



Engineering Solutions & Electromagnetic Compatibility Services

## FCC Part 101 Certification Report

**4RF Limited**  
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New Zealand  
Contact: Paul Young

**Model: XE 2000-500-AC**  
**2180 MHz – 2290 MHz**

**FCC ID: UIPXE20001300**

**April 13, 2013**

Standards Referenced for this Report	
FCC Part 101	Fixed Microwave Services (10-1-12)
ANSI TIA-603-C-2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

Frequency Range (MHz)	Rated Transmit Power Conducted (W)	Measured Frequency Tolerance (ppm)	Emission Designator
2180-2290	0.794	N/A	500KD7W

**Report Prepared by Test Engineer: Daniel W. Baltzell**

Document Number: 2013045

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*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

The following Certification Report is prepared on behalf of **4RF Limited** in accordance with the Federal Communications Commission rules and regulations. The Equipment Under Test (EUT) was the **XE 2000-500-AC, FCC ID: UIPXE20001300**. The test results reported in this document relate only to the item that was tested.

All measurements contained in this application were conducted in accordance with FCC Rules and Regulations CFR 47 Parts 2 and 101. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

We acknowledge that certification is not required for this type of equipment operating under Part 101 in the 2180 – 2200 MHz band, but certification is being requested. Additionally, EF grant listing for 2200 – 2290 MHz is being requested as well for federal users.

### 1.1 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc., 360 Herndon Parkway, Suite 1400, Herndon, Virginia, 20170.

## 2 Tested System Details

The EUT is a paired channel fixed point-to-point base station radio that operates in the 2180-2290 MHz bands. The rated RF output power is 29.0 dBm. The EUT is digitally modulated using either a QPSK, 16 QAM, 32 QAM, or 64 QAM modulation type.

The test samples were received on March 4, 2013. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

<b>Model Tested</b>	XE 2000-500-AC
<b>Frequency Band</b>	2180-2290 MHz
<b>Modulation Type</b>	QPSK, 16 QAM, 32 QAM, and 64 QAM
<b>Channel Step Size</b>	500 kHz
<b>Authorized Channel Bandwidth</b>	500 kHz
<b>Primary Power</b>	115/230 VAC
<b>Rated Transmitter Output Power</b>	29.0 dBm
<b>Duty Cycle</b>	Continuous 100%

**Table 2-1: Equipment Under Test (EUT)**

Part	Manufacturer	Model Number	Serial Number	RTL Bar Code
Aprisa Radio	4RF Limited	XE 2000-500-AC	21816396	20986
Aprisa Radio	4RF Limited	XE 2000-500-AC	21816395	20987
Duplexer (2289.5- 2180.8125)	4RF Limited	CMD882	25222033	21018
Duplexer (2180.8-2130.8)	4RF Limited	CMD882	25222035	20989

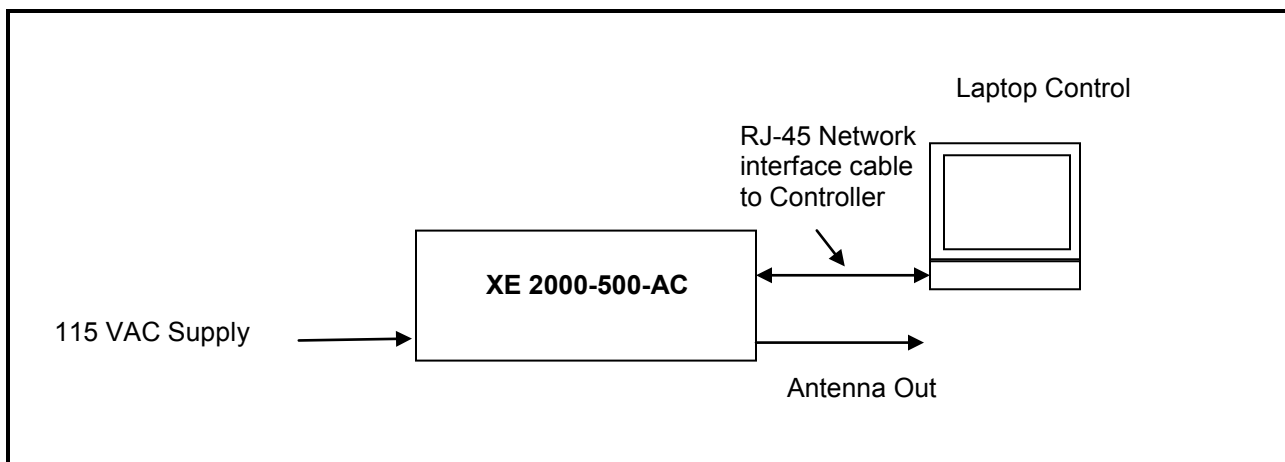
**Table 2-2: Ports and Cabling (EUT)**

Port	Cable Type	Quantity	Length (meter)	Shield
AC Power	10 AWG	1	3	No
RF Output	N-type	1	N/A	N/A
Ethernet	RJ-45	4	4.5	No
Alarm	RJ-45	1	2	No
Setup	RJ-45	1	N/A	No </td
QJET	RJ-45	4	1.5	No

**Table 2-3: Support Equipment**

Part	Manufacturer	Model	PN/SN	ID	RTL Bar Code
Laptop Computer	Dell	Inspiron 6400	N/A	N/A	901465

**Figure 2-1: Configuration of Tested System**



### 3 RF Power Output - FCC 2.1046, 101.113

#### 3.1 Test Limits

#### 3.2 Test Procedure

ANSI TIA-603-C-2004, Section 2.2.1.

The EUT transmitter output was connected through an appropriate 50 ohm attenuator to a spectrum analyzer.

Limit: 45 dBW EIRP

#### 3.3 Test Data

**Table 3-1: RF Power Output: Carrier Output Power**

Frequency (MHz)	QPSK Power (dBm)	16QAM Power (dBm)	32QAM Power (dBm)	64QAM Power (dBm)
2180.8125	28.6	28.7	28.7	28.8
2289.5000	28.3	28.4	28.4	28.5

**Table 3-2: RF Power Output (Rated Power)**

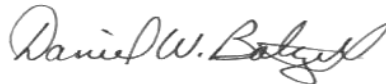
Manufacturer's Rated Power
29.0 dBm

**Table 3-3: Test Equipment for Testing RF Power Output - Conducted**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13
901536	Aeroflex	48-40-34	40 dB Attenuator	CB6627	10/14/13

#### Test Personnel:

Daniel Baltzell  
 Test Engineer



Signature

April 6, 2013  
 Date of Test

#### 4 Occupied Bandwidth – FCC 2.1049, 101.109

##### 4.1 Occupied Bandwidth Test Procedure

The bandwidths were measured using a 50 ohm spectrum. The device was modulated. The occupied bandwidths are presented below.

Limit: 800 kHz

**Table 4-1: Occupied Bandwidth Test Equipment**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13
901536	Aeroflex	48-40-34	40 dB Attenuator	CB6627	10/14/13

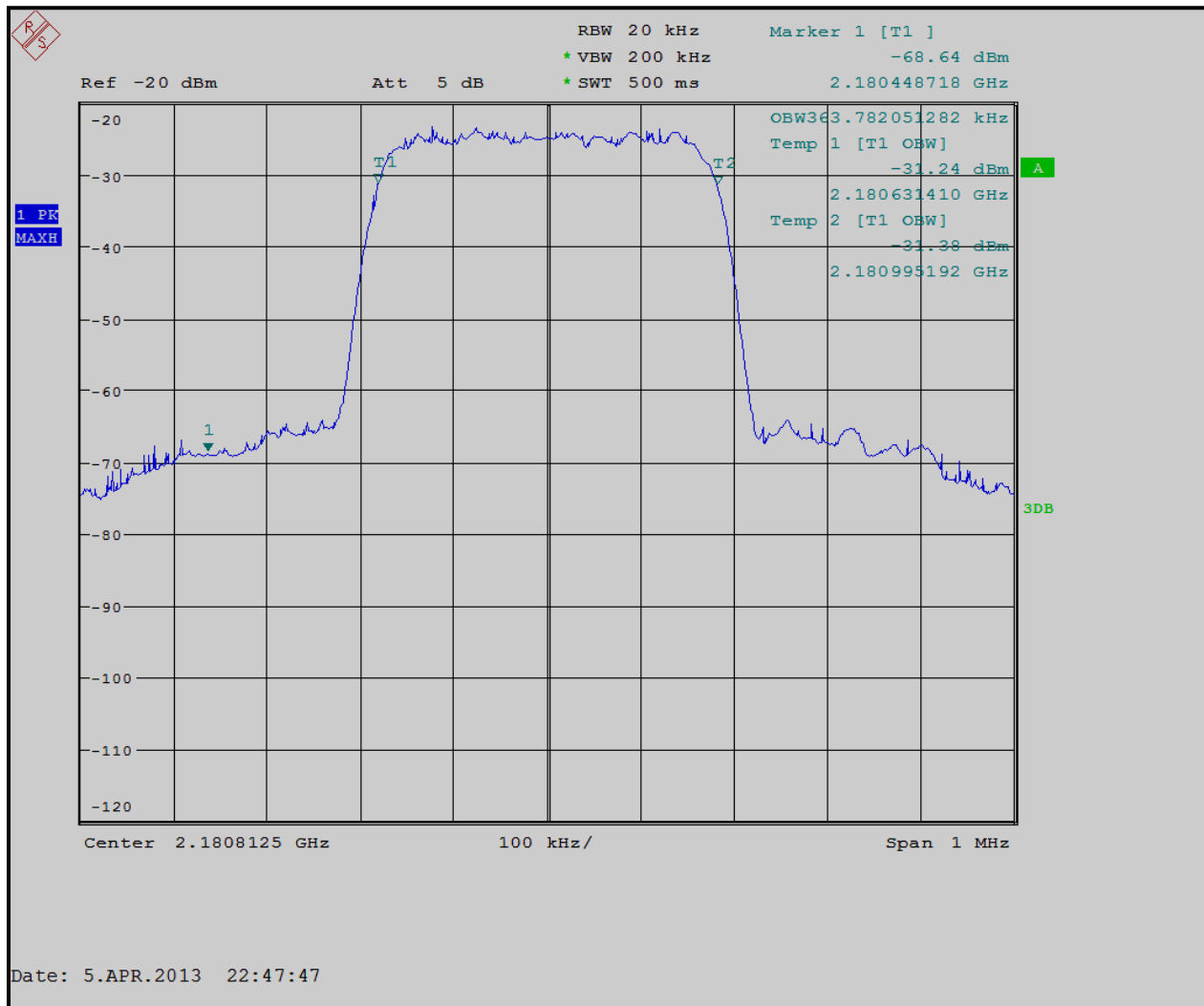
##### 4.2 Occupied Modulated Bandwidth Test Data

**Table 4-2: Occupied Bandwidth Test Data**

Frequency (MHz)	Occupied Bandwidth (kHz)	Minimum Limit (kHz)	Pass/Fail
2180.8125	363.8	800	Pass
2289.5000	363.8	800	Pass



**Plot 4-1: Occupied Bandwidth – 2180.8125 MHz**



**Plot 4-2: Occupied Bandwidth – 2289.5000 MHz**



**Test Personnel:**

Daniel W. Baltzell  
 Test Engineer

Signature

April 5, 2013  
 Date of Test

## **5 Conducted Spurious Emissions – FCC 2.1051, 101.111(a)(2)(i)**

### **5.1 Test Limits**

For operations in the bands 2180–2290 MHz, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by the following amounts:  $43 + 10 \log (p)$  dB

### **5.2 Test Procedure**

ANSI TIA-603-C-2004, Section 2.2.13.

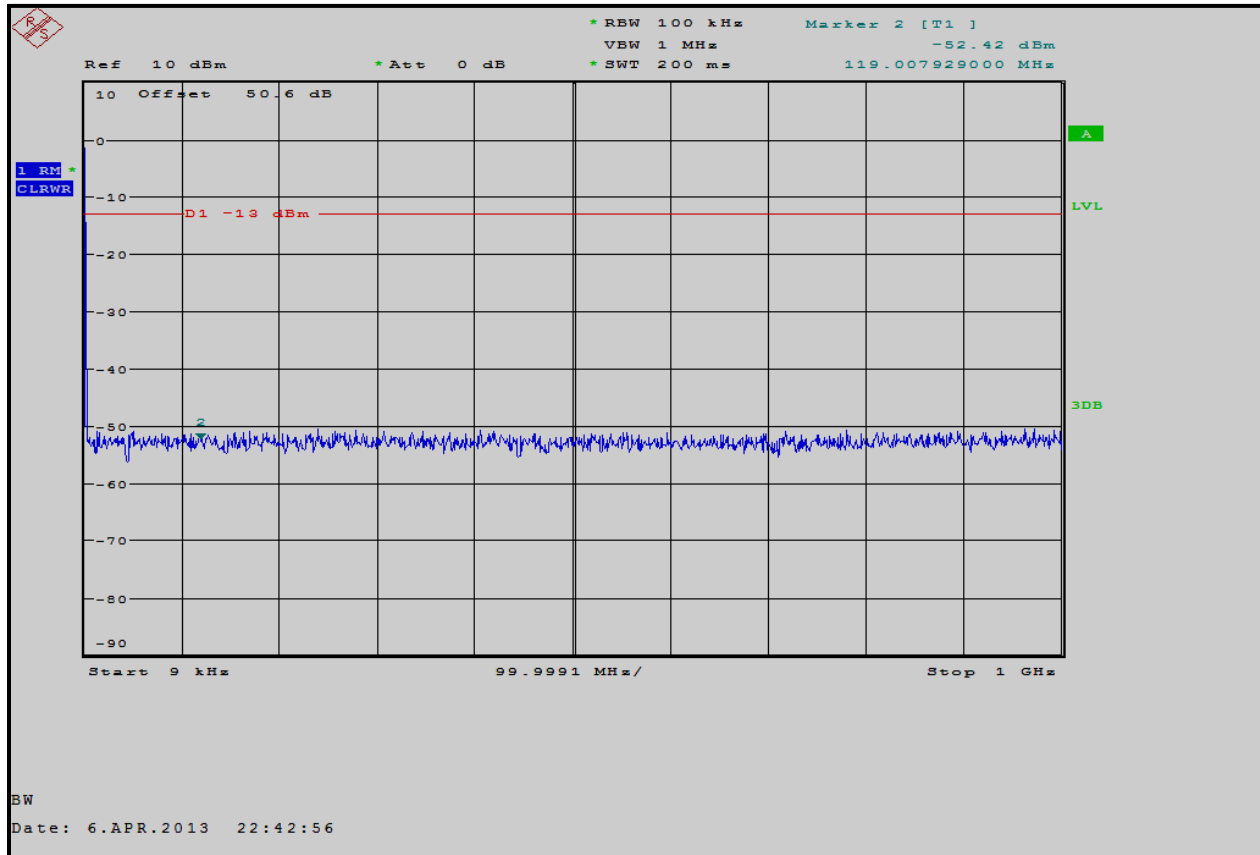
The transmitter is terminated with a 50  $\Omega$  load and interfaced with a spectrum analyzer.

Device with digital modulation: Modulated to its maximum extent using a 100% modulated duty cycle internal QPSK, 16 QAM, 32 QAM, and 64 QAM modulation. The insertion loss from the connecting cable and attenuator was measured together and added to the measurement level and compared to the limit. The resolution bandwidth used was 1 MHz for those measurements taken above 1 GHz; the video bandwidth was 3 MHz. The following channels (in MHz) were investigated: 2180.8125 and 2289.5MHz.

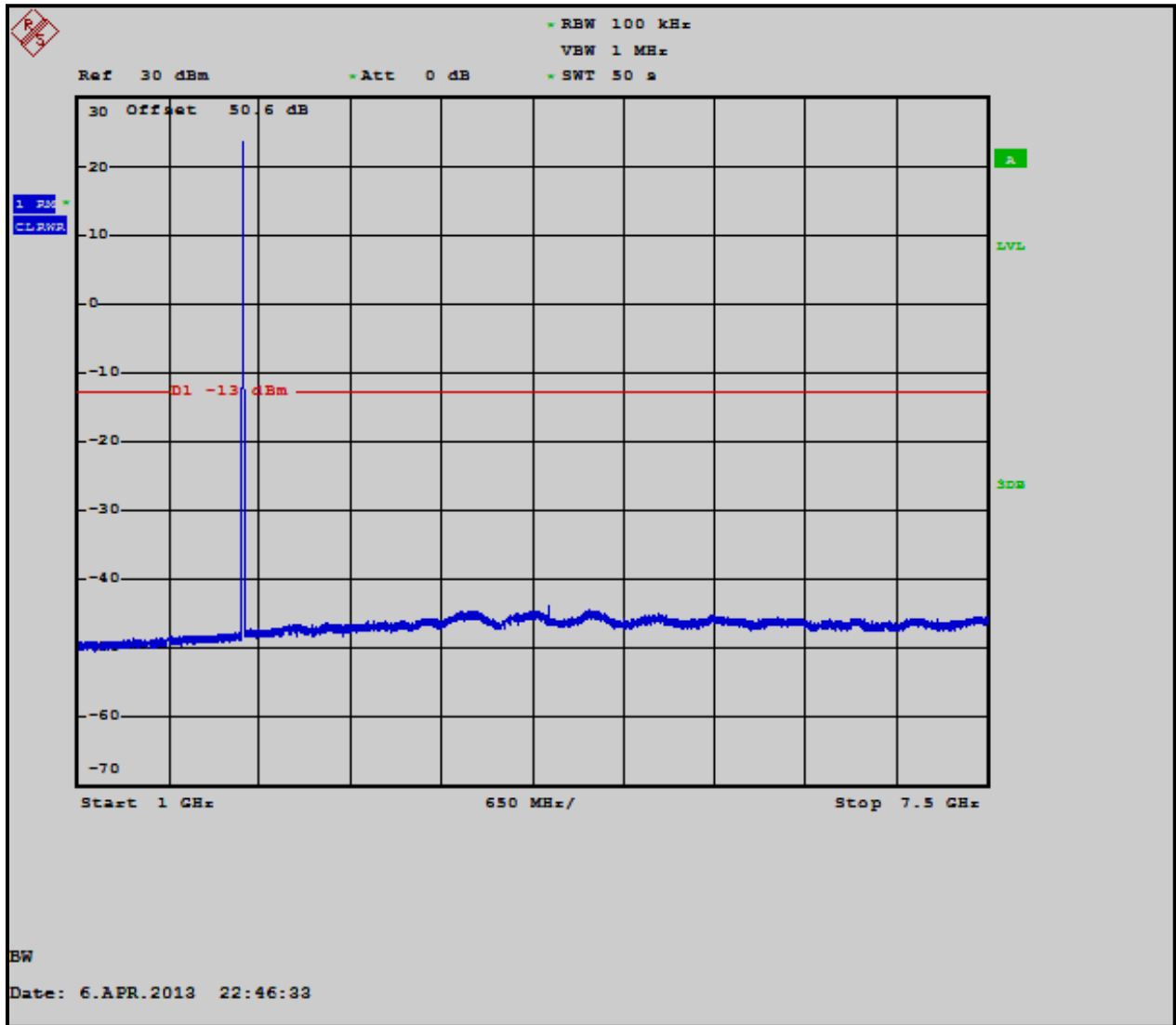
### 5.3 Out of Band Spurious Test Data

Frequency range of measurement: 9 kHz to 3 x Fc.

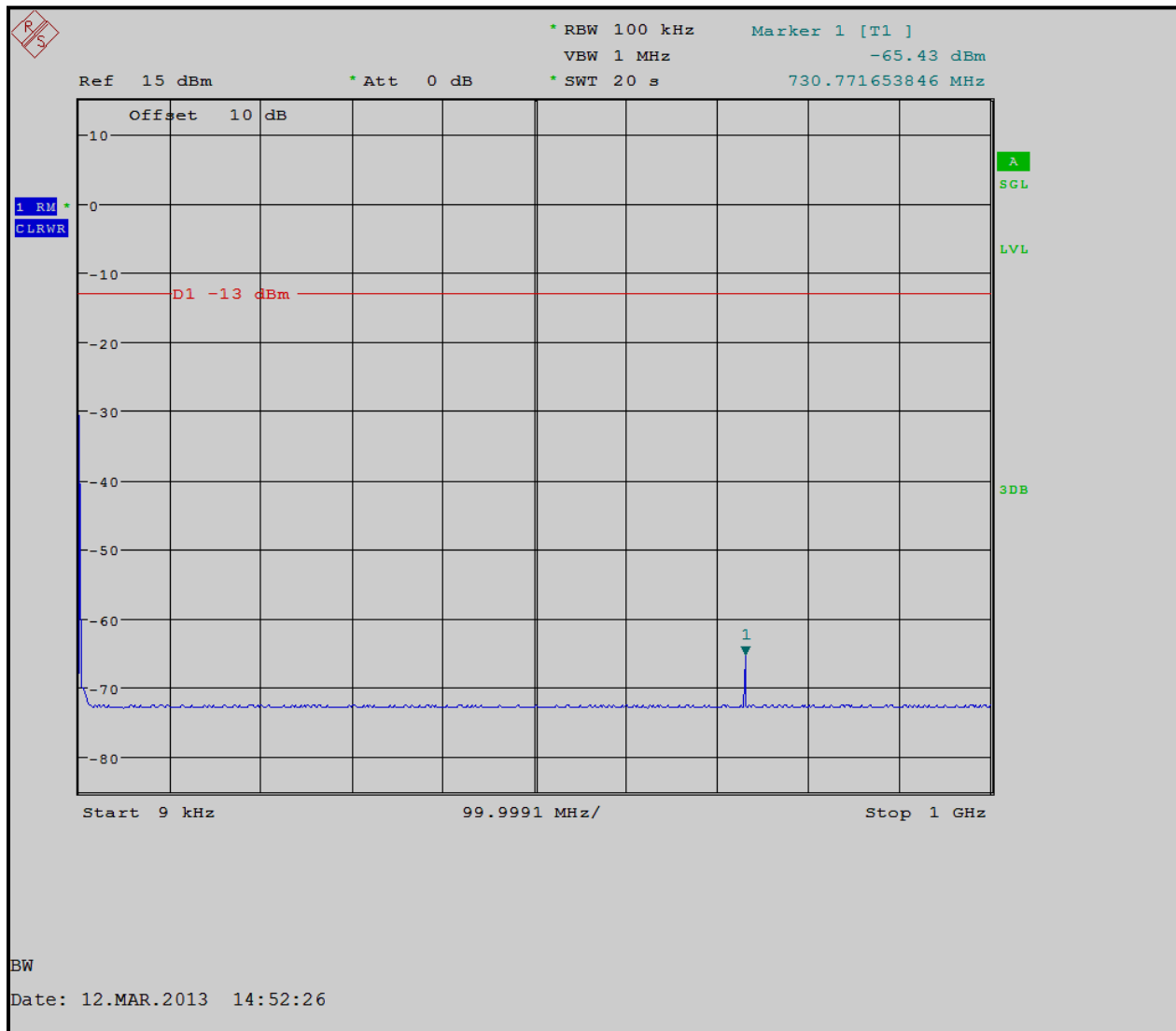
**Plot 5-1: Conducted Spurious Emissions; 2180.8125 MHz; 9 kHz – 1 GHz**



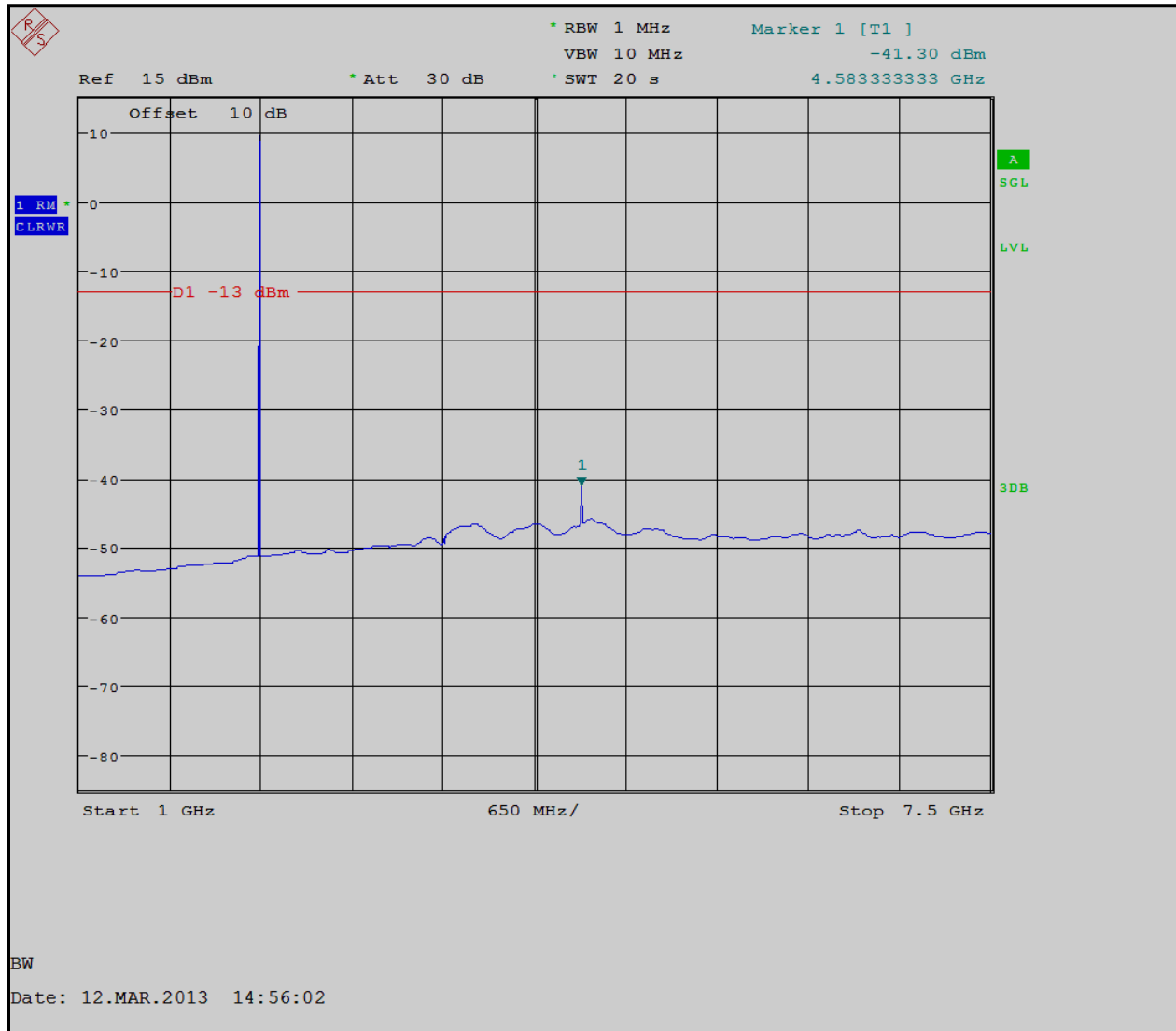
**Plot 5-2: Conducted Spurious Emissions; 2180.8125 MHz; 1 GHz – 7.5 GHz**



**Plot 5-3: Conducted Spurious Emissions; 2289.5000 MHz; 9 kHz – 1 GHz**



**Plot 5-4: Conducted Spurious Emissions; 2289.5000 MHz; 1 GHz – 7.5 GHz**

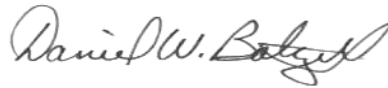


**Table 5-1: Test Equipment for Testing Conducted Spurious Emissions**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13
900819	Weinschel Corp	2	10 dB Attenuator; 5 W	BF0830	3/5/14

**Test Personnel:**

Daniel Baltzell  
Test Engineer



Signature

March 12 & April 7, 2013  
Dates of Test



## 6 Occupied Bandwidth, 2.1051, 101.111(a)(2)(i) Unwanted Emissions

### 6.1 Test Procedure

Device with digital modulation: Modulated to its maximum extent using a 100% modulated duty cycle internal QPSK, 16 QAM, 32 QAM, and 64 QAM modulation. The cable loss and attenuator used were added, and an offset in the spectrum analyzer used, to compensate for these values.

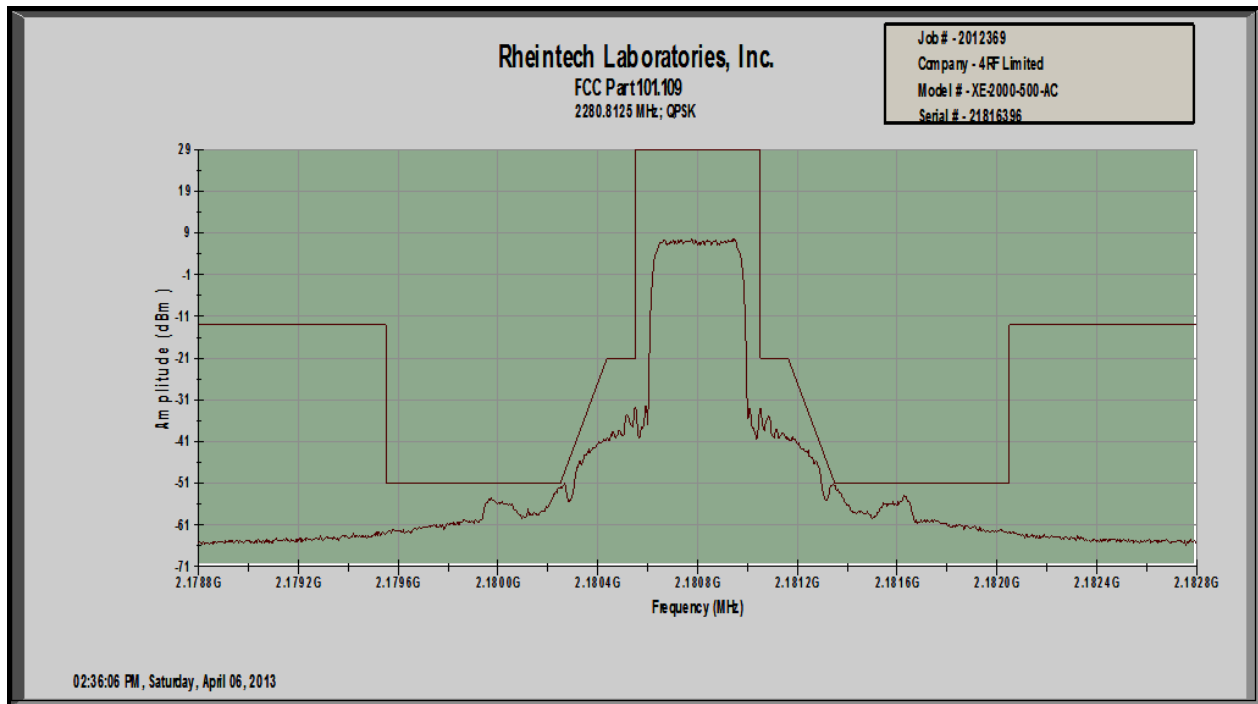
ANSI TIA-603-C-2004, Section 2.2.11.

Frequency range of measurement: 2180 – 2290 MHz

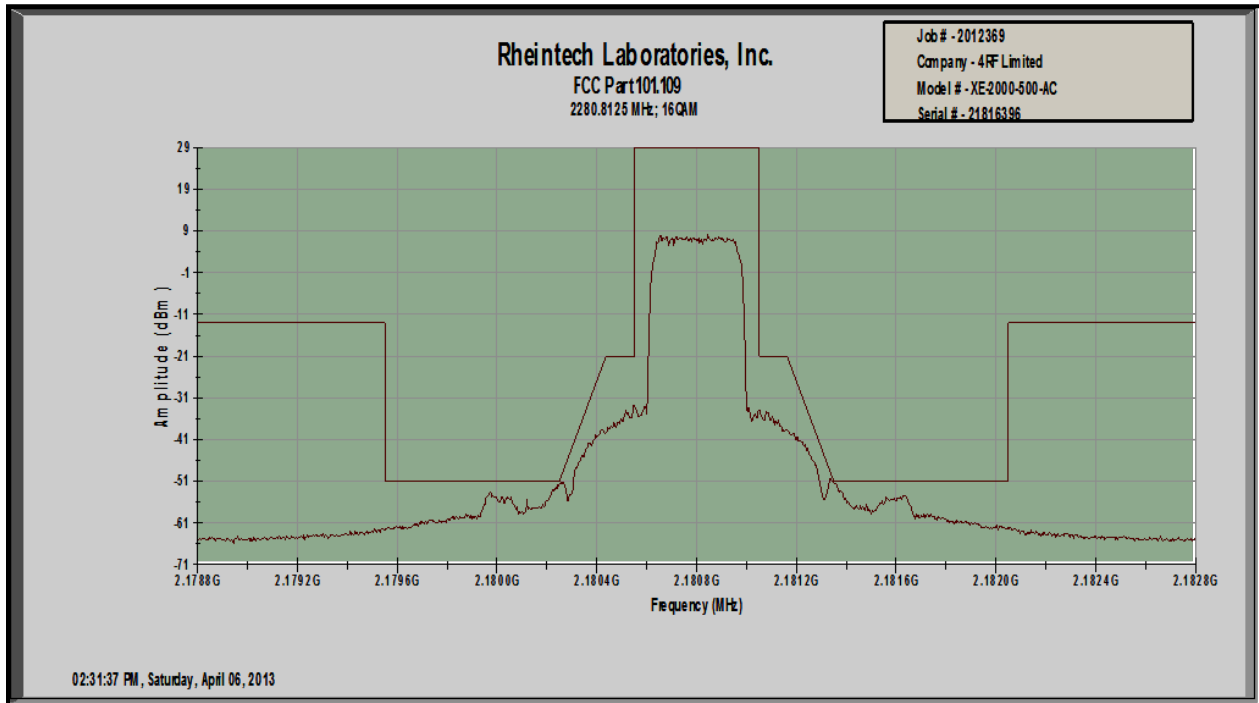
Limits:  $A = 35 + 0.8(\% - 50) + 10 \log(BW)$

### 6.2 In Band Spurious Test Data

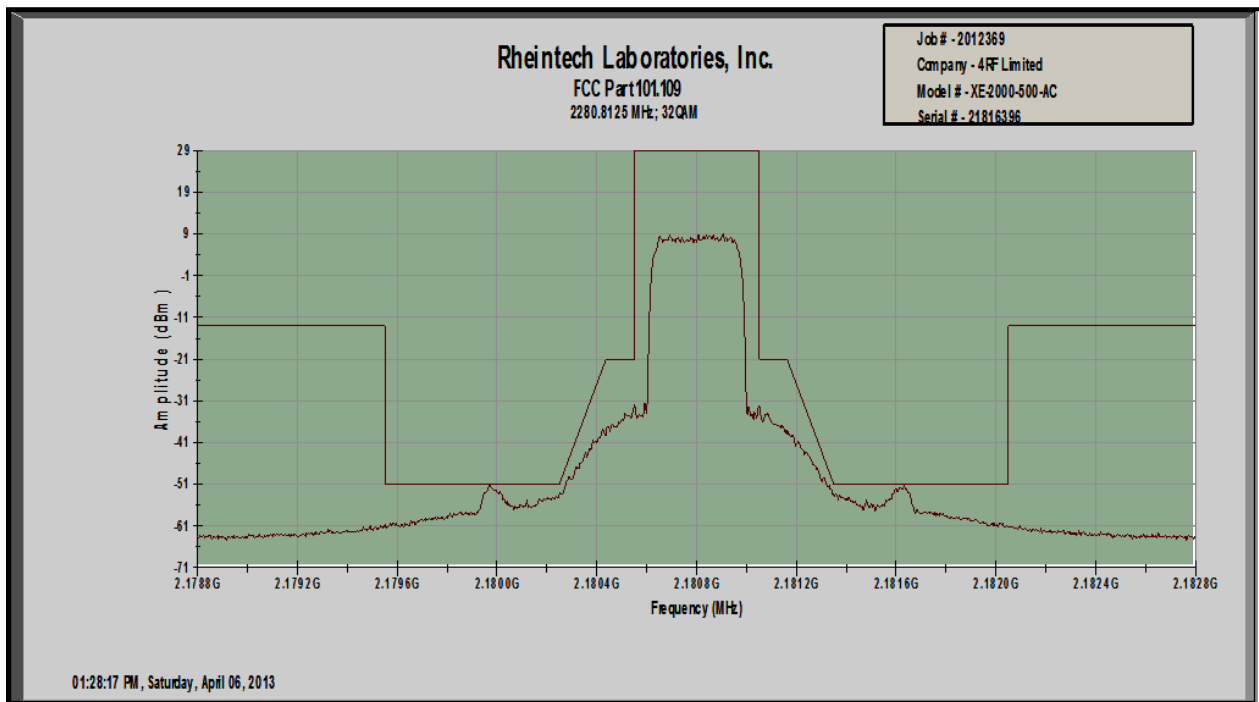
Plot 6-1: Occupied Bandwidth; 2180.8125 MHz; QPSK



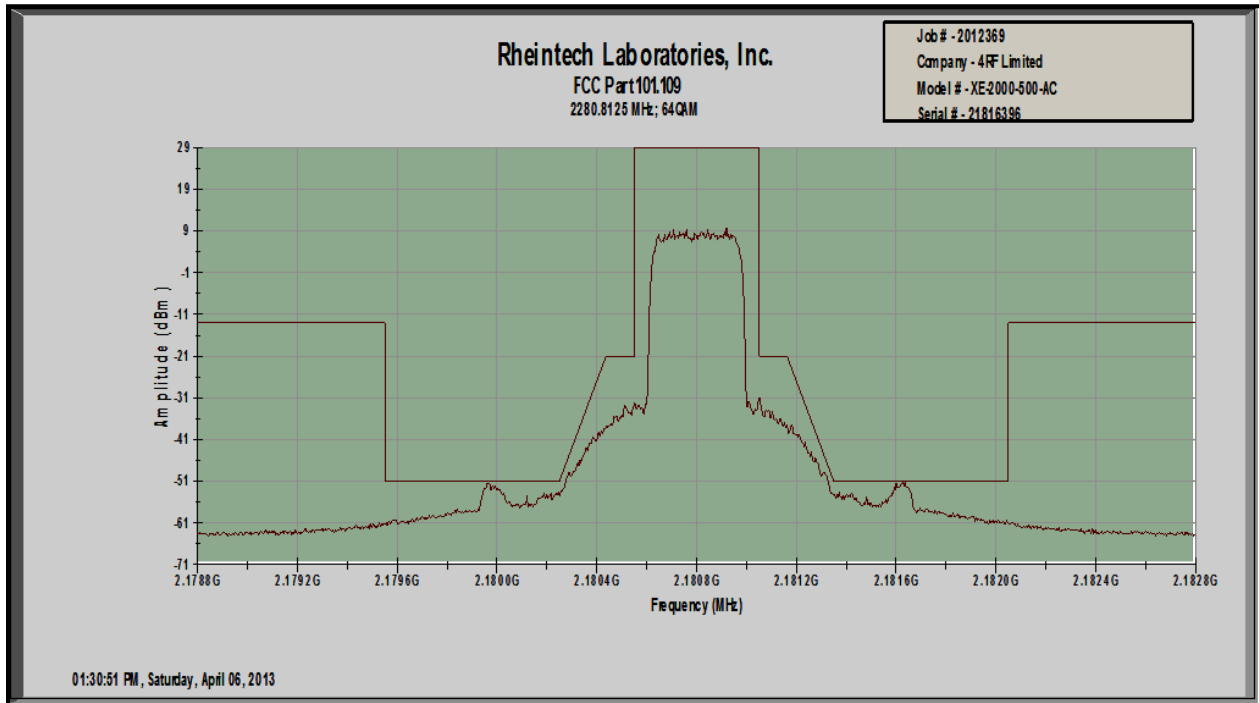
**Plot 6-2: Occupied Bandwidth; 2180.8125 MHz; 16QAM**



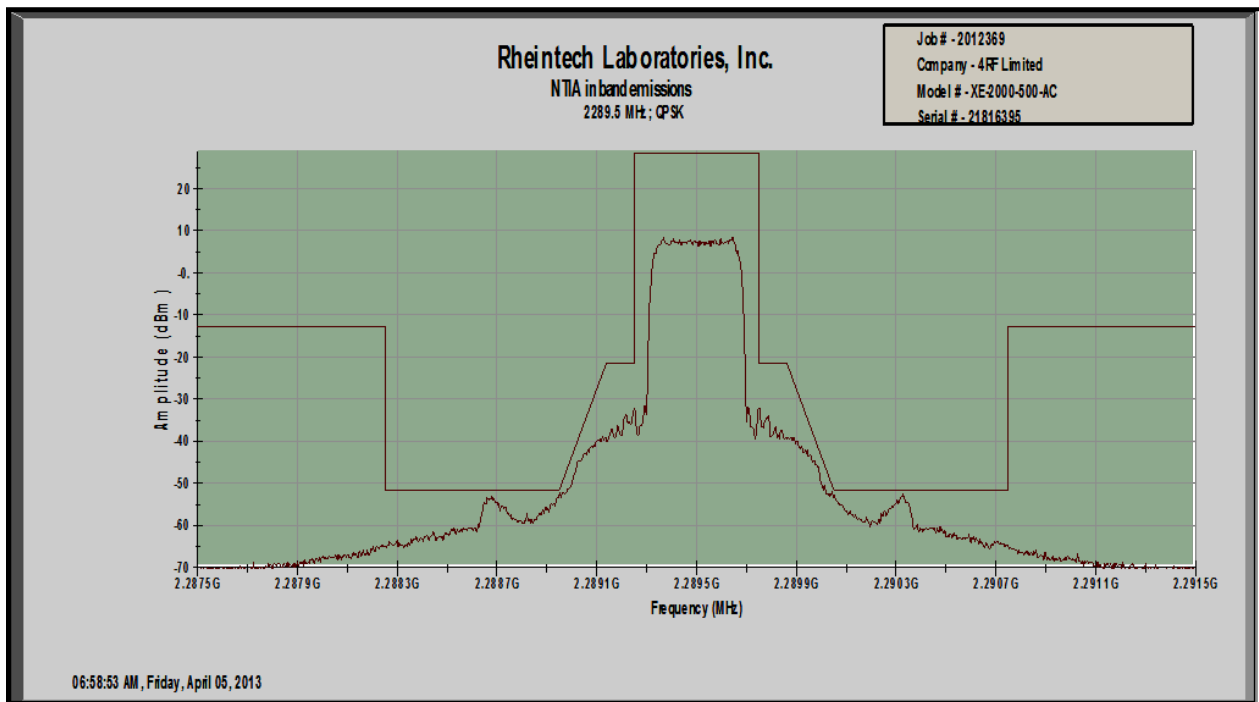
**Plot 6-3: Occupied Bandwidth; 2180.8125 MHz (500 kHz bandwidth); 32QAM**



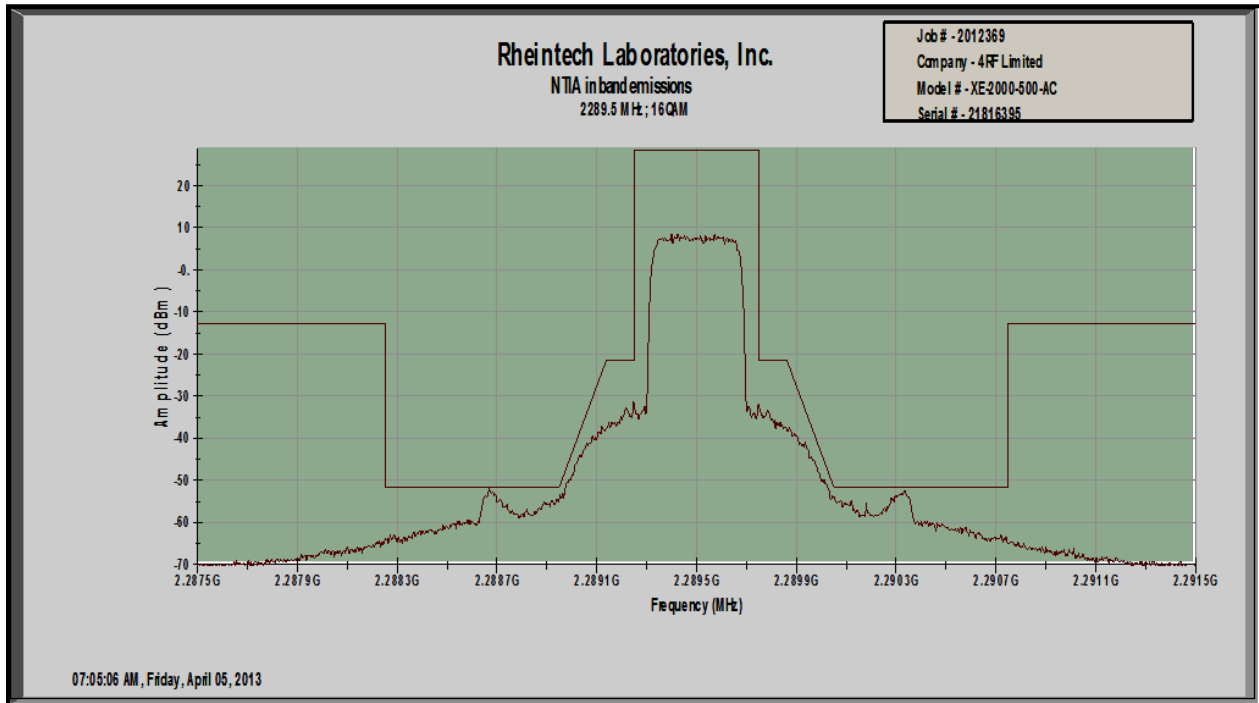
**Plot 6-4: Occupied Bandwidth; 2180.8125 MHz (500 kHz bandwidth); 64QAM**



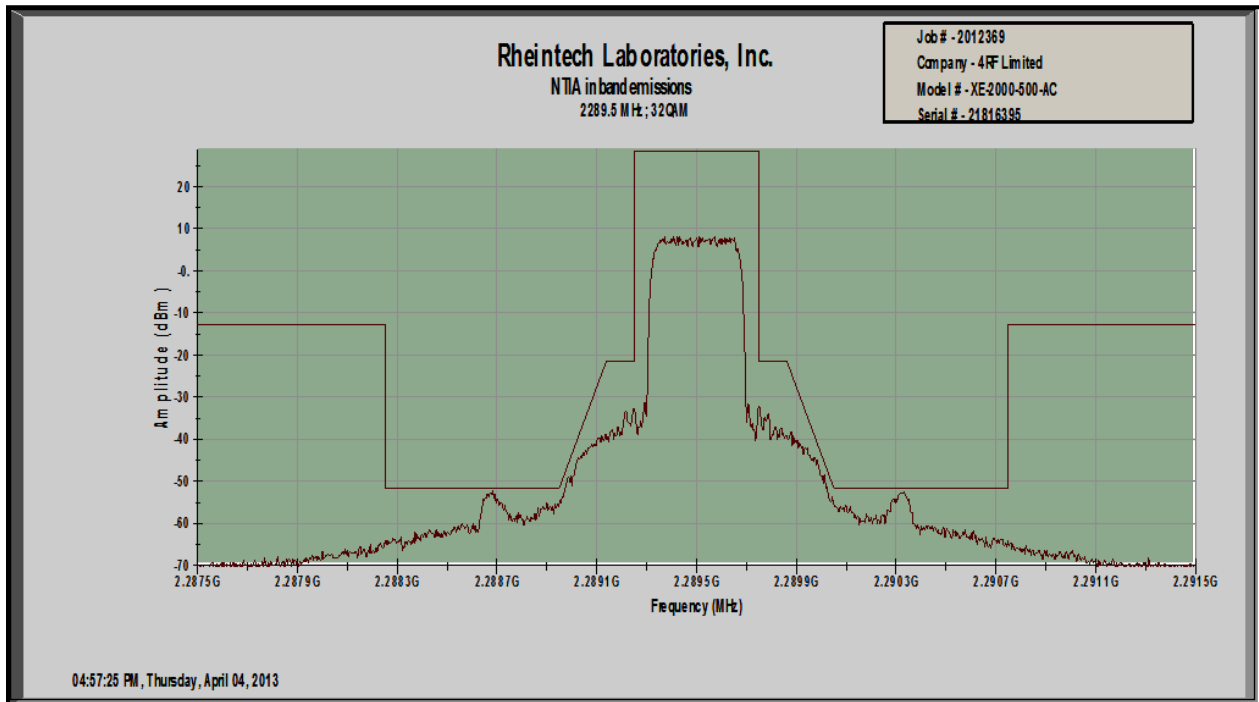
**Plot 6-5: Occupied Bandwidth; 2289.5000 MHz; QPSK**



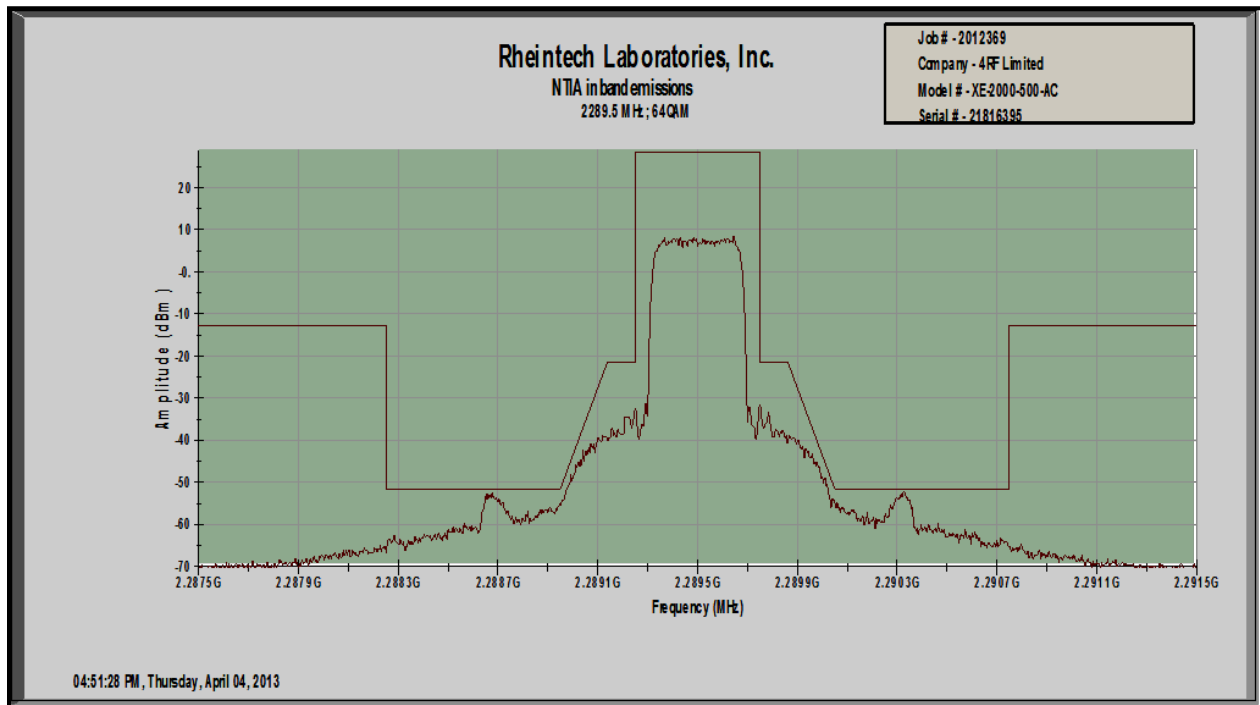
**Plot 6-6: Occupied Bandwidth; 2289.5000 MHz; 16QAM**



**Plot 6-7: Occupied Bandwidth; 2289.5000 MHz; 32QAM**



**Plot 6-8: Occupied Bandwidth; 2289.5000 MHz; 64QAM**



**Table 6-1: Test Equipment for Testing Occupied Bandwidth/Emissions Masks**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13
901536	Aeroflex	48-40-34	40 dB Attenuator	CB6627	10/14/13

**Test Personnel:**

Daniel Baltzell  
 Test Engineer

Signature

April 4-6, 2013  
 Dates of Test

## 7 Radiated Spurious Emissions - FCC 2.1053(a)

### 7.1 Test Procedure

ANSI/TIA-603-2004, section 2.2.12

The spurious emissions levels were measured, and the device under test was replaced by a substitution antenna connected to a signal generator. This signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator, and the gain of the antenna (dBd) was added to achieve the ERP level, then converted from the corrected signal generator level (dBm) to dBc and compared to the limit.

### 7.2 Test Data

**Table 7-1: Radiated Spurious Emissions – 2180.8125 MHz**

Conducted Power 28.8 dBm; 0.759 W; Limit=43+10LogP=41.8 dBc

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss to Transmit Antenna (dB)	Substitution Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
4361.6250	24.4	-82.0	0.8	8.8	102.7	-60.9
6542.4375	22.6	-82.4	1.0	9.4	102.8	-61.0
8723.2500	23.3	-73.1	1.3	9.4	93.8	-52.0
10904.0625	23.3	-74.9	1.5	10.6	94.5	-52.7
13084.8750	19.7	-73.7	1.6	11.1	93.0	-51.2
15265.6875	22.2	-69.5	1.7	11.5	88.6	-46.8
17446.5000	22.1	-68.1	1.8	9.6	89.1	-47.3
19627.3125	21.5	-70.8	1.8	20.0	81.4	-39.6
21808.1250	20.9	-70.8	1.8	20.0	81.4	-39.6

**Table 7-2: Radiated Spurious Emissions – 2289.5000 MHz**

Conducted Power 28.5 dBm; 0.708 W; Limit=43+10LogP=41.5 dBc

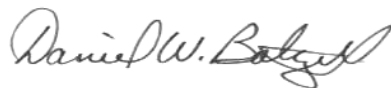
Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss to Transmit Antenna (dB)	Substitution Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
4579.0	22.5	-84.0	0.8	9.0	104.3	-62.8
6868.5	22.5	-82.2	1.1	9.2	102.6	-61.1
9158.0	22.0	-75.5	1.3	10.0	95.3	-53.8
11447.5	21.7	-76.2	1.5	10.5	95.8	-54.3
13737.0	20.5	-72.1	1.7	10.2	92.1	-50.6
16026.5	22.0	-69.8	1.8	13.9	86.2	-44.7
18316.0	20.5	-71.7	1.8	20.0	82.0	-40.5
20605.5	21.3	-71.1	1.8	20.0	81.4	-39.9
22895.0	20.7	-70.1	1.8	20.0	80.4	-38.9

**Table 7-3: Test Equipment Used For Radiated Spurious Emissions Testing**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	8/10/13
900878	Rhein Tech Laboratories	AM3-1197-0005	3 meter antenna mast, polarizing	OATS1	N/A
901592	Insulated Wire Inc.	KPS-1503-3600-KPR	SMK RF Cables 20'	NA	8/16/13
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	NA	8/16/13
901594	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	NA	8/16/13
901242	Rhein Tech Laboratories	WRT-000-0003	Wood rotating table	N/A	N/A
900791	Chase	CBL6111B	Biolog Antenna (30 MHz – 2000 MHz)	N/A	2/2/14
900321	EMCO	3161-03	Horn Antennas (4 – 8 GHz)	9508-1020	4/19/14
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	4/19/14
901582	Rohde & Schwarz	1167.0000.02	Signal Generator	101903	4/23/13
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13
900905	Rhein Tech Laboratories	PR-1040	OATS 1 Preamplifier 40dB (30 MHz – 2 GHz)	1006	8/20/13
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
901218	EMCO	3160-09	Horn Antenna (18 - 26 GHz)	960281-003	4/19/14

**Test Personnel:**

Daniel Baltzell  
 Test Engineer



Signature

April 7, 2013  
 Date of Test



## 8 Frequency Stability - FCC 2.1055, 101.107

### 8.1 Test Procedure

ANSI/TIA/EIA-603-2004, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +50°C.

The temperature was initially set to -30°C and a 1-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½-hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, the power supply voltage of the EUT was varied +/-15% nominal input voltage.

**Limit: 0.001%**

### 8.2 Test Data

**Table 8-1: Temperature Frequency Stability – 2180.8125 MHz**

Temperature (°C)	Measured Frequency (Hz)	Deviation (%)
-30	2180.810578	-0.0000881
-20	2180.811738	-0.0000349
-10	2180.812589	0.0000041
0	2180.812863	0.0000166
10	2180.812602	0.0000047
20	2180.812145	-0.0000163
30	2180.811869	-0.0000289
40	2180.812311	-0.0000087
50	2180.812584	0.0000039

**Table 8-2: Voltage Frequency Stability – 2180.8125 MHz**

Voltage (AC)	Measured Frequency (Hz)	Deviation (%)
97.75	2180.812148	-0.00002
115	2180.81215	-0.00002
132.25	2180.81215	-0.00002

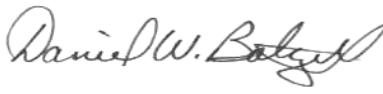
Results: The EUT is compliant.

**Table 8-3: Test Equipment Used For Testing Frequency Stability**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	1/13/14
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	1/13/14
901536	Aeroflex	48-40-34	40 dB Attenuator	CB6627	10/14/13
901350	Meterman	33XR	Multimeter	040402802	3/20/15

**Test Personnel:**

Daniel Baltzell  
Test Engineer



Signature

April 6, 2013  
Date of Tests

**9 Conclusion**

The data in this measurement report shows that the **4RF Limited Model XE 2000-500-AC, FCC ID: UIPXE20001300**, complies with the applicable requirements of FCC Parts 2 and 101.