



Engineering Solutions & Electromagnetic Compatibility Services

FCC Type Certification Report

4RF Limited
26 Glover Street, Ngauranga
PO Box 13-506
Wellington 6032
New Zealand
Contact: Paul Young
Phone: +64 4 499 6000
E-Mail: Paul.Young@4rf.com

Model: APRISA XE 700-bbb-vv

FCC ID: UIPN0700AAAA0000A

August 3, 2012

Standards Referenced for this Report	
Part 2: 2011	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 27: 2011	Miscellaneous Wireless Communications Services
ANSI TIA-603-C-2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
ANSI/TIA/EIA – 102.CAAA; 2002	Digital C4FM/CQPSK Transceiver Measurement Methods

Frequency Range (MHz)	Rated Transmit Power Conducted (W)	Measured Frequency Tolerance (ppm)	Emission Designator
698-746	3.2	0.5	500KD7W
698-746	3.2	0.5	1M00D7W
698-746	3.2	0.5	1M75D7W

Report Prepared by Test Engineer: Daniel W. Baltzell

Document Number: 2012078

No part of this report may be reproduced without the full written approval of Rhein Tech Laboratories, Inc. and 4RF Limited. The results reported relate only to the item(s) tested.

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.

Table of Contents

1	General Information.....	4
1.1	Test Facility.....	4
1.2	Related Submittal(s)/Grant(s).....	4
2	Tested System Details.....	5
3	RF Power Output: Conducted; FCC Rules and Regulations Part §27.50(c)(1&2).....	7
3.1	Test Limits.....	7
3.2	Test Procedure.....	7
3.3	Test Data.....	7
4	Spurious Emissions at Antenna Terminals; FCC Rules and Regulations Part §27.53(g).....	8
4.1	Test Limits.....	8
4.2	Test Procedure.....	8
4.3	Out of Band Spurious Test Data.....	8
4.4	In Band Spurious Test Data.....	9
5	Occupied Bandwidth; FCC Rules and Regulations Part §2.202(a).....	11
5.1	Test Procedure.....	11
5.2	In Band Spurious Test Data.....	11
6	Field Strength of Spurious Radiation; FCC Rules and Regulations Part §27.53(g) Emission Limits.....	14
6.1	Test Limits.....	14
6.2	Test Procedure.....	14
6.3	Test Data.....	14
7	Frequency Stability; FCC Rules and Regulations Part §27.54: Frequency Stability.....	16
7.1	Test Limits.....	16
7.2	Test Procedure.....	16
7.3	Frequency Stability Test Data.....	16
8	Necessary Bandwidth; FCC Rules and Regulations Part §2.202(b).....	18
9	Conclusion.....	18

Table of Plots

Plot 4-1:	Lower Band Edge (701 MHz, 1.75 MHz Bandwidth).....	9
Plot 4-2:	Upper Band Edge (743 MHz, 1.75 MHz Bandwidth).....	10
Plot 5-1:	Occupied Bandwidth; 701 MHz (500 kHz bandwidth).....	11
Plot 5-2:	Occupied Bandwidth; 701 MHz (1.5 MHz bandwidth).....	12
Plot 5-3:	Occupied Bandwidth; 701 MHz (1.75 MHz bandwidth);.....	13

Table of Figures

Figure 2-1:	Configuration of Tested System.....	6
-------------	-------------------------------------	---

Table of Tables

Table 2-1:	Equipment Under Test (EUT).....	5
Table 2-2:	Ports and Cabling (EUT)	5
Table 2-3:	Support Equipment.....	6
Table 3-1:	RF Power Output: Carrier Output Power	7
Table 3-2:	RF Power Output (Rated Power)	7
Table 3-3:	Test Equipment for Testing RF Power Output - Conducted	7
Table 4-1:	Test Equipment for Testing Conducted Spurious Emissions	10
Table 5-1:	Test Equipment for Testing Occupied Bandwidth/Emissions Masks	13
Table 6-1:	Field Strength of Spurious Radiation – 701 MHz	14
Table 6-2:	Field Strength of Spurious Radiation - 743 MHz.....	15
Table 6-3:	Test Equipment for Testing Field Strength of Spurious Radiation	15
Table 7-1:	Frequency Stability – 743 MHz	16
Table 7-2:	Voltage Stability – 743 MHz	17
Table 7-3:	Test Equipment for Testing Frequency Stability	17

Table of Appendixes

Appendix A:	RF Exposure Compliance	19
Appendix B:	Agency Authorization Letter.....	20
Appendix C:	Confidentiality Request Letter	21
Appendix D:	ID Label Information.....	22
Appendix E:	Operational Description	23
Appendix F:	Parts List	24
Appendix G:	Schematics.....	25
Appendix H:	Block Diagrams	26
Appendix I:	Manual	27
Appendix J:	Test Configuration Photographs	28
Appendix K:	External Photographs.....	30
Appendix L:	Internal Photographs.....	31

Table of Photographs

Photograph 1:	FCC ID Label Location	22
Photograph 2:	Radiated Spurious Emissions Test – Front View	28
Photograph 3:	Radiated Spurious Emissions Test – Back View.....	29

1 General Information

The following Type Certification Report is prepared on behalf of **4RF LIMITED**, in accordance with the Federal Communications Commission's radio specifications. The Equipment Under Test (EUT) was the **APRISA XE 700-bbb-vv, FCC ID: UIPN0700AAAA0000A**. 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 Parts 2, 15 and 27. Calibration checks are performed regularly on the instruments, and all accessories including the high pass filter, coaxial attenuator, preamplifier and cables.

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.

1.2 Related Submittal(s)/Grant(s)

This is an original FCC certification application report.

2 Tested System Details

The EUT is a paired channel fixed point-to-point base station radio that operates in the 698-746 MHz bands. The rated RF output power is 35.0 dBm. The EUT is digitally modulated using either QPSK, 16 QAM, 32 QAM, or 64 QAM modulation type.

The test sample was received on July 3, 2012. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

The unit tested covers the following model numbers: XE 700-bbb-vv, where:

- bbb represents the channel bandwidth/size, and is 500, 1M0 or 1M75.
- vv represents the power supply and is 24 or 48.
- It totals 6 different models.

Model Tested	APRISA XE 700-bbb-vv
Frequency Band	698-746 MHz
Modulation Type	QPSK, 16 QAM, 32 QAM, and 64 QAM
Channel Step Size	500 kHz; 1 MHz; 1.75 MHz
Authorized Channel Bandwidth	500 kHz; 1 MHz; 1.75 MHz
Primary Power	24 or 48 VDC
Rated Transmitter Output Power	35.0 dBm (QPSK); 31.0 dBm (16QAM); 30.0 dBm (32QAM); 29.0 dBm (64QAM)
Duty Cycle	Continuous 100%

Table 2-1: Equipment Under Test (EUT)

Part	Manufacturer	Model Number	Serial Number	FCC ID	RTL Bar Code
Aprisa Radio with internal 24 or 48 VDC power supplies and QuadJet card	4RF Limited	XE 700-1M0-48	21815434	UIPN0700AAAA0000A	20750

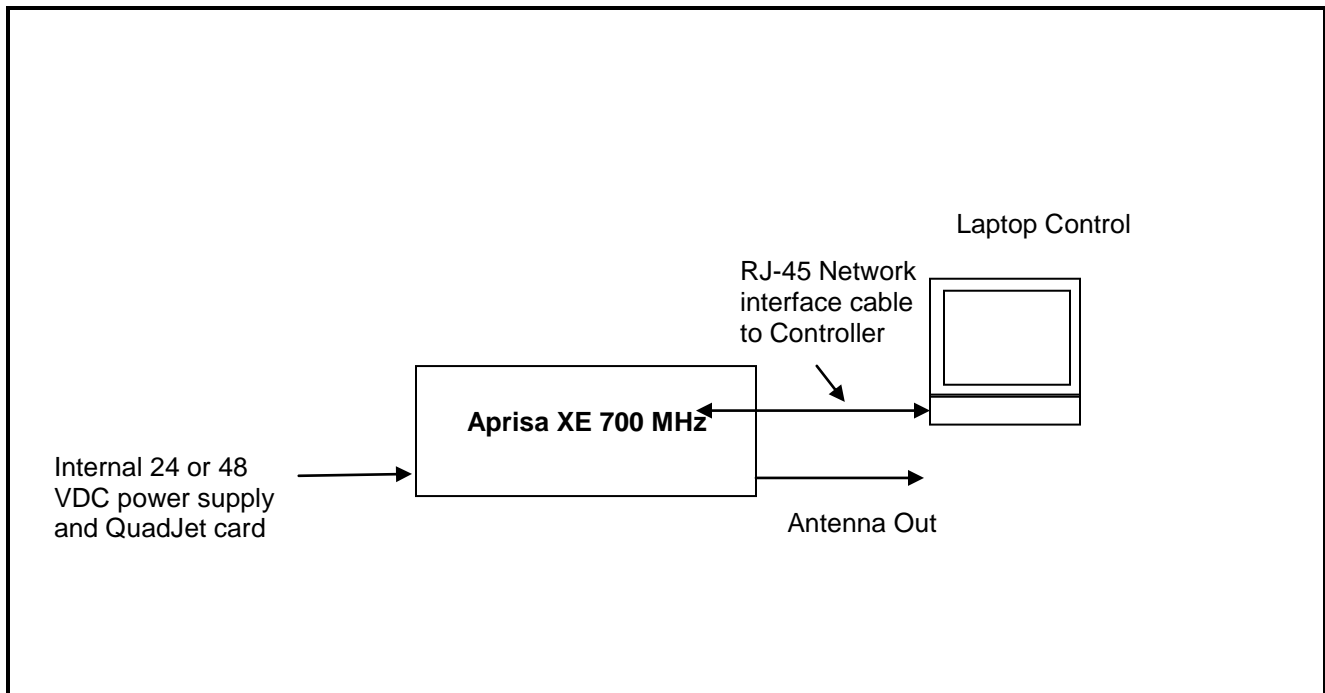
Table 2-2: Ports and Cabling (EUT)

Port	Cable Type	Quantity	Length (meter)	Shield
DC 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
QuadJet	RJ-45	4	1.5	No

Table 2-3: Support Equipment

RTL Bar Code	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901550	Samsung	NP300E5A-A01UB	Laptop	HJVF93EB903201D	N/A
N/A	Hewlett Packard	6024A	Power Supply	N/A	N/A
N/A	Elgin Electronics	ER15620-23R	Power Supply	N/A	N/A

Figure 2-1: Configuration of Tested System



3 RF Power Output: Conducted; FCC Rules and Regulations Part §27.50(c)(1&2)

3.1 Test Limits

Part 27.50 (c): The following power and antenna height requirements apply to stations transmitting in the 698–746 MHz band:

(1) Fixed and base stations transmitting a signal with an emission bandwidth of 1 MHz or less must not exceed an effective radiated power (ERP) of 1000 watts and an antenna height of 305m height above average terrain (HAAT), except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section;

(2) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal with an emission bandwidth of 1 MHz or less must not exceed an ERP of 2000 watts and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts ERP in accordance with Table 2 of this section;”

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.

3.3 Test Data

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

Frequency (MHz)	Power QPSK 35 setting (dBm)	Power 16QAM 31 setting (dBm)	Power 32QAM 30 setting (dBm)	Power 64QAM 29 setting (dBm)
701	35.1	31.3	30.3	29.3
731	35.0	31.2	30.1	29.1
713	35.0	31.2	30.1	29.1
743	35.0	31.2	30.1	29.1

*Measurement accuracy: +/-0.3 dB

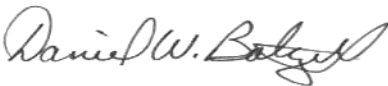
Table 3-2: RF Power Output (Rated Power)

Manufacturer's Rated Power
35.0 dBm

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

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901537	Aeroflex	48-40-34	40 dB Attenuator	CB6628	10/14/12
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13

Test Personnel:

Daniel Baltzell Test Engineer	 Signature	July 10, 2012 Date of Tests
----------------------------------	---	--------------------------------

4 Spurious Emissions at Antenna Terminals; FCC Rules and Regulations Part §27.53(g)

4.1 Test Limits

For operations in the 698–746 MHz band, the power of any emission outside a 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 at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

4.2 Test Procedure

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

The transmitter is terminated with a 50 Ω 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 attenuator was measured 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. All bandwidths were investigated, and the worst case data is shown.

4.3 Out of Band Spurious Test Data

Frequency range of measurement: 9 kHz to $10 \times F_c$.

Limits: $P(\text{dBm}) - (43 + 10 \times \text{LOG } P(\text{W}))$

The following channels (in MHz) were investigated: 701, 731, 713, and 743 MHz.

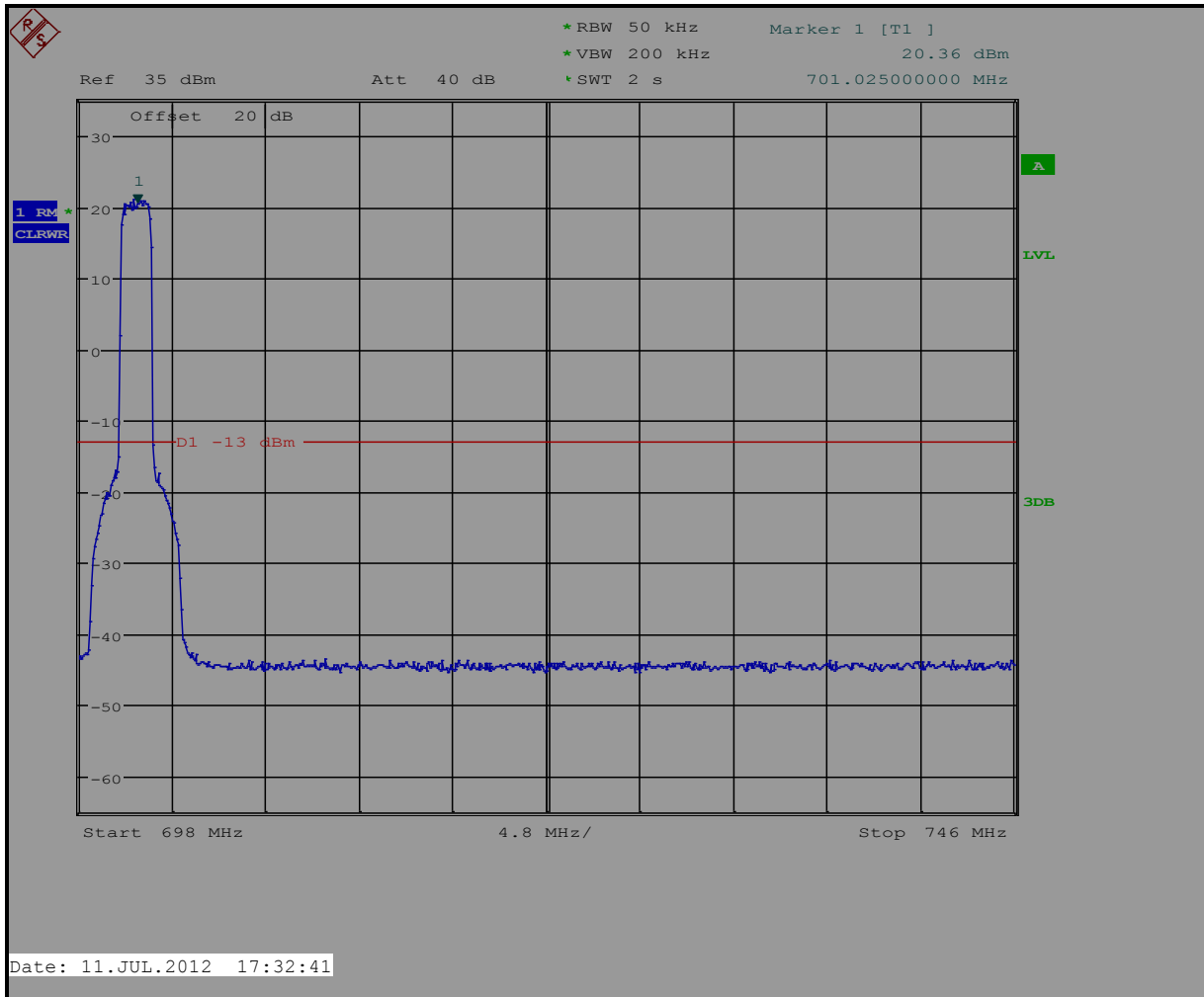
Per 47 CFR § 2.1053, no data is being reported since the magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

4.4 In Band Spurious Test Data

Frequency range of measurement: 698 MHz – 746 MHz

Limits: $P(\text{dBm}) - (43 + 10 \times \text{LOG } P(\text{W})) = -13 \text{ dBm}$

Plot 4-1: Lower Band Edge (701 MHz, 1.75 MHz Bandwidth)



5 Occupied Bandwidth; FCC Rules and Regulations Part §2.202(a)

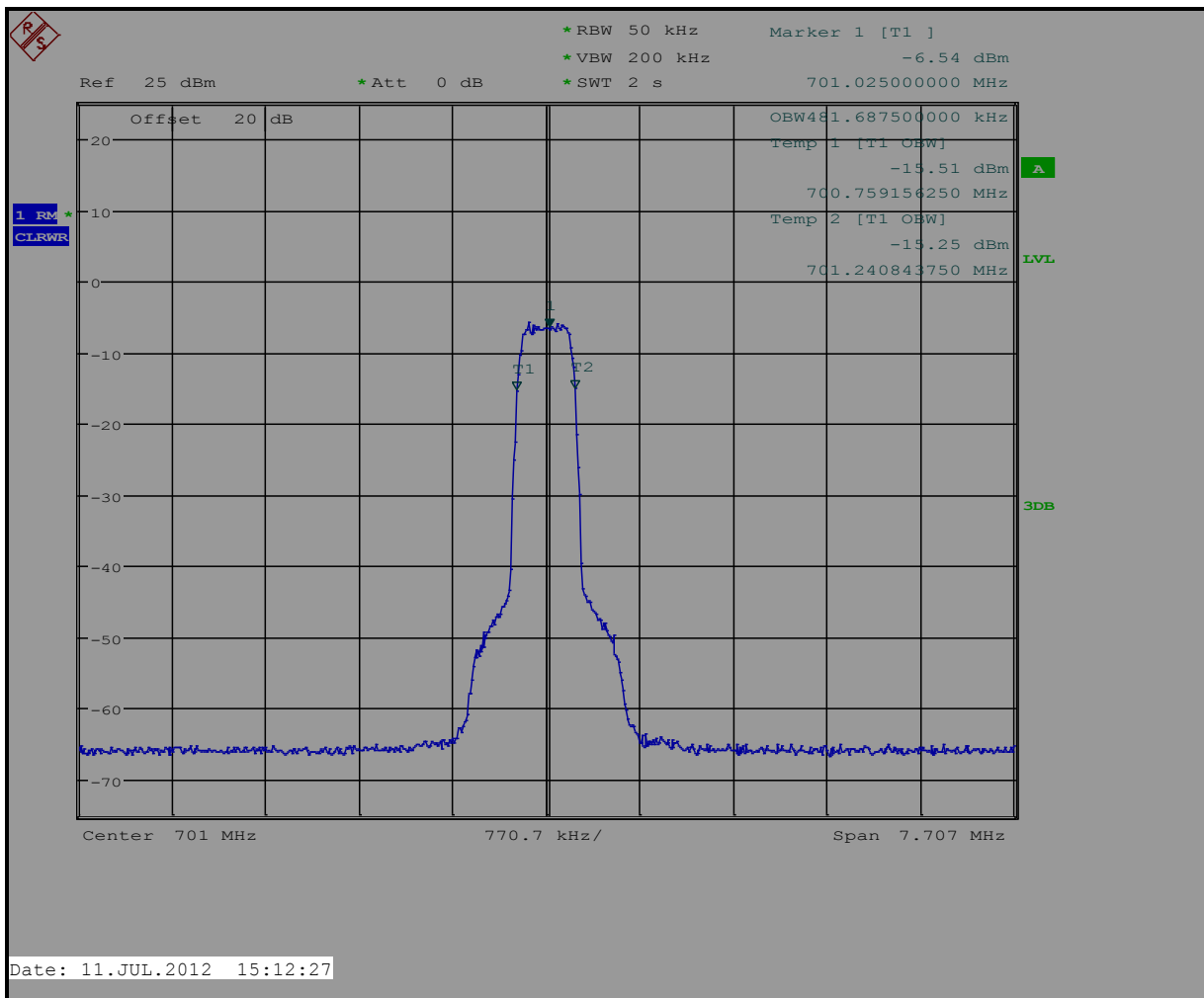
5.1 Test Procedure

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.

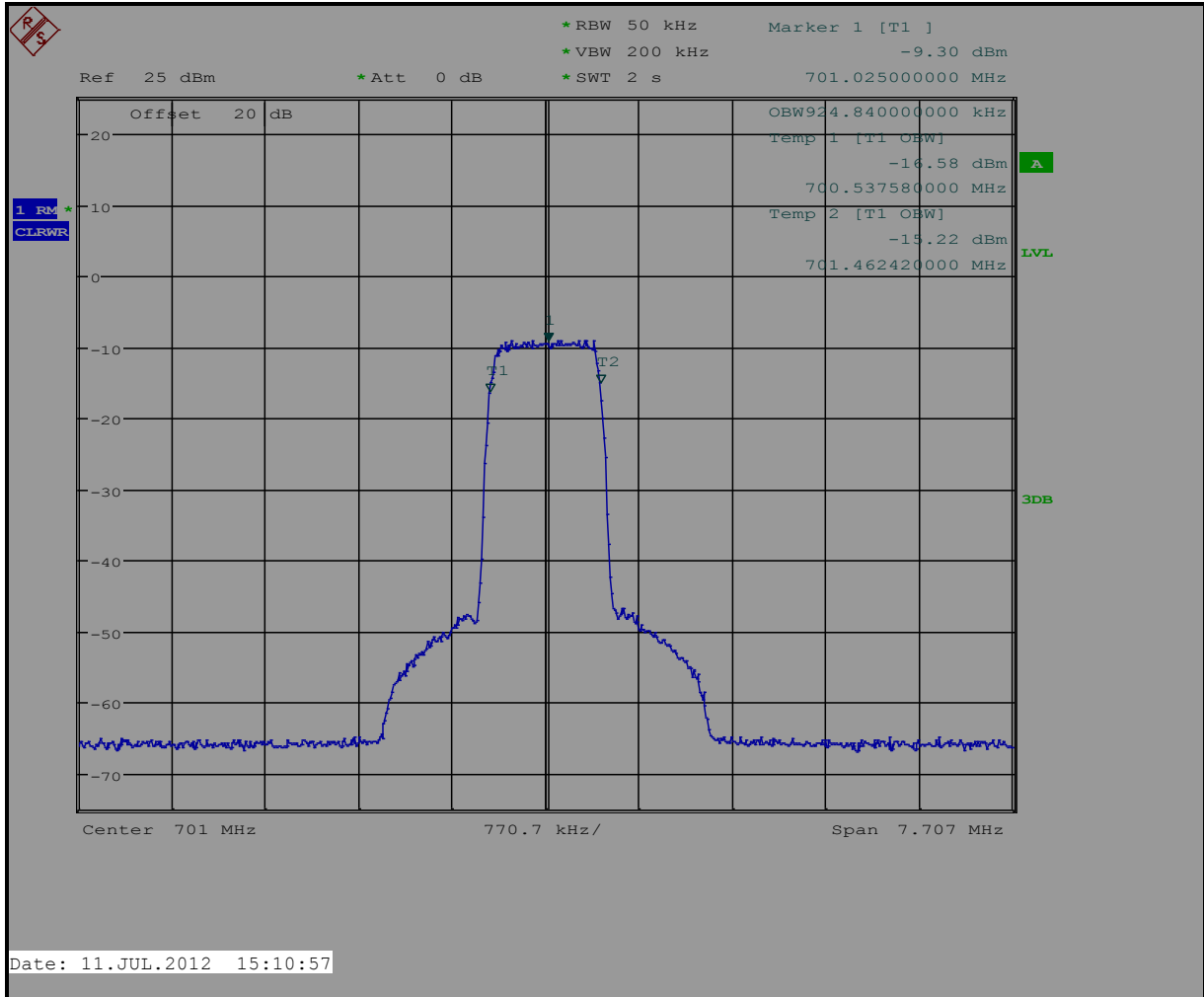
ANSI TIA-603-C-2004, Section 2.2.11.

5.2 In Band Spurious Test Data

Plot 5-1: Occupied Bandwidth; 701 MHz (500 kHz bandwidth)



Plot 5-2: Occupied Bandwidth; 701 MHz (1.5 MHz bandwidth)



Plot 5-3: Occupied Bandwidth; 701 MHz (1.75 MHz bandwidth);

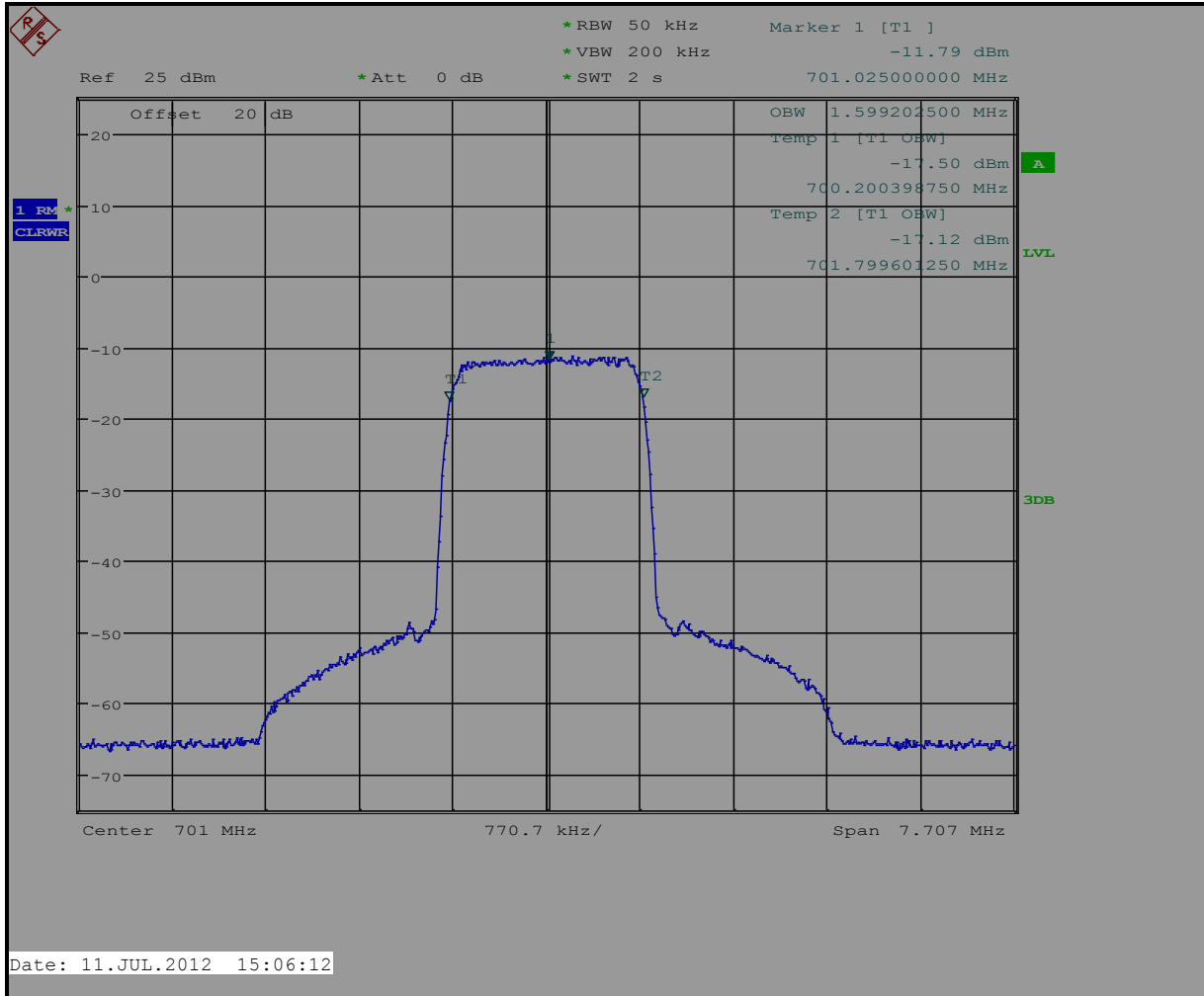
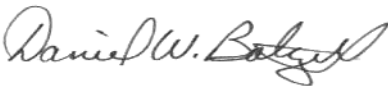


Table 5-1: Test Equipment for Testing Occupied Bandwidth/Emissions Masks

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
1139	Weinschel Corp.	48-20-34 DC-18GHz	Attenuator, 100W 20dB	BK5859	2/29/13
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13

Test Personnel:

Daniel Baltzell Test Engineer	 Signature	July 11, 2012 Date of Tests
----------------------------------	---	--------------------------------

6 Field Strength of Spurious Radiation; FCC Rules and Regulations Part §27.53(g) Emission Limits

6.1 Test Limits

For operations in the 698–746 MHz band, the power of any emission outside a 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 at least $43 + 10 \log (P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee’s frequency block, a resolution bandwidth of at least 30 kHz may be employed.

6.2 Test Procedure

ANSI TIA-603-C-2004, section 2.2.12.

The EUT was set to channel 6 for each band and modulated to its maximum extent using a 100% modulated duty cycle internal QPSK, 16 QAM, 32 QAM, and 64 QAM. The EUT was placed on a non-conducting table 80 cm above the ground plane. The antenna-to-EUT distance is 3 m. The EUT is rotated through 360° to maximize emissions. The antenna is scanned in both vertical and horizontal polarizations. 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 transmit antenna added.

The EUT was scanned from 30 GHz to the 10th harmonic of the fundamental. The spectrum analyzer resolution bandwidth is set to 100 kHz for less than 1 GHz, and the video bandwidth is set to 1 MHz. The resolution bandwidth is 1 MHz when measuring above 1 GHz.

The spurious radiated emissions limit is calculated as follows:

$$\text{Limits: } P(\text{dBm}) - (43 + 10 \times \text{LOG } P(\text{W}))$$

6.3 Test Data

Table 6-1: Field Strength of Spurious Radiation – 701 MHz

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss* (dB)	Antenna Gain (dBd)	SG Level Corrected (dBc)	Limit	Margin (dB)
1402.0	44.6	-47.0	1.0	5.7	77.4	48.1	-29.3
2103.0	42.6	-49.8	1.2	6.4	79.6	48.1	-31.5
2804.0	38.3	-53.1	1.4	7.6	81.9	48.1	-33.8
3505.0	36.8	-55.2	1.5	7.1	84.7	48.1	-36.6
4206.0	35.4	-51.9	1.7	8.2	80.5	48.1	-32.4
4907.0	34.0	-51.2	1.8	8.5	79.6	48.1	-31.5
5608.0	34.2	-54.9	1.9	8.5	83.5	48.1	-35.4
6309.0	31.5	-52.8	2.0	8.9	81.0	48.1	-32.9
7010.0	31.7	-55.0	2.1	9.4	82.8	48.1	-34.7

Table 6-2: Field Strength of Spurious Radiation - 743 MHz

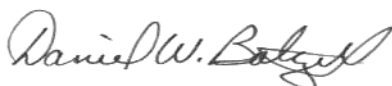
Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss* (dB)	Antenna Gain (dBd)	SG Level Corrected (dBc)	Limit	Margin (dB)
1486.0	42.7	-46.9	1.0	6.1	76.8	48.0	-28.8
2229.0	43.4	-50.9	1.2	6.9	80.3	48.0	-32.3
2972.0	41.5	-52.1	1.4	7.1	81.4	48.0	-33.4
3715.0	33.5	-54.8	1.6	6.6	84.7	48.0	-36.7
4458.0	30.9	-56.2	1.7	8.5	84.5	48.0	-36.5
5201.0	32.1	-52.8	1.9	8.2	81.5	48.0	-33.5
5944.0	33.0	-52.2	2.0	9.0	80.2	48.0	-32.2
6687.0	31.3	-53.6	2.1	9.2	81.5	48.0	-33.5
7430.0	31.8	-51.8	2.2	8.6	80.4	48.0	-32.4

Table 6-3: Test Equipment for Testing Field Strength of Spurious Radiation

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900151	Rohde and Schwarz	HFH2-Z2	Loop Antenna (9 kHz - 30 MHz)	827525/019	10/1/12
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	7/14/12
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13
900905	Rhein Tech Laboratories	PR-1040	OATS 1 Preamplifier 40 dB (30 MHz – 2 GHz)	1006	7/14/12
900878	Rhein Tech Laboratories	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required
901516	Insulated Wire, Inc.	KPS-1503-2400-KPS-09302008	RF cable, 20'	NA	10/14/12
901590	Sucoflex	104	6.5' SMA Cable	145883/4	5/15/13
901591	Sucoflex	104	6.5' SMA Cable	145880/4	5/15/13
901242	Rhein Tech Laboratories	WRT-000-0003	Wood rotating table	N/A	Not Required
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	4/19/14
900321	EMCO	3161-03	Horn Antennas (4 - 8,2 GHz)	9508-1020	4/19/14
900791	Chase	CBL6111B	Bilog antenna (30 MHz – 2000 MHz)	N/A	1/31/13

Test Personnel:

Daniel Baltzell
 Test Engineer



Signature

July 13, 2012
 Date of Tests

7 Frequency Stability; FCC Rules and Regulations Part §27.54: Frequency Stability

7.1 Test Limits

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

7.2 Test Procedure

ANSI TIA-603-C-2004, section 2.3.1 and 2.3.2.

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 +60°C.

The temperature was initially set to -30°C and a 2-hour period was observed for stabilization of the EUT. The EUT was set to CW mode and measured with a frequency counter. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10°C 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. Data normalized to nominal voltage/20°C is shown below.

7.3 Frequency Stability Test Data

Table 7-1: Frequency Stability – 743 MHz

Temperature (C)	Frequency Measured (MHz)	Parts Per Million
-30	742.99993300	-0.09
-20	742.99991600	-0.11
-10	742.99988800	-0.15
0	742.99988500	-0.15
10	742.99993800	-0.08
20	743.00000000	0.00
30	743.00013900	0.19
40	743.00027800	0.37
50	743.00035100	0.47
60	743.00039300	0.53


Table 7-2: Voltage Stability – 743 MHz

Voltage (DC)	Frequency Measured (MHz)	Parts Per Million
40.8	742.99999800	0.00
48.0	743.00000000	0.00
55.2	742.99999900	0.00

Table 7-3: Test Equipment 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	1/13/13
901590	Sucoflex	104	6.5' SMA Cable	145883/4	5/15/13
901350	Meterman	33XR	Multimeter	040402802	12/28/12
901300	Agilent Technologies	53131A (225 MHz)	Universal Frequency Counter	MY40001345	7/18/12
901537	Aeroflex	48-40-34	40 dB Attenuator	CB6628	10/14/12

Test Personnel:

Daniel Baltzell Test Engineer	 Signature	July 10, 2012 Date of Tests
----------------------------------	--	--------------------------------

8 Necessary Bandwidth; FCC Rules and Regulations Part §2.202(b)

Type of Emission: D7W

Calculation:

Data rate $R = 2392$ kilobits per second for 64 QAM
Number of state in each symbol $S = 64$; $\text{Log}_2S=6$
Peak deviation $D = 280$ kHz
 $K = 0.18$
 $B(n) = (R/\text{Log}_2S + 2DK) = 500$ kHz

Emission Designator: 500KD7W

Data rate $R = 4888$ kilobits per second for 64 QAM
Number of state in each symbol $S = 64$; $\text{Log}_2S=6$
Peak deviation $D = 560$ kHz
 $K = 0.17$
 $B(n) = (R/\text{Log}_2S + 2DK) = 1000$ kHz

Emission Designator: 1M00D7W

Data rate $R = 8632$ kilobits per second for 64 QAM
Number of state in each symbol $S = 64$; $\text{Log}_2S=6$
Peak deviation $D = 980$ kHz
 $K = 0.16$
 $B(n) = (R/\text{Log}_2S + 2DK) = 1750$ kHz

Emission Designator: 1M75D7W

9 Conclusion

The data in this measurement report shows that the **4RF LIMITED, Model APRISA XE 700-bbb-vv, FCC ID: UIPN0700AAAA0000A**, complies with all the applicable requirements of FCC Part 2 and 27.