ROGERS
Labs, Inc.

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

TYPE ACCEPTANCE APPLICATION

for

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

MODEL: IT 1110 ALLEGRO
HAND HELD TRANSMITTER

FREQUENCY: 909.75-921.75 MHz
FCC ID: FIH 111005276

Test Date: August 5, 1998

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

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FORWARD:

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 1997, Part 2 Subpart J, Paragraphs 2.905, 2.911, 2.913, 2.925, 2.926, 2.981 through 2.999, 2.1003, Part 90, Subpart M, Paragraphs 90.201 through 90.217, and 90.350 through 90.363; the following is submitted:

2.983 Application for Type Acceptance

a. Manufacturer: INTERMEC TECHNOLOGIES CORPORATION
AMTECH SYSTEMS DIVISION
8600 Jefferson Street, NE
Albuquerque, NM 87113

b. Identification: Model: IT 1110 ALLEGRO HAND HELD READER

FCC I.D.: FIH 111005276

c. Plan to produce quantity production.

d. (1) Emission Type:

1M75L1D

(2) Frequency Range:

909.75-921.75 MHz

(3) Operating Power Level:

0.7 Watt

(4) Max P_o:

1 Watt.

(5) Power into final amp:

4.57 Vdc @ 0.294 amps (1.3 Watts)

(6) Refer to Appendix for function of semiconductors and other active devices.

(7) Refer to Appendix for Circuit Diagrams.

(8) Refer to Appendix for Preliminary Instruction Manual.

(9) Tune Up Procedure: Refer to Appendix.

(10) Frequency Stabilizing: Refer to Appendix.

(11) Spurious and Harmonic Suppression: Refer to Appendix.

(12) Modulation: Refer to Appendix.

e. Measurement Procedure: Standard Engineering Practices were used in collecting the test data.

Reference Material: ANSI - 63.4-1992.

List of Test Equipment used: Refer to Appendix for Test Equipment List.

f. Refer to Appendix for Identification plate data.

g. Refer to Appendix for photos of equipment.

2.985 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 r.f. power output was measured at the antenna terminals by replacing the antenna with a spectrum analyzer and cable (with .3dB loss in the cable). The spectrum analyzer had an impedance of 50Ω to match the impedance of the standard antenna. An HP 8562A 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 output power of the transmitter. Data taken per Paragraph 2.985(a) and applicable parts of Part 90.

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

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

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

Results:

FREQUENCY	P_{dBm}	P_{mW}	P_W
913.6	28.4	691.8	0.7
915.0	28.4	691.8	0.7
916.7	28.1	645.6	0.65

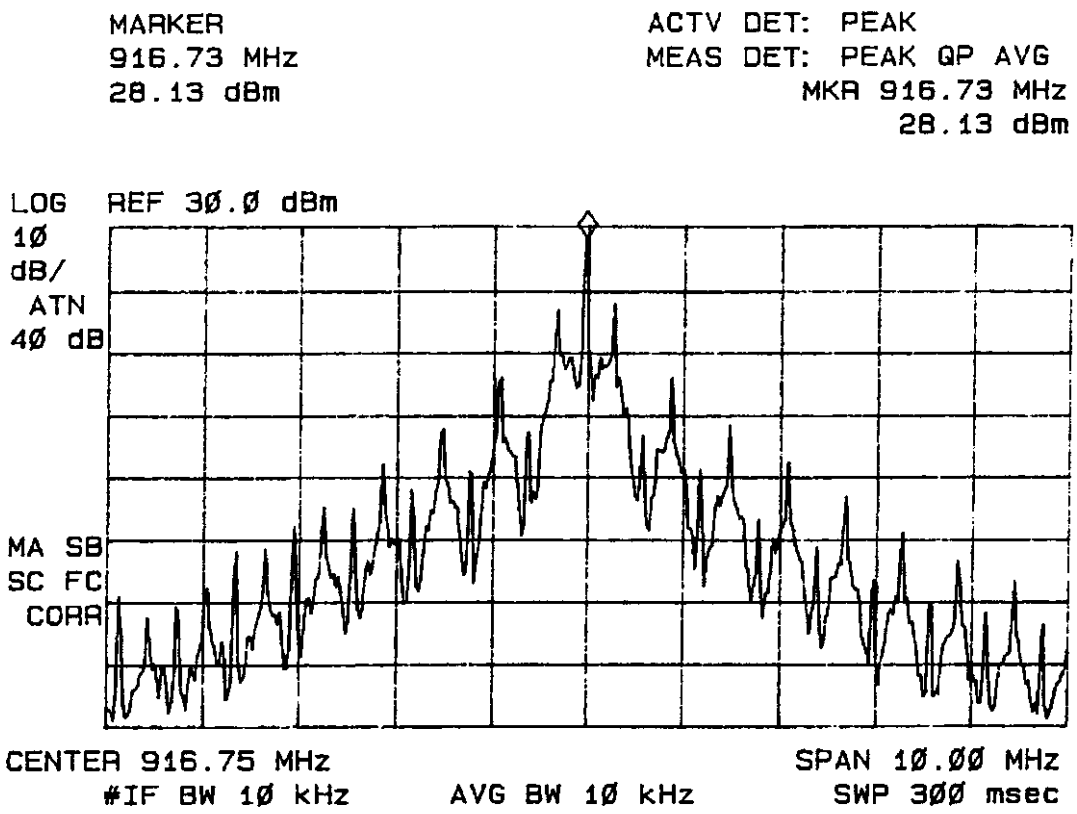


Figure 1 Output Power of Transmitter

The specifications of Paragraph 2.985(a) and 90.205 are met. There are no deviations to the specifications.

2.987 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 r.f. output was coupled to a HP 8591EM Spectrum Analyzer. The spectrum analyzer was used to observe

the r.f. spectrum with the transmitter operating in its normal mode.

Results:

The signal is modulated at 300 K baud with Manchester-encoded data. Specifications of Paragraphs 2.987(d) and 90.211 are met. There are no deviations to the specifications.

2.989 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 Figure 2 showing the 99.5% power measurement.

Test Arrangement:

Results:

MARKER Δ
1.75 MHz
-9.46 dB

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 1.75 MHz
-9.46 dB

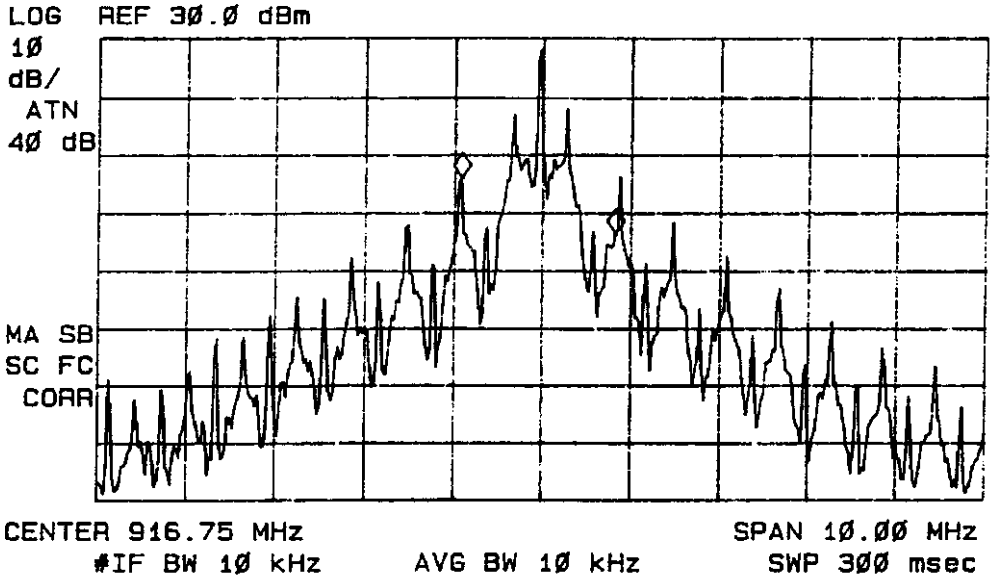


Figure 2 99.5% Power Occupied Bandwidth

f_c	O.B. MHz
916.7	1.75

Requirements of 2.988 and applicable parts of Paragraph 90 are met . There are no deviations to the specifications.

2.991 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 integral antenna was removed and replaced with a spectrum analyzer with 50 Ω impedance.

The r.f. output was coupled to an HP 8562A Spectrum Analyzer. 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 10 GHz was observed and plots produced of the frequency spectrum. Figures 3 and 4 represent data for the IT 1110 Allegro Hand Held Reader. Data taken per 2.991 and applicable parts of Part 90.

Results

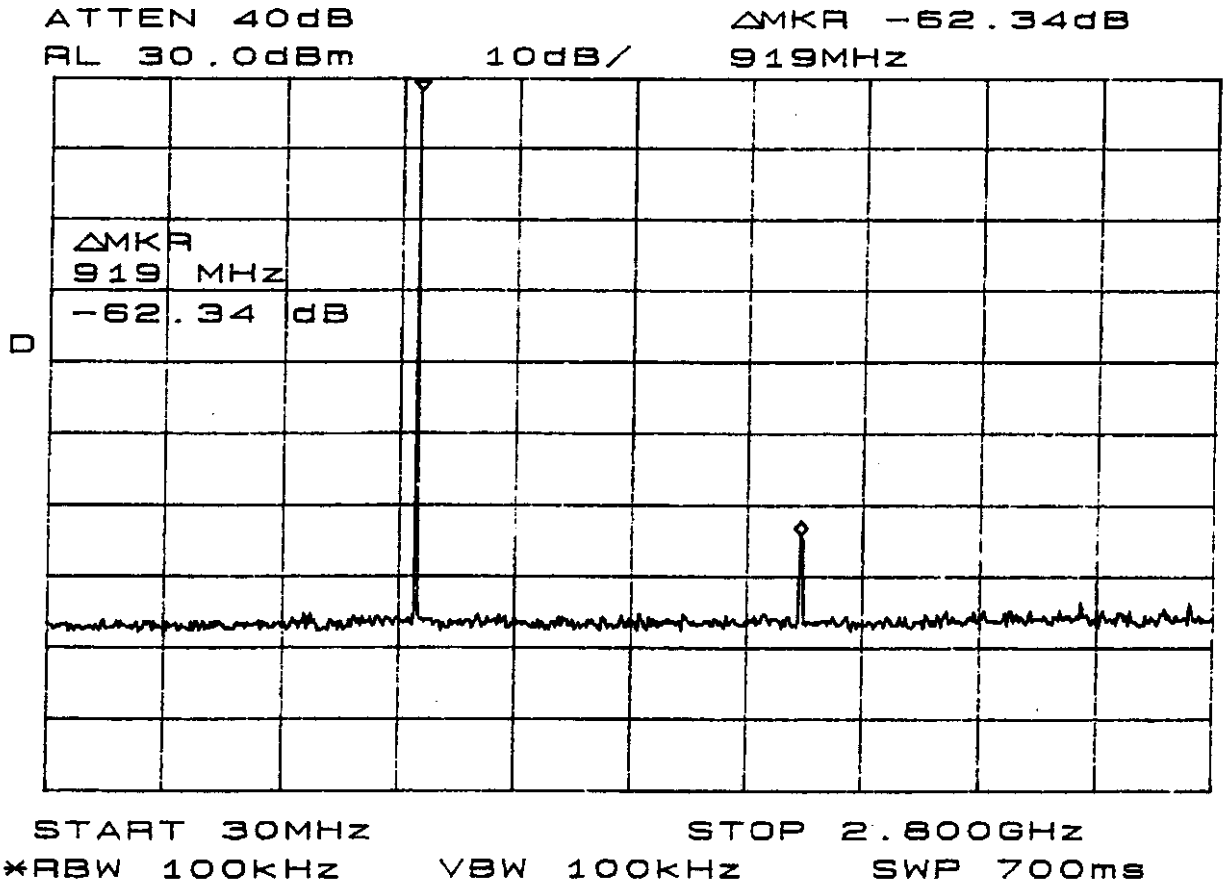


Figure 3 Spurious Emissions at Antenna Terminal

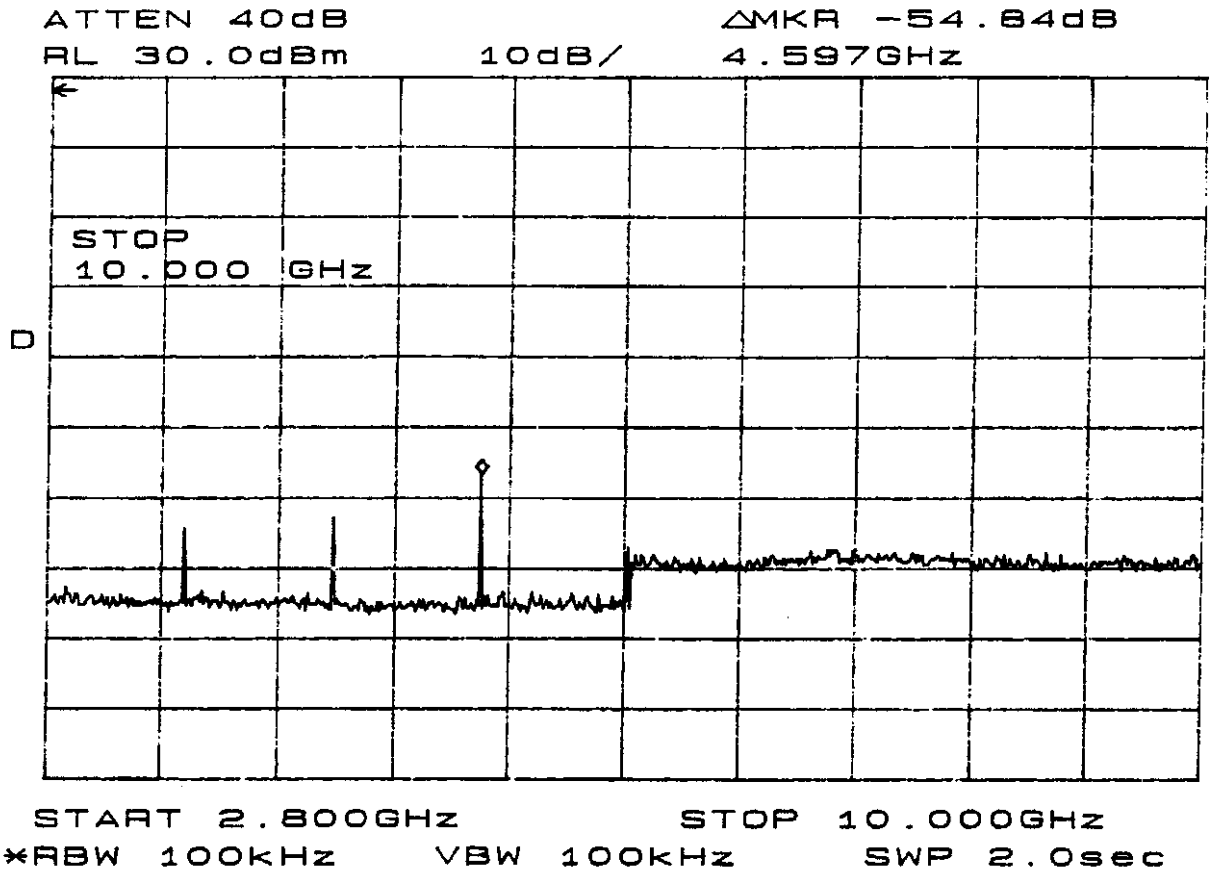


Figure 4 Spurious Emissions at Antenna Terminal

The emission mask for transmitters that are not equipped with audio low-pass filters, emissions on any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth shall be attenuated by at least 43 + 10 Log (P_o) dB. The limit for the IT 1110 Allegro Hand Held Reader:

55 + 10 Log(1)
55 + 10(0)
Limit = 55 dB

Data taken per 2.991 and applicable parts of Part 90. Specifications of Paragraphs 2.991, 2.997 and 90.211(K)(3) are met. There are no deviations to the specifications.

FREQUENCY	SPURIOUS FREQ. (GHz)	LEVEL BELOW CARRIER (dB)
913.6	1827.4	63.3
	2741.7	67.3
	3654.8	65.0
	4568.5	63.0
	5482.3	80.6
	6396.0	68.0
915.0	1830.0	62.3
	2745.0	71.8
	3660.0	62.5
	4575.0	60.5
	5490.0	64.8
	6405.0	65.0
916.7	1833.47	72.3
	2750.1	70.8
	3666.8	70.3
	4583.5	71.5
	5500.2	86.8
	6416.9	68.5

2.993 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. The integral antenna was installed on the reader for all spurious radiation measurements.

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 transmitter was activated and the frequency spectrum of the fundamental

was observed. The turntable was rotated though 360 degrees to locate the position registering the highest amplitude emission. The amplitude of the fundamental frequency was measured and recorded. 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 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 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 procedures 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 = 127.3 + 22.4 - 25
CFS = 124.7

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.

$$\begin{aligned} \text{Attenuation} &= 55 + 10\ \text{Log}_{10}(P_w) \\ &= 55 + 10\ \text{Log}_{10}(1.0) \\ &= 55\ \text{dB} \\ \text{Limit} &= 124.7 - 55 \\ &= 69.7 \end{aligned}$$

Results:

FREQUENCY (MHz)	FSM HOR. (dBµV)	FSM VERT. (dBµV)	ANTENNA FACTOR (dB)	AMPLIFIER GAIN (dB)	CFS. dBµV/m @ 3 M HOR.	CPS. dBµV/m @ 3 M VERT.
913.6	126.1	115.4	22.4	25	123.5	112.8
1827.4	41.3	31.1	27.7	25	44.0	33.8
2741.2	43.6	33.8	33.5	25	52.1	42.3
3654.8	35.5	34.5	38.4	25	48.9	47.9
4568.5	34.3	35.5	40.8	25	50.1	51.3
5482.3	33.6	34.0	41.2	25	49.8	50.2
6396.0	34.6	33.8	42.3	25	51.9	51.1
915.0	127.3	116.1	22.4	25	124.7	113.5
1830.0	43.6	33.3	27.7	25	46.3	36.0
2745.0	43.0	33.5	33.5	25	51.5	42.0
3660.0	33.3	33.3	38.4	25	46.7	46.7
4575.0	33.5	30.0	40.8	25	49.3	45.8
5490.0	30.5	31.1	41.2	25	46.7	47.3
6405.0	31.0	30.3	42.3	25	48.3	47.6
916.7	125.4	118.5	22.4	25	122.8	115.9
1833.4	44.5	32.0	27.7	25	47.2	34.7
2750.1	43.3	34.5	33.5	25	51.8	43.0
3666.8	35.0	34.6	38.4	25	48.4	48.0
4583.5	34.8	34.5	40.8	25	50.6	50.3
5500.2	35.8	33.3	41.2	25	52.0	49.5
6416.9	34.1	35.5	42.3	25	51.4	52.8

Specifications of Paragraph 2.993, 2.997 and 90.211 are met. There are no deviations to the specifications.

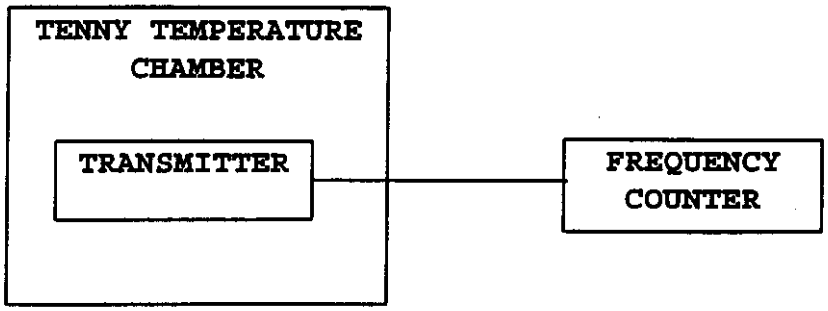
2.995 Frequency Stability

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 +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 a 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. A Sorensen DC Power Supply was used to vary the dc voltage for the power input from 6.8 Vdc to 9.2 Vdc. The unit incorporates a battery sense circuit to power down when the battery voltage is reduced below 6.6 volts. The frequency was measured and the variation in parts per million was calculated. Data was taken per Paragraphs 2.995 and 90.213.

Results:

Temperature Stability f_o = 915.0144 MHz

FREQ. (MHz)	FREQUENCY STABILITY VS TEMPERATURE IN PARTS PER MILLION (PPM)								
	Temperature in °C								
	-30	-20	-10	0	+10	+20	+30	+40	+50
915.0144	1.5	0.9	4.8	4.3	0.2	1.1	-0.2	-0.1	0.9

FREQUENCY IN MHz	STABILITY VS VOLTAGE VARIATION ±15% IN PPM INPUT VOLTAGE			
	6.8 V_{dc}	8.0 V_{dc}	9.2 V_{dc}	6.6 V_{dc}
915.0144	0	0	0	OFF

Specifications of Paragraphs 2.995 and 90.213 are met. There are no deviations to the specifications.

APPENDIX

Model: IT 1110 ALLEGRO

1. Photos of Radiated Emissions Test Set Up
2. Test Equipment List.
3. Rogers Qualifications.
4. FCC Site Approval Letter.
5. Photos of Equipment Per 2.983(g).

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	2/98
Wattmeter: Bird 43 with Load Bird 8085	2/98
Power Supplies: Sorensen SRL 20-25, DCR 150, DCR 140	2/98
H/V Power Supply: Fluke Model: 408B (SN:573)	2/98
R.F. Generator: Boonton 102F	2/98
R.F. Generator: HP 606A	2/98
R.F. Generator: HP 8614A	2/98
R.F. Generator: HP 8640B	2/98
Spectrum Analyzer: HP 8562A, Mixers: 11517A, 11980A & 11980K HP Adapters: 11518, 11519, 11520	2/98
Spectrum Analyzer: HP 8591 EM	6/97
Frequency Counter: Weston 1255	2/98
Frequency Counter: Leader LDC 825	2/98
Antenna: EMCO Log Periodic	9/97
Antenna: BCD 235/BNC Antenna Research	9/97
Antenna: EMCO Dipole Set 3121C	2/98
Antenna: C.D. B-100	2/98
Antenna: Solar 9229-1 & 9230-1	2/98
Antenna: EMCO 6509	2/98
Microline Freq. Meter: Model 27B	2/98
Dana Modulation Meter: Model 9008	2/98
Audio Oscillator: H.P. 200CD	2/98
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 2.5 M (100 dB Integrity)	
LISN 50 µHy/50 ohm/0.1 µf	9/97
LISN Compliance Eng. 240/20	2/98
SCS Power Amp Model: 2350A	2/98
Power Amp A.R. Model: 10W 1000M7	2/98
Linear Amp Mini Circuits: ZHL-1A (2 Units)	2/98
Combiner Unit Mini Circuits: ZSC-2-1 (2 Units)	2/98
ELGAR Model: 1751	2/98
ELGAR Model: TG 704A-3D	2/98
ELGAR Model: 400SD (PB)	2/98
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

02/01/98

QUALIFICATIONS

of

SCOT D. ROGERS, ENGINEER

ROGERS LABS, INC.

Mr. Rogers has approximately 10 years experience in the field of electronics. Six years working in the automated controls industry and 4 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

8/9/98

Date

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

SUPPLEMENTAL APPENDIX

to

TYPE ACCEPTANCE APPLICATION

MODEL: IT1110 Allegro Hand-held Reader

NAME: LMS Hand-held Reader

FCC ID: FIH111005276

20 August 1998

Rogers Consulting Labs
4405 West 259th Terrace
Louisburg, KS 66053
913.837.3214

Engineer: Tom McVeety
Intermec Technologies Corp.,
Amtech Systems Division
8600 Jefferson St. NE
Albuquerque, NM 87113
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Application for Type Acceptance

Table of Contents

Exhibit 2 -

*These materials are contained in the confidential attachment.

§2.983 (d)(8) Operation Manual

Please see next page for Operation Manual.