



ROGERS

Labs, Inc.

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FCC CERTIFICATION REPORT

ELECTROMAGNETIC INTERFERENCE TEST RESULTS
For CFR 47 Part 15C
Intentional Radiators Per 15.245

FOR

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

Wes Mays,
Manager of Microwave Designs

MODEL: AH1101-001
HAND HELD READER
FCC ID#: FIH11010533402

Test Date: August 28, 1998

Certifying Engineer: Scot D. Rogers

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GENERAL INFORMATION**Name of Applicant:**

INTERMEC TECHNOLOGIES CORPORATION
AMTECH SYSTEMS DIVISION
8600 Jefferson Street, NE
Albuquerque, NM 87113

Technical Information:

Model: AH1101-001 HANDHELD READER

FCC I.D.: FIH11010533402

Frequency Range: 902 to 928 MHz

Bandwidth (99.5%) 40 kHz

1) Applicable Standards & Test Procedures

- a) In accordance with Part 1, Subpart G, Paragraphs 1.1103; Part 2, Subpart J, Paragraphs 2.907, 2.925, 2.926, 2.947 2.1031 through 2.1043, and Part 15, Subpart C, Paragraphs 15.19(A)(3), 15.21, 15.27(C), 15.105(A), 15.107, 15.109, 15.201(B), 15.203 15.205, 15.209, and 15.245 of the Code of Federal Regulations, dated October 1, 1997. The transition provisions in paragraph 15.37(d) are not being requested.
- b) Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI 63.4-1992 Document.

2) Equipment Tested

<u>EUT</u>	<u>FCC I.D.#</u>
AH1101-001	FIH11010533402
PC-9000	FKGPC9000
KX-P1092	ACJ96NKX-P1092

3) Equipment and Cable Configuration

Conducted Emission Test Procedure:

The test setup, including the EUT, was arranged in a typical equipment configuration and placed on a 1 x 1.5 meter wooden bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50 µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table.

Radiated Emission Test Procedure:

The test setup, including the EUT, was placed on top of a rotatable, 1 x 1.5 meter, wooden table, 0.8 meters above the ground plane. The receiving antenna was located on a variable height antenna mast 3 meters from the table supporting the EUT and test system. The antenna height was varied between 1 and 4 meters above the ground plane and the

antenna polarization was varied between horizontal and vertical. The measured radiated EMI level was maximized by equipment placement, cable location and table rotation before data was taken using a spectrum analyzer.

4) 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 8591 EM ANALYZER SETTINGS			
CONDUCTED EMISSIONS:			
RBW	AVG. BW	DETECTOR FUNCTION	
9 kHz	30 kHz	Peak/Quasi Peak	
RADIATED EMISSIONS:			
RBW	AVG. BW	DETECTOR FUNCTION	
120 kHz	300 kHz	Peak/Quasi Peak	
HP8562A ANALYZER SETTINGS			
RBW	VIDEO BW	DETECTOR FUNTION	
100 kHz	100 kHz	Peak	
1 MHz	1 MHz	Average	

5) Units of Measurement

Conducted EMI: Data is in dBµV; dB referenced to one microvolt.

Radiated EMI: Data is in dBµV/m; dB/m referenced to one microvolt per meter.

Calculations:

$$\begin{aligned}
 \text{RFS} &= \text{Radiated field strength (dBµV/m) @ 3m} \\
 \text{RFS} &= \text{FSM (dBµV) + A.F. (dB/m) - Amp. Gain (dB)} \\
 \text{RFS} &= 33.3 \text{ (dBµV) + 9.2 (dB/m) - 35 (dB)} \\
 \text{RFS} &= 7.5 \text{ (dBµV/m)}
 \end{aligned}$$

6) Test Site Location

Conducted EMI: The AC powerline conducted emissions tests were performed in a shielded screen room located at ROGERS LABS, INC., 4405 W. 259th Terrace, Louisburg, KS.

Radiated EMI: The radiated emissions tests were performed at ROGERS LABS, INC. 3 meter open area test site (OATS) located in Louisburg, KS.

Site Approval: Refer to Appendix for FCC Site Approval Letter, Reference 31040/SIT 1300F2, Dated February 6, 1998.

7) Measurement Procedures

Conducted EMI:

The EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5 meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room.

The LISN was positioned on the floor of the screen room 80 cm

from the rear of the EUT. The power cord of the EUT was connected to the LISN. A second LISN was positioned on the floor of the screen room 80 cm from the rear of the supporting equipment. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 μ F capacitor, internal to the LISN. Power line conducted emissions testing was carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequencies of the emissions that had the highest amplitudes. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz then the data was recorded with maximum conducted emissions levels.

Radiated EMI:

The EUT was arranged in a typical equipment configuration and operated through all of its various modes. The interconnecting cables of the EUT and supporting equipment were manipulated such as to obtain maximum levels of radiated

emissions within the range of likely configurations. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Radiated emissions measurements were performed to identify the frequencies that produced the highest emissions. Plots were made of the frequency spectrum from 30 MHz to 1000 MHz for the preliminary testing. The EUT, supporting equipment and cable locations were noted and reconfigured at the open field test site. The highest radiated emission was then re-maximized at this location before final radiated emissions measurements were performed. Final data was taken with the EUT located at the open field test site at a distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 30 MHz to 1000 MHz was searched for radiated emissions. Measured emission levels were maximized by EUT placement on the table, changing cable location, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna polarization between horizontal and vertical. Antennas used were Broadband Biconical from 30 MHz to 200 MHz, Biconilog from 30 MHz to 1000 MHz, Log Periodic from 200 MHz to 5 GHz and/or pyramidal horn antennas from 5 to 40 GHz.

8) DATA

Conducted (6 Highest Emissions):

Frequency in MHz	Level L1 in dBµV	Level L2 in dBµV	FCC Limit In dBµV
1.4	29.4	29.9	60.0
3.8	29.2	27.5	69.5
3.9	30.6	31.1	69.5
4.4	26.2	27.9	69.5
12.7	23.4	28.5	69.5
20.0	26.5	27.9	69.5

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

Radiated (8 Highest Emissions):

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A. F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Limit @ 3m (dBµV/m)
49.0	33.3	43.4	9.2	35	7.5	17.6	40.0
73.0	45.3	53.3	8.2	35	18.5	26.5	40.0
86.0	46.7	53.0	8.6	35	20.3	26.6	40.0
119.0	52.8	57.0	8.8	35	26.6	30.8	43.5
172.0	56.4	45.5	9.9	35	31.3	20.4	43.5
184.1	51.6	45.2	9.9	35	26.5	20.1	43.5
300.0	37.1	34.8	15.3	35	17.4	15.1	46.0
400.0	54.9	39.7	16.1	35	36.0	20.8	46.0
COMPUTER SYSTEM							
120.0	53.4	57.0	8.8	35	27.2	30.8	43.5
140.0	64.1	63.2	10.2	35	39.3	38.4	43.5
155.5	53.9	48.9	10.4	35	29.3	24.3	43.5
160.0	48.3	53.0	10.4	35	23.7	28.4	43.5
180.0	55.8	52.5	9.9	35	30.7	27.4	43.5
265.0	53.5	49.7	12.4	35	30.9	27.1	46.0
278.2	47.0	50.8	13.5	35	25.5	29.3	46.0
298.6	49.7	54.9	13.5	35	28.2	33.4	46.0

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

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INTERMEC TECHNOLOGIES CORPORATION AMTECH SYSTEMS DIVISION
 MODEL: AH1101-001 HANDHELD READER
 Test #: 980828-1 FCCID#: FIH11010533402
 Test to: Part 15 C, Paragraph 15.245

Summary of Results:**Conducted Emissions:**

The conducted emissions for the EUT meets the requirements for FCC Part 15B Digital Devices with a 30.1 dB margin below the limit. Other emissions were present with amplitudes at least 10 dB below the FCC CLASS A limit.

Radiated Emissions

The radiated emissions for the EUT meets the requirements for FCC Part 15B Digital Devices with a 12.7 dB margin below the limit. Other emissions were present with amplitudes at least 10 dB below the FCC CLASS A limit.

Statement of Modifications

No modifications to the EUT were required for the unit to meet the FCC Part 15B CLASS A emissions standards. There were no deviations to the specifications.

9) SubPart C Intentional Radiators

As per CFR Part 15, SubPart C. The following information is submitted:

15.203 Antenna requirement: The antenna is etched on to the printed circuit board and can not be removed. Therefore, the antenna system is attached such that the requirements of Paragraph 15.203 are met.

15.205 Restricted Band of Operation: Spurious emissions falling into the restricted frequency bands of operation were measured at the OATS. The EUT utilizes frequency determining circuitry which generates harmonics falling into the restricted bands. These emissions were measured using log periodic and/or pyramidal horn antennas, amplification stages and a spectrum analyzer. No other significant emissions were recorded which fell in the restricted bands of operation.

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC CLASS A Limit @ 3m (dBµV/m)
4568.0	41.6	40.6	40.6	35	47.4	46.4	54.0
5481.0	40.0	40.2	41.2	35	46.2	46.4	54.0

15.245 Operation within the Frequency Band 902-928 MHz: The field strength of emissions from the EUT was measured at the OATS at a distance of 3 meters. The fundamental and harmonics were investigated for three different frequencies and recorded in the following table.

10) DATA

Radiated Emissions Intentional Radiator:

FREQUENCY (MHz)	FSM HOR. (dBµV)	FSM VERT. (dBµV)	ANTENNA FACTOR (dB)	AMPLIFIER GAIN (dB)	CFS: dBµV/m @ 3 M HOR.	CFS: dBµV/m @ 3 M VERT.
913.6	94.6	80.1	22.4	25	92.0	77.5
1827.4	39.5	41.1	27.7	25	42.2	43.8
2741.2	40.0	40.3	20.6	25	35.6	35.9
3654.8	41.8	40.8	20.6	25	37.4	36.4
4568.5	41.6	40.6	20.6	25	37.2	36.2
915.0	96.6	82.7	22.4	25	94.0	80.1
1830.0	43.3	44.6	27.7	25	46.0	47.3
2745.0	43.1	43.3	20.6	25	38.7	38.9
3660.0	45.1	45.1	20.6	25	40.7	40.7
4575.0	44.3	44.1	20.6	25	39.9	37.9
916.7	96.3	82.8	22.4	25	93.7	80.2
1833.4	42.3	43.3	27.7	25	45.0	46.0
2750.1	41.8	43.3	20.6	25	37.4	38.9
3666.8	44.3	42.1	20.6	25	39.9	37.7
4583.5	44.5	44.1	20.6	25	41.1	39.7

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 MODEL: AH1101-001 HANDHELD READER
 Test #: 980828-1 FCCID#: FIH11010533402
 Test to: Part 15 C, Paragraph 15.245 Page 12 of 24

Radiated (8 Highest Emissions):

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Limit @ 3m (dBµV/m)
49.0	33.3	43.4	9.2	35	7.5	17.6	40.0
73.0	45.3	53.3	8.2	35	18.5	26.5	40.0
86.0	46.7	53.0	8.6	35	20.3	26.6	40.0
119.0	52.8	57.0	8.8	35	26.6	30.8	43.5
172.0	56.4	45.5	9.9	35	31.3	20.4	43.5
184.1	51.6	45.2	9.9	35	26.5	20.1	43.5
300.0	37.1	34.8	15.3	35	17.4	15.1	46.0
400.0	54.9	39.7	16.1	35	36.0	20.8	46.0
COMPUTER SYSTEM							
120.0	53.4	57.0	8.8	35	27.2	30.8	43.5
140.0	64.1	63.2	10.2	35	39.3	38.4	43.5
155.5	53.9	48.9	10.4	35	29.3	24.3	43.5
160.0	48.3	53.0	10.4	35	23.7	28.4	43.5
180.0	55.8	52.5	9.9	35	30.7	27.4	43.5
265.0	53.5	49.7	12.4	35	30.9	27.1	46.0
278.2	47.0	50.8	13.5	35	25.5	29.3	46.0
298.6	49.7	54.9	13.5	35	28.2	33.4	46.0

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

For frequencies above 1000 MHz the average detector function was used. No emission had peak amplitude that exceeded the limits by 20 dB.

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 MODEL: AH1101-001 HANDHELD READER
 Test #: 980828-1 FCCID#: FIH11010533402
 Test to: Part 15 C, Paragraph 15.245

Summary of Results:

The radiated emissions for the EUT meet the requirements for FCC Part 15C Intentional Radiators. There are no measurable emissions in the restricted bands other than those recorded in this report.

Statement of Modifications:

No modifications were required for the EUT to meet the requirements of Part 15. There were no deviations to the specifications.

APPENDIX

- 1) Photos Conducted Emissions Setup
- 2) Photos Radiated Emissions Setup
- 3) Photos of Case Front and Back
- 4) Photos Inside of Case
- 5) Photos Printed Circuit Board
- 6) Photo FCC Label Location
- 7) Test Equipment List
- 8) Rogers Qualifications
- 9) FCC Site Approval Letter