

ROGERS LABS, INC.

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

TEST REPORT For APPLICATION of CERTIFICATION

For

Telson Information & Communications Co., LTD
356-5, GASAN-DONG, KUM CHEUN-KU
SEOUL 153-023, KOREA

Steve Dinsmore,
National Sales Manager
TEKK Incorporated
226 NW Parkway
Kansas City, MO 64150
Phone: 1 800-521-8355

MODEL: PRO-120
Family Radio Service (FRS) TRANSCEIVER
FREQUENCY: 462.5625 MHz

FCC ID: OBAPRO120

Test Date: April 14, 2000

Certifying Engineer:

Scot D. Rogers

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FORWARD:

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 1999, 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: Telson Information & Communications Co., LTD
356-5, GASAN-DONG, KUM CHEUN-KU
SEOUL 153-023, KOREA

(2) Identification: Model: PRO-120
S/N: Set 1
FCC I.D.: OBAPRO120

(3) Instruction Book:

Refer to exhibit for Draft Instruction Manual.

(4) Emission Type: 8K50F3E / 16K0F3E

(5) Frequency Range: 462.5625 MHz,

(6) Operating Power Level: 0.5 Watts

(7) Max P_o: 0.5 Watts

(8) Power into final amplifier:

0.5 Watt Unit: 1.86 Watts (6.0V @ 0.31A)

(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 Exhibit for Drawings of Components Layout and Chassis Drawings.

(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 = $10^{(P_{dBm}/10)}$

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

26.83 dBm = $10^{(26.83/10)}$

= 481.95 mW

= 0.5 Watts

Results:

| REQUNCY | P_{dBm} | P_{mW} | P _w |
|----------|-----------|----------|----------------|
| 462.5625 | 26.83 | 481.95 | 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.

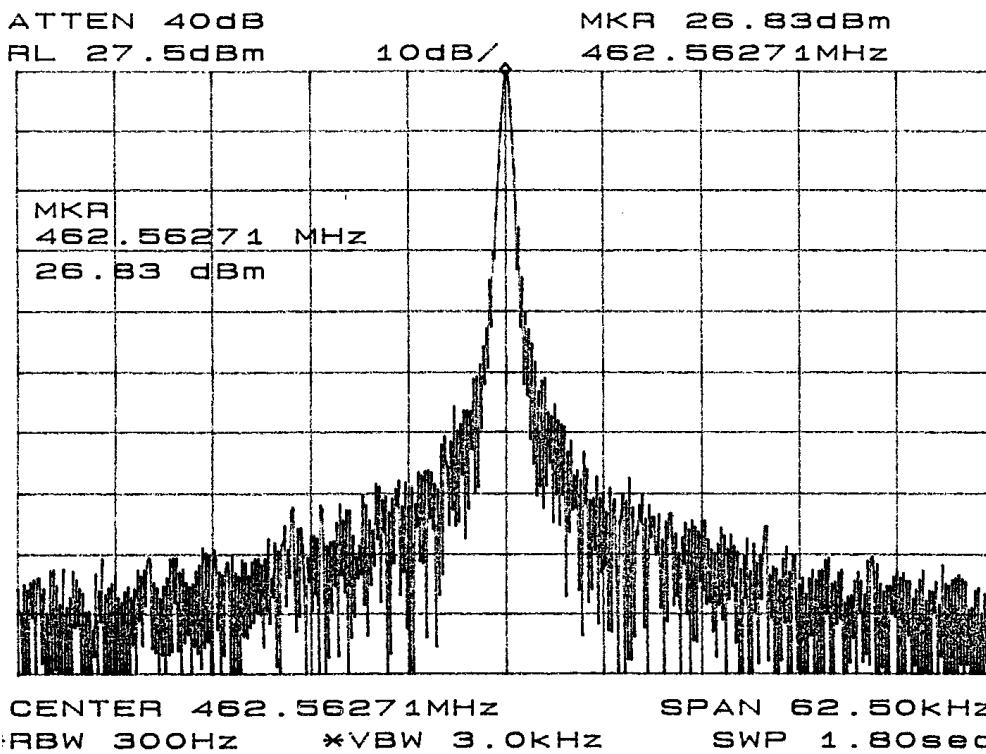


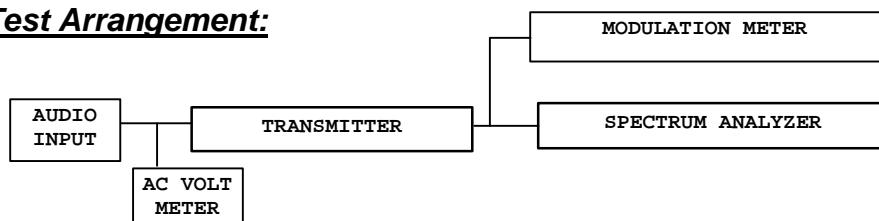
Figure 1: Power Output Channel 462.5625 (0.5 Watt)

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.

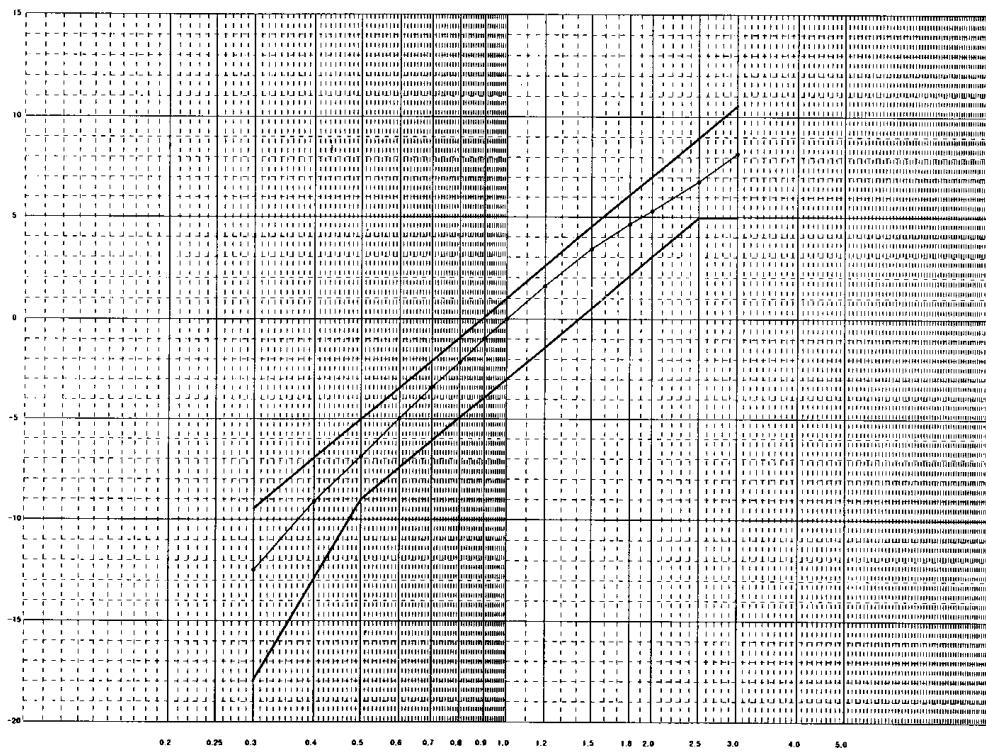


Figure 2: Audio Response Characteristics.

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.

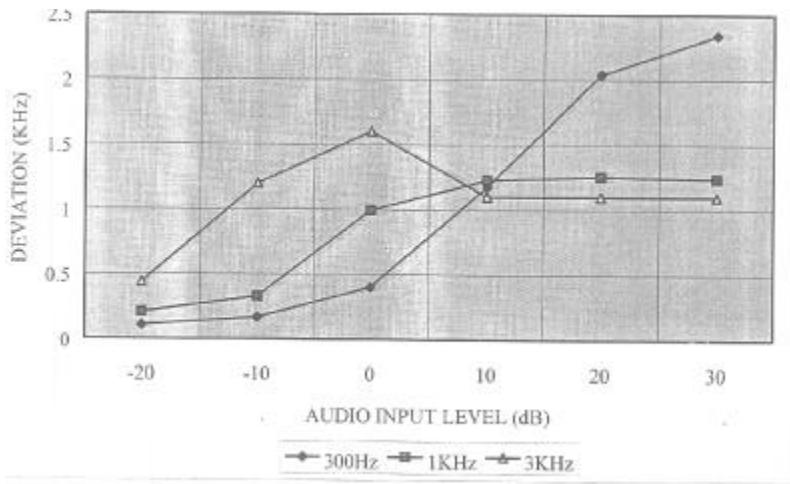


Figure 3: Deviation Characteristics.

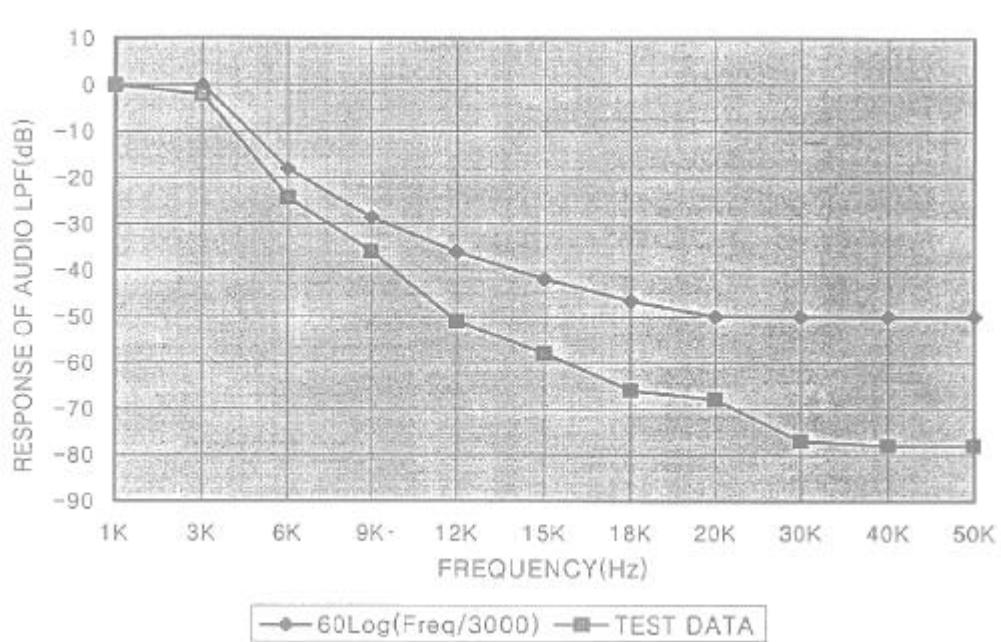
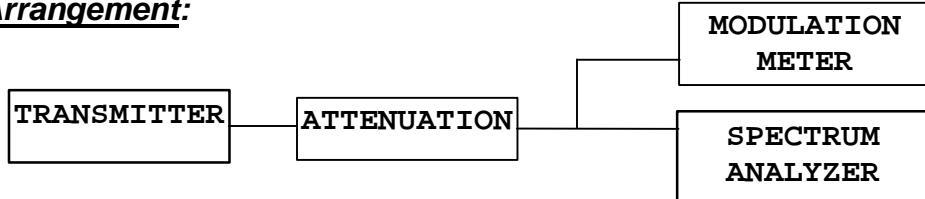


Figure 4: Frequency Response of Audio low Pass Filter

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:**

| Channel Width | f_c | O.B. kHz |
|---------------|----------|----------|
| 12.5 kHz | 462.5625 | 5.7 |
| 25 kHz | 462.5625 | 12.5 |

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 99.5% power.

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

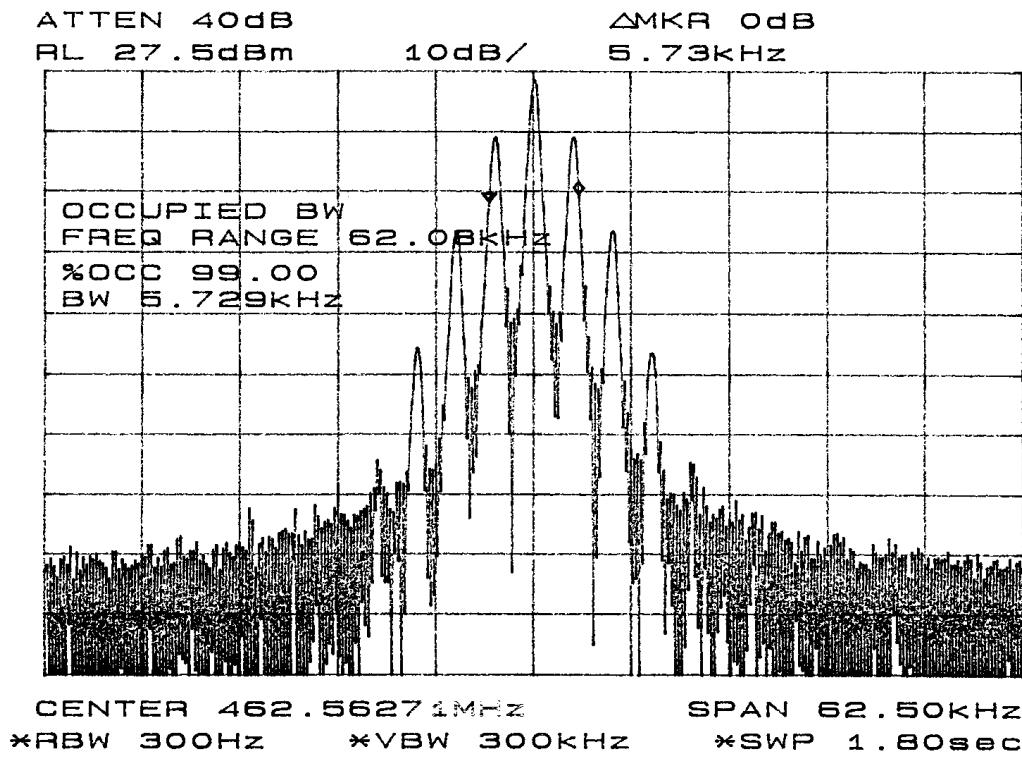


Figure 5: Occupied Band Width, Channel Width 12.5 kHz

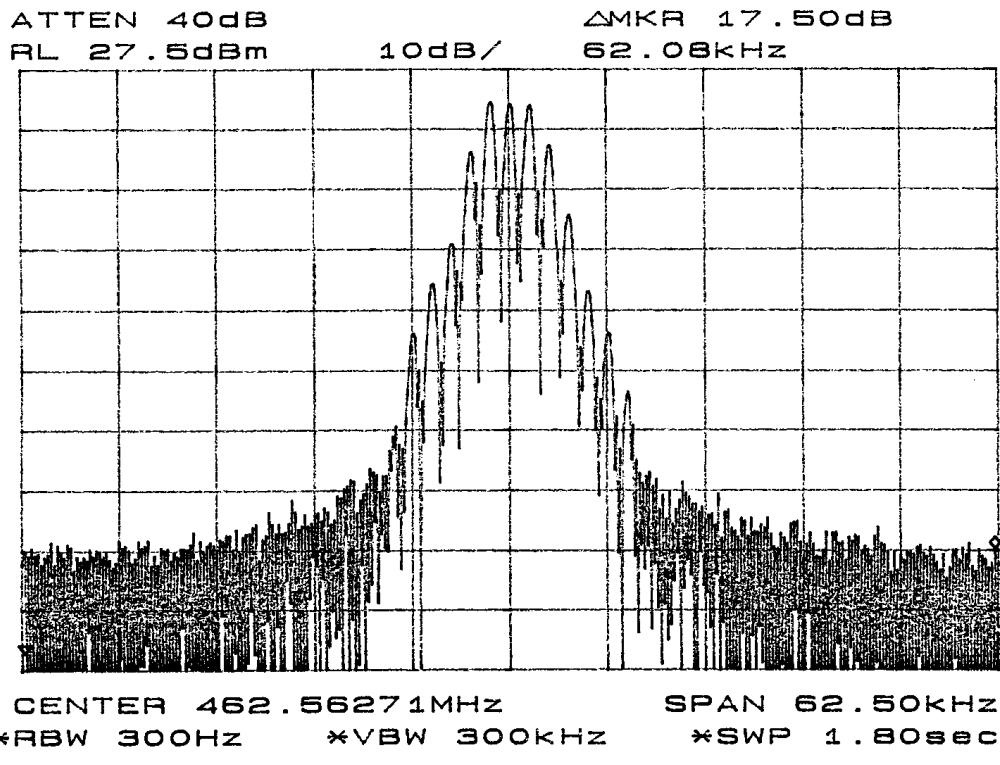


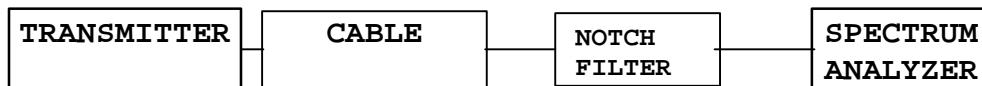
Figure 6: Occupied Band Width, Channel Width 25 kHz

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 PRO-120. Data taken per 2.1051, 2.1057, and applicable paragraphs of Parts 90 and 95.

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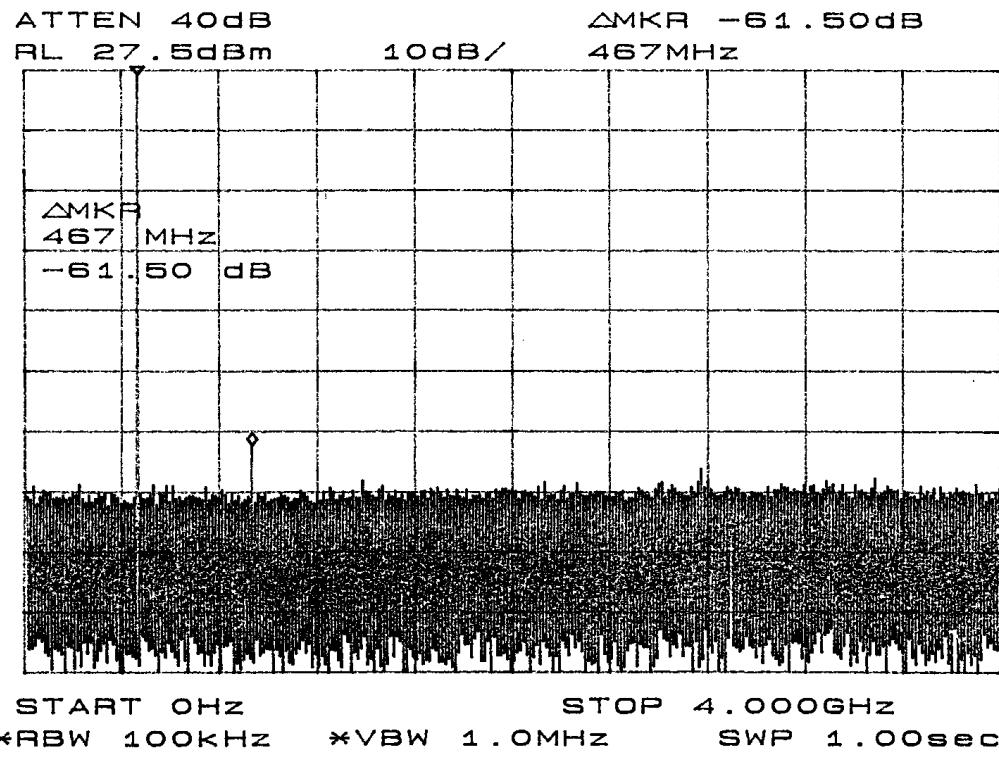


Figure 7: Emissions at Antenna Terminal

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:

$$\begin{aligned}
 5 \text{ Watt} &= 43 + 10 \text{ LOG}(P_0) \\
 &= 43 + 10 \text{ LOG}(0.5) \\
 &= 39.9
 \end{aligned}$$

| CHANNEL MHz | SPURIOUS FREQ. (MHz) | LEVEL BELOW CARRIER (dB) |
|----------------|-------------------------|-----------------------------|
| 462.5625 | 925.13 | 61.5 |
| | 1387.7 | 68.0 |
| | 1850.3 | 68.0 |

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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 dB μ V. 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 5-watt transmitter was done as follows:

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

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

This was converted to dB μ V/m using $(20 * \log \mu\text{V/m})$ for convenience.

$$20 * \log(1.66 \text{ E6}) = 124.4 \text{ dB}\mu\text{V/m @ 3 meters}$$

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

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

$$\begin{aligned} \text{Limit} &= 124.4 - 40.0 \\ &= 84.4 \text{ dB}\mu\text{V/m @ 3 meters} \end{aligned}$$

Results:

Channel 462.5625 MHz

| Frequency (MHz) | FSM Horz. (dB μ V) | FSM Vert. (dB μ V) | Ant. Factor (dB) | Amp. Gain (dB) | CFS Horz. @ 3m (dB μ V/m) | CFS Vert. @ 3m (dB μ V/m) | Limit (dB μ V/m) |
|-----------------|------------------------|------------------------|------------------|----------------|-------------------------------|-------------------------------|----------------------|
| 925.13 | 63.1 | 65.1 | 22.9 | 25 | 61.0 | 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 | 45.1 | 30.8 | 25 | 44.8 | 50.9 | 84.4 |
| 2775.4 | 38.6 | 42.5 | 32.6 | 25 | 46.2 | 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

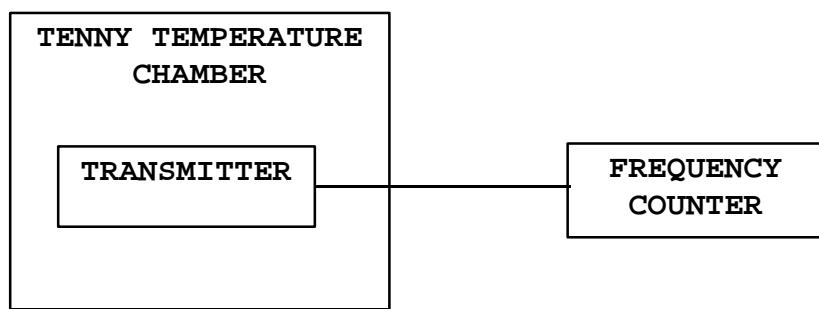
Measurements Required:

The frequency stability shall be measured with variations of ambient temperature from -30° to $+50^{\circ}$ 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

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MODEL: PRO-120 Family Radio Service (FRS) Transceiver

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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 | -2.2 | -1.9 | 0 | 0.6 | 0.2 | 0.1 | -0.4 | -0.4 | 0.2 | |

| 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 | 0.2 | 0.3 | 0.2 |

| FREQUENCY IN MHz | FREQUENCY STABILITY VS VOLTAGE VARIATION 6.0 volts nominal; RESULTS IN PPM | |
|---------------------|---|--|
| | BATTERY ENDPOINT VOLTAGE 4.2 V _{dc} | |
| 462.5625 | 0.3 | |

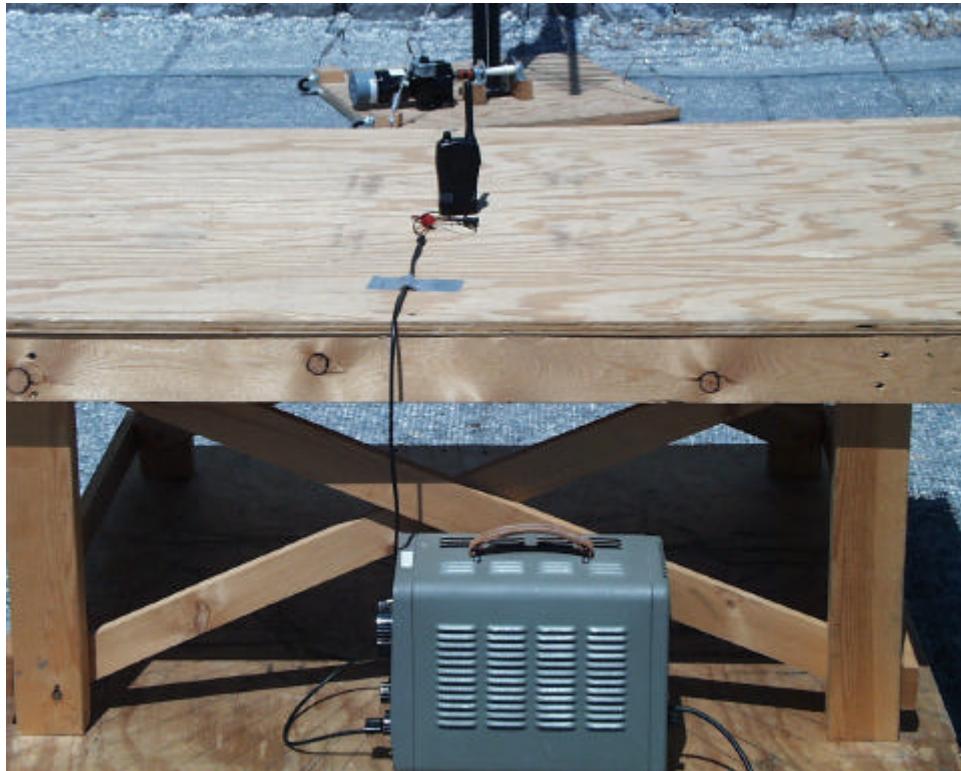
Specifications of Paragraphs 2.1055 and applicable paragraphs of parts 90 and 95 are met. There are no deviations to the specifications.

APPENDIX

Model: PRO-120

1. Photos of Radiated Emissions Test Set Up.
2. Photos Case front and back.
3. Photo of Operator Controls
4. Photo FCC ID Label Location.
5. Photo Inside Case.
6. Photos of Printed Circuit Boards.
7. Test Equipment List.
8. Rogers Qualifications.
9. FCC Site Approval Letter.

Telson Information & Communications Co., LTD
Model: PRO-120
Photos Radiated Emissions



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Model: PRO-120

Photos Case front and back



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Photos Operator Controls



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Model: PRO-120

FCC ID Label Location



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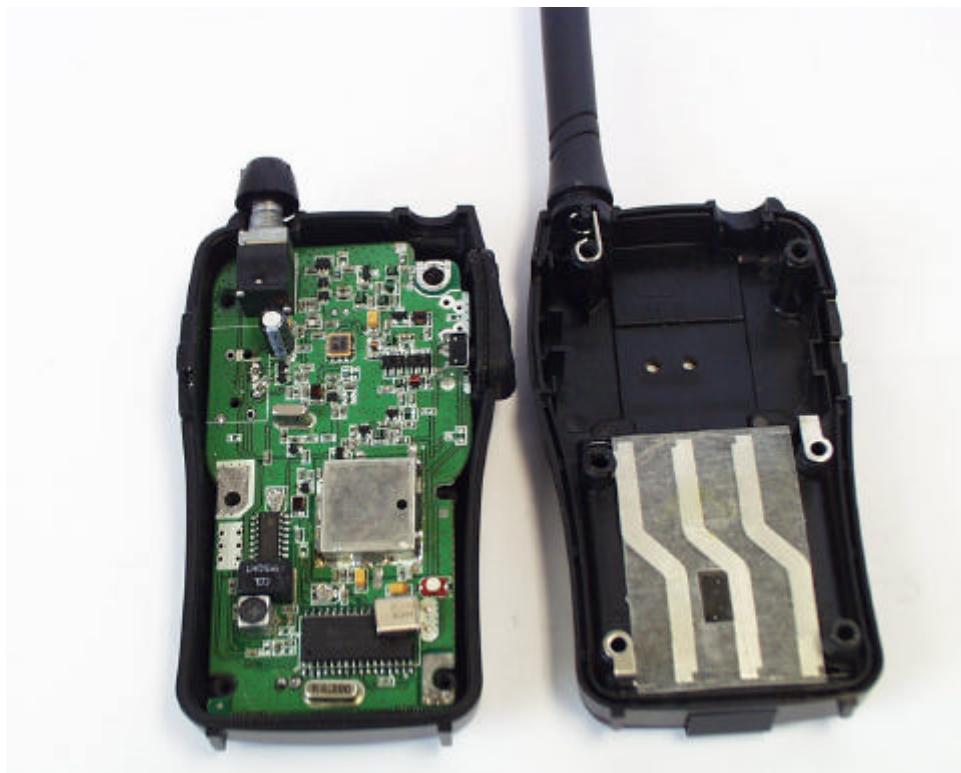
MODEL: PRO-120 Family Radio Service (FRS) Transceiver

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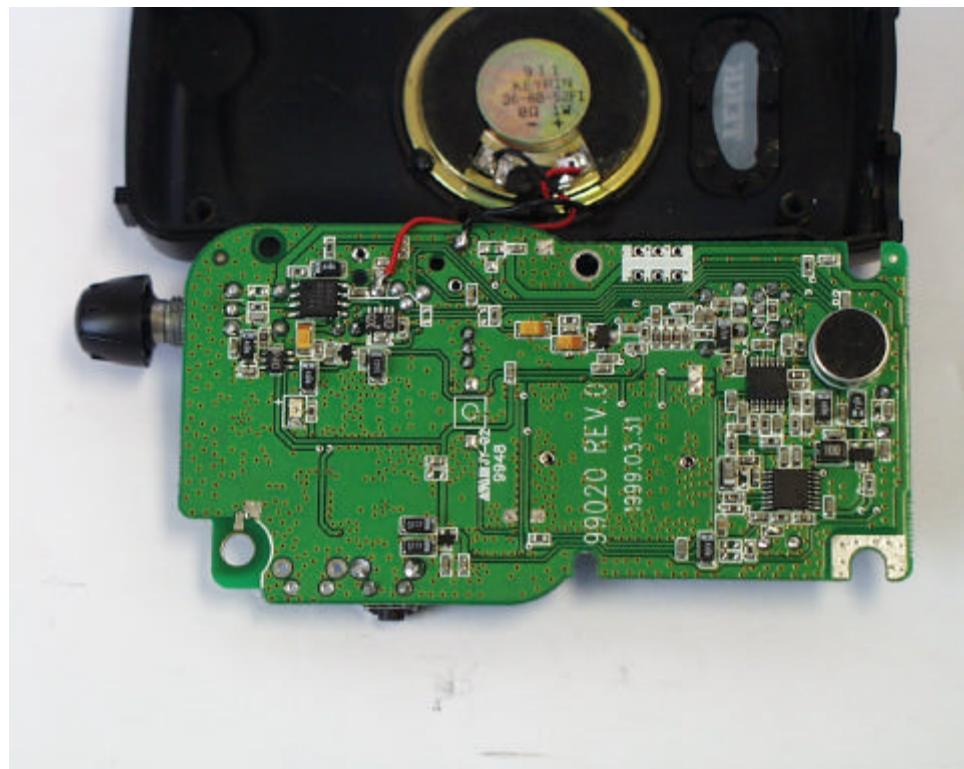
Telson Information & Communications Co., LTD
Model: PRO-120
Photos Inside Case



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Telson Information & Communications Co., LTD
Model: PRO-120
Photos Printed Circuit Board



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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.

| <u>List of Test Equipment:</u> | <u>Calibration Date:</u> |
|---|--------------------------|
| Scope: Tektronix 2230 | 2/00 |
| Wattmeter: Bird 43 with Load Bird 8085 | 2/00 |
| Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140 | 2/00 |
| H/V Power Supply: Fluke Model: 408B (SN: 573) | 2/00 |
| R.F. Generator: HP 606A | 2/00 |
| R.F. Generator: HP 8614A | 2/00 |
| R.F. Generator: HP 8640B | 2/00 |
| Spectrum Analyzer: HP 8562A, | 2/00 |
| Mixers: 11517A, 11970A, 11970K, 11970U | |
| HP Adapters: 11518, 11519, 11520 | |
| Spectrum Analyzer: HP 8591 EM | 7/99 |
| Frequency Counter: Leader LDC 825 | 2/00 |
| Antenna: EMC Biconilog Model: 3143 | 10/99 |
| Antenna: EMC Log Periodic Model: 3147 | 10/99 |
| Antenna: Antenna Research Biconical Model: BCD 235 | 10/99 |
| Antenna: EMC Dipole Set 3121C | 2/00 |
| Antenna: C.D. B-100 | 2/00 |
| Antenna: Solar 9229-1 & 9230-1 | 2/00 |
| Antenna: EMC 6509 | 2/00 |
| Audio Oscillator: H.P. 200CD | 2/00 |
| R.F. Power Amp 65W Model: 470-A-1000 | 2/00 |
| R.F. Power Amp 50W M185- 10-500 | 2/00 |
| R.F. PreAmp CPPA-102 | 2/00 |
| Shielded Room 5 M x 3 M x 3.0 M (100 dB Integrity) | |
| LISN 50 μ Hy/50 ohm/0.1 μ f | 10/99 |
| LISN Compliance Eng. 240/20 | 2/00 |
| Peavey Power Amp Model: IPS 800 | 2/00 |
| Power Amp A.R. Model: 10W 1000M7 | 2/00 |
| Power Amp EIN Model: A300 | 2/00 |
| ELGAR Model: 1751 | 2/00 |
| ELGAR Model: TG 704A-3D | 2/00 |
| ESD Test Set 2000i | 10/95 |
| Fast Transient Burst Generator Model: EFT/B-100 | 10/95 |
| Current Probe: Singer CP-105 | 2/00 |
| Current Probe: Solar 9108-1N | 2/00 |
| Field Intensity Meter: EFM-018 | 10/95 |
| KETEK Ecat Surge Generator | 10/99 |

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Phone/Fax: (913) 837-3214

Telson Information & Communications Co., LTD (TEKK Inc.)

MODEL: PRO-120 Family Radio Service (FRS) Transceiver

Test #:000409 FCC ID#: OBARPO120 SN:SET 1

Test to: FCC Parts 2, 15, 90 and 95

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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

April 17, 2000
Date

1/11/99

ROGERS LABS, INC. Telson Information & Communications Co., LTD (TEKK Inc.)
4405 West 259th Terrace MODEL: PRO-120 Family Radio Service (FRS) Transceiver
Louisburg, KS 66053 Test #:000409 FCC ID#: OBARPO120 SN:SET 1
Phone/Fax: (913) 837-3214 Test to: FCC Parts 2, 15, 90 and 95 Page 25 of 26

CERTIFICATION\TEKKPRO120 04/17/00

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

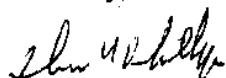
Re: Measurement facility located at above address
(3 and 10 meter site)

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

ROGERS LABS, INC.
4405 West 259th Terrace
Louisburg, KS 66053
Phone/Fax: (913) 837-3214

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