EMC Engineering Test Report
Ingenium Project Number: JCEAQ1132

EMC Testing of:
Primex Wireless, Model 72XR Command Point Amplifier

Prepared for:
Primex Wireless, Incorporated
Attention: Mr.: Michael Jonely
65 Wells Street
Lake Geneva, WI 53147
United States of America

Test Date(s):
August 12TH through August 31ST, 2009

In accordance with: U.S. Code of Federal Regulation, Title 47, part 2 and Part 90

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Reason for change: Affected Section or Area:	Added test procedure reference ANSI/TIA 603 C (2004) to the test procedure descriptions. Entire report
Reason for change: Affected Section or Area:	Added term ‘External Radio Frequency Power Amplifier (ERFPA)’ to text for clarification of the class of product being tested. Product Description
Reason for change: Affected Section or Area:	References to RSS-119 have been changed to RSS-131, as the more appropriate standard. Declaration of Conformity section
Reason for change: Affected Section or Area:	Added Dipole antenna set to the equipment list List of Equipment, Radiated Emissions
Reason for change: Affected Section or Area:	Added verbiage that information the section for ‘Carrier Frequency and Power Stability’ was provided to the client as a service for future qualifications. Carrier Frequency and Power Stability
Reason for change: Affected Section or Area:	Added verbiage on testing at minimum and maximum RF input power, and the selection of 1Watt as nominal RF input power by virtue or the source that will be used in the actual installations (the Exciter is the source). RF emissions and power stability section

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Reason for change: Affected Section or Area:	Added Pass-band Gain and Bandwidth information to satisfy RSS-131, section 4.2. Added new Figures 29 and 30, then re-sequenced all Figures. Section 2.1.2 Added Figures 29 and 30

Introduction

1.1 Scope

Between August 12TH and August 31ST, 2009, a series of Electro-Magnetic Compatibility (EMC) tests were performed on one sample of the Primex Wireless' model '72XR' Command Point Amplifier, serial number "B13H", here forth referred to as the "*Equipment Under Test*" or "*EUT*".

The radio frequency (RF) emission tests were performed are in accordance with the United States Code of Federal Regulations (CFR), Part 90, for Private Land Mobile Radio Services, using the emission standards test procedures outlined in ANSI/TIA-603-C (2004) and ANSI C63.4 (2003), with test instruments adhering to CISPR 16-2 guidelines. The tests were performed, with the EUT in pre-defined operating modes and performance criterion as defined in advance by Primex Wireless, Incorporated, here forth referred to as the *"Primex Test Plan"*.

The tests were performed to allow verification, in part, of the product's EMI compliance in accordance with the EMC standards in the United States of America. The tests were performed by Abtin Spantman, EMC Engineer at Ingenium Testing.

1.2 Product Description

1.2.1 General Product Description

The Primex model '72XR' Power Amplifier is a variable output power RF power amplifier with an operating frequency range of 72 to 76 MHz. The power amplifier is capable of delivering from 5 Watts to 50 Watts of RF power based on configuration settings ***as adjusted at the manufacturer, prior to shipment*** of the power amplifier product.

The 72XR Power Amplifier is typically installed and used in the CommandPoint 72XR System. The CommandPoint 72XR System automatically synchronizes clocks through a wireless radio signal. The GPS satellites transmit time information to the GPS receiver that sets the Transmitter's internal clock to the precise GPS time. The Transmitter rebroadcasts that time via a radio signal to system clocks and components within the range of the system. As a result, all clocks, bells, and timers in the wireless system are precisely synchronized to each other and to the U.S. Government's official NIST time standard, Coordinated Universal Time (UTC). All components of the CommandPoint 72XR System are routinely updated to ensure both precision and synchronization. The 72XR systems include an externally mounted antenna and the RF power amplifier allowing for greater coverage distance.

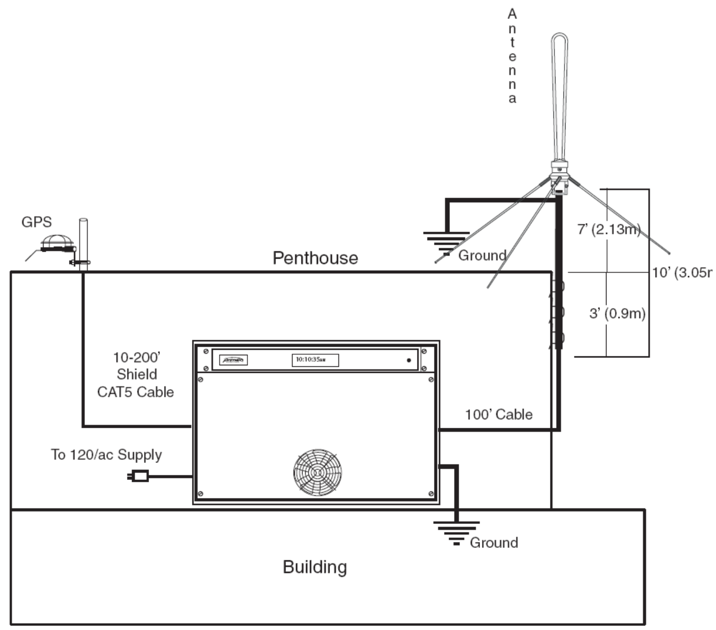


Figure 1: Block diagram of the Equipment and interconnections.

Figure 2: Front view of the 72XR power amplifier (exposed to end-user)

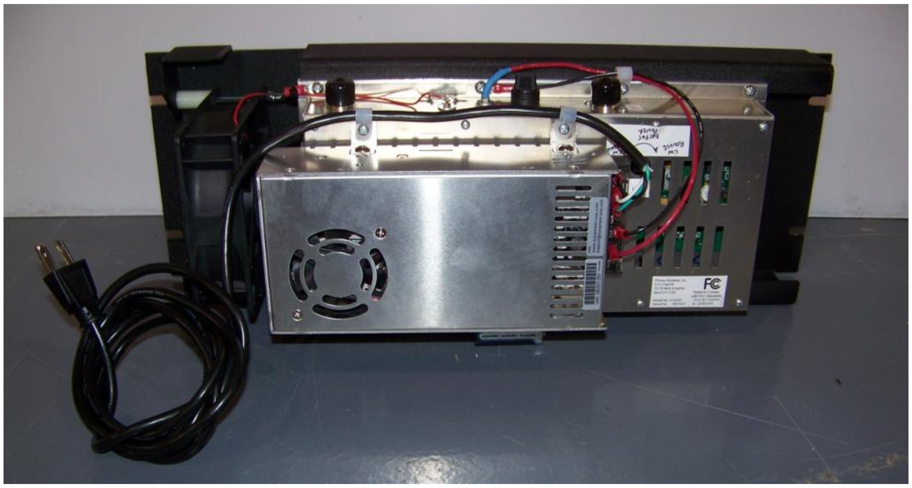


Figure 3: Rear view of the 72XR power amplifier (not exposed to end-user)

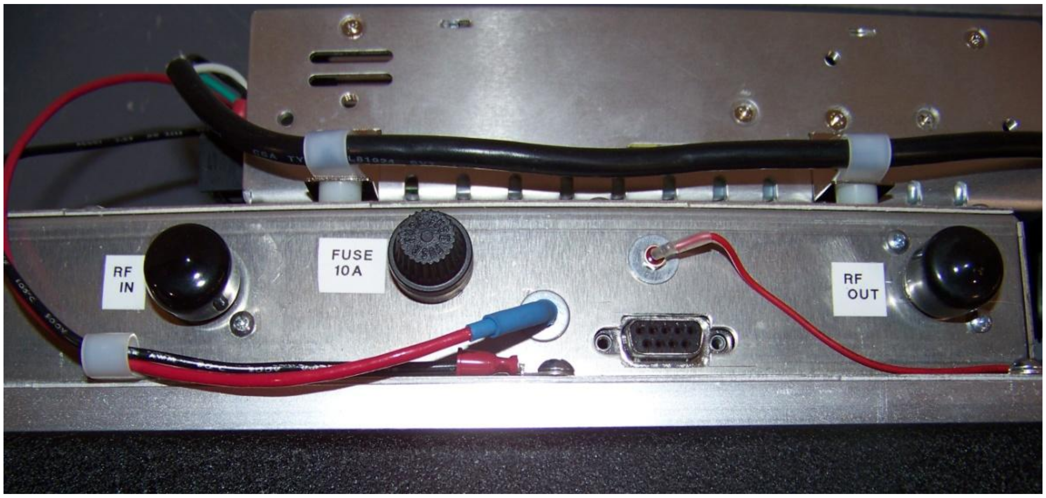


Figure 4: The 72XR power amplifier port connections, showing 'RF IN' and 'RF OUT' type N(F) connections, the DB-9 monitoring port, and DC power source hardwired connections (not exposed to the end-user)

Figure 5: The Command Point 72XR System, as presented to the end-user (includes the power amplifier) Front view.

Figure 6: The Command Point 72XR System, as presented to the end-user (includes the power amplifier) Rear view.

1.2.2 Detailed Product Description

The ‘72RX’ power amplifier can accept an RF drive level of 0.5 to 1.5 Watts, at the ‘RF IN’ connector, with a nominal level of 1 watt. The ‘72RX’ power amplifier falls within the classification of ‘External Radio Frequency Power Amplifier (ERFPA)’, and should be tested as such. The output power at the ‘RF OUT’ connector is adjustable from 5 to 50 watts with factory adjustment; the level is not user adjustable. **The output power is held to the preset power level by means of an automatic gain control circuit.** The amplifier employs an SWR protection circuit, and reduces the output power to approximately 2 watts if the SWR exceeds 4:1. The output power is returned to the set level once the SWR is reduced. The unit contains no oscillators or microprocessors; all amplifier supervisory and control signals are processed by analog computer op amp circuits.

The amplifier is mounted in a rack enclosure with a Polyphasor lightning arrestor and an FCC approved Primex exciter; the FCC ID# PZ3-XR which is used to provide the drive signal for the amplifier.

The exciter/amplifier combination is used with 100 feet of LMR400 coaxial cable, and the Kathrein-Scala GPB-75N unity gain (0 dBd) ground plane antenna.

A typical system would have the following functionality:

GPS antenna/Transmitter Extension Cable
A specially designed low-resistance data cable is available upon request to extend the distance between the GPS receiver and the Transmitter. The GPS receiver continuously sends the precise time through the cable to the Transmitter.

GPS Receiver
The Global Positioning System (GPS) Receiver has a sensitive antenna that receives the precise time (UTC) from the GPS satellite transmission. The GPS receiver must have an unobstructed "view of the sky" to maximize the GPS receiver’s ability to receive signal 24-hours per day.

Transmitter (Referred to as the Exciter, and is not an integral part of the EUT)
The Transmitter receives the time from the GPS Receiver and synchronizes to the precise GPS time. The Transmitter continuously broadcasts its GPS synchronized time to the system clocks, bells, and tones. The Transmitter operates on channels with 20kHz bandwidths between the frequencies of 72-76 MHz and is preset to one of the channels licensed by the FCC/IC to minimize interference on these frequencies and channels.

High Power Amplifier (EUT)
The 72XR system increase the output power of the base Transmitter by utilizing a high power amplifier. The amplifier is housed in an industrial style enclosure for safety reasons.

Lightning Arrestor
The lightning arrestor is housed inside the enclosure and helps protect the transmitter and amplifier from lightning damage during severe weather. However, we cannot guarantee that all damage will be prevented even with the lighting arrestor installed.

Ground Plane Omni-directional Antenna
This antenna is a heavy duty, light weight ground plane antenna designed to be mounted outdoors.

Table 1: EUT's table of Interfaces to/from the EUT

Description
AC Mains power cord – 14~10 AWG Unbalanced Zip. (Note 1)
RF IN: RF Input – N(F) coaxial connector
RF OUT: RF Output – N(F) coaxial connector
Baseband Monitor Port: RS-232 shielded cable, DB-9 connector

Notes:

1) The unit has an AC-to-DC power supply that provides power to the amplifier. This DC power supply is hard-wired and considered an integral part of the amplifier construction. The cord for the AC Mains power is considered the only power interface to the amplifier.

1.2.3 Modes of operation

The only mode of operation specified for this device is 'On' (versus Off) states.
All testing should be performed with the unit powered on.

While the power amplifier unit is on, it will provide power gain to the RF signal presented, up to the pre-set level (5 to 50 Watts), and will maintain that output power level even if the input RF signal level fluctuates within the tolerable range (0.5 to 1.5 Watts).

Testing should be performed with the Exciter, as provided by the manufacturer, or with a signal source with 1.0 Watts nominal power. If an external signal generator is utilized, it should be operated with settings to match the modulation characteristics of the Exciter.

1.2.4 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Table 2: Equipment Under Test (EUT) Product Information

Product Name:	72XR Power Amplifier
Model Number:	72XRnn (where 'nn' signifies output power in Watts)
Serial Number:	B13H

Table 3: Support Equipment Product Information

Product Name:	Exciter
Model Number:	XR
Serial Number:	0000000389 (part of assembly number: Q13200-2)

Product Name:	Triplite IBAR12, Isobar Premium Surge Protector
Model Number:	IB6421
Serial Number:	973AS1

1.2.5 EUT's Technical Specifications (Additional information)

Table 4: Equipment Under Test (EUT) Technical Specifications

Frequency Range (in MHz)	72 to 76
RF Power (W)	Adjustable 5 W to 50 W
Apparent Gain of Antenna	N/A (No antenna tested)
System/RF channel Impedance	50 Ohms
Field Strength (and at what distance)	N/A
Occupied Bandwidth (99% BW)	N/A (source dependant)
Type of Modulation	N/A (source dependant)
Output Linearity across frequency	± 1 dB Gain Flatness
Emission Designator	N/A (source dependant)
Transmitter Spurious (worst case)	46.3 dBµV/m at 10m, 144.04 MHz
Frequency Tolerance %, Hz, ppm	N/A (source dependant)
Microprocessor Model # (if applicable)	N/A
EUT will be operated under FCC Rule Part(s)	Part 90
Modular Filing	☐ Yes ☒ No
Cabinet Size	20.8"w x 17.6"h x 21.4"d
Cabinet Weight	75 Pounds
Power Requirements	115 VAC, 60 Hz, 5 to 50 A
Environmental Operating conditions	System: (0 to 50 ^{o}C) 0 – 95 % RH, Non-condensing
Communication Ports	Baseband Monitor: RS-232

1.3 Applicable Normative Documents

Table 5: Regulatory documents

Publication	Year	Title
47 CFR, Parts 0-90 (FCC)	Release Date 2008-07-10	United States of America Code of Federal Regulations Title 47 - Telecommunications
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
EIA/TIA 603-C	(2004-08)	Telecommunications Industry Association Land Mobile FM or PM- Communication Equipment- Measurement and Performance Standards
RSS-119	Issue 7 (2007-04)	Industry Canada Spectrum Management and Telecommunications Radio Standard Specification. Land Mobile and Fixed Radio Transmitters and Receivers Operating in the Frequency Range 27.41-960 MHz.
CISPR 16-1-1	Edition 2.1 (2006-11)	International Electrotechnical Commission (IEC) standard. Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-1-2	Edition 1.2 (2006-08)	International Electrotechnical Commission (IEC) standard. Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Ancillary equipment – conducted disturbances..
CISPR 16-1-3	Second Edition (2004-06)	International Electrotechnical Commission Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-3: Radio disturbance and immunity measuring apparatus - Ancillary equipment – Disturbance power.
CISPR 16-2-1	Edition 1.1 (2005-09)	International Electrotechnical Commission (IEC) standard. Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement.
CISPR 16-2-2	Edition 1.2 (2005-09)	International Electrotechnical Commission (IEC) standard. Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-2: Measurement of disturbance power.
CISPR 16-2-3	Second Edition (2006-07)	International Electrotechnical Commission (IEC) standard. Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-3: Methods of Measurement of disturbance and immunity – Radiated disturbance measurements

Table 6: Non-Regulatory controlled documents from Primex Wireless or Ingenium Testing.

Document	Owner	Title
Command Point 72XR5 and 72XR30 User Guide	Primex Wireless	Command Point 72XR5 and 72XR30 User Guide
JCEAQ1132 quote	Ingenium Testing	Quotation and statement of work for the 72XR Power Amplifier

1.4 Defined Performance Criterion

Manufacturer and Device-Specific Operational Definitions and Performance Criterion:

The following are general performance definitions, as described in 47 CFR 90.213 (a) and 47 CFR 2.1055 (d)(1):

- In normal operational mode, the power amplifier unit shall operate per manufacturer specifications.
- Frequency excursions due to susceptibility testing should be less than ± 5 ppm from the nominal center frequency.
- Output power excursions due to susceptibility testing should be less than ± 1 dB from nominal output power.

Susceptibility test results are to be evaluated for the performance of the amplifier and not of the RF source. Care should be taken to ensure the source and the amplifier are exercised appropriately.

Performance Criterion A:
During testing, normal performance within the specification limits (is the only acceptable performance level).

The following functions must operate per manufacturers specifications as listed below, for acceptance criterion A:

- Center Frequency of Source: Range:72-76 MHz
  - Nominal at 72.0 MHz; Acceptable Excursion during test: ± 360 Hz from nominal.
  - Nominal at 76.0 MHz; Acceptable Excursion during test: ± 380 Hz from nominal.
- Output Power: Range:5 – 50 Watt
  - Nominal at 5 Watt (+37 dBm); Acceptable Excursion during test: ± 1 dBm from nominal.
  - Nominal at 50 Watt (+47 dBm); Acceptable Excursion during test: ± 1 dBm from nominal.

Performance Criterion B:
Not defined for this product or this series of tests.

Performance Criterion C:
Not defined for this product or this series of tests.

1.5 Applicable Test Matrix and Test Results

The following matrix defines the scope of testing as covered by this report, and agreed to between Primex Wireless (Client) and Ingenium Testing, LLC.

This series of testing is performed to verify that the electromagnetic performance of the 72XR Pwer Amplifier adheres to the expected performance stated in the aforementioned standards. These tests verified that the performance characteristics meet the specific limits dictated by 47CFR 90. The following matrix describes the test regiment.

Table 7: Test Matrix and Test Results

Port Definition	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
Enclosure	5 Watt Mode	Radiated RF Emissions 47 CFR 90.210	30 MHz-1.0 GHz Measured RF Emission should be Below specified Limits	Pass
	50 Watt Mode	Radiated RF Emissions 47 CFR 90.210	30 MHz-1.0 GHz Measured RF Emission should be Below specified Limits	Pass
AC Power	5 Watt Mode	AC Mains Conducted RF Emissions 47 CFR 15.107 Class B	150kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
	50 Watt Mode	AC Mains Conducted RF Emissions 47 CFR 15.107 Class B	150kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
	5 Watt Mode	Frequency Stability 47CFR 2.1055(d)(1) 47CFR 90.213(a)	Freq. Excursion < 5 ppm 85% of V_{NOM} 115% of V_{NOM} Criterion B	Pass
	50 Watt Mode	Frequency Stability 47CFR 2.1055(d)(1) 47CFR 90.213(a)	Freq. Excursion < 5 ppm 85% of V_{NOM} 115% of V_{NOM} Criterion B	Pass
RF Port	5 Watt Mode	Occupied Bandwidth 47 CFR 2.202(a) 47 CFR 90.209(b)(5)	OCCBW < 20 kHz	Pass
	50 Watt Mode	Occupied Bandwidth 47 CFR 2.202(a) 47 CFR 90.209(b)(5)	OCCBW < 20 kHz	Pass
	5 Watt Mode	RF Power Output 47 CFR 90.205(c)	Pout < 300 W As licensed	Pass
	50 Watt Mode	RF Power Output 47 CFR 90.205(c)	Pout < 300 W As licensed	Pass
	5 Watt Mode	Band-Edge 47 CFR 90.210	Spurious Pout < -13dBm < 71.7dBuV/m@10m	Pass
	50 Watt Mode	Band-Edge 47 CFR 90.210	Spurious Pout < -13dBm < 71.7dBuV/m@10m	Pass
	5 Watt Mode	Conducted Spurious Output Power	Conducted Spurious Pout < -13dBm	Pass

		47 CFR 90.210		
	50 Watt Mode	Conducted Spurious Output Power 47 CFR 90.210	Conducted Spurious Pout < -13dBm	Pass

Notes:

1.6 Notes and Exceptions to Report

Item 1) No exceptions to report.

1.7 Declaration of Conformity

DECLARATION OF CONFORMITY

*The Primex Wireless' model '72XR' Power Amplifier was found to **MEET** the requirements as described within the specifications of the FCC, Title 47 CFR, Part 90 for performance of an amplifier product in the 72-76 MHz band, Title 47 CFR, Part 15.107 for conducted emissions onto AC Mains, as well as the Industry Canada requirements specified within RSS-131 for an amplifier product. The conformity statement is limited in scope to the testing that was commissioned and administered and covered in this report.*

If some emissions are seen to be within 3 dB of their respective limits:
As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

Ingenium Testing, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

1.8 Signatories

The test matrix presented in section 1.4 of this report was generated, in agreement, by the cognizant parties representing the client as the manufacturer of the equipment, and by the cognizant parties at Ingenium Testing. The performance of the tests and reporting of the results are accurate to the best of our collective knowledge as presented within the body of this report.

The testing of this product was approved by the cognizant parties representing the manufacturer:

Mr. Michael Jonely **Electrical Engineer, Primex Wireless**	**Date**

Manufacturer Name:	Primex Wireless **Primex Wireless**
Address:	Primex Wireless 965 Wells Street Lake Geneva, WI 53174 T: +1 800-537-0464 F: +1 262-248-0061 www.PrimexWireless.com
Contact Person: *Technical, and Administrative*	Mr. Mike Jonely Electrical Engineer Primex Wireless 965 Wells Street Lake Geneva, WI 53174 T: +1 262-249-2362 mjonely@quartexusa.com

This Test Report is issued under the Authority of:

Michael M. Miller	**Date**
Laboratory Manager, Ingenium Testing, LLC	

The testing was performed by:

Abtin Spantman	**Date**
RF/EMC Engineer, Ingenium Testing, LLC	

1.9 Test Facility and Accreditations

1.9.1 Ingenium Testing, LLC Accreditation

Ingenium Testing, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

Ingenium Testing, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. A copy of the accreditation may be accessed on our web site: www.IngeniumTesting.com. Accreditation status can be verified at A2LA’s web site: www.a2la2.net.

1.9.2 Location of Test Facility

All testing was performed at Ingenium Testing, LLC, 3761 South Central Avenue, Rockford, Illinois, 61102-4292, United States of America, utilizing the facilities listed below, unless otherwise noted.

List of Facilities Located at Ingenium Testing, LLC:

- 10-meter Semi-Anechoic Chamber, designated Chamber number 6.
- RF Shielded room, designated Chamber 11.

Test Details

2.1 Electromagnetic Emission Tests

2.1.1 Conducted RF Performance Parameters – Conducted RF Power Output Measurements

2.1.1.1 Test Criterion

The test matrix in section 1.5 was used as a guide for test points and conditions.

Port Definition	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
Enclosure	5 Watt Mode	RF Power Output 47 CFR 90.205(c)	Pout < 300 W As licensed	Pass
	50 Watt Mode	RF Power Output 47 CFR 90.205(c)	Pout < 300 W As licensed	Pass

The following table presents the limits for fundamental RF emissions, conducted at the RF output port, as specified in the FCC Title 47 CFR, Part §2.1046, §90.205(c) and §90.210(c) for products qualifying as licensed transmitters.

The power of any emission within the authorized operating frequency ranges must be within the terms of the license as granted.

Frequency (MHz)	Emission Limit Antenna Conducted (dBm)
72.0 – 76.0	As Licensed (37.0 dBm = 5W) §90.210(c) – Mask c
72.0 – 76.0	As Licensed (47.0 dBm = 50W) §90.210(c) – Mask c

Table 8: Field Strength Limit for radiated harmonic and spurious RF emissions under 47CFR 2.1053.

The emission mask in the FCC Title 47 CFR, Part §90.210(c) will be used to assess the compliance of the modulated signal, as presented by the Exciter as a source signal.

2.1.1.2 Test Equipment

All Ingenium Testing, LLC test and monitoring equipment/instrumentation is calibrated for Testing Laboratory requirements of ISO/IEC 17025:2005, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers. Calibration information was checked and recorded before each test in which the equipment was used.

List of Equipment Used:

Manufacturer	Model	Ingenium Asset #	Description	Last Cal date	Cal due date
Agilent	E4440A	1207	PSA Spec. Analyzer	18 Dec 2008	18 Dec 2009
Agilent	N9039A	1206	Pre-Selector	23 Dec 2008	23 Dec 2009
Agilent	N5182	1208	RF Generator	18 Dec 2008	18 Dec 2009
Werlatone	C6047	0344	Directional Coupler	22 Jun 2009	22 Jun 2010
Kalmus	505C	0069	Pre-amplifier	Verify on Use	Verify on Use
Agilent	33220A	1438	Waveform Generator	15 Dec 2008	15 Dec 2009

Correction factors and cable loss factors were entered into the appropriate test equipment. As a result, the data taken accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected measurement result.

2.1.1.3 Test Setup

The EUT was tested as a “Table-Top” type product, as described in TIA-603-C. The EUT was placed on a non-conductive table, 80 cm above the reference ground plane, inside an RF shielded Chamber located at Ingenium Testing. The AC power supply of 120V, 60 Hz was provided to the EUT via appropriate broadband EMI Filters. The EUT (power amplifier) was connected to the Exciter source, as would be in normal use, using a short length of coaxial cable. The output of the EUT was connected to a directional coupler, and to a 50 ohm coaxial terminating load. The spectrum analyzer was connected to the directional coupler, at the forward power tap. An attenuator was installed in the RF path between the forward tap and the spectrum analyzer, to protect the test instruments. The EUT was exercised under standard operating conditions, as defined in section 1.2.3.1. of this report. The amplifier was exercised with the Exciter for this series of tests.

Figure 7: The EUT setup during RF Output Power Measurements.

2.1.1.4 Test Procedure

The amplifier RF output was connected through a directional coupler, to a 50 ohm coaxial load. The Forward Power tap on the directional coupler was then connected to a series attenuator and to the Spectrum Analyzer as the measuring instrument.

The RF Output Power of the fundamental frequency was investigated at the lowest and highest channels, using the source (Exciter), coupled through the amplifier. Measurements were made at the output of the amplifier (EUT). This test was repeated four times, on combinations of low and high channels, at low and high power.

The loss factors from the directional coupler, cables and the attenuator were added as correction settings directly on the analyzer, thereby allowing direct measurements, without the need for any further corrections. The Output Power of the fundamental frequency was measured with the Spectrum Analyzer using a 'Peak Detector' function, with 300 kHz RBW and VBW of 8 MHz. The Amplifier (EUT) was configured to run in normal operating mode, and presented with a nominal 1 Watt CW RF signal source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the charts that follow. The test was then repeated with the Exciter providing a modulated RF source, using typical data as would be in normal operation. The emission limits, as set forth by FCC Title 47 CFR, Part §2.1046, §90.205(c) and §90.210(c) for products qualifying as licensed transmitters were applied.

2.1.1.5 Test Results

The EUT was found to **MEET** the requirements as set forth by FCC Title 47 CFR, Part §2.1046, §90.205(c) and §90.210(c) for products qualifying as licensed transmitters

	RF Output Power	
72.02 MHz, 5W	36.74 (dBm)	4.72 (Watt)
75.98 MHz, 5W	36.24 (dBm)	4.21 (Watt)
72.02 MHz, 50W	46.91 (dBm)	49.09 (Watt)
75.98 MHz, 50W	46.43 (dBm)	43.95 (Watt)

Table 9: RF Output Power results

72.02 MHz (5W)

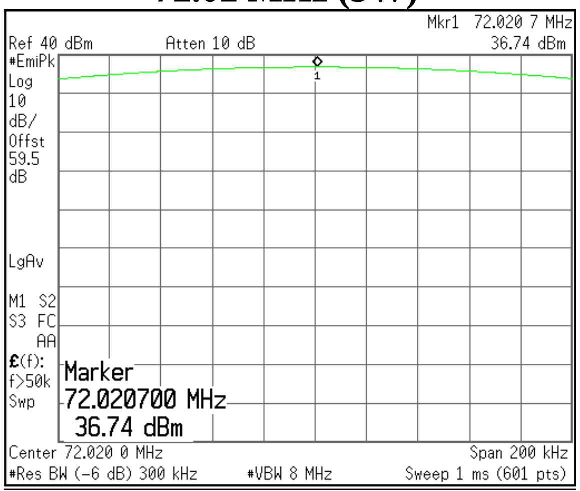


Figure 8: RF Output Power, 72.02 MHz, 5W

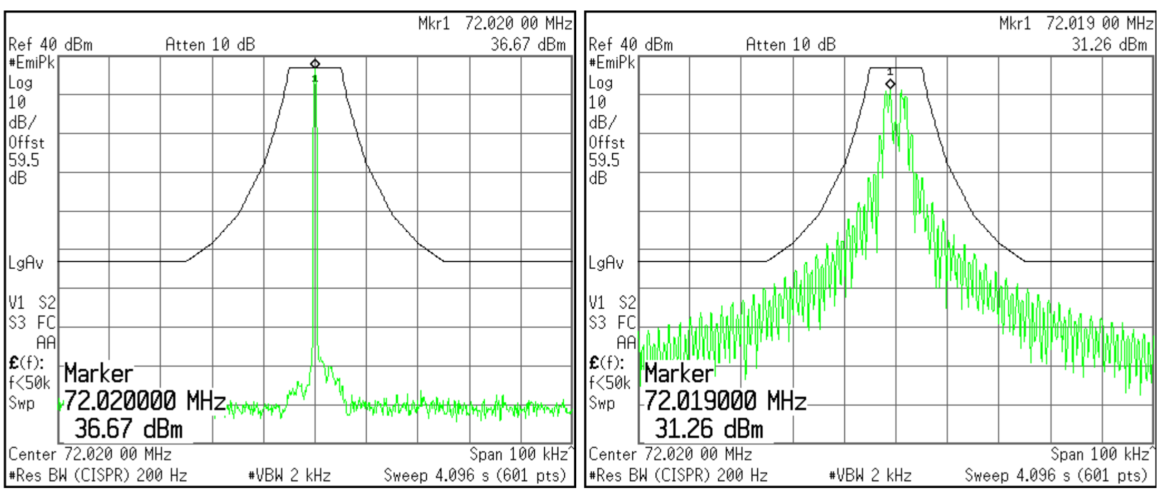


Figure 9: RF Output Power and Emission Mask, 72.02 MHz, 5W

75.98 MHz (5W)

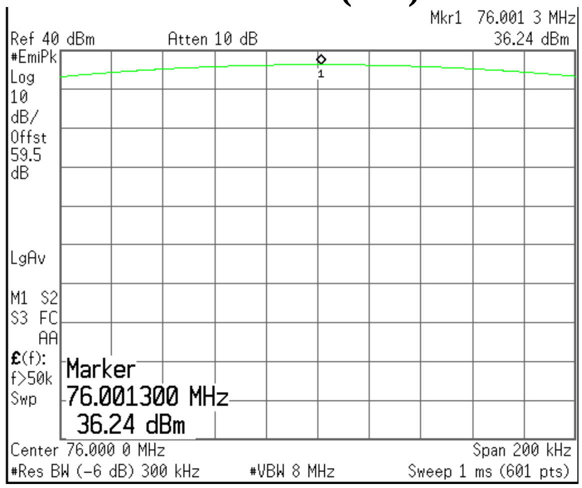


Figure 10: RF Output Power, 75.98 MHz, 5W

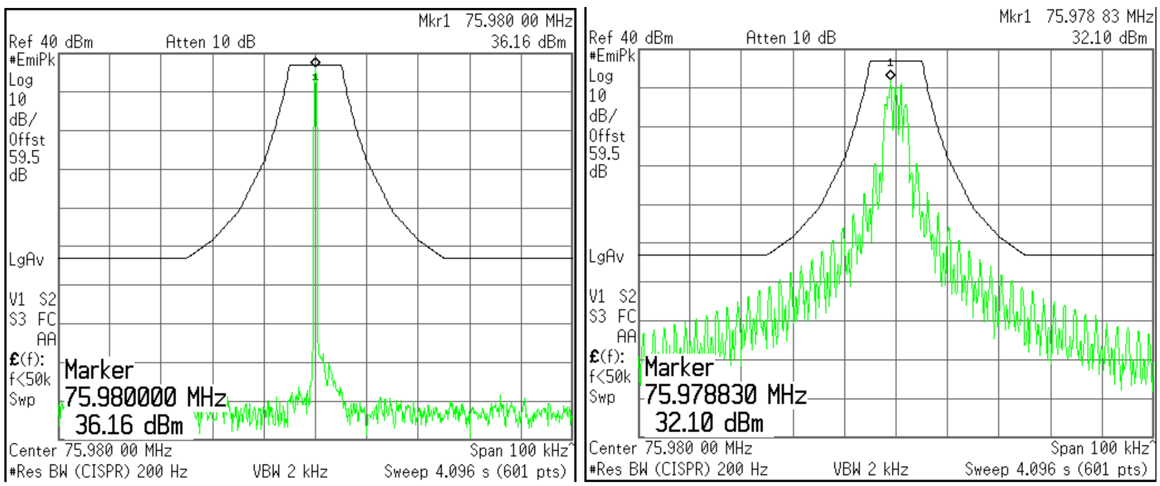


Figure 11: RF Output Power and Emission Mask, 75.98 MHz, 5W

72.02 MHz (50W)

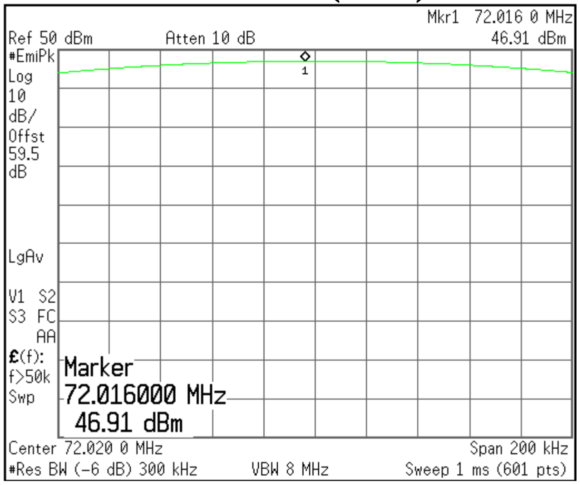
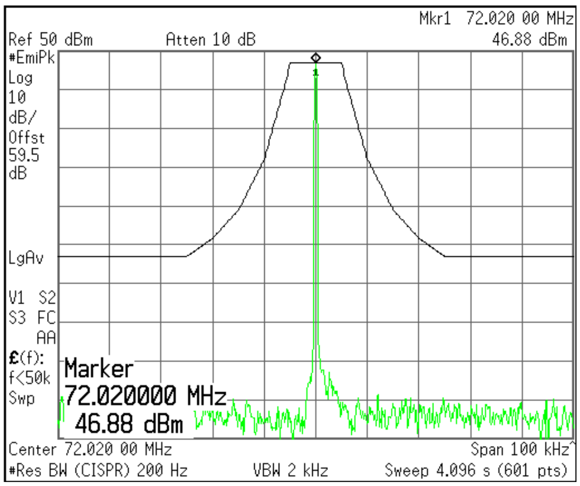


Figure 12: RF Output Power, 72.02 MHz, 50W



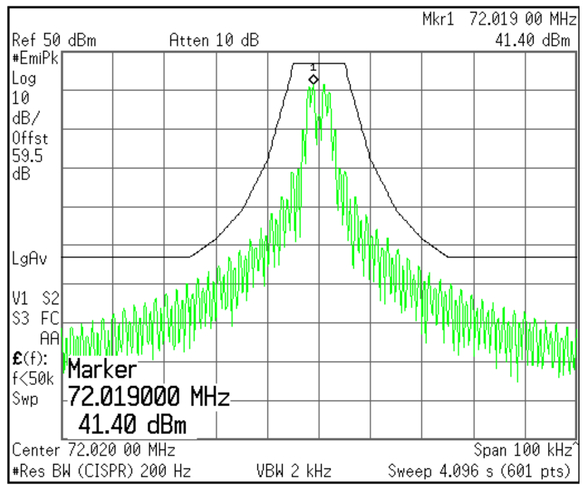


Figure 13: RF Output Power and Emission Mask, 72.02 MHz, 50W

75.98 MHz (50W)

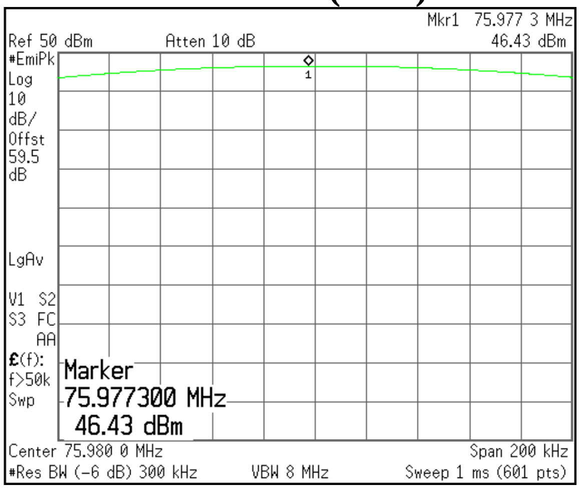


Figure 14: RF Output Power, 75.98 MHz, 50W

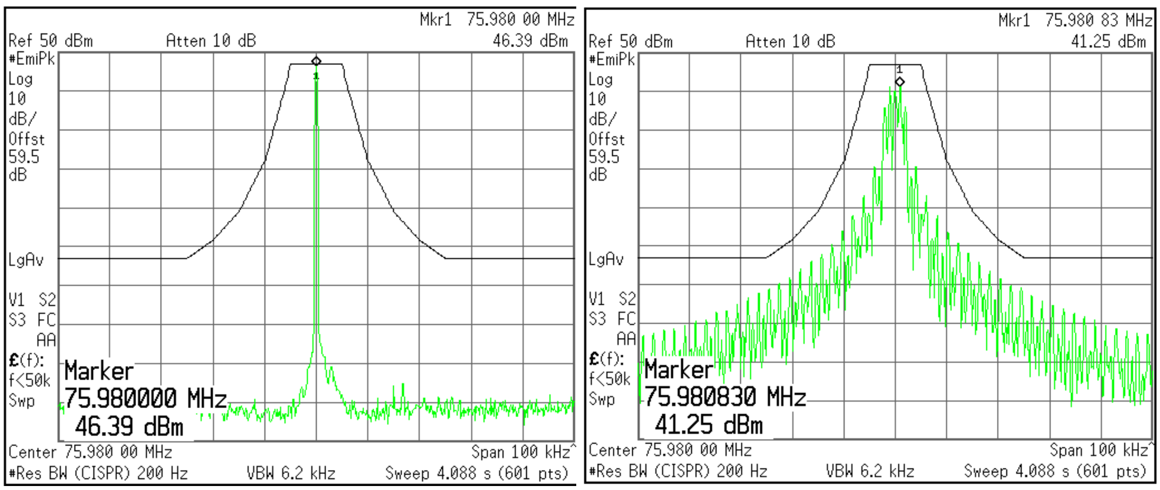


Figure 15: RF Output Power and Emission Mask, 75.98 MHz, 50W

2.1.2 Conducted RF Performance Parameters – Occupied Bandwidth Measurements

2.1.2.1 Test Criterion

This product is an amplifier. As such, the product does not contain a direct carrier frequency or modulation source generator, and hence does not have a modulation or Occupied Bandwidth characteristic. The Occupied Bandwidth characteristics may be requested at some point for filing and licensing requirements. The rationale in the test methodology and process, as chosen for these series of tests, are explained in the following paragraphs.

The test matrix in section 1.5 was used as a guide for test points and conditions.

Port Definition	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
RF Port	5 Watt Mode	Occupied Bandwidth 47 CFR 2.202(a) 47 CFR 90.209(b)(5)	OCCBW < 20 kHz	Pass
	50 Watt Mode	Occupied Bandwidth 47 CFR 2.202(a) 47 CFR 90.209(b)(5)	OCCBW < 20 kHz	Pass

Rationale and the limits:
Limits are imposed on the maximum bandwidth of operation, for a licensed transmitter of this category, as specified in the FCC Title 47 CFR, Part §2.202(a), §2.1049, §90.209(b)(5) and §90.213(a).to be **less than 20 kHz.** This product is not a transmitter, but will be used in conjunction with a transmitter. The challenge, then, is to demonstrate compliance with the 20 kHz bandwidth limitation, using a typical transmitter (the Exciter). The measured Occupied Bandwidth would then be from the transmitter, plus any distortion that may be caused by the amplifier. There are no limits on distortion for the amplifiers in this category. The frequency distortion limit is indirectly adopted from §90.213(a), to be less than 5 ppm.

Although this product is not a transmitter, the product was tested for occupied bandwidth, in the form of any added distortion that may be superimposed onto the signal between the RF input and output ports of the EUT. This test was accomplished by examining the Occupied Bandwidth of input signal, as presented by the Exciter as in normal use, and comparing it to the Occupied Bandwidth of the amplified output signal. The decision criteria would be a change is the occupied bandwidth, of more than 5 ppm, in the form of frequency distortion. The goal of the test was to demonstrate the amount of added distortion, and then to demonstrate that a typical transmitter would meet the 20 kHz Occupied Bandwidth limitation imposed for this category of transmitters.

Frequency (MHz)	§90.213(a) Limit Added Frequency Distortion (Hz)	§90.209(b)(5) Limit Total Occupied Bandwidth (kHz)
72.02	Less than 360 Hz	Less than 20 kHz
75.98	Less than 380 Hz	Less than 20 kHz

2.1.2.2 Test Equipment

All Ingenium Testing, LLC test and monitoring equipment/instrumentation is calibrated for Testing Laboratory requirements of ISO/IEC 17025:2005, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers. Calibration information was checked and recorded before each test in which the equipment was used.

List of Equipment Used:

Manufacturer	Model	Ingenium Asset Number	Description	Last Cal data	Cal due date
Agilent	E4440A	1207	PSA Spec. Analyzer	18 Dec 2008	18 Dec 2009
Agilent	N9039A	1206	Pre-Selector	23 Dec 2008	23 Dec 2009
Agilent	N5182	1208	RF Generator	18 Dec 2008	18 Dec 2009
Werlatone	C6047	0344	Directional Coupler	22 Jun 2009	22 Jun 2010

The data presented accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected measurement result.

2.1.2.3 Test Setup

The EUT was tested as a "Table-Top" type product, as described in TIA-603-C. The EUT was placed on a non-conductive table, 80 cm above the reference ground plane, inside an RF shielded Chamber located at Ingenium Testing. The AC power supply of 120V, 60 Hz was provided to the EUT via appropriate broadband EMI Filters. The EUT (power amplifier) was connected to the Exciter source, as would be in normal use, using a short length of coaxial cable. The output of the EUT was connected to a directional coupler, and to a 50 ohm coaxial terminating load. The spectrum analyzer was connected to the directional coupler, at the forward power tap. An attenuator was installed in the RF path between the forward tap and the spectrum analyzer, to protect the test instruments. The EUT was exercised under standard operating conditions, as defined in section 1.2.3.1. of this report. The amplifier was exercised with the Exciter for this series of tests.

Figure 16: The EUT setup during Occupied Bandwidth tests.

2.1.2.4 Test Procedure

The amplifier RF output was connected through a directional coupler, to a 50 ohm coaxial load. The Forward Power tap on the directional coupler was then connected to a series attenuator and to the Spectrum Analyzer as the measuring instrument.

The Occupied Bandwidth of the source (Exciter) was measured directly, and then measured again through the amplifier setup, as described above. The measured Occupied Bandwidth was compared between the Exciter output and the Amplifier (EUT) output. The expected variance was less than 5 ppm or approximately 360 Hz to 380 Hz, depending on the frequency channel under test. This test was repeated four times, on combinations of low and high channels, at low and high power.

The loss factors from the directional coupler, cables and the attenuator were added as correction settings directly on the analyzer, there by allowing direct measurements, without the need for any further corrections. The bandwidth of the fundamental frequency was measured with the Spectrum Analyzer using 200 Hz RBW and VBW of 2 kHz. The Amplifier (EUT) and the Exciter were configured to run in normal operating mode, and the Exciter was supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the charts that follow.

2.1.2.5 Test Results

The EUT was found to **MEET** the requirements of maximum Occupied Bandwidth of 20 kHz, as specified in the FCC Title 47 CFR, Part §2.1049 and §90.209(b)(5) suitable for use with a transmitter of this category. Supporting evidence of significant measured RF emissions, are tabulated and presented below.

Port Definition	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
RF Port	5 Watt Mode	Occupied Bandwidth 47 CFR 2.202(a) 47 CFR 90.209(b)(5)	OCCBW < 20 kHz	Pass
	50 Watt Mode	Occupied Bandwidth 47 CFR 2.202(a) 47 CFR 90.209(b)(5)	OCCBW < 20 kHz	Pass

CLIMATE TEST CONDITIONS

Temperature:	73 °F (22.8 °C)
Humidity:	48 % RH

Test	72.02 MHz -20 dB_c Occ.BW.	75.98 MHz -20 dB_c Occ.BW.
Exciter Output (1W)	6.7720 kHz	5.0673 kHz
Amplifier Output (5W)	6.6911 kHz	5.2693 kHz
Amplifier Output (50W)	6.7797 kHz	5.2114 kHz
Max. Excursion	88.6 Hz	202 Hz
5ppm Excursion test	< 360 Hz = Pass	< 380 Hz = Pass
Occ. BW < 20 kHz test	< 20 kHz = Pass	< 20 kHz = Pass

Additional data for documentation and filing purposes only:

Test	72.02 MHz -6 dB_c Occ.BW.	75.98 MHz -6 dB_c Occ.BW.
Amplifier Output (5W)	4.60 kHz	4.37 kHz
Amplifier Output (50W)	4.67 kHz	4.40 kHz
Occ. BW < 20 kHz test	< 20 kHz = Pass	< 20 kHz = Pass

Test	72.02 MHz -20 dB_c Occ.BW.	75.98 MHz -20 dB_c Occ.BW.
Amplifier Output (5W)	6.83 kHz	5.07 kHz
Amplifier Output (50W)	6.80 kHz	5.17 kHz
Occ. BW < 20 kHz test	< 20 kHz = Pass	< 20 kHz = Pass

Test	72.02 MHz -26 dB_c Occ.BW.	75.98 MHz -26 dB_c Occ.BW.
Amplifier Output (5W)	10.84 kHz	8.74 kHz
Amplifier Output (50W)	10.73 kHz	8.73 kHz
Occ. BW < 20 kHz test	< 20 kHz = Pass	< 20 kHz = Pass

72.02 MHz

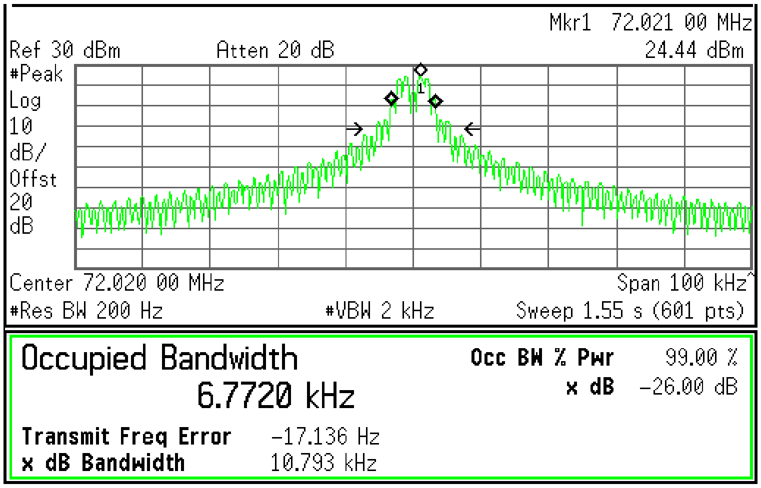


Figure 17: Exciter Occupied Bandwidth, 72.02 MHz

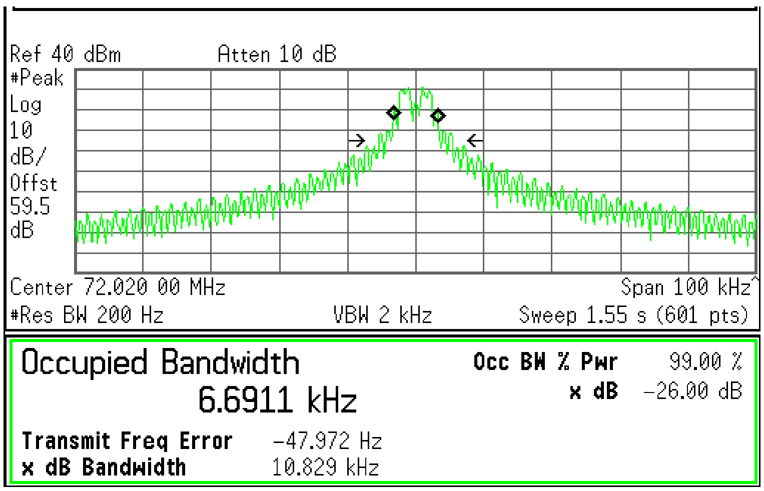


Figure 18: Amplifier Occupied Bandwidth, 72.02 MHz (5W)

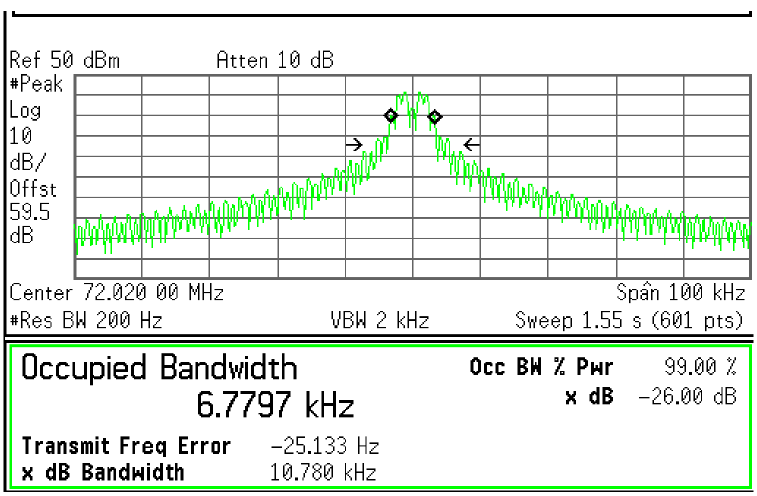


Figure 19: Amplifier Occupied Bandwidth, 72.02 MHz (50W)

75.98 MHz

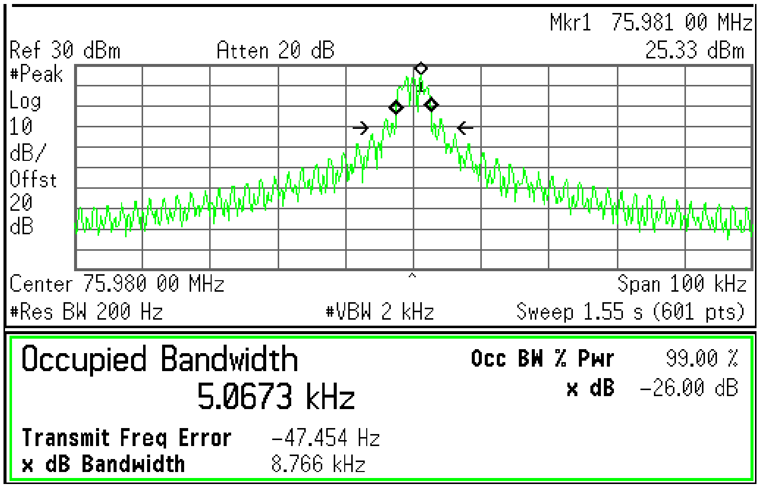


Figure 20: Exciter Occupied Bandwidth, 75.98 MHz

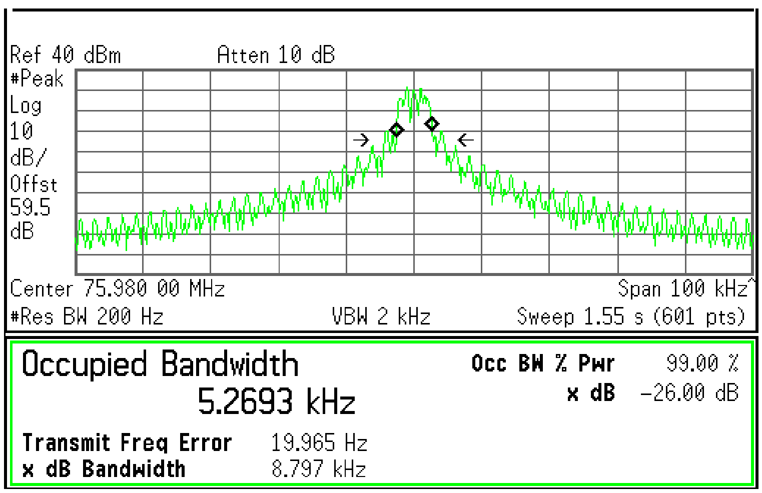


Figure 21: Amplifier Occupied Bandwidth, 75.98 MHz (5W)

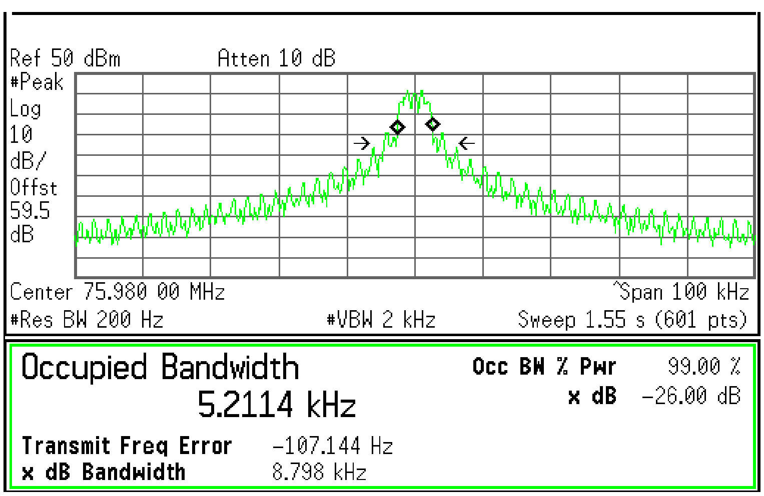


Figure 22: Amplifier Occupied Bandwidth, 75.98 MHz (50W)

72.02 MHz ~ Additional Information (5W) ~ 75.98 MHz

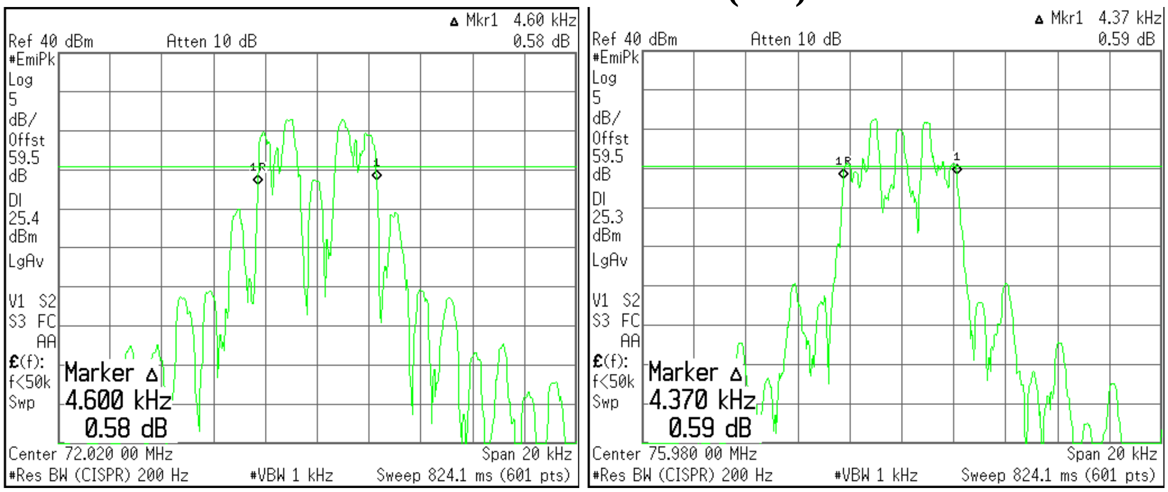


Figure 23: Amplifier (5W) Occupied Bandwidth, (-6 dBc)

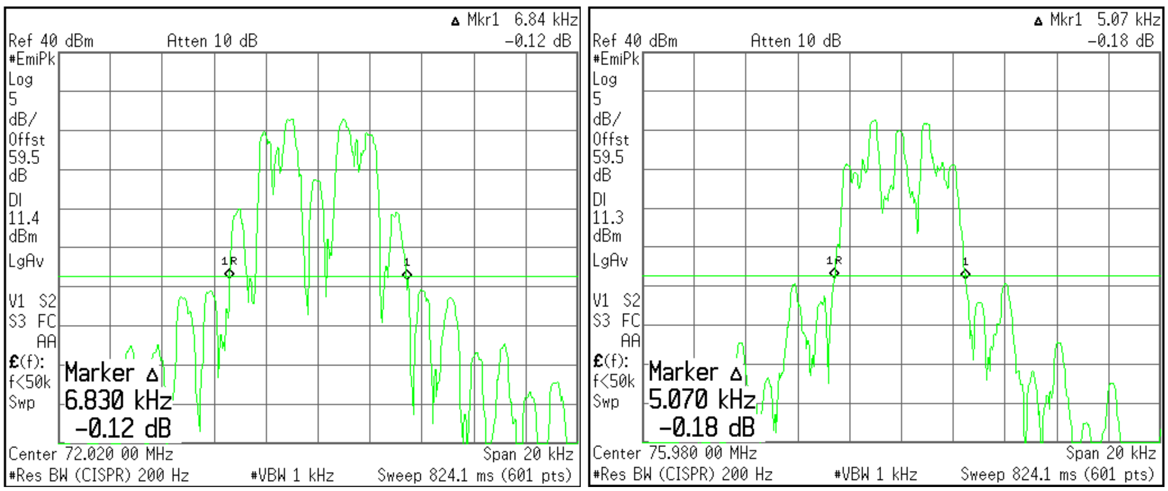


Figure 24: Amplifier (5W) Occupied Bandwidth, (-20 dBc)

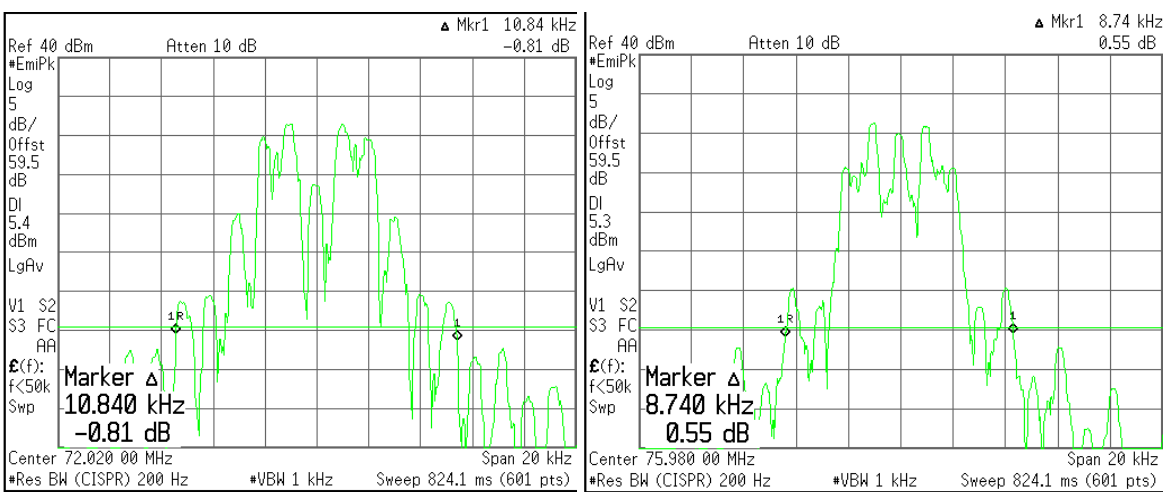


Figure 25: Amplifier (5W) Occupied Bandwidth, (-26 dBc)

72.02 MHz ~ Additional Information (50W) ~ 75.98 MHz

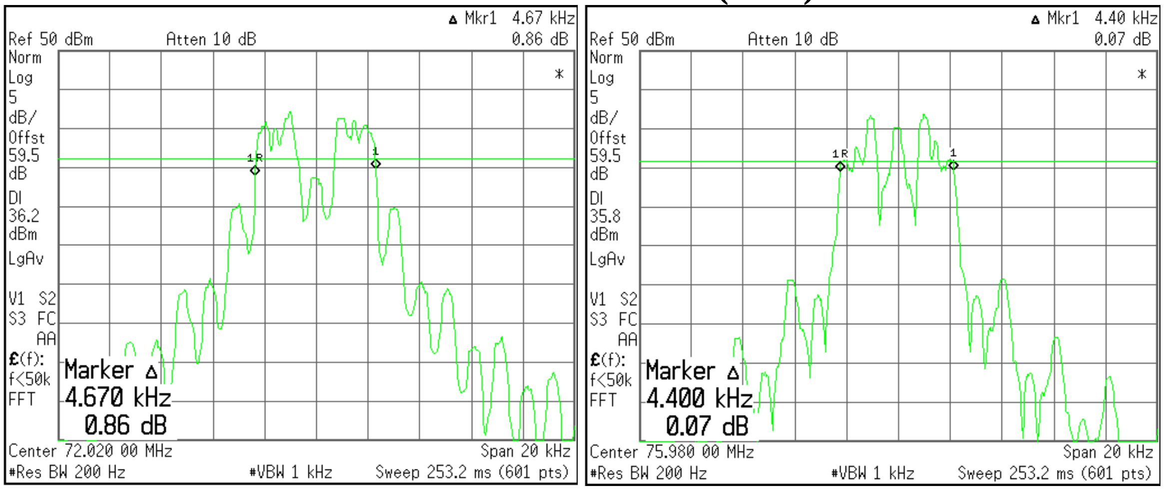


Figure 26: Amplifier (50W) Occupied Bandwidth, (-6 dBc)

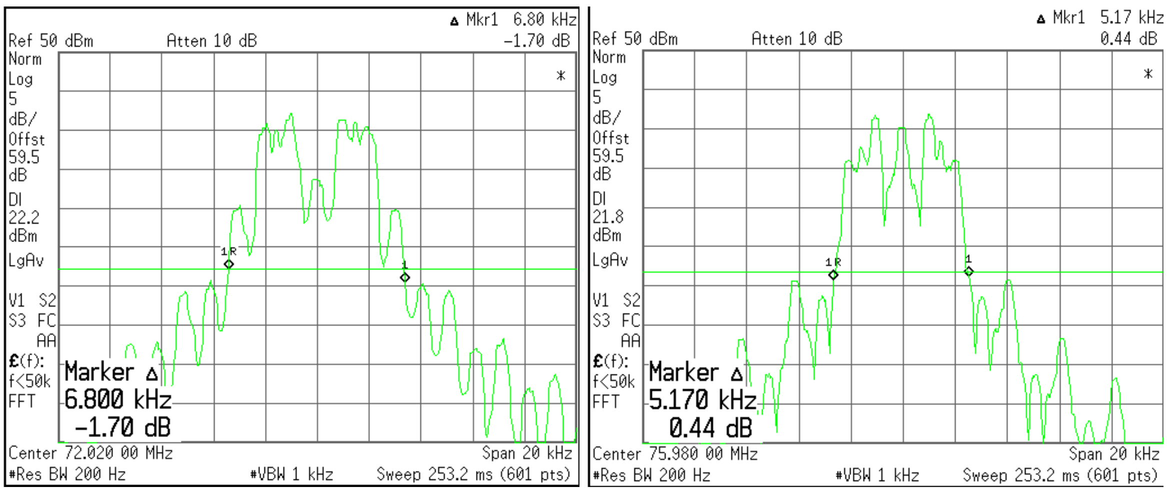


Figure 27: Amplifier (50W) Occupied Bandwidth, (-20 dBc)

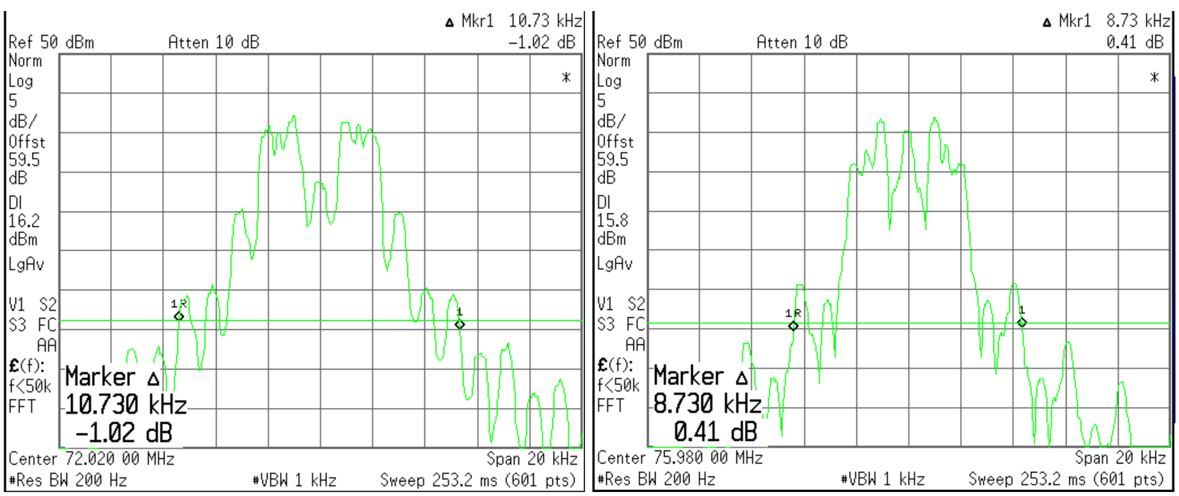


Figure 28: Amplifier (50W) Occupied Bandwidth, (-26 dBc)

Additional Information (50W)

The following information is provided as support evidence for future conformity assessments. The -20dBc bandwidth of the amplifier was determined based on the amplifier maximum output. The operation of the amplifier, however, is limited to only a very small portion of that range, as depicted in the following figure.

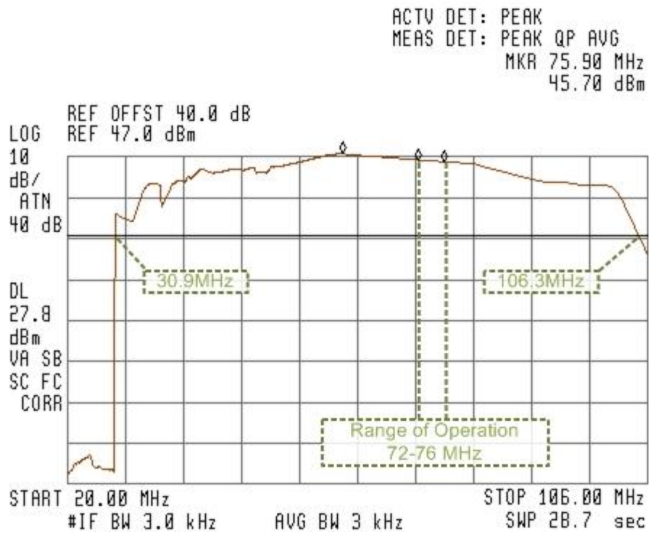


Figure 29: Amplifier (50W) Pass-band Gain and Bandwidth.

The gain flatness of the amplifier was measured to be approximately ±0.25 dB, compared to the manufacturer specification of ±1 dB, across the band of intended operation.

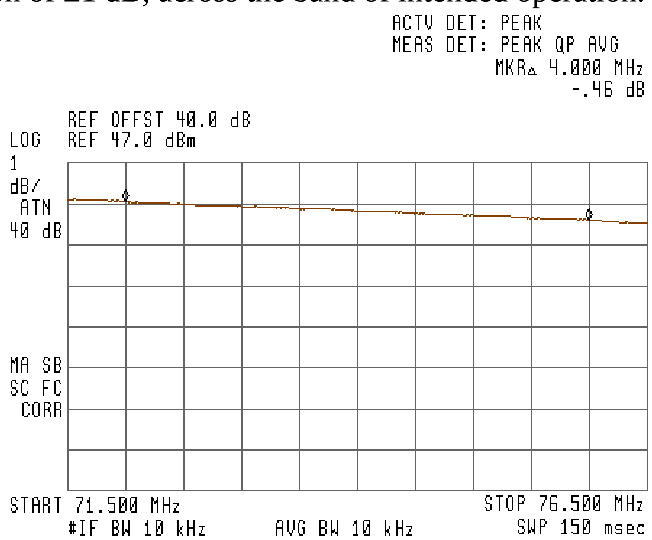


Figure 30: Amplifier (50W) Pass-band Gain Flatness

2.1.3 Conducted RF Performance Parameters – Band-Edge Measurements

2.1.3.1 Test Criterion

Although this device is an amplifier, it will serve during the operation of a transmitter, and is tested with a typical transmitter (Exciter) as a signal source. The characteristics measured, are then from a combination of the amplifier (EUT) and the source (Exciter).

The device shall have no emissions at the band-edges, outside of the 72-76 MHz band, above the limits set forth by FCC Title 47 CFR, Part §90.210(c) for products qualifying as licensed transmitters. Although this device is an amplifier, it will serve during the operation of a transmitter, and is tested with a typical transmitter (Exciter) as a signal source.

The following ports should be tested for compliance according to the test matrix:

Port Definition	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
RF Port	5 Watt Mode	Band-Edge 47 CFR 90.210	Spurious Pout <-13dBm < 71.7dBuV/m@10m	Pass
	50 Watt Mode	Band-Edge 47 CFR 90.210	Spurious Pout <-13dBm < 71.7dBuV/m@10m	Pass

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P), in Watts, by a factor, in dB, of at least { 43 + 10 Log (P) }.

For a 5 Watt (37dBm) transmitter, the spurious emission limit would be calculated as follows:

$$37\ (\text{dBm}) - (43 + 10\ \text{Log}\ (5\text{W})\ ) = -13\ (\text{dBm})$$

For a 50 Watt (47dBm) transmitter, the spurious emission limit would be calculated as follows:

$$47\ (\text{dBm}) - (43 + 10\ \text{Log}\ (50\text{W})\ ) = -13\ (\text{dBm})$$

2.1.3.2 Test Equipment

All Ingenium Testing, LLC test and monitoring equipment/instrumentation is calibrated for Testing Laboratory requirements of ISO/IEC 17025:2005, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers. Calibration information was checked and recorded before each test in which the equipment was used.

List of Equipment Used:

Manufacturer	Model	Ingenium Asset #	Description	Last Cal date	Cal due date
Agilent	E4440A	1207	PSA Spec. Analyzer	18 Dec 2008	18 Dec 2009
Agilent	N9039A	1206	Pre-Selector	23 Dec 2008	23 Dec 2009
Agilent	N5182	1208	RF Generator	18 Dec 2008	18 Dec 2009
Werlatone	C6047	0344	Directional Coupler	22 Jun 2009	22 Jun 2010
Agilent	E4404B	RP-0077	ESA Spec. Analyzer	29 Jun 2009	29 Jun 2010

The data presented accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected measurement result.

2.1.3.3 Test Setup

The EUT was tested as a “Table-Top” type product, as described in TIA-603-C. The EUT was placed on a non-conductive table, 80 cm above the reference ground plane, inside an RF shielded Chamber located at Ingenium Testing. The AC power supply of 120V, 60 Hz was provided to the EUT via appropriate broadband EMI Filters. The EUT (power amplifier) was connected to the Exciter source, as would be in normal use, using a short length of coaxial cable. The output of the EUT was connected to a directional coupler, and to a 50 ohm coaxial terminating load. The spectrum analyzer was connected to the directional coupler, at the forward power tap. The EUT was exercised under standard operating conditions, as defined in section 1.2.3.1. of this report. The amplifier was exercised with the Exciter for this series of tests.

Figure 31: The EUT setup during Band-Edge Measurements.

2.1.3.4 Test Procedure

The amplifier RF output was connected through a directional coupler, to a 50 ohm coaxial load. The Forward Power tap on the directional coupler was then connected to the Spectrum Analyzer as the measuring instrument.

The spurious emissions at the Band-Edges were investigated at the lowest and highest channels, using the source (Exciter) coupled through the amplifier, and measured at the output of the amplifier (EUT). This test was repeated four times, on combinations of low and high channels, at low and high power.

The loss factors from the directional coupler, cables and the attenuator were added as correction settings directly on the analyzer, thereby allowing direct measurements, without the need for any further corrections. The Amplifier (EUT) and the Exciter were configured to run in normal operating mode, and the Exciter was supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the charts that follow. The emission limits, as set forth by FCC Title 47 CFR, Part §90.210(c) were applied.

2.1.3.5 Test Results

As the supporting evidence demonstrates, the emissions at the band-edges are well behaved, using the same source type that would typically be used with this amplifier (EUT).

72.02 MHz (5W)

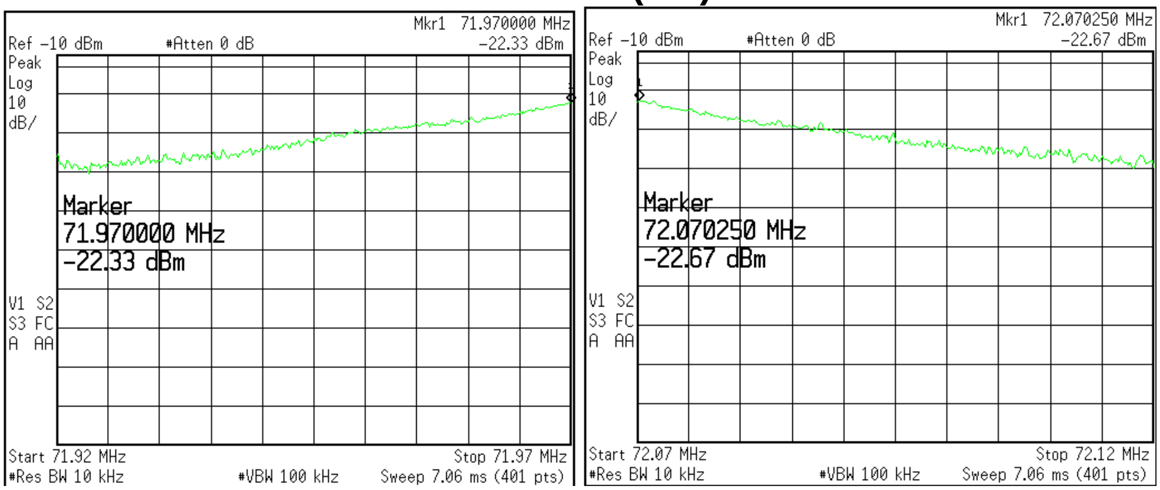


Figure 32: Band-Edge investigations, 72.02 MHz, 5W.

75.98 MHz (5W)

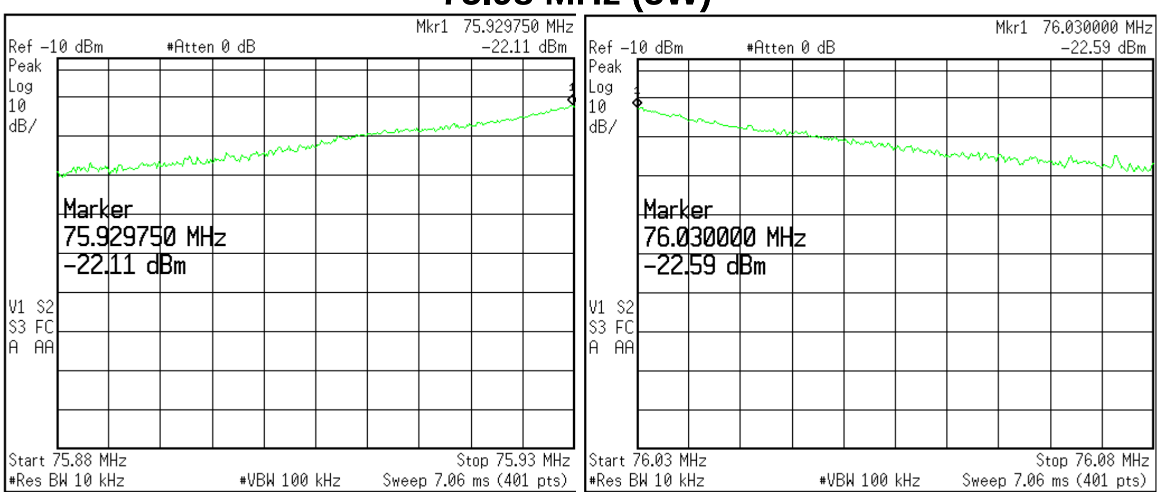


Figure 33: Band-Edge investigations, 75.98 MHz, 5 W.

72.02 MHz (50W)

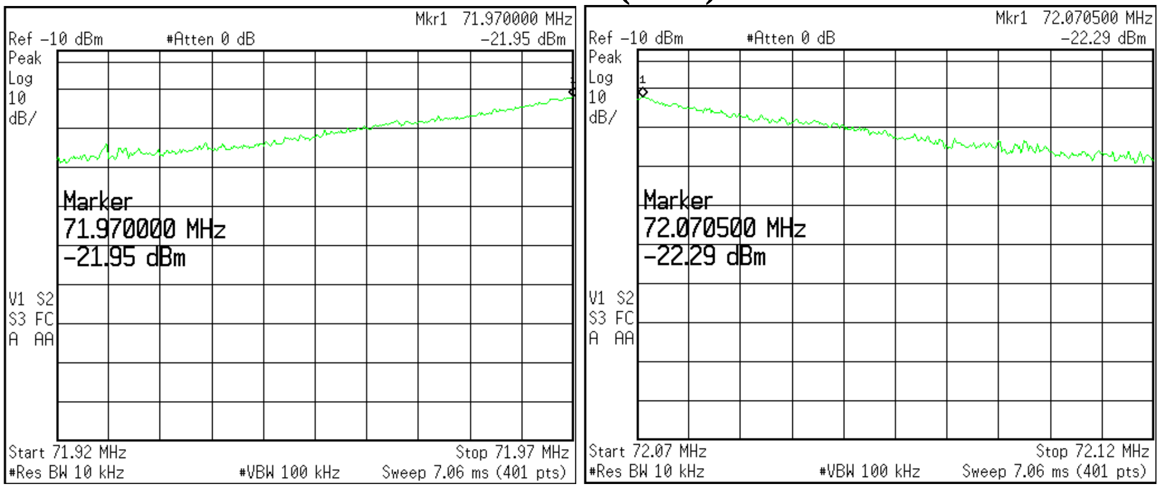


Figure 34: Band-Edge investigations, 72.02 MHz, 50W.

75.98 MHz (50W)

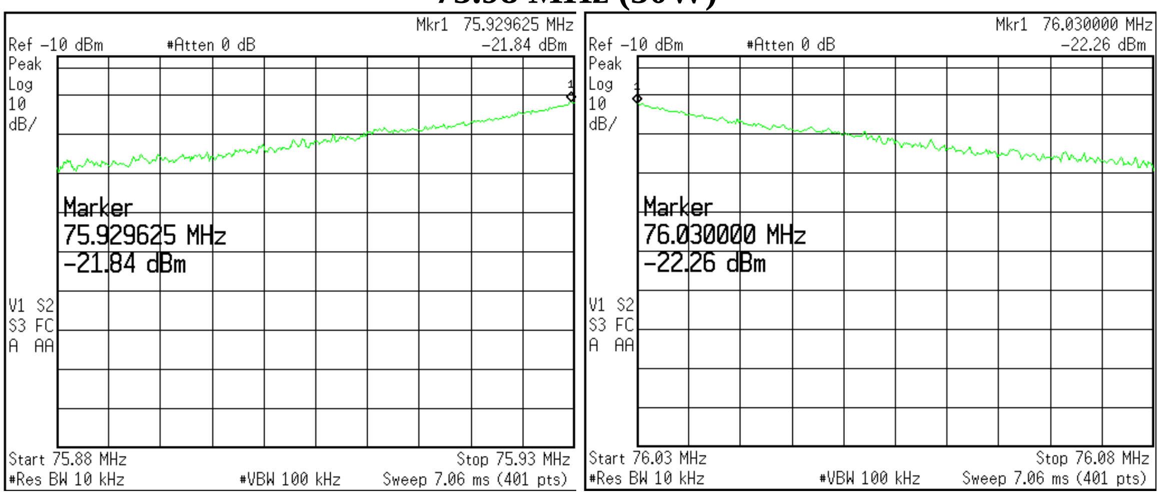


Figure 35: Band-Edge investigations, 75.98 MHz, 50 W.

2.1.4 Conducted RF Performance Parameters – Spurious RF Emission Measurements

2.1.4.1 Test Criterion

Although this device is an amplifier, it will serve during the operation of a transmitter, and is tested with a typical transmitter (Exciter) as a signal source. The characteristics measured, are then from a combination of the amplifier (EUT) and the source (Exciter).

The device shall have no emissions at the band-edges, outside of the 72-76 MHz band, above the limits set forth by FCC Title 47 CFR, Part §90.210(c) for products qualifying as licensed transmitters. Although this device is an amplifier, it will serve during the operation of a transmitter, and is tested with a typical transmitter (Exciter) as a signal source.

The following ports should be tested for compliance according to the test matrix:

Port Definition	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
RF Port	5 Watt Mode	Conducted Spurious Output Power 47 CFR 90.210	Conducted Spurious Pout <-13dBm	Pass
	50 Watt Mode	Conducted Spurious Output Power 47 CFR 90.210	Conducted Spurious Pout <-13dBm	Pass

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P), in Watts, by a factor, in dB, of at least { 43 + 10 Log (P) }.

For a 5 Watt (37dBm) transmitter, the spurious emission limit would be calculated as follows:

$$37 \text{ (dBm)} – (43 + 10 \text{ Log } (5W)) = -13 \text{ (dBm)}$$

For a 50 Watt (47dBm) transmitter, the spurious emission limit would be calculated as follows:

$$47 \text{ (dBm)} – (43 + 10 \text{ Log } (50W)) = -13 \text{ (dBm)}$$

2.1.4.2 Test Equipment

All Ingenium Testing, LLC test and monitoring equipment/instrumentation is calibrated for Testing Laboratory requirements of ISO/IEC 17025:2005, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers. Calibration information was checked and recorded before each test in which the equipment was used.

List of Equipment Used:

Manufacturer	Model	Ingenium Asset #	Description	Last Cal date	Cal due date
Agilent	E4440A	1207	PSA Spec. Analyzer	18 Dec 2008	18 Dec 2009
Agilent	N9039A	1206	Pre-Selector	23 Dec 2008	23 Dec 2009
Agilent	N5182	1208	RF Generator	18 Dec 2008	18 Dec 2009
Werlatone	C6047	0344	Directional Coupler	22 Jun 2009	22 Jun 2010
Werlatone	C3908	0342	Directional Coupler	23 Jun 2009	23 Jun 2010

The data presented accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected measurement result.

2.1.4.3 Test Setup

The EUT was tested as a "Table-Top" type product, as described in TIA-603-C. The EUT was placed on a non-conductive table, 80 cm above the reference ground plane, inside an RF shielded Chamber located at Ingenium Testing. The AC power supply of 120V, 60 Hz was provided to the EUT via appropriate broadband EMI Filters. The EUT (power amplifier) was connected to the Exciter source, as would be in normal use, using a short length of coaxial cable. The output of the EUT was connected to a directional coupler, and to a 50 ohm coaxial terminating load. The spectrum analyzer was connected to the directional coupler, at the forward power tap. The EUT was exercised under standard operating conditions, as defined in section 1.2.3.1. of this report. The amplifier was exercised with the Exciter for this series of tests.

Figure 36: The EUT setup during Spurious RF Emissions Measurements.

2.1.4.4 Test Procedure

The amplifier RF output was connected through a directional coupler, to a 50 ohm coaxial load. The Forward Power tap on the directional coupler was then connected to a series attenuator and to the Spectrum Analyzer as the measuring instrument.

The spurious emissions at the Band-Edges were investigated at the lowest and highest channels, using the source (Exciter) coupled through the amplifier, and measured at the output of the amplifier (EUT). This test was repeated four times, on combinations of low and high channels, at low and high power.

The loss factors from the directional coupler, cables and the attenuator were added as correction settings directly on the analyzer, thereby allowing direct measurements, without the need for any further corrections. For this test, the bandwidth of the fundamental frequency was measured with the Spectrum Analyzer using 100 kHz RBW and VBW of 1 MHz. The Amplifier (EUT) and the Exciter were configured to run in normal operating mode, and the Exciter was supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the charts that follow. The emission limits, as set forth by FCC Title 47 CFR, Part §90.210(c) were applied.

2.1.4.5 Test Results

As the supporting evidence demonstrates, the spurious RF emissions are well behaved, using the same source type that would typically be used with this amplifier (EUT). No significant spurious or harmonic emissions could be noted greater than -30 dBm for this product.

CLIMATE TEST CONDITIONS

Temperature:	73 ^{o}F (22.8 ^{o}C)
Humidity:	48 % RH

	72.02 MHz, 5W	75.98 MHz, 5W	72.02 MHz, 50W	75.98 MHz, 50W
Fundamental	+ 36.7 (dBm)	+ 36.1 (dBm)	+ 46.9 (dBm)	+ 46.4 (dBm)
2nd Harmonic	- 45.8 (dBm)	- 45.3 (dBm)	- 33.9 (dBm)	- 40.4 (dBm)
3rd Harmonic	- 46.4 (dBm)	- 45.2 (dBm)	- 43.1 (dBm)	- 43.6 (dBm)
4th Harmonic	Note (1)	Note (1)	- 38.3 (dBm)	- 42.4 (dBm)
5th Harmonic	Note (1)	Note (1)	Note (1)	Note (1)
6th Harmonic	Note (1)	Note (1)	Note (1)	Note (1)
7th Harmonic	Note (1)	Note (1)	Note (1)	Note (1)
8th Harmonic	Note (1)	Note (1)	Note (1)	Note (1)
9th Harmonic	Note (1)	Note (1)	Note (1)	Note (1)
10th Harmonic	Note (1)	Note (1)	Note (1)	Note (1)

Notes:
(1) Measurement at system noise floor.

72.02 MHz (5W)

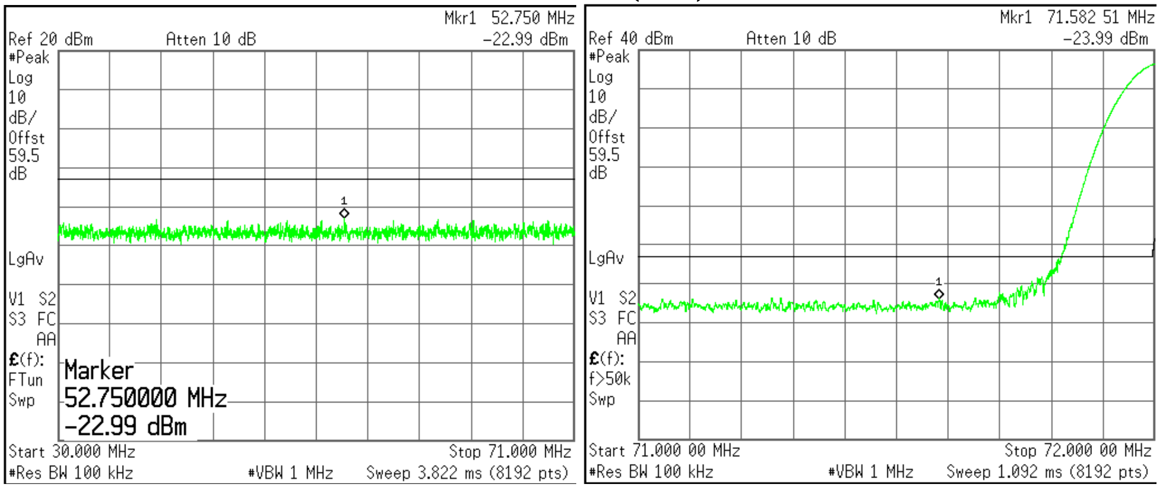


Figure 37: Spurious RF Emissions, 72.02 MHz, 5W, investigation range 30 MHz- to 72 MHz.

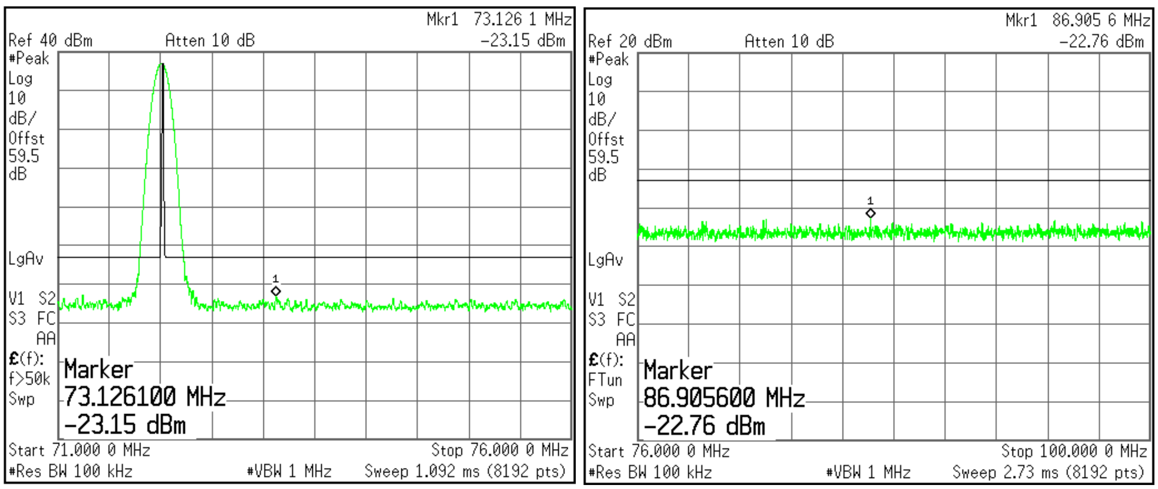


Figure 38: Spurious RF Emissions, 72.02 MHz, 5W, investigation range 71 MHz- to 100 MHz.

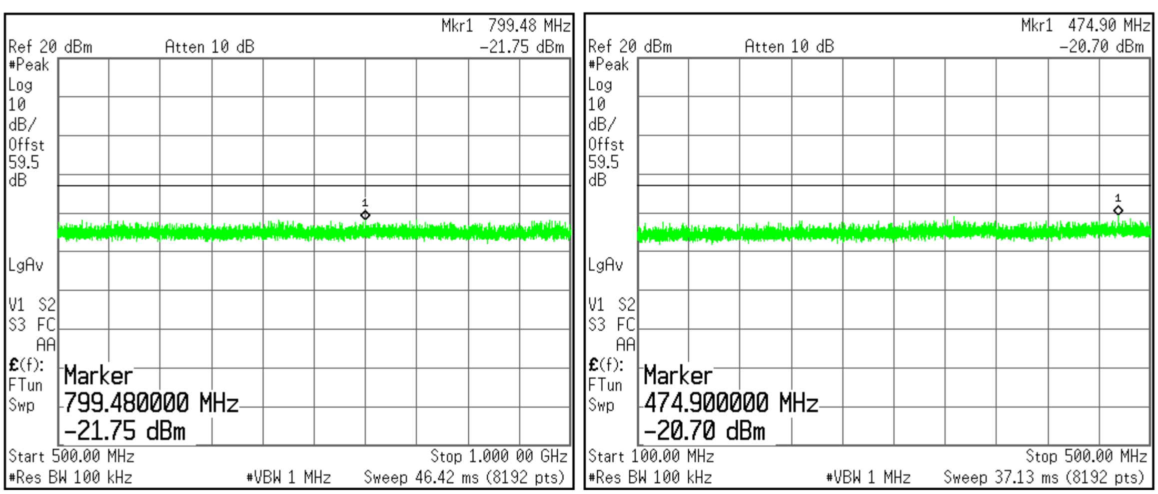


Figure 39: Spurious RF Emissions, 72.02 MHz, 5W, investigation range 100 MHz- to 1000 MHz.

75.98 MHz (5W)

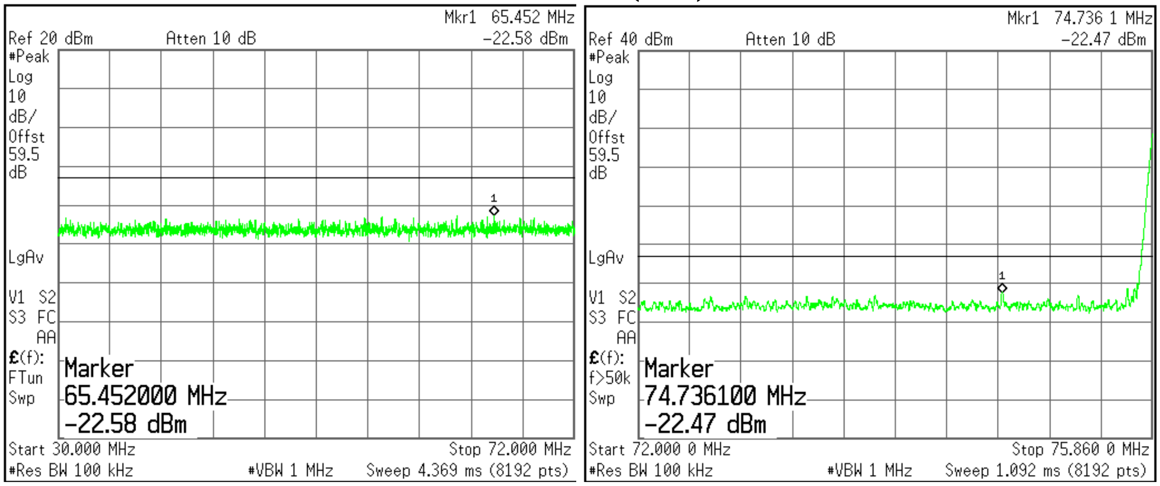


Figure 40: Spurious RF Emissions, 75.98 MHz, 5W, investigation range 30 MHz- to 72 MHz.

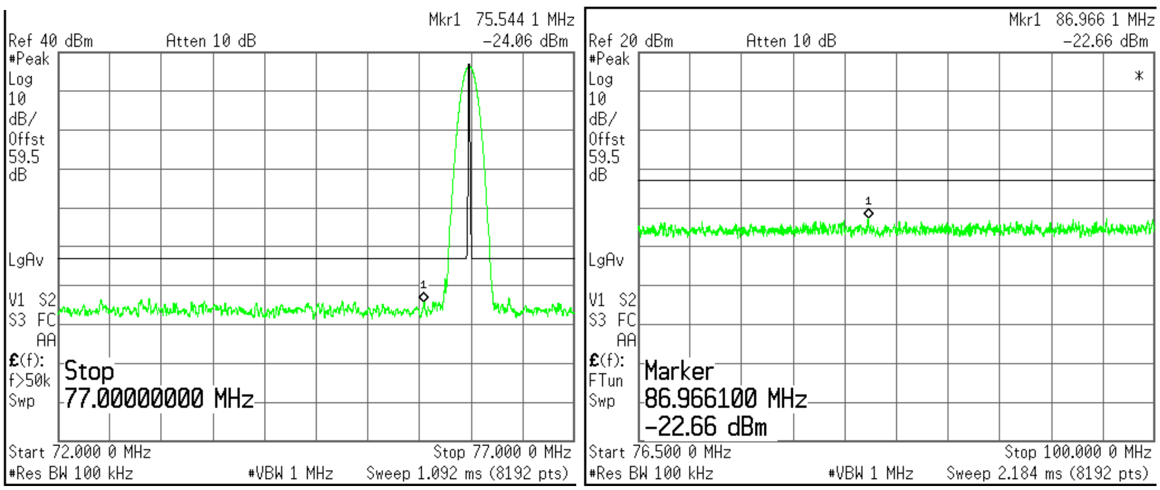


Figure 41: Spurious RF Emissions, 75.98 MHz, 5W, investigation range 72 MHz- to 100 MHz.

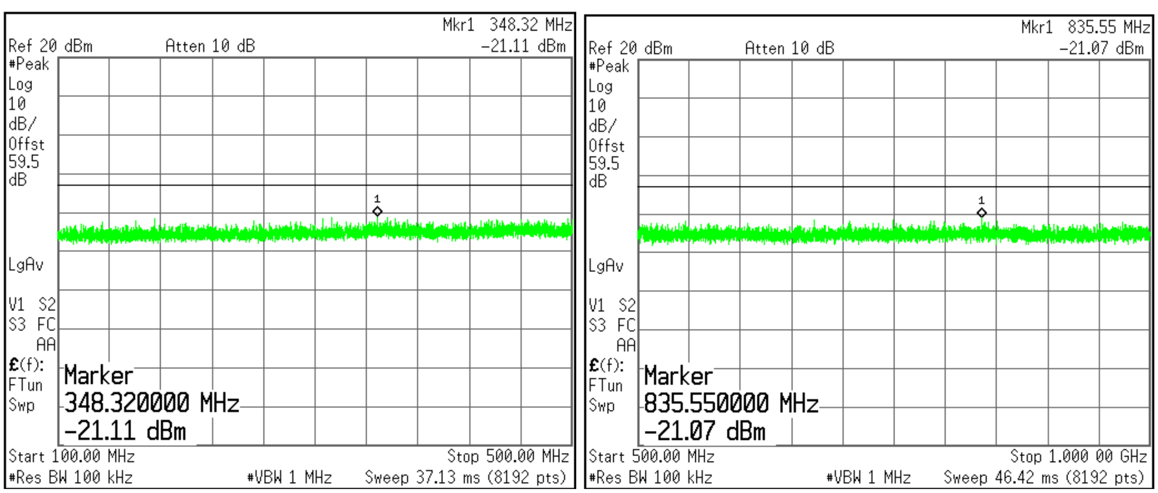


Figure 42: Spurious RF Emissions, 75.98 MHz, 5W, investigation range 100 MHz- to 1000 MHz.

72.02 MHz (50W)

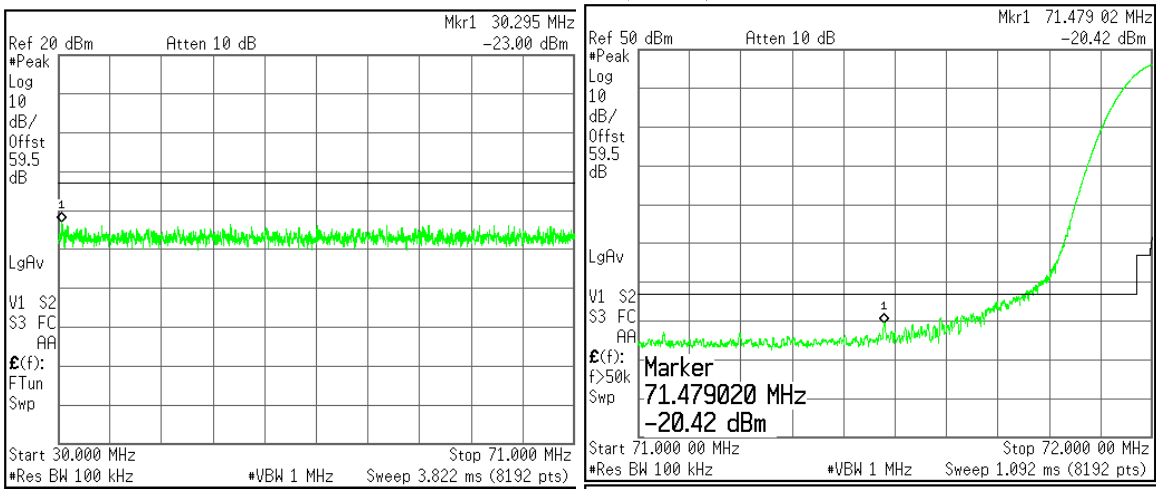


Figure 43: Spurious RF Emissions, 72.02 MHz, 50W, investigation range 30 MHz- to 72 MHz.

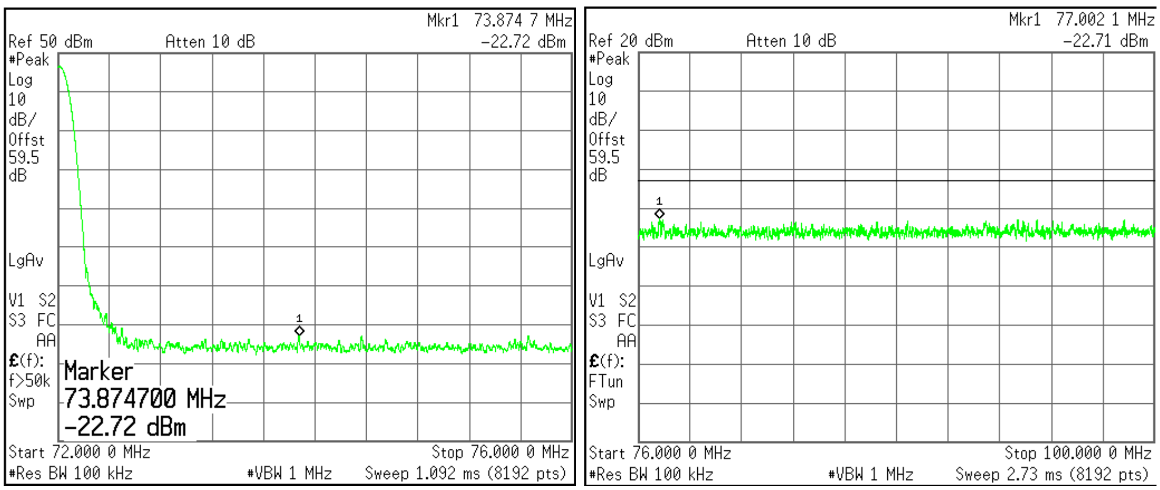


Figure 44: Spurious RF Emissions, 72.02 MHz, 50W, investigation range 72 MHz- to 100 MHz.

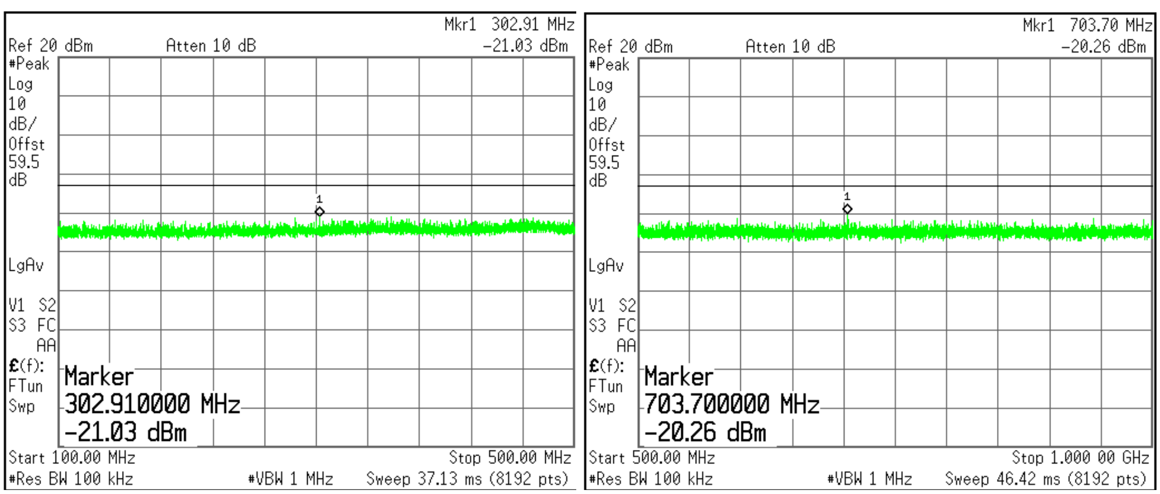


Figure 45: Spurious RF Emissions, 72.02 MHz, 50W, investigation range 100 MHz- to 1000 MHz.

75.98 MHz (50W)

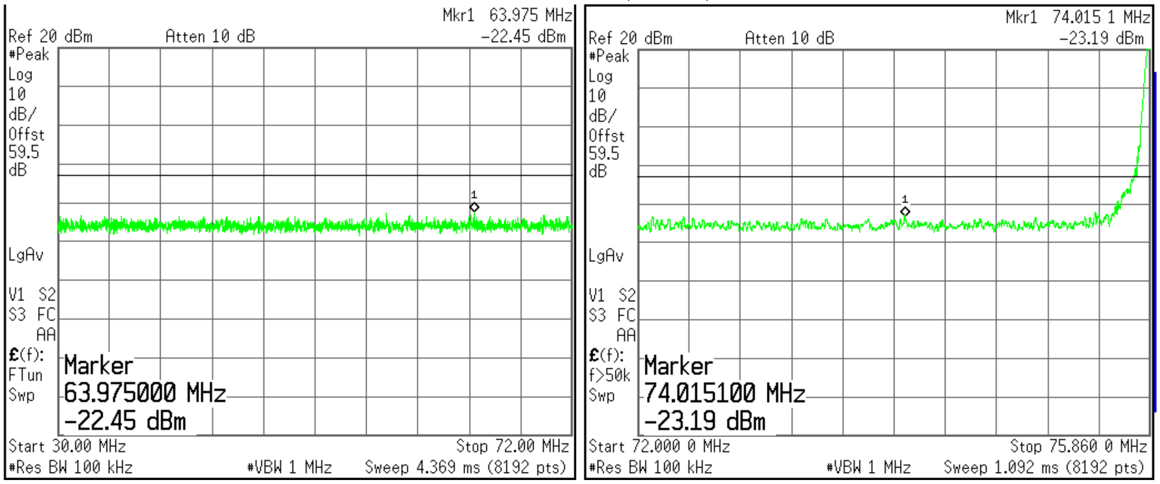


Figure 46: Spurious RF Emissions, 75.98 MHz, 50W, investigation range 30 MHz- to 75.8 MHz.

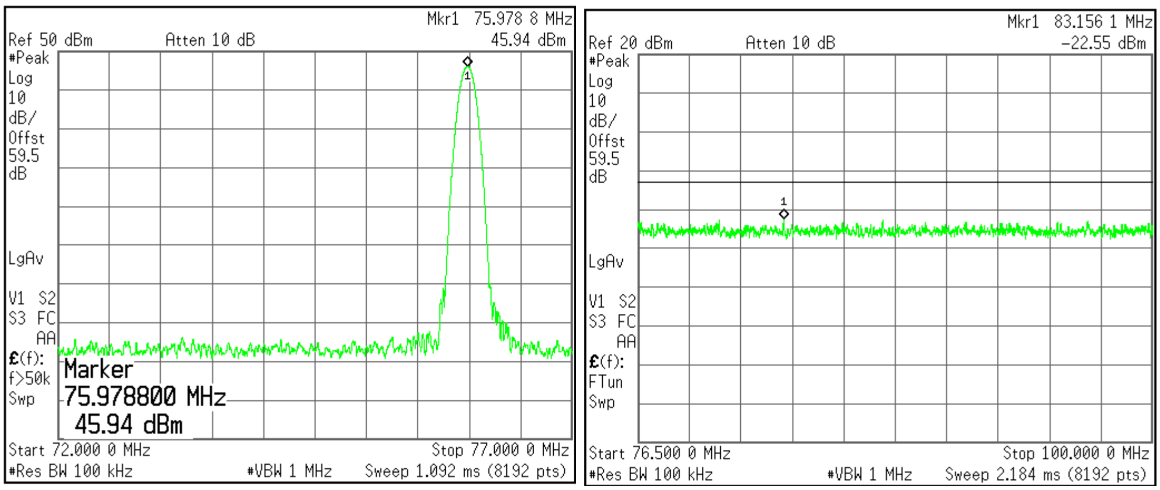


Figure 47: Spurious RF Emissions, 75.98 MHz, 50W, investigation range 72 MHz- to 100 MHz.

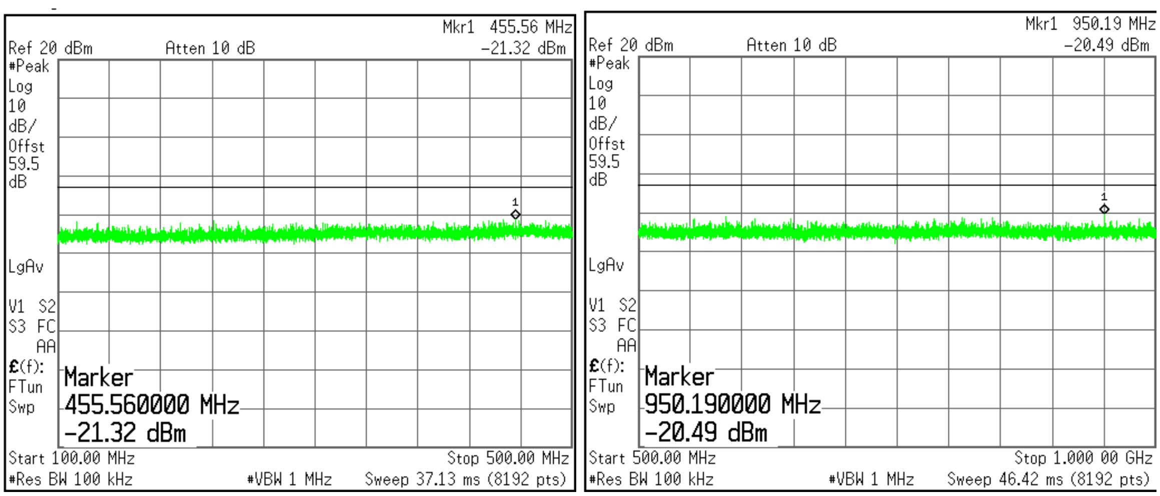


Figure 48: Spurious RF Emissions, 75.98 MHz, 50W, investigation range 100 MHz- to 1000 MHz.

2.1.5 Conducted RF Performance Parameters – Carrier Frequency and RF Power Stability Measurements (Voltage Variation)

2.1.5.1 Test Criterion

The information provided in this section is a service to the client for use in future qualifications. Although this device is an amplifier, it will serve during the operation of a transmitter, and is tested with a typical transmitter (Exciter) as a signal source. The characteristics measured, are then from a combination of the amplifier (EUT) and the source (Exciter).

The following ports should be tested for compliance according to the test matrix:

Port Definition	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
AC Power	5 Watt Mode	Frequency Stability 47CFR 2.1055(d)(1) 47CFR 90.213(a)	Freq. Excursion < 5 ppm 85% of V_{NOM} 115% of V_{NOM} Criterion B	Pass
	50 Watt Mode	Frequency Stability 47CFR 2.1055(d)(1) 47CFR 90.213(a)	Freq. Excursion < 5 ppm 85% of V_{NOM} 115% of V_{NOM} Criterion B	Pass

The following are general performance definitions, as described in 47 CFR 90.213 (a) and 47 CFR 2.1055 (d)(1):

- Frequency excursions due to susceptibility testing should be less than ± 5 ppm from the nominal center frequency.
  - (Nominal at 72.0 MHz; Acceptable Excursion during test: ± 360 Hz from nominal)
  - (Nominal at 76.0 MHz; Acceptable Excursion during test: ± 380 Hz from nominal)
- Output power excursions due to susceptibility testing should be less than ± 1 dB from nominal output power.
  - Nominal at 5 Watt (+37 dBm); Acceptable Excursion during test: ± 1 dBm from nominal.
  - Nominal at 50 Watt (+47 dBm); Acceptable Excursion during test: ± 1 dBm from nominal.

2.1.5.2 Test Equipment

All Ingenium Testing, LLC test and monitoring equipment/instrumentation is calibrated for Testing Laboratory requirements of ISO/IEC 17025:2005, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers. Calibration information was checked and recorded before each test in which the equipment was used.

Testing for immunity against Voltage variations and interruptions was carried out using the EM Test model 'UCS 500 M4' Power Fail Simulator along with the motorized variac.

List of Equipment Used:

Manufacturer	Model	Ingenium Asset #	Description	Last Cal date	Cal due date
EM Test	UCS 500 M4	1324	EFT/B Generator	26 May 2009	26 May 2010
EM Test	MV2616	1325	Motorized Variac	N/A	N/A
Agilent	E4440A	1207	PSA Spec. Analyzer	18 Dec 2008	18 Dec 2009
Agilent	N9039A	1206	Pre-Selector	23 Dec 2008	23 Dec 2009
Agilent	N5182	1208	RF Generator	18 Dec 2008	18 Dec 2009
ETS	3142C	1360	Hybrid Antenna	17 Mar 2008	17 Mar 2010
Werlatone	C6047	0344	Directional Coupler	22 Jun 2009	22 Jun 2010
Werlatone	C3908	0342	Directional Coupler	23 Jun 2009	23 Jun 2010
Kalmus	505C	0069	Pre-amplifier	Verify on Use	Verify on Use
Agilent	33220A	1438	Waveform Generator	15 Dec 2008	15 Dec 2009

Correction factors and cable loss factors were entered into the appropriate test equipment. As a result, the data taken accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected measurement result.

2.1.5.3 Test Setup

The EUT was tested as a “Table-Top” type product, as described in TIA-603-C. The EUT was placed on a non-conductive table, 80 cm above the reference ground plane, inside an RF shielded Chamber located at Ingenium Testing.

The variable AC power supply of 120V ±15%, 60 Hz was provided to the EUT by the EM Test source control and motorized variac. The EUT (power amplifier) was connected to the Agilent MXG RF generator as an RF signal source, using a short length of coaxial cable, and then to the Kalmus pre-amplifier to provide exactly 1 Watt of nominal RF input power. The output of the EUT was connected to a directional coupler, and to a 50 ohm coaxial terminating load. The spectrum analyzer was connected to the directional coupler, at the forward power tap. An attenuator was installed in the RF path between the forward tap and the spectrum analyzer, to protect the test instruments. The EUT was exercised under standard operating conditions, as defined in section 1.2.3.1. of this report. The amplifier was exercised with the Agilent RF source for this series of tests.

Figure 49: The EUT setup during Carrier stability measurements.

2.1.5.4 Test Procedure

The stability of the device was examined as a function of the input voltage available to the EUT.

During the initial investigation of the EUT, the system was tested with minimum RF input and maximum RF input power as allowed by the EUT specifications. There was no discernable change in the response or emission levels from the EUT. The test was then performed at nominal RF power input, as it will be the case in actual operation, with RF input levels tightly controlled by the Exciter.

During the final test, the amplifier RF output was connected through a directional coupler, to a 50 ohm coaxial load. The Forward Power tap on the directional coupler was then connected to a series attenuator and to the Spectrum Analyzer as the measuring instrument. The loss factors from the directional coupler, cables and the attenuator were added as correction settings directly on the analyzer, thereby allowing direct measurements, without the need for any further corrections.

The frequency stability was investigated at the lowest and highest channels, using the RF generator as the source, coupled through the amplifier, and measured at the output of the amplifier (EUT). This test was repeated four times, on combinations of low and high channels, at +15% and -15% of nominal AC voltage.

The frequency of operation was measured with the Spectrum Analyzer using 20 Hz RBW and VBW of 1 kHz. The Amplifier (EUT) was configured to run in normal operating mode, and the RF generator was supplying a CW RF signal. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the charts that follow. The frequency excursion limits, as set forth by FCC Title 47 CFR, Part §90.213(a) were applied, for a transmitter of this category. The EUT is an amplifier, not a transmitter, so the frequency excursion was measured based on the reference frequency at the nominal source voltage.

The same technique of relative excursion was used to investigate RF power stability as a function of source voltage variations, with only a difference in the RBW/VBW setting on the spectrum analyzer. During the power variation tests, the analyzer was set to RBW= 300 kHz, and VBW= 8 MHz. Observation time was approximately 1 minute, after the system had settled in with the new voltage setting.

2.1.5.5 Test Results

The frequency excursions seemed closely tied to the RF source, as expected, rather than the amplifier (EUT). Maximum excursion observed was 48 Hz, compared to a limit of 360 Hz.

Frequency Excursions	AC Voltage Source	
	102 VAC	138 VAC
72.02 MHz, 5W	48 (Hz)	14 (Hz)
75.98 MHz, 5W	11 (Hz)	37 (Hz)
72.02 MHz, 50W	-35 (Hz)	-11 (Hz)
75.98 MHz, 50W	24 (Hz)	29 (Hz)

Table 10: Frequency Stability results

No anomalies were noted, in the measured transmit power, varying less than 1 dB, during the voltage variation tests.

Output Power Excursions	AC Voltage Source	
	102 VAC	138 VAC
72.02 MHz, 5W	0.5 (dB)	0.6 (dB)
75.98 MHz, 5W	0.5 (dB)	0.5 (dB)
72.02 MHz, 50W	0.5 (dB)	0.5 (dB)
75.98 MHz, 50W	0.5 (dB)	0.4 (dB)

Table 11: Power Stability results

2.1.6 Radiated RF Emissions Measurements

2.1.6.1 Test Criterion

The test matrix in section 1.5 was used as a guide for test points and conditions.
The following table presents the limits for radiated harmonic and spurious RF emissions, as specified in the FCC Title 47 CFR, Part §2.1053, and §90.210 for products qualifying as licensed transmitters.

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P), in Watts, by a factor, in dB, of at least { 43 + 10 Log (P) }.

The following ports should be tested for compliance according to the test matrix:

Port Definition	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
Enclosure	5 Watt Mode	Radiated RF Emissions 47 CFR 90.210	30 MHz-1.0 GHz Measured RF Emission should be Below specified Limits	Pass
	50 Watt Mode	Radiated RF Emissions 47 CFR 90.210	30 MHz-1.0 GHz Measured RF Emission should be Below specified Limits	Pass

For a 5 Watt (37dBm) transmitter, at 10 meters separation distance, the spurious emission limit would be calculated as follows:

37 (dBm) – (43 + 10 Log (5W)) + 84.7 (conversion to dBμV/m at 10m) = 71.7 (dBμV/m at 10m)

For a 50 Watt (47dBm) transmitter, at 10 meters separation distance, the spurious emission limit would be calculated as follows:

47 (dBm) – (43 + 10 Log (50W)) + 84.7 (conversion to dBμV/m at 10m) = 71.7 (dBμV/m at 10m)

Table 12: Field Strength Limit for radiated harmonic and spurious RF emissions under 47CFR 2.1053.

Frequency (MHz)	Emission Limit Antenna Conducted (dBm)	Emission Limit Radiated Field Strength (dBμV/m at 10m)
30.0 – 72	-13	71.7
72.0 – 76.0	As Licensed (37.0 dBm = 5W)	As Licensed (121.8)
72.0 – 76.0	As Licensed (47.0 dBm = 50W)	As Licensed (131.8)
76.0 – 1000.0	-13	71.7

Notes: In the calculations for margin below the limit, the limits are rounded to one digit past the decimal.

2.1.6.2 Test Equipment

All Ingenium Testing, LLC test and monitoring equipment/instrumentation is calibrated for Testing Laboratory requirements of ISO/IEC 17025:2005, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers. Calibration information was checked and recorded before each test in which the equipment was used.

List of Equipment Used:

Manufacturer	Model	Ingenium Asset Number	Description	Last Cal data	Cal due date
Agilent	E4440A	1207	PSA Spec. Analyzer	18 Dec 2008	18 Dec 2009
Agilent	N9039A	1206	Pre-Selector	23 Dec 2008	23 Dec 2009
Agilent	N5182	1208	RF Generator	18 Dec 2008	18 Dec 2009
HP	8447	RP-0054	Pre-Amplifier	13 Mar 2009	13 Sep 2009
ETS	3142C	1360	Hybrid Antenna	17 Mar 2008	17 Mar 2010
ETS	3121C	1355,1356,1357,1358	Dipole Antenna set	19 Nov 2007	19 Nov 2009

The data presented accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected measurement result.

2.1.6.3 Test Setup

The EUT was tested as a “Table-Top” type product, and staged in a semi-anechoic chamber as described in section (1.5.3.7) of TIA-603-C. The EUT was placed on a non-conductive table, 80 cm above the reference ground plane, centered on a flush-mounted 3 meter-diameter turntable in the 10 Meter FCC Listed Semi-Anechoic Chamber located at Ingenium Testing. The test setup also complies with the necessary procedures as described in the ANSI standard.

The EUT (power amplifier) was connected to the Exciter source, as would be in normal use, using a short length of coaxial cable. The output of the EUT was connected to a directional coupler, and to a 50 ohm coaxial terminating load. The EUT was exercised under standard operating conditions, and powered by 120VAC/60Hz. The spectrum analyzer was connected to the directional coupler, at the forward power tap.

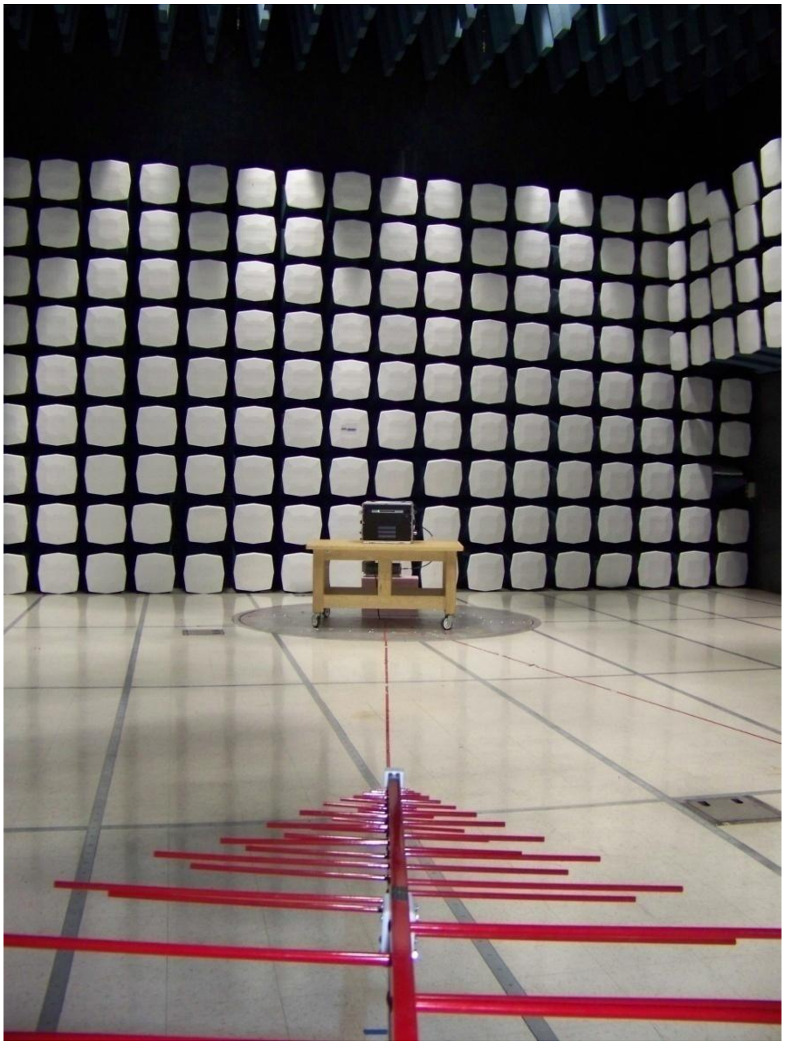


Figure 50: The EUT setup during radiated emissions tests, with Exciter as RF source: view as seen from the sense antenna.

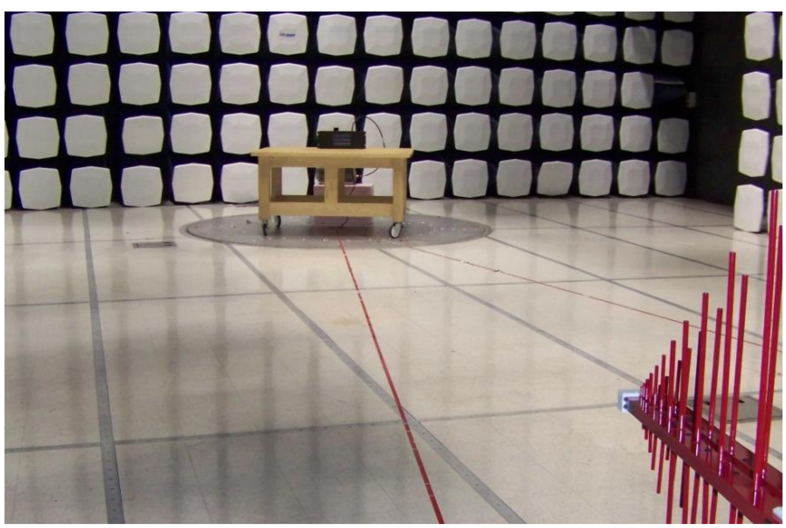


Figure 51: The EUT setup during radiated emissions tests, with terminated RF source: view as seen from the sense antenna.

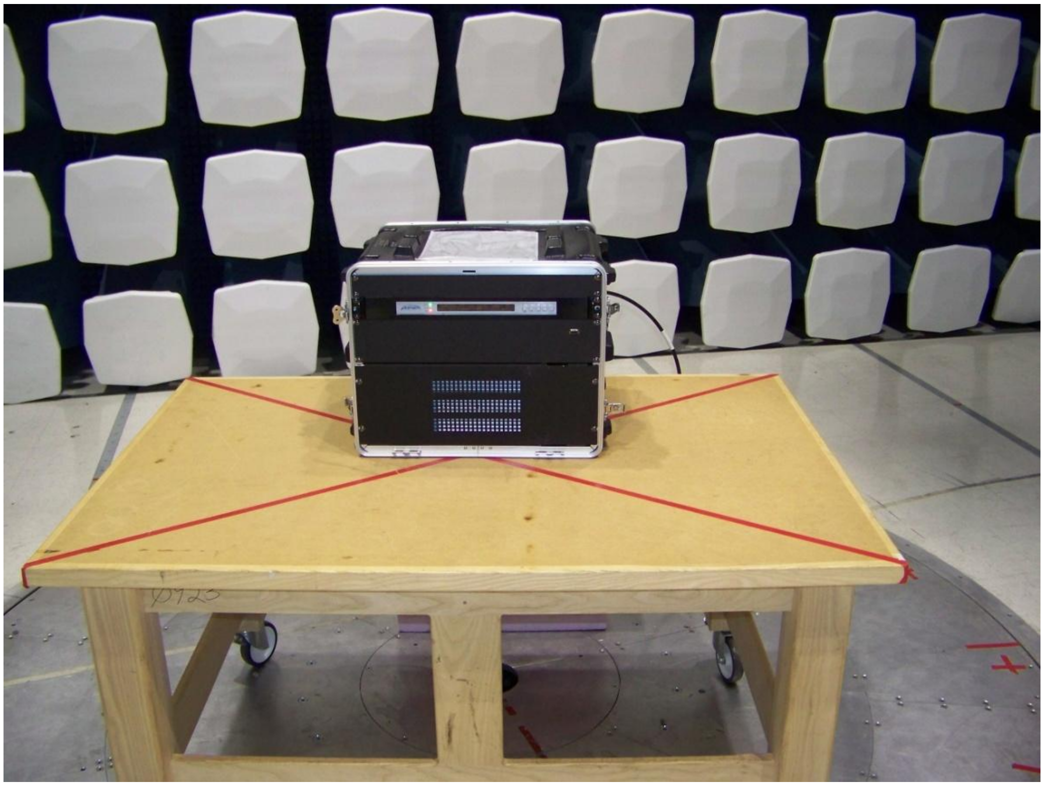


Figure 52: The EUT setup during radiated emissions tests, with Exciter as RF source: close up view of the front of the EUT.

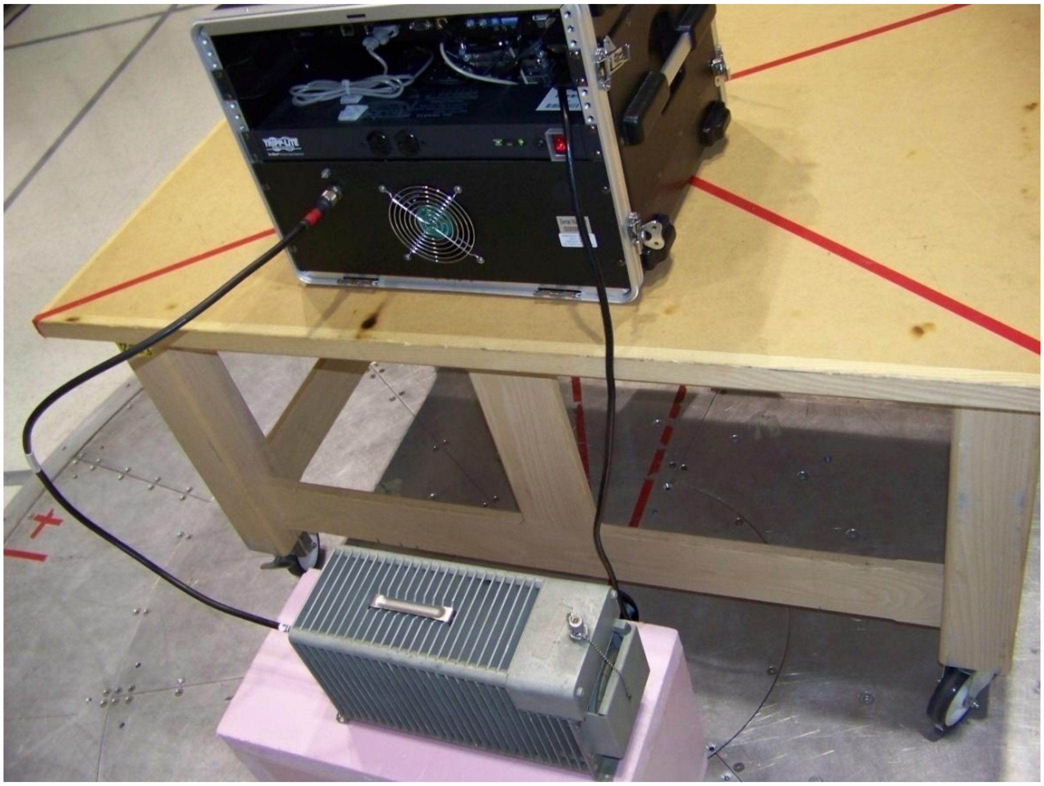


Figure 53: The EUT setup during radiated emissions tests, with Exciter as RF source: Rear of the EUT showing placement of terminating load.

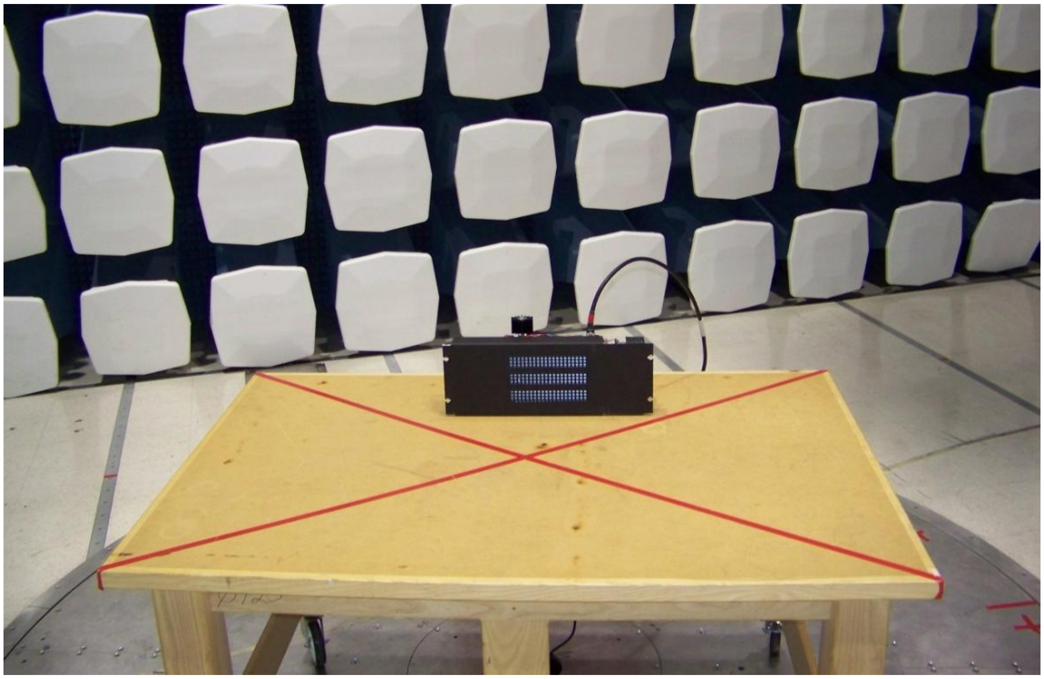


Figure 54: The EUT setup during radiated emissions tests, with terminated RF source: close up view of the front of the EUT.

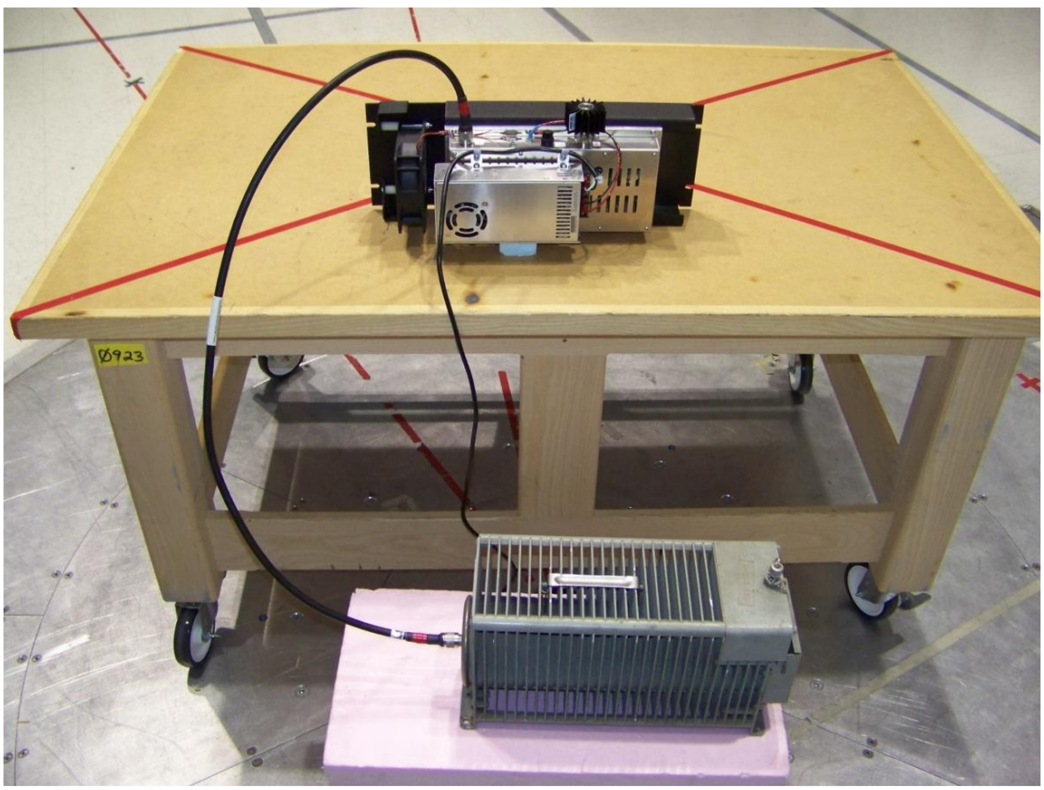


Figure 55: The EUT setup during radiated emissions tests, with terminated RF source: Rear of the EUT showing placement of terminating load.

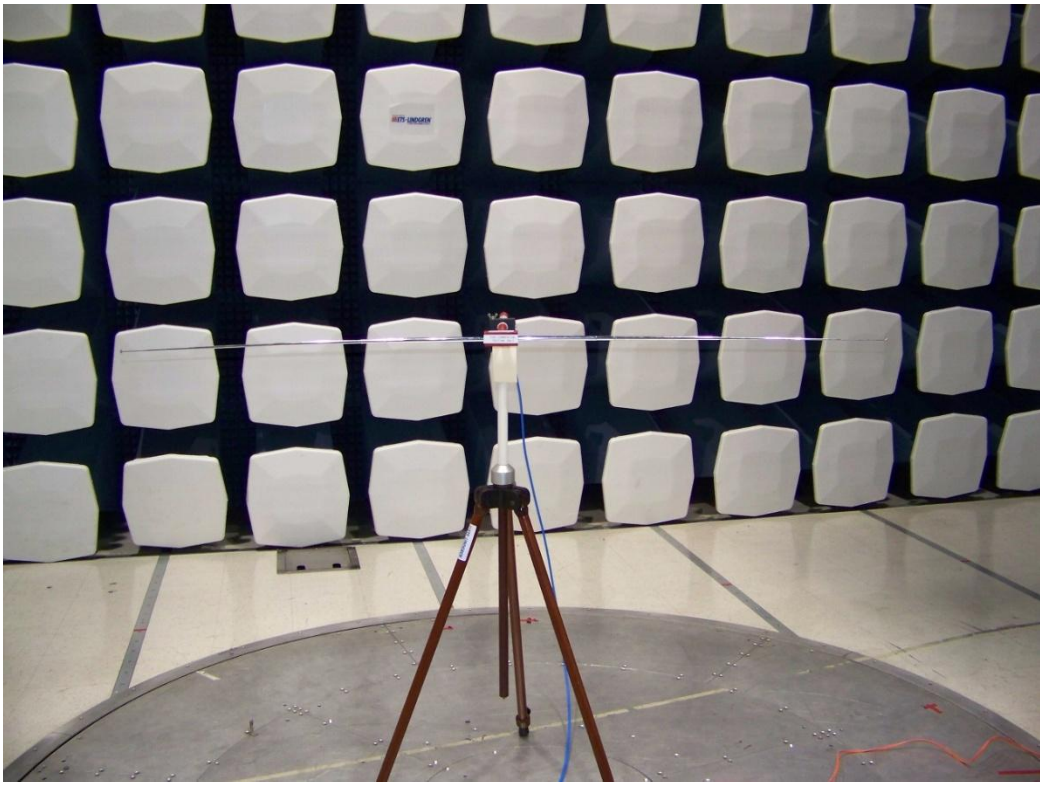


Figure 56: Antenna and source substitution method, with substitution antenna in horizontal polarization.

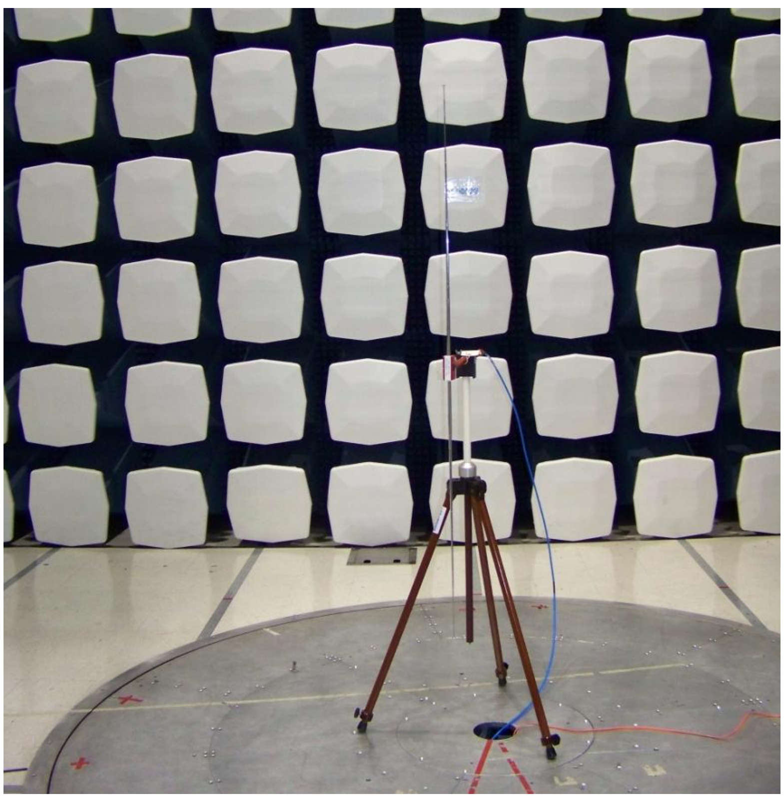


Figure 57: Antenna and source substitution method, with substitution antenna in vertical polarization.

2.1.6.4 Test Procedure

The EUT was measured for Radiated RF Emissions in the 10 Meter FCC Listed Semi-Anechoic Chamber located at Ingenium Testing. The frequency range from 30 MHz to 1000 MHz was investigated for RF emissions, and emission levels were noted along with the fixed degree settings of azimuth on the turntable and sense antenna height. The EUT was placed on a non-conductive pedestal (table), 80 cm above the reference ground plane, centered on a turn-table with a conductive rotating surface, flush and in contact with the conductive ground plane. The antenna mast was placed such that the antenna was separated by 10 meters from the test object. A Hybrid Biconni-Log antenna was used to measure emissions from 30 MHz to 1000 MHz. The maximum radiated emissions were found by raising and lowering the antenna between 1 and 4 meters in height, while utilizing the turn-table to rotate the product. The process was repeated using both horizontal and vertical antenna polarizations. The maximum emission levels were then recorded along with the attitude of the product.

During the initial investigation of the EUT, the system was tested with no RF input, and terminated on the input terminal with a 50 ohm terminating resistor, and then tested again with minimum RF input and maximum RF input power as allowed by the EUT specifications. There was no discernable change in the response or emission levels from the EUT.

During the final tests, measurements were made with 1Watt nominal RF power input, as it will be the case in actual operation, with RF input levels tightly controlled by the Exciter.

The measurements were made using a CISPR-16 compliant EMC receiver, through an automated test program. The receiver was operated with the IF resolution bandwidth (RBW) of 120 kHz for measurements between 30 MHz and 1 GHz (video bandwidth of 300 kHz). The applicable limits, as noted in 47 CFR 90.210 were applied.

The EUT was set-up and operated in the proper mode ‘Standard continuous duty’ as defined in TIA-603. The mode tested was in normal operation, with the Exciter as an RF signal source for the amplifier (EUT).

The highest radiated RF emissions measured in the ANSI 63.4 setup were then re-tested using the antenna and source substitution method per ANSI/TIA 603, using a Dipole set as the reference illuminating antenna.

2.1.6.5 Test Results

The EUT was found to **MEET** the requirements of radiated harmonic and spurious RF emissions, as specified in the FCC Title 47 CFR, Part §2.1053, and §90.210 for products qualifying as licensed transmitters . Supporting evidence of significant measured RF emissions, are tabulated and presented below.

CLIMATE TEST CONDITIONS

Temperature:	73 ^{o}F (22.8 ^{o}C)
Humidity:	48 % RH

5 Watt mode, 72.02 MHz

Table 13: The following table depicts the level of significant spurious radiated RF emissions measured on channel 17 (72 MHz), (5W)

Frequency (MHz)	Ant. / EUT Polarization	Height (cm)	Azimuth (0° - 360°)	Measured EFI (dBμV/m@10m)	90.210 Limit (dBμV/m@10m)	Margin (dB)	Substitution Method (dBm)	Substitution Margin (dB)
42.49	V	100	347	18.8	71.8	53.0		
72.02	V	100	262	57.0	121.8	64.8		
80.44	V	100	337	10.6	71.8	61.2		
144.04	V	100	28	46.3	71.8	25.5	-46.6	33.6
216.07	V	100	129	35.3	71.8	36.5	-59.1	46.1
288.09	V	100	11	27.7	71.8	44.1		
360.11	V	100	270	26.7	71.8	45.1		
432.13	V	100	354	27.9	71.8	43.9		
504.15	V	100	5	16.5	71.8	55.2		
576.18	V	100	223	17.2	71.8	54.6		
648.20	V	100	296	18.2	71.8	53.6		
720.22	V	100	235	20.1	71.8	51.7		
760.05	V	100	213	24.8	71.8	46.9		
776.05	V	100	149	22.1	71.8	49.7		
791.94	V	100	342	21.6	71.8	50.1		
871.96	V	100	248	32.0	71.8	39.7		
887.97	V	100	247	32.1	71.8	39.6		
68.07	H	100	60	2.7	71.8	69.1		
72.02	H	100	216	42.3	121.8	79.4		
90.87	H	100	194	5.0	71.8	66.7		
144.04	H	100	328	39.9	71.8	31.8	-51.9	38.9
216.07	H	100	145	31.6	71.8	40.2		
288.09	H	100	56	33.7	71.8	38.1		
360.11	H	100	166	31.4	71.8	40.3		
432.13	H	100	30	32.1	71.8	39.7		
504.15	H	100	42	26.6	71.8	45.2		
576.18	H	100	54	22.8	71.8	49.0		
648.20	H	100	135	26.1	71.8	45.7		
720.22	H	100	249	21.9	71.8	49.9		
760.05	H	100	16	30.8	71.8	40.9		
776.05	H	100	18	32.5	71.8	39.3		
792.18	H	100	62	31.0	71.8	40.8		
936.22	H	100	171	29.2	71.8	42.5		

5 Watt mode, 75.98 MHz

Table 14: The following table depicts the level of significant spurious radiated RF emissions measured on channel 98 (76 MHz), (5W)

Frequency (MHz)	Ant. / EUT Polarization	Height (cm)	Azimuth (0° - 360°)	Measured EFI (dBμV/m@10m)	90.210 Limit (dBμV/m@10m)	Margin (dB)	Substitution Method (dBm)	Substitution Margin (dB)
30.40	V	100	117	11.4	71.8	60.4		
75.98	V	100	5	57.1	121.8	64.7		
151.96	V	100	15	33.9	71.8	37.9		
227.94	V	100	130	30.4	71.8	41.4		
303.92	V	100	95	42.2	71.8	29.6	-40.8	27.8
379.90	V	100	195	29.9	71.8	41.9		
455.88	V	100	289	21.7	71.8	50.1		
531.86	V	100	156	16.3	71.8	55.5		
607.84	V	100	7	17.4	71.8	54.4		
683.82	V	100	91	21.5	71.8	50.3		
759.80	V	100	327	22.8	71.8	49.0		
776.00	V	100	272	22.5	71.8	49.3		
888.00	V	100	322	31.8	71.8	40.0		
988.00	V	100	176	32.6	71.8	39.2		
75.98	H	100	218	47.7	121.8	74.1		
151.96	H	100	313	31.0	71.8	40.8		
227.94	H	100	113	25.8	71.8	46.0		
303.92	H	100	146	45.1	71.8	26.7	-49.2	36.2
379.90	H	100	70	36.5	71.8	35.4	-49.9	36.9
455.88	H	100	6	20.8	71.8	51.0		
531.86	H	100	328	21.5	71.8	50.3		
607.84	H	100	222	18.0	71.8	53.8		
683.82	H	100	147	27.2	71.8	44.6		
759.80	H	100	156	28.9	71.8	42.9		
888.00	H	100	310	29.7	71.8	42.1		
988.00	H	100	166	33.7	71.8	38.1		

50 Watt mode, 72.02 MHz

Table 15: The following table depicts the level of significant spurious radiated RF emissions measured on channel 17 (72 MHz), (50W)

Frequency (MHz)	Ant. / EUT Polarization	Height (cm)	Azimuth (0° - 360°)	Measured EFI (dBμV/m@10m)	90.210 Limit (dBμV/m@10m)	Margin (dB)	Substitution Method (dBm)	Substitution Margin (dB)
34.73	V	100	67	17.2	71.8	54.5		
42.85	V	100	180	19.1	71.8	52.7		
60.19	V	100	6	24.5	71.8	47.3		
72.02	V	100	90	67.4	131.8	64.4		
138.03	V	100	291	16.1	71.8	55.7		
144.04	V	100	51	45.6	71.8	26.2	-46.4	33.4
216.06	V	100	138	30.0	71.8	41.8		
288.08	V	100	336	38.9	71.8	32.8	-47.3	34.3
360.10	V	100	243	32.7	71.8	39.0		
432.12	V	100	235	32.0	71.8	39.8		
792.18	V	100	357	29.7	71.8	42.1		
936.22	V	100	230	31.8	71.8	40.0		
72.02	H	100	65	52.9	131.8	78.9		
128.33	H	100	80	4.3	71.8	67.5		
144.04	H	100	186	39.2	71.8	32.6		
156.71	H	100	354	5.9	71.8	65.9		
204.84	H	100	286	6.1	71.8	65.7		
216.06	H	100	164	36.6	71.8	35.2		
288.08	H	100	218	41.8	71.8	30.0	-53.1	40.1
360.10	H	100	187	37.5	71.8	34.2		
432.12	H	100	215	34.7	71.8	37.0		
504.14	H	100	307	28.4	71.8	43.4		
792.30	H	100	315	39.7	71.8	32.0	-48.2	35.2
936.22	H	100	54	29.1	71.8	42.7		

50 Watt mode, 75.98 MHz

Table 16: The following table depicts the level of significant spurious radiated RF emissions measured on channel 98 (76 MHz), (50W)

Frequency (MHz)	Ant. / EUT Polarization	Height (cm)	Azimuth (0° - 360°)	Measured EFI (dBμV/m@10m)	90.210 Limit (dBμV/m@10m)	Margin (dB)	Substitution Method (dBm)	Substitution Margin (dB)
32.43	V	100	53	17.3	71.8	54.5		
35.21	V	100	54	25.6	71.8	46.2		
43.34	V	100	216	13.8	71.8	58.0		
43.82	V	100	99	12.5	71.8	59.3		
75.95	V	100	259	65.1	131.8	66.7		
121.91	V	100	251	26.7	71.8	45.1		
151.98	V	100	65	42.6	71.8	29.2	-47.1	34.1
227.88	V	100	104	34.4	71.8	37.4		
303.90	V	100	343	35.0	71.8	36.8		
379.93	V	100	138	32.1	71.8	39.7		
759.80	V	100	84	21.7	71.8	50.1		
987.75	V	100	201	46.0	71.8	25.8	-43.2	30.2
35.34	H	100	120	9.9	71.8	61.9		
75.95	H	100	44	50.2	81.8	31.5		
118.63	H	100	125	2.9	71.8	68.9		
150.04	H	100	32	4.4	71.8	67.4		
151.98	H	100	192	41.4	71.8	30.4	-52.3	39.3
227.88	H	100	144	40.2	71.8	31.6		
303.90	H	100	219	35.1	71.8	36.7		
379.93	H	100	249	27.9	71.8	43.8		
759.80	H	100	310	30.6	71.8	41.1		
987.75	H	100	202	47.3	71.8	24.5	-44.1	31.1

Notes:

1) A Quasi-Peak Detector was used in measurements below 1 GHz. The peak detector was also used to ensure the peak emissions did not exceed 20 dB above the limits

Uncertainty Calculations – All Factors Combined Includes a comparison between CISPR 16-4-2 and Ingenium Testing			
Measurement		U_{CISPR}	Ingenium Testing
Radiated Disturbance	30 MHz – 300 MHz	7.4 dB	5.4 dB
Radiated Disturbance	300 MHz – 1 GHz	6.5 dB	5.1 dB

Notes:

Date of Estimation: November 02, 2007.

SCREEN CAPTURES – RADIATED RF EMISSIONS TESTING

These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured with the sense antenna both in vertical and horizontal polarity.

5 Watt mode, 72.02 MHz

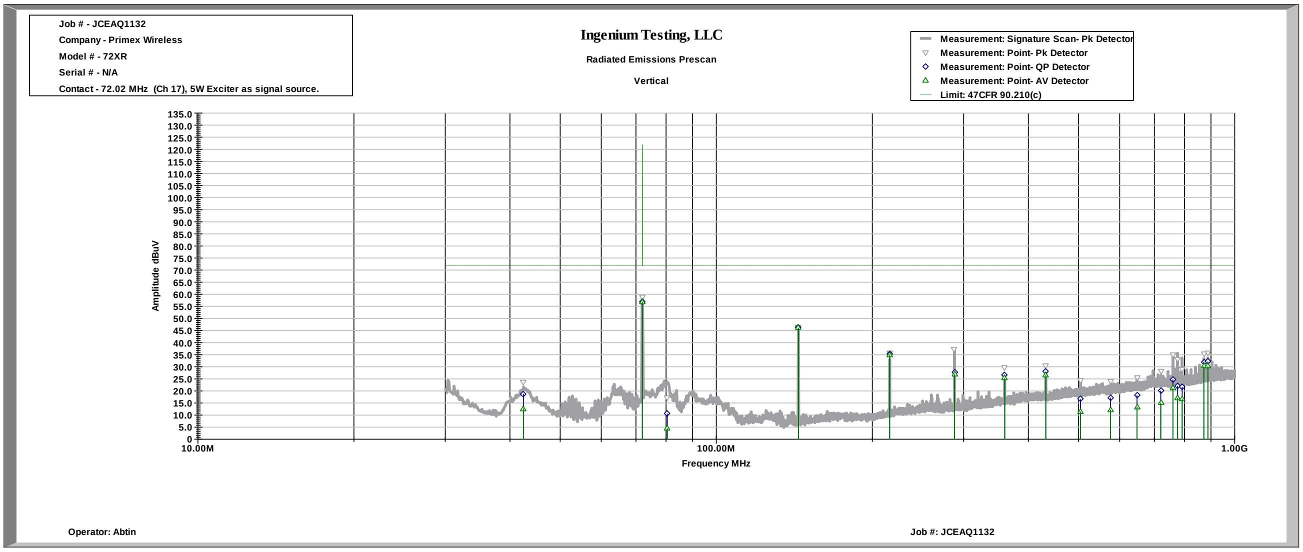


Figure 58: Antenna Vertically Polarized, 30-1000 MHz, at 10 m, 72.02 MHz, 5 Watt Mode.

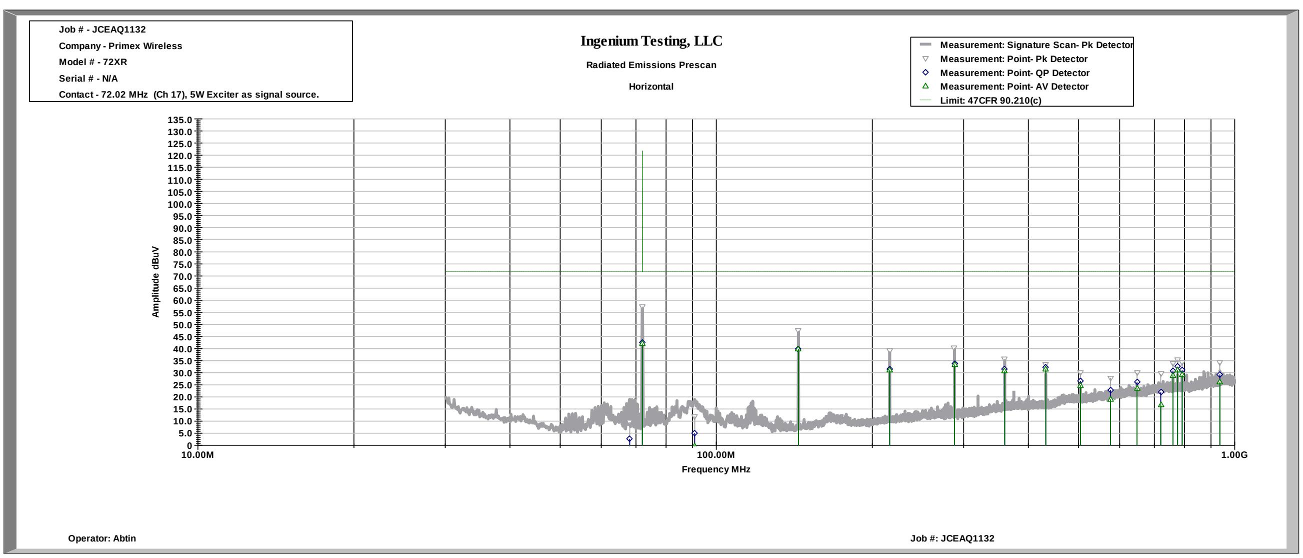


Figure 59: Antenna Horizontally Polarized, 30-1000 MHz, at 10 m, 72.02 MHz, 5 Watt Mode.

5 Watt mode, 75.98 MHz

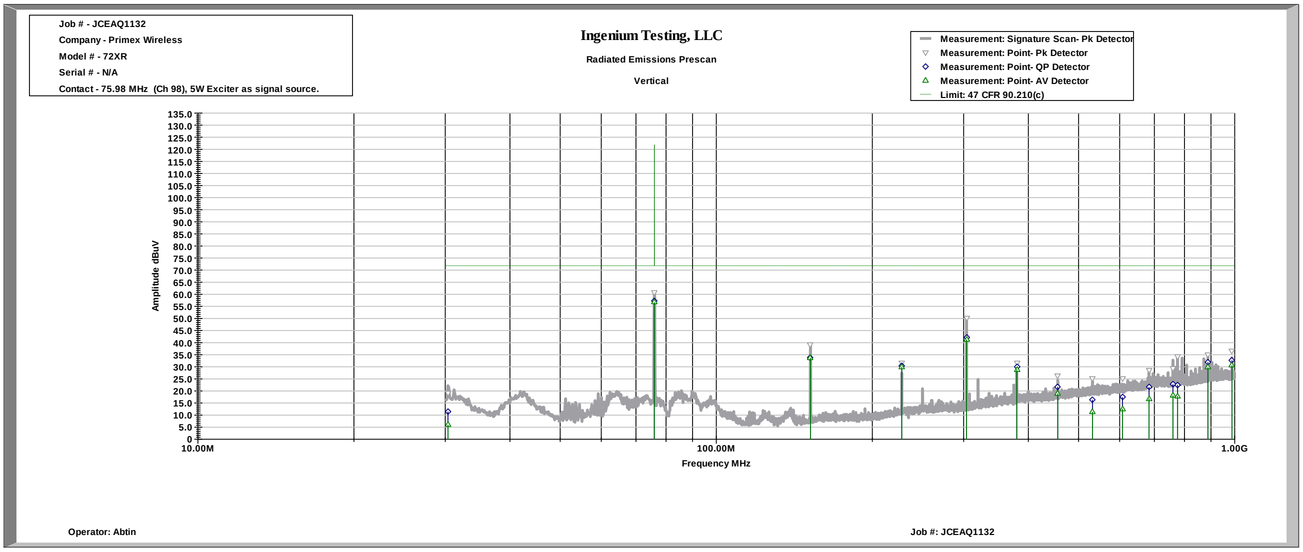


Figure 60: Antenna Vertically Polarized, 30-1000 MHz, at 10 m, 75.98 MHz, 5 Watt Mode.

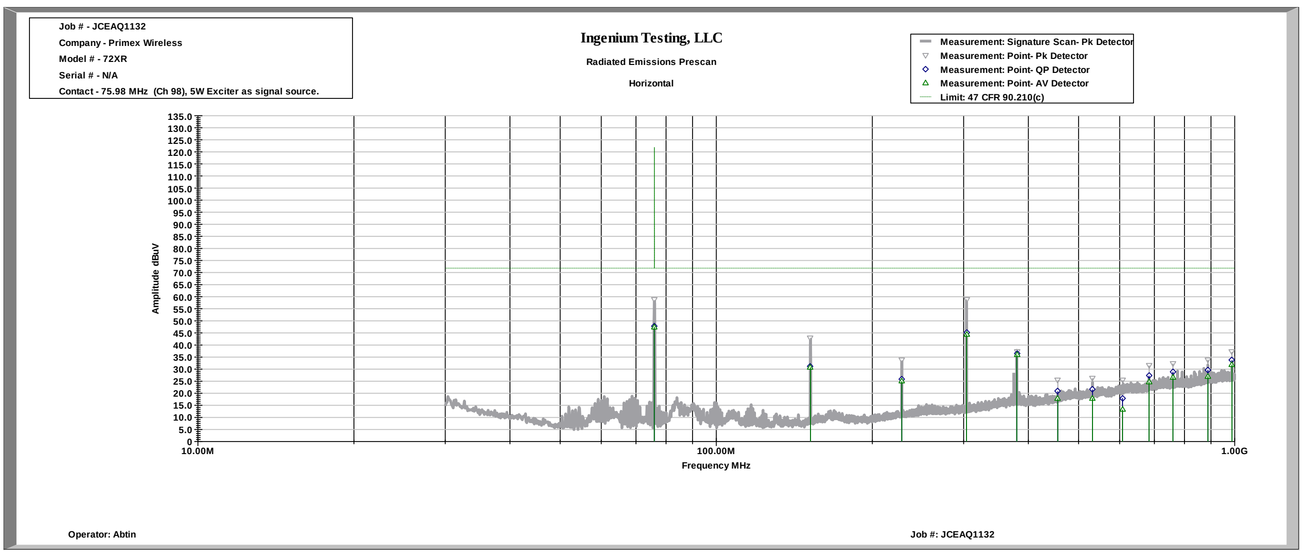


Figure 61: Antenna Horizontally Polarized, 30-1000 MHz, at 10 m, 75.98 MHz, 5 Watt Mode.

50 Watt mode, 72.02 MHz

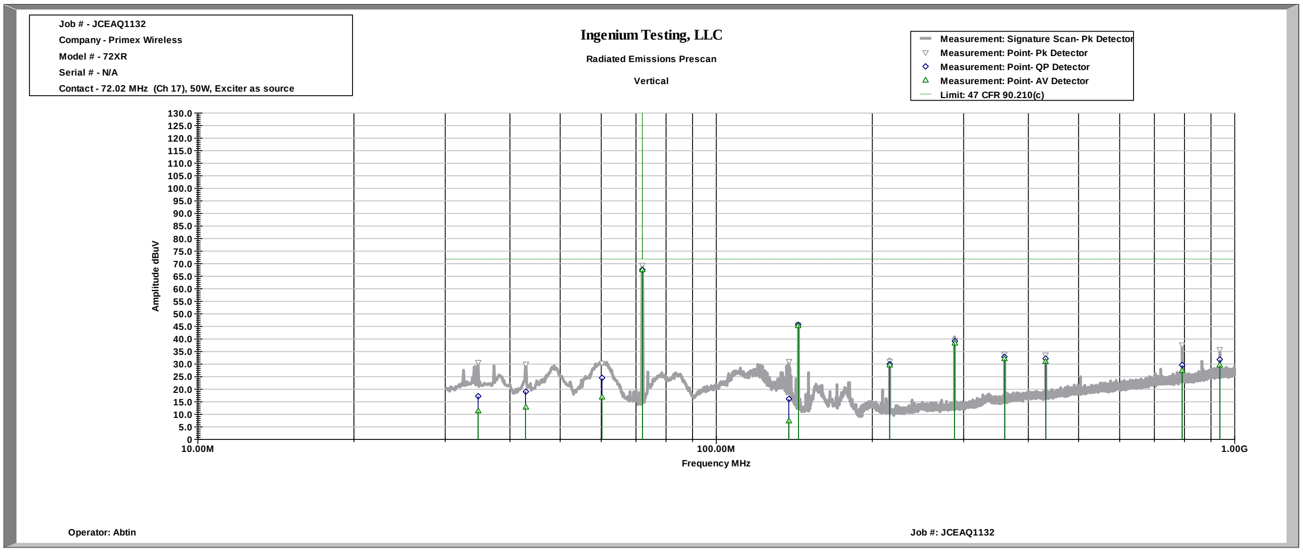


Figure 62: Antenna Vertically Polarized, 30-1000 MHz, at 10 m, 72.02 MHz, 50 Watt Mode.

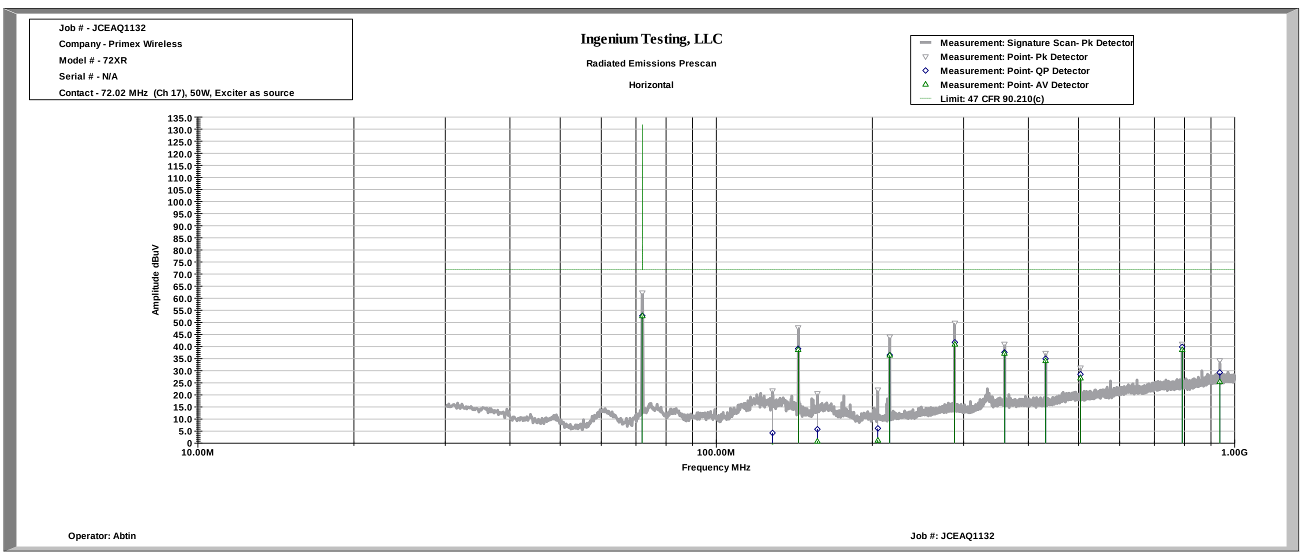


Figure 63: Antenna Horizontally Polarized, 30-1000 MHz, at 10 m, 72.02 MHz, 50 Watt Mode.

50 Watt mode, 75.98 MHz

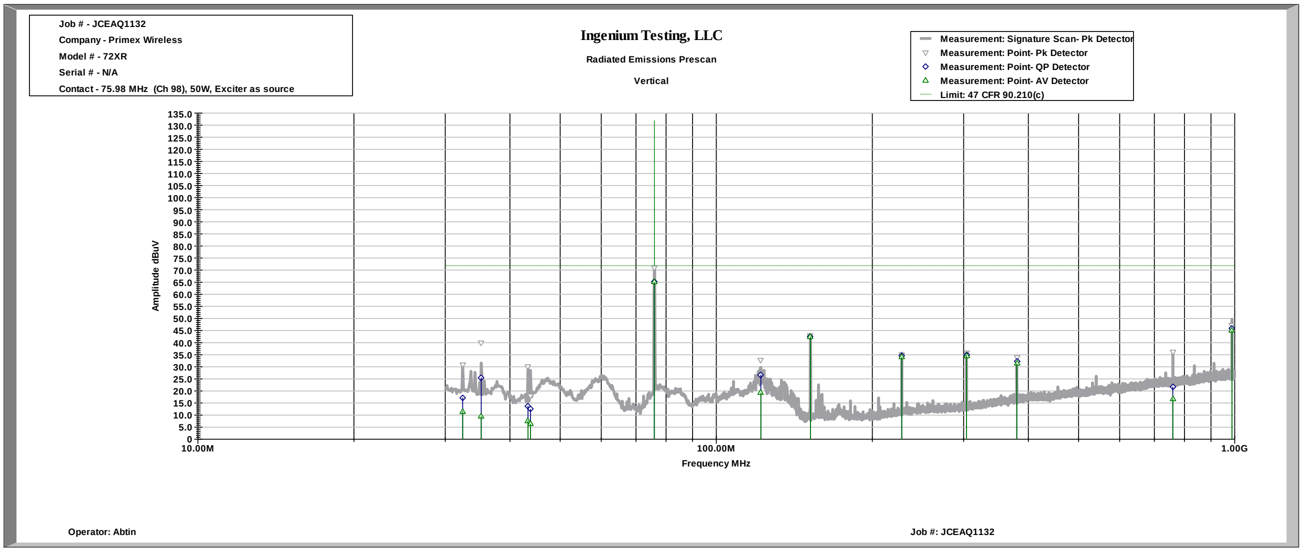


Figure 64: Antenna Vertically Polarized, 30-1000 MHz, at 10 m, 75.98 MHz, 50 Watt Mode.

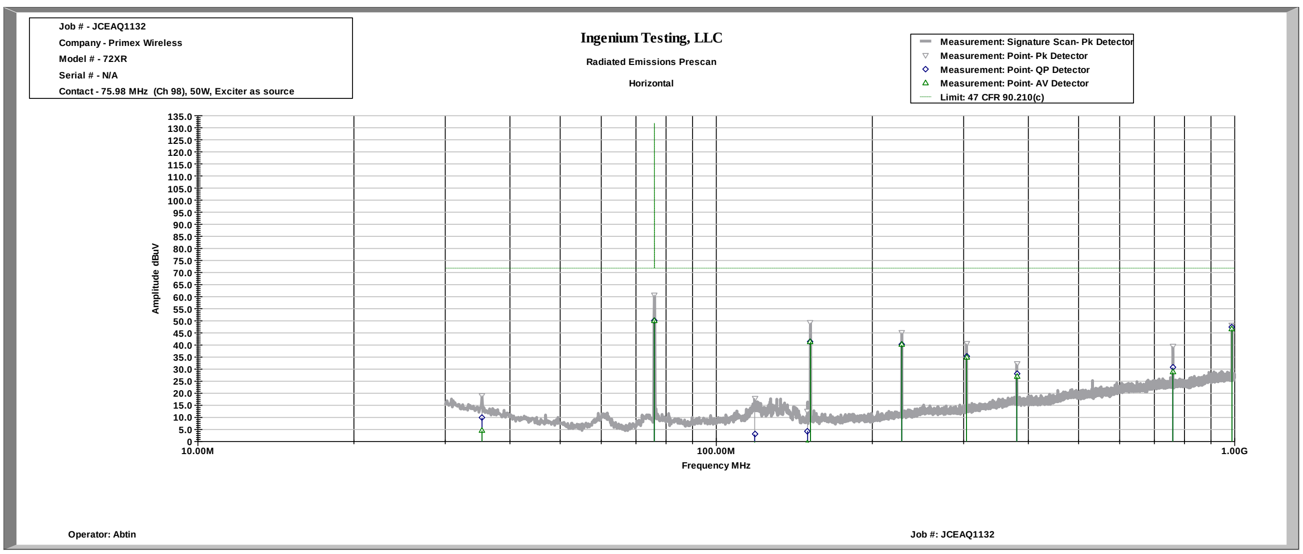


Figure 65: Antenna Horizontally Polarized, 30-1000 MHz, at 10 m, 75.98 MHz, 50 Watt Mode.

2.1.7 Conducted RF Emission onto AC Mains Measurements

2.1.7.1 Test Criterion

The information provided in this section is a service to the client for use in future qualifications. The test matrix in section 1.5 was used as a guide for test points and conditions.

Port Definition	Description/ Detail	Test Standard	Performance Criteria
AC Power	5 Watt Mode	AC Mains Conducted RF Emissions 47 CFR 15.107 Class B	150kHz-30 MHz Measured RF Emission should be Below specified Limits
	50 Watt Mode	AC Mains Conducted RF Emissions 47 CFR 15.107 Class B	150kHz-30 MHz Measured RF Emission should be Below specified Limits

The following table presents the limits for unintentional RF emissions conducted onto AC Mains, as specified in the FCC Title 47 CFR, Part 15.107(b), for unintentional radiators and products qualifying as Class B Digital Devices.

Table 17: Limits for RF conducted onto AC Mains, per 47CFR 15.107(a) – for a Class B digital device.

Frequency (MHz)	Conducted RF Voltage Quasi-peak Limit (dBμV)	Conducted RF Voltage Average Limit (dBμV)
0.15 – 0.50	66.0 Decreasing linearly with logarithm of frequency to 56.0	56.0 Decreasing linearly with logarithm of frequency to 46.0
0.50 – 5.0	56.0	46.0
5.0 – 30.0	60.0	50.0

Notes: In the calculations for margin below the limit, the limits are rounded to one digit past the decimal.

2.1.7.2 Test Equipment

All equipment is calibrated according to governing standards, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers.

List of Equipment Used:

Manufacturer	Model	Ingenium Asset Number	Description	Last Cal data	Cal due date
Hewlett Packard	8546A	1133	EMI analyzer	26 Jan 2009	26 Jan 2010
ETS	3816/2	1363	Dual LISN	11 Mar 2009	11 Mar 2010
Agilent	11947A	1314	Transient Limiter	18 Dec 2008	18 Dec 2009

The data presented accounts for the LISN correction factors as well as cable loss or other corrections, and can therefore be entered into the database as a corrected measurement result.

2.1.7.3 Test Setup

The EUT was tested as a "Table-Top" type product, as described in ANSI C63.4. The EUT was placed on a non-conductive table, 80 cm above the reference ground plane, inside an RF shielded Chamber located at Ingenium Testing. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V, 60 Hz was provided to the LISN via appropriate broadband EMI Filters. The LISN used has the ability to terminate the unused RF sampling port connection with a 50Ω (ohm) load, when switched to either L1 (line) or L2 (neutral). A transient limiter was installed in the RF path to protect the detection equipment. The EUT was exercised under standard operating conditions, as defined in section 1.2.3.1. of this report. The amplifier was exercised with a calibrated external RF generator for this series of tests.

Figure 66: The EUT setup during Conducted RF Emissions tests onto AC Mains.

2.1.7.4 Test Procedure

The EUT was measured for RF Emissions conducted onto AC Mains lines, in a Shielded Chamber located at Ingenium Testing. Frequency range from 150 kHz to 30 MHz was investigated for RF emissions. Measurements were made via a LISN, equipped with a 50 Ω RF sampling port.
The measurements were made using the "Quasi-Peak" and "Average" detector functions as defined in CISPR 16-1-1, and available on the test equipment selected for this test.

During the initial investigation of the EUT, the system was tested with no RF input, and terminated on the input terminal with a 50 ohm terminating resistor, and then tested again with minimum RF input and maximum RF input power as allowed by the EUT specifications. There was no discernable change in the response or emission levels from the EUT.

During the final tests, measurements were made with 1Watt nominal RF power input, as it will be the case in actual operation, with RF input levels tightly controlled by the Exciter.

The EUT was investigated in continuous operation for this portion of the testing, as described in section 1.2.3.1 of this report. Test automation software was used to perform the Conducted RF Emission measurements. The measuring receiver was operated with the IF resolution bandwidth (RBW) of 9 kHz for measurements between the frequencies of 150 kHz and 30 MHz (video bandwidth of 30 kHz). The applicable Class B limits, as noted in 47 CFR 15.107 for a Class B type digital product were applied.

2.1.7.5 Test Results

The EUT was found to **MEET** the requirements as described within the specifications of the FCC, Title 47 CFR, Part 15.107 for conducted emissions from a Class B digital product, onto AC Mains, as well as the Industry Canada requirements specified within ICES-003 for a Class B digital device. Supporting evidence of significant measured RF emissions, are tabulated and presented below.

CLIMATE TEST CONDITIONS

Temperature:	73 ^{o}F (22.8 ^{o}C)
Humidity:	48 % RH

5 Watt mode, 72.02 MHz

Frequency (MHz)	Line	QUASI-PEAK QP Measurement (dBµV)	QP Limit (dBµV)	QP Margin (dB)	AVERAGE Average Measurement (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.155	120V - L1	44.0	65.9	21.9	36.4	55.9	19.5
0.201	120V - L1	43.2	64.6	21.3	38.9	54.6	15.7
0.206	120V - L1	45.8	64.4	18.6	41.6	54.4	12.8
1.291	120V - L1	31.1	56.0	24.9	28.8	46.0	17.2
3.344	120V - L1	14.1	56.0	41.9	6.3	46.0	39.7
6.389	120V - L1	17.8	60.0	42.2	11.7	50.0	38.3
14.271	120V - L1	35.8	60.0	24.2	24.7	50.0	25.3
22.022	120V - L1	20.5	60.0	39.5	14.0	50.0	36.0
0.198	120V - L2	36.2	64.6	28.4	31.9	54.6	22.7
0.204	120V - L2	46.9	64.5	17.6	42.8	54.5	11.7
0.341	120V - L2	28.1	60.5	32.4	24.7	50.5	25.8
1.292	120V - L2	32.5	56.0	23.5	31.8	46.0	14.2
1.364	120V - L2	28.3	56.0	27.7	23.4	46.0	22.6
2.978	120V - L2	26.0	56.0	30.0	16.3	46.0	29.7
3.538	120V - L2	26.3	56.0	29.7	16.8	46.0	29.2
13.963	120V - L2	35.5	60.0	24.5	26.6	50.0	23.4
14.766	120V - L2	33.0	60.0	27.0	23.4	50.0	26.6
18.038	120V - L2	30.5	60.0	29.5	23.1	50.0	26.9
28.876	120V - L2	27.6	60.0	32.4	20.5	50.0	29.5

Table 18: Results table – RF emissions conducted onto AC Mains (120VAC,60Hz) – 72.02 MHz, (5W)

5 Watt mode, 75.98 MHz

Frequency (MHz)	Line	QUASI-PEAK QP Measurement (dBµV)	QP Limit (dBµV)	QP Margin (dB)	AVERAGE Average Measurement (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.155	120V - L1	44.2	65.9	21.6	37.2	55.9	18.7
0.206	120V - L1	46.8	64.4	17.6	41.5	54.4	12.9
1.291	120V - L1	31.8	56.0	24.2	31.0	46.0	15.0
3.240	120V - L1	10.7	56.0	45.3	6.1	46.0	39.9
13.664	120V - L1	35.0	60.0	25.0	27.0	50.0	23.0
14.272	120V - L1	37.5	60.0	22.5	29.3	50.0	20.7
17.744	120V - L1	33.1	60.0	26.9	26.4	50.0	23.6
28.212	120V - L1	26.0	60.0	34.0	20.0	50.0	30.0
0.155	120V - L2	43.9	65.9	21.9	36.9	55.9	18.9
0.204	120V - L2	47.7	64.5	16.7	42.6	54.5	11.9
0.271	120V - L2	33.0	62.5	29.5	27.2	52.5	25.4
1.292	120V - L2	33.1	56.0	22.9	32.5	46.0	13.5
3.541	120V - L2	28.0	56.0	28.0	18.4	46.0	27.6
14.207	120V - L2	36.4	60.0	23.6	25.5	50.0	24.5
18.062	120V - L2	29.0	60.0	31.0	23.3	50.0	26.7

Table 19: Results table – RF emissions conducted onto AC Mains (120VAC,60Hz) – 75.98 MHz, (5W)

50 Watt mode, 72.02 MHz

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line	QP Measurement (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Average Measurement (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.155	120V - L1	42.9	65.8	22.9	36.3	55.8	19.6
0.192	120V - L1	23.1	64.8	41.7	17.4	54.8	37.4
0.203	120V - L1	46.8	64.5	17.7	42.8	54.5	11.7
0.272	120V - L1	31.3	62.5	31.3	26.5	52.5	26.0
0.682	120V - L1	11.8	56.0	44.2	7.0	46.0	39.0
1.292	120V - L1	31.1	56.0	24.9	30.2	46.0	15.8
3.396	120V - L1	22.7	56.0	33.3	12.4	46.0	33.6
14.097	120V - L1	36.8	60.0	23.2	25.6	50.0	24.4
17.945	120V - L1	35.9	60.0	24.1	29.5	50.0	20.5
0.204	120V - L2	46.9	64.5	17.6	43.0	54.5	11.5
0.275	120V - L2	30.2	62.4	32.2	25.3	52.4	27.2
1.293	120V - L2	32.1	56.0	23.9	31.0	46.0	15.0
3.354	120V - L2	27.7	56.0	28.3	17.0	46.0	29.0
11.092	120V - L2	23.7	60.0	36.3	12.3	50.0	37.7
13.887	120V - L2	35.3	60.0	24.7	24.4	50.0	25.6
17.424	120V - L2	30.5	60.0	29.5	23.8	50.0	26.2

Table 20: Results table – RF emissions conducted onto AC Mains (120VAC,60Hz) – 72.02 MHz, (50W)

50 Watt mode, 75.98 MHz

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line	QP Measurement (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Average Measurement (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.201	120V - L1	42.9	64.6	21.6	38.7	54.6	15.8
0.206	120V - L1	45.9	64.4	18.5	41.8	54.4	12.6
1.294	120V - L1	32.2	56.0	23.8	30.1	46.0	15.9
3.558	120V - L1	27.0	56.0	29.0	16.4	46.0	29.6
14.062	120V - L1	38.1	60.0	21.9	28.8	50.0	21.2
17.398	120V - L1	32.2	60.0	27.8	27.1	50.0	22.9
0.155	120V - L2	44.2	65.9	21.7	37.2	55.9	18.7
0.204	120V - L2	48.1	64.4	16.4	42.7	54.4	11.7
0.274	120V - L2	31.6	62.5	30.9	26.2	52.5	26.3
1.294	120V - L2	31.1	56.0	24.9	30.0	46.0	16.0
3.185	120V - L2	22.8	56.0	33.2	11.4	46.0	34.6
3.581	120V - L2	24.0	56.0	32.0	12.4	46.0	33.6
14.206	120V - L2	38.0	60.0	22.0	28.8	50.0	21.2
17.540	120V - L2	34.9	60.0	25.1	27.5	50.0	22.5

Table 21: Results table – RF emissions conducted onto AC Mains (120VAC,60Hz) – 75.98 MHz, (50W)

Uncertainty Calculations Includes a comparison between CISPR 16-4-2 and Ingenium Testing			
Measurement		U_{CISPR}	Ingenium Testing
Conducted Disturbance	150 kHz – 30 MHz	5.1 dB	4.2 dB

Notes:

Date of Estimation: November 02, 2007.

SCREEN CAPTURES – RADIATED RF EMISSIONS TESTING

These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector and an Average detector function is utilized.

5 Watt mode, 72.02 MHz

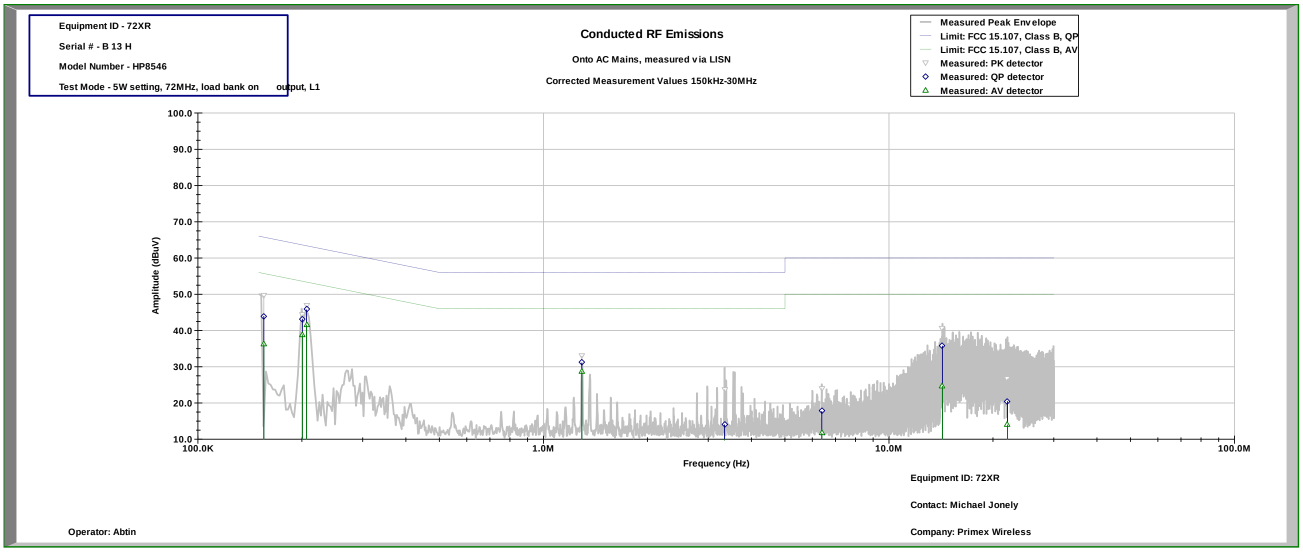


Figure 67: RF Emissions conducted onto AC Mains, 72.02 MHz, (5 W), L1

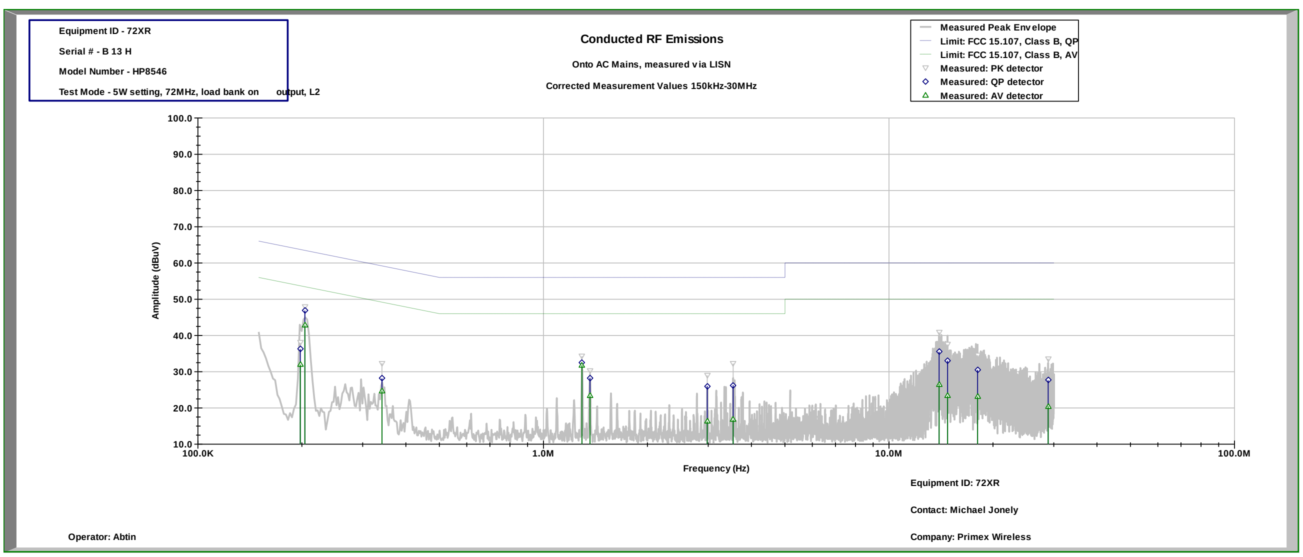


Figure 68: RF Emissions conducted onto AC Mains, 72.02 MHz, (5 W), L2

5 Watt mode, 75.98 MHz

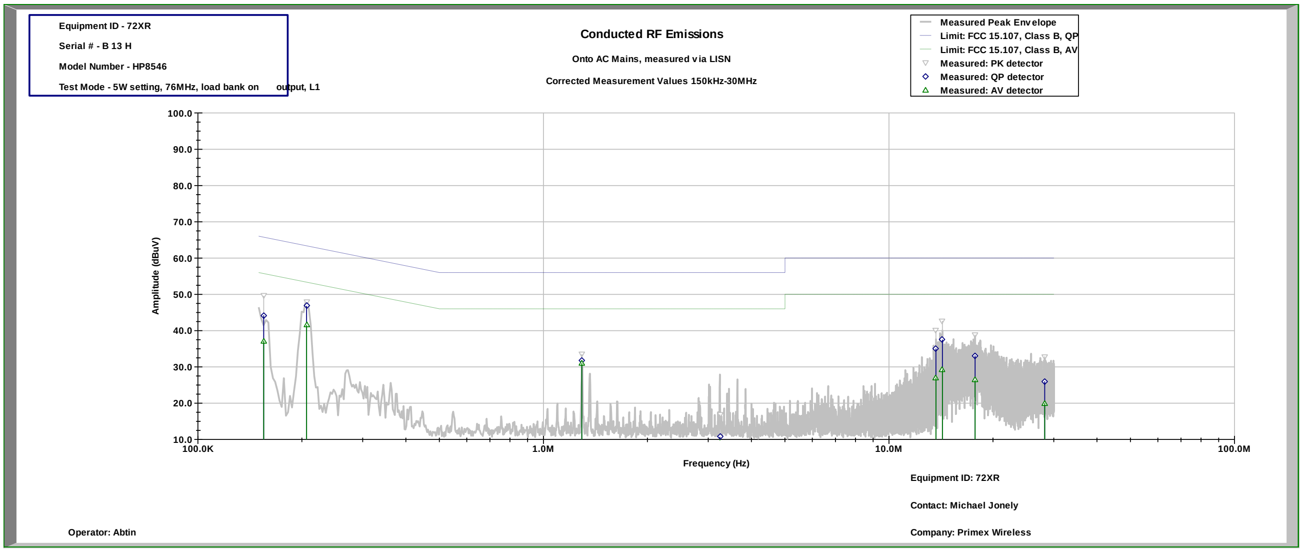


Figure 69: RF Emissions conducted onto AC Mains, 75.98 MHz, (5 W), L1

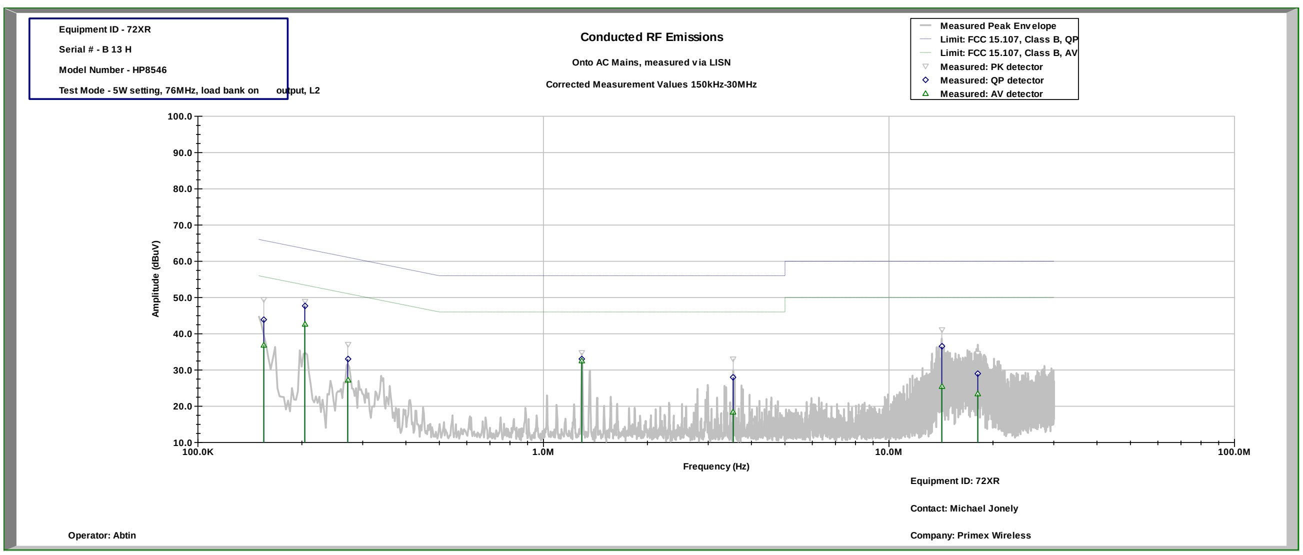


Figure 70: RF Emissions conducted onto AC Mains, 75.98 MHz, (5 W), L2

50 Watt mode, 72.02 MHz

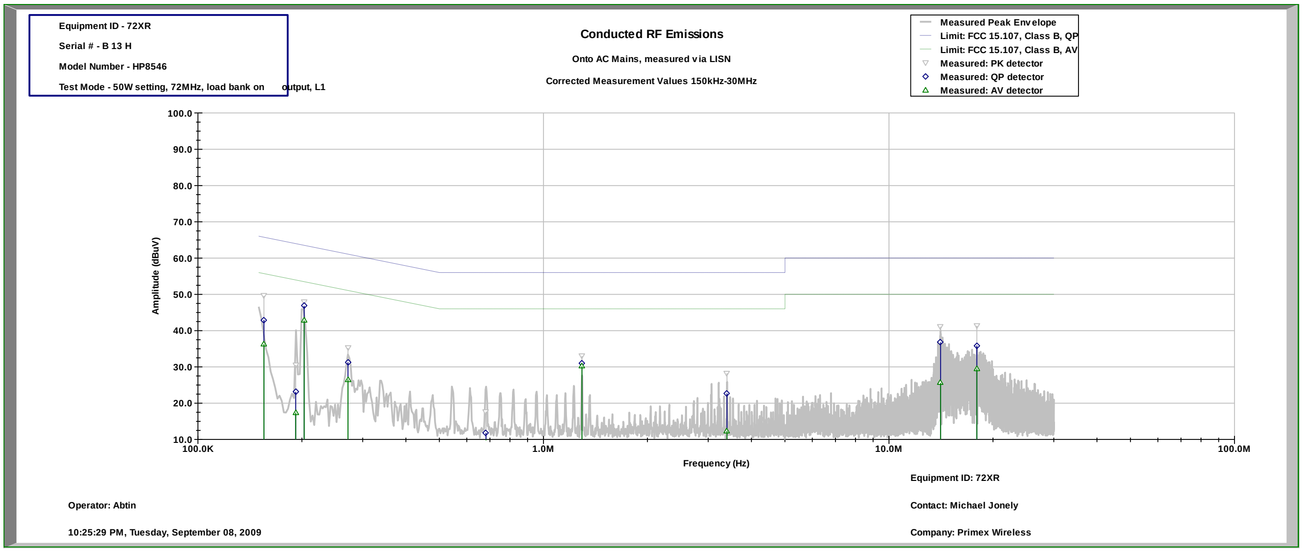


Figure 71: RF Emissions conducted onto AC Mains, 72.02 MHz, (50 W), L1

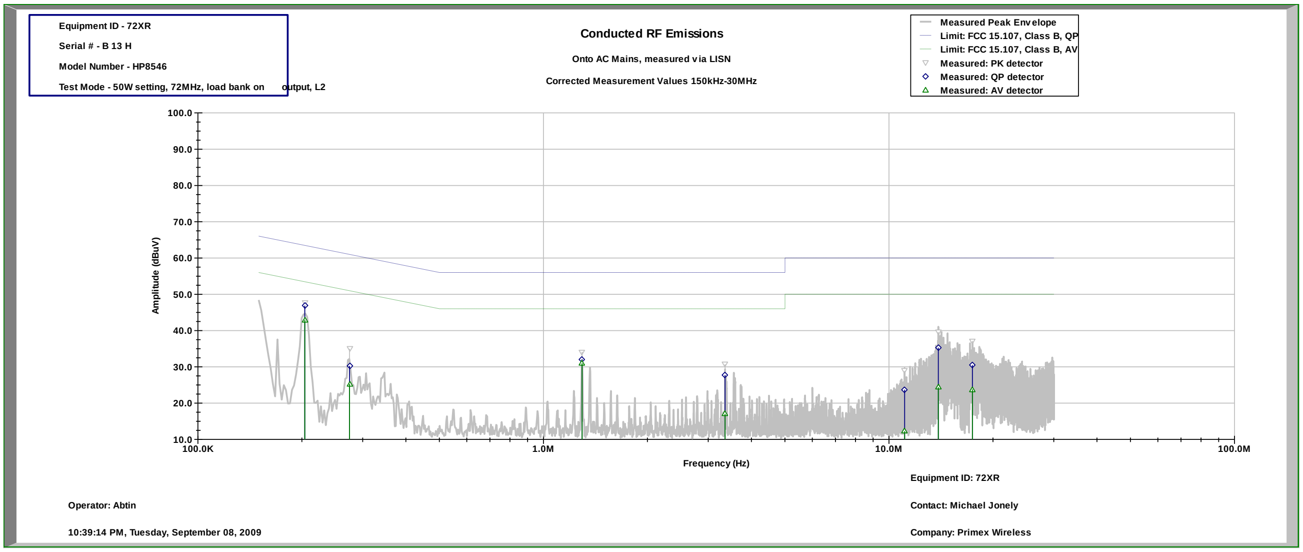


Figure 72: RF Emissions conducted onto AC Mains, 72.02 MHz, (50 W), L2

50 Watt mode, 72.02 MHz

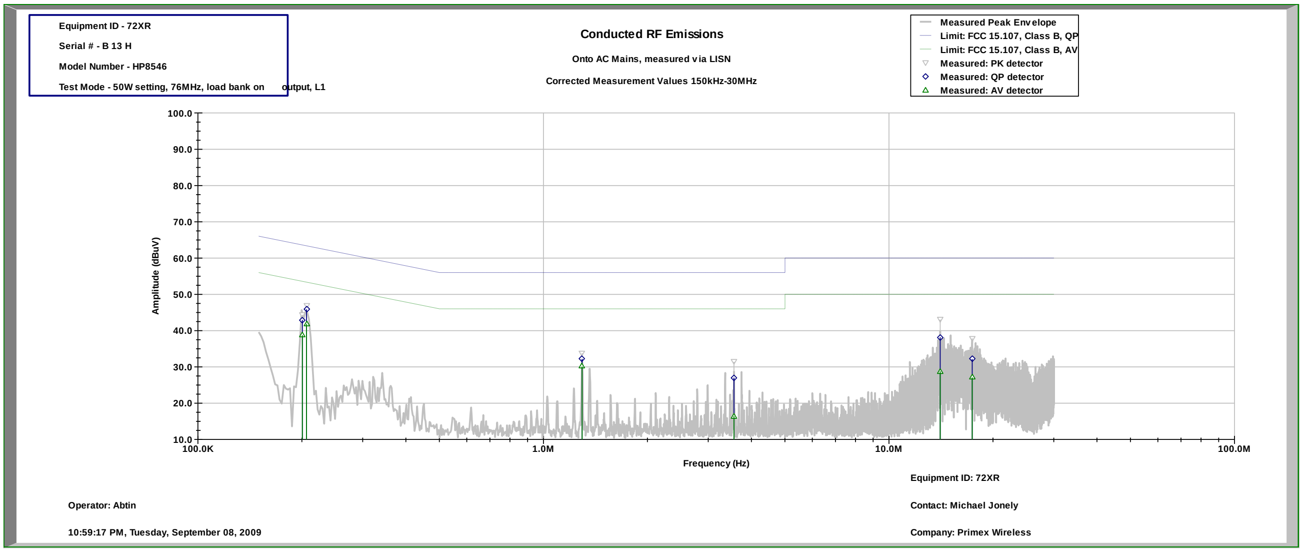


Figure 73: RF Emissions conducted onto AC Mains, 75.98 MHz, (50 W), L1

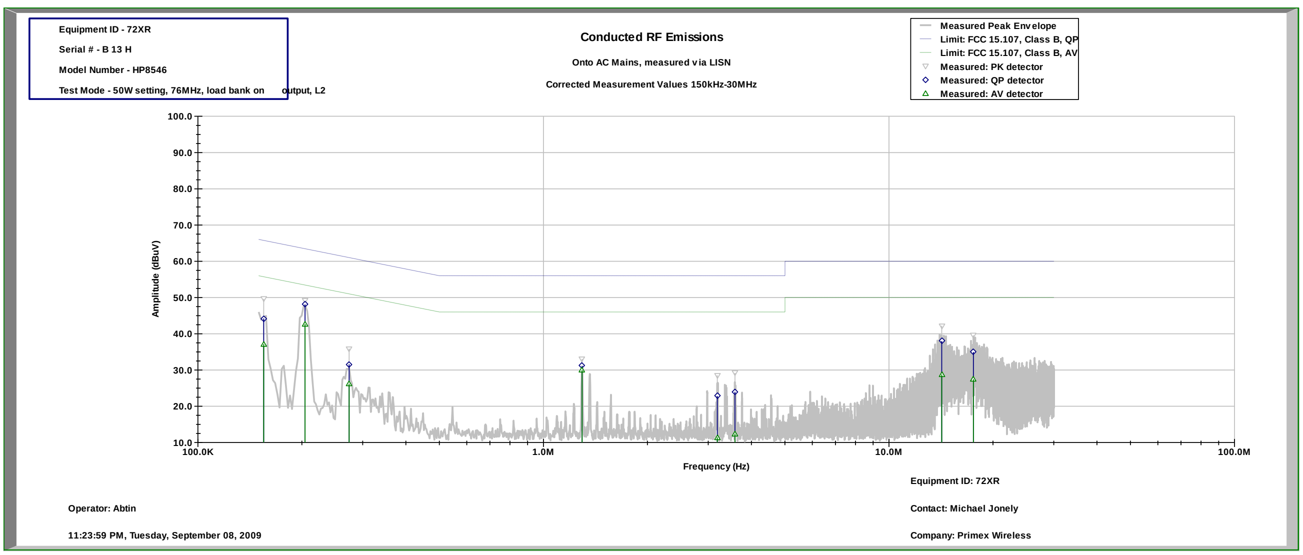


Figure 74: RF Emissions conducted onto AC Mains, 75.98 MHz, (50 W), L2

3.1 Electromagnetic Susceptibility Tests

No susceptibility tests were commissioned or performed during these series of tests.

4.1 Power Quality Tests

No susceptibility tests were commissioned or performed during these series of tests.

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Appendix A

A Conducted RF Performance Parameters – MPE Calculations.

5 Watt mode, 72.02 MHz

The following MPE calculations are based on:

- Measured RF output power of 36.74 dBm from the amplifier,
- 0 dBb (2.15 dBi) gain, Omni-directional dipole antenna (manufacturer specified antenna),
- 0.1 dB insertion loss of the co-axial protector (manufacturer specified coaxial surge arrestor) - *Ignored during these calculations.*
- 0.1 dB insertion loss of the LMR-400 (2.07 meters of the manufacturer specified coaxial feeder cable) - *Ignored during these calculations.*
- Manufacturer specified antenna installation height of 2.07 meters above the building (used as the prediction distance).

50	Load in Ω
2.07	Separation distance (m)
0	System insertion loss (dB)
2.15	Antenna gain (dBi)

dBm	mW	W	dBµV/m (@xx m)	V/m (@xx m)
36.74	4720.630	4.720630	130.90	3.506

As compared to the limit of 28 V/m as specified in RSS-102, Table 4.2.

Or, alternatively, if using power density (typically not applicable for products below 100MHz):

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density

P = power input to the antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	36.74	(dBm)
Maximum peak output power at antenna input terminal:	4720.630	(mW)
Antenna gain(typical):	2.15	(dBi)
Maximum antenna gain:	1.641	(numeric)
Prediction distance:	207	(cm)
Prediction frequency:	72	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.2	(mW/cm^2)
Power density at prediction frequency:	0.014383	(mW/cm^2)
Maximum allowable antenna gain:	13.6	(dBi)
Margin of Compliance at 207 cm =	11.4	dB

50 Watt mode, 72.02 MHz

The following MPE calculations are based on:

- Measured RF output power of 46.91 dBm from the amplifier,
- 0 dBb (2.15 dBi) gain, Omni-directional dipole antenna (manufacturer specified antenna),
- 0.1 dB insertion loss of the co-axial protector (manufacturer specified coaxial surge arrestor) - *Ignored during these calculations.*
- 0.1 dB insertion loss of the LMR-400 (2.83 meters of the manufacturer specified coaxial feeder cable) - *Ignored during these calculations.*
- Manufacturer specified antenna installation height of 2.83 meters above the building (used as the prediction distance).

50	Load in Ω
2.83	Separation distance (m)
0	System insertion loss (dB)
2.15	Antenna gain (dBi)

dBm	mW	W	dBµV/m (@xx m)	V/m (@xx m)
46.91	49090.79	49.09	143.78	15.46

As compared to the limit of 28 V/m as specified in RSS-102, Table 4.2.

Or, alternatively, if using power density (typically not applicable for products below 100MHz):

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	46.91	(dBm)
Maximum peak output power at antenna input terminal:	49090.788	(mW)
Antenna gain(typical):	2.15	(dBi)
Maximum antenna gain:	1.641	(numeric)
Prediction distance:	283	(cm)
Prediction frequency:	72	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.2	(mW/cm^2)
Power density at prediction frequency:	0.080023	(mW/cm^2)
Maximum allowable antenna gain:	6.1	(dBi)
Margin of Compliance at 283 cm =	4.0	dB

Appendix B

B Antenna Specifications.

The following are excerpts from the antenna specification document, re-printed without permission as supporting exhibits for the MPE calculations only.

KATHREIN
SCALA DIVISION

K5126411

GPB-75N

Omnidirectional Antenna
0 dBd gain
68–78 MHz

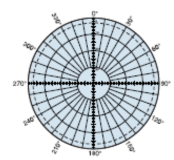
The Kathrein GPB-75N omnidirectional groundplane antenna is intended for use in professional fixed-station applications in the 68–78 MHz band. It features:

- Stainless steel radiator with fiberglass reinforced radials.
- Excellent bandwidth, broadband over 68–80 MHz.
- Variable mounting configurations allow feeder cable to be run inside or outside the support pipe.
- Easy assembly.
- All metal parts at DC ground potential.
- Stainless steel hardware and fastenings.

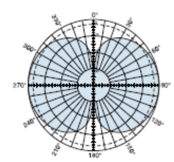
Specifications:

Frequency range	68–78 MHz (broadband)
Gain	0 dBd
Impedance	50 ohms
VSWR	<1.5:1
Polarization	Vertical
Maximum input power	75 watts (at 50°C)
H-plane beamwidth	Omni
E-plane beamwidth	78 degrees (half-power)
Connector	N female
Weight	3.97 lb (1.8 kg)
Dimensions radiating element ground radials	 29.4 inches (747 mm) 41.5 inches (1053 mm)
Equivalent flat plate area	0.68 ft² (0.063 m²)
Wind survival rating*	120 mph (200 kph)
Shipping dimensions	43 x 5 x 5 inches (1093 x 127 x 127 mm)
Shipping weight	6 lb (2.8 kg)
Mounting	Mounting hardware supplied. **A.** Mounting for 0.8 to 1.6 inch (20 to 40 mm) OD mast. **B.** Mounting for 1.6 to 2.2 inch (40 to 54 mm) OD mast.

* Mechanical design is based on environmental conditions as stipulated in EIA-222-F (June 1996) and/or ETS 300 019-1-4 which include the static mechanical load imposed on an antenna by wind at maximum velocity. See the Engineering Section of the catalog for further details.



H-plane
Horizontal pattern – V-polarization



E-plane
Vertical pattern – V-polarization

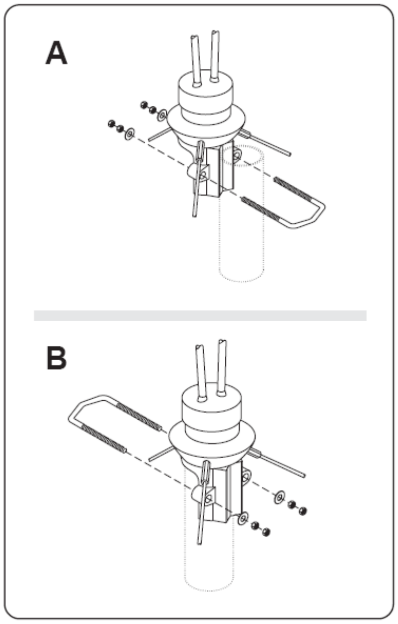
10217-B

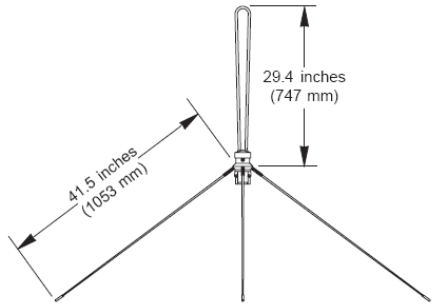
Kathrein Inc., Scala Division Post Office Box 4580 Medford, OR 97501 (USA) Phone: (541) 779-6500 Fax: (541) 779-3991
Email: communications@kathrein.com Internet: www.kathrein-scala.com

KATHREIN SCALA DIVISION

GPB-75N

Omnidirectional Antenna
0 dBd gain
68–78 MHz





Mounting Options:

	Description
A	Mounting for 0.8 to 1.6 inch (20 to 40 mm) OD mast
B	Mounting for 1.6 to 2.2 inch (40 to 54 mm) OD mast

Order Information:

Model	Description
GPB-75N K5126411	68–78 MHz Antenna with N connector

All specifications are subject to change without notice

Kathrein Inc., Scala Division Post Office Box 4580 Medford, OR 97501 (USA) Phone: (541) 779-6500 Fax: (541) 779-3991
Email: communications@kathrein.com Internet: www.kathrein-scala.com

Appendix C

C Co-Axial Protector (Lightning Surge Arrestor).

The following are excerpts from the Co-Axial Protector document, re-printed without permission as supporting exhibits for the MPE calculations only.

PolyPhaser

P.O. BOX 9000 MINDEN, NV 89423 TEL: 775-782-2511 FAX: 775-782-4476

DWG NO/PART NO/DESCRIPTION

IS-B50HN-CO

CUSTOMER PRINT

MAXIMUM CHARACTERISTICS

APPLICATION:
BULKHEAD MOUNT

FREQUENCY RANGE:
1.5MHz TO 400MHz

SURGE:
50kA IEC 1000-4-5 8/20μs WAVEFORM

TURN-ON:
1200Vdc ±20% 7ns FOR 2kV/ns

VSWR:
≤1.2:1 @ 1.5MHz TO 2MHz
≤1.1:1 @ 2MHz TO 400MHz

INSERTION LOSS:
≤0.1dB OVER FREQUENCY RANGE

MAX POWER:
HF 3kW, VHF 500W, UHF 250W

THROUGHPUT ENERGY:
≤20mJ TYPICAL

OPERATING TEMPERATURE:
+50°C

STORAGE/TEMPERATURE:
−45°C TO +85°C

RELATIVE HUMIDITY:
90% @ 40°C

VIBRATION:
1G AT 5Hz TO 100Hz

Appendix D

D Cable Specifications.

The following are excerpts from the Cable Specification document, and internet site, re-printed without permission as supporting exhibits for the MPE calculations only.

TIMES MICROWAVE SYSTEMS

A Smiths Industries company

358 Hall Ave., Wallingford, CT, 06492-5039 U.S.A.
Phone: 203-949-8400 Fax: 203-949-8423

LMR-400

Flexible Communications Cable

Electrical Specifications

Cutoff frequency	16.2 GHz*	
Velocity of propagation	85%	
Voltage withstand	2,500 VDC	
Peak power	16 kW	
DC resistance		
Inner conductor, ohms	1.39/1,000'	4.56/km
Outer conductor, ohms	1.65 /1,000'	5.41/km
Jacket spark	8,000 VRMS	
Impedance	50 ohms	
Capacitance	23.9 pF/ft	78.40 pF/m
Inductance	0.060 uH/ft	0.20 uH/m
Shielding effectiveness	>90 dB	
Phase stability	<10 ppm/°C	

*Consult factory for applications over 6 GHz.

Frequency MHz	Attenuation dB/100 ft	Attenuation dB/100 m	Avg. Power kW
30 MHz	0.7	2.2	3.3
50 MHz	0.9	2.9	2.6
150 MHz	1.5	5.0	1.5
220 MHz	1.9	6.1	1.2
450 MHz	2.7	8.9	0.83
900 MHz	3.9	12.8	0.58
1500 MHz	5.1	16.8	0.44
1800 MHz	5.7	18.6	0.40
2000 MHz	6.0	19.6	0.37
2500 MHz	6.8	22.2	0.33
5800 MHz	10.8	35.5	0.21

Add 15% to tabulated attenuation for LMR-UltraFlex

Calculate Attenuation = $(0.12229) \cdot \sqrt{FMHz} + (0.00026) \cdot FMHz$

(interactive calculator available at http://www.timesmicrowave.com)

Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F)

Power: VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

Coaxial Cable Attenuation & Power Handling Calculator

Product	Frequency (MHz)	Attenuation (db/100 feet)	Attenuation (db/100 mtrs)	Average Power (kW)
LMR-400	72	1.056	3.465	2.13
Calculate		Run Length (feet)	Total Run Attenuation(dB)	Efficiency (%)
		9.28	0.1	97.8

Appendix E

E Ingenium Testing, LLC Applicable Accreditations.

THE AMERICAN ASSOCIATION FOR
LABORATORY ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

INGENIUM TESTING, LLC
Rockford, IL

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005*).

Presented this 24th day of January 2008.

President
For the Accreditation Council
Certificate Number 2674.01
Valid to February 28, 2010

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION CORPORATE SEAL 1978 DISTRICT OF COLUMBIA A2LA

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

INGENIUM TESTING, LLC
3761 South Central Avenue
Rockford, IL 61102
James Blaha 815 315 9250 x117

ELECTRICAL

Valid To: February 28, 2010 Certificate Number: 2674.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following electromagnetic compatibility tests:

Test	Test Method
Emissions	
Radiated Emissions	47 CFR FCC Part 15.109, 209, 225, 231, 247, 249 using ANSI C63.4; 47 CFR FCC Part 18 using ANSI C63.4; FCC/OST MP-5; EN 55011; CISPR 11; AS/NZS CISPR 11; EN 55012; CISPR 12; AS/NZS CISPR 12; EN 55014-1; CISPR 14-1; AS/NZS CISPR 14-1; EN 55022; CISPR 22; AS/NZS CISPR 22; EN 61000-6-3; IEC 61000-6-3; EN 61000-6-4; IEC 61000-6-4; AS/NZS 4268+A1/A2; AS/NZS 4251-1; AS/NZS 4251-2; MIL-STD 461(E) (*Methods: RE101, RE102, RE103*); RTCA/DO160 Section 21
Conducted Emissions	47 CFR FCC Part 15.107, 207 using ANSI C63.4; 47 CFR FCC Part 18 using ANSI C63.4; FCC/OST MP-5; EN 55011; CISPR 11; AS/NZS CISPR 11; EN 55012; CISPR 12; AS/NZS CISPR 12; EN 55014-1; CISPR 14-1; AS/NZS CISPR 14-1; EN 55022; CISPR 22; AS/NZS CISPR 22; AS/NZS 4268 +A1/A2; AS/NZS 4251-1; AS/NZS 4251-2; AS/NZS 4250-1; AS/NZS 4250-2; MIL-STD 461(E) (*Methods: CE101, CE102, CE106)*; RTCA/DO160 Section 21
Harmonics	EN 61000-3-2; IEC 61000-3-2; AS/NZS 61000-3-2
Flicker	EN 61000-3-3; IEC 61000-3-3; AS/NZS 61000-3-3
Immunity	
Electrostatic Discharge (ESD)	EN 61000-4-2; IEC 61000-4-2; AS/NZS 61000-4-2; RTCA/DO160 Section 25
Electrical Fast Transient/Burst	EN 61000-4-4; IEC 61000-4-4; AS/NZS 61000-4-4
Surge Immunity	EN 61000-4-5; IEC 61000-4-5; AS/NZS 61000-4-5
Radiated	EN 61000-4-3; IEC 61000-4-3; AS/NZS 61000-4-3; MIL-STD 461(E) (*Methods: RS101, RS103*); RTCA/DO160 Section 20

(A2LA Cert. No. 2674.01) 05/20/08 Page 1 of 2

Test	Test Method
Immunity (cont'd)	
Conducted	EN 61000-4-6; IEC 61000-4-6; AS/NZS 61000-4-6; MIL-STD 461(E) (*Methods: CS101, CS103, CS104, CS105, CS109, CS114, CS115, CS116*); RTCA/DO160 Section 20
Power Frequency Magnetic Field	EN 61000-4-8; IEC 61000-4-8; AS/NZS 61000-4-8; RTCA/DO160 Section 15
Pulsed Magnetic Field	EN 61000-4-9; IEC 61000-4-9
Voltage Dips/Interrupts and Variations	EN 61000-11; IEC 6100-11; AS/NZS 61000-4-11; RTCA/DO160 Section 17
Power Input	RTCA/DO160 Section 16
Audio Frequency Conducted Susceptibility Power Inputs	RTCA/DO160 Section 18
Induced Signal Susceptibility	RTCA/DO160 Section 19
Lightning Inducted Transient	RTCA/DO160 Section 22
Generic and Product Family Standards	EN 61000-6-1; IEC 61000-6-1; AS/NZS 61000-6-1; EN 61000-6-2; IEC 61000-6-2; AS/NZS 61000-6-2; CISPR 14-2; EN 55014-2; AS/NZS CISPR 14-2; CISPR 24; EN 55024; AS/NZS CISPR 24; BS EN 60601-1-2; IEC 60601-1-2; BS EN 60947-1; IEC 60947-1; BS EN 60439-1; IEC 60439-1; BS EN 61326; IEC 61326; BS EN 50130-4; BS EN 50131-1; EN 61800-3, IEC 61800-3 (limited to 75A, 1000V); BS EN ISO 14892, ISO 14892 (using component methods except ISO-7637, ISO-11452-3)
Radio	
European Union	ETSI EN 300220-1 V2.1.1; ETSI EN 300 220-2 V2.1.1; ETSI EN 300 220-3 V1.1.1; ETSI EN 300 328 V1.7.1; ETSI EN 300 328-1 V1.3.1; ETSI EN 300 328-2 V1.2.1; ETSI EN 300 330 V1.2.1; ETSI EN 300 330-1 V1.5.1; ETSI EN 300 330-2 V1.3.1; ETSI EN 300 440-1 V1.3.1; ETSI EN 300 440-2 V1.1.2; ETSI EN 301 489-1 V1.7.1; ETSI EN 301 489-3 V1.4.1; ETSI EN 301 489-17 V1.3.1;
Canada	RSS-119; RSS-210; RSS-243; ICES-001; ICES-002; ICES-003
Telecommunications	47 CFR FCC Parts 2, 90, 95.628

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

June 12, 2008

Ingenium Testing, LLC
3761 South Central Avenue,
Rockford, IL 61102

Attention: James Blaha

Re: Accreditation of Ingenium Testing, LLC
Designation Number: US1107
Test Firm Registration #: 191720

Dear Sir or Madam:

We have been notified by American Association for Laboratory Accreditation that Ingenium Testing, LLC has been accredited as a Conformity Assessment Body (CAB).

At this time Ingenium Testing, LLC is hereby designated to perform compliance testing on equipment subject to Declaration Of Conformity (DOC) and Certification under Parts 15 and 18 of the Commission's Rules.

This designation will expire upon expiration of the accreditation or notification of withdrawal of designation.

'incerely,

George Tannahill

rge Tannahill
tronics Engineer