UL International EMC Services
333 Pfingsten Road
Northbrook, Illinois 60062-2096
(800) 873-8536
Fax No. (847) 272-8864
http://www.ul.com/emc/

February 7, 2003

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

UL Reference: File MC1343, Project 03NK4872

Subject: EMC Test and Measurement Report for
Wrist-worn data terminal with integrated Cisco Aironet AIR-LMC352 PCMCIA WLAN Module

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 03NK4872.

Best regards,

Lou Madjarov (Ext 43957)
EMC Sr. Project Engineer
International EMC Services

Reviewed by:

Eric Parent
EMC Staff Engineering Associate
International EMC Services

EMC – TEST REPORT

Issue Date: February 7, 2003

√ **EMISSIONS**

IMMUNITY

Test Report File No.	:	MC1343
Project No.	:	03NK4872
Model / Type	:	**Model WT2270**
Kind of Product	:	**Wrist-worn data terminal with integrated Cisco Aironet AIR-LMC352 PCMCIA WLAN Module**
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 9 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

SECTION TITLE

1.0 GENERAL PRODUCT DESCRIPTION

The EUT is a wrist-worn data terminal with integrated Cisco Aironet AIR-LMC352 PCMCIA WLAN Module, FCC ID: LDK102040.

1.0.1 Equipment Mobility:

Wrist-worn (portable)

1.0.2 Test Voltage and Frequency:

Voltage (V)	Frequency (Hz)
3.6V	DC

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
EUT Chameleon	WAV	WT2270	00A14C60Y	PB2WT2270
Modular Transmitter	CISCO	AIR-LMC352	VEM062807MW	LDK102040

1.5 ANTENNA CONFIGURATIONS COVERED

Antenna	EUT Output Power	Antenna Gain	Total EIRP	Exposure Category
OMNI	20dBm (100mW)	-2 to -10 dBi	20dBm (100mW)	Portable

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: 2002 + 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	Not Applicable	EUT is battery-operated device with no provision for direct connection to AC mains.
6dB Bandwidth	15.247(a)(2)	No	Considered covered by tests performed on previously certified device. (Cisco)
RF Conducted Peak Output Power	15.247(b)	No	Considered covered by tests performed on previously certified device. (Cisco)
Reduced output if directional gain exceeds 6dBi	15.247(b)(3)	No	Considered covered by tests performed on previously certified device. (Cisco)
RF Safety (SAR for portable devices)	15.247(b)(4)	**Yes**	**See Ultratech SAR report ULA-005-SAR**
Spurious emissions (RF conducted & radiated)	15.247(c)	***Radiated Only**	Conducted spurious emissions considered covered by tests performed on previously certified device. **Radiated spurious measurements were performed as part of this investigation.**
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.

* 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 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. 1-14-03, Next. Cal. 1-14-04

Antennas
EMCO, Model 3115, EMC No. 4033
Last Cal. 3-23-02, Next Cal. 3-23-03

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.
500uV/m * (3 meter / 2meters) = 750uV/m
20 log (750uV/m) = **57.5dBuV/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. 1-14-03, Next. Cal. 1-14-04

Antennas

EMCO, Model 3115, EMC No. 4033
Last Cal. 3-23-02, Next Cal. 3-23-03

Filter/Amplifier Assembly,

Last Cal. 12-19-02, Next Cal. 12-19-03. 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. 1-14-03, Next. Cal. 1-14-04

Antennas
EMCO, Model 3115, EMC No. 4033
Last Cal. 3-23-02, Next Cal. 3-23-03

Filter/Amplifier Assembly,
Last Cal. 12-19-02, Next Cal. 12-19-03. 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 : January 17, 2003

Test Dates

Start : January 17, 2003
End : January 17, 2003

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

Best regards,

Lou Madjarov (Ext 43957)
EMC Sr. Project Engineer
International EMC Services

Reviewed by:

Eric Parent
EMC Staff Engineering Associate
International EMC Services

APPENDIX A

PHOTOS

Radiated Emissions

Radiated Emissions

Radiated Emissions

APPENDIX B

TEST DATA

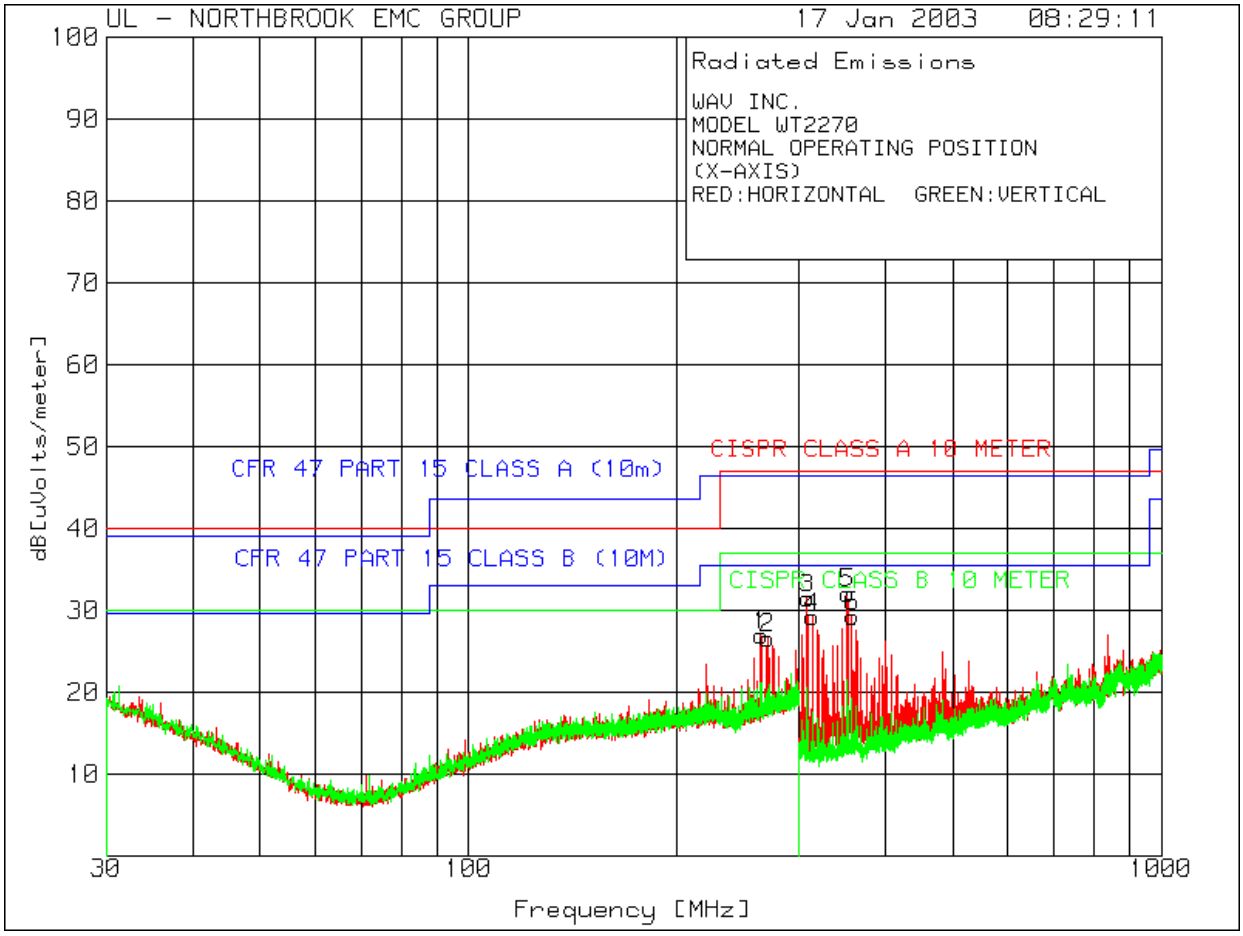
EMISSIONS

Radiated Electric Field Emissions

UNDERWRITERS LABORATORIES INC.
Radiated Emissions

Date Tested: 1-17-2003

Manufacturer	:	**WAV**
Equipment Under Test	:	**WT2270**
Requirement	:	**CFR47 Part 15 B**
Detection Mode	:	**QP,**
Bandwidth	:	120 kHz
Measurement Distance	:	10 meter
Antenna Type	:	**30 - 300 MHz, Biconical** **300 - 1000 MHz, Log-Periodic**

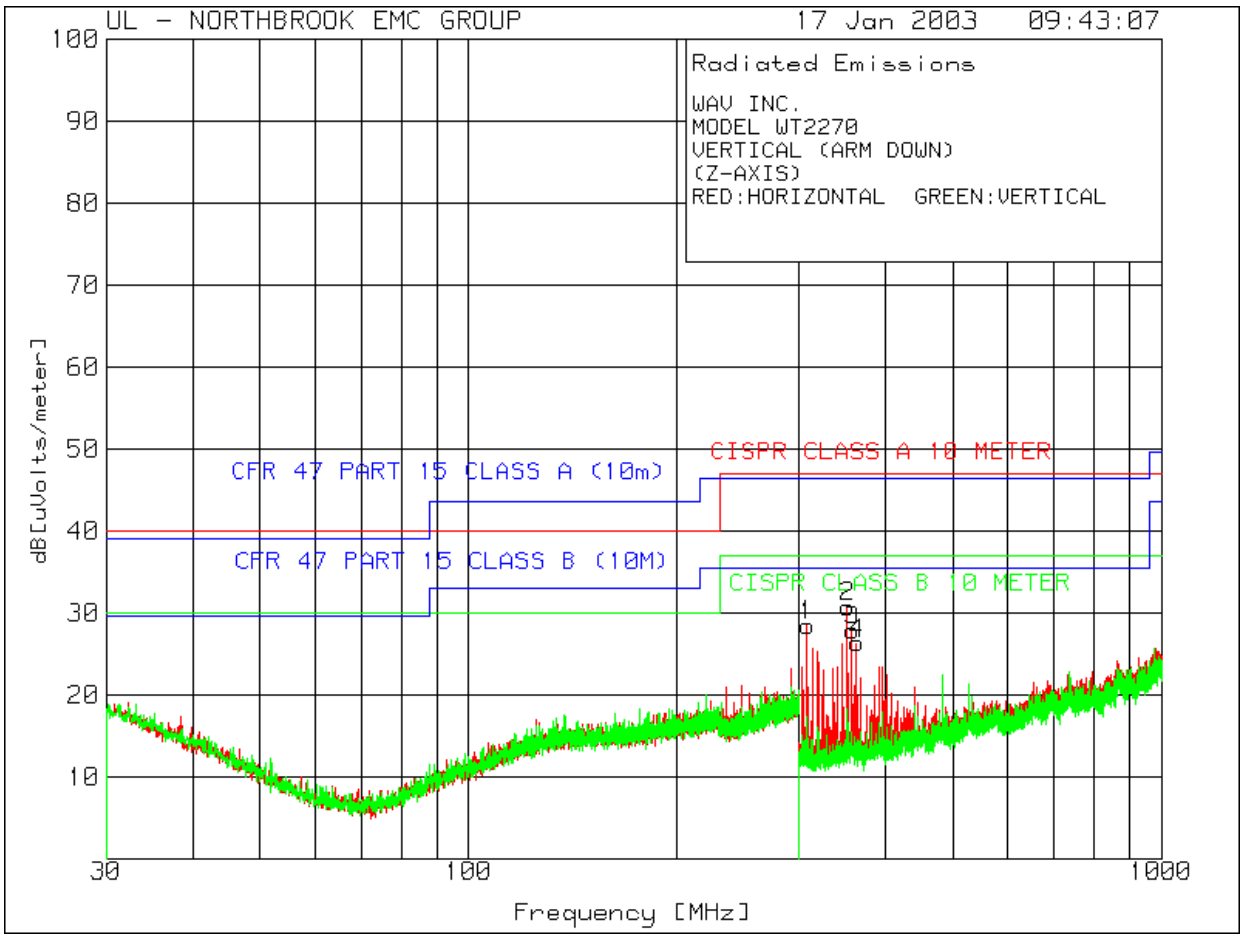


WAV INC.
MODEL WT2270
NORMAL OPERATING POSITION
(X-AXIS)
RED:HORIZONTAL GREEN:VERTICAL

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4
Range: 3 300 - 1000MHz								
351.9993	50.55 qp	-32.6	15.2	33.15	47	37	46.4	35.6
Azimuth: 33	Height:234 Horz			Margin [dB]:	-13.85	-3.85	-13.25	-2.45
307.9978	50.06 qp	-32.7	14.7	32.06	47	37	46.4	35.6
Azimuth: 18	Height:255 Horz			Margin [dB]:	-14.94	-4.94	-14.34	-3.54
313.4967	47.66 qp	-32.7	14.5	29.46	47	37	46.4	35.6
Azimuth: 29	Height:276 Horz			Margin [dB]:	-17.54	-7.54	-16.94	-6.14
357.4982	47.36 qp	-32.5	15.3	30.16	47	37	46.4	35.6
Azimuth: 211	Height:224 Horz			Margin [dB]:	-16.84	-6.84	-16.24	-5.44

LIMIT 1: CISPR CLASS A 10 METER
LIMIT 2: CISPR CLASS B 10 METER
LIMIT 3: CFR 47 PART 15 CLASS A (10m)
LIMIT 4: CFR 47 PART 15 CLASS B (10M)
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - Average log detector


UL – NORTHBROOK EMC GROUP
17 Jan 2003 09:43:07
Radiated Emissions
WAV INC.
MODEL WT2270
VERTICAL (ARM DOWN)
(Z-AXIS)
RED:HORIZONTAL GREEN:VERTICAL
CISPR CLASS A 10 METER
CFR 47 PART 15 CLASS A (10m)
CFR 47 PART 15 CLASS B (10M)
CISPR CLASS B 10 METER
dB[uVolts/meter]
Frequency [MHz]
100
90
80
70
60
50
40
30
20
10
30
100
1000

WAV INC.
MODEL WT2270
VERTICAL (ARM DOWN)
(Z-AXIS)
RED:HORIZONTAL GREEN:VERTICAL

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4
Range: 3 300 - 1000MHz									
1	308.044	46.46 pk	-32.7	14.74	28.5	47	37	46.44	35.56
	Azimuth:17	Height:299 Horz	Margin [dB]			-18.5	-8.5	-17.94	-7.06
2	352.1109	48.21 pk	-32.59	15.18	30.8	47	37	46.44	35.56
	Azimuth:242	Height:299 Horz	Margin [dB]			-16.2	-6.2	-15.64	-4.76
3	357.5319	45.12 pk	-32.52	15.3	27.9	47	37	46.44	35.56
	Azimuth:162	Height:199 Horz	Margin [dB]			-19.1	-9.1	-18.54	-7.66
4	363.1277	43.71 pk	-32.51	15.1	26.3	47	37	46.44	35.56
	Azimuth:322	Height:199 Horz	Margin [dB]			-20.7	-10.7	-20.14	-9.26

LIMIT 1: CISPR CLASS A 10 METER
LIMIT 2: CISPR CLASS B 10 METER
LIMIT 3: CFR 47 PART 15 CLASS A (10m)
LIMIT 4: CFR 47 PART 15 CLASS B (10M)
LIMIT 5: NONE
LIMIT 6: NONE

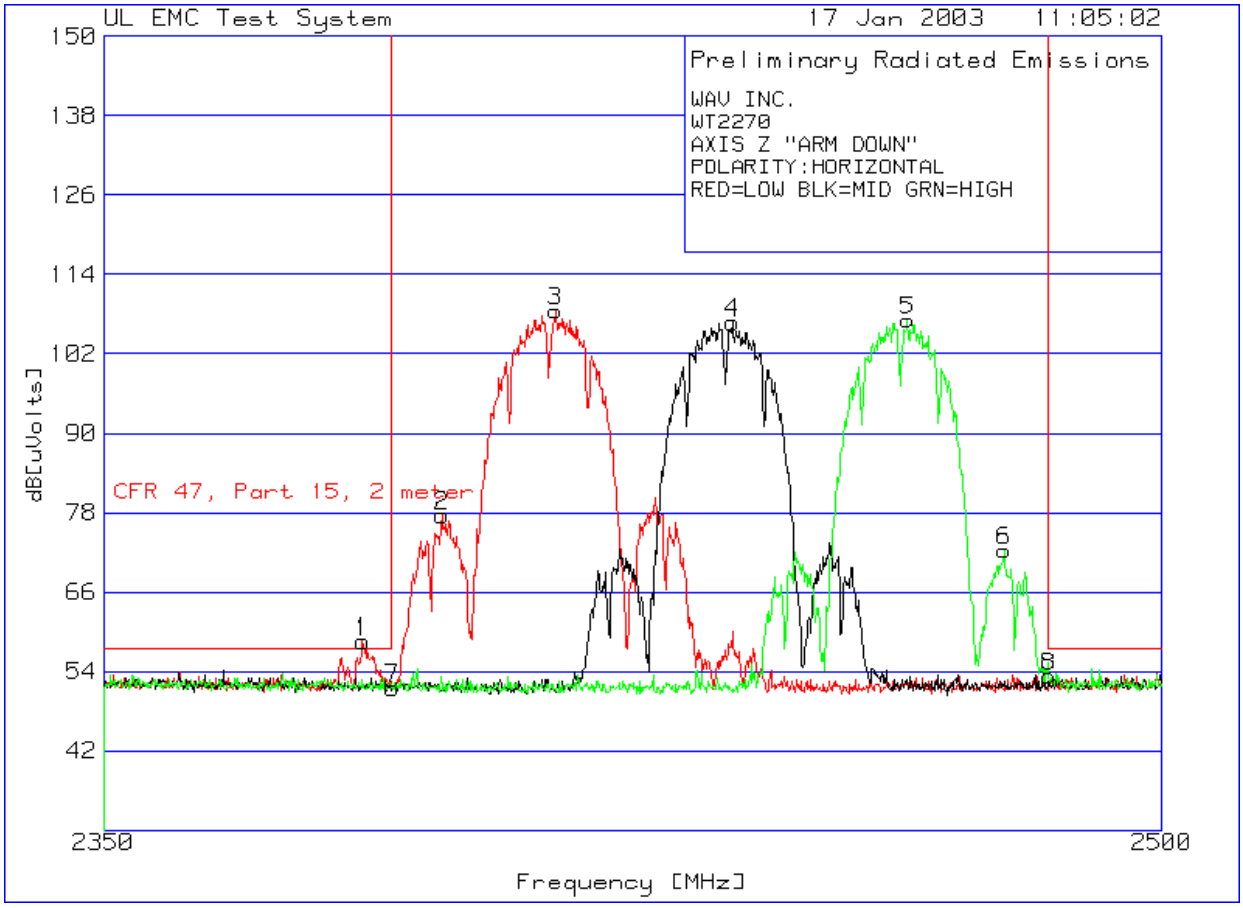
pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
tm - Trace Math Result

UNDERWRITERS LABORATORIES INC.
Radiated Emissions

Date Tested: 1-17-2003

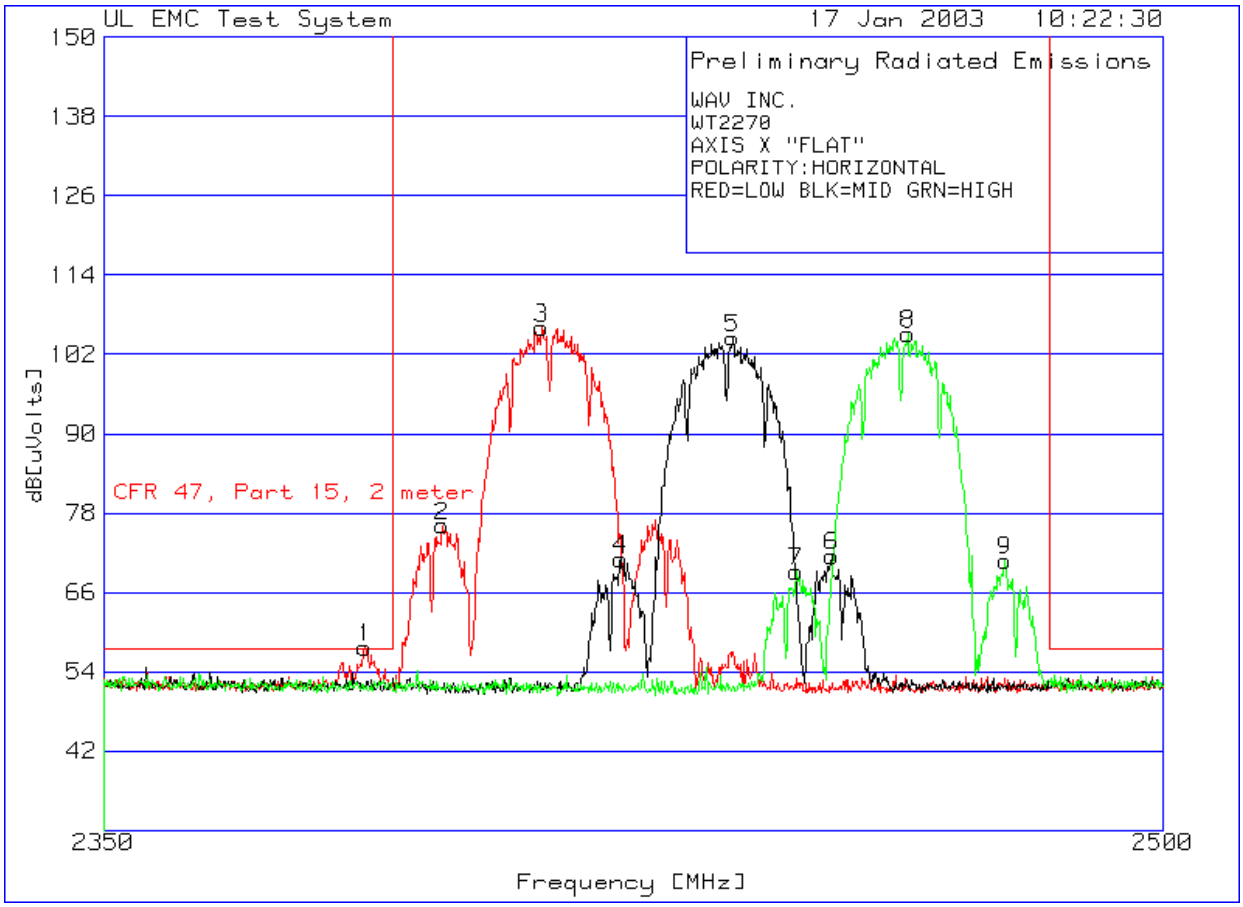
Manufacturer	:	**WAV**
Equipment Under Test	:	**WT2270**
Requirement	:	**CFR47 Part 15**
Detection Mode	:	**Pk, Avg**
Bandwidth	:	**1MHz**
Measurement Distance	:	**1-4GHz , 2 meter, 4-26.5GHz, 3 meter**
Antenna Type	:	**1-18GHz, 18-26.5GHz – Horn Antennas**

Center Frequency and Band Edge Measurements



```
 WAV INC.
 WT2270
 AXIS Z "ARM DOWN"
 POLARITY:HORIZONTAL
 RED=LOW BLK=MID GRN=HIGH
      Test     Meter     Gain/Loss  Transducer  Level  Limit:1
No. Frequency  Reading    Factor     Factor  dB[uVolts]
     [MHz]     [dB(uV)]     [dB]      [dB]
================================================================
Channel LOW 2350 - 2500MHz -------------------------------------------------
1  2385.886     26.23 pk     2.2       30.1      58.53   57.5
                 Height:200 Horz     Margin [dB]          1.03
2  2396.997     45.16 pk     2.2       30.2      77.56   999
                 Height:200 Horz     Margin [dB]          -921.44
3  2412.913     76.11 pk     2.2       30.2      108.51  999
                 Height:200 Horz     Margin [dB]          -890.49
7  2390.09      19.14 pk     2.2       30.2      51.54   999
                 Height:200 Horz     Margin [dB]          -947.46

Channel MID 2350 - 2500MHz -------------------------------------------------
4  2437.988     74.26 pk     2.2       30.3      106.76  999
                 Height:200 Horz     Margin [dB]          -892.24

Channel HIGH 2350 - 2500MHz ------------------------------------------------
5  2463.063     74.61 pk     2.2       30.3      107.11  999
                 Height:200 Horz     Margin [dB]          -891.89
6  2477.027     39.81 pk     2.2       30.3      72.31   999
                 Height:200 Horz     Margin [dB]          -926.69
8  2483.483     20.74 pk     2.2       30.4      53.34   999
                 Height:200 Horz     Margin [dB]          -945.66

LIMIT 1: CFR 47, Part 15, 2 meter
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result
```

```
 WAV INC.
 WT2270
 AXIS Z "ARM DOWN"
 POLARITY:HORIZONTAL
 RED=LOW BLK=MID GRN=HIGH
  Test     Meter     Gain/Loss  Transducer  Level  Limit:1
Frequency  Reading    Factor     Factor  dB[uVolts]
 [MHz]     [dB(uV)]     [dB]      [dB]
================================================================
Channel LOW 2350 - 2500MHz
2386.2247  24.35 av      2.2       30.1      56.65   57.5
Azimuth: 320  Height:113 Horz         Margin [dB]:   -.85

2412.93    80.21 av      2.2       30.2      112.61  999
Azimuth: 315  Height:137 Horz         Margin [dB]:   -886.39

2437.8086  29.88 av      2.2       30.3      62.38   999
Azimuth: 325  Height:136 Horz         Margin [dB]:   -936.62

2463.063   15.31 av      2.2       30.3      47.81   999
Azimuth: 332  Height:159 Horz         Margin [dB]:   -951.19


LIMIT 1: CFR 47, Part 15, 2 meter
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - Average log detector
avem - EMI Average detector
```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17 Jan 2003 10:22:30
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS X "FLAT"
POLARITY:HORIZONTAL
RED=LOW BLK=MID GRN=HIGH
CFR 47, Part 15, 2 meter
150
138
126
114
102
90
78
66
54
42
dBCuVolts]
2350
2500
Frequency [MHz]

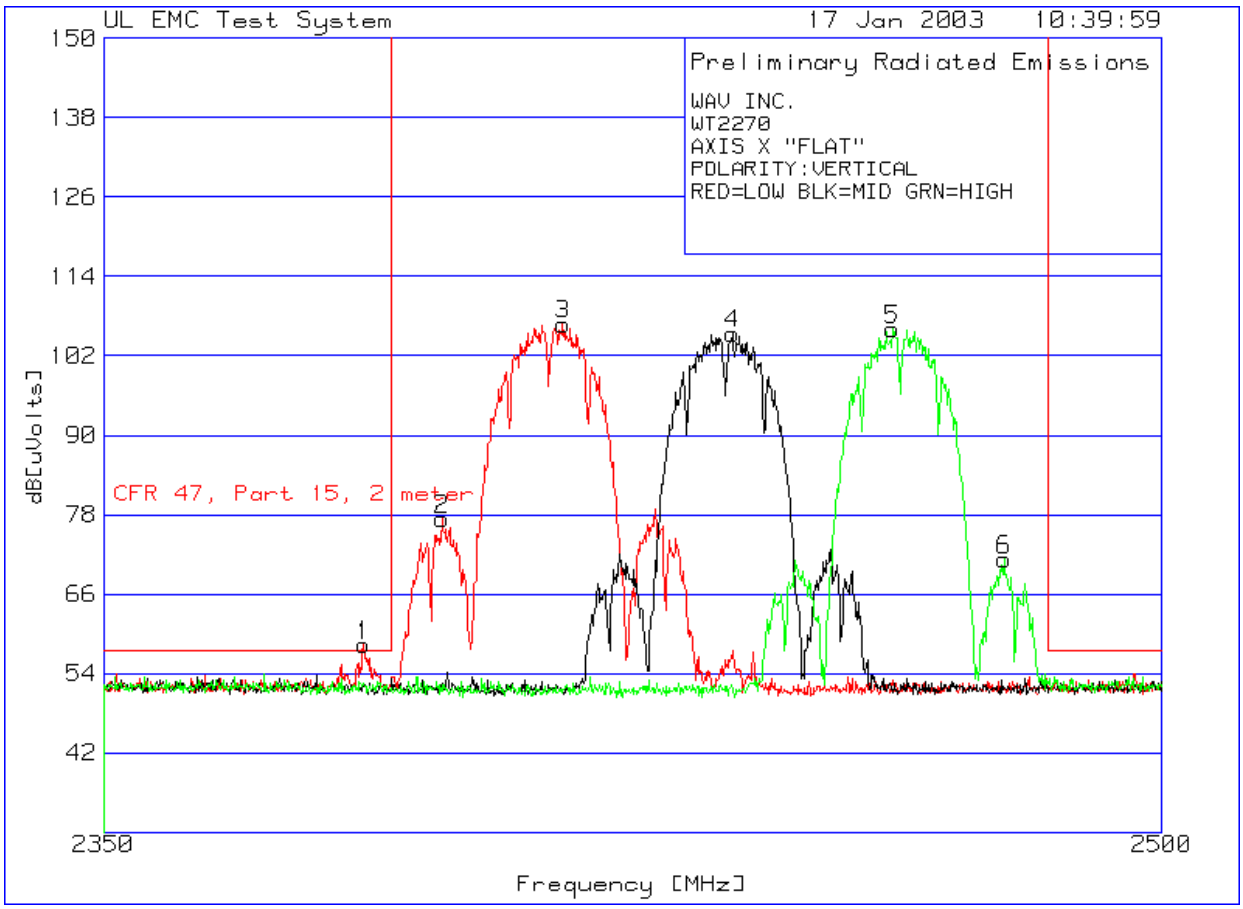
```
 WAV INC.
 WT2270
 AXIS X "FLAT"
 POLARITY:HORIZONTAL
 RED=LOW BLK=MID GRN=HIGH
      Test     Meter     Gain/Loss  Transducer  Level  Limit:1
No. Frequency  Reading    Factor     Factor  dB[uVolts]
     [MHz]     [dB(uV)]     [dB]      [dB]
================================================================
Channel LOW 2350 - 2500MHz ------------------------------------------------
1  2386.186     25.37 pk     2.2       30.1      57.67   57.5
                 Height:200 Horz     Margin [dB]          .17
2  2396.997     43.71 pk     2.2       30.2      76.11   999
                 Height:200 Horz     Margin [dB]          -922.89
3  2410.961     73.6 pk      2.2       30.2      106     999
                 Height:200 Horz     Margin [dB]          -893

Channel MID 2350 - 2500MHz ------------------------------------------------
4  2422.072     38.6 pk      2.2       30.2      71      999
                 Height:200 Horz     Margin [dB]          -928
5  2437.988     72.01 pk     2.2       30.3      104.51  999
                 Height:200 Horz     Margin [dB]          -894.49
6  2452.102     39.05 pk     2.2       30.3      71.55   999
                 Height:200 Horz     Margin [dB]          -927.45

Channel HIGH 2350 - 2500MHz -----------------------------------------------
7  2446.997     36.72 pk     2.2       30.3      69.22   999
                 Height:200 Horz     Margin [dB]          -929.78
8  2463.063     72.61 pk     2.2       30.3      105.11  999
                 Height:200 Horz     Margin [dB]          -893.89
9  2477.027     38.34 pk     2.2       30.3      70.84   999
                 Height:200 Horz     Margin [dB]          -928.16

LIMIT 1: CFR 47, Part 15, 2 meter
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result
```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17 Jan 2003 10:39:59
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS X "FLAT"
POLARITY:VERTICAL
RED=LOW BLK=MID GRN=HIGH
CFR 47, Part 15, 2 meter
dBuVolts
150
138
126
114
102
90
78
66
54
42
2350
2500
Frequency [MHz]
1
2
3
4
5
6

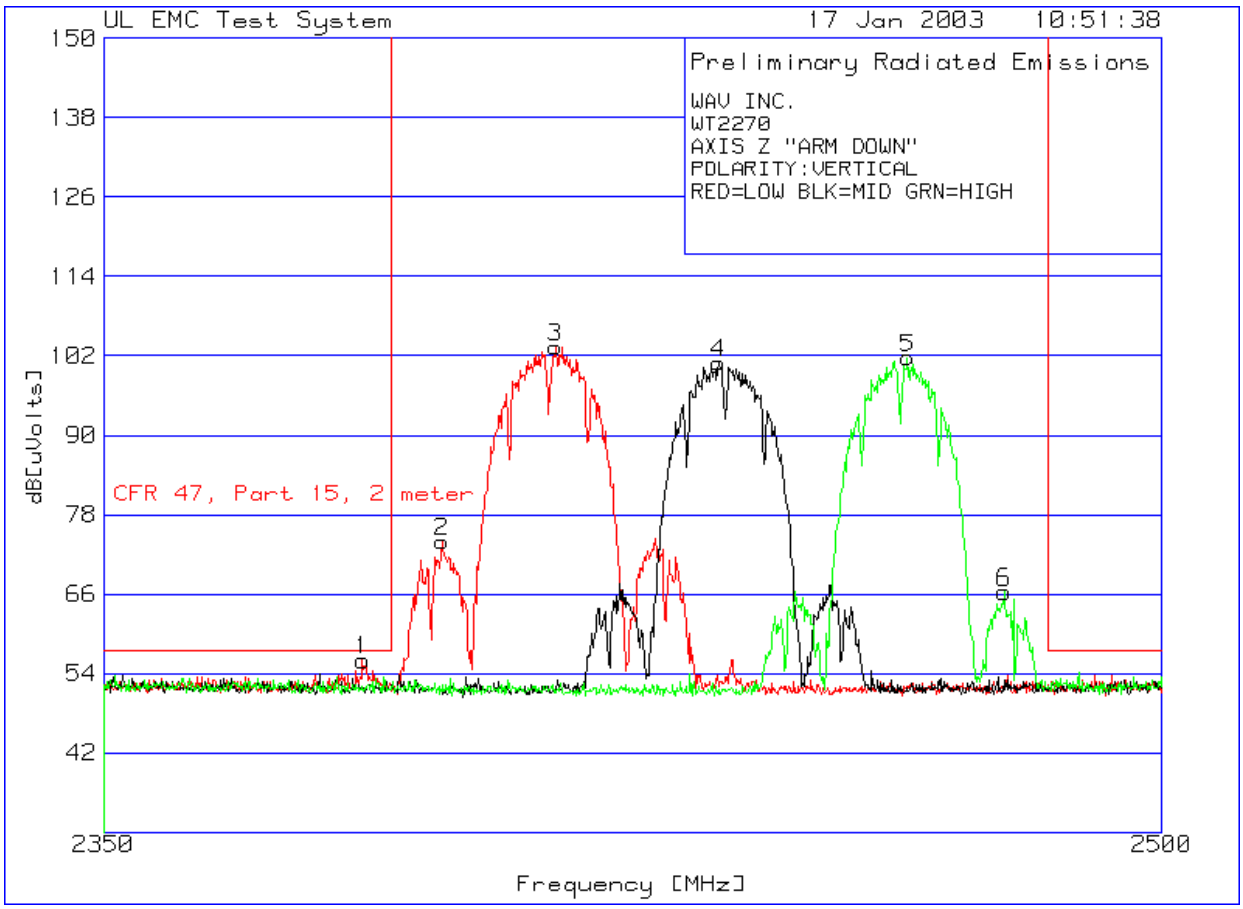
```
 WAV INC.
 WT2270
 AXIS X "FLAT"
 POLARITY:VERTICAL
 RED=LOW BLK=MID GRN=HIGH
      Test     Meter     Gain/Loss  Transducer  Level  Limit:1
No. Frequency  Reading    Factor     Factor  dB[uVolts]
     [MHz]     [dB(uV)]     [dB]      [dB]
================================================================
Channel LOW 2350 - 2500MHz ------------------------------------------------
1  2386.036     26.04 pk     2.2       30.1      58.34   57.5
                 Height:101 Vert     Margin [dB]          .84
2  2396.997     44.95 pk     2.2       30.2      77.35   999
                 Height:101 Vert     Margin [dB]          -921.65
3  2413.964     74.38 pk     2.2       30.2      106.78  999
                 Height:101 Vert     Margin [dB]          -892.22

Channel MID 2350 - 2500MHz ------------------------------------------------
4  2437.988     72.89 pk     2.2       30.3      105.39  999
                 Height:101 Vert     Margin [dB]          -893.61

Channel HIGH 2350 - 2500MHz ------------------------------------------------
5  2460.961     73.53 pk     2.2       30.3      106.03  999
                 Height:101 Vert     Margin [dB]          -892.97
6  2477.027     38.73 pk     2.2       30.3      71.23   999
                 Height:101 Vert     Margin [dB]          -927.77

LIMIT 1: CFR 47, Part 15, 2 meter
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result
```


UL EMC Test System
17 Jan 2003 10:51:38
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS Z "ARM DOWN"
POLARITY:VERTICAL
RED=LOW BLK=MID GRN=HIGH
CFR 47, Part 15, 2 meter
dBEuVolts]
150
138
126
114
102
90
78
66
54
42
2350
2500
Frequency [MHz]
1
2
3
4
5
6

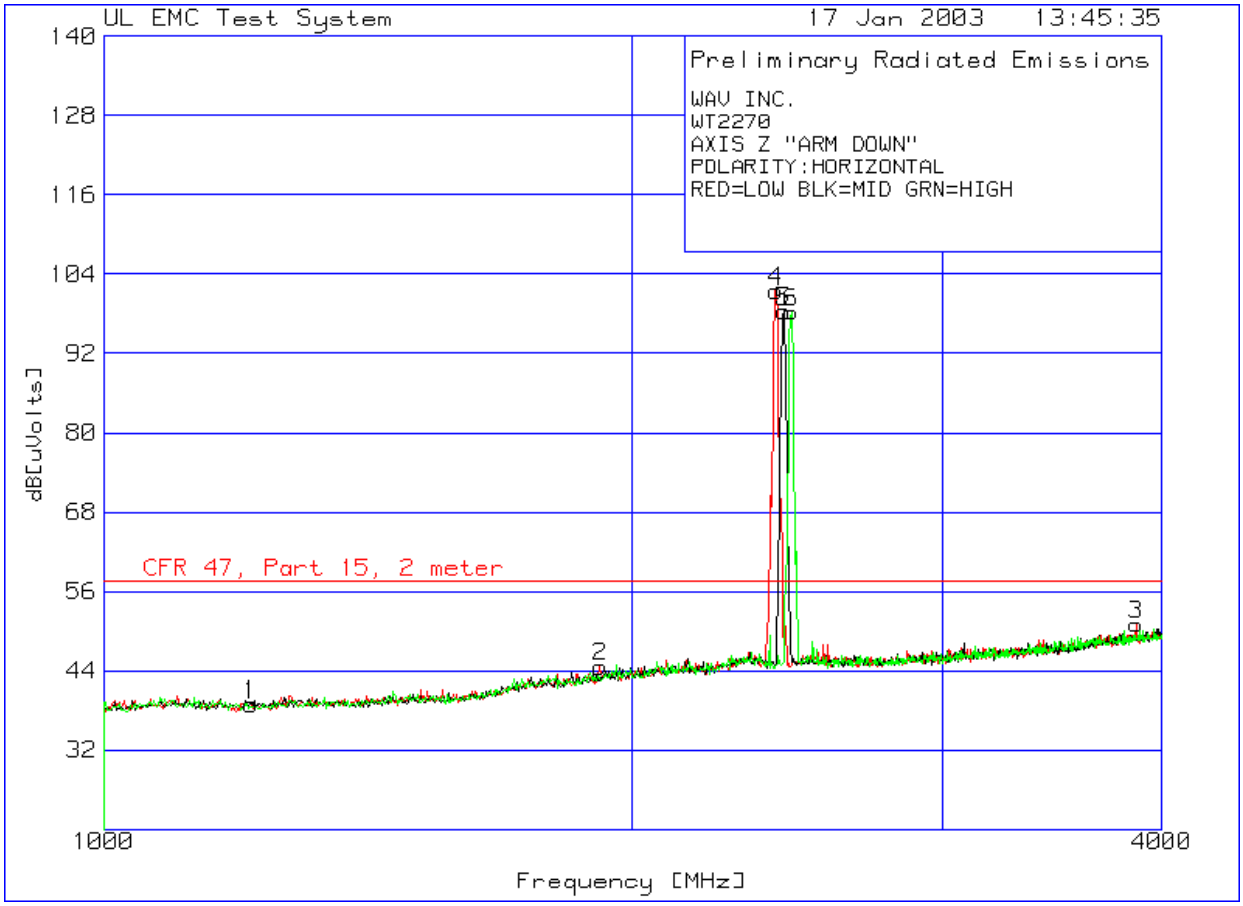
```
 WAV INC.
 WT2270
 AXIS Z "ARM DOWN"
 POLARITY:VERTICAL
 RED=LOW BLK=MID GRN=HIGH
      Test     Meter     Gain/Loss  Transducer  Level  Limit:1
No. Frequency  Reading    Factor     Factor  dB[uVolts]
     [MHz]     [dB(uV)]     [dB]      [dB]
================================================================
Channel LOW 2350 - 2500MHz -------------------------------------------------
1  2385.886     23.76 pk     2.2       30.1      56.06   57.5
                 Height:101 Vert     Margin [dB]          -1.44
2  2396.997     41.58 pk     2.2       30.2      73.98   999
                 Height:101 Vert     Margin [dB]          -925.02
3  2412.988     70.94 pk     2.2       30.2      103.34  999
                 Height:101 Vert     Margin [dB]          -895.66

Channel MID 2350 - 2500MHz -------------------------------------------------
4  2436.036     68.49 pk     2.2       30.3      100.99  999
                 Height:101 Vert     Margin [dB]          -898.01

Channel HIGH 2350 - 2500MHz ------------------------------------------------
5  2463.063     69.22 pk     2.2       30.3      101.72  999
                 Height:101 Vert     Margin [dB]          -897.28
6  2477.027     33.79 pk     2.2       30.3      66.29   999
                 Height:101 Vert     Margin [dB]          -932.71

LIMIT 1: CFR 47, Part 15, 2 meter
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result
```


UL EMC Test System
17 Jan 2003 13:45:35
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS Z "ARM DOWN"
POLARITY:HORIZONTAL
RED=LOW BLK=MID GRN=HIGH
140
128
116
104
92
80
68
56
44
32
dBuVolts
CFR 47, Part 15, 2 meter
1
2
3
4
1000
4000
Frequency [MHz]

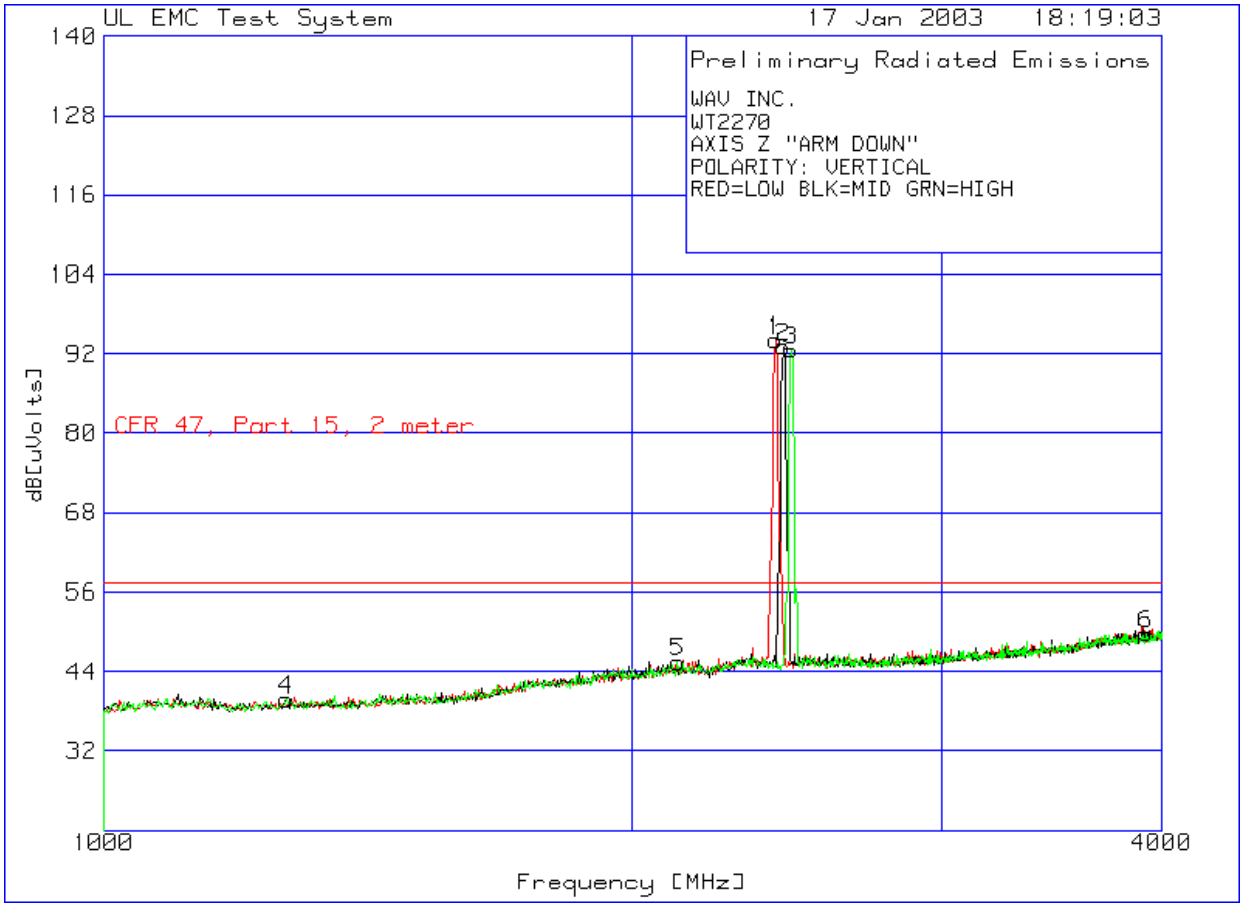
```
 WAV INC.
 WT2270
 AXIS Z "ARM DOWN"
 POLARITY:HORIZONTAL
 RED=LOW BLK=MID GRN=HIGH
      Test     Meter     Gain/Loss  Transducer  Level  Limit:1
No. Frequency  Reading    Factor     Factor  dB[uVolts]
     [MHz]     [dB(uV)]     [dB]      [dB]
================================================================
Range: 1 1000 - 4000MHz ----------------------------------------------------
1  1213.213     11.76 pk     1.6       25.6      38.96   57.5
                 Height:200 Horz     Margin [dB]         -18.54
2  1915.916     13.84 pk     2         28.8      44.64   57.5
                 Height:101 Horz     Margin [dB]         -12.86
3  3867.868     14.13 pk     2.8       34.1      51.03   57.5
                 Height:101 Horz     Margin [dB]         -6.47
4  2411.411     69.06 pk     2.2       30.2      101.46  57.5
                 Height:200 Horz     Margin [dB]         43.96

Range: 1 1000 - 4000MHz ----------------------------------------------------
5  2438.438     65.9 pk      2.2       30.3      98.4    57.5
                 Height:200 Horz     Margin [dB]         40.9

Range: 1 1000 - 4000MHz ----------------------------------------------------
6  2462.462     65.76 pk     2.2       30.3      98.26   57.5
                 Height:101 Horz     Margin [dB]         40.76

LIMIT 1: CFR 47, Part 15, 2 meter
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result
```


UL EMC Test System
17 Jan 2003 18:19:03
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS Z "ARM DOWN"
POLARITY: VERTICAL
RED=LOW BLK=MID GRN=HIGH
CFR 47, Part 15, 2 meter
dBuVolts
140
128
116
104
92
80
68
56
44
32
1000
4000
Frequency [MHz]
1
2
3
4
5
6

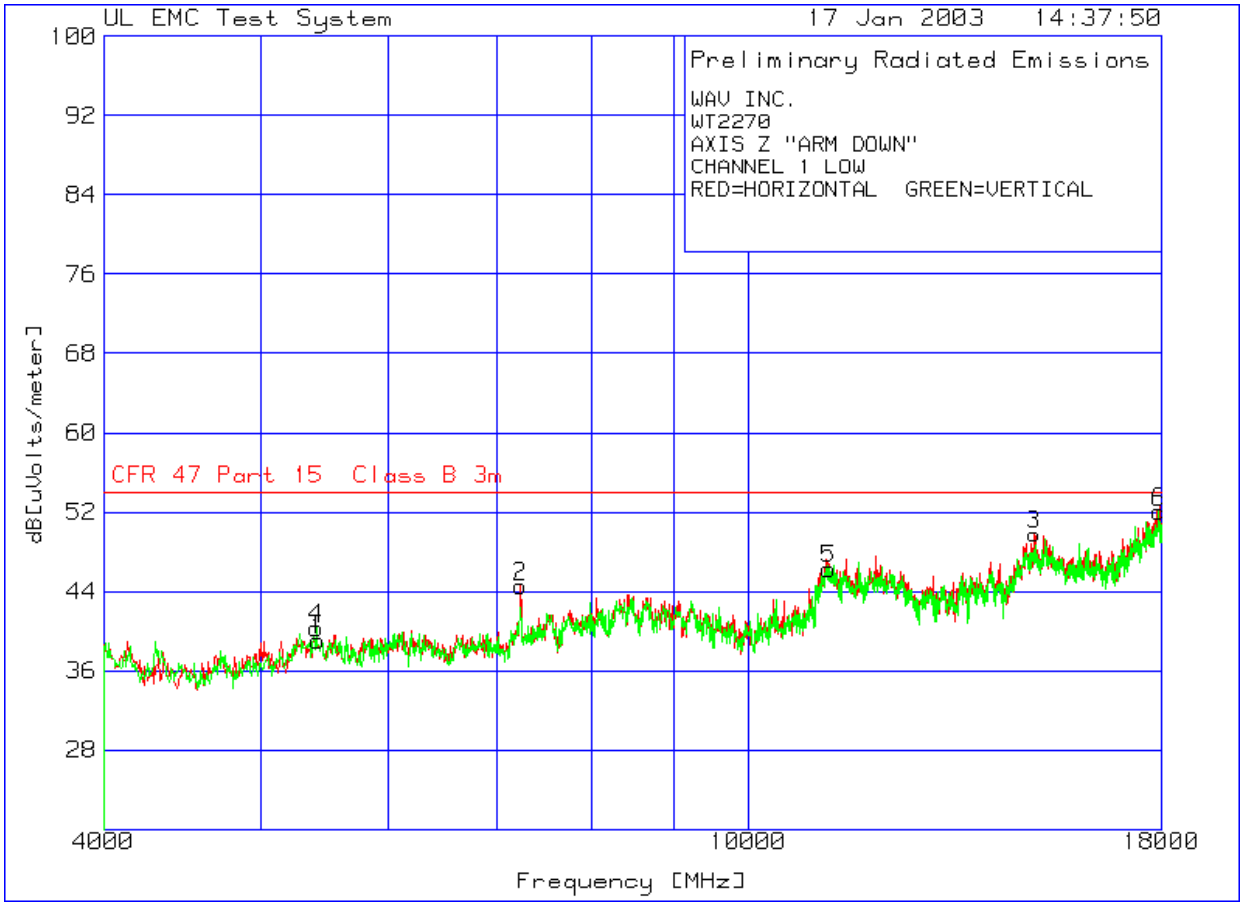
```
 WAV INC.
 WT2270
 AXIS Z "ARM DOWN"
 POLARITY: VERTICAL
 RED=LOW BLK=MID GRN=HIGH
      Test     Meter     Gain/Loss  Transducer  Level  Limit:1
No. Frequency  Reading    Factor     Factor  dB[uVolts]
     [MHz]     [dB(uV)]     [dB]      [dB]
================================================================
CHANNEL LOW 1000 - 4000MHz ------------------------------------------------
1  2411.411     61.69 pk     2.2       30.2      94.09   57.5
                 Height:101 Vert     Margin [dB]         36.59

CHANNEL MID 1000 - 4000MHz ------------------------------------------------
2  2435.435     60.59 pk     2.2       30.3      93.09   57.5
                 Height:101 Vert     Margin [dB]         35.59

CHANNEL HIGH 1000 - 4000MHz -----------------------------------------------
3  2462.462     60.09 pk     2.2       30.3      92.59   57.5
                 Height:101 Vert     Margin [dB]         35.09
4  1270.27      12.46 pk     1.6       25.7      39.76   57.5
                 Height:200 Vert     Margin [dB]         -17.74
5  2120.12      13.77 pk     2.1       29.6      45.47   57.5
                 Height:101 Vert     Margin [dB]         -12.03
6  3918.919     12.72 pk     2.8       34.2      49.72   57.5
                 Height:200 Vert     Margin [dB]         -7.78

LIMIT 1: CFR 47, Part 15, 2 meter
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result
```

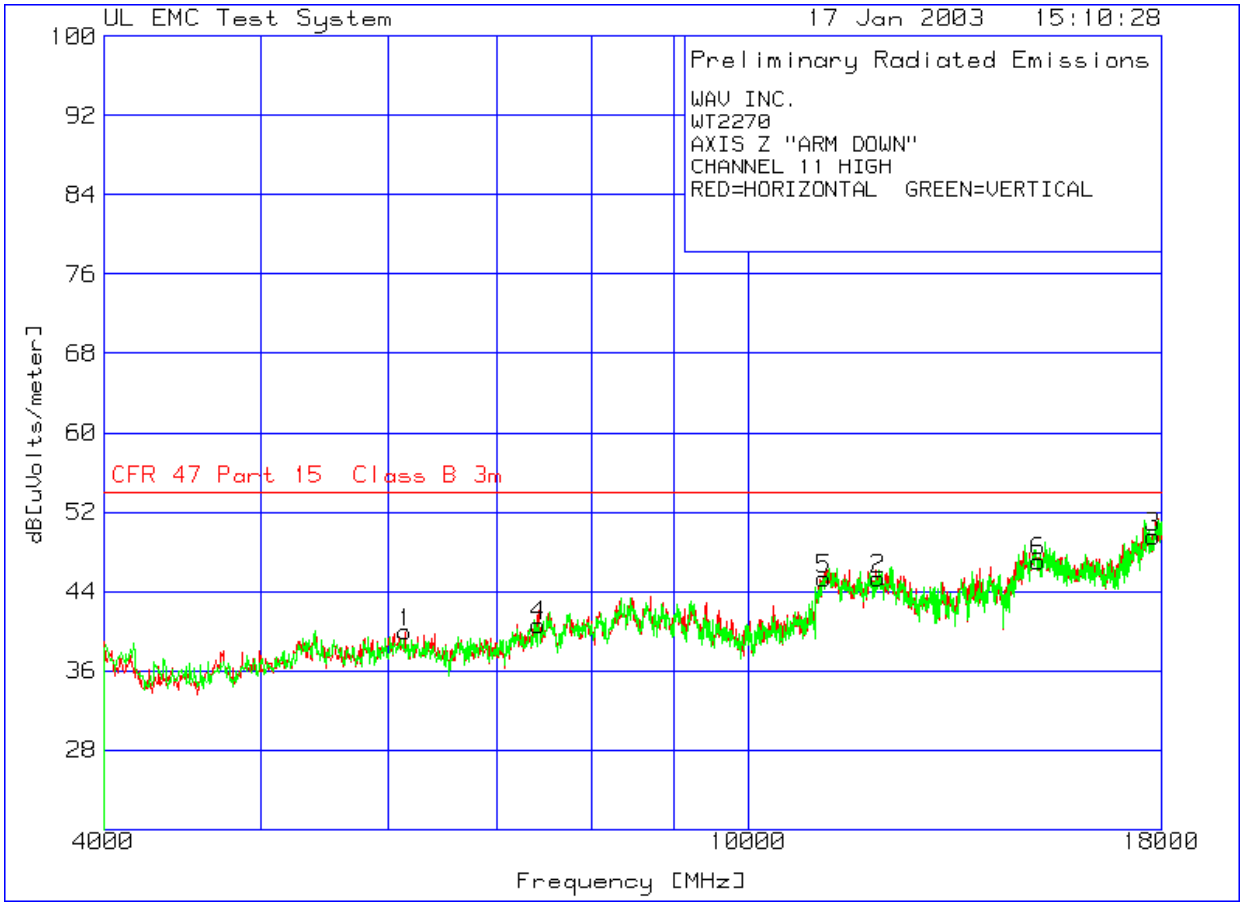

UL EMC Test System
17 Jan 2003 14:37:50
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS Z "ARM DOWN"
CHANNEL 1 LOW
RED=HORIZONTAL GREEN=VERTICAL
CFR 47 Part 15 Class B 3m
dBuVolts/meter
Frequency [MHz]
100
92
84
76
68
60
52
44
36
28
4000
10000
18000

WAV INC.
WT2270
AXIS Z "ARM DOWN"
CHANNEL 1 LOW
RED=HORIZONTAL GREEN=VERTICAL

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
Range: 1 4000 - 18000MHz						
1	5421.711	51.3 pk	-47.8	35.6	39.1	54
		Height:200 Horz		Margin [dB]		-14.9
2	7235.618	53.32 pk	-46.3	37.5	44.52	54
		Height:99 Horz		Margin [dB]		-9.48
3	15016.508	46.76 pk	-39.2	42.2	49.76	54
		Height:99 Horz		Margin [dB]		-4.24
Range: 2 4000 - 18000MHz						
4	5414.707	52.51 pk	-47.8	35.6	40.31	54
		Height:101 Vert		Margin [dB]		-13.69
5	11213.607	50.91 pk	-44.6	40	46.31	54
		Height:101 Vert		Margin [dB]		-7.69
6	17915.958	44.66 pk	-39.2	46.6	52.06	54
		Height:101 Vert		Margin [dB]		-1.94

LIMIT 1: CFR 47 Part 15 Class B 3m
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result

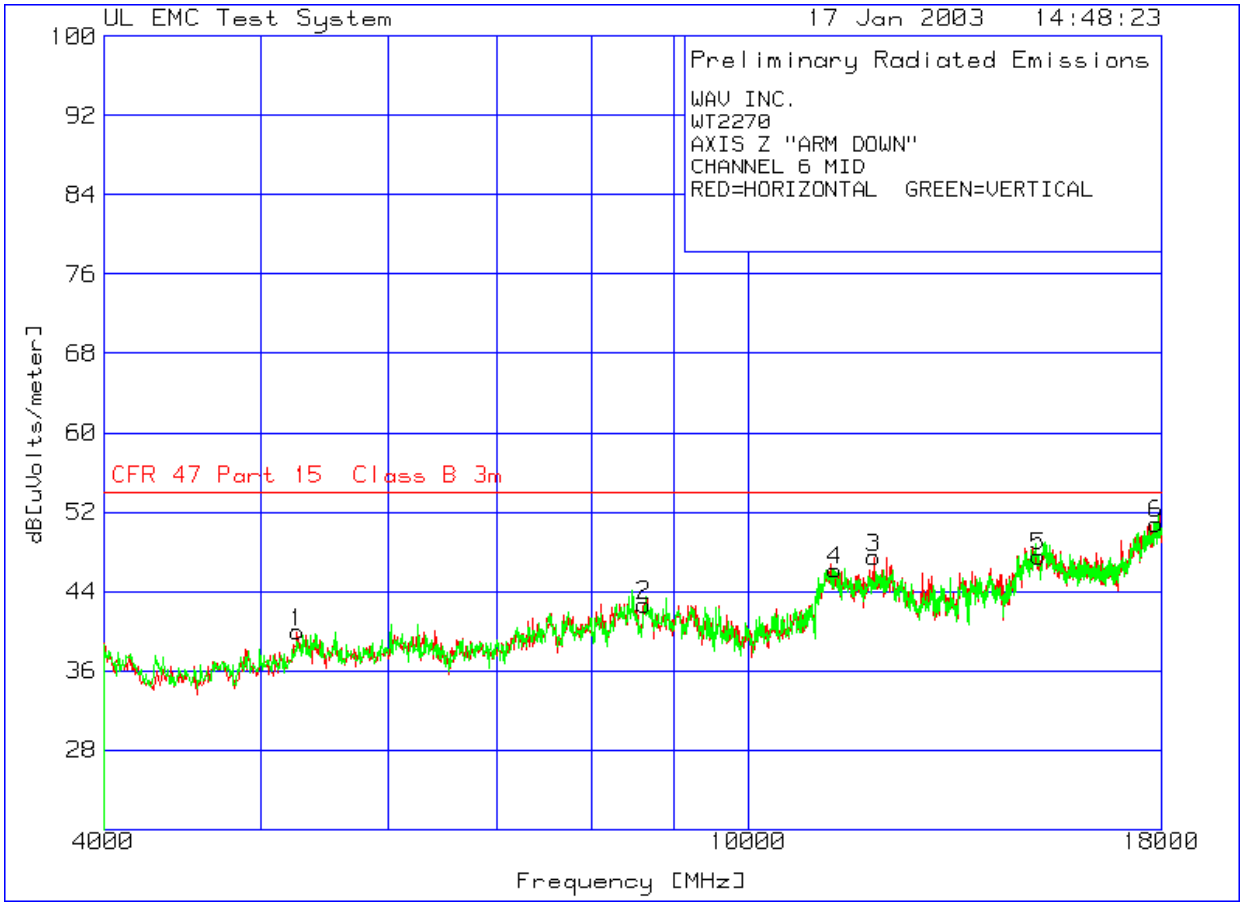

UL EMC Test System
17 Jan 2003 15:10:28
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS Z "ARM DOWN"
CHANNEL 11 HIGH
RED=HORIZONTAL GREEN=VERTICAL
CFR 47 Part 15 Class B 3m
dBuVolts/meter
100
92
84
76
68
60
52
44
36
28
4000
10000
18000
Frequency [MHz]

WAV INC.
WT2270
AXIS Z "ARM DOWN"
CHANNEL 11 HIGH
RED=HORIZONTAL GREEN=VERTICAL

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
Range: 1 4000 - 18000MHz						
1	6143.072	50.43 pk	-47	36.5	39.93	54
		Height:101 Horz	Margin [dB]			-14.07
2	12019.01	49.92 pk	-46.4	41.8	45.32	54
		Height:101 Horz	Margin [dB]			-8.68
3	17782.891	43.05 pk	-39.5	46	49.55	54
		Height:101 Horz	Margin [dB]			-4.45
Range: 2 4000 - 18000MHz						
4	7424.712	48.88 pk	-46.1	37.8	40.58	54
		Height:101 Vert	Margin [dB]			-13.42
5	11143.572	50.39 pk	-45	39.9	45.29	54
		Height:200 Vert	Margin [dB]			-8.71
6	15093.547	44.46 pk	-39.6	42.2	47.06	54
		Height:101 Vert	Margin [dB]			-6.94

LIMIT 1: CFR 47 Part 15 Class B 3m
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result

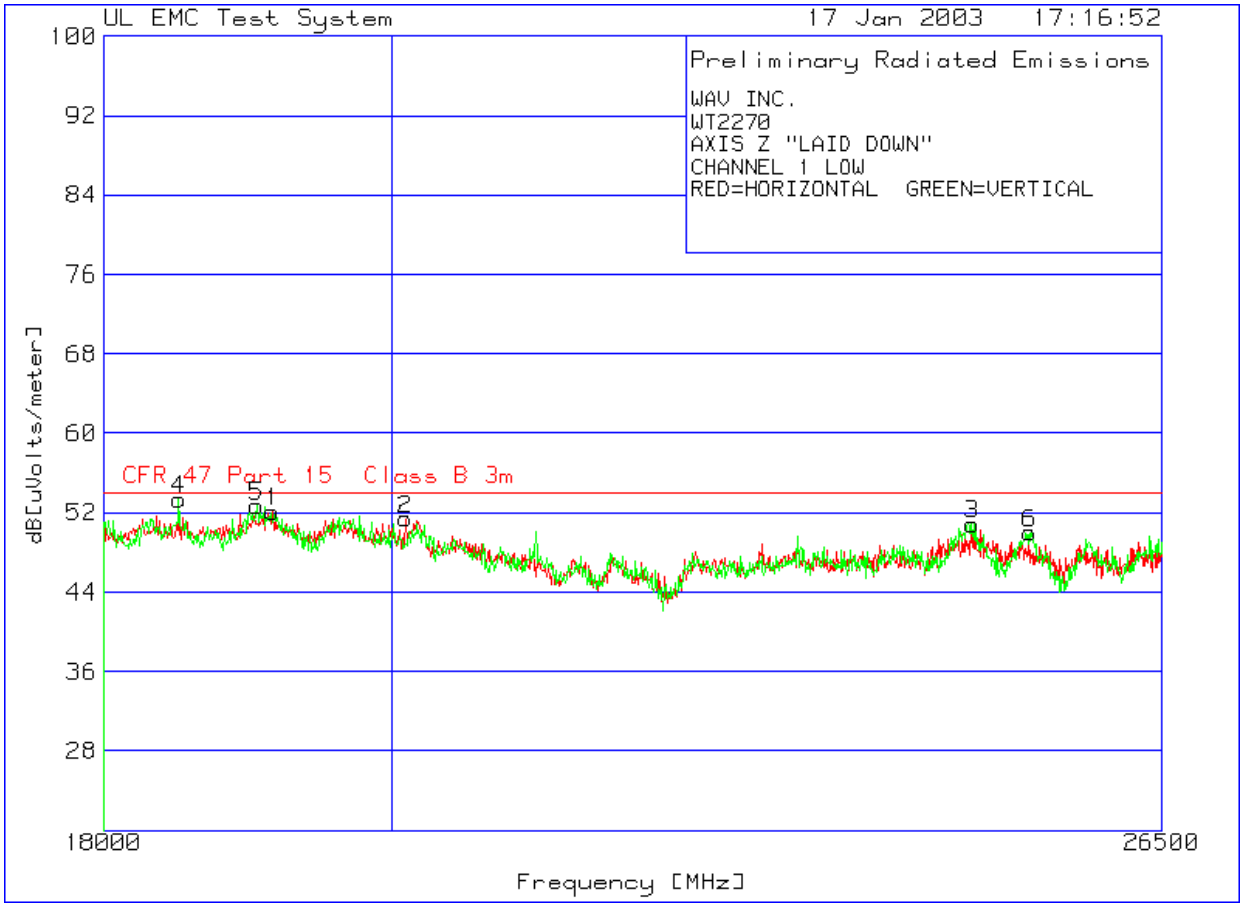

UL EMC Test System
17 Jan 2003 14:48:23
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS Z "ARM DOWN"
CHANNEL 6 MID
RED=HORIZONTAL GREEN=VERTICAL
CFR 47 Part 15 Class B 3m
dBuVolts/meter
Frequency [MHz]
100
92
84
76
68
60
52
44
36
28
4000
10000
18000

WAV INC.
WT2270
AXIS Z "ARM DOWN"
CHANNEL 6 MID
RED=HORIZONTAL GREEN=VERTICAL

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
Range: 1 4000 - 18000MHz						
1	5267.634	52.84 pk	-48.2	35.3	39.94	54
		Height:200 Horz		Margin [dB]		-14.06
2	8629.315	52.56 pk	-48.2	38.3	42.66	54
		Height:200 Horz		Margin [dB]		-11.34
3	11955.978	52.05 pk	-46.3	41.7	47.45	54
		Height:101 Horz		Margin [dB]		-6.55
Range: 2 4000 - 18000MHz						
4	11304.652	50.97 pk	-44.9	40.1	46.17	54
		Height:200 Vert		Margin [dB]		-7.83
5	15114.557	44.96 pk	-39.6	42.2	47.56	54
		Height:200 Vert		Margin [dB]		-6.44
6	17838.919	43.93 pk	-39.4	46.3	50.83	54
		Height:200 Vert		Margin [dB]		-3.17

LIMIT 1: CFR 47 Part 15 Class B 3m
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result


UL EMC Test System
17 Jan 2003 17:16:52
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS Z "LAID DOWN"
CHANNEL 1 LOW
RED=HORIZONTAL GREEN=VERTICAL
CFR 47 Part 15 Class B 3m
100
92
84
76
68
60
52
44
36
28
18000
26500
dBuVolts/meter
Frequency [MHz]

```
 WAV INC.
 WT2270
 AXIS Z "LAID DOWN"
 CHANNEL 1 LOW
 RED=HORIZONTAL  GREEN=VERTICAL
      Test     Meter     Gain/Loss  Transducer  Level  Limit:1
No. Frequency  Reading    Factor     Factor  dB[uVolts/meter]
     [MHz]     [dB(uV)]     [dB]      [dB]
============================================================
Range: 1 18000 - 26500MHz ------------------------------------------------
1  19148.649    69.8 pk      -58       40.3      52.1    54
                 Height:101 Horz     Margin [dB]         -1.9
2  20101.602    69.9 pk      -58.8     40.3      51.4    54
                 Height:200 Horz     Margin [dB]         -2.6
3  24721.722    65.55 pk     -55       40.3      50.85   54
                 Height:101 Horz     Margin [dB]         -3.15

Range: 2 18000 - 26500MHz ------------------------------------------------
4  18502.002    70.64 pk     -57.6     40.3      53.34   54
                 Height:200 Vert     Margin [dB]         -.66
5  19038.038    70.28 pk     -57.9     40.3      52.68   54
                 Height:101 Vert     Margin [dB]         -1.32
6  25249.249    63.09 pk     -53.4     40.3      49.99   54
                 Height:200 Vert     Margin [dB]         -4.01

 WAV INC.
 WT2270
 AXIS Z "LAID DOWN"
 CHANNEL 1 LOW
 RED=HORIZONTAL  GREEN=VERTICAL
  Test     Meter     Gain/Loss  Transducer  Level  Limit:1
Frequency  Reading    Factor     Factor  dB[uVolts/meter]
 [MHz]     [dB(uV)]     [dB]      [dB]
============================================================
Range: 1 18000 - 26500MHz
18502.002  71.23 av      -57.6     40.3      53.93   54
Azimuth: 46   Height:120 Vert         Margin [dB]:   -.07


LIMIT 1: CFR 47 Part 15  Class B 3m
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - Average log detector
avem - EMI Average detector
```


UL EMC Test System
17 Jan 2003 17:45:06
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS Z "ARM DOWN"
CHANNEL 11 HIGH
RED=HORIZONTAL GREEN=VERTICAL
CFR 47 Part 15 Class B 3m
100
92
84
76
68
60
52
44
36
28
dBuVolts/meter
18000
26500
Frequency [MHz]

```
 WAV INC.
 WT2270
 AXIS Z "ARM DOWN"
 CHANNEL 11 HIGH
 RED=HORIZONTAL  GREEN=VERTICAL
      Test     Meter     Gain/Loss  Transducer  Level  Limit:1
No. Frequency  Reading    Factor     Factor  dB[uVolts/meter]
     [MHz]     [dB(uV)]     [dB]      [dB]
================================================================
Range: 1 18000 - 26500MHz ------------------------------------------------------
1  18289.289    70.34 pk     -57.4     40.3      53.24   54
                 Height:101 Horz     Margin [dB]          -.76
2  19140.14     70.48 pk     -58       40.3      52.78   54
                 Height:101 Horz     Margin [dB]          -1.22
3  19973.974    69.57 pk     -58.8     40.3      51.07   54
                 Height:101 Horz     Margin [dB]          -2.93

Range: 2 18000 - 26500MHz ------------------------------------------------------
4  18969.97     70.42 pk     -58       40.3      52.72   54
                 Height:101 Vert     Margin [dB]          -1.28
5  24653.654    66.03 pk     -55.3     40.3      51.03   54
                 Height:200 Vert     Margin [dB]          -2.97
6  25240.741    63.86 pk     -53.4     40.3      50.76   54
                 Height:101 Vert     Margin [dB]          -3.24

LIMIT 1: CFR 47 Part 15  Class B 3m
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result
```


UL EMC Test System
17 Jan 2003 17:34:49
Preliminary Radiated Emissions
WAV INC.
WT2270
AXIS Z "ARM DOWN"
CHANNEL 6 MID
RED=HORIZONTAL GREEN=VERTICAL
CFR 47 Part 15 Class B 3m
100
92
84
76
68
60
52
44
36
28
18000
26500
dBuVolts/meter
Frequency [MHz]

WAV INC.
WT2270
AXIS Z "ARM DOWN"
CHANNEL 6 MID
RED=HORIZONTAL GREEN=VERTICAL

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
Range: 1 18000 - 26500MHz						
1	18246.747	69.62 pk	-57.5	40.3	52.42	54
		Height:200 Horz		Margin [dB]		-1.58
2	19199.7	69.94 pk	-58	40.3	52.24	54
		Height:200 Horz		Margin [dB]		-1.76
3	20203.704	69.54 pk	-58.3	40.3	51.54	54
		Height:200 Horz		Margin [dB]		-2.46
Range: 2 18000 - 26500MHz						
4	19004.004	70.35 pk	-57.9	40.3	52.75	54
		Height:101 Vert		Margin [dB]		-1.25
5	19608.108	70.5 pk	-58.5	40.3	52.3	54
		Height:200 Vert		Margin [dB]		-1.7
6	24755.756	65.41 pk	-55	40.3	50.71	54
		Height:200 Vert		Margin [dB]		-3.29

LIMIT 1: CFR 47 Part 15 Class B 3m
LIMIT 2: NONE
LIMIT 3: NONE
LIMIT 4: NONE
LIMIT 5: NONE
LIMIT 6: NONE

pk - Peak detector
qp - Quasi-Peak detector
av - Average detector
avlg - denotes average log detection
avem - denotes EMI average detection
tm - Trace Math Result

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).

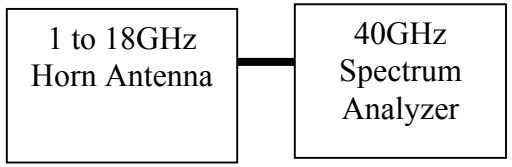
The gain/loss factor is –30.2 dB (indicating a preamplifier is included in the cable set).

The transducer factor (antenna factor) is 6.6 dB.

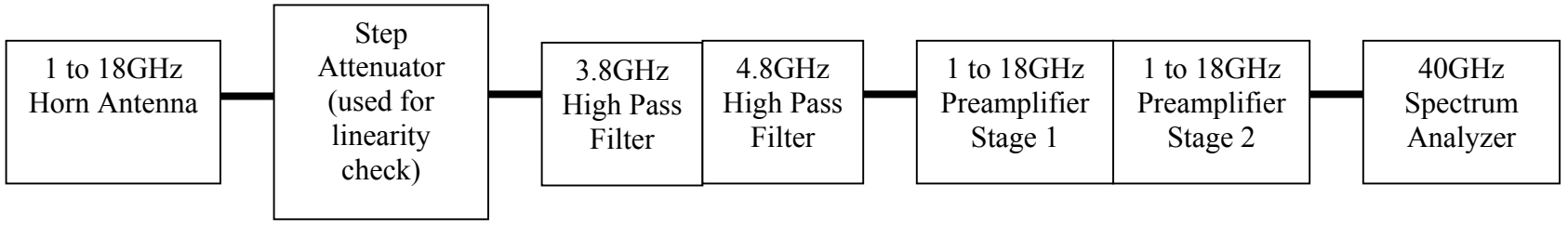
These factors are added (52.7 + (-30.2) + 6.6) resulting in a calculated field strength of 29.1 dB(uV)/meter.

APPENDIX D
Block Diagram of Measurement System

1 to 4GHz Measurement System



4 to 18GHz Measurement System



18 to 26.5GHz Measurement System