



Electrical (EMC)

**DATE: 05 August 2003**

**I.T.L. (PRODUCT TESTING) LTD.**

**EMC Test**

**for**

**RACAM - TECH LTD.\***

\* See customer's statement on page 5.

**Equipment under test:**

**Terminal Unit**

**TU**

Approved by: \_\_\_\_\_

I. Raz, EMC Laboratory Manager

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This report relates only to items tested.



Electrical (EMC)

## Measurement/Technical Report for RACAM - TECH LTD.\*

Terminal Unit

TU

**FCC ID:RBU1014401**

**05 August 2003**

This report concerns: Original Grant ☒ Class II change

Class B verification ☐ Class A verification ☐ Class I change

Equipment type: Radio Telemetry Transmitter

Request Issue of Grant:

☒ Immediately upon completion of review

Limits used:

CISPR 22 ☐

Part 15 ☒

Measurement procedure used is ANSI C63.4-1992.

Application for Certification

prepared by:

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Applicant for this device:

(different from "prepared by")

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\* See customer's statement on page 5.

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# 1. General Information

## 1.1 Administrative Information

Manufacturer:	RACAM - TECH LTD. (See customer's statement on following page).
Manufacturer's Address:	27 Leh1 St. Bnei-Brak 51200 Israel Tel: +972-3-579-8282 Fax: +972-3-579-8866
Manufacturer's Representative:	Shlomo Hass Hanoch Maliss
Equipment Under Test (E.U.T):	Terminal Unit
Equipment Model No.:	TU
Equipment Serial No.:	00378
Date of Receipt of E.U.T:	01.06.03
Start of Test:	01.06.03
End of Test:	10.07.03
Test Laboratory Location:	I.T.L (Product Testing) Ltd. Kfar Bin Nun, ISRAEL 99780
Test Specifications:	See Section 2



**RACAM-TECH LTD**  
TOTAL OUTSOURCING SERVICES

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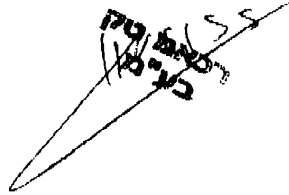
27 Iehi St. Bnei Brak 51200, Israel, Tel: 972-3-5798282, Fax: 972-3-5798866

Date: July 30, 2003

to: I Ras - I.T.L. Ltd

I hereby declare that Shoham Ltd. is representing Racam-Tech Ltd. for the tests performed at I.T.L. premises.

Sincerely,



## **1.2 List of Accreditations**

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), Registration No. 90715.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-1350, R-1285.
5. Industry Canada (Canada), File No. IC 4025.
6. TUV Product Services, England, ASLLAS No. 97201.
7. Nemko (Norway), Authorization No. ELA 207.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

### **1.3 Product Description**

Pyrologic 2000 is a wireless fireworks shooting system. Using a central Terminal Unit (TU) transmitter, a multitude of Remote Control Units (RCU's) receivers are controlled by coded RF Messages in order to fire upon command a firework electrically connected to each RCU of choice.

The Pyrologic 2000 Terminal Unit (TU), referred to as the EUT in this report, is a hand held terminal with a keyboard, LEDs and LCD display that allow the operator to program a firing sequence, store it in a "memory key" and remotely control the RCU's.

### **1.4 Test Methodology**

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2001. Radiated testing was performed at an antenna to EUT distance of 3 meters.

### **1.5 Test Facility**

The radiated emissions tests were performed at I.T.L.'s testing facility at Kfar Bin-Nun, Israel. This site is a FCC listed test laboratory (FCC Registration No. 90715, date of listing March 9, 2001).

I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.

### **1.6 Measurement Uncertainty**

Radiated Emission

The Open Site complies with the  $\pm 4$  dB Normalized Site Attenuation requirements of ANSI C63.4-2001. In accordance with Paragraph 5.4.6.1 of this standard, this tolerance includes instrumentation calibration errors, measurement technique errors, and errors due to site anomalies.

## 2. Product Labeling

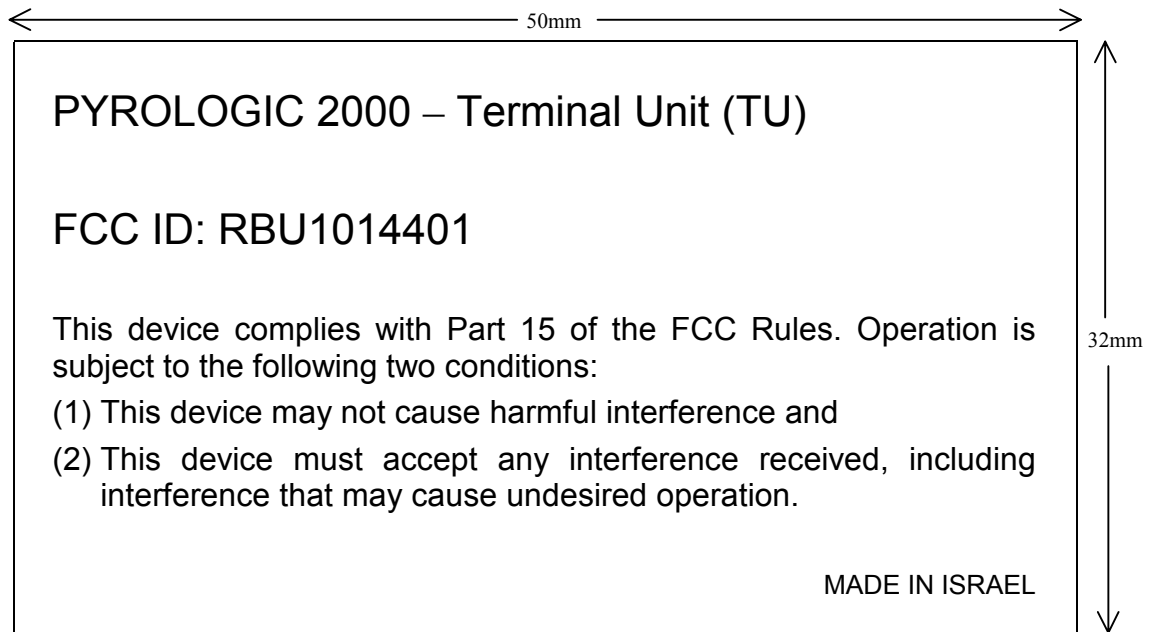


Figure 1. FCC Label

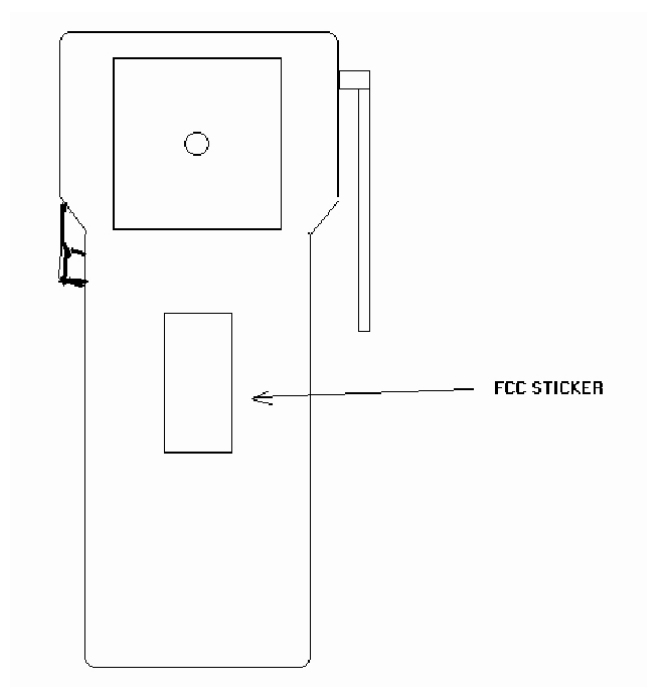


Figure 2. Location of Label on EUT



### 3. System Test Configuration

#### 3.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it). The TU was placed horizontally and the antenna was set vertically to get the maximum emission. The TU was rotated to get the maximum emission position and polarity.

Since the actual transmissions of the TU are short frames, the TU was set for measurement into two special modes, CW transmission & continuously modulated transmission. The results were calculated accordingly.

#### 3.2 EUT Exercise Software

The TU exercise software used during radiated emission testing, was the normal TU software revision 1.12. The entry to the special modes was done by entering a special manufacturer's password, and then selecting by menu the mode of transmission.

#### 3.3 Special Accessories

No special accessories were needed to achieve compliance.

#### 3.4 Equipment Modifications

Resistor R3 value was change to 16 K ohm (instead of 12 K ohm) to reduce restricted band spurious level.

#### 3.5 Configuration of Tested System

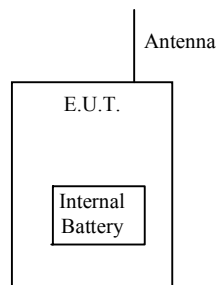


Figure 3. Configuration of Tested System

## 4. Block Diagram

### 4.1 Schematic Block/Connection Diagram

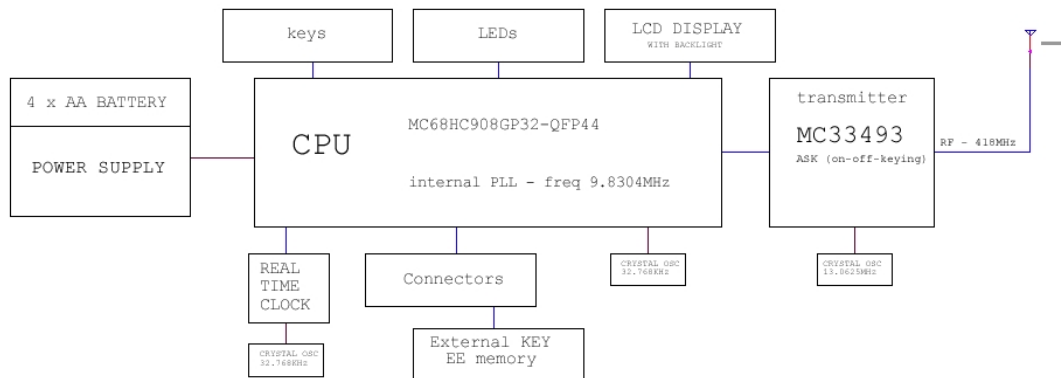


Figure 4. E.U.T. Block Diagram

### 4.2 Theory of Operation

The Pyrologic 2000 Terminal Unit (TU), referred to as the EUT in this report, is a hand held terminal with a keyboard, LEDs and LCD display that allow the operator to program a firing sequence, store it in a “memory key” and remotely control the RCU’s.

The TU use the Motorola MC68HC908GP32 micro-controller with external crystal of 32.768kHz. The controller uses internal PLL to generate the internal bus frequency of 2.4576MHz.

The TU uses the EM MICROELECTRONIC-MARIN SA V3021 Real-Time-Clock with external crystal of 32.768kHz.

The TU is powered by 4 x 1.5V AA battery and uses a National Semiconductor LM2704 DC-DC switching regulator.

The RF section of the TU is based on MOTOROLA Tango3 MC33493 UHF transmitter with an external crystal of 13.0625MHz. The Tango3 use internal PLL to generate RF frequency of 418MHz. The modulation is ASK (OOK). The bit rate is 2778 bps with Manchester encoding of 50%. The transmission frame is built of a transmit block of 40msec & one frame is transmitted every 100msec. The transmission is manually operated and in any case ceases within 5 sec of switch or key being released. The output power was set to the level allowed under Part 15.231 A-D of the FCC regulation.

The TU uses a fixed (screwed) 360° rotated Antenna.

## 5. Radiated Measurement Photos



**Figure 5. Radiated Emission Test. Front**



**Figure 6. Radiated Emission Test. Side**

## 6. Field Strength of Fundamental

### 6.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.231

### 6.2 Test Procedure

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

The E.U.T. was placed on a non-conductive table, 0.8 meters above the O.A.T.S. ground plane.

The EMI receiver was set to the E.U.T. Fundamental Frequency (418MHz) and Peak Detection.

The turntable and antenna mast were adjusted for maximum level reading on the EMI receiver.

The measurement was performed for vertical and horizontal polarizations of the test antenna.

The final result is:

Peak Level(dBμV/m) – E.U.T. Max. Duty Cycle Factor, in 100msec time window (dB)

### 6.3 Measured Data

JUDGEMENT: Passed by 3.6 dBμV

The EUT met the FCC Part 15, Subpart C, Section 15.231 specification requirements.

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

TEST PERSONNEL:

Tester Signature: 

Date: 05 August 2003

Typed/Printed Name: Y. Mordukhovitch

## Field Strength of Fundamental

E.U.T Description    Terminal Unit  
Type                      TU  
Serial Number:        00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal  
Test Distance: 3 meters

Frequency range: MHz  
Detector: Peak

Freq.	Pol.	Peak Amp (1)	D.C.F. (2)	Correction (3)	Final Result (4)	Specification	Margin
(MHz)	V/H	(dBμV/m)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB μV/m)
417.98	V	90.6	-14.0	18.7	76.6	80.3	-3.7
417.98	H	90.7	-14.0	18.7	76.7	80.3	-3.6

**Figure 7. Field Strength of Fundamental. Antenna Polarization: HORIZONTAL/VERTICAL.  
Detector: Peak**

Note: 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.

(1) "Peak Amp." (dBμV/m) included the "correction" numbers.

(2) "Duty Cycle Factor (D.C.F.)="  $20 \log \frac{20(m \text{ sec})}{100(m \text{ sec})} = -14dB$  (See Section 1.3 of this report).

(3) "Correction" (dB) = Test Antenna Correction Factor(dB) + Coax Cable.

(4) "Final Result" (dBμV/m)=Peak Amp. (dBμV/m)+D.C.F. (dB).

#### 6.4 Test Instrumentation Used, Field Strength of Fundamental

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3411A00102	January 31, 2003	1 year
RF Section	HP	85420E	3427A00103	January 31, 2003	1 year
Antenna Bioconical	ARA	BCD 235/B	1041	April 20, 2003	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	ThinkJet 2225	2738508357.0	N/A	N/A

## **7. Spurious Radiated Emission, Below 1 GHz**

### **7.1 Test Specification**

30-1000 MHz, F.C.C., Part 15, Subpart C, Section 15.231

### **7.2 Test Procedure**

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 30-1000 MHz was scanned, and the list of the highest emissions was verified and updated accordingly.

The final measured result is based on a peak detector measurement minus the transmission duty cycle factor in a time window of 100msec. (Section 15.231(b)(2)).

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

The emission levels for other frequencies were compared to the fundamental carrier level and the requirement of Section 15.231 (a).

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.

### 7.3 **Measured Data**

JUDGEMENT: Passed by 29.4 dB $\mu$ V/m

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

The details of the highest emissions are given in Figure 8 to Figure 9.

TEST PERSONNEL:

Tester Signature: 

Date: 05 August 2003

Typed/Printed Name: Y. Mordukhovitch



## Spurious Radiated Emission

E.U.T Description    Terminal Unit  
Type                      TU  
Serial Number:        00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal  
Test Distance: 3 meters

Frequency range: 30 MHz to 1.0 GHz  
Detector: Peak

Frequency (MHz)	Peak Amp (1) (dBμV/m)	D.C.F. (2) (dB)	Correction (3) (dB)	Final Result (4) (dBμV/m)	Specification (dBμV/m)	Margin (dB μV/m)
73.60	18.2	-14.0	10.3	+4.2	40.0	-35.8
114.43	19.5	-14.0	13.3	+5.5	43.5	-38.0
156.75	21.4	-14.0	15.2	+7.4	43.5	-36.1
170.30	21.7	-14.0	15.5	+7.7	43.5	-35.8
248.19	27.3	-14.0	20.4	+13.3	46.0	-32.7
274.31	27.9	-14.0	21.7	+13.9	46.0	-32.1
325.34	23.6	-14.0	15.7	+9.6	46.0	-36.4
609.18	30.6	-14.0	22.4	+16.6	46.0	-29.4
968.03	36.3	-14.0	28.3	+22.3	54.0	-31.7

**Figure 8. Spurious Radiated Emission. Antenna Polarization: HORIZONTAL.  
Detector: Peak**

Note: 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.

(1) "Peak Amp." (dBμV/m) includes the "correction" numbers.

(2) "Duty Cycle Factor (D.C.F.)=  $20 \log \frac{20(m \text{ sec})}{100(m \text{ sec})} = -14 \text{ dB}$  (See Section 1.3 of this report).

(3) "Correction" (dB) = Test Antenna Correction Factor(dB) + Coax Cable.

(4) "Final Result" (dBμV/m)=Peak Amp. (dBμV/m)+D.C.F. (dB).

# Spurious Radiated Emission

E.U.T Description    Terminal Unit  
Type                      TU  
Serial Number:        00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical  
Test Distance: 3 meters

Frequency range: 30 MHz to 1.0 GHz  
Detector: Peak

Frequency (MHz)	Peak Amp (1) (dBμV/m)	D.C.F. (2) (dB)	Correction (3) (dB)	Final Result (4) (dBμV/m)	Specification (dBμV/m)	Margin (dB μV/m)
74.40	23.6	-14.0	10.3	+9.6	40.0	-30.4
130.63	19.5	-14.0	13.9	+5.5	43.5	-38.0
143.71	20.1	-14.0	14.6	+6.1	43.5	-37.4
158.75	21.1	-14.0	15.2	+7.1	43.5	-36.4
248.30	27.0	-14.0	20.4	+13.0	46.0	-33.0
274.34	28.0	-14.0	21.7	+14.0	46.0	-32.0
325.34	21.9	-14.0	15.7	+7.9	46.0	-38.1
609.18	29.4	-14.0	22.4	+15.4	46.0	-30.6
968.03	35.6	-14.0	28.3	+21.6	54.0	-32.4

**Figure 9. Spurious Radiated Emission. Antenna Polarization: VERTICAL.  
Detector: Peak**

Note: 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.

(1) "Peak Amp." (dBμV/m) includes the "correction" numbers.

(2) "Duty Cycle Factor (D.C.F.)=  $20 \log \frac{20(m \text{ sec})}{100(m \text{ sec})} = -14dB$  (See Section 1.3 of this report).

(3) "Correction" (dB) = Test Antenna Correction Factor(dB) + Coax Cable.

(4) "Final Result" (dBμV/m)=Peak Amp. (dBμV/m)+D.C.F. (dB).

#### 7.4 Test Instrumentation Used, Spurious Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3411A00102	January 31, 2003	1 year
RF Section	HP	85420E	3427A00103	January 31, 2003	1 year
Antenna Bioconical	ARA	BCD 235/B	1041	April 20, 2003	1 year
Antenna –Log Periodic	ARA	LPD-2010/A	1038	April 20, 2003	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	ThinkJet 2225	2738508357.0	N/A	N/A

## 7.5 **Field Strength Calculation**

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

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

FS: Field Strength [dB $\mu$ V/m]  
RA: Receiver Amplitude [dB $\mu$ V]  
AF: Receiving Antenna Correction Factor [dB/m]  
CF: Cable Attenuation Factor [dB]

No external pre-amplifiers are used.

## 8. Spurious Radiated Emission Above 1 GHz

### 8.1 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 characterize 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.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

The emission levels for other frequencies were compared to the fundamental carrier level and the requirement of Section 15.231(b).

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

In the frequency range 2.9-42 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. During average measurements, the I.F. bandwidth was 1 MHz and video bandwidth was 100 Hz.

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.)

### 8.2 Test Data

JUDGEMENT: Passed by 10.3 dBμV/m

The EUT met the requirements of the F.C.C. Part 15, Subpart C, specification.  
The worst cases were:

The details of the highest emissions are given in Figure 10 to Figure 17.

TEST PERSONNEL:

Tester Signature:



Date: 05 August 2003

Typed/Printed Name: Y. Mordukhovitch

## Spurious Radiated Emission Above 1 GHz

E.U.T Description    Terminal Unit  
Type                    TU  
Serial Number:        00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal  
Test Distance: 3 meters

Frequency range: 1 GHz to 2.9 GHz  
Detector: Average

Frequency (MHz)	Avg Amp (dB $\mu$ V/m)	Correction (dB)	Specification (dB $\mu$ V/m)	Margin (dB $\mu$ V/m)
1253.92	43.7	34.1	54.0	-10.3
1306.20	31.3	34.5	54.0	-22.7
1436.72	32.6	35.8	54.0	-21.4
1671.90	38.0	37.7	54.0	-16.0
1698.04	34.9	37.9	54.0	-19.1
2246.57	39.4	41.6	54.0	-14.6

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

## Spurious Radiated Emission Above 1 GHz

E.U.T Description    Terminal Unit  
Type                      TU  
Serial Number:        00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal  
Test Distance: 3 meters

Frequency range: 1 GHz to 2.9 GHz  
Detector: Peak

Frequency (MHz)	Peak Amp (dB $\mu$ V/m)	Correction (dB)	Specification (dB $\mu$ V/m)	Margin (dB $\mu$ V/m)
1253.92	49.6	34.1	74.0	-24.4
1306.20	45.6	34.5	74.0	-28.4
1436.72	45.5	35.8	74.0	-28.5
1671.90	49.2	37.7	74.0	-24.8
1698.04	47.8	37.9	74.0	-26.2
2246.57	52.2	41.6	74.0	-21.8

**Figure 11. Radiated Emission. Antenna Polarization: HORIZONTAL.  
Detector: Peak**

Note: 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.

## Spurious Radiated Emission Above 1 GHz

E.U.T Description    Terminal Unit  
Type                      TU  
Serial Number:        00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal  
Test Distance: 3 meters

Frequency range: 2.9 GHz to 4.3 GHz  
Detector: Peak

Freq.	Peak Amp	Correction Factors			Peak. Specification	Peak Final Result FR (P)*	Peak. Margin
(MHz)	(dBμV)	Antenna AF	Cable CF	Low Noise Amp	(dB μV/m)	(dB μV/m) See Note *	(dB)
2925.80	45.0	32.6	1.8	30.5	70.5	48.9	-21.3
3343.80	48.2	33.4	2.0	30.5	70.5	53.1	-17.4
3761.80	40.6	34.0	2.4	30.5	74.0	46.5	-23.5

**Figure 12. Radiated Emission. Antenna Polarization: HORIZONTAL.  
Detector: Peak**

Note: 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.

Note \*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(P) = Peak + AF + CF - PF$$

Where: FR (P) is final peak detector result.

Peak is peak detector measurement.

AF is antenna factor.

CF is cable factor.

PF is preamplifier factor.



## Spurious Radiated Emission Above 1 GHz

E.U.T Description    Terminal Unit  
 Type    TU  
 Serial Number:    00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal

Frequency range: 2.9 GHz to 4.3 GHz

Test Distance: 3 meters

Detector: Average

Freq. (MHz)	Avg Amp (dBμV)	Correction Factors			AVG Specification (dB μV/m)	AVG Final Result FR (A) (dB μV/m) See Note *	AVG Margin (dB)
		Antenna AF (dB)	Cable CF (dB)	Low Noise Amp (dB)			
2925.80	39.5	32.6	1.8	30.5	70.5	43.4	-27.1
3343.80	42.6	33.4	2.0	30.5	70.5	47.5	-23.1
3761.80	30.7	34.0	2.4	30.5	54.0	36.6	-17.3

**Figure 13. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Average**

Note: 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.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(A) = AVG + AF + CF - PF$$

Where: FR(A) is final average detector result.

AVG is average detector measurement.

AF is antenna factor.

CF is cable factor.

PF is preamplifier factor.

## Spurious Radiated Emission Above 1 GHz

E.U.T Description    Terminal Unit  
Type                      TU  
Serial Number:        00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical  
Test Distance: 3 meters

Frequency range: 1 GHz to 2.9 GHz  
Detector: Average

Frequency (MHz)	Avg Amp (dB $\mu$ V/m)	Correction (dB)	Specification (dB $\mu$ V/m)	Margin (dB $\mu$ V/m)
1253.93	43.4	34.1	54.0	-10.6
1306.20	31.4	34.5	54.0	-22.6
1436.72	32.6	35.8	54.0	-21.4
1671.89	39.4	37.7	54.0	-14.6
1698.04	34.9	37.9	54.0	-19.1
2246.57	39.5	41.6	54.0	-14.5

**Figure 14. Radiated Emission. Antenna Polarization: VERTICAL.  
Detector: Average**

Note: 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.

## Spurious Radiated Emission Above 1 GHz

E.U.T Description    Terminal Unit  
Type                      TU  
Serial Number:        00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical  
Test Distance: 3 meters

Frequency range: 1 GHz to 2.9 GHz  
Detector: Peak

Frequency (MHz)	Peak Amp (dB $\mu$ V/m)	Correction (dB)	Specification (dB $\mu$ V/m)	Margin (dB $\mu$ V/m)
1253.93	49.6	34.1	74.0	-24.4
1306.20	44.5	34.5	74.0	-29.5
1436.72	45.5	35.8	74.0	-28.5
1671.89	49.7	37.7	74.0	-24.3
1698.04	48.4	37.9	74.0	-25.6
2246.57	53.6	41.6	74.0	-20.4

**Figure 15. Radiated Emission. Antenna Polarization: VERTICAL.  
Detector: Peak**

Note: 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.

## Spurious Radiated Emission Above 1 GHz

E.U.T Description    Terminal Unit  
Type                      TU  
Serial Number:        00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical  
Test Distance: 3 meters

Frequency range: 2.9 GHz to 4.2 GHz  
Detector: Peak

Freq.	Peak Amp	Correction Factors			Peak. Specification	Peak Final Result FR (P)	Peak. Margin
(MHz)	(dBμV/m)	Antenna AF	Cable CF	Low Noise Amp (dB)	(dB μV/m)	(dB μV/m) See Note *	(dB)
2925.80	43.7	32.6	1.8	30.5	70.3	47.6	-22.7
3343.80	47.4	33.4	2.0	30.5	70.3	52.3	-18.0
3761.80	38.9	34.0	34.0	30.5	74.0	44.8	-29.2

**Figure 16. Radiated Emission. Antenna Polarization: VERTICAL.  
Detector: Peak**

Note: 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.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(P) = Peak + AF + CF - PF$$

Where: FR (P) is final peak detector result,

Peak is peak detector measurement,

AF is antenna factor,

CF is cable factor,

PF is preamplifier factor.

## Spurious Radiated Emission Above 1 GHz

E.U.T Description    Terminal Unit  
 Type                    TU  
 Serial Number:        00378

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical  
 Test Distance: 3 meters

Frequency range: 2.9 GHz to 4.2 GHz  
 Detector: Average

Freq. (MHz)	Avg Amp (dBμV)	Correction Factors			AVG Specification (dB μV/m)	AVG Final Result FR (A)* (dB μV/m) See Note *	AVG Margin (dB)
		Antenna AF (dB)	Cable CF (dB)	Low Noise Amp (dB)			
2925.80	36.7	32.6	1.8	30.5	70.3	40.6	-29.7
3343.80	41.6	33.4	2.0	30.5	70.3	46.5	-23.8
3761.80	27.3	34.0	2.4	30.5	54.0	33.2	-20.8

**Figure 17. Radiated Emission. Antenna Polarization: VERTICAL  
 Detector: Average**

Note: 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.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(A) = AVG + AF + CF - PF$$

Where: FR(A) is average detector result,

AVG is average detector measurement,

AF is antenna factor,

CF is cable factor,

PF is preamplifier factor.

### 8.3 *Test Instrumentation Used, Spurious Radiated Measurements Above 1 GHz*

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Receiver	HP	85422E	3411A00102	January 31, 2003	1 year
RF Section	HP	85420E	3427A00103	January 31, 2003	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001.0	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	SAS-200/511	253.0	January 31,2003	2 year
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	April 10, 2003	1 year
Spectrum Analyzer	HP	8592L	3745A08184	January 31,2003	1 year

## 9. Bandwidth

### 9.1 Test procedure

The transmitter unit operated with normal modulation. The spectrum analyzer was set to 30 kHz resolution BW and center frequency of the transmitter fundamental. The spectrum bandwidth of the transmitter unit at the points of 20 dB below maximum peak power was measured and recorded.

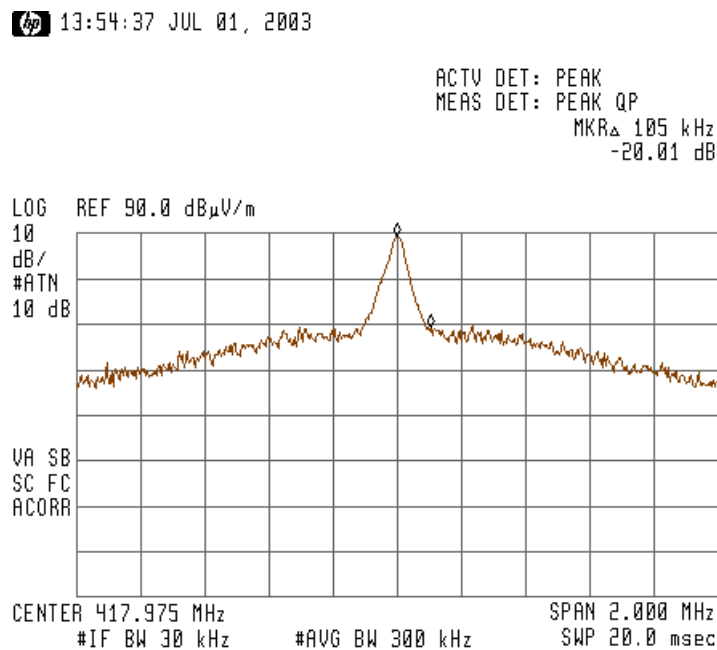


Figure 18

14:01:32 JUL 01, 2003

ACTV DET: PEAK  
 MEAS DET: PEAK QP  
 MKR $\Delta$  -110 kHz  
 -20.23 dB

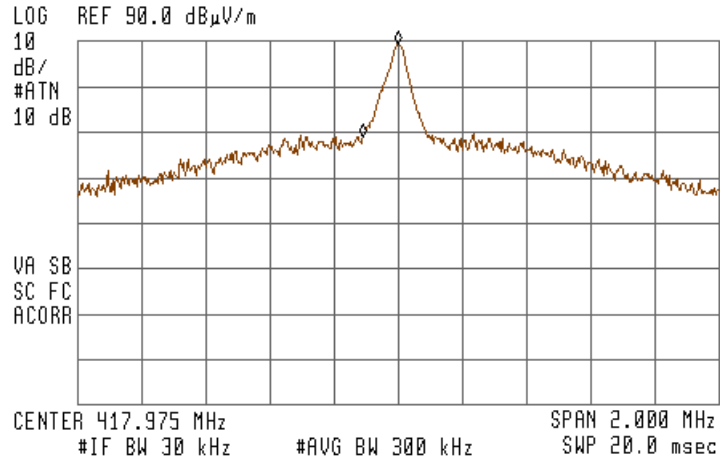


Figure 19



## 9.2 Results table

E.U.T Description: Transmitter Unit

Model: TU

Serial Number: Not Designated

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

Operation Frequency (MHz)	Reading (ΔkHz)	Specification (1) (ΔkHz)	Margin (kHz)
417.98	+105.0	+522.5	-417.5
417.98	-110.0	-522.5	-412.5

**Figure 20 Bandwidth**

JUDGEMENT: Passed by 412.5 kHz

TEST PERSONNEL:

Tester Signature: \_\_\_\_\_

Date:

Typed/Printed Name: Y. Mordukhovitch

(1) 0.25% of the E.U.T. fundamental frequency, Section 15.231(c).

### 9.3 Test Equipment Used.

Bandwidth

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3411A00102	January 31, 2003	1 year
RF Section	HP	85420E	3427A00103	January 31, 2003	1 year
Antenna Bioconical	ARA	BCD 235/B	1041	April 20, 2003	1 year
Antenna –Log Periodic	ARA	LPD-2010/A	1038	April 20, 2003	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	ThinkJet 2225	2738508357.0	N/A	N/A

**Figure 21 Test Equipment Used**

## 10. R.F Exposure/Safety

The E.U.T. is a mobile unit for applications of remote control operation of fireworks. The distance between the E.U.T. and the user's body or any other person is at least 0.2 meter.

Calculation of Maximum Permissible Exposure (MPE)

Based on Section 1.1307(b)(1) Requirements

(a) FCC limits at 418 MHz, for general population/uncontrolled exposure

$$S = \frac{418}{1500} = 0.28 \frac{mW}{cm^2}$$

Using table 1 of Section 1.1310 limit for general population/uncontrolled exposures, the above level is an average over 30 minutes.

(b) The power density produced by the E.U.T. is

$$S = \frac{P_t G_t}{4\pi R^2}$$

P<sub>t</sub>- Transmitted Power -3dBm (0.5mw) (Peak)

G<sub>t</sub>- Antenna Gain, 1 (0dBi)

R- Distance from Transmitter using 20cm worst case for mobile units.

(c) The peak power density is :

$$S_p = \frac{0.5 \times 1}{4\pi (20)^2} = 9.95 \times 10^{-5} \frac{mW}{cm^2}$$

(d) This is below the FCC limit by at least 4 orders of magnitude.

(f) Considering average power/time further reduces the power density level.

## 11. Photographs of Tested E.U.T.



Figure 22 Top View Closed Cover

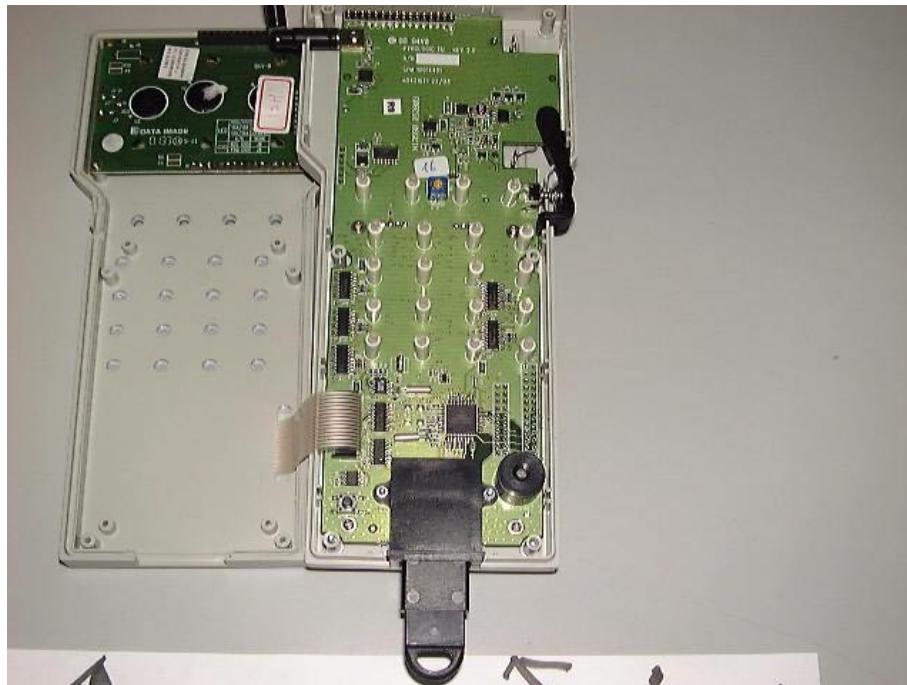


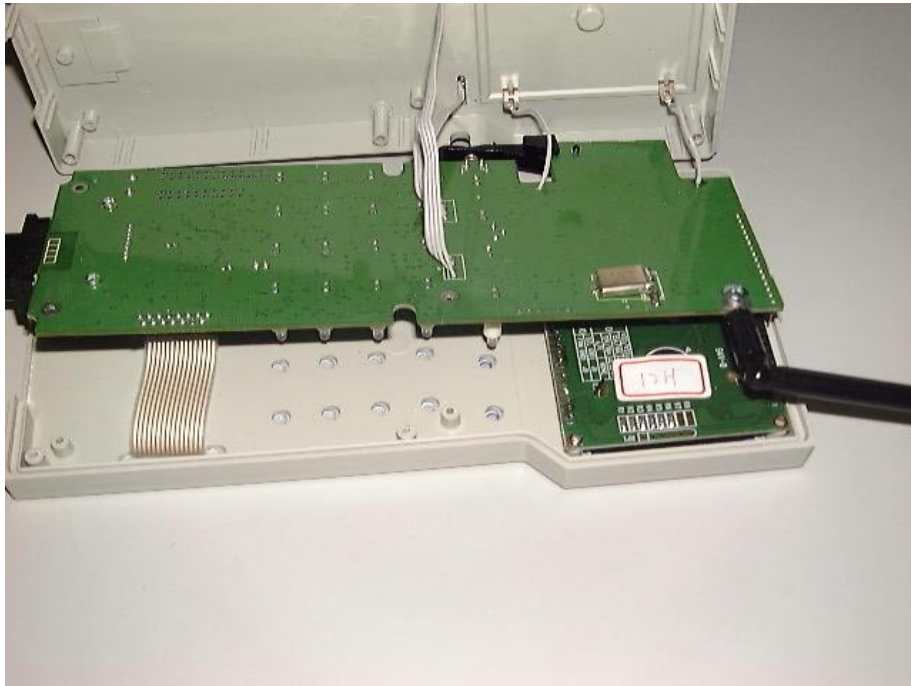
Figure 23 Top View Cover Removed



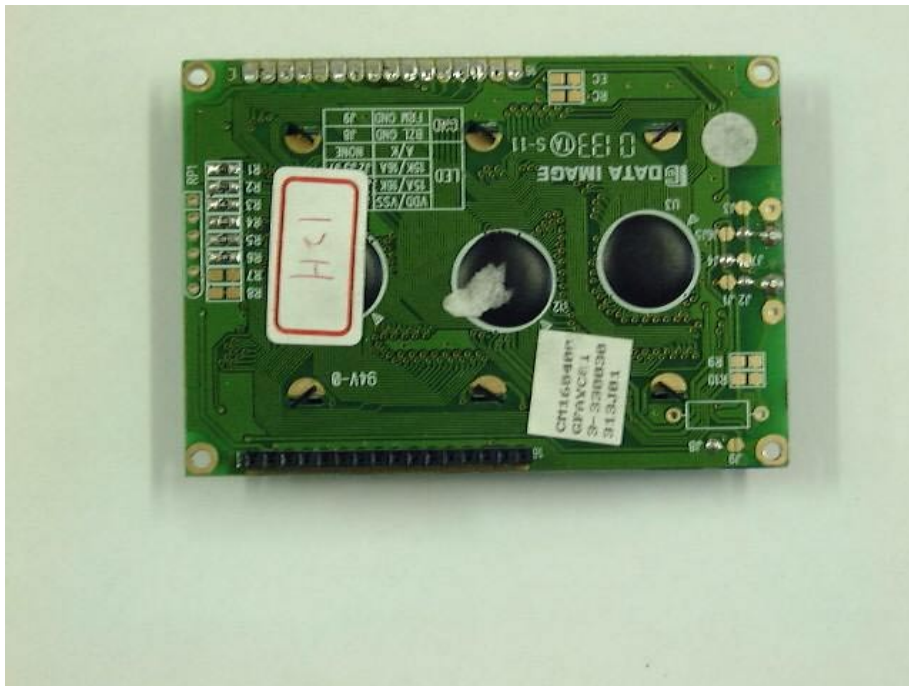
**Figure 24 External View Bottom**



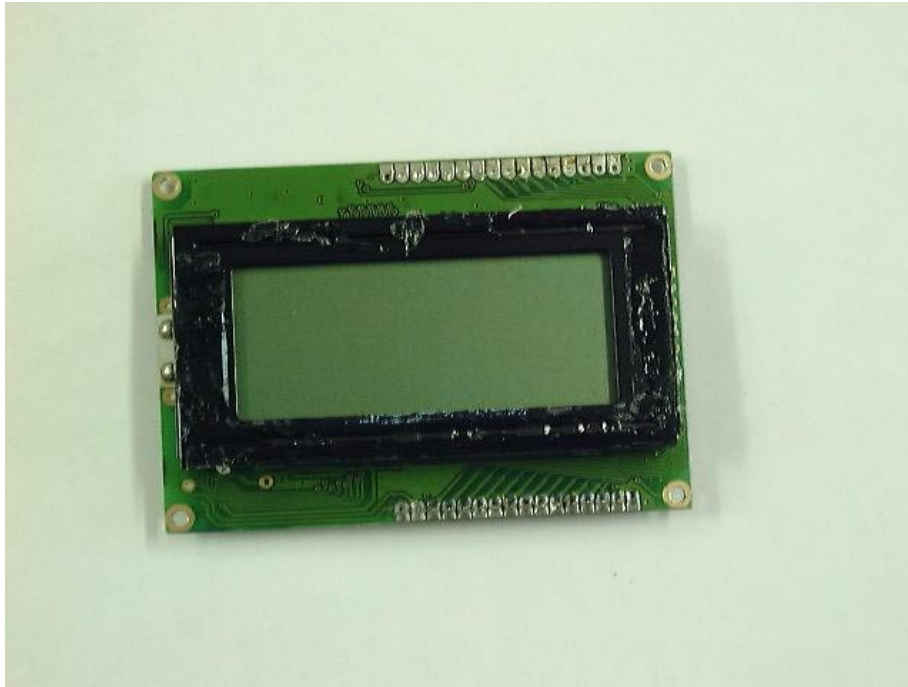
**Figure 25 External View Battery Cover Open**



**Figure 26 Print Side Main Board**



**Figure 27 Print Side Screen**



**Figure 28 Screen**



**Figure 29 Screen in Housing Print side**