

Electrical (EMC)

DATE: 31 July 2000

I.T.L. (PRODUCT TESTING) LTD.
FCC EMC Test Report
for
ELPAS - Electro-optic Systems Ltd.

Equipment under test:
IR and RF Personal Badge
PBU00916

Approved by: _____
Y. Mordukhovitch, Test Engineer

Approved by: _____
I. Raz, EMC Laboratory Manager

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This report relates only to items tested.

Measurement/Technical Report for ELPAS - Electro-optic Systems Ltd.

Equipment under test:

IR and RF Personal Badge

P/N PBU00916

FCC ID: O4XB01

DATE: 31 July 2000

This report concerns: Original Grant x Class II change

Class B verification Class A verification Class I change

Equipment type: Radio Telemetry Transmitter

Request Issue of Grant:

 x Immediately upon completion of review

Limits used:

CISPR 22 Part 15 x

Measurement procedure used is ANSI C63.4-1992.

Application for Certification

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1. General Information

1.1 *Product Description*

A small, portable, personal clip-on badge. The badge sends Infra Red signals, in addition to RF signals in the frequency of 916.5 MHz. The tag is used for locating people in enclosed environments and providing various location dependent functions (open doors, alert indication, etc.).

1.2 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4:1992. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the data is located at Kfar Bin Nun, Israel. This site has been fully described in reports dated April 10, 1995 and May 8, 1995, submitted to the FCC office, and accepted in a letter dated July 23, 1998 (31040/SIT 1300F2).

1.4 Measurement Uncertainty

Radiated Emission

The Open Site complies with the ± 4 dB Normalized Site Attenuation requirements of ANSI C63.4-1992. In accordance with Paragraph 5.4.6.2 of this standard, this tolerance includes instrumentation calibration errors, measurement technique errors, and errors due to site anomalies.

2. Product Labeling

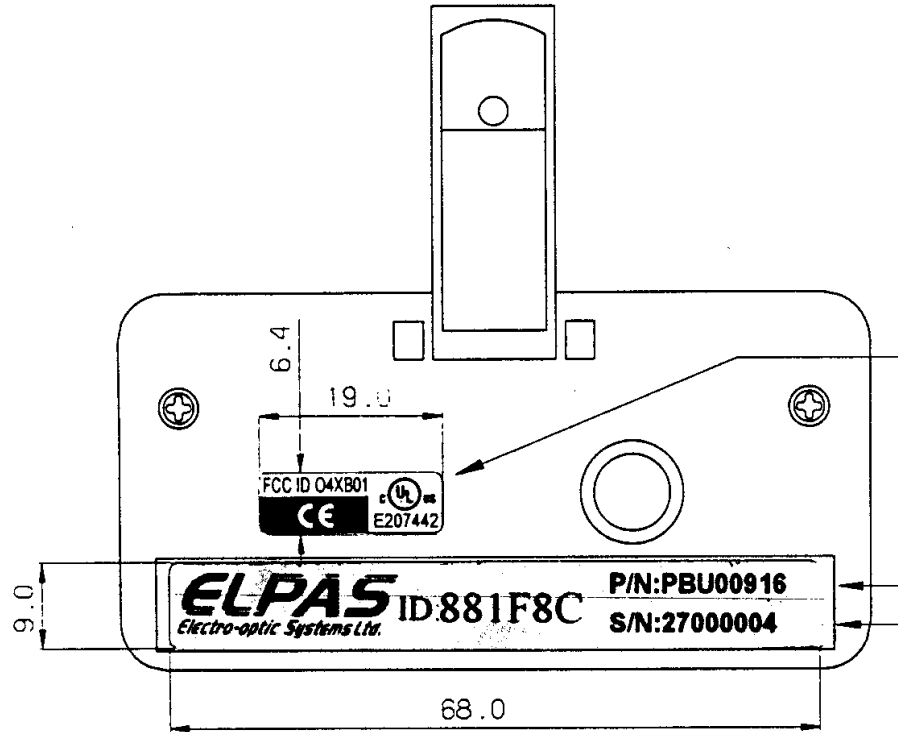


Figure 1. FCC Label



Figure 2. Location of Label on EUT

3. System Test Configuration

3.1 *Justification*

The E.U.T was configured for testing in a typical fashion. In this typical mode of operation, the E.U.T. transmits an ID message of 4 bytes (one start bit, 8bits data, none parity, one stop bit per byte) every in sec. at 19200 BPS on OOK (On/Off Keying) modulation.

3.2 *EUT Exercise Software*

The software version (Ver. Tst 1) that was used for the emission test is auto starting on battery installation and transmitting continuously non stop random data on OOK modulation at 19200 BPS rate. This mode of operation enables better detection of the emission.

3.3 *Special Accessories*

No special accessories were needed to achieve compliance.

3.4 *Equipment Modifications*

No special modifications were needed to achieve compliance.

3.5 *Configuration of Tested System*

The configuration of the tested system is described below.

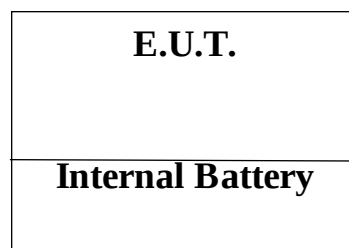


Figure 3. Configuration of Tested System

4. Block Diagram

4.1 Schematic Block/Connection Diagram

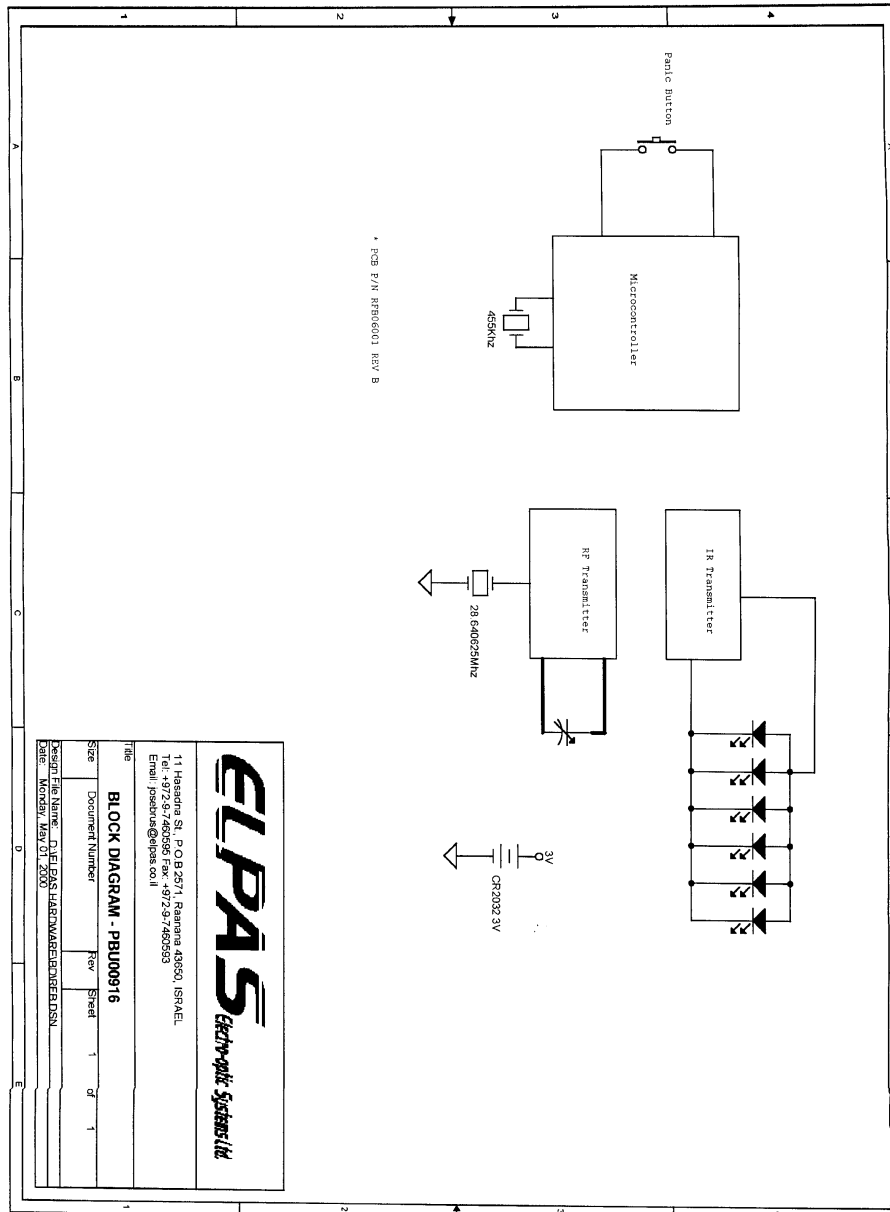


Figure 4. Block Diagram

5. Radiated Emission Data

5.1 Radiated Emission 10KHz-1000 MHz, Below 1GHz

The E.U.T. operation mode and test set-up are as described in Section 3.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in Figure 3.1.

The frequency range 10KHz-1000 MHz was scanned, and the list of the highest emissions was verified and updated accordingly.

The emissions were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

Verification of the E.U.T emissions was based on the following methods:

- Turning the E.U.T on and off.

- Using a frequency span less than 10 MHz.

- Observation of the signal level during turntable rotation. Background noise is not affected by the rotation of the E.U.T.

During this test the E.U.T. was operated in continuous transmission to enable better detection of signals.

A correction factor of $20 \log 100(\text{ms})/2(\text{msec})^* = 34\text{dB}$ was applied for the fundamental and harmonics.

*Note: Actual E.U.T. transmission on time is 2msec.

5.2 Measured Data

JUDGEMENT: Passed by 0.5 dBμV/m

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 15.231(e) specification.

The worst case was for 945.19 MHz, vertical polarization.

The details of the highest emissions are given in Figure 5 to Figure 7.

Radiated Emission

E.U.T Description IR and RF Personal Badge
Type PBU00916
Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C:
Section 15.231(e)

Antenna Polarization: Horizontal Frequency range: 10 KHz to 300MHz
Test Distance: 3 meters Detector: Quasi-peak
TX operation Frequency 916.55MHz

Freq. (MHz)	(3) QP Amp (dBμV/m)	(4) QP Result (dBμV/m)	Spec. (dB μV/m)	(1) Margin (dBμV/m)	Correction Factors		
					Antenna (db)	Cable (db)	(2) (db)
85.92	12.6	12.6	54.0	-41.4	9.4	1.7	N/A
114.56	14.5	14.5	43.5	-29.0	11.2	2.1	N/A
143.20	15.7	15.7	43.5	-27.8	12.3	2.3	N/A
171.84	17.1	17.1	54.0	-36.9	13.1	2.5	N/A
229.12	20.2	20.2	54.0	-33.8	16.2	2.8	N/A
286.4	23.3	23.3	54.0	-30.7	19.0	3.2	N/A

**Figure 5. Radiated Emission. Antenna Polarization: HORIZONTAL.
Detector: Quasi-peak**

- Note:
1. Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
 2. Duty Cycle correction factor
 3. This level includes the reading plus all correction factors except the duty cycle factor.
 4. This level is equal to “QP amp” plus duty cycle factor.

Radiated Emission

E.U.T Description IR and RF Personal Badge
Type PBU00916
Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C:
Section 15.231(e)

Antenna Polarization: Horizontal Frequency range: 300 MHz to 1000 MHz
Test Distance: 3 meters Detector: Quasi-peak
TX operation Frequency 916.55MHz

Freq. (MHz)	(3) QP Amp (dBμV/m)	(4) QP Result (dBμV/m)	Spec. (dB μV/m)	(1) Margin (dBμV/m)	Correction Factors		
					Antenna (db)	Cable (db)	(2) (db)
315.07	16.4	16.4	54.0	-37.6	11.9	3.4	N/A
372.42	18.7	18.7	54.0	-35.3	13.6	3.9	N/A
429.41	20.3	20.3	54.0	-33.7	14.8	4.1	N/A
486.79	21.4	21.4	54.0	-32.6	15.1	4.6	N/A
544.16	22.4	22.4	54.0	-31.6	16.1	4.8	N/A
630.17	24.8	24.8	54.0	-29.2	17.8	5.1	N/A
887.91	44.0	44.0	54.0	-10.0	20.6	6.1	N/A
916.55	71.9	37.9	74.0	-36.1	21.0	6.4	-34
945.19	41.7	41.7	54.0	-12.3	21.4	6.5	N/A

**Figure 6. Radiated Emission. Antenna Polarization: HORIZONTAL.
Detector: Quasi-peak**

- Note:
1. Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
 2. Duty Cycle correction factor
 3. This level includes the reading plus the correction factors except the duty cycle factor.
 4. This level is equal to the “QP amp” plus the duty cycle factor.

Radiated Emission

E.U.T Description IR and RF Personal Badge
Type PBU00916
Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C:
Section 15.231(e)

Antenna Polarization: Vertical Frequency range: 10 KHz to 300 MHz
Test Distance: 3 meters Detector: Quasi-peak
TX operation Frequency 916.55MHz

Freq. (MHz)	(3) QP Amp (dB μ V/m)	(4) QP Result (dB μ V/m)	Spec. (dB μ V/m)	(1) Margin (dB μ V/m)	Correction Factors		
					Antenna (db)	Cable (db)	(2) (db)
57.28	12.7	12.7	54.0	-41.3	9.4	1.4	N/A
85.92	12.4	12.4	54.0	-41.6	9.4	1.7	N/A
114.56	14.5	14.5	43.5	-29.0	11.2	2.1	N/A
143.20	15.8	15.8	54.0	-38.2	12.3	2.3	N/A
229.23	20.3	20.3	54.0	-33.7	16.2	2.8	N/A
286.51	23.4	23.4	54.0	-30.6	19.0	3.2	N/A

**Figure 7. Radiated Emission. Antenna Polarization: VERTICAL.
Detector: Quasi-peak**

- Note:
1. Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
 2. Duty Cycle correction factor
 3. This level includes the reading plus the correction factors except the duty cycle factor.
 4. This level is equal to the “QP amp” plus the duty cycle factor.

Radiated Emission

E.U.T Description IR and RF Personal Badge
Type PBU00916
Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C:
Section 15.231(e)

Antenna Polarization: Vertical Frequency range: 300 MHz to 1000 MHz
Test Distance: 3 meters Detector: Quasi-peak
TX operation Frequency 916.55MHz

Freq. (MHz)	(3) QP Amp (dBμV/m)	(4) QP Result (dBμV/m)	Spec. (dB μV/m)	(1) Margin (dBμV/m)	Correction Factors		
					Antenna (db)	Cable (db)	(2) (db)
315.07	16.6	1664	54.0	-37.4	11.9	3.4	N/A
372.42	19.1	19.1	54.0	-34.9	13.6	3.9	N/A
429.41	20.5	20.5	54.0	-33.5	14.8	4.1	N/A
486.79	21.4	21.4	54.0	-32.6	15.1	4.6	N/A
572.82	23.7	23.7	54.0	-30.3	16.7	4.9	N/A
630.17	25.0	25.0	54.0	-29.0	17.8	5.1	N/A
916.55	86.3	52.3	74.0	-21.7	21.0	6.4	-34
945.19	53.5	53.5	54.0	-0.5	21.4	6.5	N/A

**Figure 8. Radiated Emission. Antenna Polarization: VERTICAL.
Detector: Quasi-peak**

- Note:
1. Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
 2. Duty Cycle correction factor
 3. This level includes the reading plus the correction factors except the duty cycle factor.
 4. This level is equal to the “QP amp” plus the duty cycle factor.

5.3 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Receiver	HP	8542E	3427A00103/34	December 24, 1999	1 year
Loop Antenna	EMCO	6507	2950	January 1, 2000	1 year
Antenna - Biconical HP	ARA	BCD-235/B	1041	April 10, 2000	1 year
Antenna - Log Periodic	ARA	LPD-2010/A	1038	April 9, 2000	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	ThinkJet2225	2738508357.0	N/A	N/A

5.4 **Field Strength Calculation**

In the frequency range below 2.9GHz the field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, (except for the DCF factor) using the following equation:

$$[\text{dB}\mu\text{V/m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF} + \text{DCF}^*$$

FS: Field Strength [dB μ V/m]

RA: Receiver Amplitude [dB μ V]

AF: Receiving Antenna Correction Factor [dB/m]

CF: Cable Attenuation Factor [dB]

DCF: Duty Cycle Factor (dB) DCF = 20log 2/100=-34dB

*Note: applicable for Fundamental and Harmonics

No external pre-amplifiers are used.

In the frequency range above 2.9GHz, the field strength is manually calculated using the following equation

$$[\text{dB}\mu\text{V/m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF} + \text{PRAF} + \text{DCF}$$

PRAF: Preamplifier Gain Factor

6. Radiated Emission Data

6.1 Radiated Emission Above 1 GHz

The E.U.T operation mode and test set-up are as described in Section 3.

A preliminary measurement to characterise the E.U.T was performed inside the shielded room, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in Figure 3.1.

In the frequency range 1-2.9 GHz, a computerized EMI receiver complying to CISPR 16 requirements was used. The test distance was 3 meters.

In the frequency range 2.9-9.2 GHz, a spectrum analyzer including a low noise amplifier was used. The test distance was 3 meters. During peak measurements, the I.F. bandwidth was 1 MHz, and video bandwidth 3 MHz.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

6.2 Test Data

JUDGEMENT: Passed by 4.4 dB μ V/m

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 15.231(e) specification.

The worst case was: for 2778.26 MHz, horizontal polarization

The details of the highest emissions are given in Figure 9 to Figure 13.

Radiated Emission Above 1 GHz

E.U.T Description IR and RF Personal Badge
Type PBU00916
Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C:
Section 15.231(e)

Antenna Polarization: Horizontal
Test Distance: 3 meters

Frequency range: 1 GHz to 2.9 GHz
Detector: Peak

Freq. (MHz)	(2) Peak Amp (dBμV/m)	(3) Peak Result (dBμV/m)	Spec. (dB μV/m)	(1) Margin (dBμV/m)	Correction Factor		
					Ant. dB	Cable dB	Duty cycle dB
1804.44	56.3	56.3	74.0	-17.7	29.1	9.6	N/A
1833.08	66.3	32.3	74.0	-41.7	29.3	9.7	-34
1861.73	57.8	57.8	74.0	-16.2	29.4	9.9	N/A
2720.98	62.9	62.9	74.0	-11.1	31.9	12.2	N/A
2749.62	67.4	33.4	74.0	-40.6	32.0	12.3	-34
2778.26	62.4	62.4	74.0	-11.6	32.1	12.4	N/A

**Figure 9. Radiated Emission above 1 GHz Antenna Polarization: HORIZONTAL.
Detector: Peak**

Note:

1. Margin refers to the test peak results obtained, minus the specification requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
2. This level includes the reading plus all correction factors except the duty cycle factor.
3. This level is equal to “Peak amp” plus duty cycle factor.

Radiated Emission Above 1 GHz

E.U.T Description IR and RF Personal Badge
Type PBU00916
Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C:
Section 15.231(e)

Antenna Polarization: Horizontal
Test Distance: 3 meters

Frequency range: 1 GHz to 2.9 GHz
Detector: Average

Freq. (MHz)	(2) AVG Amp (dBμV/m)	(3) AVG Result (dBμV/m)	(4) Spec. (dB μV/m)	(1) Margin (dBμV/m)	Correction Factor		
					Ant. dB	Cable dB	Duty cycle dB
1804.44	42.8	42.8	54.0	-11.2	29.1	9.6	N/A
1833.08	56.2	22.2	54.0	-31.8	29.3	9.7	-34
1861.73	43.1	43.1	54.0	-10.9	29.4	9.9	N/A
2720.98	49.2	49.2	54.0	-4.8	31.9	12.2	N/A
2749.62	55.5	21.5	54.0	-32.5	32.0	12.3	-34
2778.26	49.6	49.6	54.0	-4.4	32.1	12.4	N/A

**Figure 10. Radiated Emission above 1 GHz Antenna Polarization: HORIZONTAL.
Detector: Average**

Note:

1. Margin refers to the test peak results obtained, minus the specification requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
2. This level includes the reading plus all correction factors except the duty cycle factor.
3. This level is equal to “AVG amp” plus duty cycle factor.
4. Limit for average detector.

Radiated Emission Above 1 GHz

E.U.T Description IR and RF Personal Badge
Type PBU00916
Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C:
Section 15.231(e)

Antenna Polarization: Vertical
Test Distance: 3 meters

Frequency range: 1 GHz to 2.9 GHz
Detector: Peak

Freq. (MHz)	(2) Peak Amp (dBμV/m)	(3) Peak Result (dBμV/m)	Spec. (dB μV/m)	(1) Margin (dBμV/m)	Correction Factor		
					Ant. dB	Cable dB	Duty cycle dB
1804.44	56.5	56.5	74.0	-17.5	29.1	9.6	N/A
1833.08	65.8	31.8	74.0	-42.2	29.3	9.7	-34
1861.73	57.8	57.8	74.0	-16.2	29.4	9.9	N/A
2720.98	62.2	62.2	74.0	-12.8	31.9	12.2	N/A
2749.62	68.7	34.7	74.0	-39.3	32.0	12.3	-34
2778.26	63.5	63.5	74.0	-10.5	32.1	12.4	N/A

**Figure 11. Radiated Emission above 1 GHz Antenna Polarization: VERTICAL.
Detector: Peak**

Note:

1. Margin refers to the test peak results obtained, minus the specification requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
2. This level includes the reading plus all correction factors except the duty cycle factor.
3. This level is equal to “AVG amp” plus duty cycle factor.

Radiated Emission Above 1 GHz

E.U.T Description IR and RF Personal Badge

Type PBU00916

Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C:
Section 15.231(e)

Antenna Polarization: Vertical

Frequency range: 1 GHz to 2.9GHz

Test Distance: 3 meters

Detector: Average

Freq. (MHz)	(2) AVG Amp (dBμV/m)	(3) AVG Result (dBμV/m)	(4) Spec. (dB μV/m)	(1) Margin (dBμV/m)	Correction Factor		
					Ant. dB	Cable dB	Duty cycle dB
1804.44	42.8	42.8	54.0	-11.2	29.1	9.6	N/A
1833.08	55.7	21.7	54.0	-32.3	29.3	9.7	-34
1861.73	43.3	43.3	54.0	-10.7	29.4	9.9	N/A
2720.98	49.1	49.1	54.0	-4.9	31.9	12.2	N/A
2749.62	56.3	22.3	54.0	-31.7	32.0	12.3	-34
2778.26	49.5	49.5	54.0	-4.5	32.1	12.4	N/A

**Figure 12. Radiated Emission above 1 GHz Antenna Polarization: VERTICAL.
Detector: Average**

Note:

1. Margin refers to the test peak results obtained, minus the specification requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
2. This level includes the reading plus all correction factors except the duty cycle factor.
3. This level is equal to “AVG amp” plus duty cycle factor.
4. Limit for average detector.

E.U.T Description IR and RF Personal Badge
Type PBU00916
Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C
Section 15.231(e)

Antenna Polarization: Horizontal
Test Distance: 3 meters

Frequency range: 2.9 GHz to 9.2 GHz
Detector: Peak

Freq. (GHz)	(2) Peak Amp (dBμV)	(3) Peak Result (dBμV/m)	(4) Spec. AVG (dB μV/m)	(1) Margin (dBμV/m)	Correction Factor			
					Ant. dB	Cable dB	Gain dB	Duty cycle dB
3.666	46	18.9	54.0	-35.1	33.7	4.3	-31.1	-34
4.582	39	14.4	54.0	-39.6	35.4	4.9	-30.9	-34
5.499	36	13.4	54.0	-40.6	36.7	5.4	-30.7	-34
6.415	35	14.2	54.0	-39.8	37.9	5.8	-30.5	-34
7.332	40	21.1	54.0	-32.9	39.0	6.5	-30.4	-34
8.248	40	23.6	54.0	-30.4	40.2	7.7	-30.3	-34
9.165	39	24.9	54.0	-29.1	40.9	9.2	-30.2	-34

**Figure 13. Radiated Emission above 1 GHz Antenna Polarization: HORIZONTAL.
Detector: Peak**

Note:

1. Margin refers to the test peak results obtained, minus the specification requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
2. This level includes the reading without all correction factors.
3. This level is equal to “peak amp” plus all other correction factors.
4. Limit for average detector.

E.U.T Description IR and RF Personal Badge
Type PBU00916
Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C
Section 15.231(e)

Antenna Polarization: Vertical
Test Distance: 3 meters

Frequency range: 2.9 GHz to 9.2 GHz
Detector: Peak

Freq. (GHz)	(2) Peak Amp (dBμV)	(3) Peak Result (dBμV/m)	(4) Spec. (dB μV/m)	(1) Margin (dBμV/m)	Correction Factor			
					Ant. dB	Cable dB	Gain dB	Duty cycle dB
3.666	47	19.9	54.0	-33.1	33.7	4.3	-31.1	-34
4.582	42.5	17.9	54.0	-36.1	35.4	4.9	-30.9	-34
5.499	35	12.4	54.0	-41.6	36.7	5.4	-30.7	-34
6.415	37	16.2	54.0	-37.8	37.9	5.8	-30.5	-34
7.332	39.5	20.6	54.0	-33.4	39.0	6.5	-30.4	-34
8.248	38.2	21.8	54.0	-32.2	40.2	7.7	-30.3	-34
9.165	40	25.9	54.0	-28.1	40.9	9.2	-30.2	-34

**Figure 14. Radiated Emission above 1 GHz Antenna Polarization:VERTICAL.
Detector: Peak**

Note:

1. Margin refers to the test peak results obtained, minus the specification requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
2. This level includes the reading without all correction factors.
3. This level is equal to “peak amp” plus all other correction factors.
4. Limit for average detector.

6.3 Test Instruments used, Radiated Measurement Above 1 GHZ

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Spectrum Analyzer	HP	8592L	3826A01204	August 2, 1999	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	ThinkJet2225	2738508357.0	N/A	N/A
Antenna – Log Periodic	A.H. System	SA5-200/511	253	January 27, 2000	1 year
Low Noise Amplifier	DBS	0411N313	003	December 24, 1999	1 year
Receiver	HP	8542E	3427A00103/34	December 24, 1999	1 year

6.4 *Field Strength Calculation*

In the frequency range below 2.9GHz the field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, (except for the DCF factor) using the following equation:

$$[\text{dB}\mu\text{V/m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF} + \text{DCF}^*$$

FS: Field Strength [dB μ V/m]

RA: Receiver Amplitude [dB μ V]

AF: Receiving Antenna Correction Factor [dB/m]

CF: Cable Attenuation Factor [dB]

DCF: Duty Cycle Factor (dB) DCF = $20\log 2/100 = -34\text{dB}$

*Note: applicable for Fundamental and Harmonics

No external pre-amplifiers are used.

In the frequency range above 2.9GHz, the field strength is manually calculated using the following equation

$$[\text{dB}\mu\text{V/m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF} + \text{PRAF} + \text{DCF}$$

PRAF: Preamplifier Gain Factor

7. Fundamental Emission Bandwidth

7.1 Test Specification

433.92 MHz, FCC Part 15, Subpart C, Section 15.231(c)

7.2 Test Procedure

The E.U.T. operation mode is described in Section .3

The test used the same set-up as was used for the Radiated Emission Test (Section 6).

One of the receiver markers was placed on the peak of the fundamental frequency, and the delta marker was moved to a level lower than the 20dB from the fundamental marker. The Frequency of the delta marker was recorded.

7.3 Measured Data

Judgement: Passed by 2.25 MHz

The E.U.T. met the requirements of FCC Part 15, Subpart C, Section 15.231 (c)

See additional details in Figure 15 to Figure 17.

Fundamental Emission

E.U.T Description	IR and RF Personal Badge
Type	PBU00916
Serial Number:	Not designated

Specification: FCC Part 15, Subpart C, Section 15.231 (c)

Operation Frequencies (MHz)	Reading	*	Margin (MHz)
	(•) (KHz)	Specification (MHz)	
916.55	+37.5	+2.29	2.25
	-33.8	-2.29	2.26

Figure 15. Fundamental Emission

Note: *Band width not greater than 0.50% of the center frequency.

Fundamental Emission

E.U.T Description IR and RF Personal Badge
 Type PBU00916
 Serial Number: Not designated

Specification: FCC Part 15, Subpart C, Section 15.231 (c)

08:36:41 JUL 27, 2000

ACTV DET: PEAK
 MEAS DET: PEAK QP AVG
 MKR Δ -33.8 kHz
 -20.00 dB

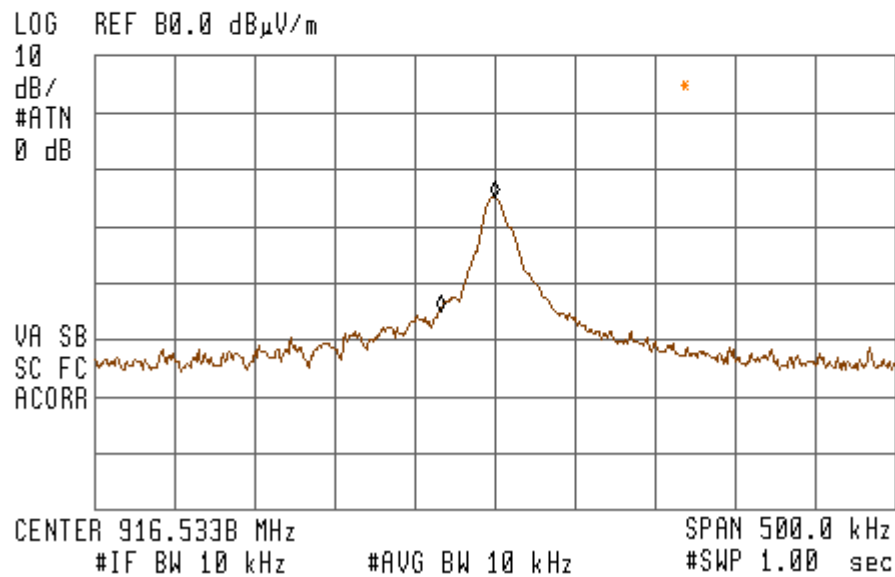


Figure 16. Fundamental Emission

Fundamental Emission

E.U.T Description IR and RF Personal Badge
 Type PBU00916
 Serial Number: Not designated

Specification: FCC Part 15, Subpart C, Section 15.231 (c)

08:44:00 JUL 27, 2000

ACTV DET: PEAK
 MEAS DET: PEAK QP AVG
 MKR Δ 37.5 kHz
 -20.02 dB

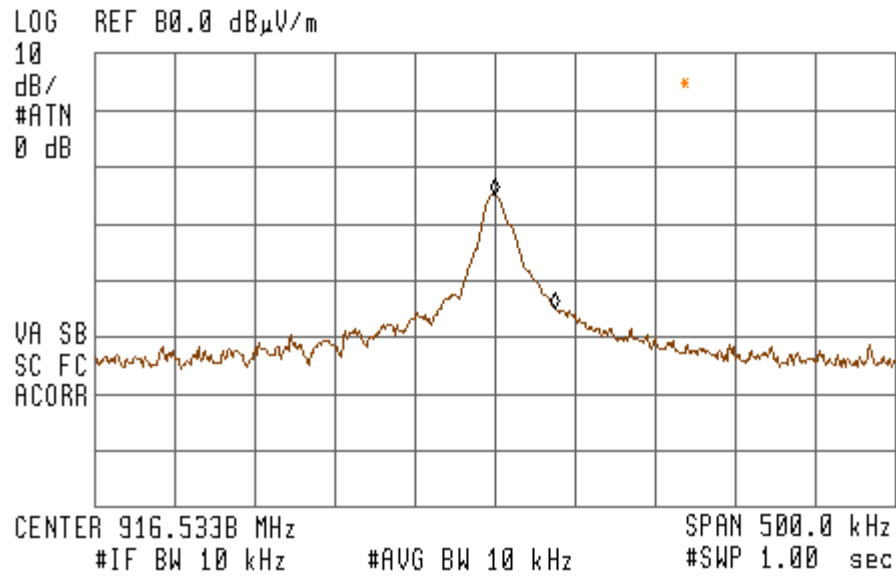


Figure 17. Fundamental Emission

7.4 Test Instrumentation Used, Fundamental Emission Band Width

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Receiver	HP	8542E	3427A00103/34	December 24, 1999	1 year
Antenna - Biconical HP	ARA	BCD-235/B	1041	April 10, 2000	1 year
Antenna - Log Periodic	ARA	LPD-2010/A	1038	April 9, 2000	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	ThinkJet2225	2738508357.0	N/A	N/A

8. Photographs of Tested E.U.T.



Figure 18 Front/Top View

Figure 19 Side View

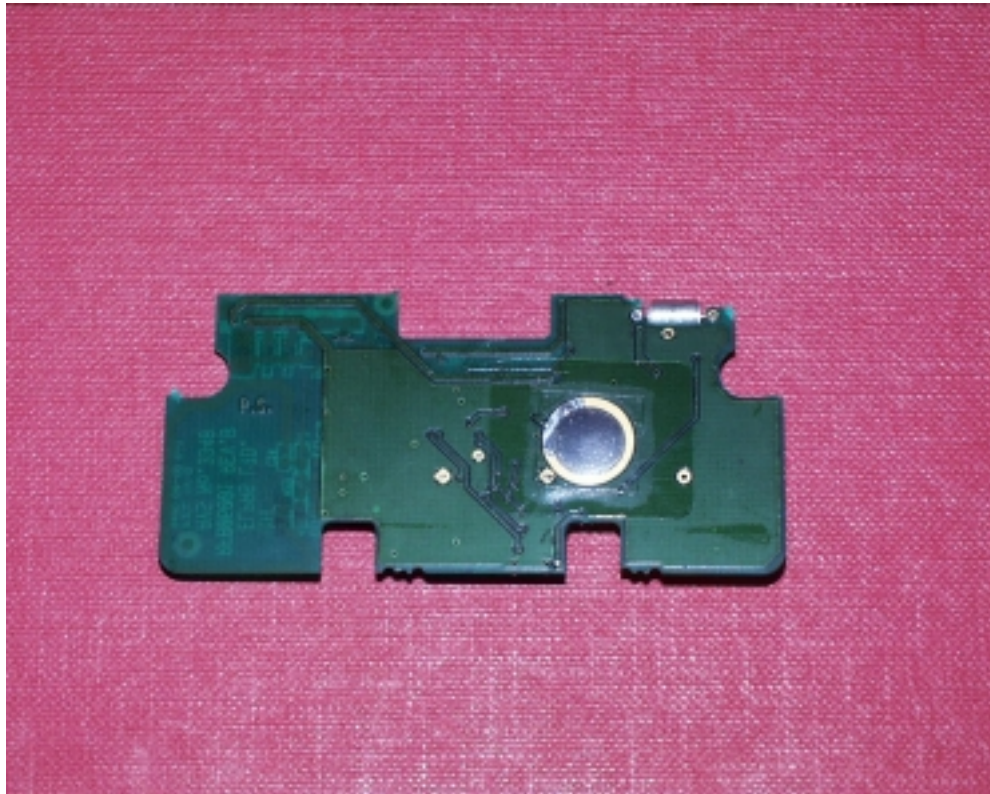


Figure 20 PCB

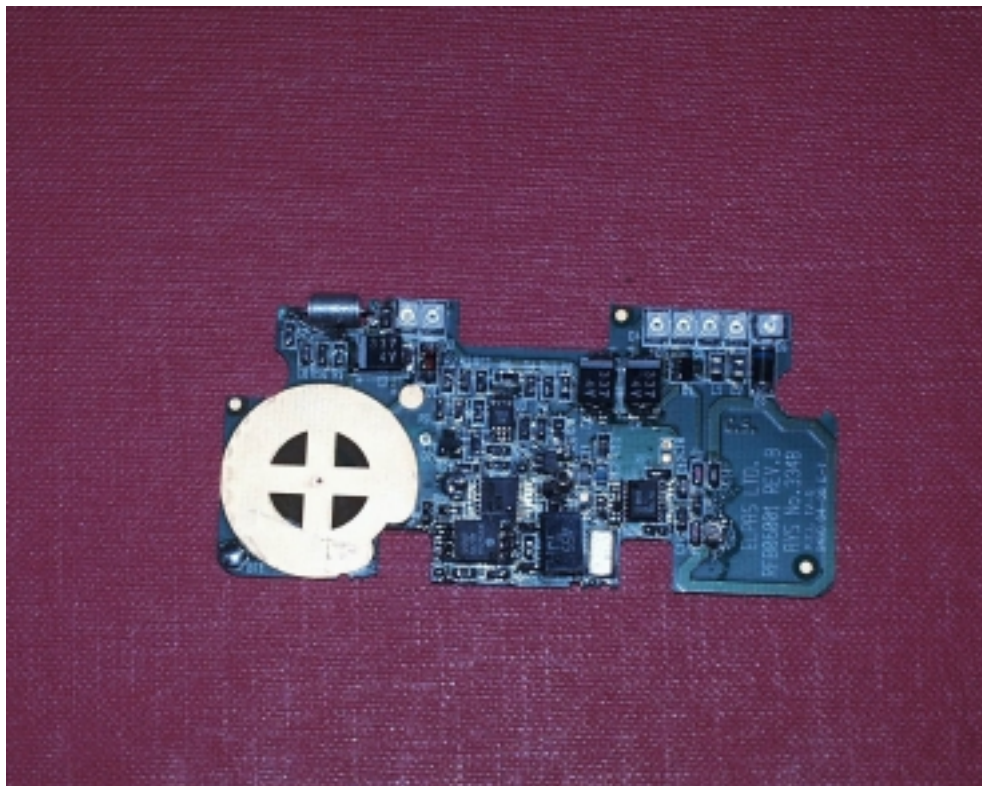


Figure 21 PCB



Figure 22 External Photo Top View

Figure 23 External Photo Bottom View

9. Signatures of the E.U.T's Test Engineers

Test	Test Engineer Name	Signature	Date
Radiated Emissions	Y. Mordukhovitch		
Fundamental Emissions Band Width	Y. Mordukhovitch		

10. APPENDIX A - CORRECTION FACTORS

10.1 Correction factors for CABLE

from EMI receiver
to test antenna
at 3 meter range.

FREQUENCY	CORRECTION FACTOR	FREQUENCY	CORRECTION FACTOR
(MHz)	(dB)	(MHz)	(dB)
10.0	0.5	1200.0	7.5
20.0	0.7	1400.0	8.2
30.0	1.0	1600.0	9.0
40.0	1.2	1800.0	9.6
50.0	1.3	2000.0	10.7
60.0	1.5	2300.0	11.1
70.0	1.6	2600.0	11.8
80.0	1.7	2900.0	12.8
90.0	1.8		
100.0	1.9		
150.0	2.4		
200.0	2.7		
250.0	3.0		
300.0	3.3		
350.0	3.7		
400.0	4.0		
450.0	4.3		
500.0	4.7		
600.0	4.9		
700.0	5.4		
800.0	5.8		
900.0	6.3		
1000.0	6.7		

NOTES:

1. The cable type is RG-214.
2. The overall length of the cable is 27 meters.
3. The above data is located in file 27MO3MO.CBL on the disk marked "Radiated Emission Tests EMI Receiver".

10.2 Correction factors for CABLE

from EMI receiver
to test antenna
at 10 meter range.

FREQUENCY	CORRECTION	FREQUENCY	CORRECTION
(MHz)	FACTOR	(MHz)	FACTOR
10.0	0.6	1200.0	9.7
20.0	1.1	1400.0	10.5
30.0	1.3	1600.0	11.5
40.0	1.6	1800.0	12.6
50.0	1.7	2000.0	13.5
60.0	1.9	2300.0	14.3
70.0	2.0	2600.0	15.5
80.0	2.2	2900.0	16.4
90.0	2.3		
100.0	2.4		
150.0	3.1		
200.0	3.6		
250.0	4.2		
300.0	4.5		
350.0	4.8		
400.0	5.2		
450.0	5.5		
500.0	6.2		
600.0	6.4		
700.0	7.0		
800.0	7.5		
900.0	8.1		
1000.0	8.6		

NOTES:

1. The cable type is RG-214.
2. The overall length of the cable is 34 meters.
3. The above data is located in file 34M10MO.CBL on the disk marked "Radiated Emissions Tests EMI Receiver".

10.3 Correction factors for LOG PERIODIC ANTENNA

**Type LPD 2010/A
at 3 and 10 meter ranges.**

Distance of 3 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.1
250.0	10.2
300.0	11.4
400.0	14.5
500.0	15.2
600.0	17.3
700.0	19.0
850.0	20.1
1000.0	22.2

Distance of 10 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.0
250.0	10.1
300.0	11.2
400.0	14.4
500.0	15.2
600.0	17.2
700.0	19.0
850.0	20.1
1000.0	22.1

NOTES:

1. Antenna serial number is 1038.
2. The above lists are located in file number 38M30.ANT for a 3 meter range,
and file number 38M100.ANT for a 10 meter range.
3. The files mentioned above are located on the disk marked "Radiated Emission
Test EMI Receiver".

10.4 Correction factors for BICONICAL ANTENNA

**Type BCD-235/B,
at 3 and 10 meter ranges**

3 meter range

FREQUENCY (MHz)	AFE (dB/m)
30.0	14.8
40.0	11.9
50.0	10.2
60.0	9.1
70.0	8.5
80.0	8.9
90.0	9.6
100.0	10.3
110.0	11
120.0	11.5
130.0	11.7
140.0	12.1
150.0	12.6
160.0	12.8
170.0	13
180.0	13.5
190.0	14
200.0	14.8
210.0	15.3
220.0	15.8
230.0	16.2
240.0	16.6
250.0	17.6
260.0	18.2
270.0	18.4
280.0	18.7
290.0	19.2
300.0	19.9

10 meter range

FREQUENCY (MHz)	AFE (dB/m)
30.0	12.1
40.0	10.6
50.0	10.6
60.0	8.9
70.0	8.5
80.0	9.6
90.0	9.4
100.0	9.6
110.0	10.3
120.0	10.7
130.0	12.6
140.0	12.7
150.0	12.7
160.0	13.8
170.0	13.7
180.0	14.9
190.0	13.4
200.0	13.1
210.0	14.0
220.0	14.5
230.0	15.8
240.0	16.0
250.0	16.6
260.0	16.7
270.0	18.3
280.0	18.5
290.0	19.3
300.0	20.9

NOTES:

1. Antenna serial number is 1041.
2. The above list is located in file 41BC10M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver".

10.5 Correction factors for **BICONICAL ANTENNA Type 3109** 3 meter range

FREQUENCY (MHz)	AFE (dB/m)
20.0	18.4
30.0	14.0
40.0	12.3
50.0	10.6
60.0	8.3
70.0	8.7
80.0	7.2
90.0	8.6
100.0	10.1
110.0	11.2
120.0	11.8
130.0	12.3
140.0	12.7
150.0	12.5
160.0	12.4
170.0	12.1
180.0	12.2
190.0	12.8
200.0	13.7
210.0	14.5
220.0	15.4
230.0	15.9
240.0	16.3
250.0	16.7
260.0	17.1
270.0	17.2
280.0	17.5
290.0	18.1
300.0	18.9

NOTES:

1. Antenna serial number is 3244.
2. The above list is located in file 44BIC3M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver"

10.6 Correction factors for **BICONICAL ANTENNA Type 3109** 10 meter range

FREQUENCY (MHz)	AFE (dB/m)
20.0	16.4
30.0	13.2
40.0	11.9
50.0	10.4
60.0	8.6
70.0	9.0
80.0	6.8
90.0	7.5
100.0	9.4
110.0	10.8
120.0	11.7
130.0	12.2
140.0	12.5
150.0	12.3
160.0	12.1
170.0	12.2
180.0	12.5
190.0	13.2
200.0	14.0
210.0	14.4
220.0	14.8
230.0	15.0
240.0	15.1
250.0	15.2
260.0	15.7
270.0	15.9
280.0	16.5
290.0	17.0
300.0	17.8

NOTES:

1. Antenna serial number is 3244.
2. The above list is located in file 44BIC10M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver"

10.7 Correction factors for SAS ANTENNA, 3 meter range

Type SAS-200/511

FREQUENCY (MHz)	AFE (dB/m)	FREQUENCY (MHz)	AFE (dB/m)
1.0	24.9	7.0	38.6
1.5	27.8	7.5	39.2
2.0	29.9	8.0	39.9
2.5	31.2	8.5	40.4
3.0	32.8	9.0	40.8
3.5	33.6	9.5	41.1
4.0	34.3	10.0	41.7
4.5	35.2	10.5	42.4
5.0	36.2	11.0	42.5
5.5	36.7	11.5	43.1
6.0	37.2	12.0	43.4
6.5	38.1	12.5	44.4

NOTES:

1. Antenna serial number is 253.
2. The above list is located in file SASLP3M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver"