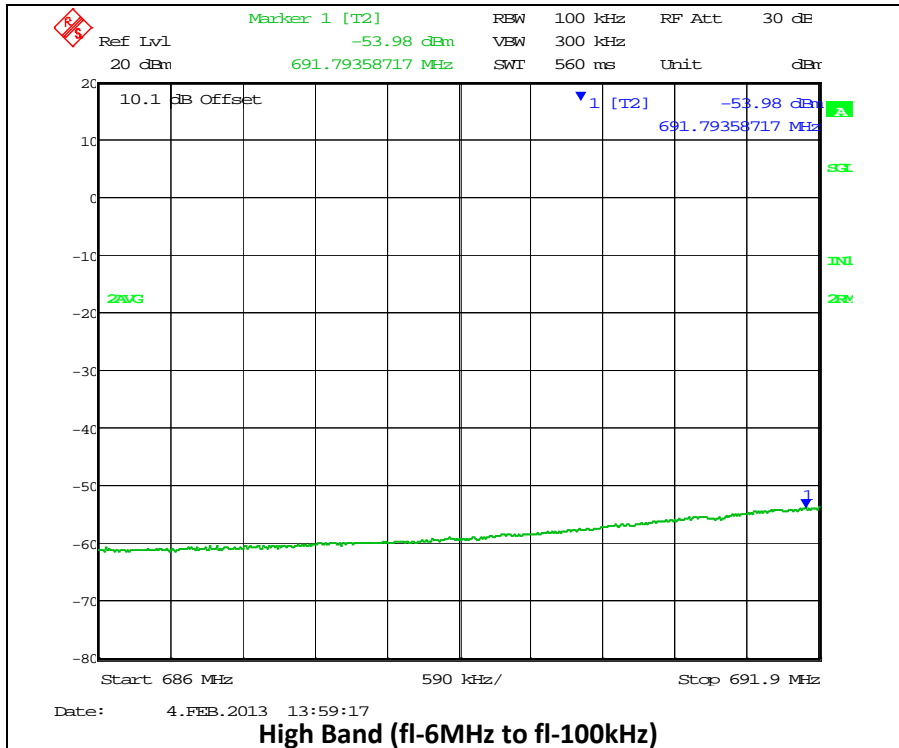


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 FCC ID: QC8-RDL3000RMF
 REPORT: R\Redline_QC8\208AUT13\208AUT13TestReport.doc

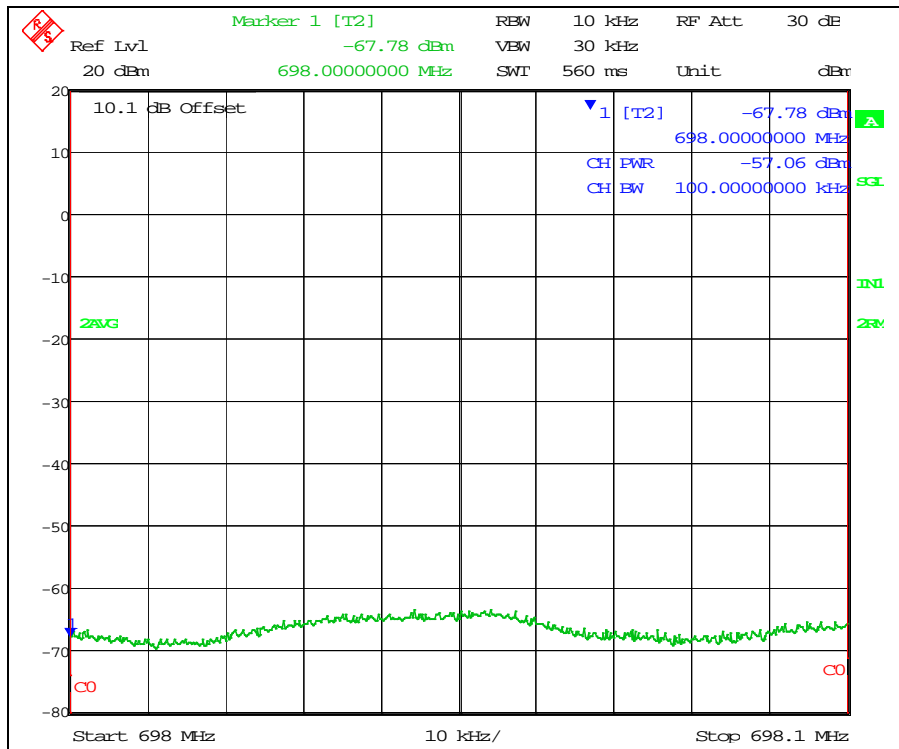


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 FCC ID: QC8-RDL3000RMF
 REPORT: R\Redline_QC8\208AUT13\208AUT13TestReport.doc

○ Test Results #2 High Band:

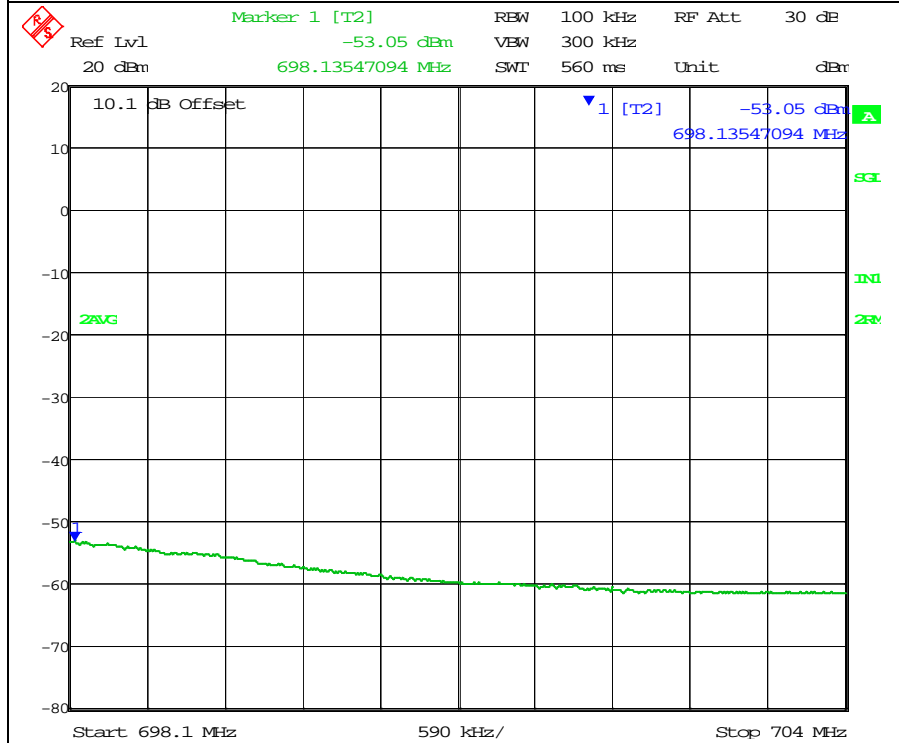


APPLICANT. REDLINE COMMUNICATIONS, INC.
 FCC ID: QC8-RDL3000RMF
 REPORT: R\Redline_QC8\208AUT13\208AUT13TestReport.doc



Date: 4.FEB.2013 13:56:23

High Band (fH to fH+100kHz)



Date: 4.FEB.2013 13:57:47

High Band (fH+100 to fH+6MHz)

APPLICANT. REDLINE COMMUNICATIONS, INC.
 FCC ID: QC8-RDL3000RMF
 REPORT: R\Redline_QC8\208AUT13\208AUT13TestReport.doc

§15.709(c)(4) Emission in the band of 602-620MHz Limits for TVBDs

Requirements:

Frequency MHz	Field Strength dB μ V/m/120kHz
602-607	120-5[F(MHz)-602]
607-608	95
608-614	30
614-615	95
615-620	120-5[620-F(MHz)]

Worst case limits for the respective bands,

Frequency MHz	Field Strength dB μ V/m/120kHz
602-607	95 (@607 MHz)
607-608	95
608-614	30
614-615	95
615-620	95 (@615 MHz)

Test Data:

Note:

The testing distance was 1m. Quasi-peak detector was used for measurement in the 608-614 MHz band.

- **602-620 MHz Emissions (with TX at CH 35)**

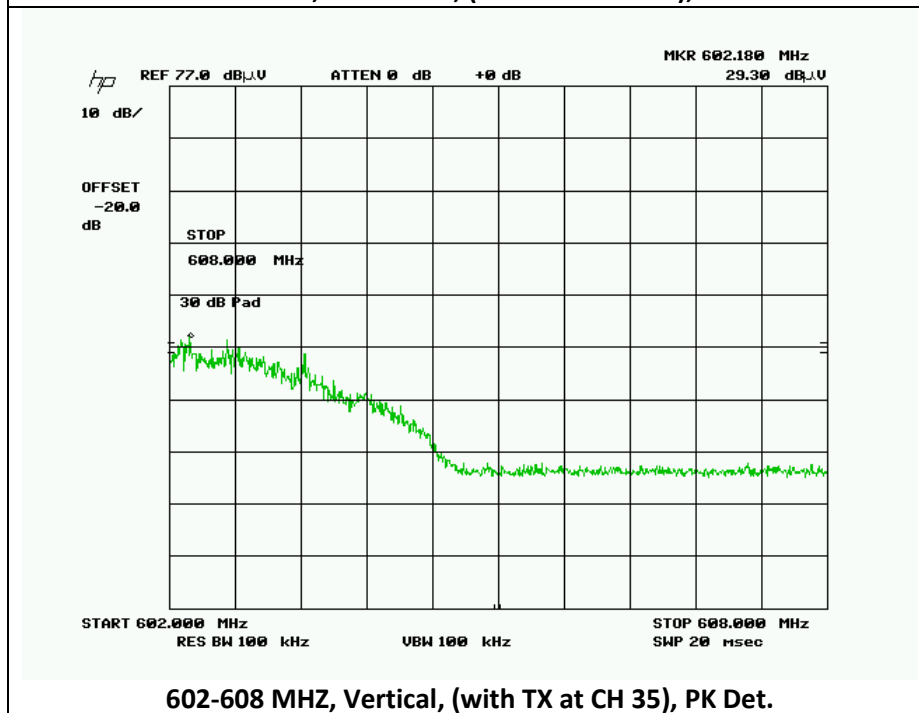
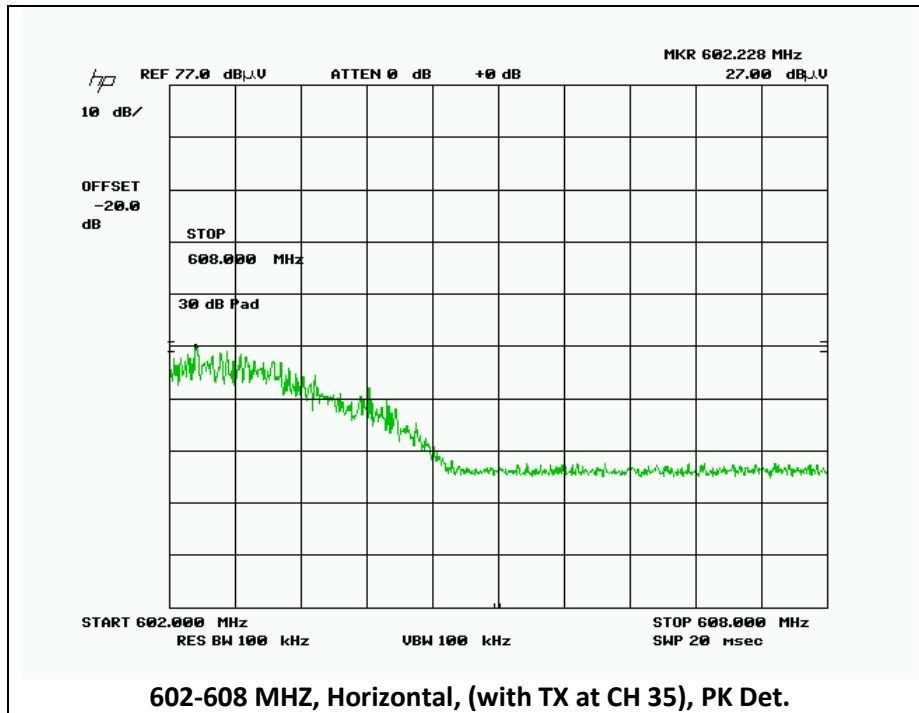
Emission Frequency MHz	Meter Reading dB μ V	Det.	Ant. Pol.	Coax Loss dB	Correction Factor dB/m	Field Strength dB μ V/m	Worst Case Limit dB μ V/m
602.18	59.3	PK	V	1.60	19.82	80.72	95
602.22	57.0	PK	H	1.60	19.82	78.42	95
608.00	6.3	QP	V	1.61	19.88	27.74	30
608.00	4.8	QP	H	1.61	19.88	26.31	30
611.04	4.4	QP	H	1.61	19.91	25.91	30
611.04	4.0	QP	V	1.61	19.91	25.54	30
615.54	35.4	PK	V	1.62	19.96	56.98	95
616.82	35.6	PK	H	1.62	19.97	57.19	95

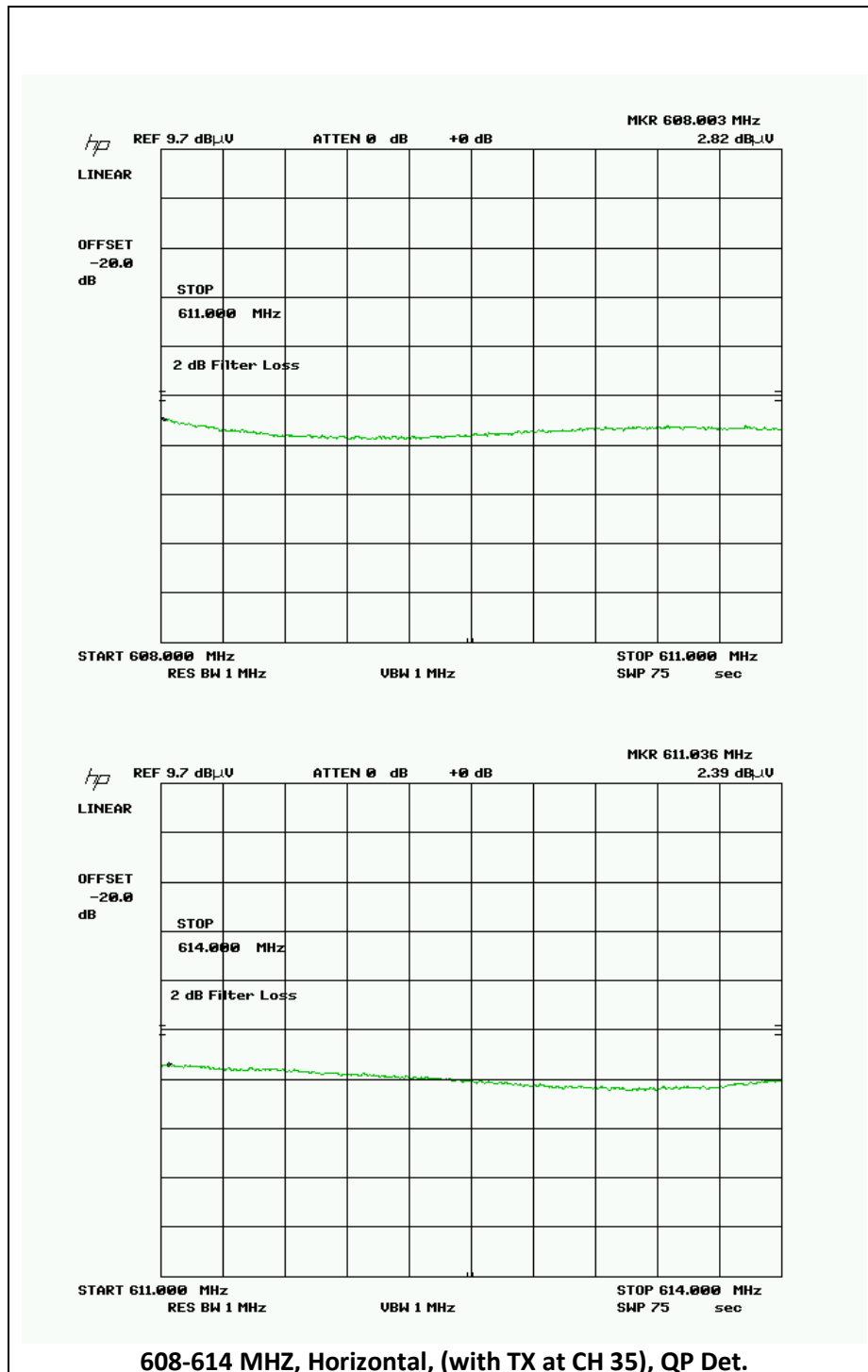
- **602-620 MHz Emissions (with TX at CH 39)**

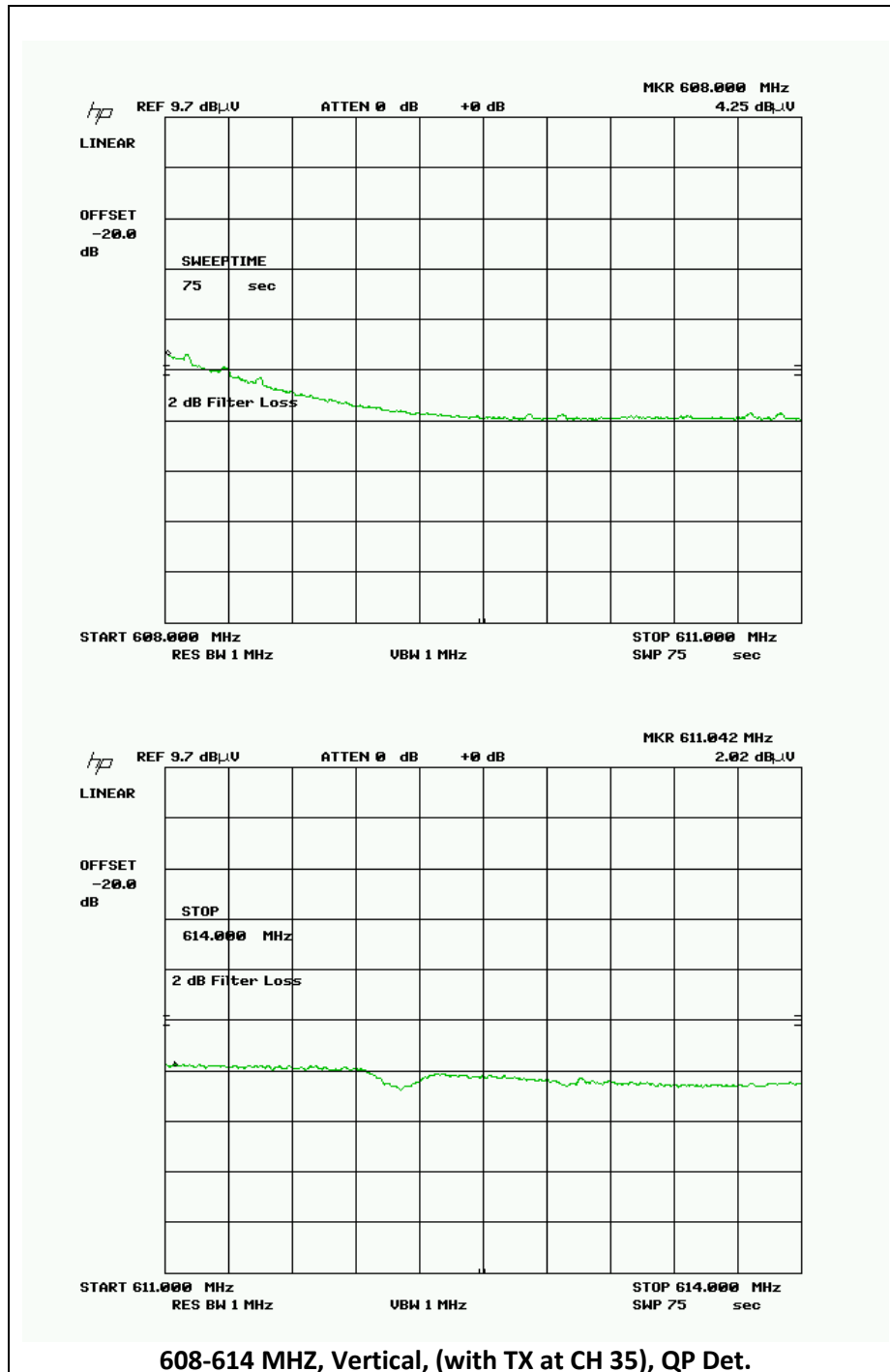
Emission Frequency MHz	Meter Reading dBμV	Det.	Ant. Pol.	Coax Loss dB	Correction Factor dB/m	Field Strength dBμV/m	Worst Case Limit dBμV/m
602.41	35.0	PK	V	1.60	19.82	56.42	95
605.24	35.2	PK	H	1.61	19.85	56.66	95
608.00	5.1	QP	V	1.61	19.88	26.61	30
611.00	5.0	QP	H	1.61	19.91	26.53	30
611.63	4.3	QP	V	1.61	19.92	25.78	30
613.96	5.8	QP	H	1.61	19.94	27.32	30
619.44	60.6	PK	H	1.62	19.99	82.21	95
619.89	58.1	PK	V	1.62	20.00	79.72	95

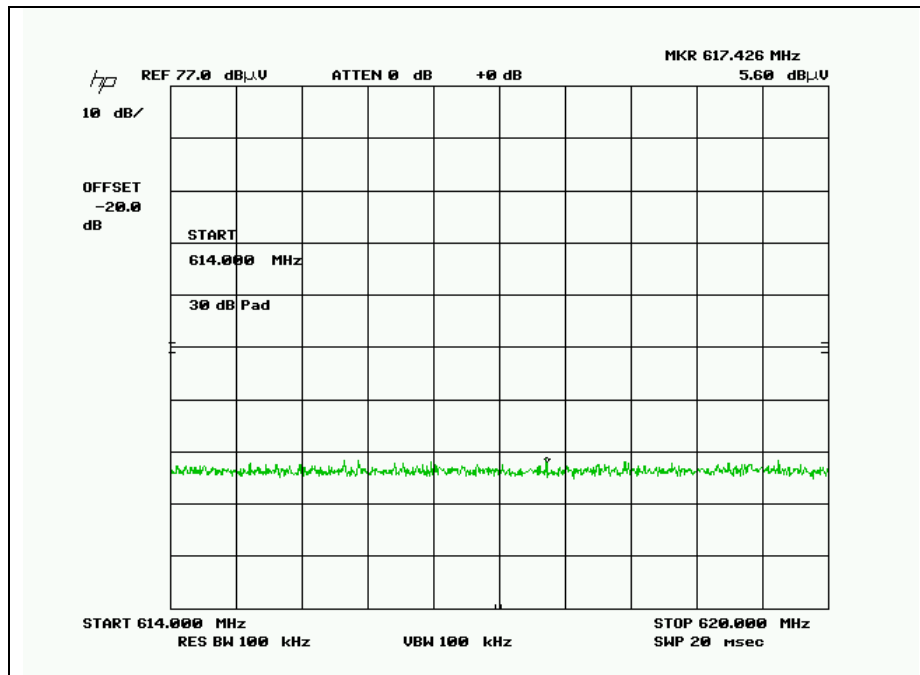
Plots:

- 602-620 MHz Emissions (with TX at CH 35)

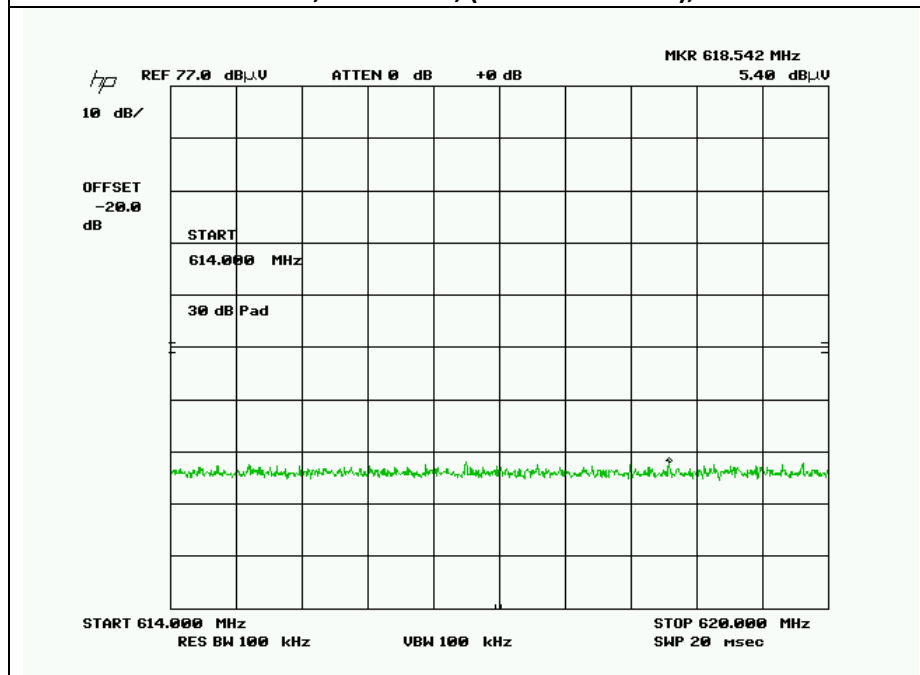






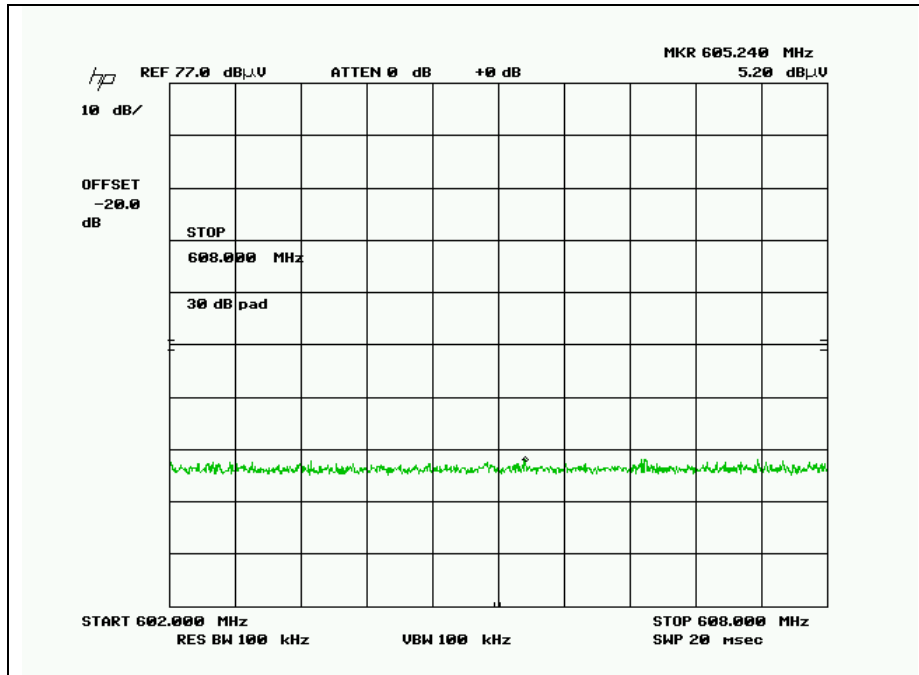


614-620 MHz, Horizontal, (with TX at CH 35), PK Det.

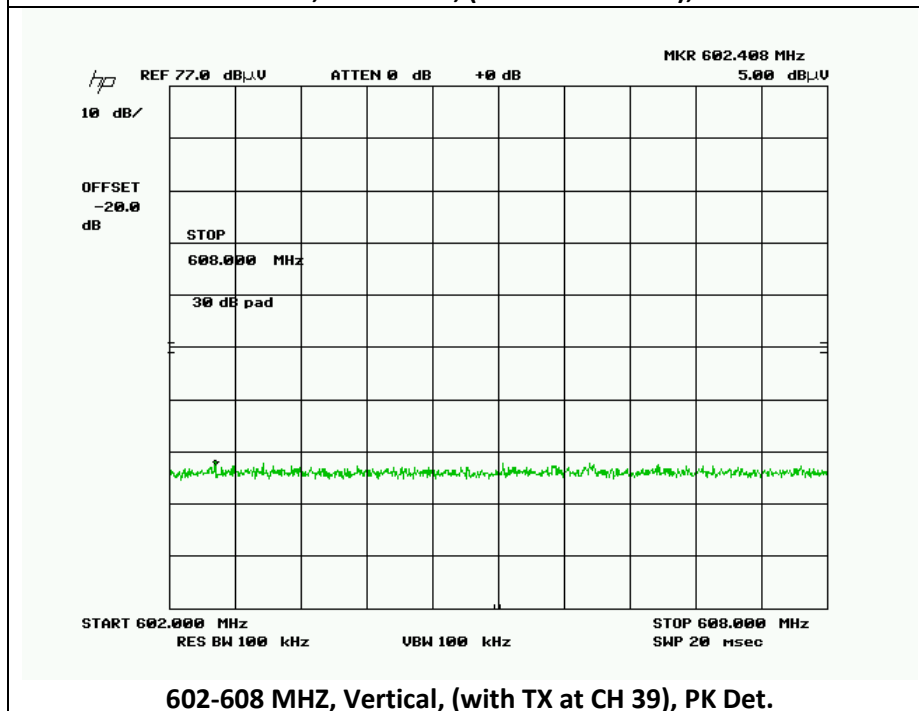


614-620 MHz, Vertical, (with TX at CH 35), PK Det.

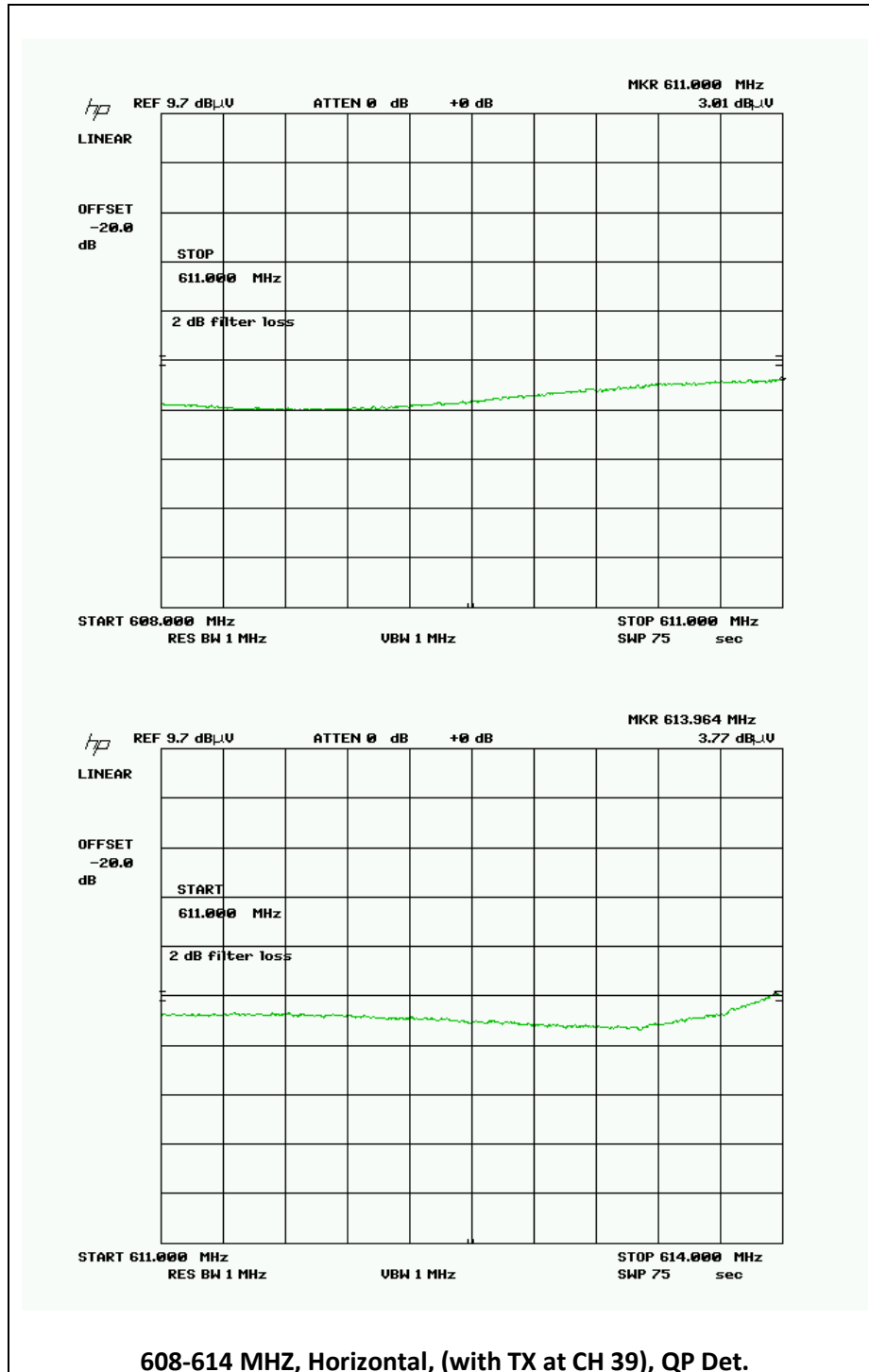
- 602-620 MHz Emissions (with TX at CH 39)

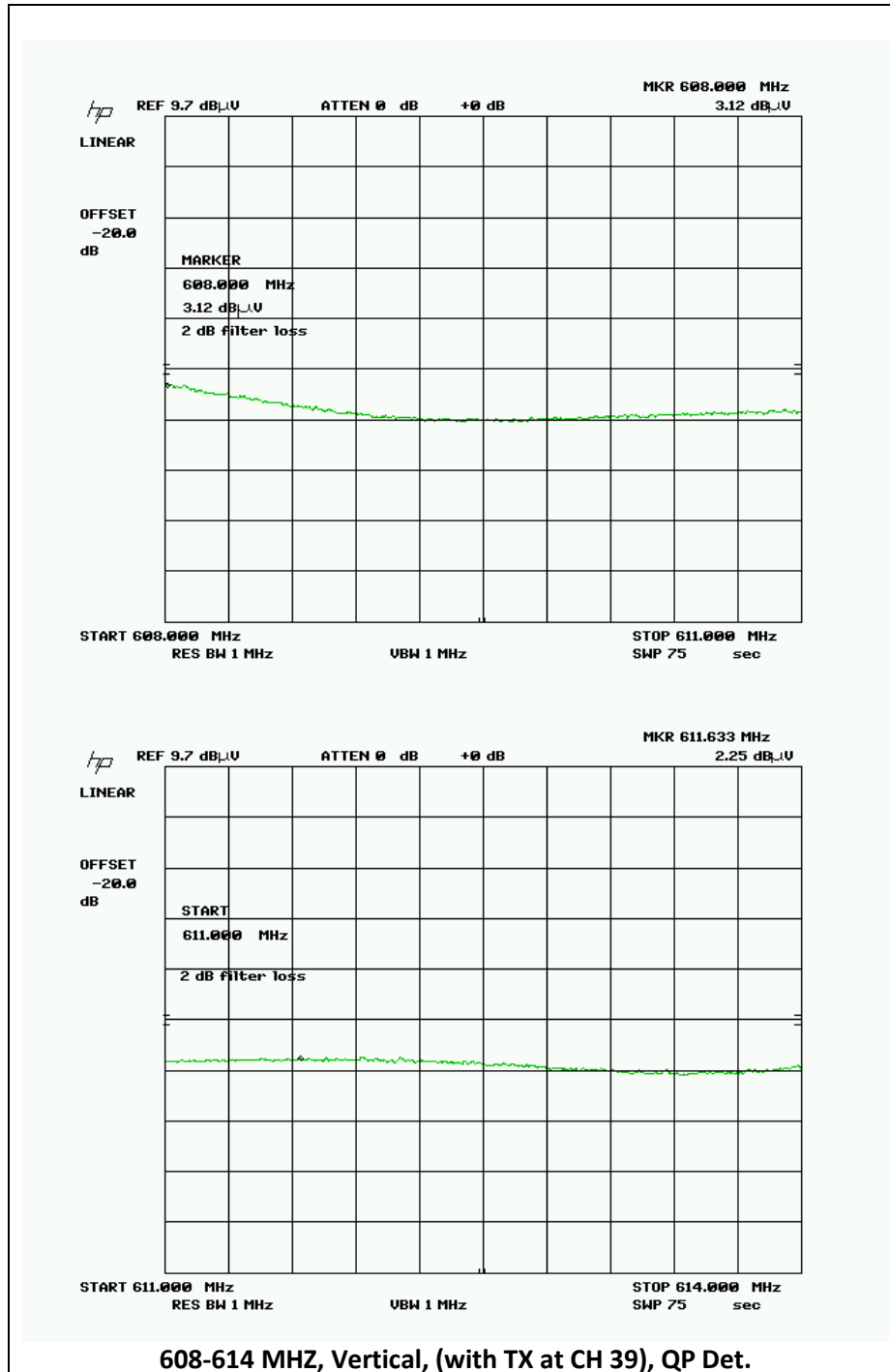


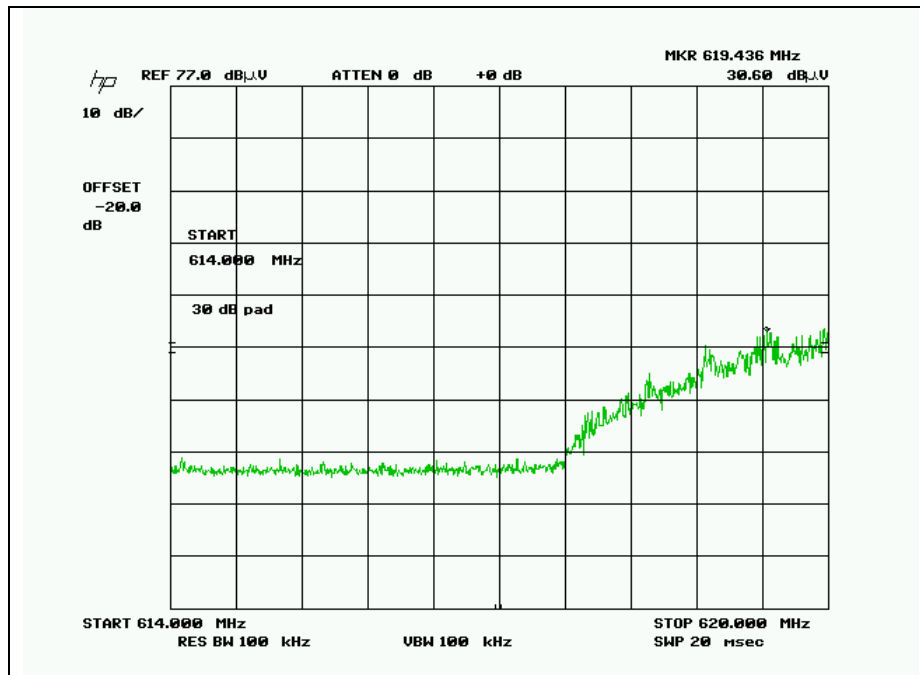
602-608 MHz, Horizontal, (with TX at CH 39), PK Det.



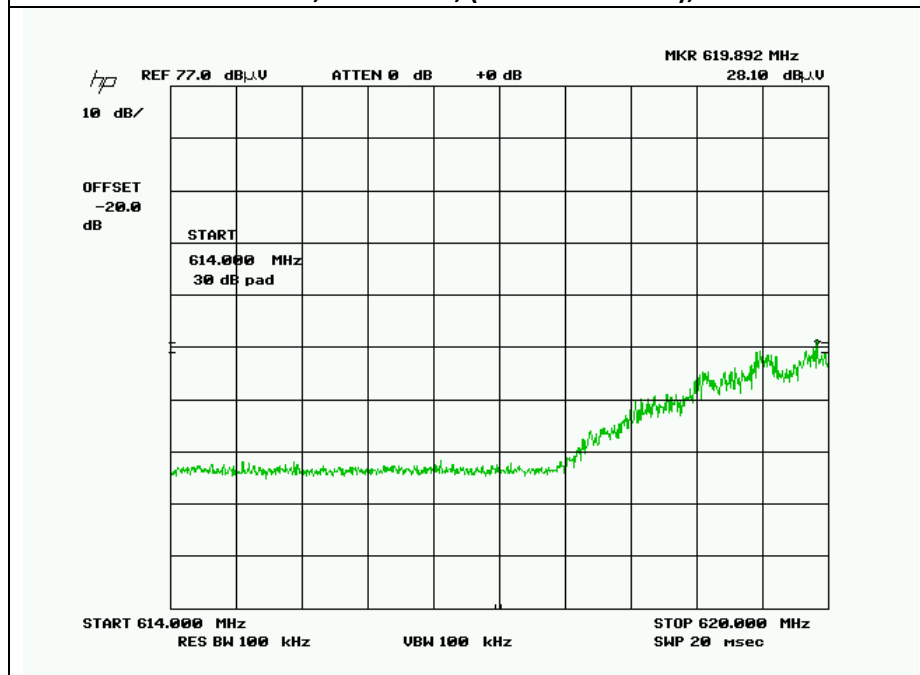
602-608 MHz, Vertical, (with TX at CH 39), PK Det.







614-620 MHz, Horizontal, (with TX at CH 39), PK Det.

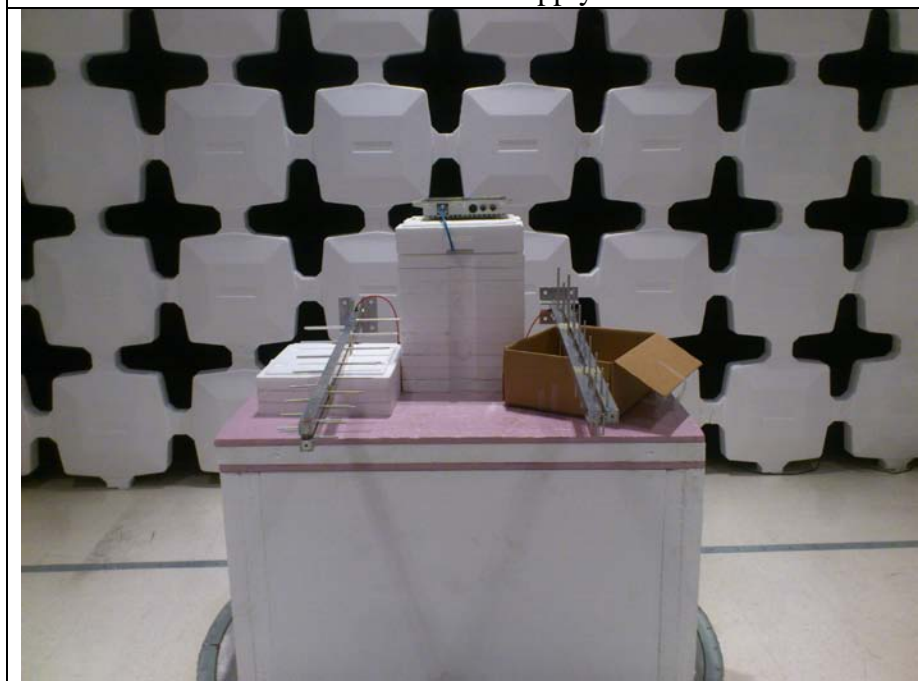


614-620 MHz, Vertical, (with TX at CH 39), PK Det

Product Photos



POE Power Supply



Antenna

APPLICANT. REDLINE COMMUNICATIONS, INC.
FCC ID: QC8-RDL3000RMF
REPORT: R\Redline_QC8\208AUT13\208AUT13TestReport.doc