ROGERS LABS, INC.

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

TEST REPORT

For

APPLICATION of CERTIFICATION

For

Genex Electronics Co. LTD
3263 HA-AHN Industrial Zone
201 HA-AHN 3-Dong
Kwang Myung-City 423-754 Korea

Clark Cheon

MODEL: FRS-300
Family Radio Service (FRS) TRANSCEIVER
FREQUENCY: 462 & 467 MHz

FCC ID: PM3 FRS-300

Test Date: April 19, 2001

Certifying Engineer: Scot D Rogers

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

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2000, 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, 90 and 95, the following is submitted for use in obtaining a Grant of Certification.

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	300 kHz	Peak

2.1033(c) Application for Certification

(1) Manufacturer: Genex Electronics Co. LTD
3263 HA-AHN Industrial Zone
201 HA-AHN 3-Dong
Kwang Myung-City 423-754 Korea

(2) Identification: Model: FRS-300
S/N: Set 1
FCC I.D.: PM3 FRS-300

(3) Instruction Book:

Refer to exhibit for Instruction Manual.

(4) Emission Type: 8K0F3E

(5) Frequency Range: 462.5625-462.7125 and 467.5625-467.7125 MHz

(6) Operating Power Level: 0.5 Watts

(7) Max P_o: 0.5 Watts

(8) Power into final amplifier:
0.5 Watt Unit: 1.91 Watts (6.0V @ 0.32A)

(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 and 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 appendix for photographs of EUT.

(13) Detail Description of Digital Modulation:

Not applicable.

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.

Test Arrangement:

The radio frequency power output was measured at the antenna terminal by replacing the antenna with a coax cable and spectrum analyzer. The spectrum analyzer had an impedance of 50Ω to match the impedance of the standard antenna. A 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 Figure 1 showing the output power of the transmitter. Data taken per Paragraph 2.1046(a) and applicable paragraphs of Parts 90 and 95.

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

26.83 dBm = $10^{(26.83/10)}$
= 481.95 mW
= 0.5 Watts

Results:

REQUENCY	P_{dBm}	P_{mw}	P_{w}
462.5625	26.83	481.95	0.5
467.7125	26.82	480.84	0.5

The specifications of Paragraph 2.1046(a) and applicable paragraphs of Parts 90 and 95 are met. There are no deviations to the specifications.

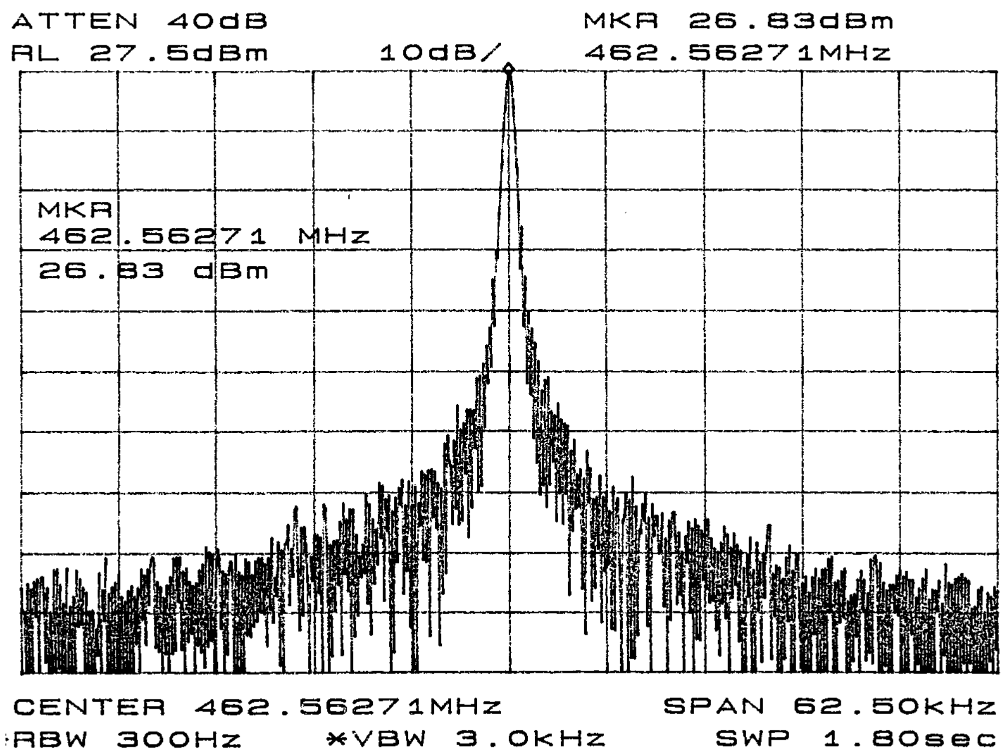


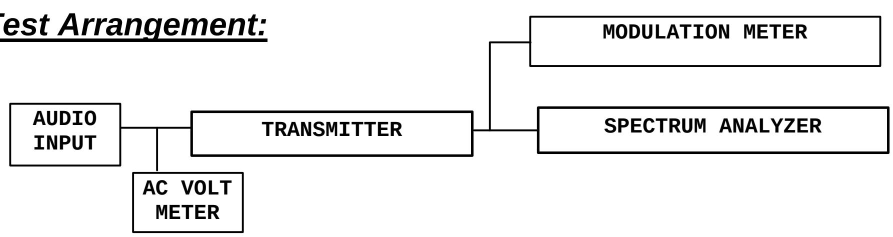
Figure 1: Power Output Channel 462.5625 (0.5 Watt)

2.1047 Modulation Characteristics

Measurements Required:

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

Test Arrangement:



The radio frequency output was coupled to a HP Spectrum Analyzer and a modulation meter. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in its various modes. The modulation meter was used to measure the percent modulation.

Results:

Figure 2 displays the graph made showing the audio frequency response of the modulator. The frequency generator was set to 1 kHz and injected into the audio input port of the EUT. The amplitude was adjusted to obtain 50% modulation at 1000 Hz. This level was then taken as the 0-dB reference. The frequency of the generator was then varied and the output level recorded while holding the input levels constant.

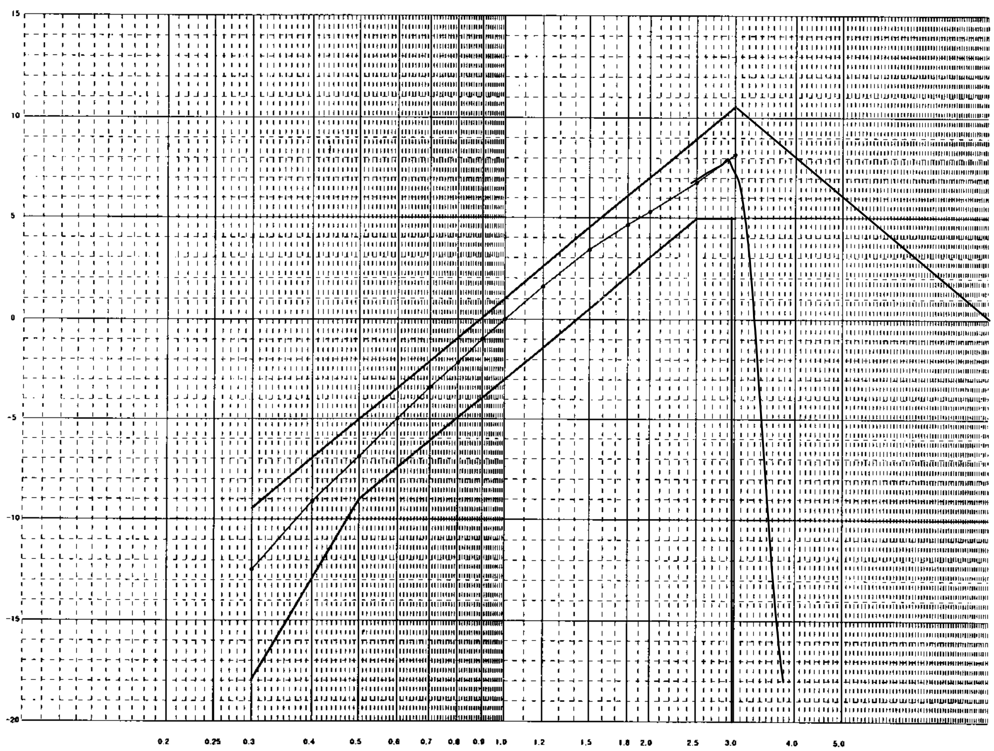


Figure 2: Audio Response Characteristics.

Figure 3 shows the deviation response for each of three frequencies while the input voltage was varied. The frequency is held constant and the frequency deviation is read from the deviation meter. Figure 4 shows the frequency response of the audio low pass filter. The specifications of Paragraph 2.1047 and applicable paragraphs of parts 90 and 95 are met.

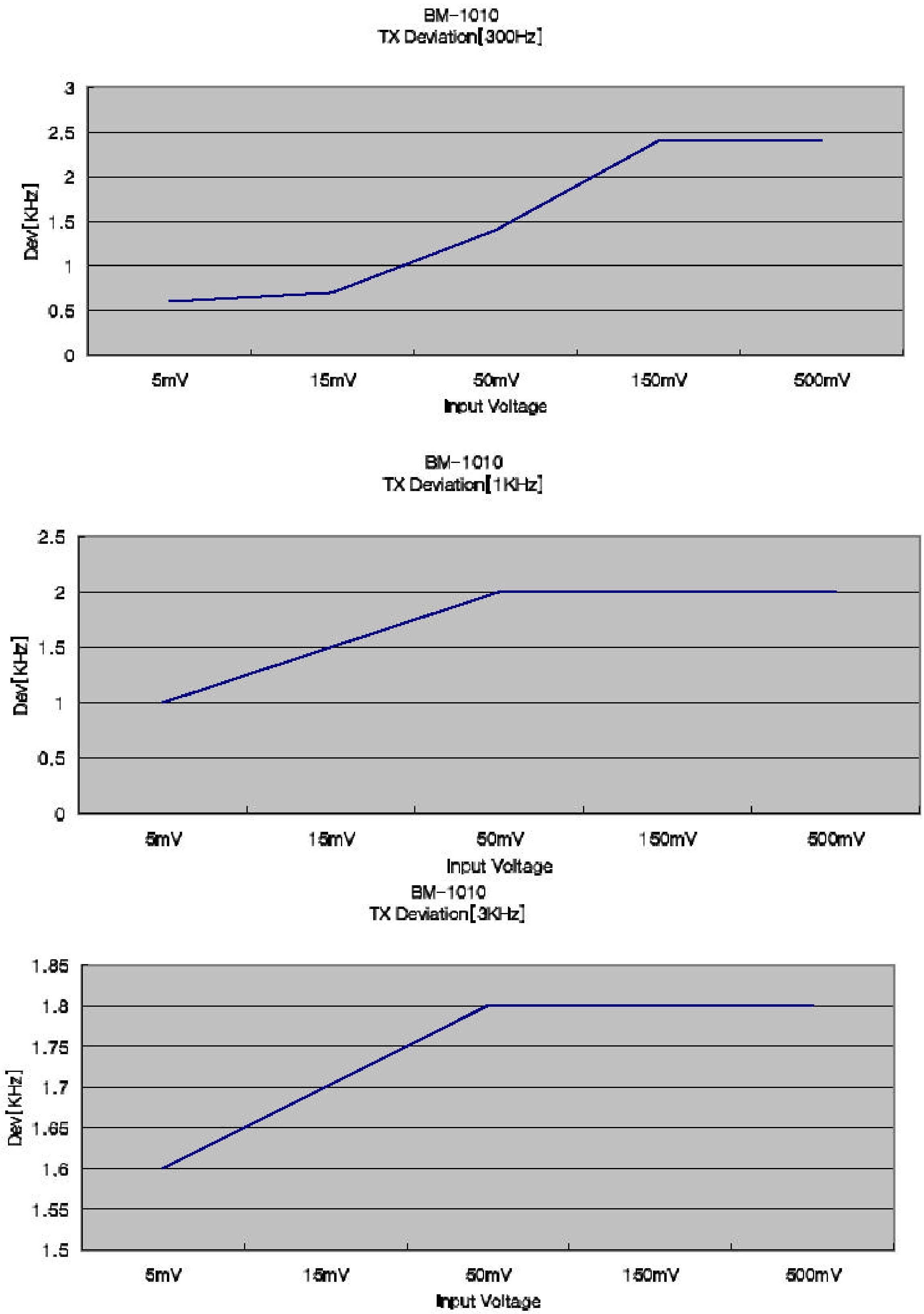


Figure 3: Deviation Characteristics.

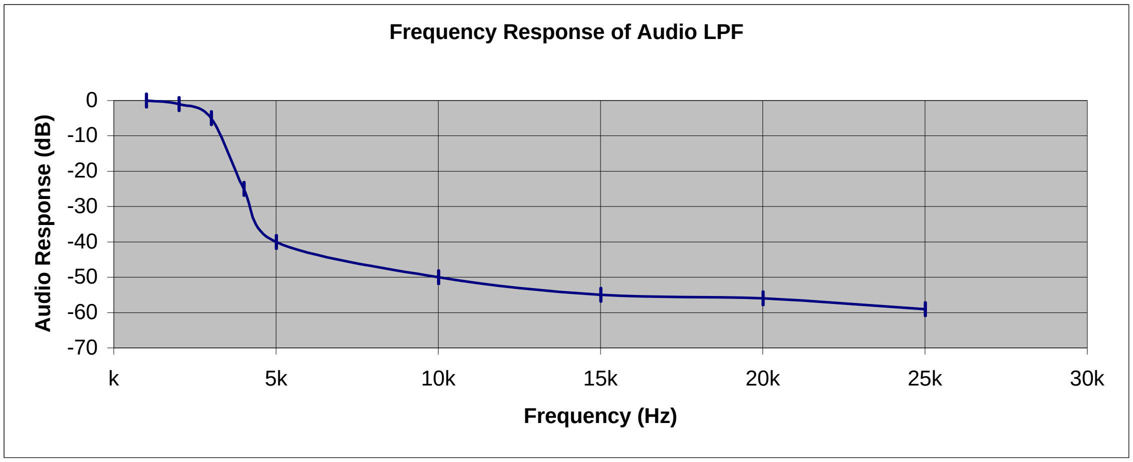


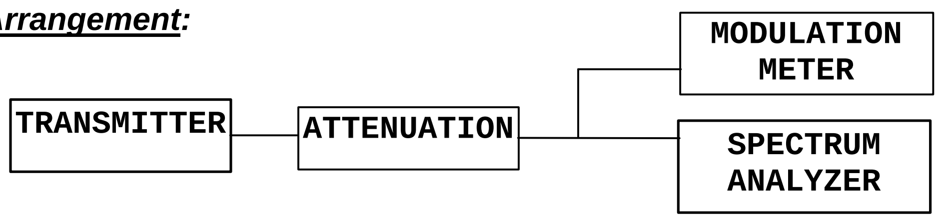
Figure 4: Frequency Response of Audio low Pass Filter

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
462.5625	8.0

A spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in a normal mode, modulated by a frequency of 2500 Hz at a level 16 dB above 50% modulation. The power ratio in dB representing 99.5% of the total mean power was recorded from the spectrum analyzer. Refer to figures 5 and 6 for plots of occupied bandwidth.

Requirements of 2.1049(c)(1) and applicable paragraphs of Parts 90 and 95 are met. There are no deviations to the specifications.

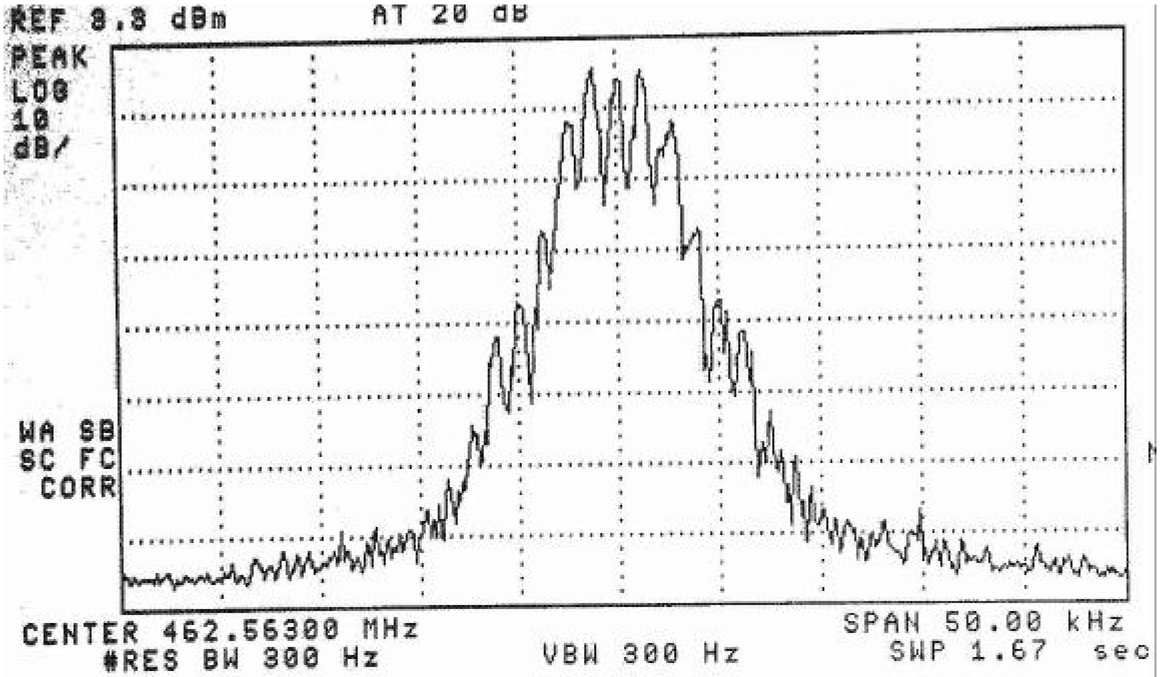


Figure 5: Plot showing occupied BandWidth.

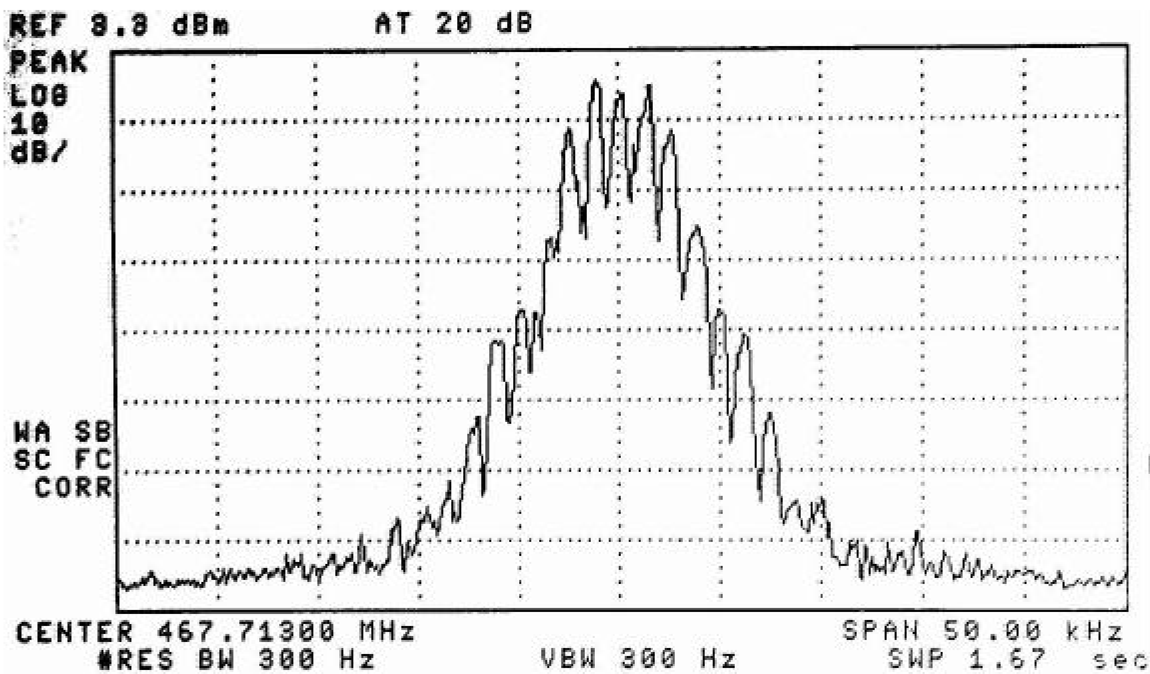


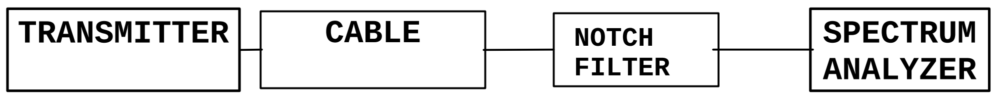
Figure 6: Plot showing occupied BandWidth.

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 spectrum analyzer for observation. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operated in a normal mode. The frequency spectrum from 10 MHz to 4 GHz was observed and a plot produced of the frequency spectrum. Figure 7 represents data for the FRS-300. Data taken per 2.1051, 2.1057, and applicable paragraphs of Parts 90 and 95.

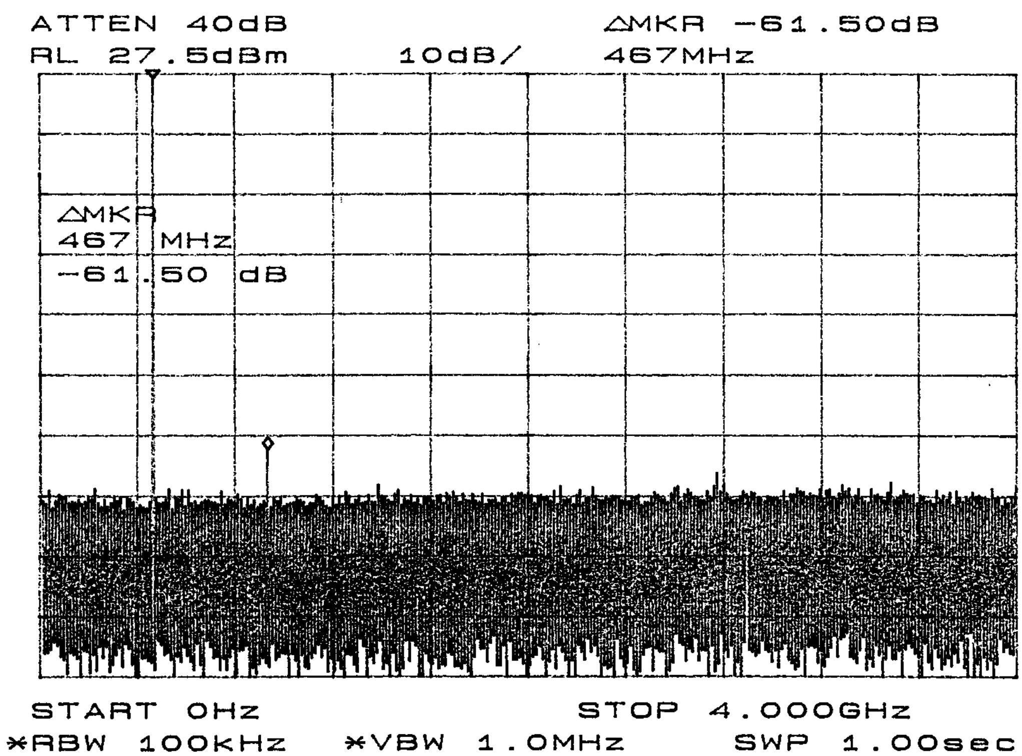


Figure 7: Emissions at Antenna Terminal

Results:

The output of the unit was coupled to a spectrum analyzer and the frequency emissions were measured. Data was taken as per 2.1051 and applicable paragraphs of Parts 90 and 95. Specifications of Paragraphs 2.1051, 2.1057 and applicable paragraphs of parts of 22, 74, 90 and 97 are met. There are no deviations to the specifications.

FCC Limit:

0.5 Watt = 43 + 10 LOG(P_o)

= 43 + 10 LOG(0.5)

= 39.9

CHANNEL MHz	SPURIOUS FREQ. (MHz)	LEVEL BELOW CARRIER (dB)
462.5625	925.13	61.5
	1387.7	68.0
	1850.3	68.0
467.7125	935.4	62.3
	1403.1	67.5
	1870.9	68.1

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 0.8 meters above the ground plane and at a distance of 3 meters from the FSM antenna. 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. 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 31040/SIT, 1300F2, dated February 6, 1998. 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 = 63.1 + 22.9 - 25
CFS = 61.0

The limit 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 0.5-watt transmitter 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.

$$E = \frac{5.5\sqrt{0.5(1.64)}}{3} = 1.66 \text{ V/m} = 1.66E6 \mu V/m \text{ at 3 meters.}$$

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

20*Log(1.66E6) = 124.4 dBμV/m @ 3 meters

On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth: at least 43 + 10 Log (P_o) dB.

$$\begin{aligned} \text{Attenuation} &= 43 + 10\ \text{Log}_{10}(P_w) \\ &= 43 + 10\ \text{Log}_{10}(0.5) \\ &= 40.0\ \text{dB} \end{aligned}$$

Limit = 124.4 – 40.0
= 84.4 dBµV/m @ 3 meters

Results:

Channel 462.5625 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)
925.13	61.3	65.1	22.9	25	59.2	63.0	84.4
1387.7	51.5	51.0	26.0	25	52.5	52.0	84.4
1850.3	39.1	43.6	29.1	25	43.2	47.7	84.4
2312.8	39.0	41.1	30.8	25	44.8	46.9	84.4
2775.4	38.6	41.5	32.6	25	46.2	49.1	84.4

Channel 467.7125 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)
935.4	62.1	64.3	22.9	25	60.0	62.2	84.4
1403.1	52.2	50.5	26.0	25	53.2	51.5	84.4
1870.9	38.6	45.3	29.1	25	42.7	49.4	84.4
2338.6	39.4	41.7	30.8	25	45.2	47.5	84.4
2806.3	39.3	42.5	32.6	25	46.9	50.1	84.4

Specifications of Paragraph 2.1053, 2.1057, applicable paragraphs of parts 90 and 95 are met. There are no deviations to the specifications.

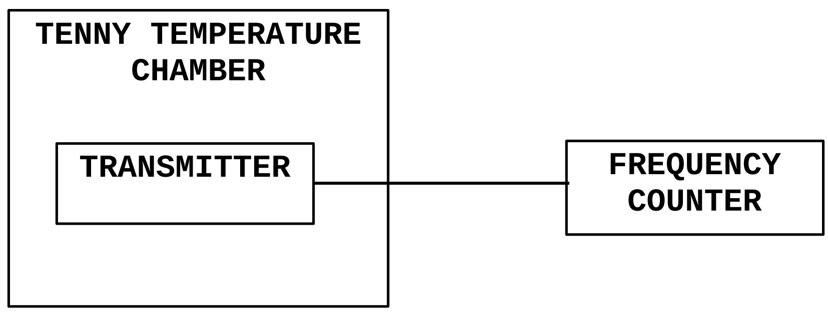
2.1055 Frequency Stability

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:

Steps 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 +25°C. 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 radio frequency power output at the duty cycle, for which it is rated, for a duration of at least 5 minutes. The radio frequency 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. A Topward 6303A DC Power Supply was used to vary the dc voltage for the power input from 5.1 Vdc to 6.9 Vdc. The frequency was measured and the variation in parts per million was calculated. Data was taken per Paragraphs 2.1055 and applicable paragraphs of parts 90 and 95.

Results:

FREQ. (MHz)	FREQUENCY STABILITY VS TEMPERATURE IN PARTS PER MILLION (PPM)								
	Temperature in °C								
	-30	-20	-10	0	+10	+20	+30	+40	+50
462.5625	-2.3	-2.3	0.76	0.56	0.02	0.0	-0.04	-0.14	-1.5

FREQUENCY IN MHz	FREQUENCY STABILITY VS VOLTAGE VARIATION 6.0 volts nominal; RESULTS IN PPM INPUT VOLTAGE		
	5.1 V_{dc}	6.0 V_{dc}	6.9 V_{dc}
462.5625	0.05	0.0	0.06

FREQUENCY IN MHz	**FREQUENCY STABILITY VS VOLTAGE VARIATION 6.0 volts nominal; RESULTS IN PPM BATTERY ENDPOINT VOLTAGE 4.2 V_{dc}**
462.5625	0.1

Specifications of Paragraphs 2.1055 and applicable paragraphs of parts 90 and 95 are met. There are no deviations to the specifications.

Refer to FRS300Appendix.doc for photographs of equipment.

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	2/01
Wattmeter: Bird 43 with Load Bird 8085	2/01
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/01
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/01
R.F. Generator: HP 606A	2/01
R.F. Generator: HP 8614A	2/01
R.F. Generator: HP 8640B	2/01
Spectrum Analyzer: HP 8562A,	4/01
Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	
HP Adapters: 11518, 11519, 11520	
Spectrum Analyzer: HP 8591 EM	7/00
Frequency Counter: Leader LDC 825	2/01
Antenna: EMCO Biconilog Model: 3143	4/01
Antenna: EMCO Log Periodic Model: 3147	10/00
Antenna: Antenna Research Biconical Model: BCD 235	10/00
Antenna: EMCO Dipole Set 3121C	2/01
Antenna: C.D. B-101	2/01
Antenna: Solar 9229-1 & 9230-1	2/01
Antenna: EMCO 6509	2/01
Audio Oscillator: H.P. 201CD	2/01
R.F. Power Amp 65W Model: 470-A-1010	2/01
R.F. Power Amp 50W M185- 10-501	2/01
R.F. PreAmp CPPA-102	2/01
Shielded Room 5 M x 3 M x 3.0 M (101 dB Integrity)	
LISN 50 µHy/50 ohm/0.1 µf	10/00
LISN Compliance Eng. 240/20	2/01
Peavey Power Amp Model: IPS 801	2/01
Power Amp A.R. Model: 10W 1010M7	2/01
Power Amp EIN Model: A301	2/01
ELGAR Model: 1751	2/01
ELGAR Model: TG 704A-3D	2/01
ESD Test Set 2010i	2/01
Fast Transient Burst Generator Model: EFT/B-101	2/01
Current Probe: Singer CP-105	2/01
Current Probe: Solar 9108-1N	2/01
Field Intensity Meter: EFM-018	2/01
KETEK Ecat Surge Generator	2/01

04/24/2001

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

April 19, 2001
Date

1/11/00

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