



FCC ID O4XB01

Electrical (EMC)

DATE: 27 August 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: 27 August 2000

This report concerns: Original Grant x Class II change

Class B verification Class A verification Class I change

Equipment type: Radio 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

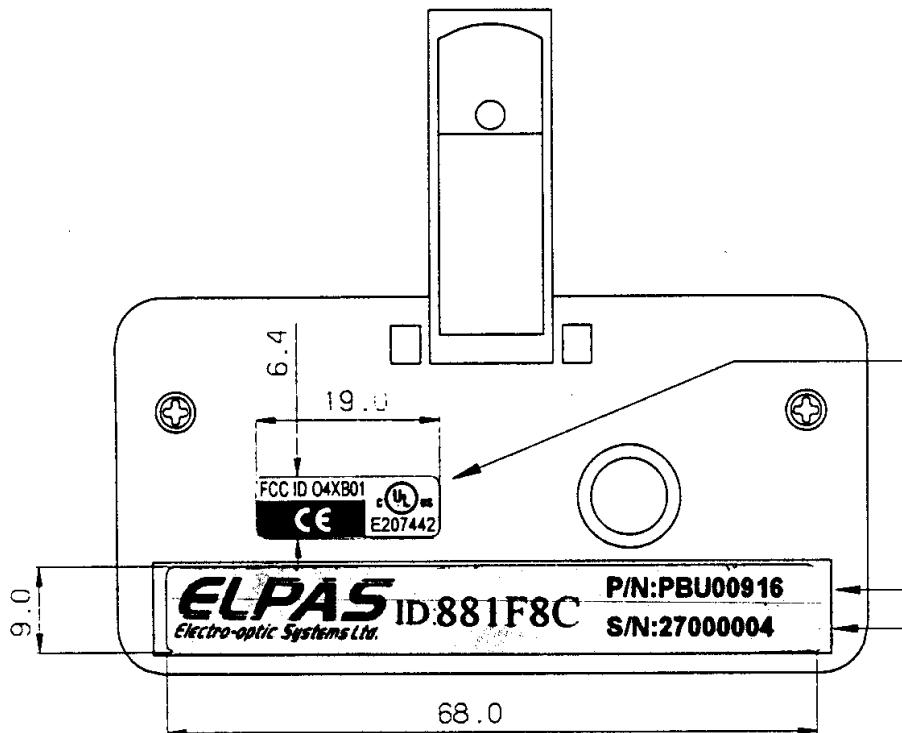


Figure 1. FCC Label



Figure 2. Location of Label on EUT



FCC ID: O4XB01

3. System Test Configuration

3.1 *Justification*

The E.U.T was configured for testing in a worst case fashion. In this panic or emergency 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 0.4 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 every 0.4 sec. 4 bytes message data on OOK modulation at 19200 BPS rate.

3.3 *Special Accessories*

No special accessories were needed to achieve compliance.

3.4 *Equipment Modifications*

- 3.4.1 Replacement of R24 with 470Ω resistor.
- 3.4.2 Adjustment of C15 to minimum level of second harmonic.

3.5 *Configuration of Tested System*

The configuration of the tested system is described below.

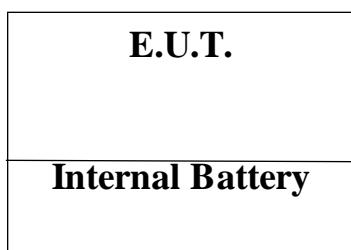


Figure 3. Configuration of Tested System

4. Block Diagram

4.1 Schematic Block/Connection Diagram

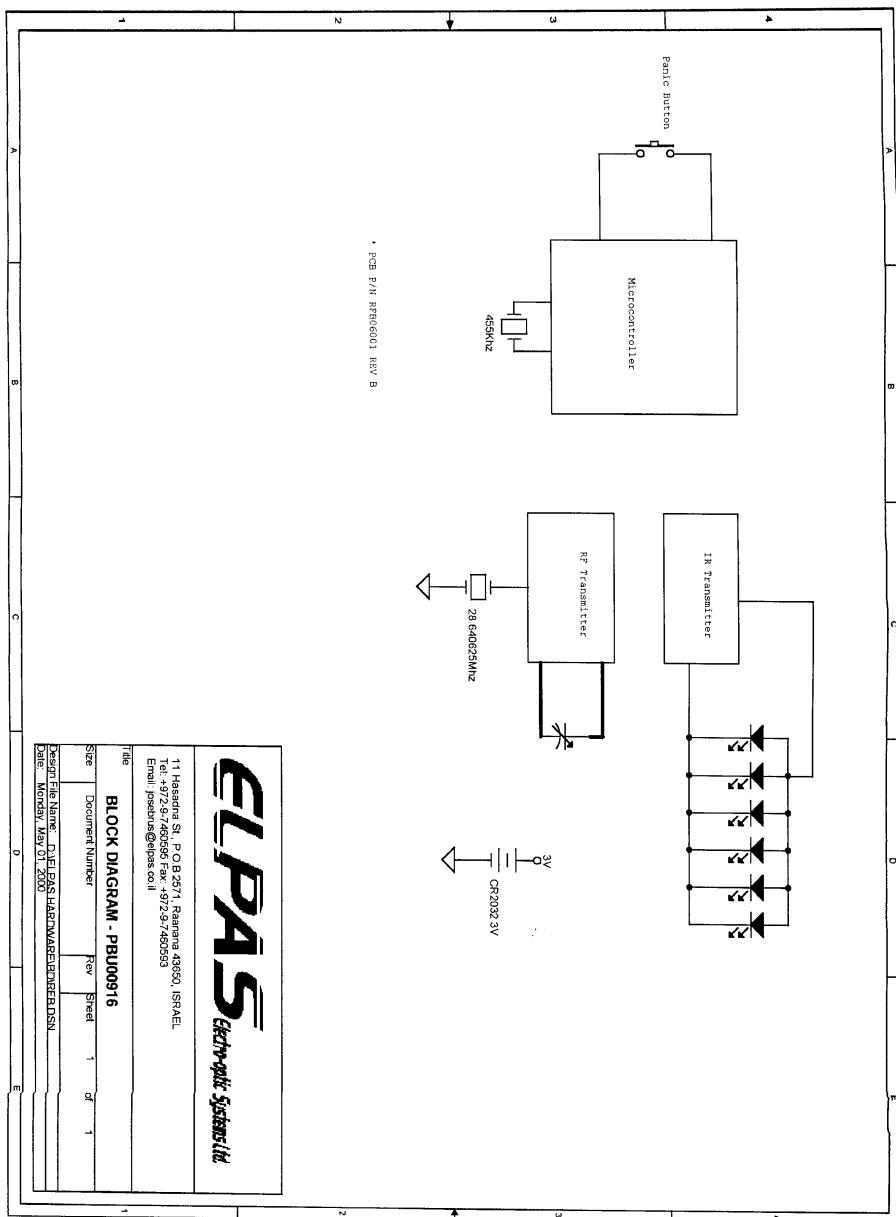


Figure 4. Block Diagram

5. Radiated Emission Data

5.1 Radiated Emission 10KHz-9.17GHz

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.

The frequency range 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 periodic transmission intervals of 400 msec..

In the frequency range 10KHz-2.9GHz, 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 was used. The test distance was 3 meters. During peak measurements, the I.F. bandwidth was 1MHz ,and video bandwidth 3 MHz.

5.2 Measured Data

JUDGEMENT: Passed by 1.0 dB μ V/m

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 15.249 specification.

The worst case was for 1.833 MHz, vertical polarization.

The details of the highest emissions are given in Figure 5. to Figure 10.

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 15.249

Antenna Polarization: Horizontal Frequency range: 10 MHz to 1 GHz
 Test Distance: 3 meters Detector: Quasi-peak
 TX operation Frequency 916.55MHz

Freq. (MHz)	QP Result (dB μ V/m)	Spec. (dB μ V/m)	(1) Margin (dB μ V/m)	Correction Factors	
				Antenna (db)	Cable (db)
630.1	24.6	46.0	-21.4	17.8	5.2
887.9	34.5	46.0	-11.5	20.6	6.1
915.0	40.5	46.0	-5.5	21.0	6.3
915.5	41.1	46.0	-4.9	21.0	6.3
916.5	76.2	94.0	-17.8	21.0	6.3
917.0	41.5	46.0	-4.5	21.1	6.3
917.5	40.1	46.0	-5.9	21.1	6.3
918.0	39.4	46.0	-6.6	21.1	6.3
945.1	35.0	46.0	-10.0	21.4	6.5

**Figure 5. Radiated Emission. Antenna Polarization: Horizontal
Detector: Quasi-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 indicated that the product passes the test.

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 15.249

Antenna Polarization: Horizontal Frequency range: 1 GHz to 9.17 GHz
 Test Distance: 3 meters Detector: Peak

Freq. (GHz)	(2) QP Amp (dB μ V/m)	(3) Peak Result (dB μ V/m)	(1) Spec. Peak (dB μ V/m)	(1) Margin (dB μ V/m)	Correction Factors	
					Antenn a (db)	Cable (db)
1.833	30.0	69.0	74.0	-5.0	29.3	9.7
2.749	17.7	62.0	74.0	-12.0	32.0	12.3
3.666	29.3	67.3	74.0	-6.7	33.7	4.3

**Figure 6. Radiated Emission 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 the correction factors.
 3. This level is equal to "Peak Amp" plus all other correction factors..
 4. Limit for Peak detector.
 5. Above 2.9 GHz an 8 meter RG-214 coax cable was used.

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 15.249

Antenna Polarization: Horizontal Frequency range: 1 GHz to 9.17 GHz
 Test Distance: 3 meters Detector: Average

Freq. (MHz)	(2) AVG Amp (dB μ V/m)	(3) AVG Result (dB μ V/m)	(4) Spec. (dB μ V/m)	(1) Margin (dB μ V/m)	Correction Factor	
	Ant. dB	Cable dB				
1.833	-2.9	36.1	54.0	-7.9	29.3	9.7
2.749	-1.6	42.7	54.0	-11.3	32.0	12.3
3.666	12.8	49.8	54.0	-4.2	32.7	4.3

Figure 7. Radiated Emission 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.
5. Above 2.9 GHz an meter RG-214 coax cable was used.

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 15.249

Antenna Polarization: Vertical Frequency range: 10KHz to 1GHz
 Test Distance: 3 meters Detector: Quasi-peak
 TX operation Frequency 916.55MHz

Freq. (MHz)	QP Result (dB μ V/m)	Spec. (dB μ V/m)	(1) Margin (dB μ V/m)	Correction Factors	
				Antenna (db)	Cable (db)
486.9	21.2	46.0	-24.8	15.1	4.6
630.08	24.5	46.0	-21.5	17.8	5.2
887.9	36.6	46.0	-9.4	20.6	6.1
915.0	44.5	46.0	-1.5	21.0	6.3
916.5	79.0	94.0	-15.0	21.0	6.3
917.5	43.6	46.0	-2.4	21.1	6.3
918.0	43.8	46.0	-2.2	21.1	6.3
945.1	36.4	46.0	-9.6	21.4	6.5

**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.

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 15.249

Antenna Polarization: Vertical
 Test Distance: 3 meters

Frequency range: 1 GHz to 9.17 GHz
 Detector: Peak

Freq. (GHz)	(2) QP Amp (dB μ V/m)	(3) Peak Result (dB μ V/m)	(1) Spec. Peak (dB μ V/m)	(1) Margin (dB μ V/m)	Correction Factors	
					Antenn a (db)	Cable (db)
1.833	34.0	73.0	74.0	-1.0	29.3	9.7
2.749	17.4	59.2.0	74.0	-14.9	32.0	12.3
3.666	31.1	68.1	74.0	-5.4	32.7	4.3
4.582	30.2	70.4	74.0	-3.6	35.4	4.8

**Figure 9. Radiated Emission 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 the correction factors.
 3. This level is equal to "Peak Amp" plus all other correction factors..
 4. Limit for Peak detector.
 5. Above 2.9 GHz an 8 meter RG-214 coax cable was used

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 15.249

Antenna Polarization: Vertical

Frequency range: 1 GHz to 9.17 GHz

Test Distance: 3 meters

Detector: Average

Freq. (MHz)	(2) AVG Amp	(3) AVG Result	(4) Spec.	(1) Margin	Correction Factor	
	(dB μ V/m)	(dB μ V/m)	(dB μ V/m)	(dB μ V/m)	Ant. dB	Cable dB
1.833	3.7	42.7	54.0	-11.3	29.3	9.7
2.749	-1.6	42.7	54.0	-11.3	32.0	12.3
3.666	12.8	49.8	54.0	-4.2	32.7	4.3

Figure 10. Radiated Emission. Antenna Polarization: Vertical
Detector : Average

Note:

6. 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.
7. This level includes the reading plus all correction factors except the duty cycle factor.
8. This level is equal to “AVG amp” plus duty cycle factor.
9. Limit for average detector.
10. Above 2.9 GHz an meter RG-214 coax cable was used.

5.3 *Test Instrumentation Used, Radiated Measurements*

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Receiver	HP	8542E	3427A00103/34	December 24, 1999	1 year
Spectrum Analyzer	HP	85922	3826A 01204	July 25, 2000	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, using the following equation:

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

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]

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

6. Photographs of Tested E.U.T.



Figure 11 Front/Top View

Figure 12 Side View

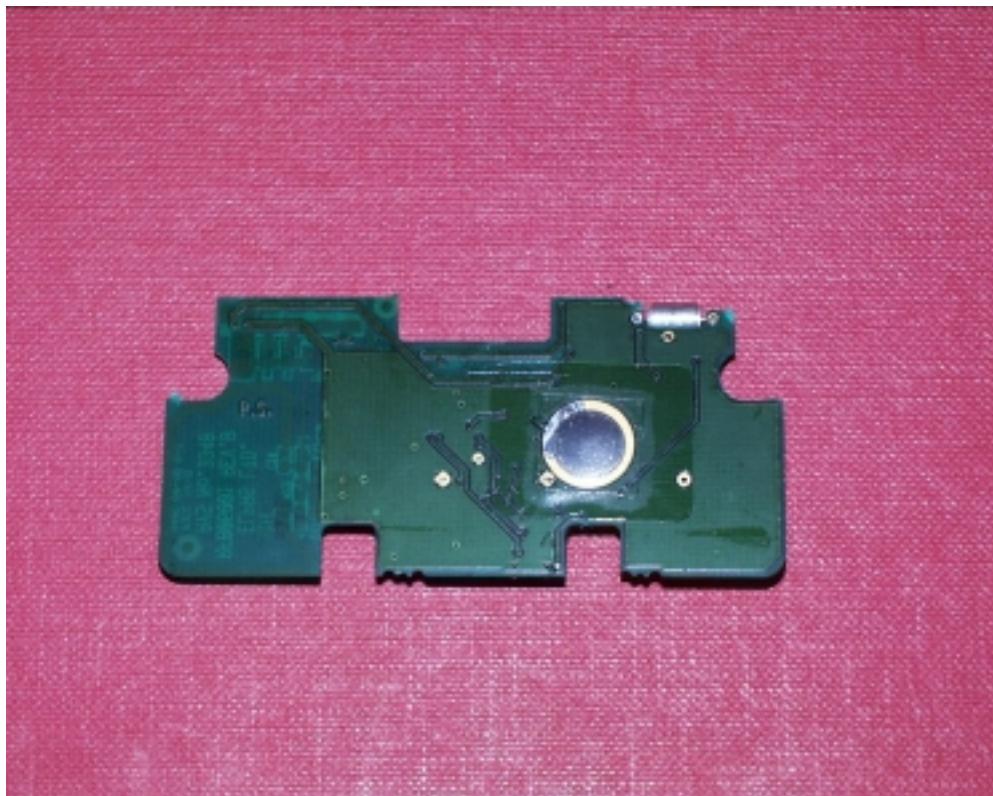


Figure 13 PCB

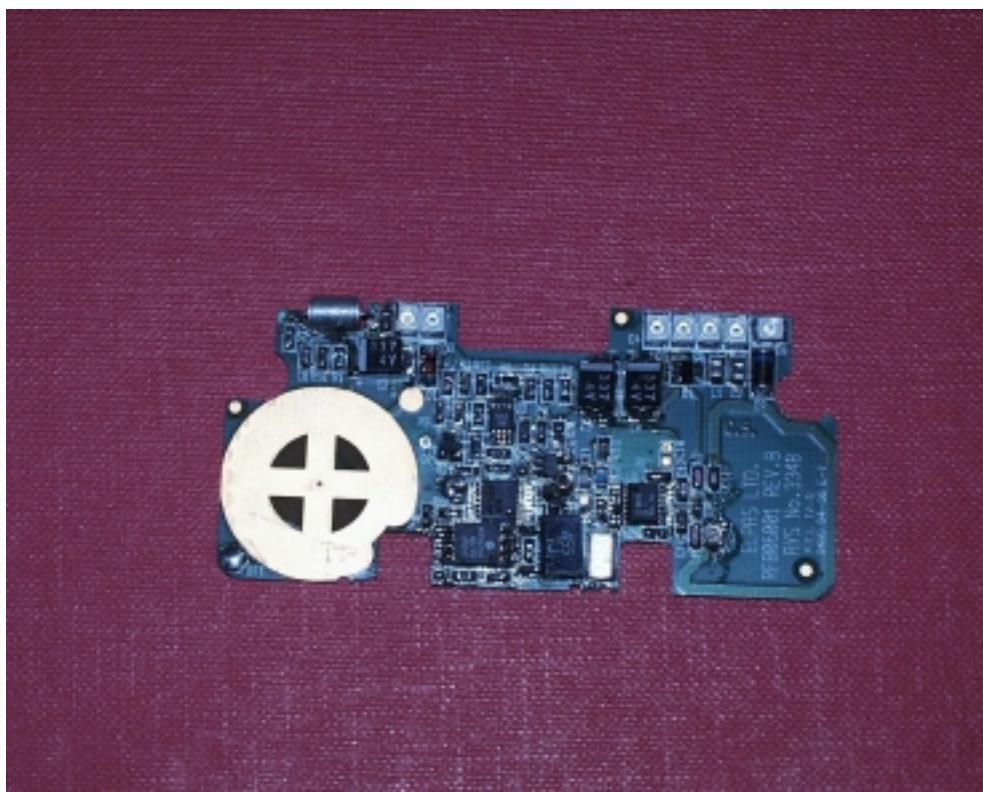


Figure 14 PCB



Figure 15 External Photo Top View

Figure 16 External Photo Bottom View

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

Test	Test Engineer Name	Signature	Date
Radiated Emissions	Y. Mordukhovitch		

8. APPENDIX A - CORRECTION FACTORS

8.1 Correction factors for CABLE

from EMI receiver
to test antenna
at 3 meter range.

FREQUENCY (MHz)	CORRECTION FACTOR (dB)	FREQUENCY (MHz)	CORRECTION FACTOR (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".

8.2 **Correction factors for CABLE**

**from EMI receiver
to test antenna
at 10 meter range.**

FREQUENCY (MHz)	CORRECTION FACTOR (dB)	FREQUENCY (MHz)	CORRECTION FACTOR (dB)
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".

8.3 **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".

8.4 **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".

8.5 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"

8.6 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"

8.7 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"