ROGERS LABS, INC.

4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

TEST REPORT

For

APPLICATION of CERTIFICATION

For

Withus Co., LTD
Migeumpark 2F, 150 Geumgok-dong
Bundang-gu, Seongnam-si
KYONGKI-DO, KOREA 463-480

S.J. Kim
R&D Institute Director

MODEL: WLR-1900C (BE BAND)
CDMA PCS REPEATER
FREQUENCY: 1870-1890 MHz Uplink
1950-1970 MHz Downlink
FCC ID: PSB WLR-1900BE

Test Date: July 25, 2002

Certifying Engineer: Scot D Rogers

Scot D. Rogers
ROGERS LABS, INC.
4405 West 259th Terrace
Louisburg, KS 66053
Phone: (913) 837-3214
FAX: (913) 837-3214

TABLE OF CONTENTS

FORWARD:

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2001, Part 2 Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.915, 2.925, 2.926, 2.1031 through 2.1057, applicable paragraphs of Parts 15, 22 and 24, the following is submitted:

List of Test Equipment

A Hewlett Packard 8591EM and or 8562A Spectrum Analyzer was used as the measuring device for the emissions testing. The analyzer settings used are described in the following table. Refer to the Appendix for a complete list of Test Equipment.

HP 8591EM SPECTRUM ANALYZER SETTINGS		
CONDUCTED EMISSIONS:		
RBW	AVG. BW	DETECTOR FUNCTION
9 kHz	30 kHz	Peak/Quasi Peak
RADIATED EMISSIONS (30 – 1000 MHz):		
RBW	AVG. BW	DETECTOR FUNCTION
120 kHz	300 kHz	Peak/Quasi Peak
HP 8562A SPECTRUM ANALYZER SETTINGS		
RADIATED EMISSIONS (1 – 40 GHz):		
RBW	AVG. BW	DETECTOR FUNCTION
1 MHz	1 MHz	Peak/Average
ANTENNA CONDUCTED EMISSIONS:		
RBW	AVG. BW	DETECTOR FUNCTION
100 kHz	100 kHz	Peak

2.1033(c) Application for Certification

(1) Manufacturer: Withus Co., LTD
Migeumpark 2F, 150 Geumgok-dong
Bundang-gu, Seongnam-si
KYONGKI-DO, KOREA 463-480

Marketer/Vendor:
TEKK Incorporated
226 NW Parkway
Kansas City, MO 64150

(2) Identification: Model: WLR-1900C (BE BAND)
S/N: 020200042 BE
FCC I.D.: PSB WLR-1900BE

(3) Instruction Book:

Refer to exhibit for Draft Instruction Manual.

(4) Emission Type: Bi-directional Amplifier of CDMA signals, 1M3G7W

(5) Frequency Range: Up-link 1870-1890 MHz Downlink 1950-1970 MHz

(6) Operating Power Level: Uplink, 0.032 Watts (Maximum Power). Downlink, 0.005 Watts. The power is continuously variable from the value listed to 5%-10% of the maximum output power.

(7) Max P_o: Uplink, 15 dBm, 0.032 Watts. Downlink, 7 dBm, 0.005 Watts.

(8) Power into final amplifier: 1.75 Watts (5.0 V @ 0.350 A)

(9) Tune Up Procedure for Output Power:

Refer to Exhibit for Transceiver Alignment Procedure.

(10) Circuit Diagrams; description of circuits, frequency stability, spurious suppression, and power and modulation limiting:
Refer to Exhibit for Circuit Diagrams.
Refer to Exhibit for Theory of Operation.

(11) Photograph or drawing of the Identification Plate:

Refer to Exhibit for Photograph or Drawing.

(12) Drawings of Construction and Layout: Refer to Exhibit for Drawings of Components Layout and Chassis Drawings.

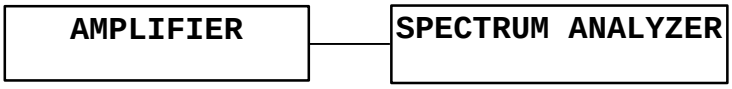
(13) Detail Description of Digital Modulation:
Not applicable. The unit is an amplifier to be used with CDMA signals.

2.1046 RF Power Output

Measurements Required:

Measurements shall be made to establish the radio frequency power delivered by the transmitter into the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted below:
If the power output is adjustable, measurements shall be made for the highest and lowest power levels. The uplink and downlink of the test sample were alternately connected through external attenuators and cables to a spectrum analyzer. Each link received an unmodulated signal from a signal source delivered to the input. The level of the input signal was adjusted to achieve maximum output power of the amplifier. Testing was performed at three frequencies within each passband.

Test Arrangement:



The radio frequency power output was measured at the antenna terminal by replacing the antenna with a spectrum analyzer, and cable. The spectrum analyzer had an impedance of 50W to match the impedance of the standard antenna. A HP 8562 Spectrum Analyzer was used to measure the radio frequency power at the antenna port. The data was taken in dBm and converted to watts as shown in the following Table. Refer to figures 1 and 2 showing the output power of the amplifier. Data was taken per Paragraph 2.1046(a) and applicable paragraphs of Parts 22 and 24.

P_{dBm} = power in dB above 1 milliwatt.
$Milliwatts = 10^{(PdBm/10)}$
Watts = (Milliwatts)(0.001)(W/mW)

15.0 dBm
$milliwatts\ conversion = 10^{(15/10)}$
milliwatts conversion = 31.62 mW
= 0.032 Watts

Results:

FREQUENCY	P_{dBm}	P_{mw}	P_w
UPLINK			
1870.0	15.0	31.6	0.032
1880.0	14.8	30.2	0.030
1890.0	14.8	30.2	0.030
DOWNLINK			
1950.0	6.3	4.3	0.004
1960.0	7.0	5.0	0.005
1970.0	6.8	4.8	0.005

The specifications of Paragraph 2.1046(a) and applicable Parts of 22 and 24 are met. There are no deviations to the specifications.

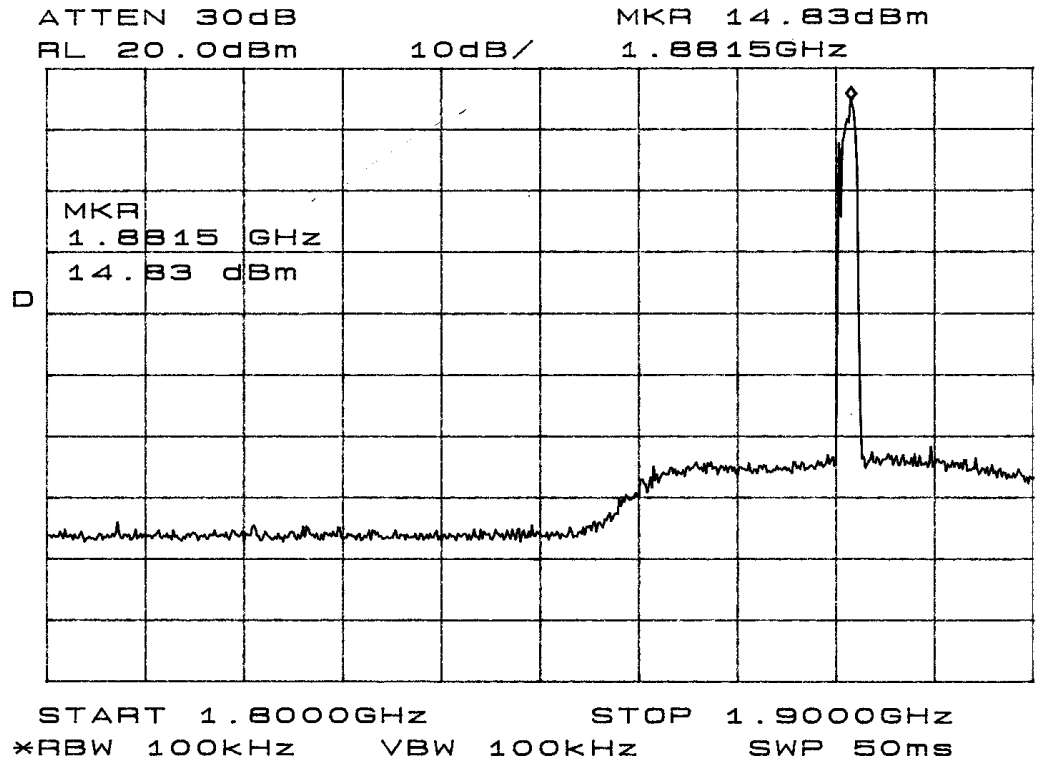


Figure 1 Uplink Power Output 1880.0 MHz.

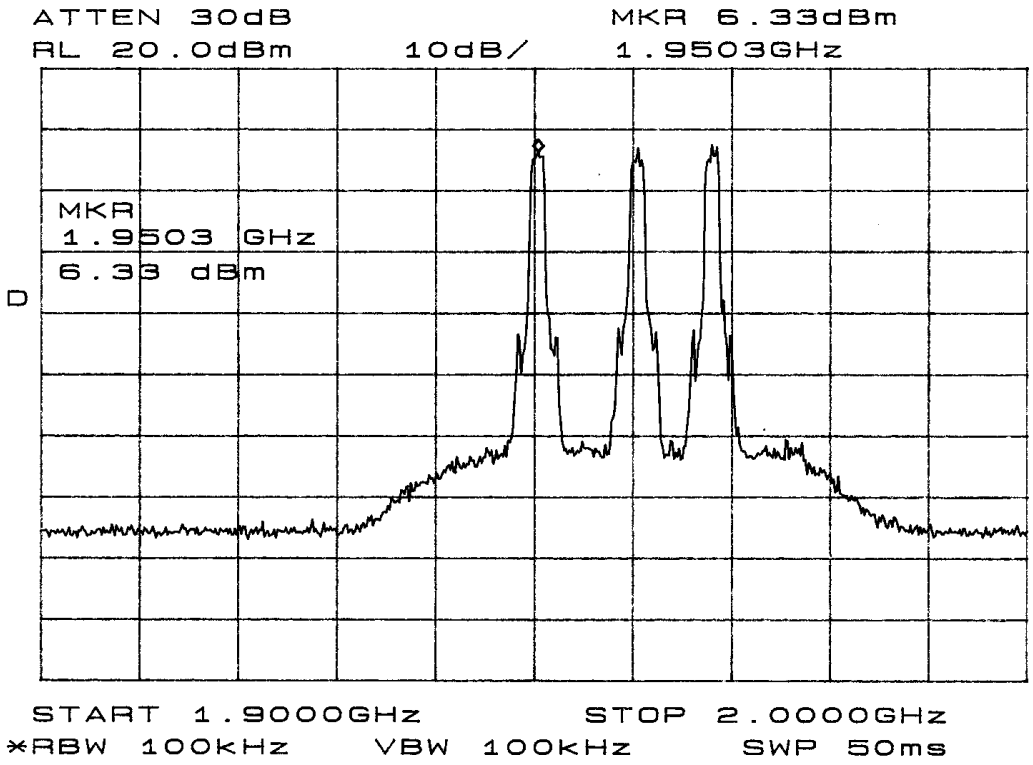


Figure 2 Downlink Power Output 1960.0 MHz.

2.1047 Modulation Characteristics

Measurements Required:

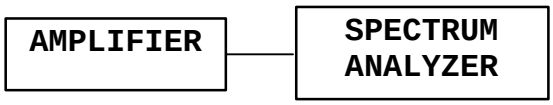
The EUT is a bi-directional amplifier and has no provision to modulate the signals. The modulation is dictated by the CDMA protocol. The specifications of Paragraph 2.1047 and applicable parts of 22, and 24 are met.

2.1049 Occupied Bandwidth

Measurements Required:

The occupied bandwidth, that is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers radiated are equal to 0.5 percent of the total mean power radiated by a given emission.

Test Arrangement:



Results:

Frequency	46 dB down < 2.5 MHz
1880.0	Pass
1960.0	Pass

A spectrum analyzer was used to observe the radio frequency spectrum with the amplifier operating in a normal mode, modulated by a CDMA generator. The signal generator was connected to the amplifier input and the output connected to the spectrum analyzer and the output the captured to the screen. Next, the CDMA modulation was enabled and the output captured to the screen of the analyzer. The screen captures are shown in figures 3 and 4. The output waveforms were then compared to the emission mask requirements for CDMA signal (46 dB down at plus and minus one channel spacing 1.25 MHz). Testing was performed at one frequency in each passband (uplink and downlink). The requirements of 2.1049 and applicable paragraphs of Parts 22, and 24 are met. There are no deviations to the specifications.

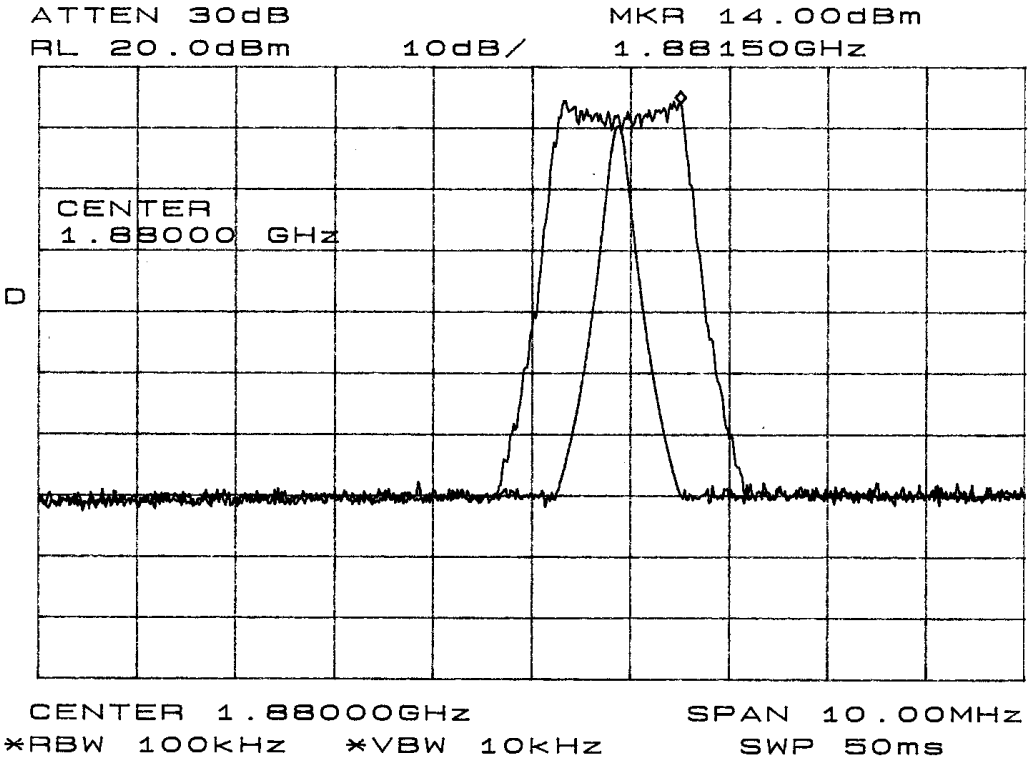


Figure 3 Occupied Bandwidth.

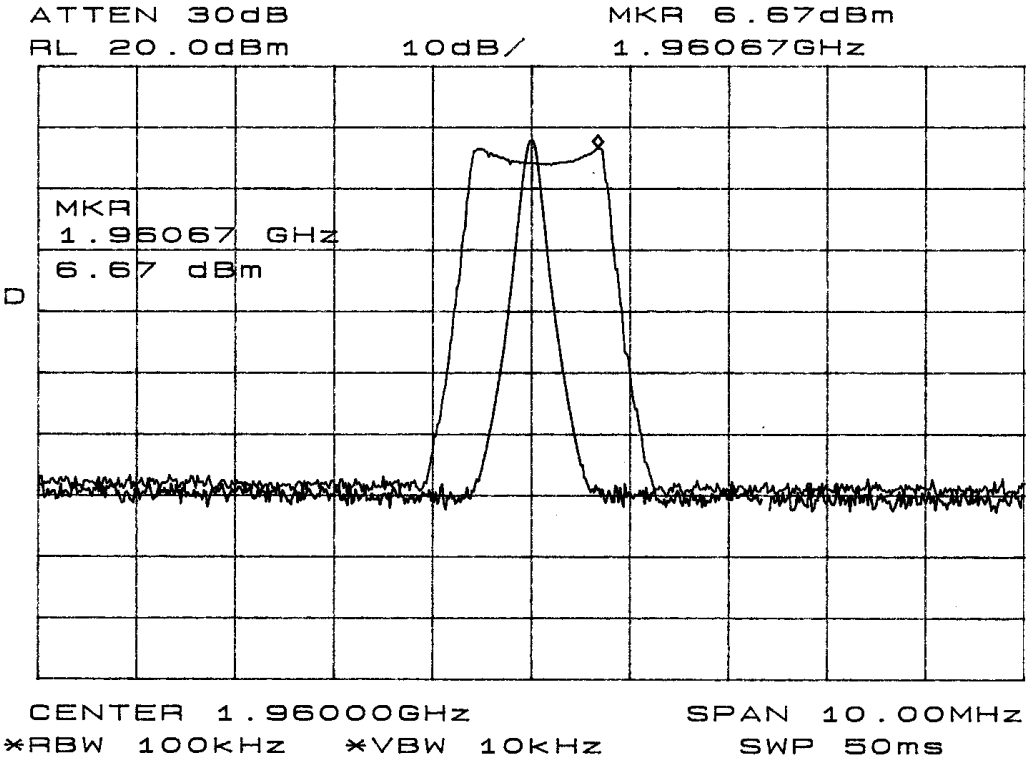


Figure 4 Occupied Bandwidth.

2.1051 Spurious Emissions at Antenna Terminals

Measurements Required:

The radio frequency voltage or power generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.

Test Arrangement:

The radio frequency output was coupled to a HP 8562 Spectrum Analyzer. The spectrum analyzer was used to observe the radio frequency spectrum with the amplifier operated in a normal mode. The frequency spectrum from 30 MHz to 20 GHz was observed and plots produced of the frequency spectrum for both the uplink and downlink operation. Figures 5 through 10 represent data for the WLR-1900C (BE BAND). Data was taken per 2.1051, 2.1057, and applicable paragraphs of Parts 22, and 24.

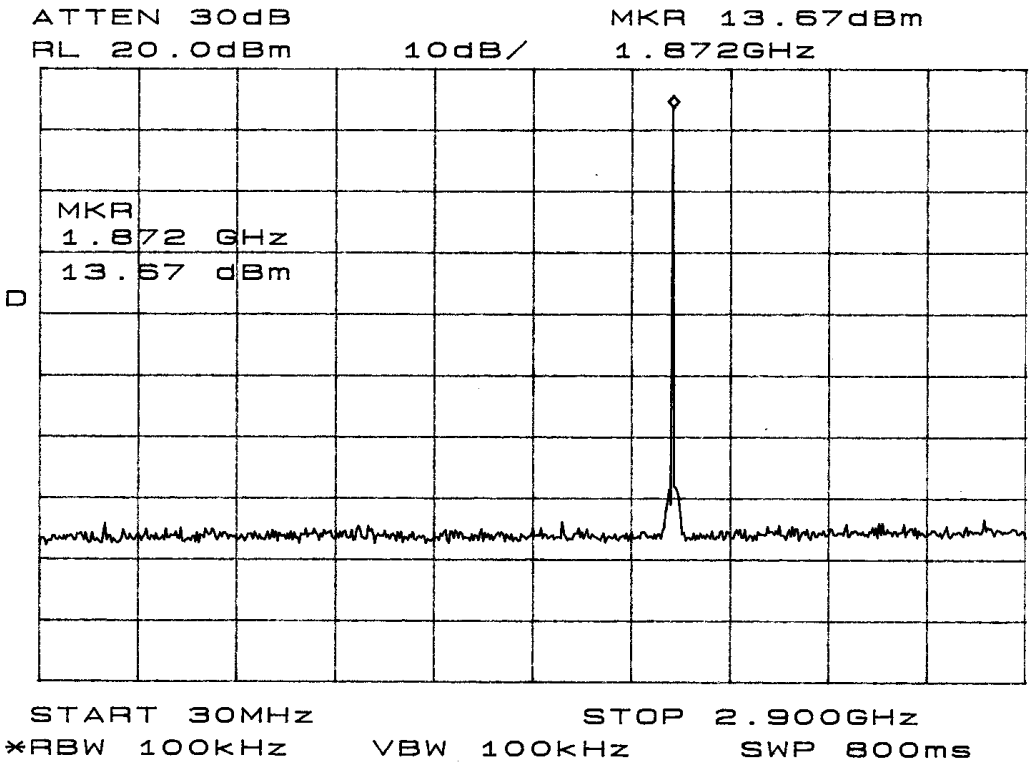


Figure 5 Emissions at Antenna Terminal.

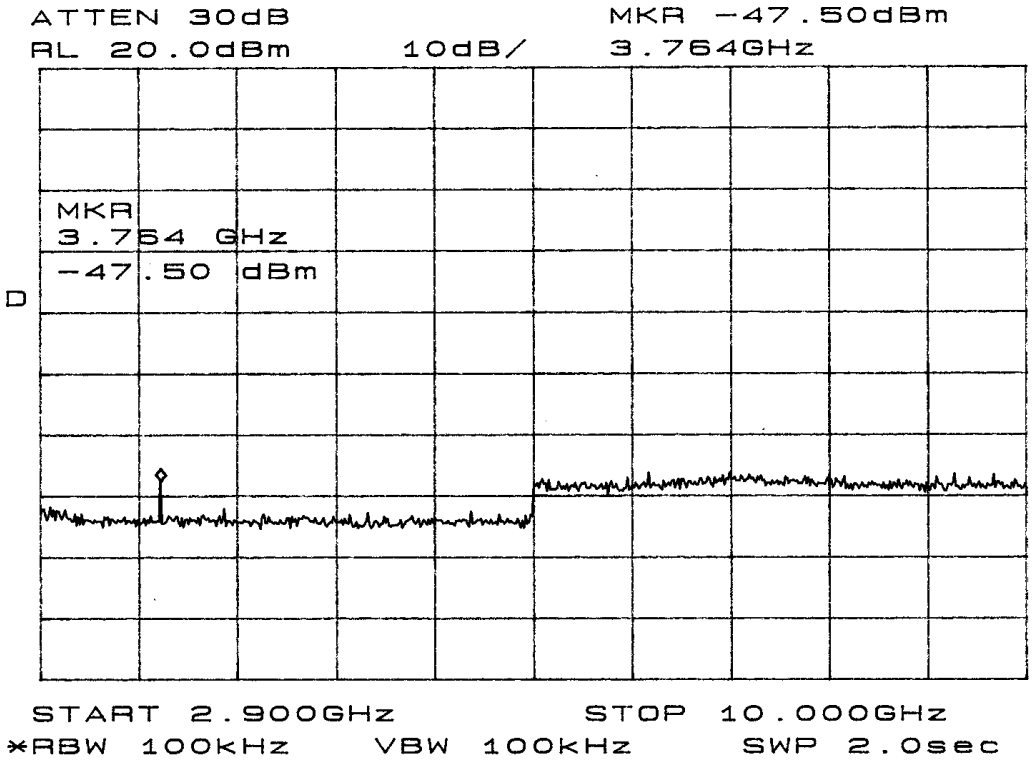


Figure 6 Emissions at Antenna Terminal.

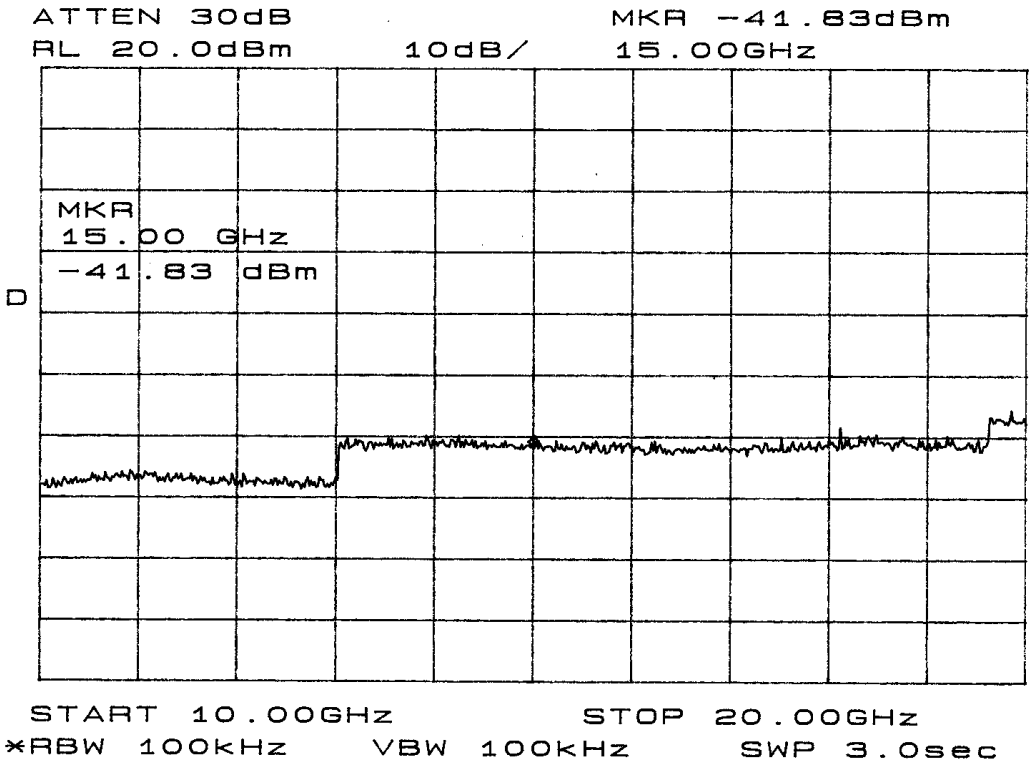


Figure 7 Emissions at Antenna Terminal.

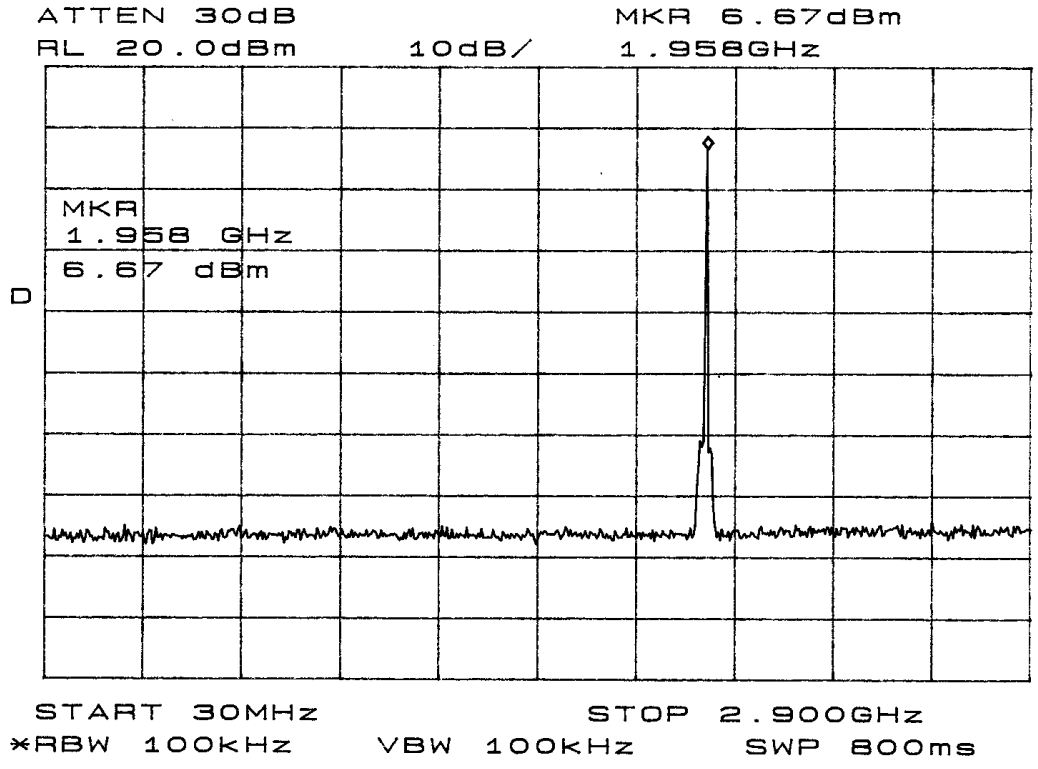


Figure 8 Emissions at Antenna Terminal.

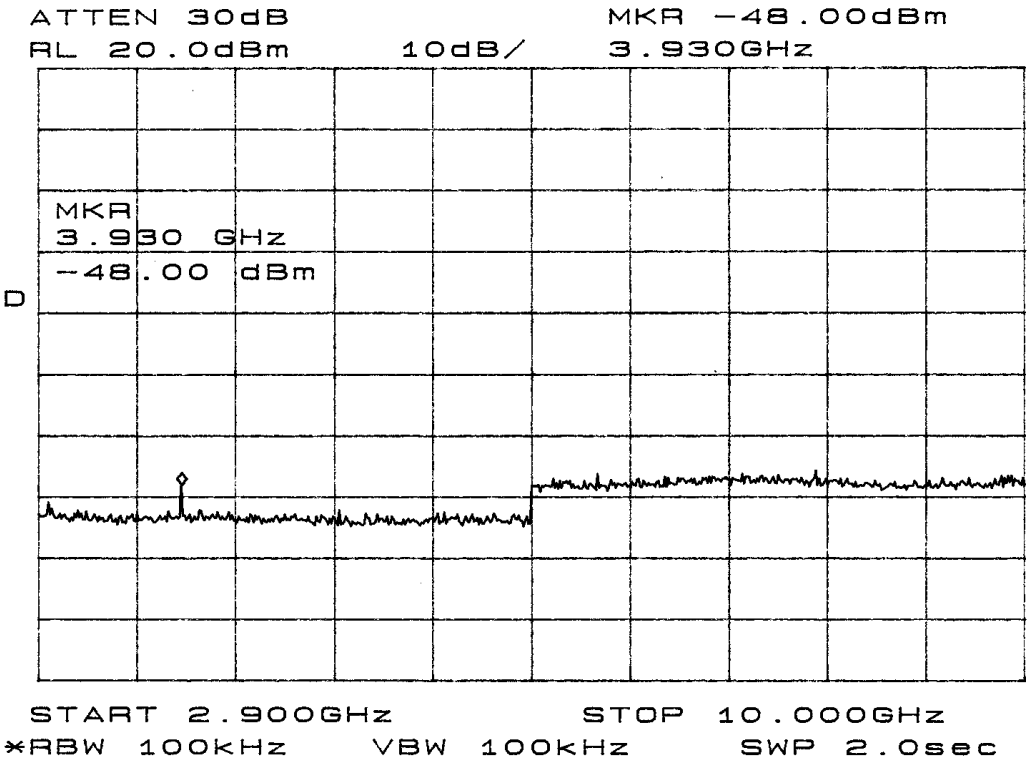


Figure 9 Emissions at Antenna Terminal.

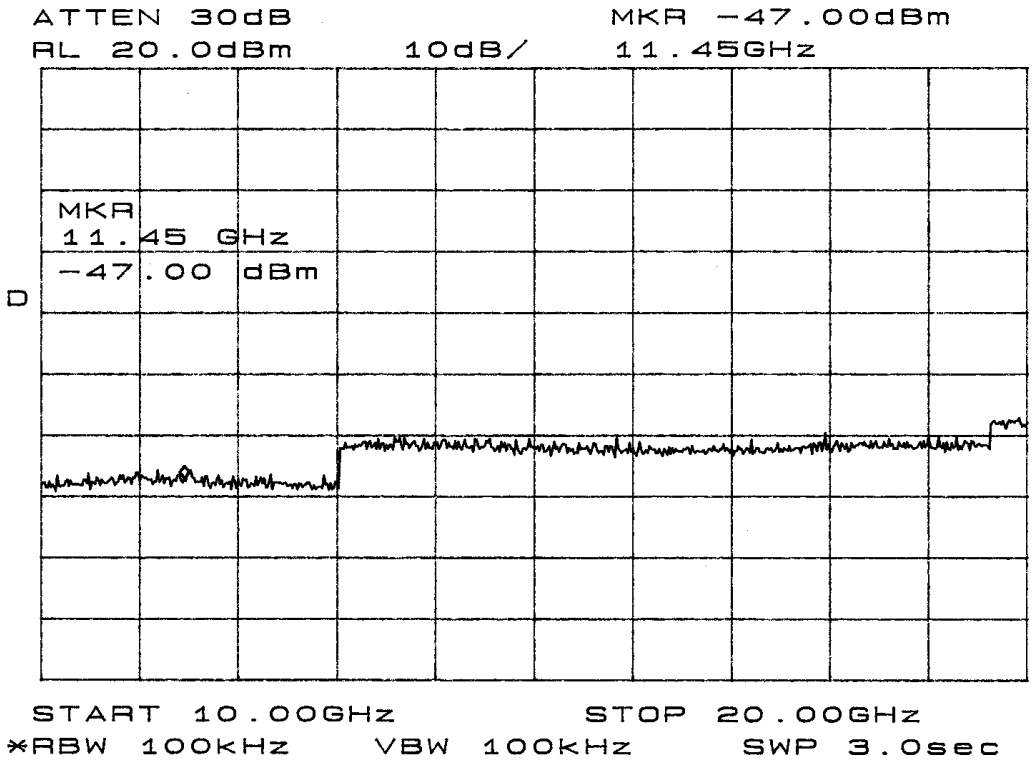


Figure 10 Emissions at Antenna Terminal.

Results:

The output of the unit was coupled to a HP Spectrum Analyzer and the frequency emissions were measured. Data was taken as per 2.1051 and applicable paragraphs of Parts 22, and 24. Specifications of Paragraphs 2.1051, 2.1057 and applicable paragraphs of parts of 22, and 24 are met. There are no deviations to the specifications.

FCC Limit:
Uplink = 43 + 10 LOG(P_o)
= 43 + 10 LOG(0.032)
= 28.05

Uplink Output

CHANNEL MHz	SPURIOUS FREQ. (MHz)	LEVEL BELOW CARRIER (dB)
1880.0	3760.0	62.5
	5640.0	68.8
	7520.0	64.0
	9400.0	63.8
	11,280.0	63.2
	13,160.0	64.0

Downlink = 43 + 10 LOG(P_o)
= 43 + 10 LOG(0.005)
= 19.9

Downlink Output

CHANNEL MHz	SPURIOUS FREQ. (MHz)	LEVEL BELOW CARRIER (dB)
1960.0	3920.0	55.0
	5880.0	66.6
	7840.0	61.3
	9800.0	60.5
	11,760.0	60.5
	13,720.0	61.2

2.1053 Field Strength of Spurious Radiation

Measurements Required:

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation.

Test Arrangement:

The amplifier was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the FSM antenna. The amplifier input was supplied from a signal generator with an appropriate CDMA signal. The turntable was rotated though 360 degrees to locate the position registering the highest amplitude emission. The frequency spectrum was then searched for spurious emissions generated from the amplifier. The amplitude of each spurious emission was maximized by raising and lowering the FSM antenna, and rotating the turntable before final data was recorded. A log periodic antenna was used for frequencies of 200 MHz to 5 GHz and pyramidal horn antennas were used for frequencies of 5 GHz to 40 GHz. Emission levels were measured and recorded from the spectrum analyzer in dBµV. This level was then added to the antenna factor less amplification stages, to calculate the field strength at 3 meters. Data was taken at the ROGERS LABS, INC. 3 meters open area test site (OATS). A description of the test facility is on file with the FCC, Reference 90910, and

dated December 8, 2000. The testing procedures used conform to the procedures stated in the ANSI 63.4-1992 document.

Calculations made are as follows:

CFS = Calculated Field Strength
FSM = Field Strength Measurement
CFS = FSM + Antenna Factor – Amplifier Gain
CFS = 97.0 + 29.4 - 20
CFS = 106.4

The limits for emissions are defined by the following equations:

Limit = Amplitude of spurious emission must be attenuated by this amount below the level of the fundamental.

Calculating the field strength at 3 meters for the amplifier was done as follows:

$E = \frac{5.5\ \sqrt{PG}}{d}$ where E is V/m, P is Watts, G = 1.64 and d is meters.

$E = \frac{5.5\ \sqrt{0.032(1.64)}}{3}$ = 0.42 V/m = 0.42E6µV/m at 3 meters.

This was converted to dBµV/m using (20*log µV/m) for convenience.

20*Log(0.42E6) = 112.4 dBµV/m @ 3 meters

On any frequency removed from the assigned frequency band the spurious emissions shall be attenuated by at least 43 + 10 Log (P_o) dB.

Attenuation = 43 + 10 $Log_{10}(P_w)$
= 43 + 10 $Log_{10}(0.032)$
= 28.0 dB

Limit = 112.4 – 28.0
= 84.4 dBµV/m @ 3 meters

Results:

Uplink data for a channel frequency of 1880.0 MHz.

Frequency (MHz)	FSM Horz. (dBµV)	FSM Vert. (dBµV)	Ant. Factor (dB)	Amp. Gain (dB)	CFS Horz. @ 3m (dBµV/m)	CFS Vert. @ 3m (dBµV/m)	Limit (dBµV/m)
1880.0	97.0	106.5	29.4	20	106.4	115.9	
3760.0	29.8	34.0	38.6	20	48.4	52.6	84.4
5640.0	33.8	34.0	29.9	20	43.7	43.9	84.4
7520.0	35.5	37.6	29.9	20	45.4	47.5	84.4
9400.0	38.0	40.0	33.5	20	51.5	53.5	84.4
11,280.0	36.8	39.8	33.5	20	50.3	53.3	84.4

Downlink data for a channel frequency of 1960.0 MHz.

Frequency (MHz)	FSM Horz. (dBµV)	FSM Vert. (dBµV)	Ant. Factor (dB)	Amp. Gain (dB)	CFS Horz. @ 3m (dBµV/m)	CFS Vert. @ 3m (dBµV/m)	Limit (dBµV/m)
1960.0	87.0	90.8	29.4	20	96.4	100.2	
3920.0	26.8	27.0	38.6	20	45.4	45.6	84.4
5880.0	24.8	25.0	29.9	20	44.7	44.9	84.4
7840.0	33.6	36.5	29.9	20	43.5	46.4	84.4
9800.0	33.4	35.8	33.5	20	46.9	49.3	84.4
11,760.0	32.0	33.0	33.5	20	45.5	46.5	84.4

Specifications of Paragraph 2.1053, 2.1057, applicable paragraphs of parts 22, and 24 are met. There are no deviations to the specifications.

2.1055 Frequency Stability

Measurements Required:

The frequency stability shall be measured with variations of input signal level and supply voltage input.

The frequency stability was measured with variations in the input signal level and power supply voltage from 85 to 115 percent of the nominal value. The radio frequency output of the signal generator was connected to the input (uplink and downlink) of the test sample and the output was connected to a spectrum analyzer. The input signal level was varied from signal levels –15, -30, -45, and –60 dB from the maximum input power. An Elgar AC power supply was used to vary the ac voltage for the power input from 102.0 Vac to 138.0 Vac. The frequency was measured and the variation in parts per million were calculated. Data was taken per Paragraphs 2.1055 and applicable paragraphs of parts 22, and 24.

Results:

FREQ. (MHz)	FREQUENCY STABILITY VS INPUT SIGNAL LEVEL IN PARTS PER MILLION (PPM)			
	-15	-30	-45	-60
	0.0	0.0	0.0	0.0

FREQUENCY IN MHz	FREQUENCY STABILITY VS VOLTAGE VARIATION 120.0 volts nominal; RESULTS IN PPM		
	INPUT VOLTAGE		
	102.0 V_{ac}	120.0 V_{ac}	138.0 V_{ac}
	0.0	0.0	0.0

Specifications of Paragraphs 2.1055 and applicable paragraphs of parts 22, and 24 are met. There are no deviations to the specifications.

Conducted Emissions on Power lines

Conducted EMI

The EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room.

The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. The manufacturer supplied AC power cord for the EUT was connected to the LISN. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the EUT. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor, internal to the LISN. Power line conducted emissions testing was carried out individually for each current carrying conductor of the computer. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequency of each emission, which had the highest amplitude. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz then the data was recorded with maximum conducted emissions levels. Refer to figures 11 and 12 showing AC line conducted emissions for the amplifier.

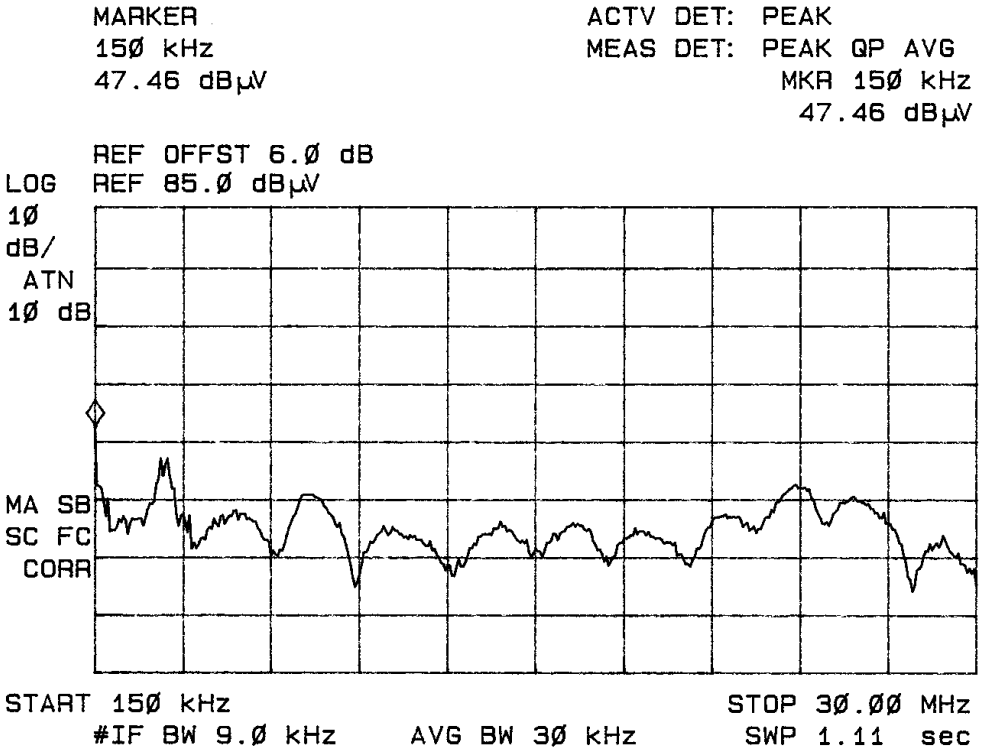


Figure 11 L1 line conducted emissions of EUT.

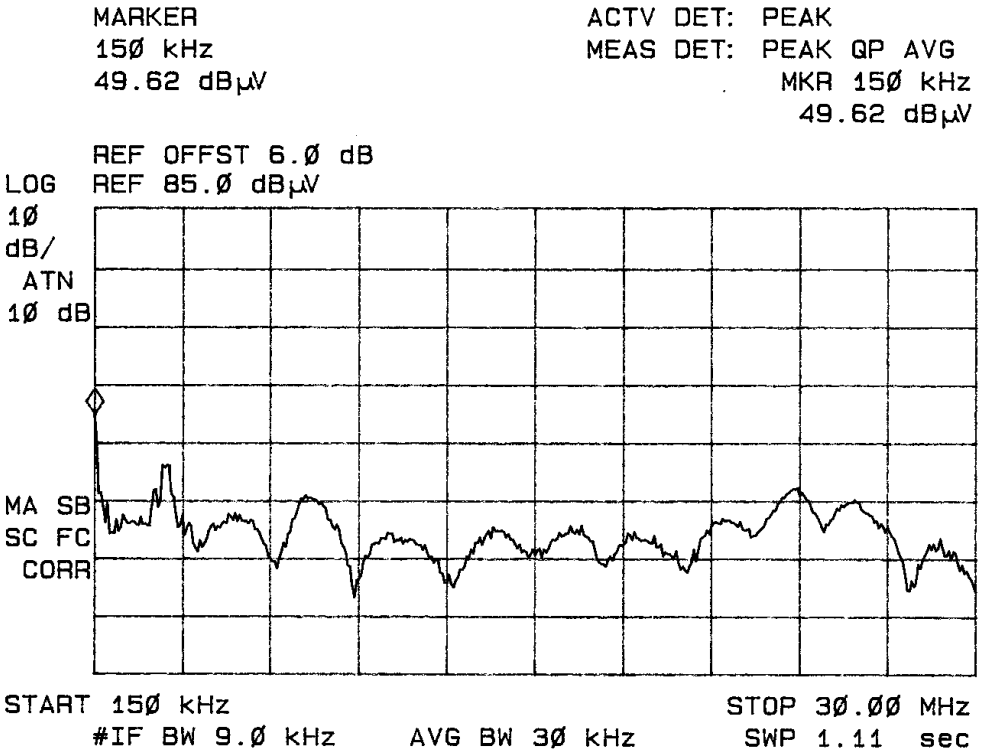


Figure 12 L2 line conducted emissions of EUT.

Results:

Conducted (7 Highest Emissions)

Frequency band (MHz)	L1 Level (dBµV) Peak	Q.P.	AVE	L2 Level (dBµV) Peak	Q.P.	AVE	CISPR 22 Q.P./AVE Limit(dBµV)
0.15 - 0.5	51.3	45.2	40.6	47.0	46.7	39.8	66/56
0.5 – 5	44.3	43.3	35.3	41.7	40.4	31.8	56/46
5 – 10	32.5	30.4	28.4	33.3	31.7	30.3	60/50
10 – 15	26.3	22.7	17.9	29.4	26.7	23.2	60/50
15 – 20	25.7	22.7	18.4	27.6	24.7	20.5	60/50
20 – 25	30.8	28.1	23.5	31.5	28.8	24.0	60/50
25 - 30	29.8	25.8	20.5	28.0	24.8	19.3	60/50

Other emissions present had amplitudes at least 10 dB below the limit.

Specifications of Paragraph 15.107 and applicable paragraphs of parts 22, and 24 are met. There are no deviations to the specifications.

APPENDIX

Model: WLR-1900C (BE BAND)

1. Test Equipment List.
2. Rogers Qualifications.
3. FCC Site Approval Letter.

TEST EQUIPMENT LIST FOR ROGERS LABS, INC.

The test equipment used is maintained in calibration and good operating condition. Use of this calibrated equipment ensures measurements are traceable to national standards.

List of Test Equipment:	Calibration Date:
Scope: Tektronix 2230	2/02
Wattmeter: Bird 43 with Load Bird 8085	2/02
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/02
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/02
R.F. Generator: HP 606A	2/02
R.F. Generator: HP 8614A	2/02
R.F. Generator: HP 8640B	2/02
Spectrum Analyzer: HP 8562A, Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W HP Adapters: 11518, 11519, 11520	7/02
Spectrum Analyzer: HP 8591 EM	7/02
Frequency Counter: Leader LDC 825	2/02
Antenna: EMCO Biconilog Model: 3143	5/02
Antenna: EMCO Log Periodic Model: 3147	10/01
Antenna: Antenna Research Biconical Model: BCD 235	7/02
Antenna: EMCO Dipole Set 3121C	2/02
Antenna: C.D. B-101	2/02
Antenna: Solar 9229-1 & 9230-1	2/02
Antenna: EMCO 6509	2/02
Audio Oscillator: H.P. 201CD	2/02
R.F. Power Amp 65W Model: 470-A-1010	2/02
R.F. Power Amp 50W M185- 10-501	2/02
R.F. PreAmp CPPA-102	2/02
Shielded Room 5 M x 3 M x 3.0 M (101 dB Integrity)	
LISN 50 µHy/50 ohm/0.1 µf	10/01
LISN Compliance Eng. 240/20	2/02
Peavey Power Amp Model: IPS 801	2/02
Power Amp A.R. Model: 10W 1010M7	2/02
Power Amp EIN Model: A301	2/02
ELGAR Model: 1751	2/02
ELGAR Model: TG 704A-3D	2/02
ESD Test Set 2010i	2/02
Fast Transient Burst Generator Model: EFT/B-101	2/02
Current Probe: Singer CP-105	2/02
Current Probe: Solar 9108-1N	2/02
Field Intensity Meter: EFM-018	2/02
KEYTEK Ecat Surge Generator	2/02

07/20/2002

QUALIFICATIONS

of

SCOT D. ROGERS, ENGINEER

ROGERS LABS, INC.

Mr. Rogers has approximately 13 years experience in the field of electronics. Six years working in the automated controls industry and 6 years working with the design, development and testing of radio communications and electronic equipment.

POSITIONS HELD:

Systems Engineer:	A/C Controls Mfg. Co., Inc. 6 Years
Electrical Engineer:	Rogers Consulting Labs, Inc. 5 Years
Electrical Engineer:	Rogers Labs, Inc. Current

EDUCATIONAL BACKGROUND:

1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.

2) Bachelor of Science Degree in Business Administration Kansas State University.

3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

Scot D Rogers

Scot D. Rogers

July 25, 2002
Date

1/08/2001

FEDERAL COMMUNICATIONS COMMISSION
Laboratory Division
7435 Oakland Mills Road
Columbia, MD. 21046

December 08, 2000

Registration Number: 90910

Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053

Attention: Scot D. Rogers

Re: Measurement facility located at Louisburg
3 & 10 meter site
Date of Listing: December 08, 2000

Gentlemen:

Your submission of the description of the subject measurement facility has been reviewed and found to be in compliance with the requirements of Section 2.948 of the FCC Rules. The description has, therefore, been placed on file and the name of your organization added to the Commission's list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that this filing must be updated for any changes made to the facility, and at least every three years from the date of listing the data on file must be certified as current.

If requested, the above mentioned facility has been added to our list of those who perform these measurement services for the public on a fee basis. An up-to-date list of such public test facilities is available on the Internet on the FCC Website at WWW.FCC.GOV, E-Filing, OET Equipment Authorization Electronic Filing.

Sincerely,

Thomas W. Phillips

Thomas W Phillips
Electronics Engineer