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Test of Narrowband Radio Modem, GFU20-1

To FCC 47 CFR Part 90 & IC RSS-119

Test Report Serial No.: ARWT02-A1 Rev A





Test of Narrowband Radio Modem, GFU20-1

To FCC 47 CFR Part 90 & IC RSS-119

Test Report Serial No.: ARWT02-A1 Rev A

This report supersedes NONE

Note: This report for product GFU20-1 contains supplementary information to MiCOM Labs report #: ARWT01-A1 for the AlphaWave AW400 Narrow Band Radio Modem

**Manufacturer:** ArWest Communications Corp.  
300 Orchard City Drive, Suite #126  
Campbell, California 95008  
USA

**Product Function:** System Monitoring and Control Applications

**Copy No:** pdf      **Issue Date:** 30th June 2005

**This Test Report is Issued Under the Authority of:**

**MiCOM Labs, Inc.**

3922 Valley Avenue, Suite B

Pleasanton, California 94566, USA

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## **LISTINGS**

MiCOM Labs test facilities are listed by the following organizations;

### **North America**

#### **United States of America**

Federal Communications Commission (FCC) Listing #: 102167

#### **Canada**

Industry Canada (IC) Listing #: 4143

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## DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	June 30 <sup>th</sup> '05	

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## 1. TEST RESULT CERTIFICATE

Manufacturer:	ArWest Communications Corp. 300 Orchard City Drive, Suite #126, Campbell, California 95008 USA	Tested By:	MiCOM Labs, Inc. 3922 Valley Avenue 'B' Pleasanton California, 94566, USA
EUT:	AlphaWave Narrowband Radio Modem	Telephone:	+1 925 462 0304
Model:	GFU20-1	Fax:	+1 925 462 0306
S/N:	Not Available		
Test Date(s):	27th & 28th May 2005	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 90 & IC RSS-119 Partial testing, see Section 4 Test Summary	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

### Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:

  
\_\_\_\_\_  
Graeme Grieve  
Quality Manager MiCOM Labs,

  
\_\_\_\_\_  
Gordon Hurst  
President & CEO MiCOM Labs, Inc.

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## **2. REFERENCES AND MEASUREMENT UNCERTAINTY**

### **2.1. Normative References**

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 90	2001	Code of Federal Regulations
(ii)	Industry Canada RSS-119	Issue 6 March 25 <sup>th</sup> 2000	Land Mobile and Fixed Radio Transmitters and Receivers, 27.41 to 960 MHz
(iii)	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(iv)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(v)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vi)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(vii)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(viii)	UKAS LAB 1	Edition 4 May 2004	Reference to Accreditation for Laboratories.
(ix)	DTI URN 98/997	2003	Conditions for the use of National Accreditation Marks by UKAS and UKAS Accredited Organizations.

### **2.2. Test and Uncertainty Procedures**

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor  $k = 2$ , providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.





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### 3. PRODUCT DETAILS AND TEST CONFIGURATIONS

#### 3.1. Technical Details

Details	Description
Purpose:	Test of the GFU20-1 to FCC and Industry Canada regulations
Applicant:	As manufacturer
Manufacturer:	ArWest Communications Corp. 300 Orchard City Drive, Suite #126 Campbell, California 95008, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 3922 Valley Avenue, Suite "B" Pleasanton, California 94566 USA
Test report reference number:	ARWT02-A1 Rev A
Date EUT received:	6 May 2005
Dates of test (from - to):	27th & 28th May 2005
Standard(s) applied:	FCC 47 CFR Part 90 & IC RSS-119
No of Units Tested:	1
Type of Equipment:	Product Description
Manufacturers Trade Name:	AlphaWave
Model:	GFU20-1
Location for use:	Indoor and Outdoor
Declared Frequency Range(s):	430 to 470 MHz
Type of Modulation:	DBPSK, DQPSK, D8PSK, GMSK, D16 QAM
Declared Nominal Output Power:	+13 to +33dBm (2 Watts) in 1dB steps
EUT Modes of Operation:	Channel Spacing's: <ul style="list-style-type: none"><li>• 25 KHz</li><li>• 12.5 KHz</li><li>• 6.25 KHz</li></ul>
Transmit/Receive Operation:	Half Duplex and Simplex Device
Rated Input Voltage and Current:	Nominal: +12 Vdc, 0.5A Extremes: +9 Vdc +24 Vdc
Operating Temperature Range:	-30°C to +50°C
ITU Emission Designator:	<u>PSK &amp; 16 QAM Modulation</u> 25 kHz Channel Spacing - 11K2G1D 12.5 kHz Channel Spacing - 5K71G1D 6.25 kHz Channel Spacing - 2K86G1D  <u>GMSK Modulation</u> 25 kHz Channel Spacing - 11K2F1D 12.5 kHz Channel Spacing - 5K91F1D 6.25 kHz Channel Spacing - 3K00F1D
Microprocessor(s) Model:	BF532SBBC-400
Clock/Oscillator(s):	12.288 MHz

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Frequency Stability:	1).. $\pm 1.5$ ppm initial (temperature variation) 2).. $\pm 0.5$ ppm aging/year 3).. $\pm 3$ ppm/10 years
Equipment Dimensions:	5.87" x 2.93" X 1.51" (137mm X 67mm x 29mm)
Weight:	8.8oz (250g)
Primary function of equipment:	System Monitoring and Control Applications

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### 3.2. Scope of Test Program

The scope of the test program was to verify that the GFU20-1 Narrowband Radio Modem complied with the unwanted emission limits against appropriate FCC and Industry Canada regulatory requirements;

FCC CFR 47 Part 90, Subsection I frequency band 430 – 470 MHz

Industry Canada RSS-119

The GFU20-1 is a technical variant of the AlphaWave AW400. The client declared the difference between variants is the case style enclosing the module electronics. The GFU20-1 instead of the metal case uses a plastic housing, see photograph. As full compliance testing was performed on the AlphaWave AW400, see MiCOM Labs test report ARWT01-A1 limited testing was completed on the GFU20-1. Test results reported in this document identify the additional testing i.e. unwanted emission measurements.

The GFU20-1 employs several modulation schemes in the frequency range 430 – 470 MHz;

- DBPSK
- DQPSK
- D8PSK
- 16 QAM
- GMSK

#### ArWest Communications GFU20-1





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### 3.3. Equipment Model(s) and Serial Number(s)

Name	Manufacturer	Model No.	Serial No.
GFU20-1	ArWest Communications Corp.	GFU20-1	Not Available

### 3.4. Antenna Details

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Serial No.
Gainflex	2.5	Kathrein Antenna Electronic	K71 53236	Not Available

### 3.5. Cabling and I/O Ports

Number and type of I/O ports

1. 8-pin socket Lemo Connector

### 3.6. Test Configurations

Matrix of test configurations

Parameter	Operational Mode	Test Conditions	Frequencies (MHz)
Unwanted Emissions	CW	Ambient	430, 450, 470

### 3.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. Receiver Biasing

Biasing on the receiver LNA was insufficient causing a spurious emission to be present only when the transmitter was in the off-state. The value of resistor R122 which provides bias to the first LNA was increased from 30 Ohm's to 49.9 Ohm's. Increasing this value cleared the emission and brought the EUT into compliance.



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### **3.8. Deviations from the Test Standard**

The following deviations from the test standard were required in order to complete the test program:

1. As the GFU20-1 is a technical variant of the Alphawave AW400 only unwanted emissions was completed as part of this program, see Section 3.2 Scope of Test Program for further information.

### **3.9. Subcontracted Testing or Third Party Data**

1. NONE

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## 4. TEST SUMMARY

### List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 90** and **Industry Canada RSS-119**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
<b>90.205(g)</b> <b>5.4</b>	Output Power	Average unmodulated and modulated Output Power	Conducted	Not Tested <sup>4</sup>	
<b>90.209(b)(5)</b> <b>90.210(d)</b> <b>5.5 &amp; 6.4</b>	Occupied BW & Emission Mask	Plot includes emission mask and bandwidth measurement	Conducted	Not Tested <sup>4</sup>	
<b>90.213</b> <b>7</b>	Frequency Stability	Includes temperature and voltage variations	Conducted	Not Tested <sup>4</sup>	
<b>90.210</b> <b>6.3</b>	Conducted Spurious Emissions  Transmitter  Receiver	Emissions from the antenna port  30MHz – 5 GHz 30MHz – 2 GHz	Conducted	Not Tested <sup>4</sup>	
<b>90.214</b> <b>6.5</b>	Transmitter Transient Behavior	Stabilization of RF frequency	Conducted	Not Tested <sup>4</sup>	
<b>90.210</b> <b>6.3</b>	Unwanted Emissions	Spurious emissions 30MHz–5GHz	Radiated	Complies	5.1.1

**Note 1:** Test results reported in this document relate only to the items tested

**Note 2:** The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria

**Note 3:** Section 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

**Note 4:** Section 3.2 Scope of Test Program explains why this parameter was untested.

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## 5. TEST RESULTS

### 5.1. Device Characteristics

#### 5.1.1. Unwanted Emissions

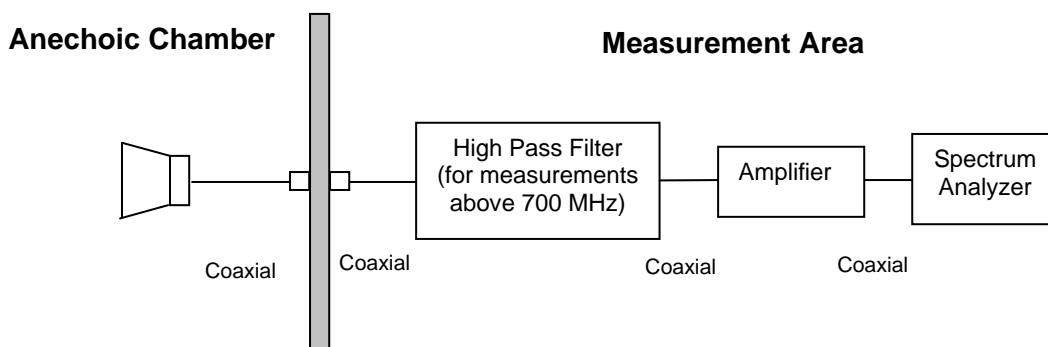
**FCC, Part 15 Subpart C §15.247(c)**  
**Industry Canada RSS-210 §6.3**

#### **Test Procedure**

Radiated emissions from 30 MHz to the 10<sup>th</sup> harmonic of the fundamental i.e. 5 GHz were measured in a CW operational mode. The antenna specified in Section 3.4 Antenna Details was installed during all measurements. The measurement equipment was set to measure in peak hold mode. The total transmitter output power was measured and expressed in similar units. The emissions were measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a high pass filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

Measurements below 1 GHz utilized 100 KHz RBW, measurements above 1 GHz were performed using a minimum RBW of 1 MHz.

#### **Test Measurement Set up**



Measurement set up for Radiated Emission Test



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Unwanted Emission Limits;

**25 kHz Channel Spacing: Emission Mask C**

On any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth: At least  $43 + 10 \log_{10}(P)$   
 $P = +33 \text{ dBm}$ , Attenuation = 46 dB

**12.5 kHz Channel Spacing: Emission Mask D**

On any frequency removed from the carrier frequency by a displacement frequency of than 12.5 kHz: At least  $50 + 10 \log_{10}(P)$  or 70 dB, whichever is the lesser attenuation.  
 $P = +33 \text{ dBm}$ , Attenuation = 53 dB

**6.25 kHz Channel Spacing: Emission Mask E**

On any frequency removed from the carrier frequency by more than 4.6 kHz: At least  $55 + 10 \log_{10}(P)$  or 65 dB, whichever is the lesser attenuation.  
 $P = +33 \text{ dBm}$ , Attenuation = 58 dB

**Calculated Limit**

The limits calculated for 6.25 kHz channel spacing (attenuation = 58 dB) is worst case therefore in CW operational mode emissions must be a minimum of 58 dB below the peak fundamental frequency. The peak fundamental amplitude was found for each of the following channels;

Channel	Polarity	Peak Fundamental (dB $\mu$ V/m)	Limit (peak - 58dB) (dB $\mu$ V/m)
430 MHz	H	115.41	57.41
450 MHz	H	115.95	57.95
470 MHz	H	116.65	58.65

The unwanted emission limit was set for worst case 57.41 dB $\mu$ V/m

Prior to unwanted emission testing the unmodulated output power was verified.

Center Frequency (MHz)	Power (dBm)
430	32.11
450	32.55
470	32.71

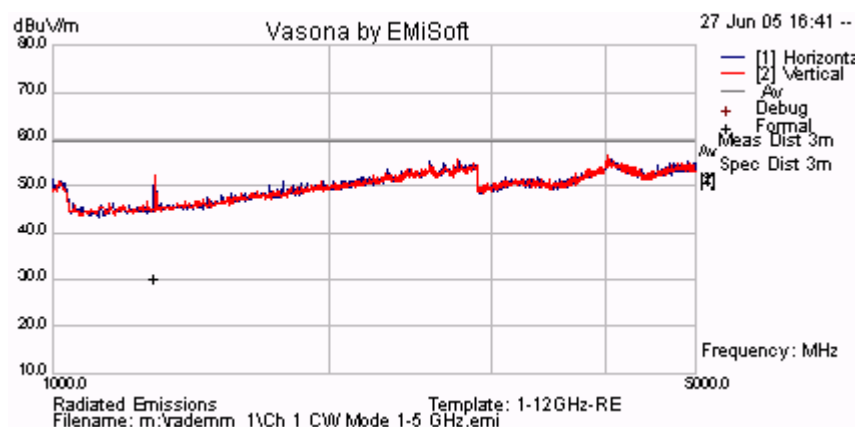
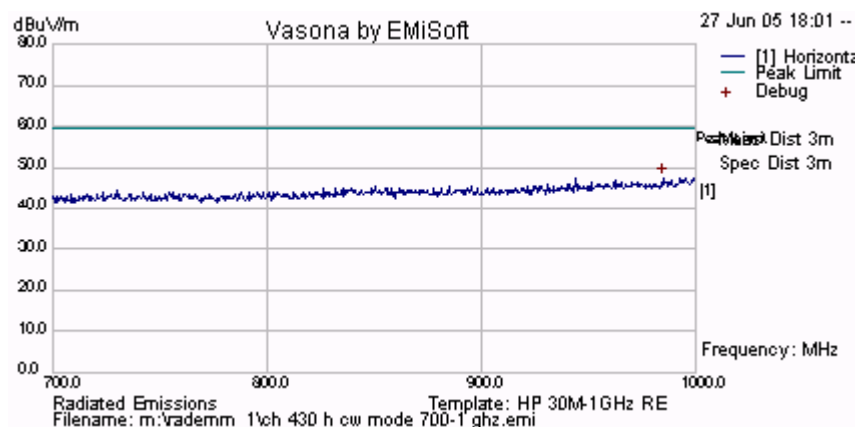
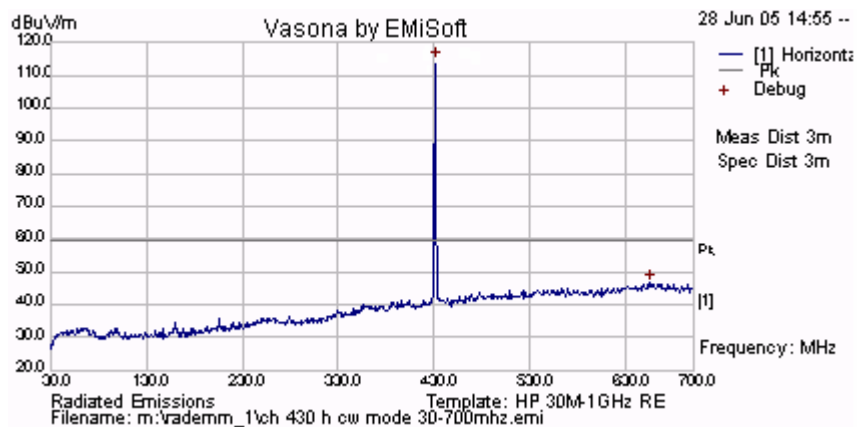
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### Channel 430 MHz



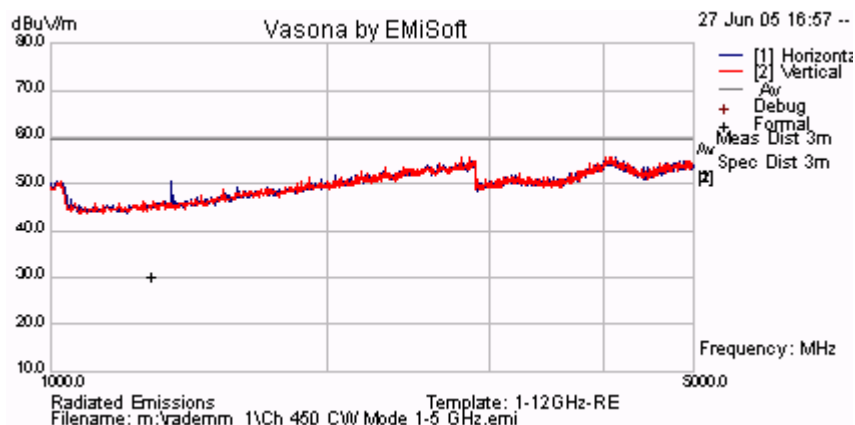
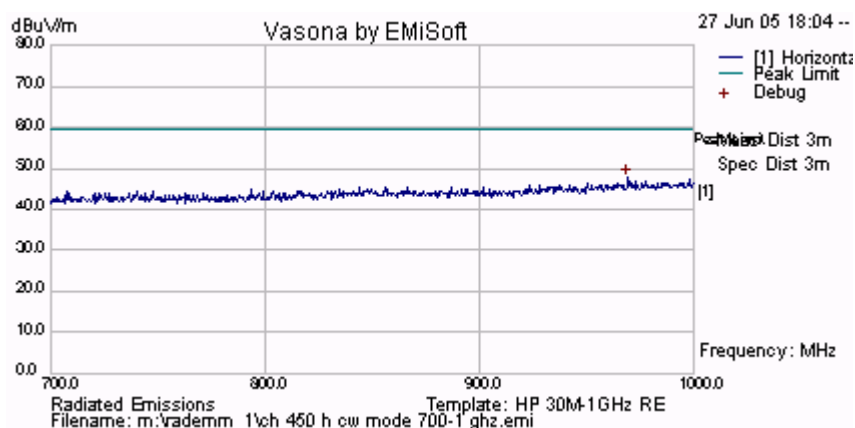
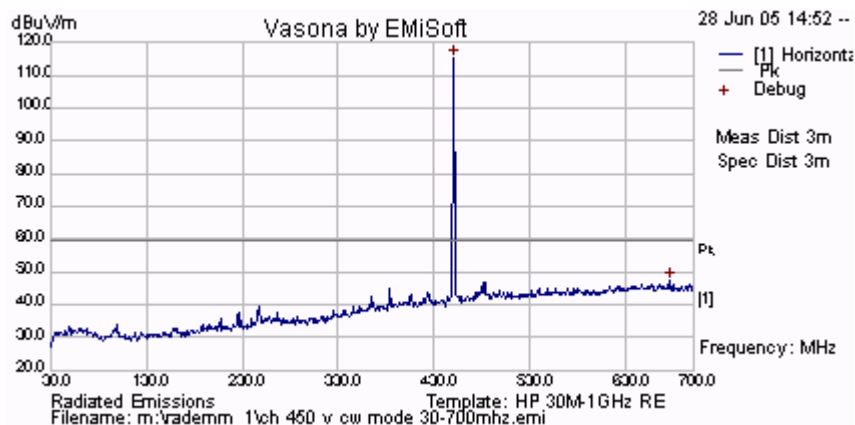
No peak emissions found on or above the limit

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### Channel 450 MHz



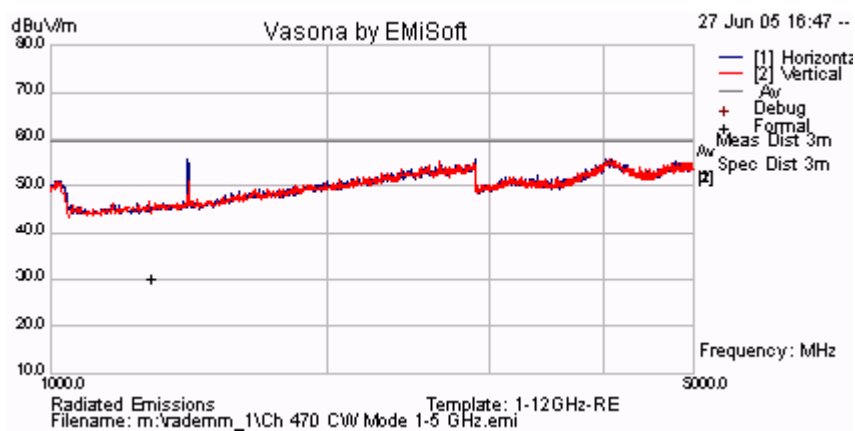
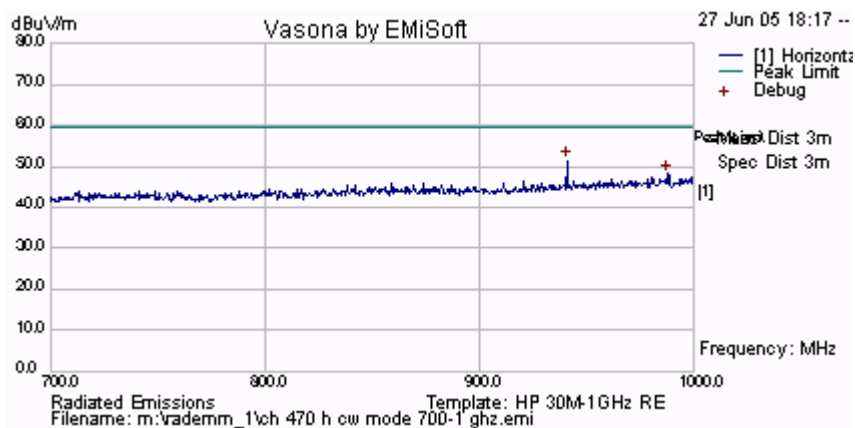
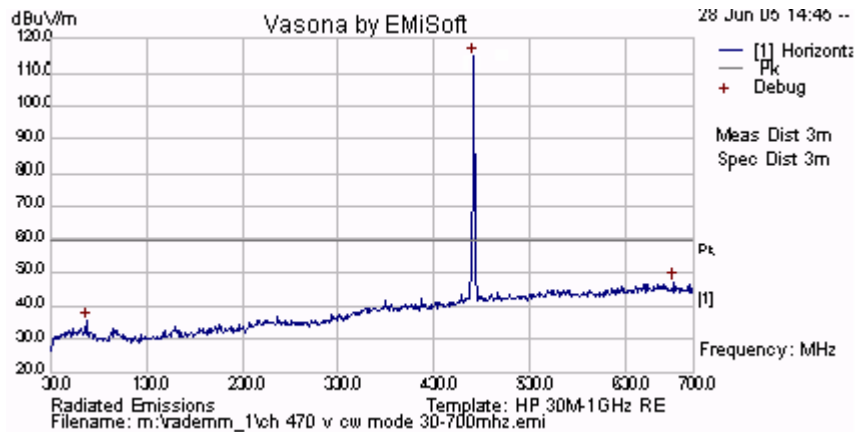
No peak emissions found on or above the limit

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### Channel 470 MHz



No peak emissions found on or above the limit

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#### Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
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#### Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0078, 0088, 0104, 0116, 0156, 0134, 0223, 0305, 0310, 0311, 0312

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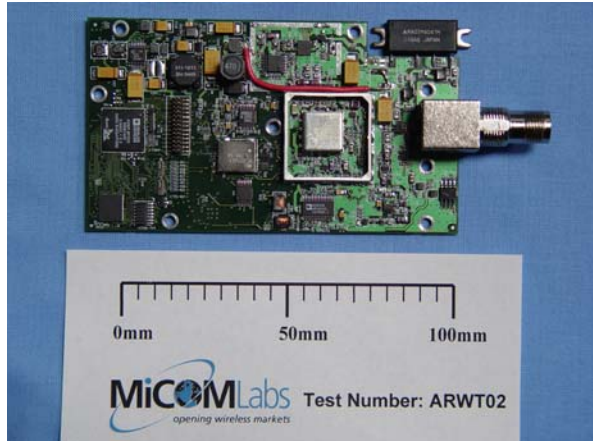
## 6. PHOTOGRAPHS

### 6.1. Unwanted Emissions (30 MHz - 5 GHz)

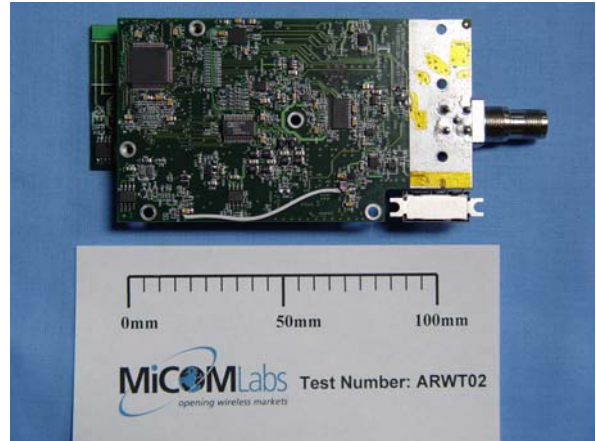


## 6.2. EUT Photographs

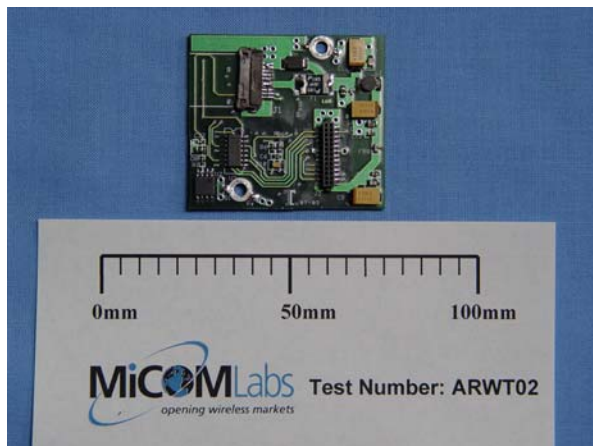
Top Side of Main Assembly



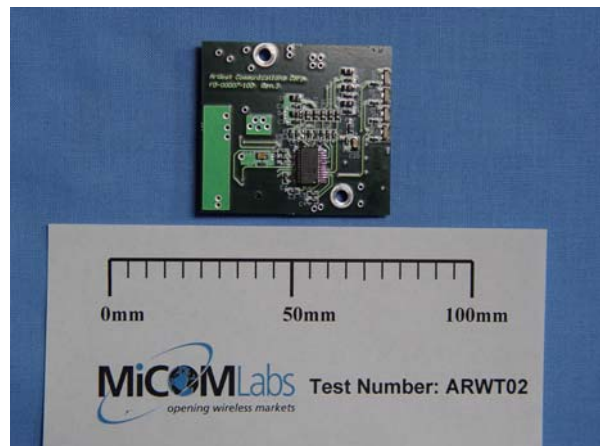
Lower Side of Main Assembly



Top Side of Sub Assembly



Lower Side of Sub Assembly







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## 7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Calibration Due Date	Serial #
0078	Antenna (30M-2GHz)	Schaffner and Chase	CBLG140A	Not Applicable	1195
0088	Spectrum Analyzer	Hewlett Packard	HP 8564E	22-Jun-06	3410A00141
0104	1-18GHz Horn Antenna	The Electro-Mechanics Company	3115	12 <sup>th</sup> Aug '05	9205-3882
0116	Power Sensor	Hewlett Packard	R8485A	7 <sup>th</sup> Apr '06	3318A19694
0134	Amplifier	Com Power	PA 122	1 <sup>st</sup> Sept '05	181910
0156	Barometer /Thermometer	Control Co.	4196	12 <sup>th</sup> Aug '05	E2844
0223	Power Meter	Hewlett Packard	HP EPM-442A	13 <sup>th</sup> May '06	3125U13554
0305	Amplifier	ML	ML001	24 <sup>th</sup> Nov '05	001
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	16 <sup>th</sup> Dec '05	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	16 <sup>th</sup> Dec '05	209092-001
0313	Coupler	Hewlett Packard	86205A	N/A	1623
--	High Pass Filter	Mini Circuits	SHP - 700	N/A	--

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