



UL International EMC Services  
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October 31, 2000

WAV, Inc.  
Attn: Mr. Chuck Bolvin  
245 West Roosevelt Road  
Building 7, Suite 48  
West Chicago, IL 60185

UL Reference: File MC1343, Project 00NK34916

Subject: EMC Test and Measurement Report for  
**Chameleon WLAN 80 Modular Transmitter**

Dear Mr. Bolvin:

We have provided with this letter your EMC Test Report for the above referenced model. The product was determined to comply with the requirements noted in the report.

Please review the attached report and direct any questions or comments to me. Samples were returned following testing.

We appreciate your interest in UL's EMC Services, and encourage you to contact us in the future should you need EMC test services. This closes Project 00NK34916.

Best regards,

Reviewed by:

A handwritten signature in black ink, appearing to read 'Jack Steiner'.

A handwritten signature in black ink, appearing to read 'Michael J. Windler'.

Jack Steiner (Ext 42307)  
Engineering Group Leader  
International EMC Services

Michael J. Windler  
Associate Managing Engineer  
International EMC Services

# EMC – TEST REPORT

Issue Date: October 31, 2000

## Ö EMISSIONS IMMUNITY

Test Report File No. : MC1343  
 Project No. : 00NK34916

Model / Type : Chameleon WLAN 80  
 Kind of Product : Modular Transmitter

Applicant : WAV, Inc.  
 License Holder : WAV, Inc.  
 Address : 245 West Roosevelt Road  
 : Building 7, Suite 48  
 : West Chicago, IL 60185

Manufacturer : Same as Applicant  
 :

**Test Result : COMPLIANT**

**This report without appendices consists of 10 pages. Appendix A contains test photos, Appendix B contains original test data, Appendix C contains sample calculations and Appendix D contains a block diagram of the measurement system.**

**The data contained in this report reflects only the items tested in the configurations and mode of operations described. An attempt has been made to arrange the EUT, with the equipment provided, into a test configuration which maximizes the observed emissions of the EUT while simulating, as close as practical, a typical end-use installation. The photos and data provided in this report document that configuration.**

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**Underwriters Laboratories Inc. 333 Pfingsten Rd. Northbrook, IL 60062  
 Fax: (847) 272-8864**

# REPORT DIRECTORY

<u>SECTION</u>	<u>TITLE</u>
----------------	--------------

## GENERAL

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| 1.2 | Environmental Conditions in Test Lab                  |
| 1.3 | Calibration Details of Equipment Used for Measurement |
| 1.4 | EUT (Equipment Under Test) Configuration              |
| 1.5 | Antenna Configuration                                 |
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| 1.7 | Device Modifications                                  |

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- |     |   |
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- |     |                           |
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- |     |                 |
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| B | Test Data                                   |
| C | Sample Calculations                         |
| D | Block Diagram of the Measurement System     |

## 1.0 GENERAL PRODUCT DESCRIPTION

The EUT is a 2.4GHz, direct sequence spread spectrum modular transmitter in a self-contained PCMCIA card.

The EUT is identical to a previously certified device (Lucent Technologies, Model LUC PC24 –H-FC, FCC ID: IMRWLPC24H), except for the following:

1. External antenna configurations.
2. The Lucent card was tested inside a host laptop computer. This EUT (Chameleon WLAN 80) was tested external to a laptop.

The original Lucent Test Report is attached as Attachment 1 (Senton Test Report No. 56305-90203-1) for reference purposes.

### 1.0.1 Equipment Mobility:

Table-top

### 1.0.2 Test Voltage and Frequency:

<u>Voltage (V)</u>	<u>Frequency (Hz)</u>
120	60

## 1.1 MODEL DIFFERENCES

**Any other model(s) represented by the models tested in this investigation will be documented by the manufacturer.**

## 1.2 ENVIRONMENTAL CONDITIONS IN TEST LAB

**Temperature: 20-25 °C**  
**Relative Humidity: 30-60% RH**  
**Atmospheric Pressure: 860-1060 mbar**

## 1.3 CALIBRATION OF EQUIPMENT USED FOR MEASUREMENT

**All test equipment and test accessories are calibrated on a regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less.**

**All test equipment calibrations are traceable to the National Institute of Standards and Technology (NIST), therefore, all test data recorded in this report is traceable to NIST.**

#### 1.4 EUT CONFIGURATION(s)

See Appendix A for individual set-up configuration(s). In addition to the EUT, the following peripheral devices and/or cables were connected during the measurement:

Device	Manufacturer	Model	Serial #	FCC ID
<b>EUT</b> <b>Chameleon</b> <b>WLAN 80</b> (Lucent Silver OEM 802.11b 2.4Ghz WLAN Adapter)	Lucent	Chameleon WLAN 80 (Lucent Model 012699/B)	00UT25330564	PB2WO80A (Lucent IMRWLPC24H)
CF-25 Laptop Computer	Panasonic	CF-25EGC2AAM	N/A	ACJ9TGCF-25
Lightning Arrestor	AMP	P/N: 15X24B999X	N/A	N/A
PCMCIA Card Extender	Swart	P/N: EXT-PCM-68-CC	N/A	N/A
PCMCIA Extender Cable Assembly 20cm	Card-Wize	P/N: FLEX-11	N/A	N/A
12 dBi <b>OMNI</b> Antenna	MobileMark	P/N: OD12-2400	N/A	N/A
13.5 dBi <b>YAGI</b> Antenna	Telex	P/N: 2415AB	N/A	N/A

Cable	Manuf.	Length	Type	Shield Type	Shield Termination
<b>YAGI</b> LMR-200 Coaxial Cable STD N	Lucent	20 feet	P/N: 848 274 171	Bonded aluminum foil and tinned copper braid	Continuous
<b>YAGI</b> Lucent to STD N Male Pigtail	Lucent	N/A	P/N: 848 223 350	N/A	N/A
<b>OMNI</b> Belden 9913 Coaxial Cable RP-TNC	Aironet	20 feet	P/N: 420-003346-020	Tinned copper braid	Continuous
<b>OMNI</b> Lucent to RP- TNC Jack Pigtail	WAV	N/A	P/N: LUC-RPJACK	N/A	N/A

## 1.5 ANTENNA CONFIGURATIONS COVERED

Antenna	EUT Output Power	Antenna Gain	Total EIRP	Exposure Category
*OMNI	15dBm (~32mW)	12 dBi	27dBm (~501mW)	Fixed
OMNI	15dBm (~32mW)	< 0dBi	15dBm (~32mW)	Portable
*YAGI	15 dBm (~32mW)	13.5 dBi	28.5dBm (~708mW)	Fixed
YAGI	15 dBm (~32mW)	8 dBi	23dBm (~200mW)	Fixed

\* These antennas were tested and considered representative of their families.

## 1.6 EUT OPERATING MODE(s)

**The equipment under test was operated during the measurements under the following conditions:**

Continuous operation.

## 1.7 DEVICE MODIFICATIONS

**The following modifications were necessary for compliance:**

None.

## 2.0 EMISSIONS TEST REGULATIONS

### 47 CFR Part 15 Subpart B: 1999 + ANSI C63.4 – 1992

#### The device was evaluated to 15.247 of CFR 47, Part 15

Since the EUT is identical to a previously certified device except as noted in Section 1.0, only a limited test program was required. Testing was covered / required as noted below:

Test / Requirement	CFR 47, Part 15 Reference	Test Required	Notes
Conducted emission	15.207	No	Considered covered by tests performed on previously certified device.
6dB Bandwidth	15.247(a)(2)	No	Considered covered by tests performed on previously certified device.
RF Conducted Peak Output Power	15.247(b)	No	Considered covered by tests performed on previously certified device.
Reduced output if directional gain exceeds 6dBi	15.247(b)(3)	No	Considered covered by tests performed on previously certified device.
RF Safety (SAR for portable devices)	15.247(b)(4)	Yes	<b>If employed in a portable device, antenna gain is limited to 0dBi to keep EIRP less than 50mW (actual ~32mW)</b>  <b>See statement in User's Manual</b>
Spurious emissions (RF conducted & radiated)	15.247(c)	<b>*Radiated Only</b>	Conducted spurious emissions considered covered by tests performed on previously certified device.  <b>Radiated spurious measurements were performed as part of this investigation.</b>
Power spectral density	15.247(d)	No	Considered covered by tests performed on previously certified device.
Processing gain	15.247(e)	No	Considered covered by tests performed on previously certified device.

\* The radiated measurements were performed on the highest gain antenna in each antenna family. Since the output power is not adjusted for different antenna configurations, measurements on highest output power configuration were also covered. Since the transmitter operates over a frequency range greater than 10MHz, measurements must be performed on low, mid and high channels per 15.31(m).

**RADIATED ELECTRIC FIELD EMISSIONS, 1 TO 4 GHz**Test Location

10 Meter Semi-Anechoic Chamber

UL Procedure

3014ANBK-LPG-002A

Test InstrumentsMeasurement Software

UL-EMC Program, Version V 3.02, validated May 15, 2000

Spectrum Analyzer

Rhode &amp; Schwarz, Model FSEK20, EMC No. 4182

Last Cal. 11-12-99, Next. Cal. 11-12-00

Antennas

EMCO, Model 3115, EMC No. 4033

Last Cal. 4-1-00, Next Cal. 4-1-01

Frequency Range of Measurement

1 to 4 GHz

Measurement Distance**\*2 meters**Test Results

The requirements are:

MET

Remarks

See App. B for complete test results.

\*To avoid overload in the transmit mode no preamplifier was used between 1 GHz and 4 GHz. Measurements were made at a 2 meter distance to allow an adequate margin between the measurement systems noise floor and the limit. The 2 meter limit was calculated as follows:

Limit above 960MHz per 15.209 is 500uV/m.

$500\mu\text{V/m} * (3 \text{ meter} / 2\text{meters}) = 750\mu\text{V/m}$

$20 \log (750\mu\text{V/m}) = \mathbf{57.5\text{dBuV/m}}$



## **RADIATED ELECTRIC FIELD EMISSIONS, 4 TO 18 GHz**

### Test Location

10 Meter Semi-Anechoic Chamber

### UL Procedure

3014ANBK-LPG-002A

### Test Instruments

#### Measurement Software

UL-EMC Program, Version V 3.02, validated May 15, 2000

#### Spectrum Analyzer

Rhode & Schwarz, Model FSEK20, EMC No. 4182

Last Cal. 11-12-99, Next. Cal. 11-12-00

#### Antennas

EMCO, Model 3115, EMC No. 4033

Last Cal. 4-1-00, Next Cal. 4-1-01

#### Filter/Amplifier Assembly,

Last Cal. 10-14-00, Next Cal. 10-14-01. Consists of the following:

Hewlett-Packard Step Attenuator, Model HP84904K (used for linearity check)

Cascaded 3.8GHz and 4.8GHz high pass filters, TTE Models H710-3.8G-50-A and H711-4.8G-50-A (attenuates fundamental 90dB)

Preamplifiers, MITEQ, Model ASF5-00501800-5, EMC No. 4194 and EMC No. 4195

### Frequency Range of Measurement

4 to 18 GHz

### Measurement Distance

**3 meters**

### Test Results

The requirements are: MET

### Remarks

See App. B for complete test results. To avoid overload in the transmit mode, two high pass filters were cascaded to attenuate the fundamental (2.4GHz) signal 90dB. These filters were located prior to the preamplifier stage to avoid overload of the preamplifiers. See Appendix D for a block diagram of the measurement system.

**RADIATED ELECTRIC FIELD EMISSIONS, 18 TO 26.5 GHz**

Test Location

10 Meter Semi-Anechoic Chamber

UL Procedure

3014ANBK-LPG-002A

Test Instruments

Measurement Software

UL-EMC Program, Version V 3.02, validated May 15, 2000

Spectrum Analyzer

Rhode & Schwarz, Model FSEK20, EMC No. 4182

Last Cal. 11-12-99, Next. Cal. 11-12-00

Antennas

ETS, Model 3160-09, EMC No. 4155

Filter/Amplifier Assembly,

Last Cal. 10-14-00, Next Cal. 10-14-01. Consists of the following:

Hewlett-Packard Step Attenuator, Model HP84904K (used for linearity check)

Preamplifiers, MITEQ, Models AFS44-00102650-40-10P-44 and AFS42-00102650-40-10P-42, EMC No. 4186 and EMC No. 4192

Frequency Range of Measurement

18 to 26.5 GHz

Measurement Distance

**3 meters**

Test Results

The requirements are:

MET

Remarks

See App. B for complete test results.

The attenuation of fundamental signal (2.4GHz) by the horn antenna is sufficient to avoid overload of the preamplifier stage. See Appendix D for a block diagram of the measurement system.

### 3.0 IMMUNITY TEST REGULATIONS

**Immunity testing was not performed.**

### 4.0 GENERAL REMARKS

Sample Receipt Date : October 20, 2000

Test Dates

Start : October 20, 2000

End : October 20, 2000

### 4.1 SUMMARY

The requirements according to the technical regulations are:

MET

Underwriters Laboratories Inc.  
333 Pfingsten Road  
Northbrook, IL 60062 USA

**FCC Site Number: 31040/SIT 1300F2**

Test Engineer:



Jack Steiner (Ext 42307)  
Engineering Group Leader  
International EMC Services

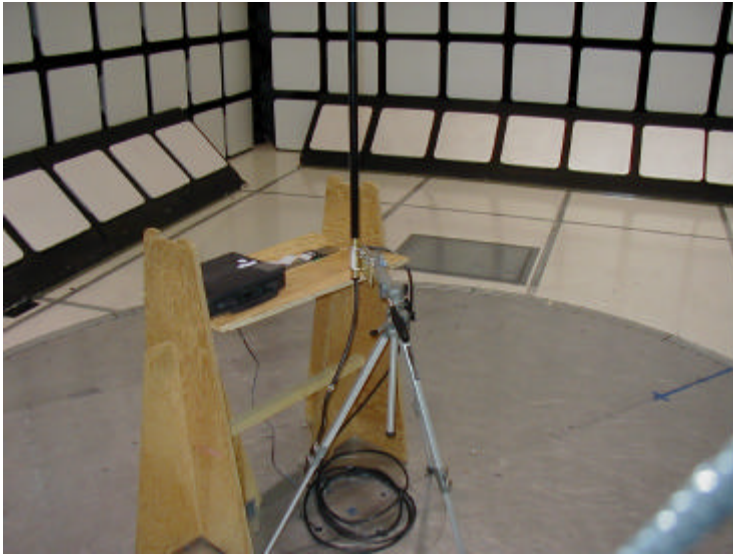
Reviewed by:



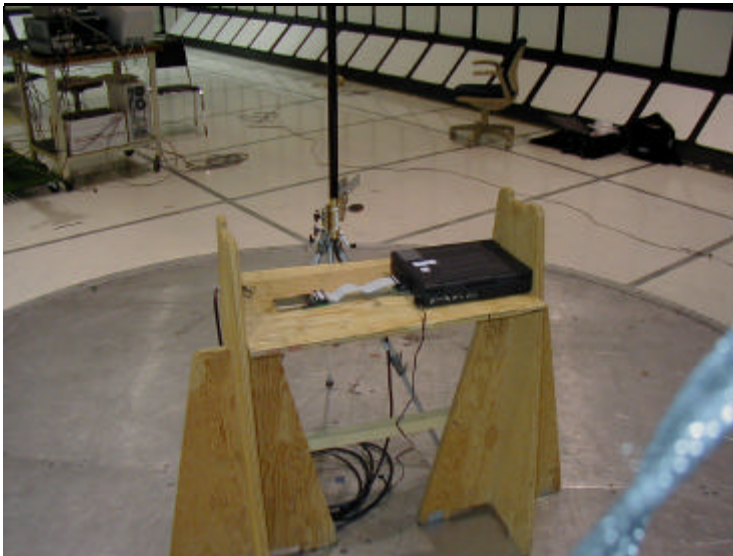
Michael J. Windler  
Associate Managing Engineer  
International EMC Services

**APPENDIX A**

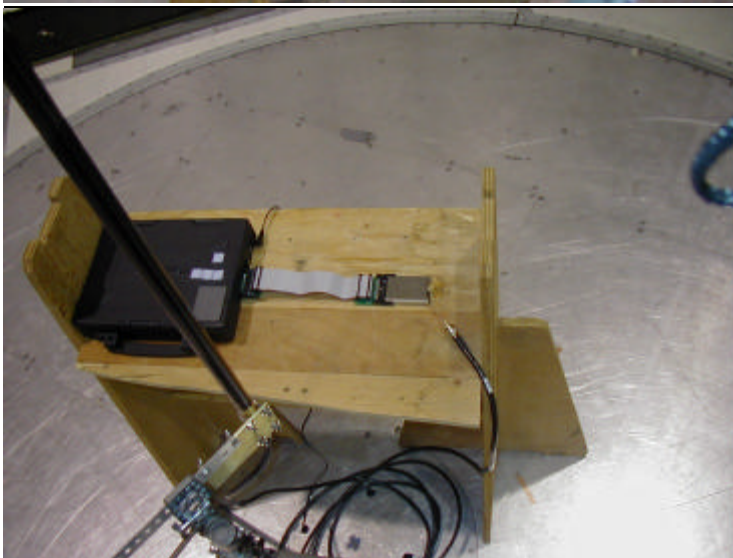
**PHOTOS**



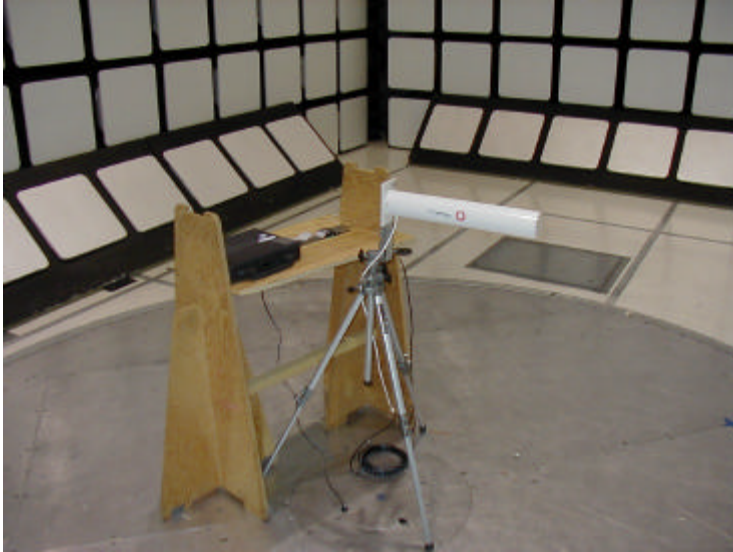
**Radiated Emissions  
OMNI Antenna**



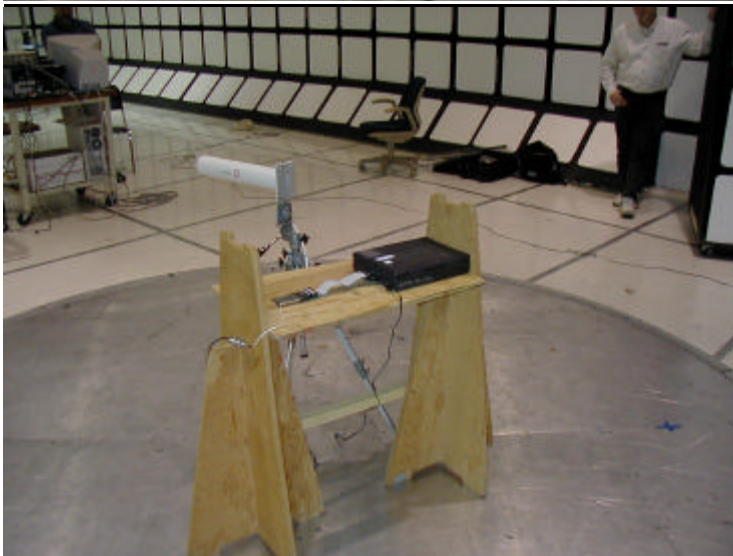
**Radiated Emissions  
OMNI Antenna**



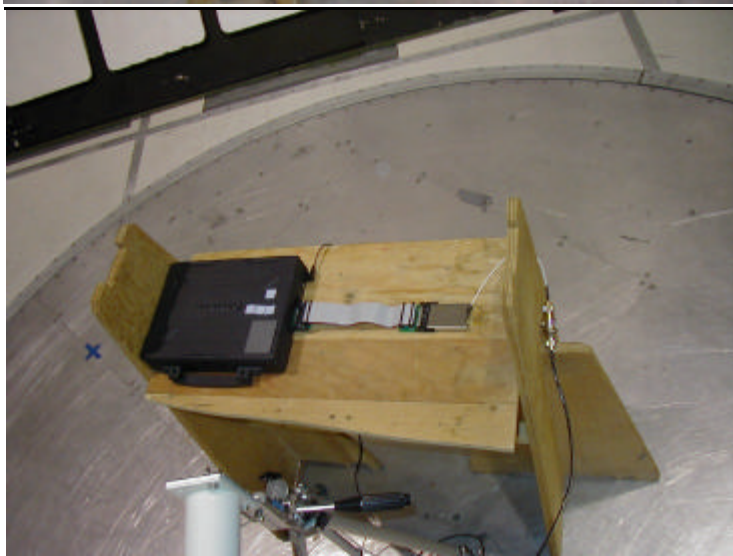
**Radiated Emissions  
OMNI Antenna**



**Radiated Emissions  
YAGI Antenna**



**YAGI Antenna**



**YAGI Antenna**

**APPENDIX B**

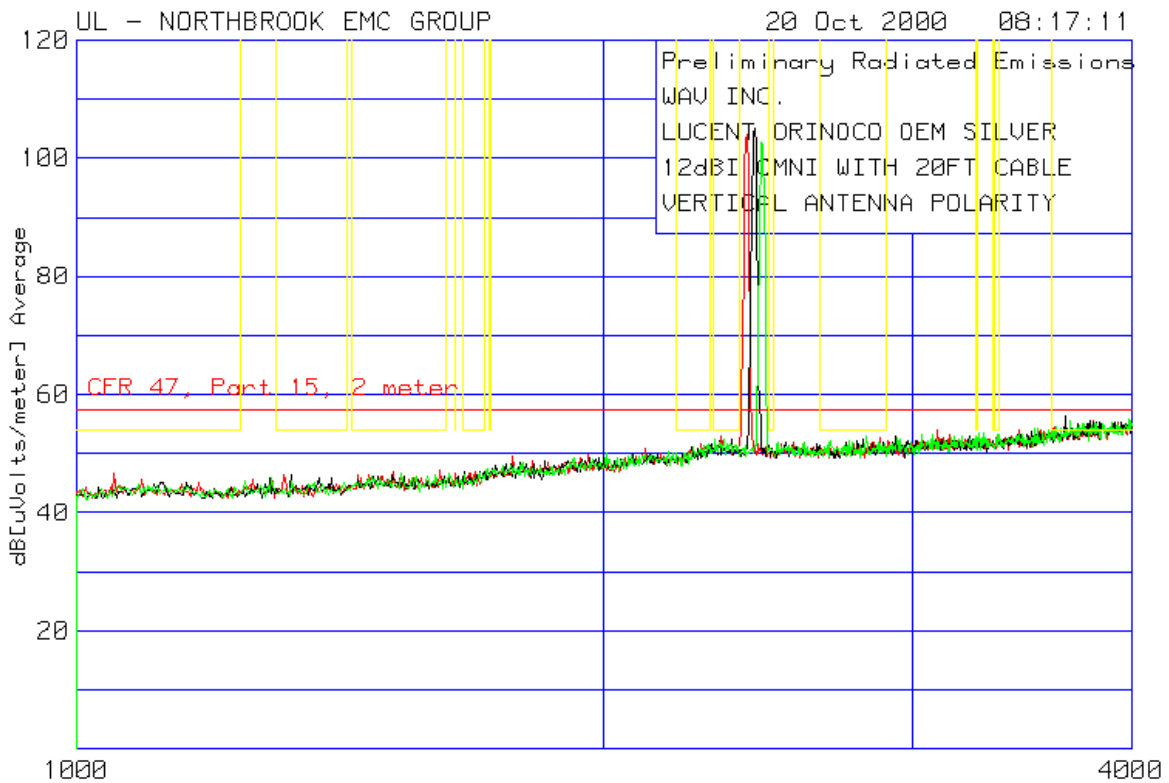
**TEST DATA**

**EMISSIONS**

Radiated Electric Field Emissions, OMNI Antenna, Pages B2 to B9  
Radiated Electric Field Emissions, YAGI Antenna, Pages B9 to B17

**Radiated Spurious Emissions, 1 to 4GHz**  
**Measurement Antenna - Vertical**  
**Transmit Antenna – 12dBi OMNI**  
RBW = VBW = 1 MHz

**Preliminary Peak Data**





**Preliminary Peak Data**

RBW = VBW = 1 MHz

WAV INC.  
 LUCENT ORINOCO OEM SILVER  
 12dBI OMNI WITH 20FT CABLE  
 VERTICAL ANTENNA POLARITY

Test	Meter	Gain/Loss	Transducer	Level	Limit:1	2	3	4
Frequency	Reading	Factor	Factor	dB[uVolts/meter]				
[MHz]	[dB(uV)]	[dB]	[dB]					
=====								
Low Channel								
2414.414	71.83 pk	2	30.3	104.13	57.5	999	N/A	N/A
Azimuth: N/A		Height:100 Vert		Margin [dB]	46.63	-894.87	N/A	N/A
Mid Channel								
2438.438	72.78 pk	2	30.4	105.18	57.5	999	N/A	N/A
Azimuth: N/A		Height:100 Vert		Margin [dB]	47.68	-893.82	N/A	N/A
High Channel								
2459.459	70.23 pk	2	30.5	102.73	57.5	999	N/A	N/A
Azimuth: N/A		Height:100 Vert		Margin [dB]	45.23	-896.27	N/A	N/A

- LIMIT 1: CFR 47, Part 15, 2 meter
- LIMIT 2: FCC Restricted Bands 1
- LIMIT 3: FCC Restricted Bands 2
- LIMIT 4: FCC Restricted Bands 3

**Final Maximized Average Data**  
**Azimuth – 0 to 360 degrees**  
**Antenna Height – 0.75 to 2.5 meters**  
**RBW = 1 MHz, VBW = 10Hz**

WAV INC.  
 LUCENT ORINOCO OEM SILVER  
 12dBI OMNI WITH 20FT CABLE  
 VERTICAL ANTENNA POLARITY

Test	Meter	Gain/Loss	Transducer	Level	Limit:1	2	3	4
Frequency	Reading	Factor	Factor	dB[uVolts/meter]				
[MHz]	[dB(uV)]	[dB]	[dB]					

=====

Low Channel, **Not in restricted band**  
 2413.2104 76.09 av 2 30.3 108.39 57.5 999 N/A N/A  
 Azimuth: 357 Height:121 Vert Margin [dB] 50.89 -890.61 N/A N/A

Low Channel, **Band-Edge measurement**  
 2390 17.6 av 2 30.3 49.9 57.5 999 N/A N/A  
 Azimuth: 357 Height:121 Vert Margin [dB] **-7.6** -949.1 N/A N/A

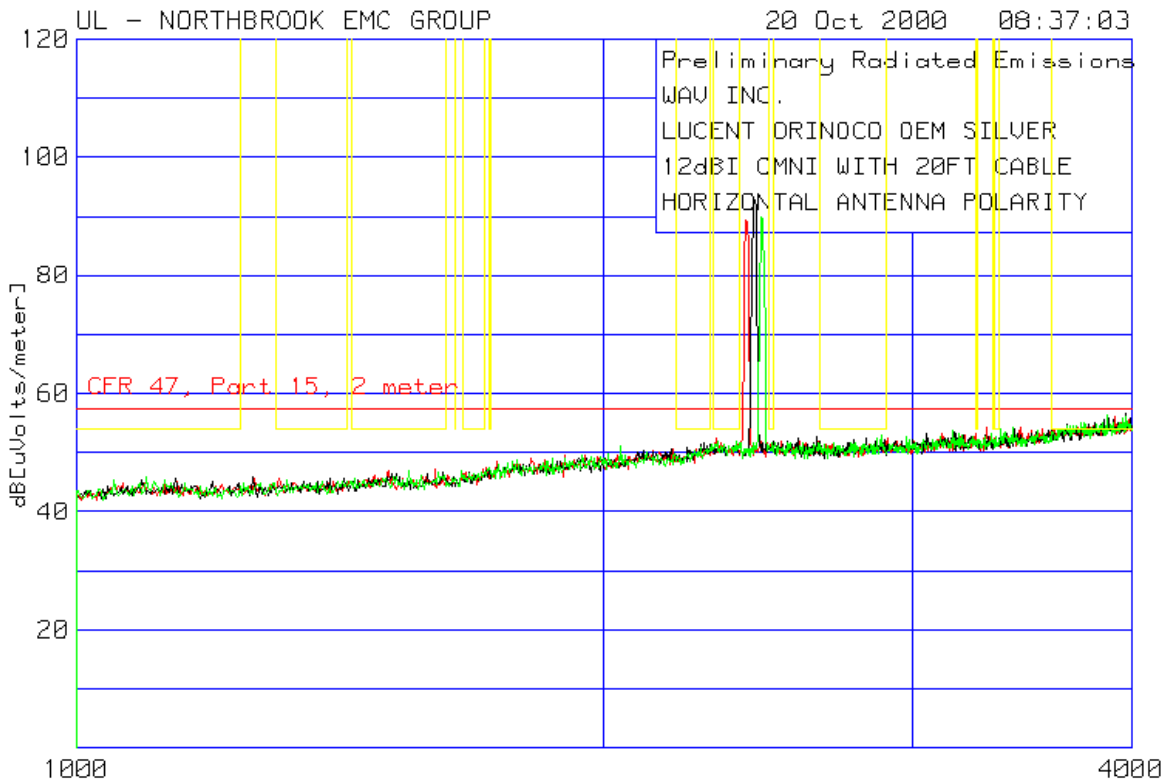
High Channel, **Not in restricted band**  
 2459.5571 74.53 av 2 30.5 107.03 57.5 999 N/A N/A  
 Azimuth: 206 Height:121 Vert Margin [dB] 49.53 -891.97 N/A N/A

High Channel, **Band-Edge measurement**  
 2483.5 15.69 av 2 30.6 48.29 57.5 54 N/A N/A  
 Azimuth: 206 Height:121 Vert Margin [dB] **-9.21** -5.71 N/A N/A

LIMIT 1: CFR 47, Part 15, 2 meter  
 LIMIT 2: FCC Restricted Bands 1  
 LIMIT 3: FCC Restricted Bands 2  
 LIMIT 4: FCC Restricted Bands 3

**Radiated Spurious Emissions, 1 to 4GHz**  
**Measurement Antenna - Horizontal**  
**Transmit Antenna – 12dBi OMNI**  
RBW = VBW = 1 MHz

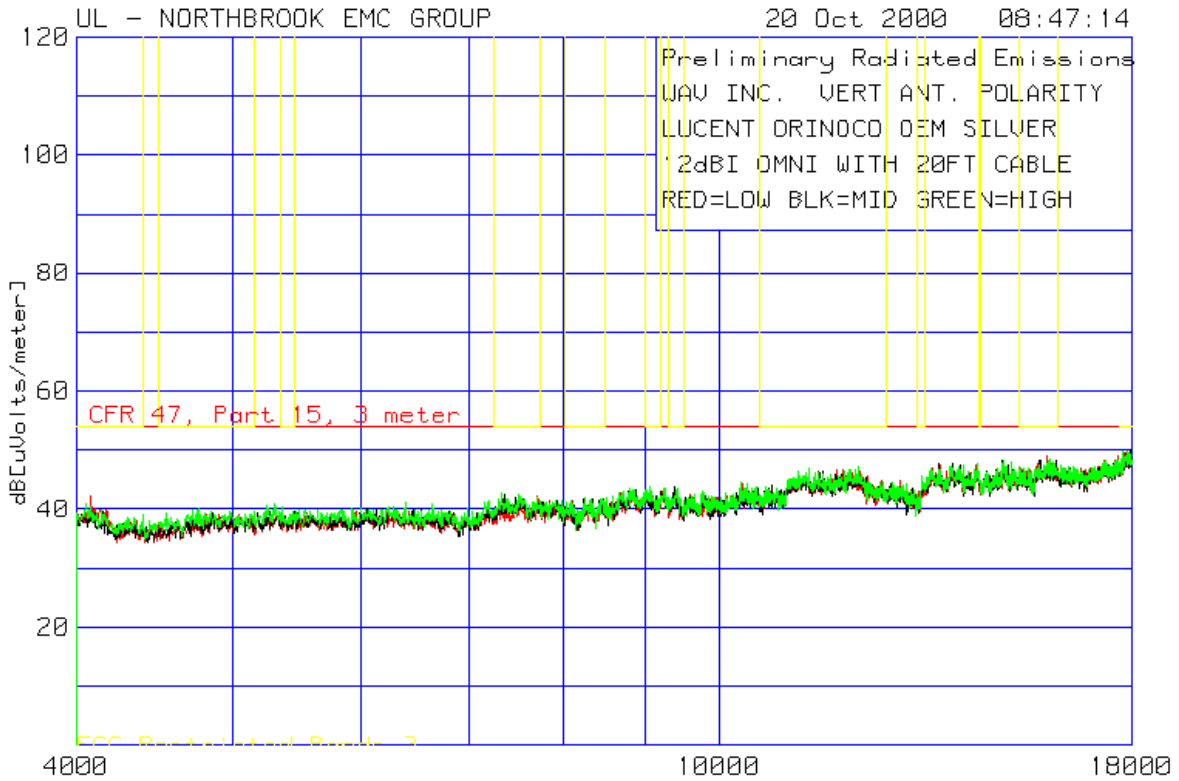
**Preliminary Peak Data**



**Average measurements were not considered necessary in the horizontal antenna polarity based on preliminary data. Measurements in vertical polarity were considered to cover horizontal polarity data (vertical more severe).**

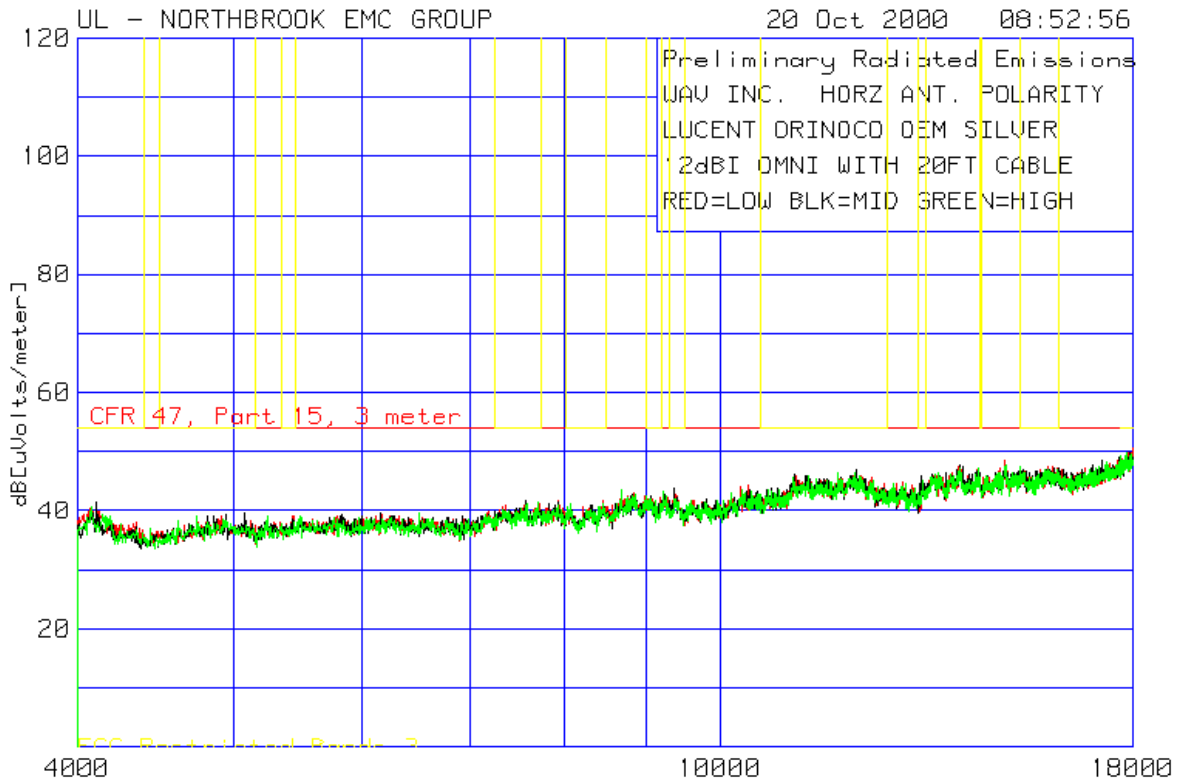
**Radiated Spurious Emissions, 4 to 18GHz**  
**Measurement Antenna - Vertical**  
**Transmit Antenna – 12dBi OMNI**  
RBW = VBW = 1 MHz

**Preliminary Peak Data**



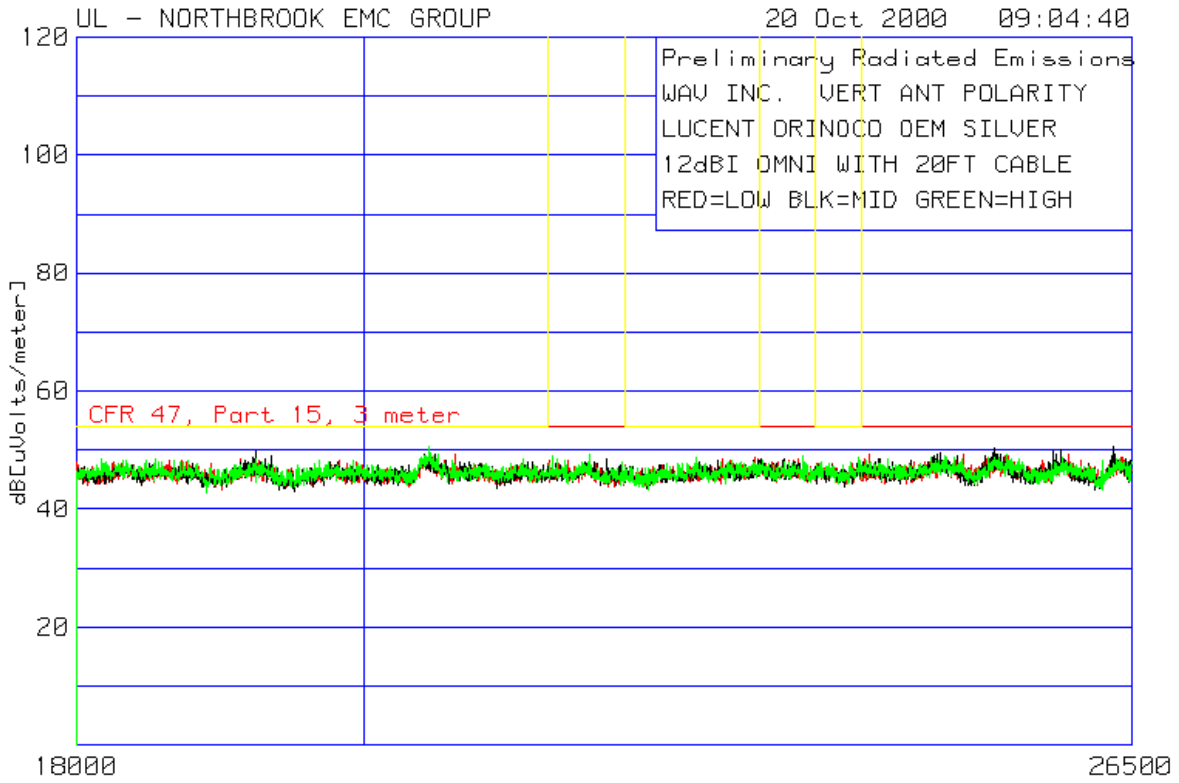
**Radiated Spurious Emissions, 4 to 18GHz**  
**Measurement Antenna - Horizontal**  
**Transmit Antenna – 12dBi OMNI**  
RBW = VBW = 1 MHz

**Preliminary Peak Data**



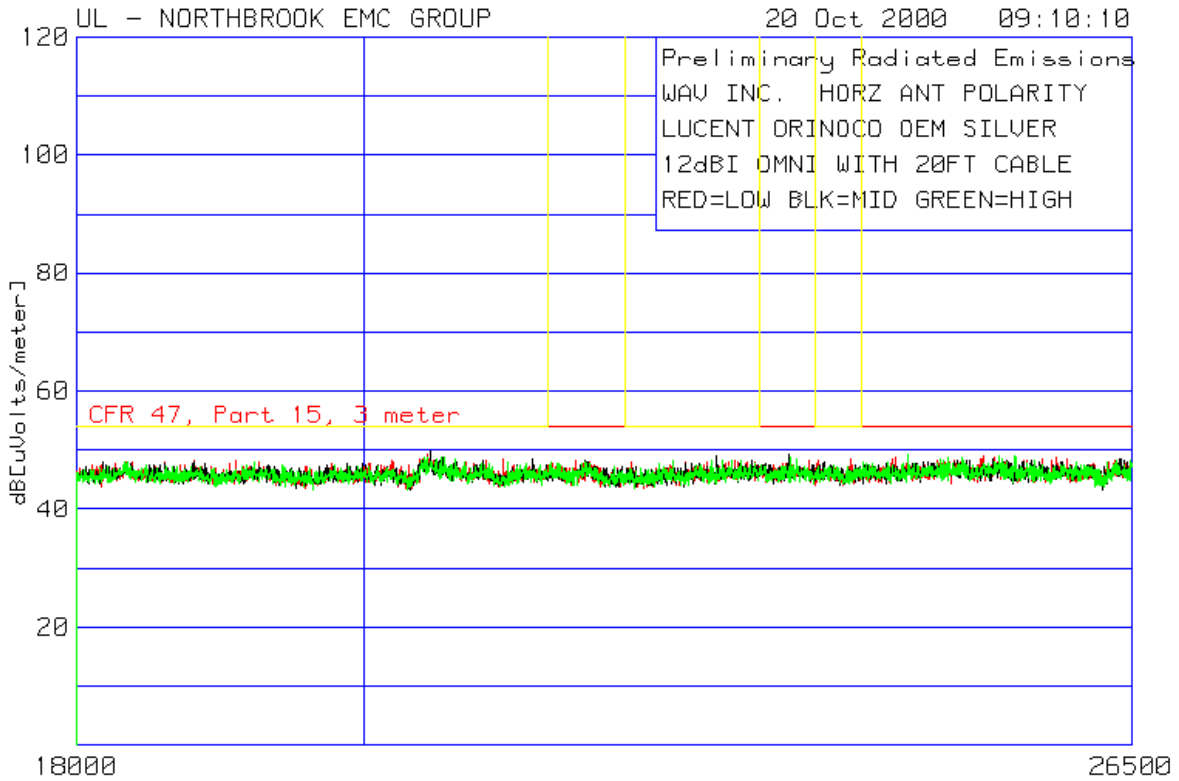
**Radiated Spurious Emissions, 18 to 26.5GHz**  
**Measurement Antenna - Vertical**  
**Transmit Antenna – 12dBi OMNI**  
RBW = VBW = 1 MHz

**Preliminary Peak Data**



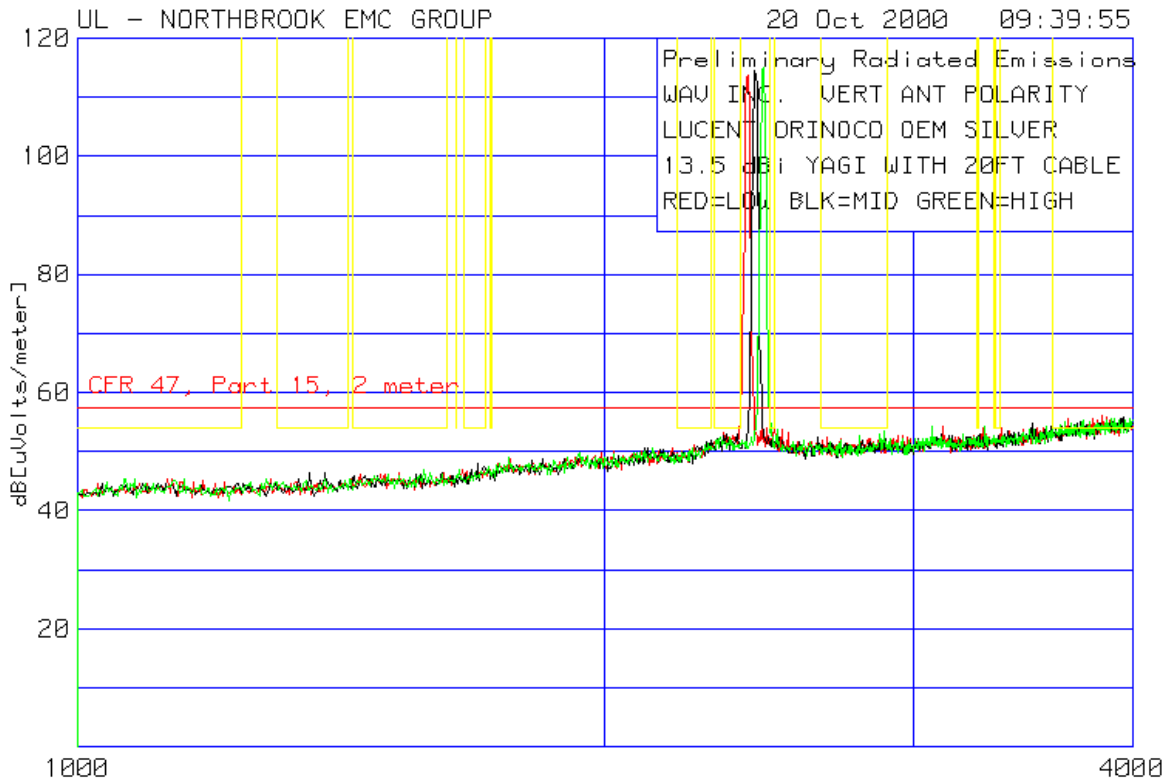
**Radiated Spurious Emissions, 18 to 26.5GHz**  
**Measurement Antenna - Horizontal**  
**Transmit Antenna – 12dBi OMNI**  
RBW = VBW = 1 MHz

**Preliminary Peak Data**



**Radiated Spurious Emissions, 1 to 4GHz**  
**Measurement Antenna - Vertical**  
**Transmit Antenna – 13.5dBi YAGI**  
RBW = VBW = 1 MHz

**Preliminary Peak Data**





**Preliminary Peak Data**

RBW = VBW = 1 MHz

WAV INC. VERT ANT POLARITY  
 LUCENT ORINOCO OEM SILVER  
 13.5 dBi YAGI WITH 20FT CABLE  
 RED=LOW BLK=MID GREEN=HIGH

Test	Meter	Gain/Loss	Transducer	Level	Limit:1	2	3	4
Frequency	Reading	Factor	Factor	dB[uVolts/meter]				
[MHz]	[dB(uV)]	[dB]	[dB]	[dB]				

Low Channel

2414.414	81.43 pk	2	30.3	113.73	57.5	999	N/A	N/A
Azimuth: N/A		Height:100		Horz Margin [dB]		56.23	-885.27	N/A N/A

Mid Channel

2435.435	82.07 pk	2	30.4	114.47	57.5	999	N/A	N/A
Azimuth: N/A		Height:100		Horz Margin [dB]		56.97	-884.53	N/A N/A

High Channel

2462.462	82.52 pk	2	30.5	115.02	57.5	999	N/A	N/A
Azimuth: N/A		Height:100		Horz Margin [dB]		57.52	-883.98	N/A N/A

- LIMIT 1: CFR 47, Part 15, 2 meter
- LIMIT 2: FCC Restricted Bands 1
- LIMIT 3: FCC Restricted Bands 2
- LIMIT 4: FCC Restricted Bands 3

**Final Maximized Average Data**  
**Azimuth – 0 to 360 degrees**  
**Antenna Height – 0.75 to 2.5 meters**  
**RBW = 1 MHz, VBW = 10Hz**

WAV INC. VERT ANT POLARITY  
 LUCENT ORINOCO OEM SILVER  
 13.5 dBi YAGI WITH 20FT CABLE  
 RED=LOW BLK=MID GREEN=HIGH

Test	Meter	Gain/Loss	Transducer	Level	Limit:1	2	3	4
Frequency	Reading	Factor	Factor	dB[uVolts/meter]				
[MHz]	[dB(uV)]	[dB]	[dB]					

=====

Low Channel, **Not in restricted band**  
 2413.2074 84.36 av 2 30.3 116.66 57.5 999 N/A N/A  
 Azimuth: 359 Height:109 Horz Margin [dB] 59.16 -882.34 N/A N/A

Low Channel, **Band-Edge measurement**  
 2390 21.07 av 2 30.3 53.37 57.5 999 N/A N/A  
 Azimuth: 359 Height:109 Horz Margin [dB] **-4.13** -945.63 N/A N/A

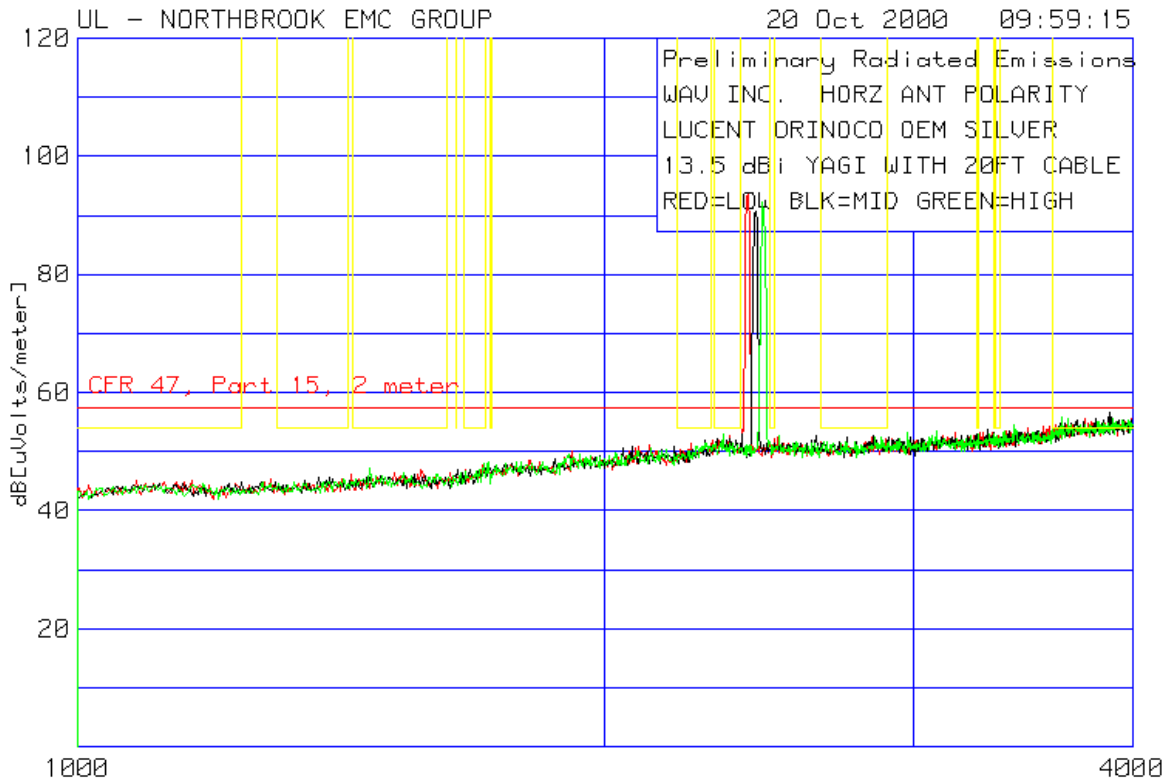
High Channel, **Not in restricted band**  
 2462.9188 84.16 av 2 30.5 116.66 57.5 999 N/A N/A  
 Azimuth: 357 Height:111 Horz Margin [dB] 59.16 -882.34 N/A N/A

High Channel, **Band-Edge measurement**  
 2483.5 20.11 av 2 30.6 52.71 57.5 54 N/A N/A  
 Azimuth: 357 Height:111 Horz Margin [dB] **-4.79** -1.29 N/A N/A

LIMIT 1: CFR 47, Part 15, 2 meter  
 LIMIT 2: FCC Restricted Bands 1  
 LIMIT 3: FCC Restricted Bands 2  
 LIMIT 4: FCC Restricted Bands 3

**Radiated Spurious Emissions, 1 to 4GHz**  
**Measurement Antenna - Horizontal**  
**Transmit Antenna – 13.5dBi YAGI**  
 RBW = VBW = 1 MHz

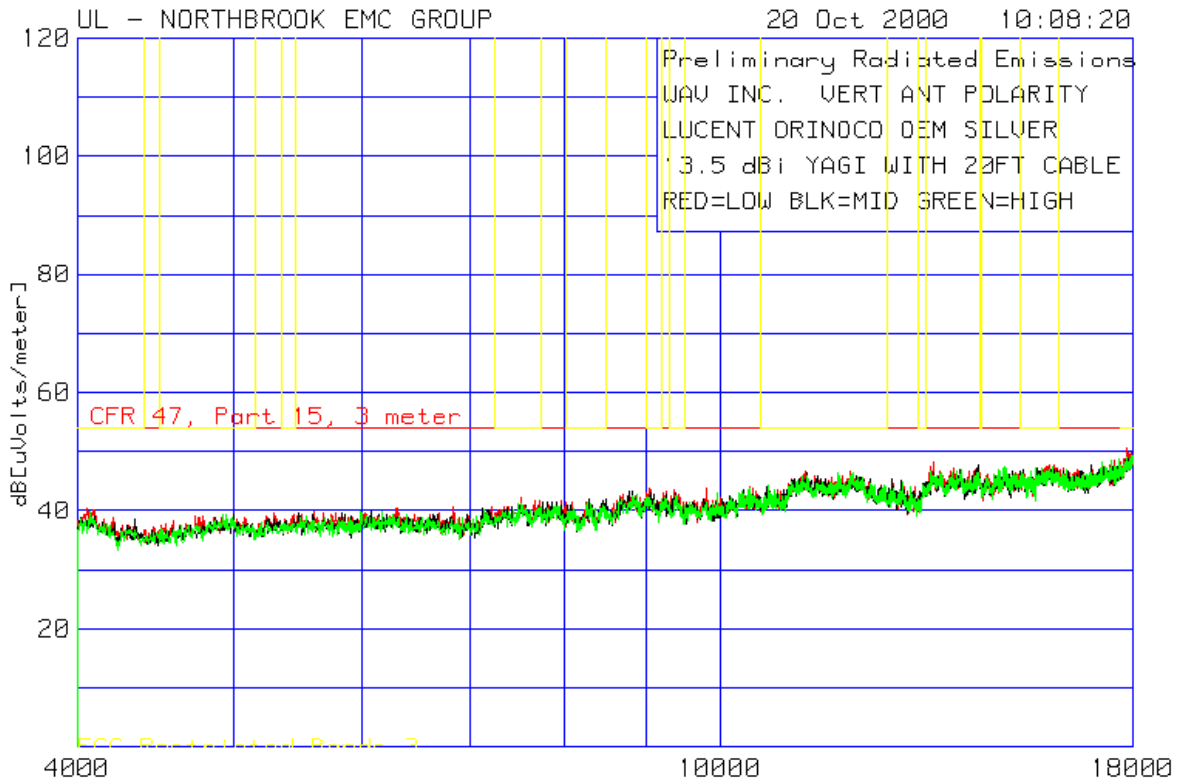
**Preliminary Peak Data**



**Average measurements were not considered necessary in the horizontal antenna polarity based on preliminary data. Measurements in vertical polarity were considered to cover horizontal polarity data (vertical more severe).**

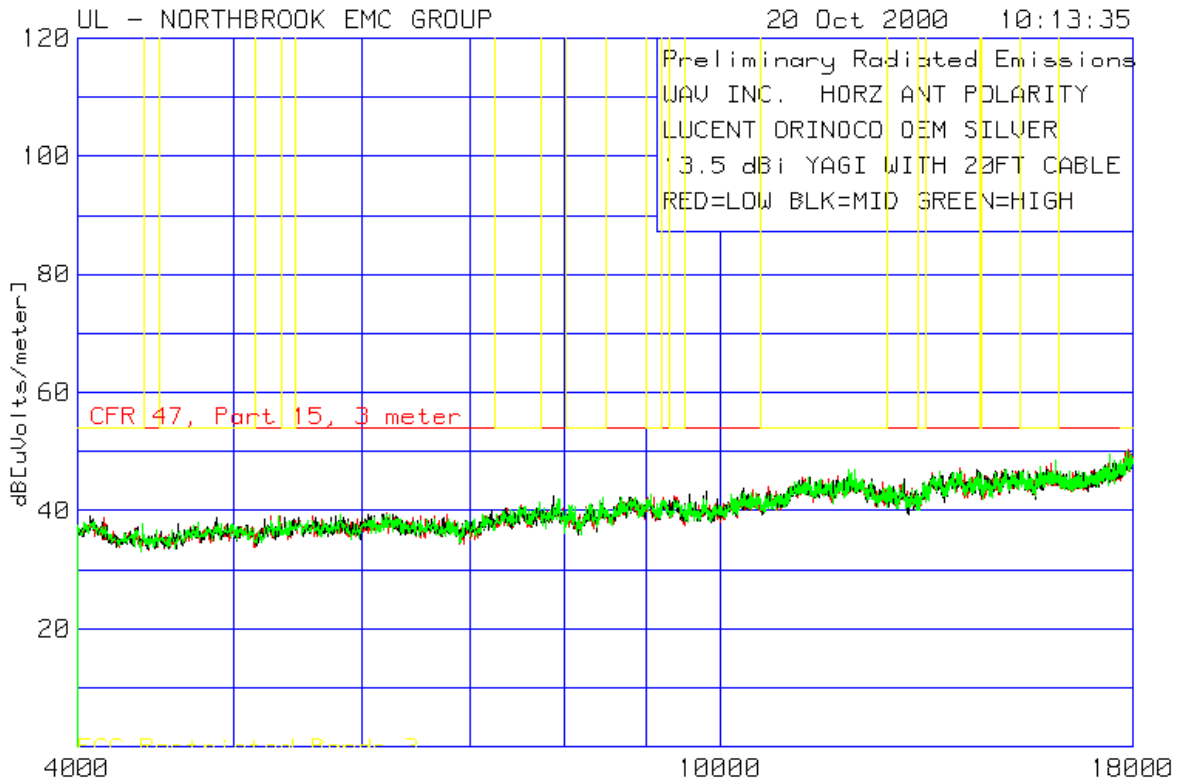
**Radiated Spurious Emissions, 4 to 18GHz**  
**Measurement Antenna - Vertical**  
**Transmit Antenna – 13.5dBi YAGI**  
RBW = VBW = 1 MHz

**Preliminary Peak Data**



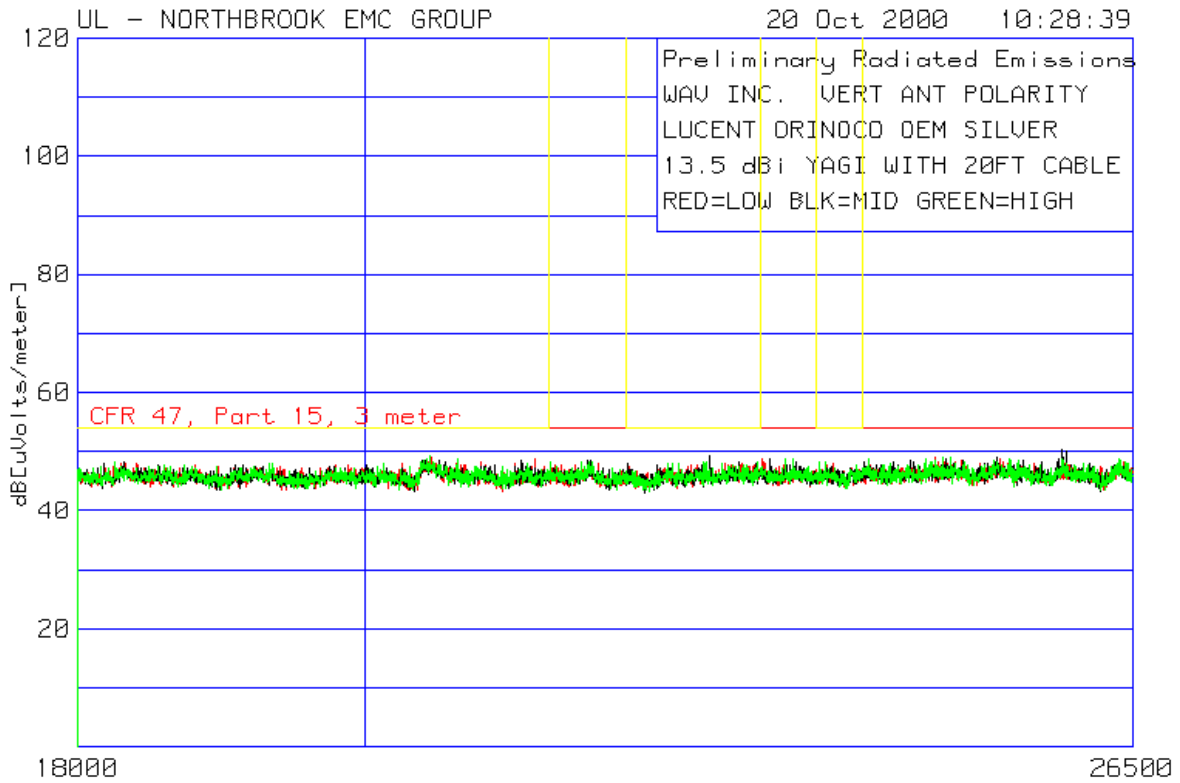
**Radiated Spurious Emissions, 4 to 18GHz**  
**Measurement Antenna - Horizontal**  
**Transmit Antenna – 13.5dBi YAGI**  
RBW = VBW = 1 MHz

**Preliminary Peak Data**



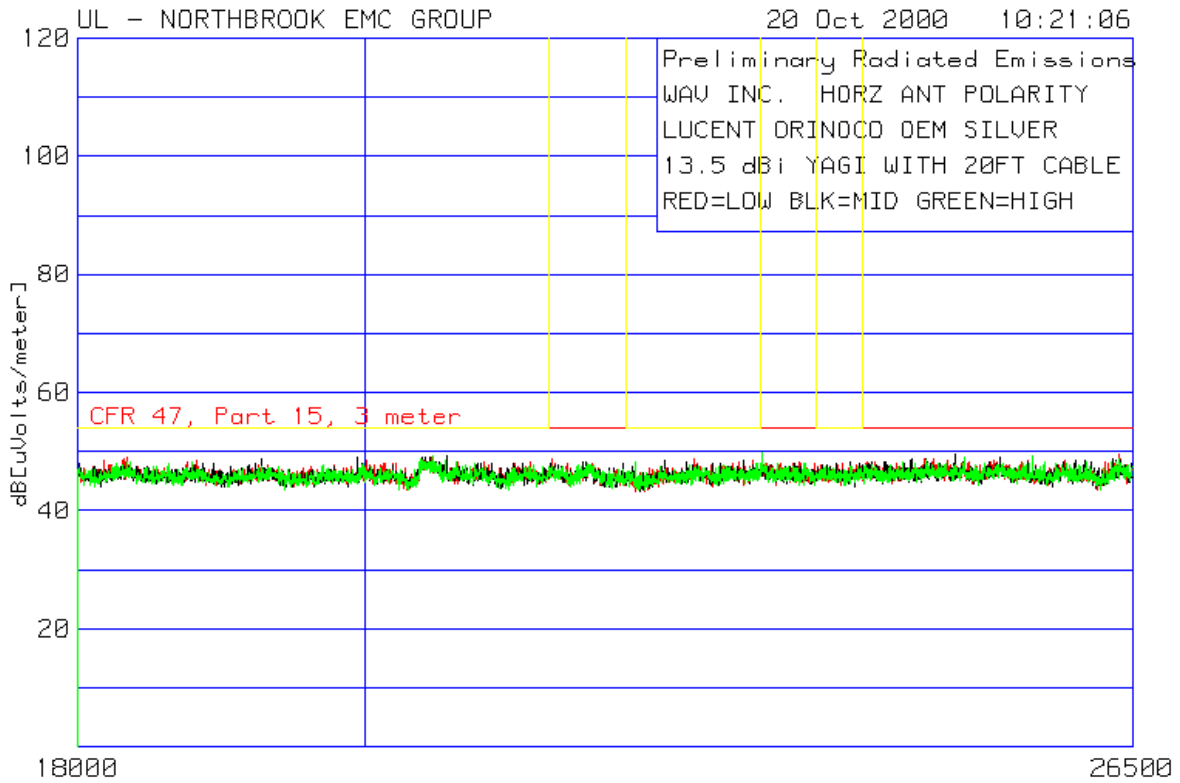
**Radiated Spurious Emissions, 18 to 26.5GHz**  
**Measurement Antenna - Vertical**  
**Transmit Antenna – 13.5dBi YAGI**  
RBW = VBW = 1 MHz

**Preliminary Peak Data**



**Radiated Spurious Emissions, 18 to 26.5GHz**  
**Measurement Antenna - Horizontal**  
**Transmit Antenna – 13.5dBi YAGI**  
RBW = VBW = 1 MHz

**Preliminary Peak Data**



## APPENDIX C

### Sample Calculations of Field Strengths

#### Basic Equation:

The field strength is calculated by adding the Meter Reading, Cable Set Gain/Loss and Transducer (Antenna or LISN) Factor. The basic equation is as follows:

$$FS = MR + GL + TF$$

Where:

FS = Calculated Field Strength in dB(uV)/meter

MR = Meter Reading of receiver amplitude in dB(uV)

GL = Gain/Loss factor of cable set in dB

A negative Gain/Loss indicates signal amplification (gain)

A positive Gain/Loss indicates signal attenuation (loss)

TF = Transducer Factor of antenna or LISN in dB

#### Sample Calculation:

The measured receiver amplitude is 52.7 dB(uV).

The gain/loss factor is -30.2 dB (indicating a preamplifier is included in the cable set).

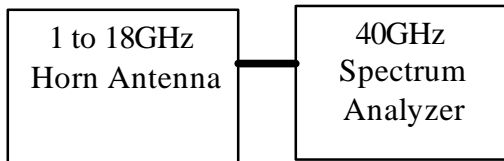
The transducer factor (antenna factor) is 6.6 dB.

These factors are added ( $52.7 + (-30.2) + 6.6$ ) resulting in a calculated field strength of 29.1 dB(uV)/meter.

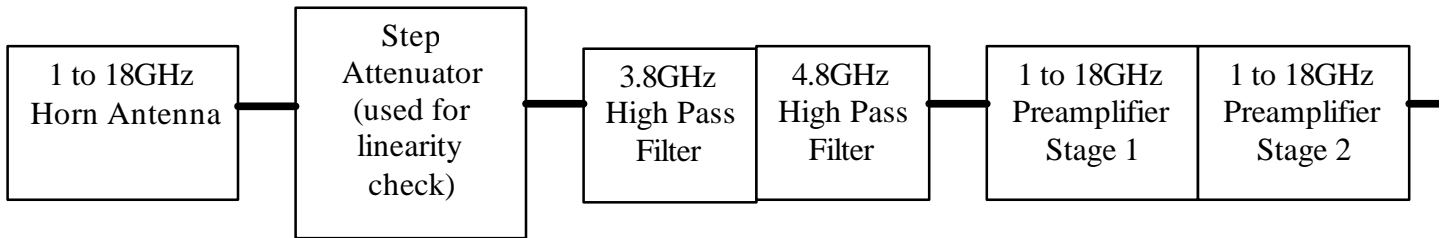


**APPENDIX D**  
**Block Diagram of Measurement System**

**1 to 4GHz Measurement System**



**4 to 18GHz Measurement System**



**18 to 26.5GHz Measurement System**

