

Test Report For Application of Certification

For

INTERMEC TECHNOLOGIES CORPORATION
AMTECH SYSTEMS DIVISION
8600 Jefferson Street, NE
Albuquerque, NM 87113
Phone: (505) 856-8054

MODEL:
Parking Access and Revenue Collection (PARC) Reader
10-510-100
LMS Transmitter

FREQUENCY: 912.5-919 MHz

FCC ID: FIH 10-510-100

Test Date: November 29, 1999

Certifying Engineer: *Scot D Rogers*

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

This report shall not be reproduced except in full, without the written approval of the laboratory. This report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

TABLE OF CONTENTS

FORWARD:	3
LIST OF TEST EQUIPMENT	3
2.1033(C) APPLICATION FOR CERTIFICATION	4
2.1046 RF POWER OUTPUT	5
<u>Measurements Required:</u>	5
<u>Test Arrangement:</u>	5
<u>Results:</u>	5
2.1047 MODULATION CHARACTERISTICS	8
<u>Measurements Required:</u>	8
<u>Test Arrangement:</u>	8
<u>Results:</u>	8
2.1049 OCCUPIED BANDWIDTH	8
<u>Measurements Required:</u>	8
<u>Test Arrangement:</u>	9
<u>Results:</u>	9
2.1051 SPURIOUS EMISSIONS AT ANTENNA TERMINALS	10
<u>Measurements Required:</u>	10
<u>Test Arrangement:</u>	10
<u>Results:</u>	12
2.1053 FIELD STRENGTH OF SPURIOUS RADIATION	12
<u>Measurements Required:</u>	12
<u>Test Arrangement:</u>	12
Radiated (8 Highest Emissions)	14
<u>Results:</u>	14
2.1055 FREQUENCY STABILITY	15
<u>Measurements Required:</u>	15
<u>Test Arrangement:</u>	15
<u>Results:</u>	16
APPENDIX	17

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; 90.201 through 90.217, 90.350 through 90.363; and Report and Order FCC 98-58 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 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: INTERMEC TECHNOLOGIES CORPORATION
Amtech Systems Division
8600 Jefferson Street, NE
Albuquerque, NM 87113
2. Identification: Model: 10-510-100
FCC I.D.: FIH 10-510-100
3. Refer to Installation and Operating Instruction Manual.
4. Emission Type:
Continuous Wave Emission Designator. NON
Modulated Signal Emission Designator. 220kL1D
5. Frequency Range:
912.5 - 919.0 MHz
6. Operating Power Level:
2 Watts. Maximum power output is factory set and may be attenuated up to 10 dB in 1-dB steps via software.
7. Max P_o :
2 Watts per channel.
8. Power into final amplifier:
+8.5 Vdc @ 0.8 amps (6.8 Watts)
9. Tune Up Procedure: Refer to Exhibits.
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:

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 terminals by replacing the antenna with a spectrum analyzer, 20dB Attenuator and cable (with 2dB loss in the 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 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 through 3 showing the output power of the transmitter. Data taken per Paragraph 2.1046(a) and applicable parts of Part 90.

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

$$\text{Milliwatts} = 10^{(P_{\text{dBm}}/10)}$$

$$\text{Watts} = (\text{Milliwatts})(0.001)(\text{W/mW})$$

Results:

0 dB ATTENUATION

FREQUENCY	P _{dBm}	P _{mw}	P _w
912.0	33.0	1,995	2.0
916.0	33.0	1,995	2.0
919.0	32.8	1,905	2.0

6 dB ATTENUATION

FREQUENCY	P _{dBm}	P _{mw}	P _w
916.0	28.3	676	0.7

10 dB ATTENUATION

FREQUENCY	P _{dBm}	P _{mw}	P _w
916.0	23.6	229	0.2

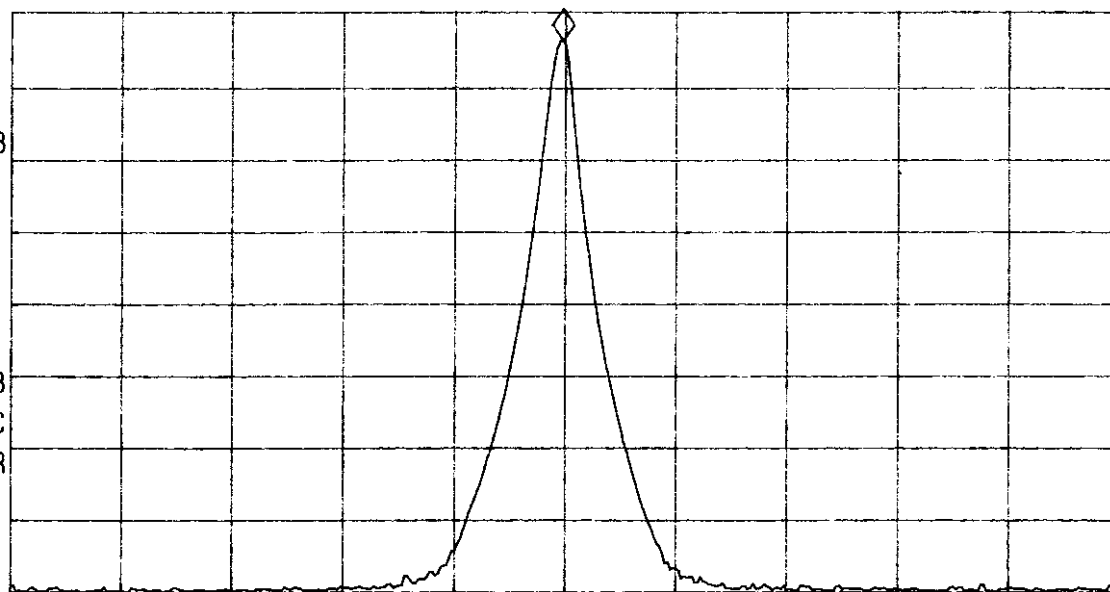
MARKER
915.998 MHz
11.03 dBm

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 915.998 MHz
11.03 dBm

LOG REF 15.0 dBm

10
dB/
ATN
30 dB

VA SB
SC FC
CORR



CENTER 916.000 MHz
#IF BW 10 kHz

AVG BW 10 kHz

SPAN 1.000 MHz
SWP 30.0 msec

Figure 1 0dB Attenuation

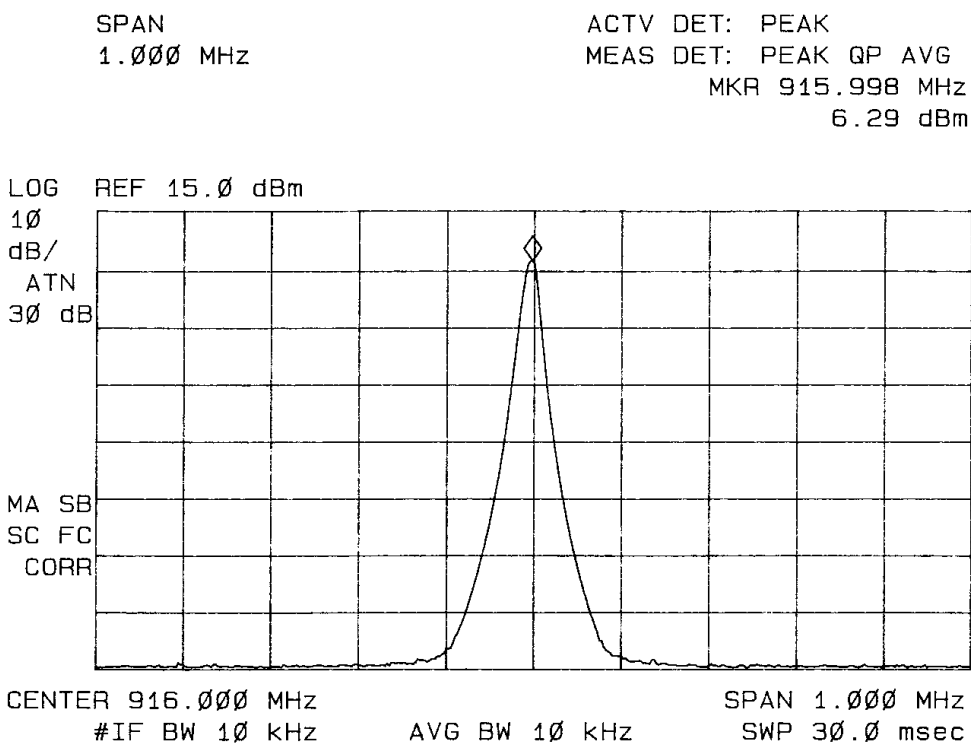


Figure 2 6dB Attenuation

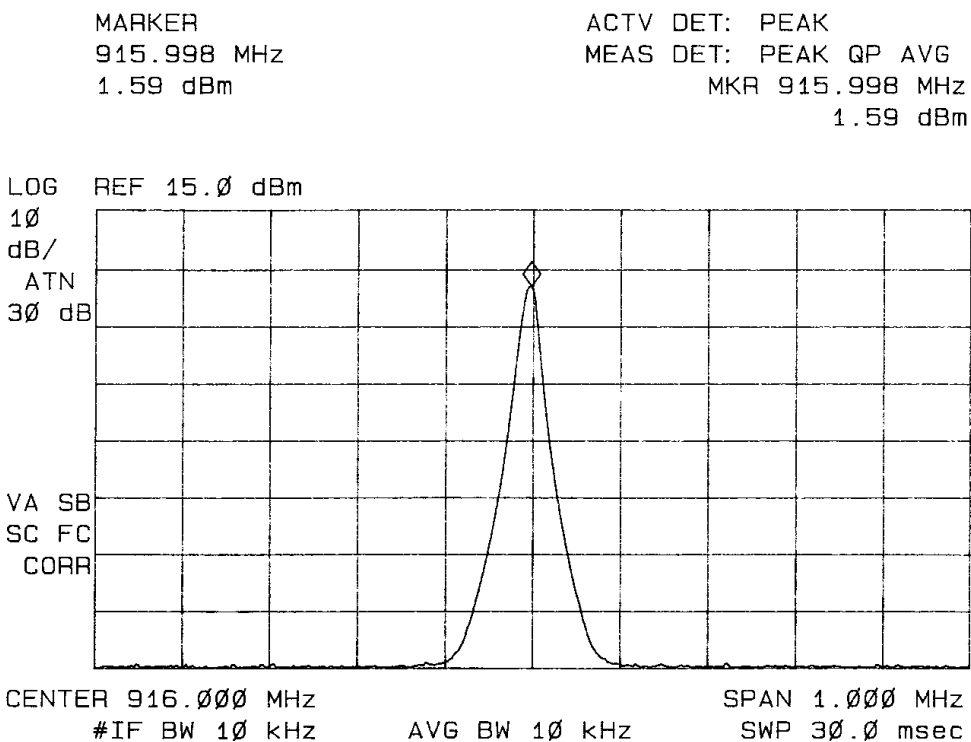


Figure 3 10dB Attenuation

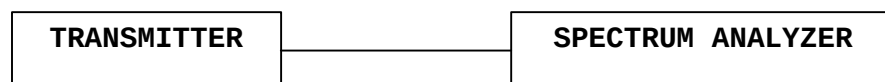
The specifications of Paragraph 2.1046(a) and 90.205 are met. There are no deviations to the specifications.

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.

Test Arrangement:



The radio frequency output was coupled to a HP 8591EM Spectrum Analyzer. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in its normal mode.

Results:

The transmitter operates in two modes continuous wave (CW) mode and modulated mode. The modulation is at 30 KB/s and consists of 22 synchronization bits followed by a 1 ms pause and then approximately 216 more bits. The pattern is retransmitted approximately every 11 ms with a pause of about 6 ms between 5 ms bursts. During all pauses, the carrier is on continuously without modulation. During the 6ms pause, the PARC 10-510-100 Reader receives reflected modulated carrier back from the target RF tag(s). Specifications of Paragraphs 2.1047 and 90.211 are met. There are no deviations to the specifications.

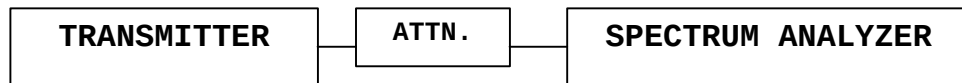
2.1049 Occupied Bandwidth

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. Refer to figures 4 and 5 for plots of the occupied band width measurement.

Test Arrangement:



Results:

MODE	f_c	O.B. kHz
CW	916.0	33
MOD	916.0	213

MARKER Δ
33 kHz
3.18 dB

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 33 kHz
3.18 dB

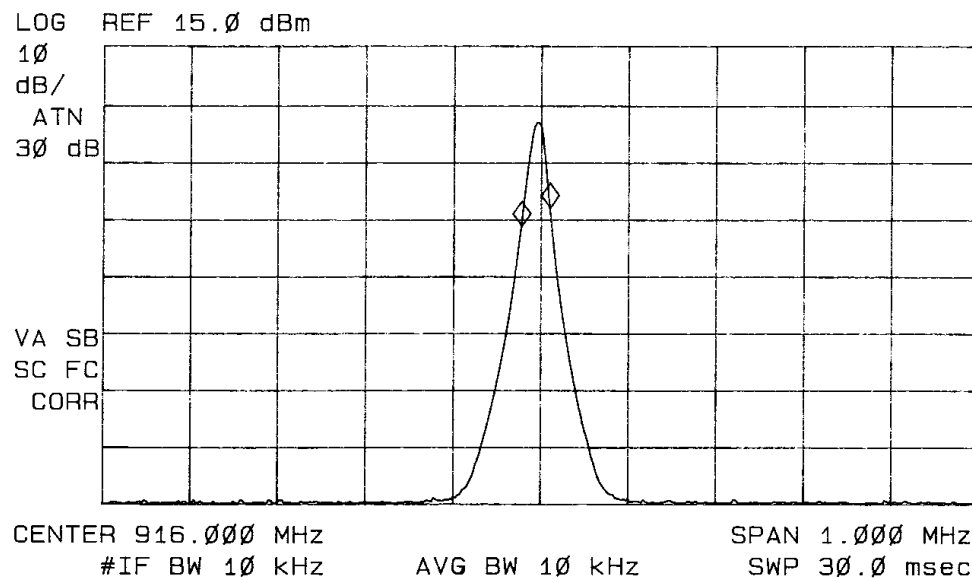


Figure 4 Occupied Bandwidth CW Mode

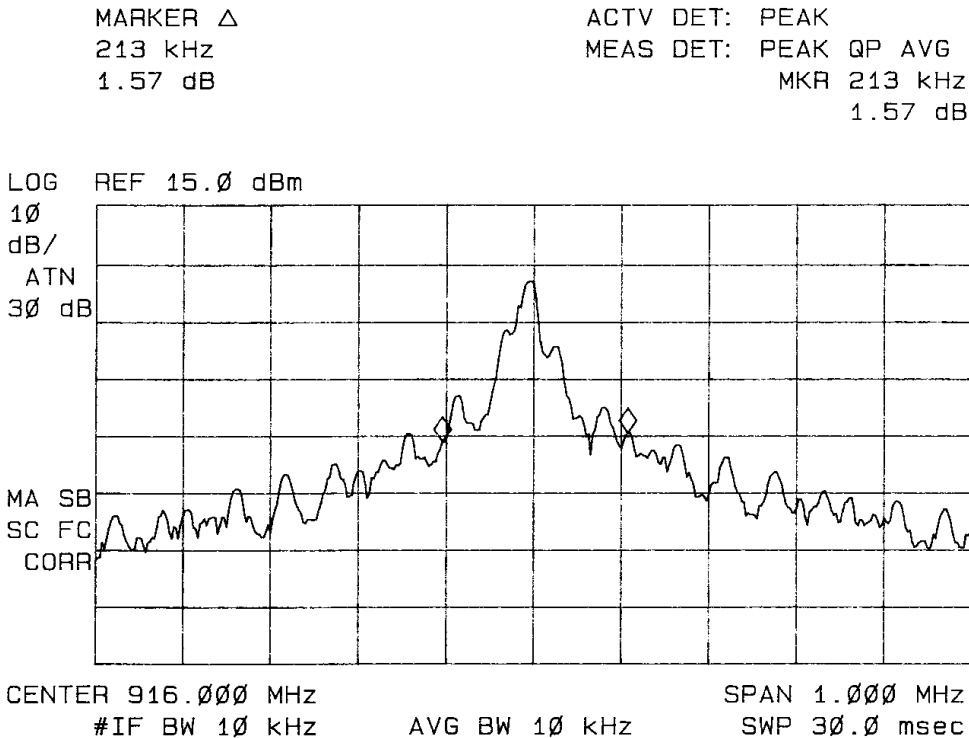


Figure 5 Occupied Bandwidth Modulated Mode

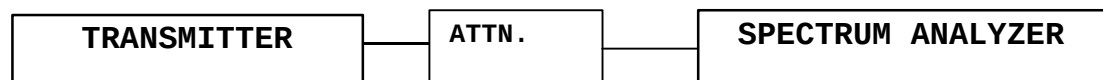
Requirements of 2.1049 and applicable parts of Paragraph 90 are met. There are no deviations to the specifications.

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 radio frequency output was coupled to a HP 8562A Spectrum Analyzer. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in its normal mode. The frequency spectrum from 0 to 10 GHz was observed and plots produced of the frequency spectrum. Figures 6 and 7 represent plots of the spurious emissions

measurements for the EUT. Data taken per 2.1051 and applicable parts of Part 90.

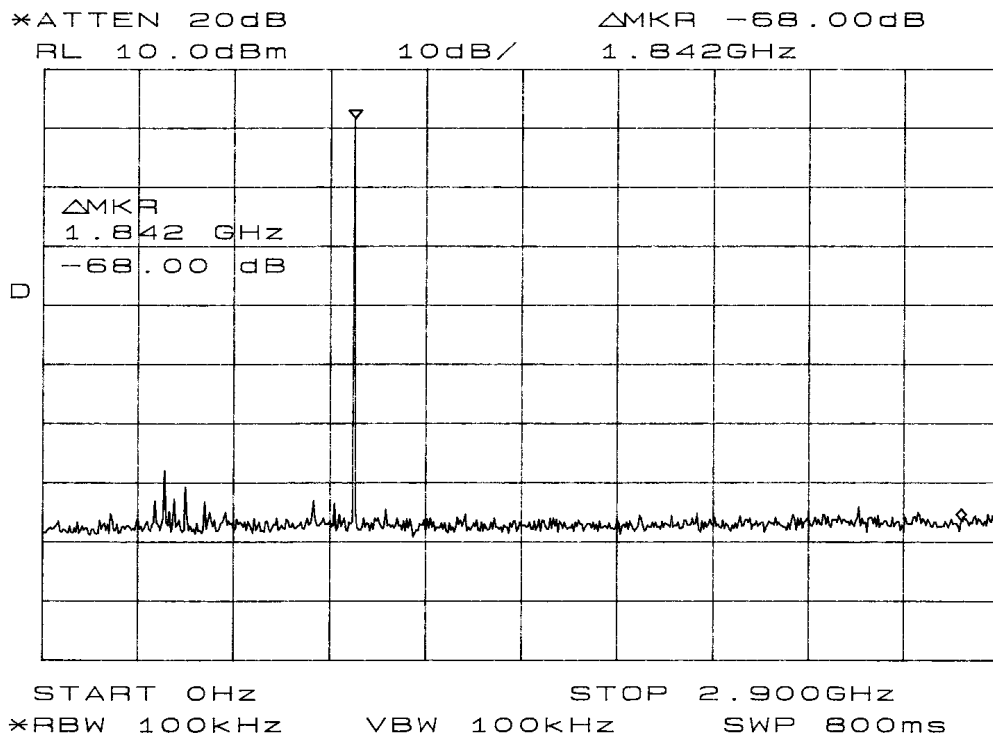


Figure 6 Emissions at Antenna Terminal

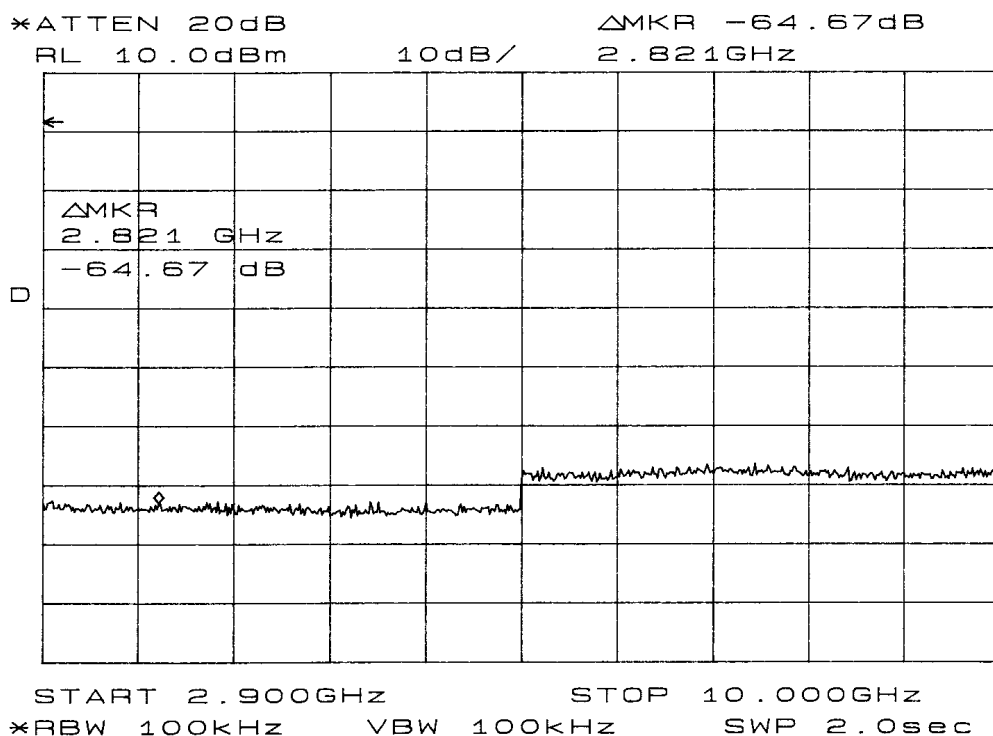


Figure 7 Emissions at Antenna Terminal

Results:

Data taken per 2.1051 and applicable parts of Part 90. Specifications of Paragraphs 2.1051, 2.1057 and 90.211(3) are met. There are no deviations to the specifications.

FREQUENCY	SPURIOUS FREQ. (GHz)	LEVEL BELOW CARRIER (dB)
912.00	1824.0	-69.0
	2736.0	-73.7
	3648.0	-73.5
	4560.0	-73.3
916.00	1832.0	-68.0
	2748.0	-73.5
	3664.0	-73.5
	4580.0	-73.1

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 antenna port connected to the standard antenna. The transmitter was activated and the frequency spectrum was observed. The turntable was rotated through 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 = 58.9 + 8.9 - 35
CFS = 32.8

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.

Attenuation = $55 + 10 \log_{10}(P_w)$
= $55 + 10 \log_{10}(2.0)$
= 58 dB

Radiated (8 Highest Emissions)

Freq. In MHz	FSM Hor. (dBµV)	FSM Vert. (dBµV)	Ant. Fact. (dB)	Amp. Gain (dB)	Comp. Hor. (dBµV/m) @ 10m	Comp. Vert. (dBµV/m) @ 10 m	FCC Limit (dBµV/m) @ 10 M
80.0	58.9	60.5	8.9	35	32.8	34.4	40.0
112.0	43.7	67.5	7.6	35	16.3	40.1	43.5
120.0	56.7	70.2	7.9	35	29.6	43.1	43.5
140.0	56.7	64.7	10.5	35	32.2	40.2	43.5
160.0	53.3	66.0	9.7	35	28.0	40.7	43.5
240.0	63.0	67.8	12.1	35	40.1	44.9	46.0
360.0	65.3	65.2	15.3	35	45.6	45.5	46.0
400.0	50.3	62.5	16.4	35	31.7	43.9	46.0

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

Results:

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
1824.0	43.0	35.3	29.1	25	47.1	39.4	54.0
2736.0	38.9	38.1	32.6	25	46.5	45.7	54.0
3648.0	41.0	39.1	37.1	25	53.1	51.2	54.0
4560.0	35.3	35.0	40.7	25	51.0	50.7	54.0
1832.0	33.1	32.3	29.1	25	37.2	36.4	54.0
2748.0	38.3	38.3	32.6	25	45.9	45.9	54.0
3664.0	40.0	36.5	37.1	25	52.1	48.6	54.0
4580.0	33.3	34.3	40.7	25	49.0	50.0	54.0
1838.0	37.1	34.0	29.1	25	41.2	38.1	54.0
2757.0	33.1	34.0	32.6	25	40.7	41.6	54.0
3676.0	41.5	38.3	37.1	25	53.6	50.4	54.0
4595.0	35.3	34.4	40.7	25	51.0	50.1	54.0

Specifications of Paragraph 2.1053, 2.1057 and 90.211 are met.
There are no deviations to the specifications.

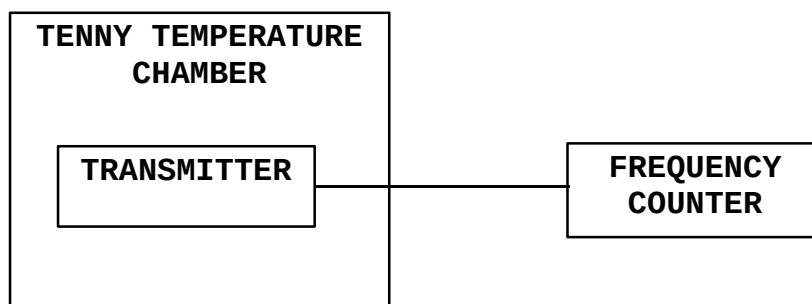
2.1055 Frequency Stability

Measurements Required:

Pursuant to 90.213(a), Note 13, frequency stability testing is not required. However, pursuant to good engineering practices, temperature stability was measured for the operating temperature range of the unit and recorded in the supplemental Appendix.

- (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 +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 r.f. power output at the duty cycle for which it is rated,

for 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.

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 ac voltage for the power input from 102 Vac to 138 Vac. The frequency was measured and the variation in parts per million was calculated. Data was taken per Paragraphs 2.1055 and 90.213.

Results:

FREQ. (MHz)	FREQUENCY STABILITY VS TEMPERATURE IN PARTS PER MILLION (PPM)								
	Temperature in °C								
	-30	-20	-10	0	+10	+20	+30	+40	+50
916.000	-18.6	-17.8	-18.1	-17.4	-19.7	-20.9	-20.7	-19.4	-15.5

FREQUENCY IN MHz	STABILITY VS VOLTAGE VARIATION $\pm 15\%$ IN PPM		
	INPUT VOLTAGE		
	102.0 V _{ac}	120.0 V _{ac}	138.0 V _{ac}
916.00	0	0	0

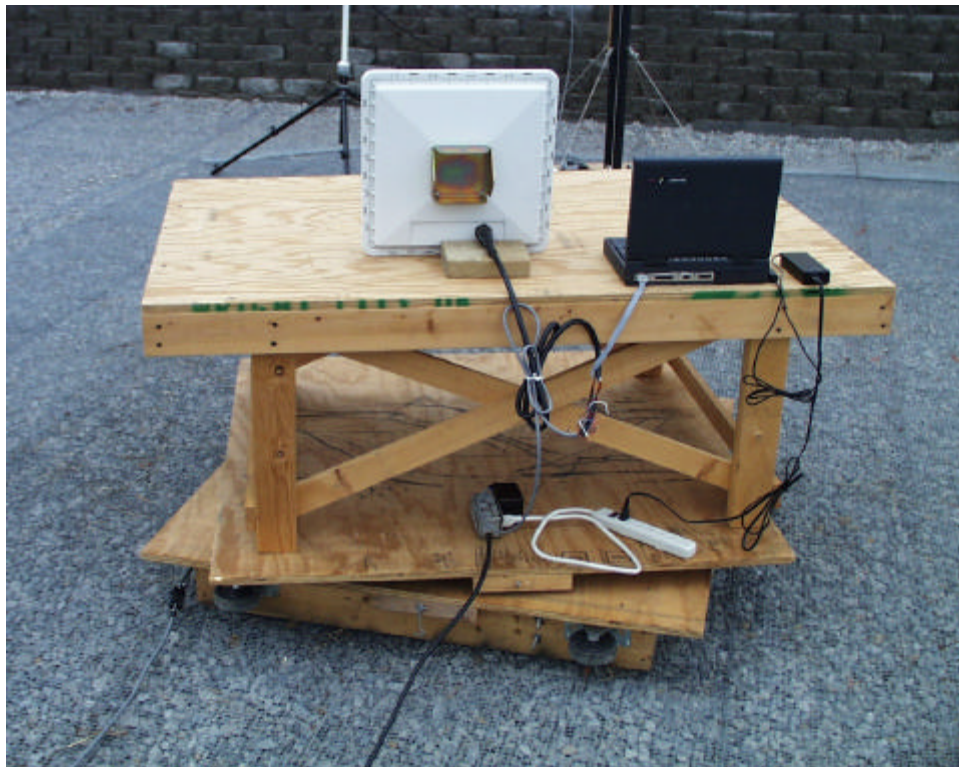
Specifications of Paragraphs 2.1055 and 90.213 are met.
There are no deviations to the specifications.

APPENDIX

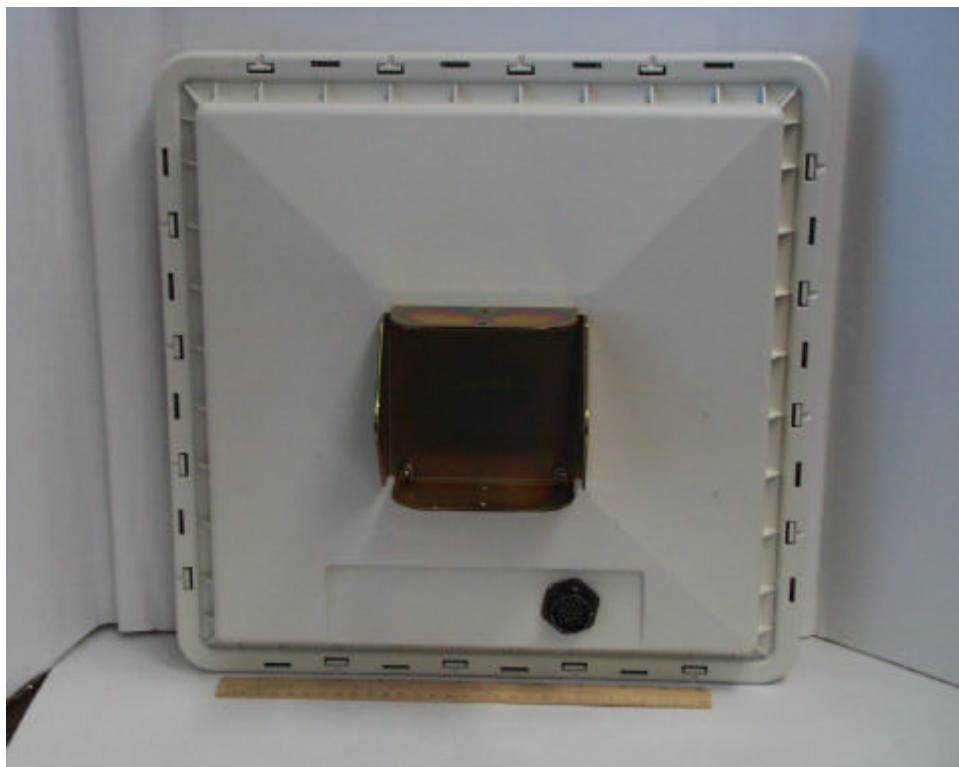
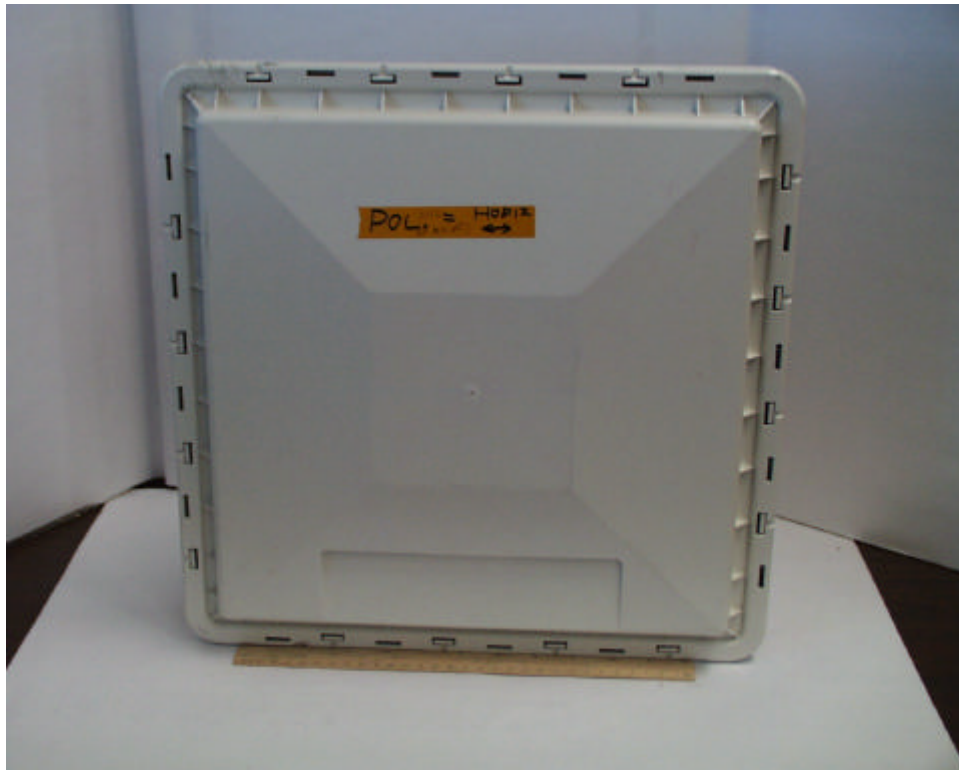
Model: PARC 10-510-100

1. Photos of Radiated Emissions Test Set Up
2. Photos of Case Front and Back
3. Photos Inside of Case
4. Photos RF PC Board
5. Photos FCC ID Label and Location
7. Test Equipment List
8. Rogers Qualifications
9. FCC Site Approval Letter

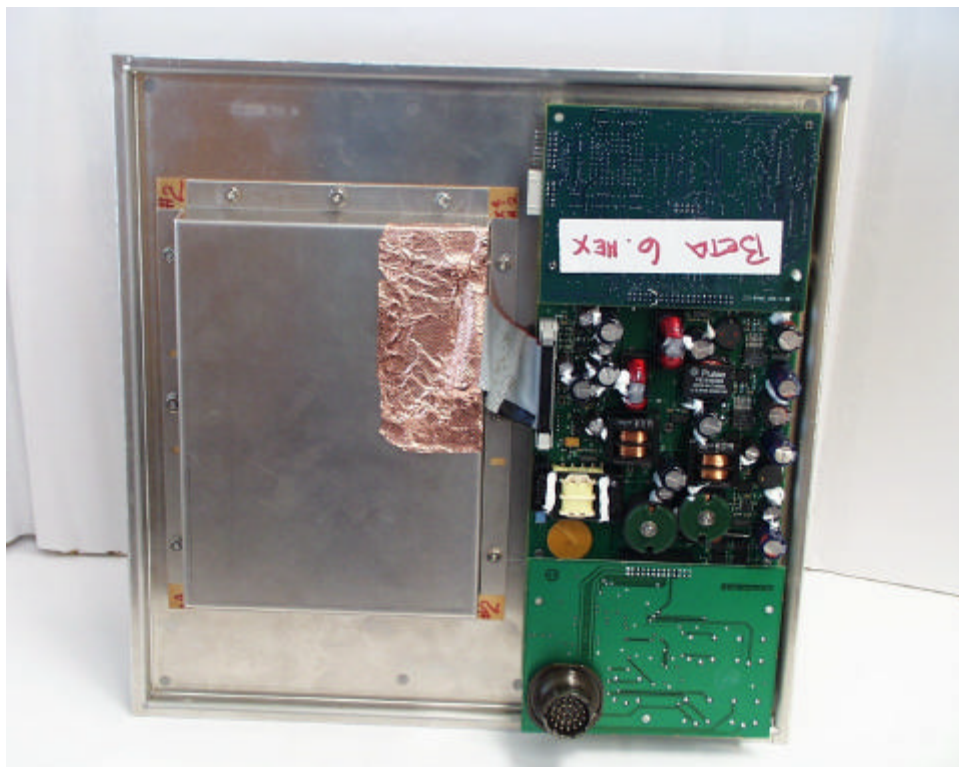
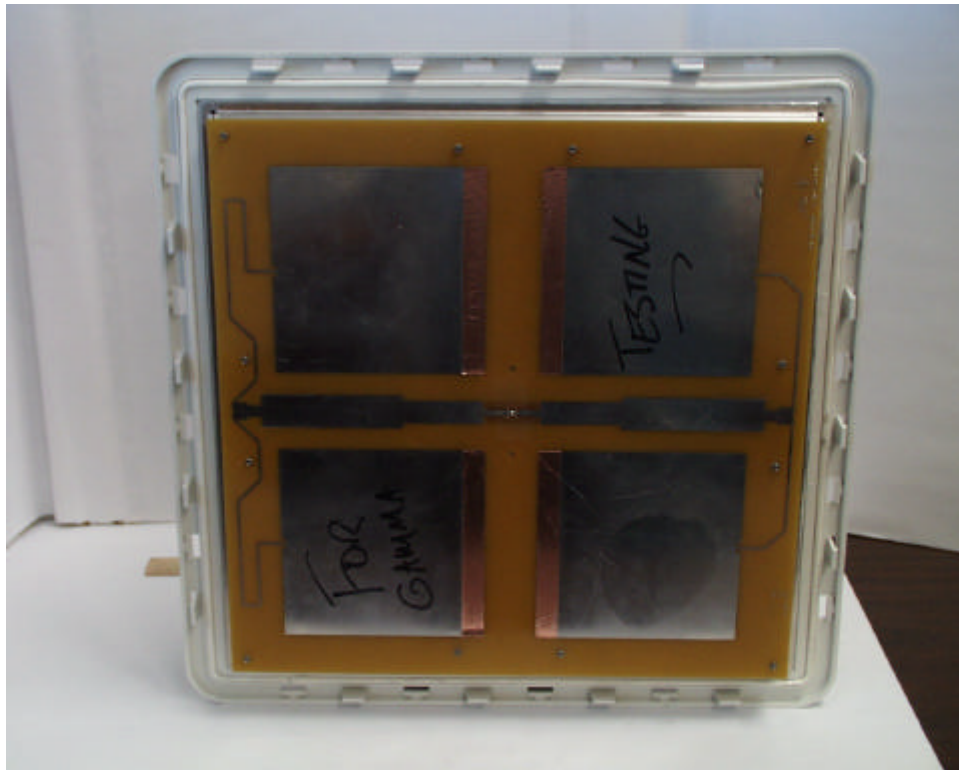
INTERMEC TECHNOLOGIES, CORPORATION
AMTECH SYSTEMS DIVISION
Model: PARC 10-510-100
Photos Radiated Emissions



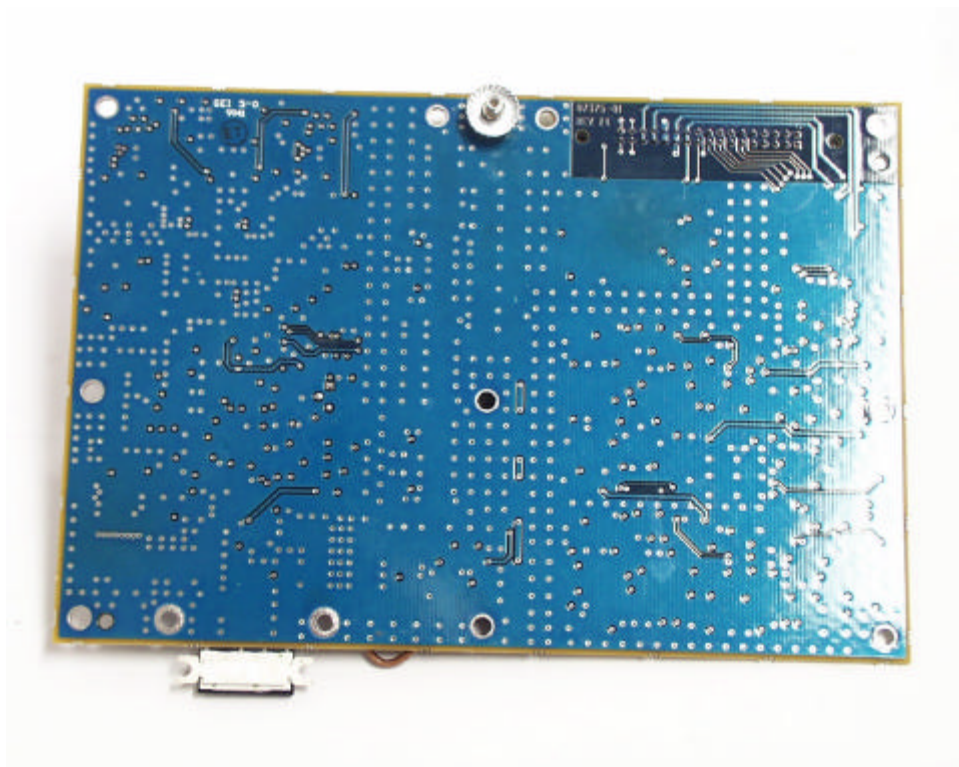
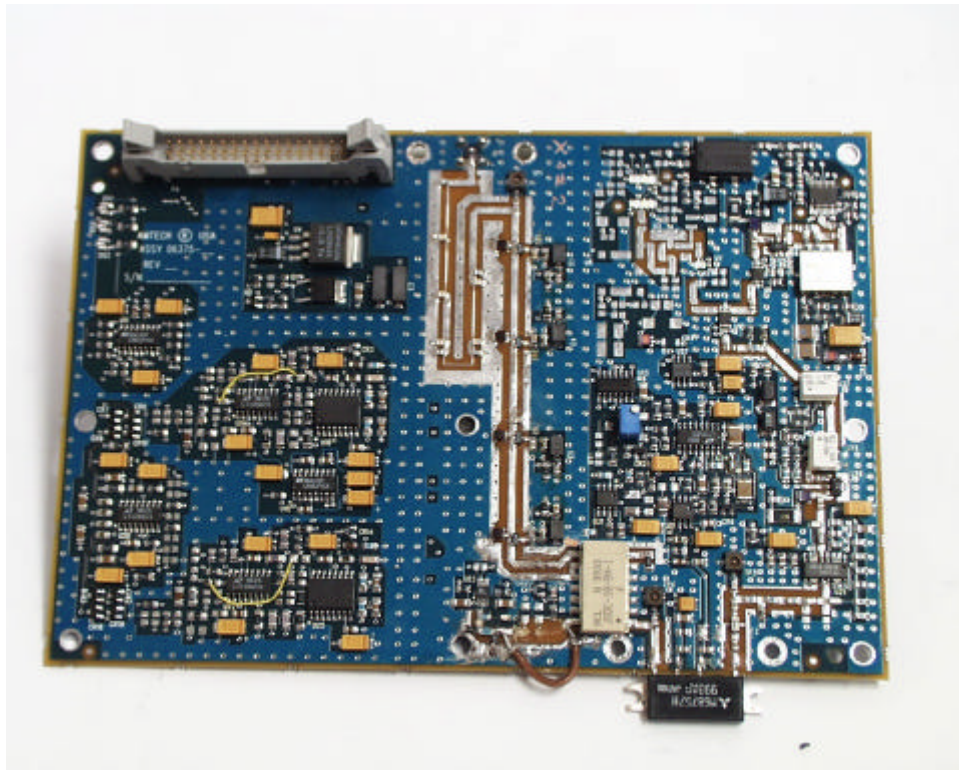
INTERMEC TECHNOLOGIES, CORPORATION
AMTECH SYSTEMS DIVISION
Model: PARC 10-510-100
Photos Case Front and Back



INTERMEC TECHNOLOGIES, CORPORATION
AMTECH SYSTEMS DIVISION
Model: PARC 10-510-100
Photos Inside of Case



INTERMEC TECHNOLOGIES, CORPORATION
AMTECH SYSTEMS DIVISION
Model: PARC 10-510-100
Photos RF P.C. Board



INTERMEC TECHNOLOGIES, CORPORATION
 AMTECH SYSTEMS DIVISION
 Model: PARC 10-510-100
 Photo FCC ID Label Location



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,	2/99
Mixers: 11517A, 11980A & 11980K	
HP Adapters: 11518, 11519, 11520	
Spectrum Analyzer: HP 8591 EM	7/99
Frequency Counter: Weston 1255	2/99
Frequency Counter: Leader LDC 825	2/99
Antenna: EMC0 Log Periodic	10/99
Antenna: BCD 235/BNC Antenna Research	10/99
Antenna: EMC0 Dipole Set 3121C	2/99
Antenna: C.D. B-100	2/99
Antenna: Solar 9229-1 & 9230-1	2/99
Antenna: EMC0 6509	2/99
Microline Freq. Meter: Model 27B	2/99
Dana Modulation Meter: Model 9008	2/99
Audio Oscillator: H.P. 200CD	2/99
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	9/97
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	2/99
SCS Power Amp Model: 2350A	2/99
Power Amp A.R. Model: 10W 1000M7	2/99
Power Amp EIN Model: A300	1/99
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)	2/99
ESD Test Set 2000i	10/95
Fast Transient Burst Generator Model: EFT/B-100	10/95
Current Probe: Singer CP-105	8/97
Current Probe: Solar 9108-1N	8/97
Field Intensity Meter: EFM-018	10/95
KETEK Ecat Surge Generator	10/99

11/01/99

QUALIFICATIONS
Of
SCOT D. ROGERS, ENGINEER
ROGERS LABS, INC.

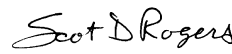
Mr. Rogers has approximately 12 years experience in the field of electronics. Six years working in the automated controls industry and 6 years working with the design, development and testing of radio communications and electronic equipment.

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

November 29, 1999
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

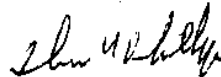
Re: Measurement facility located at above address
(3 and 10 meter site)

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