ROGERS
Labs, Inc.

4405 West 259TH Terrace • Louisburg, KS 66053 • PHONE & FAX: (913) 837-3214

Test Report
For
Application of Certification

For

AIRSYS ATM INC.
23501 West 84th Street
Shawnee, KS 66227
Phone: (913)422-2600

MODEL: AN415
P/N: 527400001D
FREQUENCY: 960-1215 MHz
FCC ID: BOJ415

Test Date: July 6, 1999

Certifying Engineer: Scot D Rogers

Scot D. Rogers
ROGERS LABS, INC.
4405 W. 259th Terrace
Louisburg, KS 66053
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FORWARD:

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 1998, Part 2 Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057; Part 87, Subchapter D, Paragraphs 87.131 through 87.147, and FCC Report and Order FCC 98-58 following is submitted:

Device Description and Use

The equipment under test (EUT) was a Distance Measuring Equipment (DME) low power ground station. The unit operates in the 960 MHz to 1215 MHz frequency range and is compatible with the existing FAA systems.

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 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	300 kHz	Peak

Equipment Tested

The EUT system was assembled with the following equipment.

EQUIPMENT	FCC ID#
DME	BOJ415

2.1033(c) Application for Certification

1. Manufacturer: AIRSYS ATM INC.
   23501 West 84th Street
   Shawnee, KS 66227

2. Identification: Model: AN415

   FCC I.D.: BOJ415

3. Refer to Installation and Operating Instruction Manual Exhibit.

4. Emission Type:

   700KM1A

5. Frequency Range:

   960-1215 MHz

6. Operating Power Level:

   100 Watts. The output power can be reduced by 1, 2 or 3 dB under software control.

   RF Output Power: 100 Watts Peak

7. Max P_o:

   Peak Power: 125 Watts.

8. Power into final amplifier:

   DC Voltage: 50.0 Volts
   DC Current: 6 Amps
   300 Watts at Final Amplifier

9. Tune Up Procedure: Refer to Exhibit.

10. Refer to Exhibits for function of semiconductors and other active devices.

11. Refer to Exhibit for FCC ID Label.

12. Refer to Exhibit for photographs of equipment.

13. Refer to Exhibit for details of modulation techniques.

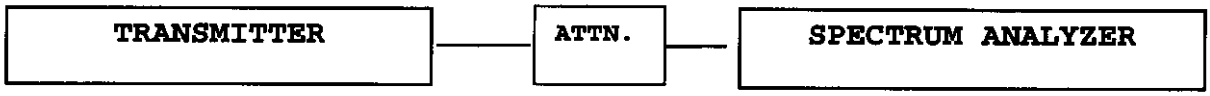
2.1046 RF Power Output

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:

Test Arrangement:



The r.f. power output was measured at the antenna terminal by replacing the antenna with a spectrum analyzer, 50dB Attenuation and 3.6 dB loss in cable. The spectrum analyzer had impedance of 50Ω to match the impedance of the standard antenna. A HP 8591EM Spectrum Analyzer was used to measure the r.f. power at the antenna port. The data was taken in dBm and converted to watts as shown in the following Table. Refer to Figure 1 showing the peak output power of the transmitter. Data taken per Paragraph 2.1046(a) and applicable parts of Part 87.

P_{dBm} = power in dB above 1 milliwatt.

$Milliwatts = 10^{(PdBm/10)}$

Watts = (Milliwatts)(0.001)(W/mW)

Results:

FREQUENCY	Peak P_{dBm}	Peak P_{mW}	Peak P_W
962	49.6	91,201	91.2
1024	49.7	93,325	93.3
1213	49.6	91,201	91.2

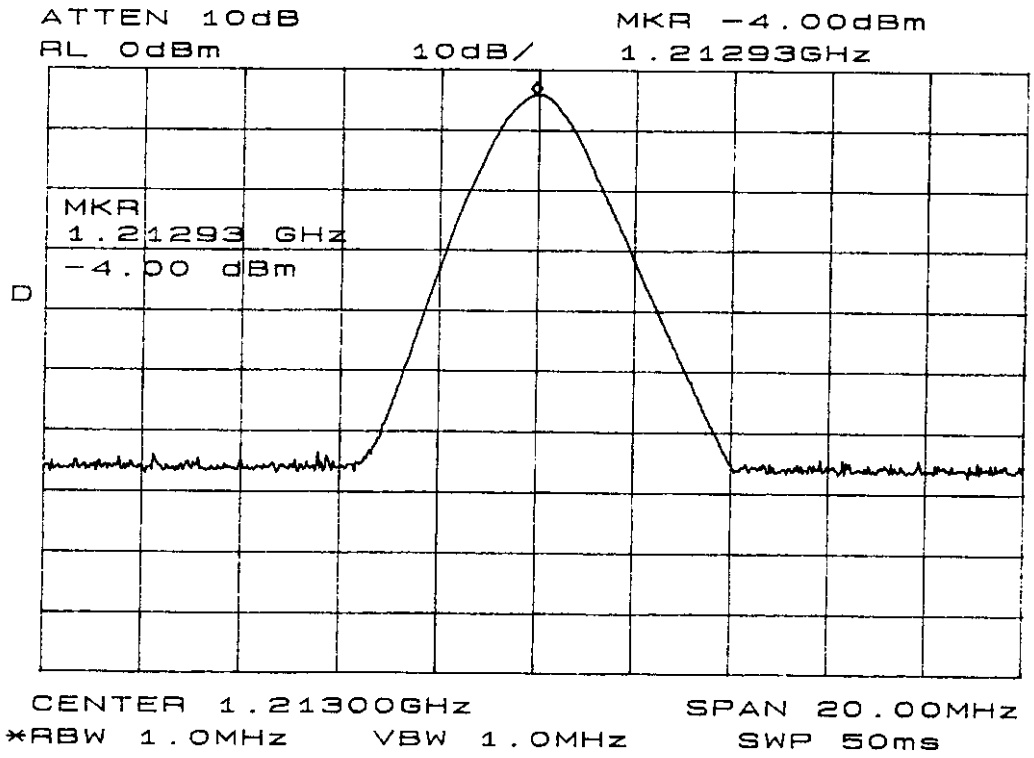


Figure 1 Peak Output Power @ 1213 MHz

The specifications of Paragraph 2.1046(a) and 87.131 are met. There are no deviations to the specifications.

2.1047 Modulation Characteristics

Measurements Required:

A curve or equivalent data that shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed shall be submitted.

Results:

Refer to Exhibit for Modulation Characteristics. Specifications of Paragraphs 2.1047 and applicable part of 87 are met. There are no deviations to the specifications.

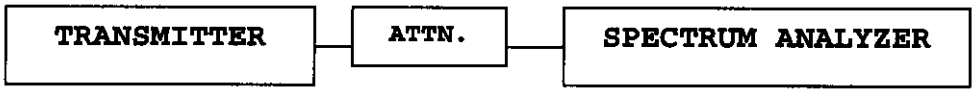
2.1049 Occupied Bandwidth

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:

f_c	O.B. kHz
1213	435

Refer to Figure 2 for a plot of the Occupied Bandwidth measurements.

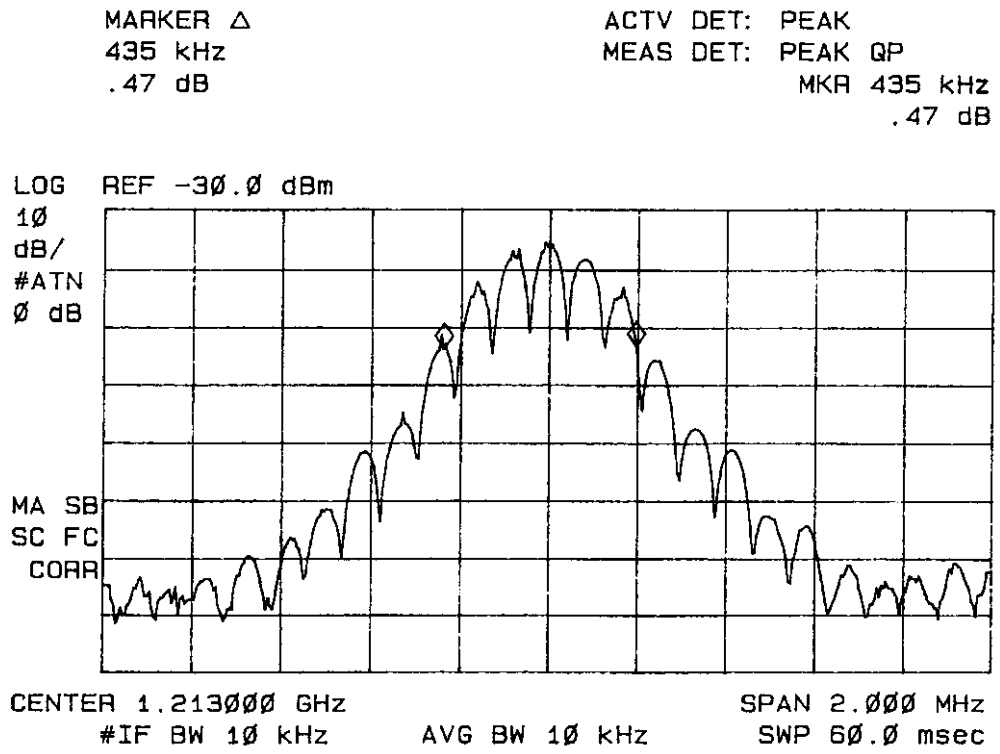


Figure 2 Occupied Bandwidth 1213 MHz

Requirements of 2.1049 and applicable parts of Paragraph 87 are met. There are no deviations to the specifications.

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 r.f. output was coupled to a HP 8562A Spectrum Analyzer through a 26 dB notch filter and attenuation. The spectrum analyzer was used to observe the r.f. spectrum with the transmitter operating in its normal mode. The frequency spectrum from 0 to 15 GHz was observed and plots produced of the frequency spectrum. Figures 3 and 4 represent data for the AN415. Data taken per 2.1051 and applicable parts of Part 87.

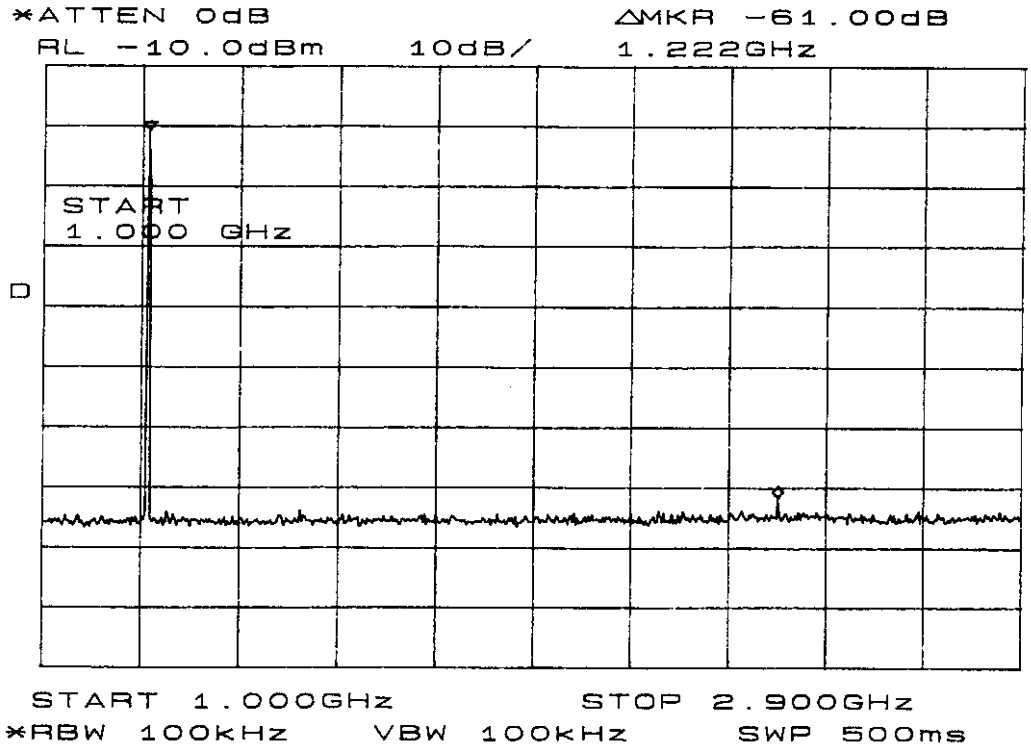


Figure 3 Emissions at Antenna Terminal

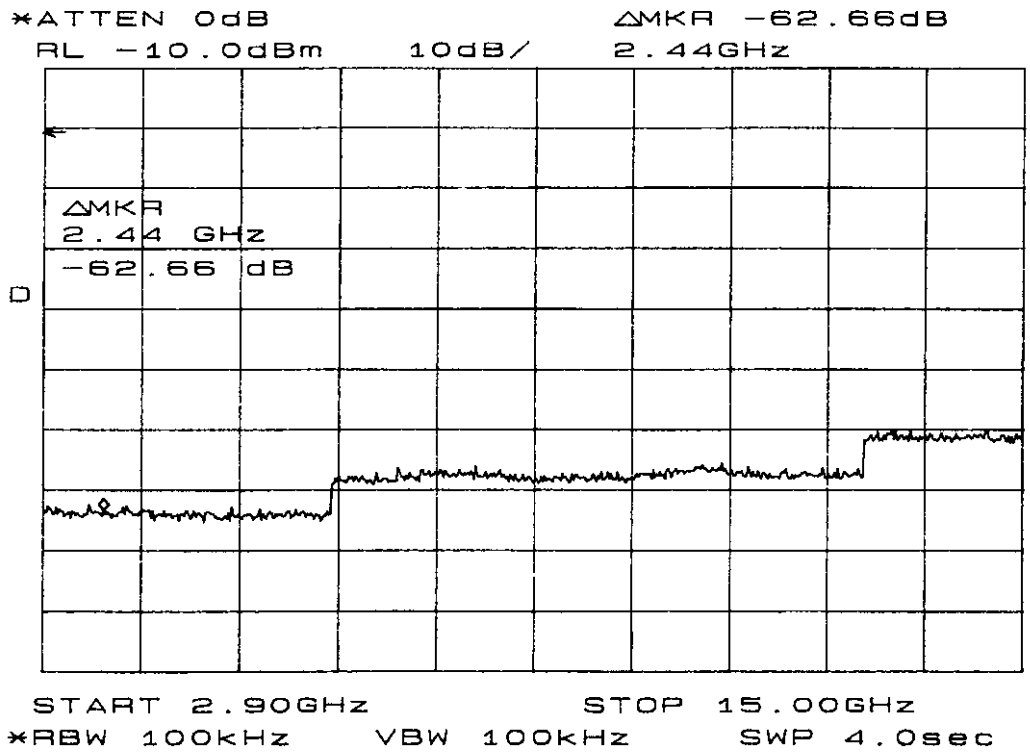


Figure 4 Emissions at Antenna Terminal

Results:

Data taken per 2.1051 and applicable parts of Part 87. Specifications of Paragraphs 2.1051, 2.1057 and 87.139 are met. There are no deviations to the specifications.

FREQUENCY	SPURIOUS FREQ. (GHz)	LEVEL BELOW CARRIER (dB)
962	1924	64.0
	2886	64.6
	3848	66.0
	4810	67.0
1024	2048	65.1
	3072	66.1
	4096	65.6
	5120	66.0
1213	2426	64.3
	3639	68.0
	4852	66.7
	6065	68.0

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 transmitter was placed on a wooden turntable 0.1 meters above the ground plane and at a distance of 3 meters from the FSM antenna. The antenna port was terminated into a 50 • load. The transmitter was activated and the frequency spectrum was observed. 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 transmitter and support equipment. The amplitude of each spurious emission was maximized by raising and lowering the FSM antenna, rotating the turntable; and changing antenna polarization between horizontal and vertical before data was recorded. A Biconilog antenna was used to measure frequencies from 30 to 1000 MHz and/or 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 the amplifier gain 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: 31040/SIT, 1300F2, dated February 6, 1998. The testing procedure used conforms 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 = 42.1 + 8.9 - 35
CFS = 16.0

Radiated General Emissions (6 Highest Emissions)

Freq. In MHz	FSM Hor. (dBµV)	FSM Vert. (dBµV)	Ant. Fact. (dB)	Amp. Gain (dB)	Comp. Hor. (dBµV/m) @ 3m	Comp. Vert. (dBµV/m) @ 3m	FCC Limit (dBµV/m) @ 3M
80.8	42.1	56.0	8.9	35	16.0	29.9	40.0
100.0	42.9	54.8	7.9	35	15.8	27.7	43.5
120.0	53.2	58.5	7.9	35	26.1	31.4	43.5
132.7	49.5	56.0	8.9	35	23.4	29.9	43.5
170.6	53.9	58.0	9.4	35	28.3	32.4	43.5
191.8	53.5	57.6	9.9	35	28.4	32.5	43.5

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

Results:

Channel	Frequency (MHz)	FSM Horz. (dBµV)	FSM Vert. (dBµV)	Ant. Factor (dB)	Amp. Gain (dB)	CFS Horz. @ 3m (dBµV/m)	CFS Vert. @ 3m (dBµV/m)
962.0	1924.0	32.5	32.8	29.0	25	36.5	36.8
	2886.0	31.8	32.8	33.4	25	40.2	41.2
	3848.0	34.5	33.3	38.3	25	47.8	46.6
	4810.0	32.1	33.5	42.5	25	49.6	51.0
1024.0	2048.0	39.3	35.8	29.0	25	43.3	39.8
	3072.0	35.8	34.6	35.6	25	46.4	45.2
	4096.0	34.4	33.1	40.4	25	49.8	48.5
	5120.0	33.1	31.8	41.6	25	49.7	48.4
1213.0	2426.0	31.6	33.0	33.4	25	40.0	41.4
	3639.0	33.6	33.6	38.3	25	46.9	46.9
	4852.0	32.3	33.1	42.5	25	49.8	50.6
	6065.0	33.0	33.0	41.6	25	49.6	49.6
1087.0	2174.0	33.0	34.5	29.0	25	37.0	38.5
	3261.0	34.1	34.7	35.6	25	44.7	45.3
	4348.0	34.5	32.5	40.4	25	49.9	47.9
	5435.0	33.3	33.5	41.6	25	49.9	50.1

Specifications of Paragraph 2.1053, 2.1057 and 87.139 are met.
There are no deviations to the specifications.

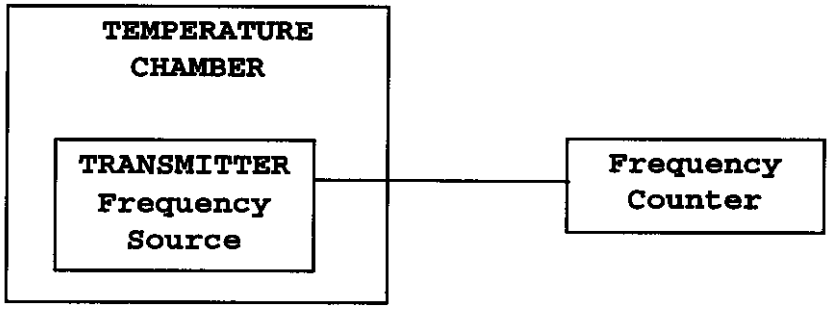
2.1055 Frequency Stability

Measurements Required:

The frequency stability shall be measured with variations of ambient temperature from -30° to +50° centigrade. Measurements shall be made at the extremes of the temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. In addition to temperature stability the frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
(2) For hand carried, batteries powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

Test Arrangement:



The measurement procedure outlined below shall be followed:

Step 1: The transmitter shall be installed in an environmental test chamber whose temperature is controllable. Provision shall be made to measure the frequency of the transmitter.
Step 2: With the transmitter inoperative (power switched "OFF"), the temperature of the test chamber shall be adjusted to +25ºC. After a temperature

stabilization period of one hour at +25°C, the transmitter shall be switched "ON" with standard test voltage applied.
Step 3: The carrier shall be keyed "ON", and the transmitter shall be operated unmodulated at full r.f. power output at the duty cycle for which it is rated, for duration of at least 5 minutes. The r.f. carrier frequency shall be monitored and measurements shall be recorded.
Step 4: The test procedures outlined in Steps 2 and 3, shall be repeated after stabilizing the transmitter at the environmental temperatures specified, -30°C to 50°C in 10 degree increments.

The frequency stability was measured with variations in the power supply voltage from 85 to 115 percent of the nominal value. An Elgar AC Power Source was used to vary the input voltage form 187 Vac to 253 Vac. The frequency was measured and the variation in parts per million was calculated. Data was taken per Paragraphs 2.1055 and 87.133.

Results:

Refer to Exhibit for Frequency Stability over Temperature.

FREQUENCY IN MHz	STABILITY VS VOLTAGE VARIATION ±15% IN PPM INPUT VOLTAGE		
	187 V_{ac}	220.0 V_{ac}	253.0 V_{ac}
1213	0	0	0

Specifications of Paragraphs 2.1055 and 87.133 are met. There are no deviations to the specifications.

APPENDIX

Model: AN415

1. Photos of Radiated Emissions Test Set Up
2. Test Equipment List.
3. Rogers Qualifications.
4. FCC Site Approval Letter.

TEST EQUIPMENT LIST FOR ROGERS LABS, INC.

The equipment is used daily and kept in good calibration and operating condition. Calibration of critical items are checked for accuracy each time used.

List of Test Equipment:	Calibration Date:
Scope: Tektronix 2230	2/99
Wattmeter: Bird 43 with Load Bird 8085	2/99
Power Supplies: Sorensen SRL 20-25, DCR 150, DCR 140	2/99
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/99
R.F. Generator: Boonton 102F	2/99
R.F. Generator: HP 606A	2/99
R.F. Generator: HP 8614A	2/99
R.F. Generator: HP 8640B	2/99
Spectrum Analyzer: HP 8562A,	
Mixers: 11517A, 11980A & 11980K	
HP Adapters: 11518, 11519, 11520	6/98
Spectrum Analyzer: HP 8591 EM	2/99
Frequency Counter: Weston 1255	2/99
Frequency Counter: Leader LDC 825	9/98
Antenna: EMCO Log Periodic	9/98
Antenna: BCD 235/BNC Antenna Research	2/99
Antenna: EMCO Dipole Set 3121C	2/99
Antenna: C.D. B-100	2/99
Antenna: Solar 9229-1 & 9230-1	2/99
Antenna: EMCO 6509	2/99
Microline Freq. Meter: Model 27B	2/99
Dana Modulation Meter: Model 9008	2/99
Audio Oscillator: H.P. 200CD	9/97
R.F. Power Amp 65W Model: 470-A-1000	9/97
R.F. Power Amp 50W M185- 10-500	9/97
R.F. PreAmp CPPA-102	
Shielded Room 5 M x 3 M x 3.0 M (100 dB Integrity)	9/98
LISN 50 µHy/50 ohm/0.1 µf	2/99
LISN Compliance Eng. 240/20	2/99
SCS Power Amp Model: 2350A	2/99
Power Amp A.R. Model: 10W 1000M7	1/99
Power Amp EIN Model: A300	2/99
Linear Amp Mini Circuits: ZHL-1A (2 Units)	2/99
Combiner Unit Mini Circuits: ZSC-2-1 (2 Units)	2/99
ELGAR Model: 1751	2/99
ELGAR Model: TG 704A-3D	2/99
ELGAR Model: 400SD (PB)	10/95
ESD Test Set 2000i	10/95
Fast Transient Burst Generator Model: EFT/B-100	8/97
Current Probe: Singer CP-105	8/97
Current Probe: Solar 9108-1N	10/95
Field Intensity Meter: EFM-018	

03/01/99

QUALIFICATIONS

Of

SCOT D. ROGERS, ENGINEER

ROGERS LABS, INC.

Mr. Rogers has approximately 12 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

7/19/99

Date

1/11/99

FEDERAL COMMUNICATIONS COMMISSION

7435 Oakland Mills Road
Columbia, MD 21046
Telephone: 301-725-1585 (ext-218)
Facsimile: 301-344-2050

February 6, 1998

IN REPLY REFER TO
31040/SIT
1300F2

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

Attention: Scot D. Rogers

Re: Measurement facility located at above address
(3 and 10 meter site)

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 or notification under Parts 15 or 18 of the Commission's Rules. Our list will also indicate that the facility complies with the radiated and AC line conducted test site criteria in ANSI C63.4-1992. Please note that this filing must be updated for any changes made to the facility, and at least every three years the data on file must be certified as current.

Per your request, the above mentioned facility has been also added to our list of those who perform these measurement services for the public on a fee basis. This list is updated monthly and is available on the Laboratory's Public Access Link (PAL) at 301-725-1072, and also on the Internet at the FCC Website www.fcc.gov/oet/info/database/testsite/.

Sincerely,

Thomas W. Phillips
Electronics Engineer
Customer Service Branch

PROVISIONAL

DME GROUND BEACON

DME 415/435

Volume 1

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