Cert. No. 1152.01
Electrical (EMC)

DATE: 18 April 2007

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

FCC EMC/Radio Test Report

for

Hi-G-Tek Ltd.

Equipment under test:

Data Tag

IG-DT-44-916

Written by: _____
D. Shidlowsky, Documentation

Approved by: _____
E. Pitt, Test Engineer

Approved by: _____
I. Raz, EMC Laboratory Manager

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This report relates only to items tested.

Measurement/Technical Report for
Hi-G-Tek Ltd.

Equipment under test:

Data Tag

FCC ID: OB6-IGDT43916

DATE: 18 April 2007

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 C63.4-2003.

Application for Certification
prepared by:
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1. General Information

1.1 Administrative Information

Manufacturer:	Hi-G-Tek Ltd.
Manufacturer's Address:	16 Hacharoshet St. Or-Yehuda 60375 Israel Tel: +972-3-533-9359 Fax: +972-3-533-9225
Manufacturer's Representative:	Yossi Hershko Arkady Genin
Equipment Under Test (E.U.T):	Data Tag
Equipment Model No.:	IG-DT-44-916
Equipment Serial No.:	QMHA01053885
Date of Receipt of E.U.T:	14.02.07
Start of Test:	14.02.07
End of Test:	21.02.07
Test Laboratory Location:	I.T.L (Product Testing) Ltd. Kfar Bin Nun, ISRAEL 99780
Test Specifications:	FCC Part 15, Subpart C

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

The DataTag is a wireless monitoring sensor that is used to tag goods and critical items. The DataTag uses active RFID (Radio Frequency Identification) wireless monitoring technology and includes a transmitter/receiver unit, read/write capability, real-time clock, memory and sensing circuitry to detect any attempt at tampering with the tag.

The DataTag senses any attempt to detach it from the asset or its cradle. The system detects any such attempt, sends an alert and records the event. In low-frequency short-range mode (125 kHz, AM modulation with 4kHz data rate.) the DataTag logs and communicates data through a handheld data terminal and can be inspected by a MicroReader. The data terminal writes the electronic manifest of the asset into the electronic tag's memory. The information could include asset description, production floor information, invoice number, etc.

The high frequency long range mode (916MHz FSK modulated with 40kHz deviation and 16kHz data.) provides full two way read/write data communication channel at a distance of 50m. The DataTag transmits the information in reply to an interrogation by the DataReader. Many DataTags can be monitored simultaneously by one DataReader. This long-range capability makes the DataTag ideal for applications such as tracking and content verification of assets in transit, protection of assets in storage and remote automatic data collection of goods in production planning applications.

Data Tag 916 Models :

The 916MHz Data Tag contains 5 models, the different between these models reflected over their sensing functionality (sensors) as shown in the table below –

Product	Freq.	P/N	Sensors		
			Tilt	*Motion*	*Tamper*
DataTag 916	916.5MHz	IGDT40916	-	-	+
	916.5MHz	IGDT41916	-	-	-
	916.5MHz	IGDT42916	-	+	-
	916.5MHz	IGDT43916	+	+	-
	916.5MHz	IGDT44916	+	+	+

Tilt Sensor: Vertical motion sensing, alerts whenever DataTag is vertically shifted.

Motion Sensor: Horizontal motion sensing, alerts whenever DataTag is horizontally shifted

Tamper Sensor: Contacts (attach/detach) sensing, alerts whenever DataTag is tampered/pulled out from its cradle.

Data Tag (916) Technical specifications:

Communications:

Frequency Range:

Low frequency: 125 kHz

High frequency: 916.5MHz

Read Range:

Low-frequency: 15cm

High-frequency 50m in open space

Antenna Characteristics:

Beam Divergence: Omni-directional on non-metal wall, while installed horizontally and Hemispherical on metal wall

Polarization: Vertical

Software Features:

Memory:

User Memory: 2048 bytes

Events Memory: 55 events

Power Requirements:

Power Source: 3.6V internal Lithium battery

Life Expectancy:

Service Life: 3 Years at 50 interrogations per day

Physical:

Size: 65 x 45 x 25mm

Weight: 80g

Housing: Splash-proof plastic reinforced with fiberglass

Environmental:

Operating Temperature: -40°C to +70°C

Storage Temperature: -40°C to +70°C

Humidity: 90% non-condensing

Vibration and Shock: Complies with MIL-STD-810D for mobile equipment and SAE J1455

Mounting:

Cradle or direct attachment can be used. Cradle or attachment fixture can be customized according to application.

Sensors:

Attach/Detach sensor (optional)

Motion/Tilt sensor (optional)

1.4 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2003. 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 December 12, 2003).
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 ±4 dB Normalized Site Attenuation requirements of ANSI C63.4-2003. 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. Label Location on EUT

3. System Test Configuration

3.1 Justification

To determine the E.U.T. antenna orientation for the spurious radiated emissions tests, the product carrier field level was measured with the E.U.T. in 3 orthogonal positions.

The vertical position of the E.U.T. was selected as the worst case final orientation position.

3.2 EUT Exercise Software

Normally, the EUT transmits short messages in short periods. Therefore, in order to enable measurements of the transmitted signals, the EUT exercise program used during the RF testing was designed to transmit continuously random data or carrier wave (cw) according to test procedures.

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.

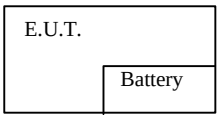

Figure 3. Configuration of Tested System

4. Block Diagram

4.1 Schematic Block/Connection Diagram

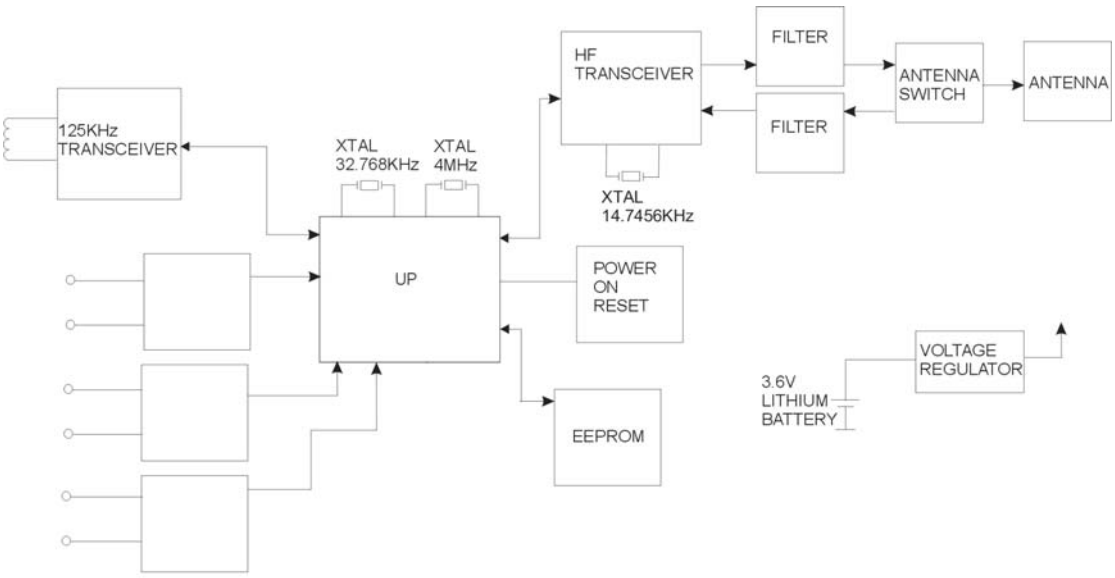

Figure 4. Block Diagram

4.2 Theory of Operation

DataTag circuit description

1. Functional Description

1.1. The DataTag opens its HF receiver once every 3 seconds to look for an interrogator. If an interrogator is not found, the DataTag goes to sleep for another 3 s. If an interrogator is found, the DataTag receives the command and transmits a message according to the command received. During the DataTag wake up, it performs seal wire test and integrity test of its stored data. The LF receiver is always opened for data. The LF channel is used to interrogate the DataTag by short range link for set-up or manual verification.

2. Hardware Description

2.1. There are 2 PCBs in the DataTag unit. Main (Digital & RF) PCB and antenna PCB. The main PCB includes a battery, µP, LF transceiver and HF transciever. The antenna PCB is located on the main PCB (internal in the unit).

3. Main PCB circuit description.

Block Diagram:

3.1. U1: MSP430F149 : System-µP.

3.2. U4: EEPROM.

3.3. U6: 2.2V voltage detector, interrupt the µP if voltage drops below 2.2V.

3.4. U3: 2.5V voltage regulator (system main supply).

3.5. BT1: TL2134, 3.6V lithium battery.

3.6. Tilt and Motion sensors. the sensors may or may not be populated, according to product model. Connection for ON/OFF sensors. Their location may vary according to product model.(refer to DataTag models table in page 2 in this document)

3.7. H1,H2: Tamper sensor - Connection for resistance measurement. A wire loop (short circuit sensing) is connected to these pins.

3.8. U2: Reset & watchdog supervisory.

3.9. U5 Analog Switch, connects battery voltage to a divider for measurement.

3.10. Y1: 4MHz µP crystal.

3.11. Y2: 32768Hz Crystal, for system clock.

3.12. Q3A: Power ON/OFF to the RF circuit.

3.13. Q3B: Battery load for battery life test.

3.14. LF Transceiver: transmit/receive at 125KHz, AM modulated (on-off key,OOK) with 4KHz data rate. The LF transmitter includes two sets of push-pull transistors Q1A,Q1B and Q2A,Q2B. They drive a resonance circuit C23,C24 & ANT1 which is a ferrite antenna. U12 is the LF receiver.

3.15. HF Transceiver: transmit/receive at 916.5MHz, FSK modulated with 40KHz deviation and 16KHz data. U8 is integrated UHF transceiver. It has a 14.7456MHz crystal (Y3). The RF-IN and RF-OUT are connected to the antenna switch (U9) via passive filtering circuits. The switch (U9) output goes to the antenna pads (A1,A2).

4. 916 MHz Antenna PCB circuit description.

4.1. The antenna is a printed custom made antenna.

5. Field Strength of Fundamental

5.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.249(a)

5.2 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 (916.500MHz) 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.

5.3 Measured Data

JUDGEMENT: Passed by 2.54 dB

The EUT met the FCC Part 15, Subpart C, Section 15.249(a) specification requirements.

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

TEST PERSONNEL:

Tester Signature: _____ Date: 18.04.07

Typed/Printed Name: E. Pitt

Field Strength of Fundamental

E.U.T Description	Data Tag
Model Number	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: F.C.C., Part 15, Subpart C 15.249(a)

Antenna Polarization: Horizontal/Vertical

Test Distance: 3 meters Detector: Peak

Freq. (MHz)	Pol. V/H	Peak Reading (*) (dBµV/m)	Specification (dBµV/m)	Margin (dB)
916.50	H	85.72	94.0	-8.28
916.50	V	91.46	94.0	-2.54

Figure 5. 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.

* "Peak Amp." includes "Correction Factors.

"Correction Factors" = Antenna Correction Factor + Cable Loss.

Field Strength of Fundamental

E.U.T Description	Data Tag
Model Number	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: F.C.C., Part 15, Subpart C 15.249(a)

Antenna Polarization: Horizonta

Test Distance: 3 meters Detector: Peak

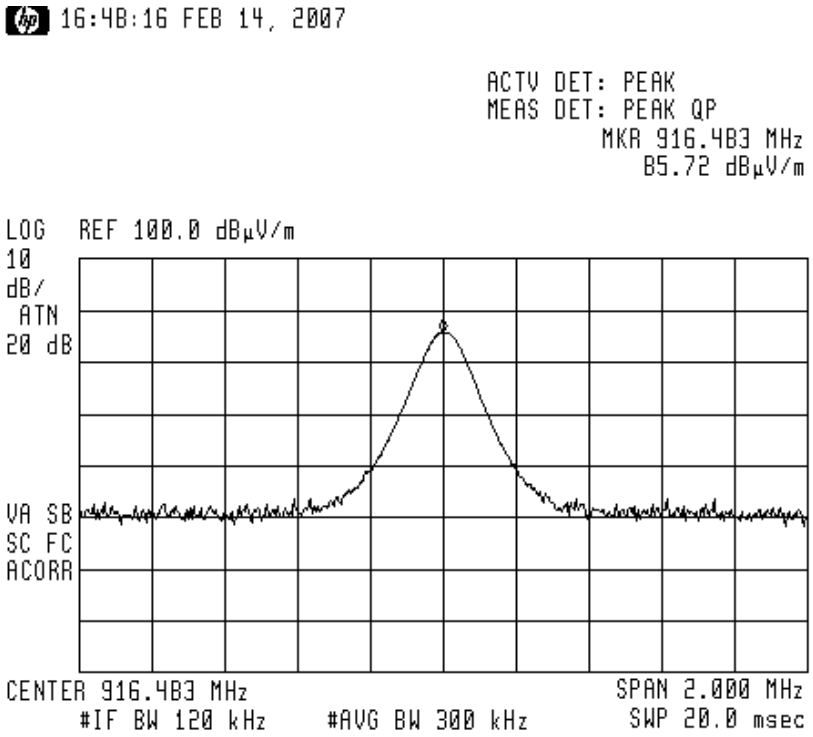

Figure 6. Field Strength of Fundamental Antenna Polarization: HORIZONTAL Detector: Peak

Field Strength of Fundamental

E.U.T Description	Data Tag
Model Number	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: F.C.C., Part 15, Subpart C 15.249(a)

Antenna Polarization: Vertical

Test Distance: 3 meters Detector: Peak

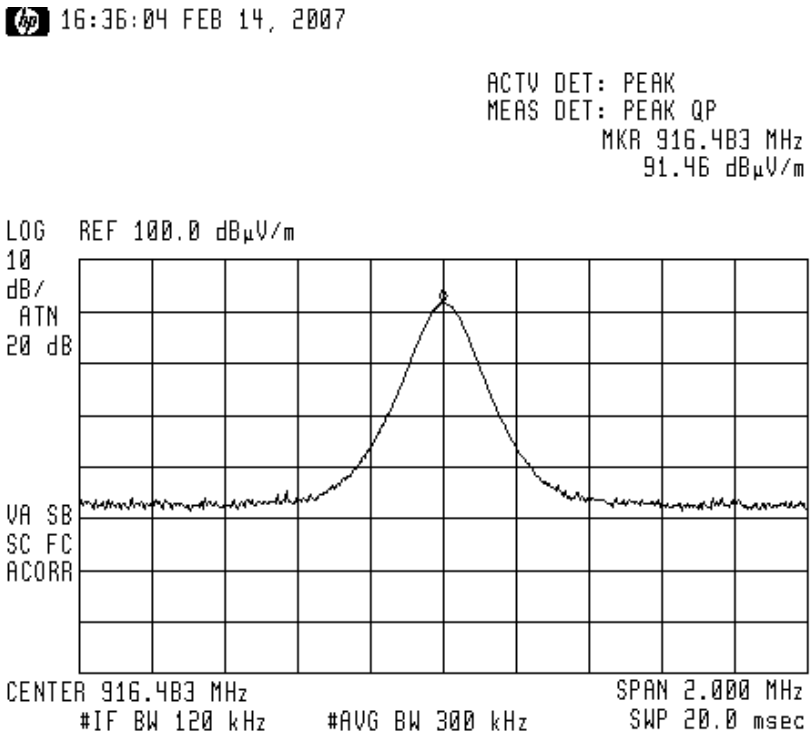

Figure 7. Field Strength of Fundamental Antenna Polarization: VERTICAL. Detector: Peak

5.4 Test Instrumentation Used, Field Strength of Fundamental

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3411A00102	November 22, 2006	1 year
RF Section	HP	85420E	3427A00103	November 22, 2006	1 year
Antenna Log Periodic	ARA	LPD-2010/A	1038	November 30, 2006	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

6. Radiated Measurement Photo

Figure 8. Radiated Emission Test

7. Radiated Emission, For Low Frequency Transmitter (125 kHz)

7.1 Test Specification

9 kHz-30 MHz, FCC, Part 15, Section 15.209

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 loop antenna. 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 configuration tested is shown in *Figure 8. Radiated Emission Test* .

The frequency range 9 kHz-30 MHz was scanned, and the list of the highest emissions was verified and updated accordingly.

In the frequency range 9 kHz-30MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter at a distance of 3 meters.

The E.U.T. was operated at the frequency of 125 kHz

7.3 Test Data

JUDGEMENT: Passed by 20.24 dB

The EUT was tested and it met the requirements of the FCC Part 15, Subpart C, specification.

In the band 9kHz-30MHz the emission levels were more than 20 dB below the specification limit.

At the frequency 125 kHz, the emission levels were 20.5 dB below the specification limit.

See details in *Figure 9*.

TEST PERSONNEL:

Tester Signature: _____ Date: 18.04.07

Typed/Printed Name: E. Pitt

Radiated Emission,
Low Frequency Transmitter

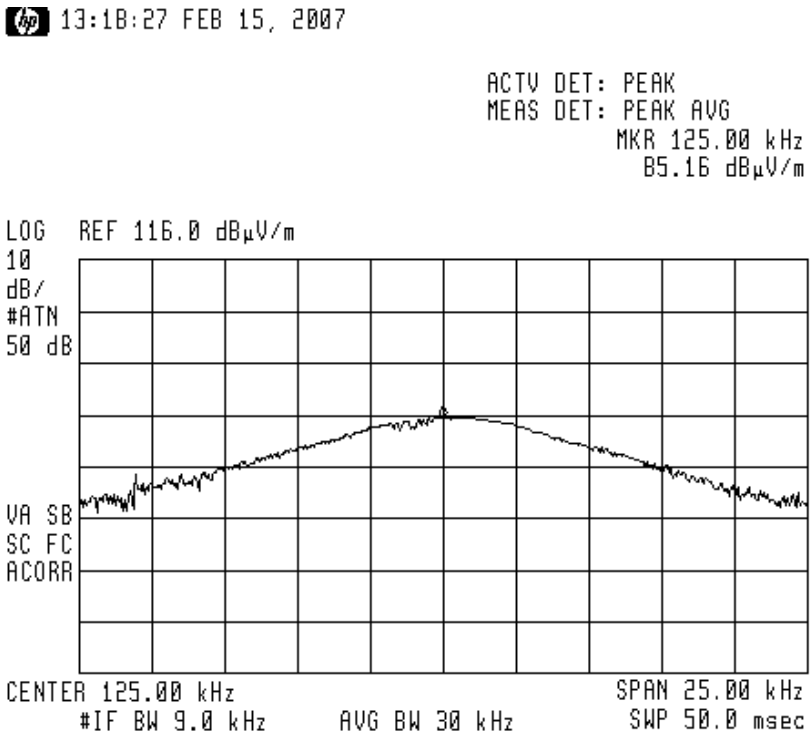

Figure 9 Spurious Radiated Emissions 9 kHz – 30 MHz

$$\text{Limit}_{3m} = 20\log\frac{2400}{125} + 40\log\frac{300}{3} = 105.7 db\mu V/m$$

7.4 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3411A00102	November 22, 2006	1 year
RF Section	HP	85420E	3427A00103	November 22, 2006	1 year
Active Loop Antenna	EMCO	6502	9506-2950	October 16, 2006	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

8. Spurious Radiated Emission 9kHz-1000 MHz

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 configuration tested is shown in *Figure 3*.

The frequency range 9kHz-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.
In the frequency range 9 kHz-30 MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter.
In the frequency range 30-1000 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.

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

8.1 Measured Data

JUDGEMENT: Passed by 17.4 dB

The results for both horizontal and vertical polarizations were the same.

The margin between the emission level and the specification limit is 17.4 dB in the worst case at the frequency of 309.88 MHz, horizontal and vertical polarizations.

The signals in the band 9 kHz – 30 MHz were 20dB below the specification limit.

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

TEST PERSONNEL:

Tester Signature: _____ Date: 18.04.07

Typed/Printed Name: E. Pitt

Radiated Emission

E.U.T Description	Data Tag
Type	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: FCC Part 15, Subpart C

Antenna Polarization: Horizontal
Antenna: 3 meters distance

Frequency range: 30 MHz to 1000 MHz
Detectors: Peak, Quasi-peak

Signal Number	Frequency (MHz)	Peak dBuV/m	QP dBuV/m	QP Delta L 1 (dB)	Avg dBuV/m	Av Delta L 2 (dB)	Corr (dB)
1	50.459063	27.0	22.5	-17.5			11.5
2	189.534863	23.7	18.1	-25.4			16.7
3	309.232106	21.3	16.0	-30.0			16.3
4	350.892600	24.0	17.8	-28.2			17.9
5	411.851700	25.2	19.6	-26.4			19.8
6	453.046800	27.0	20.3	-25.7			20.5

Figure 10. Radiated Emission. Antenna Polarization: HORIZONTAL. Detectors: Peak, Quasi-peak

Note: QP Delta 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	Data Tag
Type	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: FCC Part 15, Subpart C

Antenna Polarization: Horizontal
Antenna: 3 meters distance

Frequency range: 30 MHz to 1000 MHz
Detectors: Peak, Quasi-peak

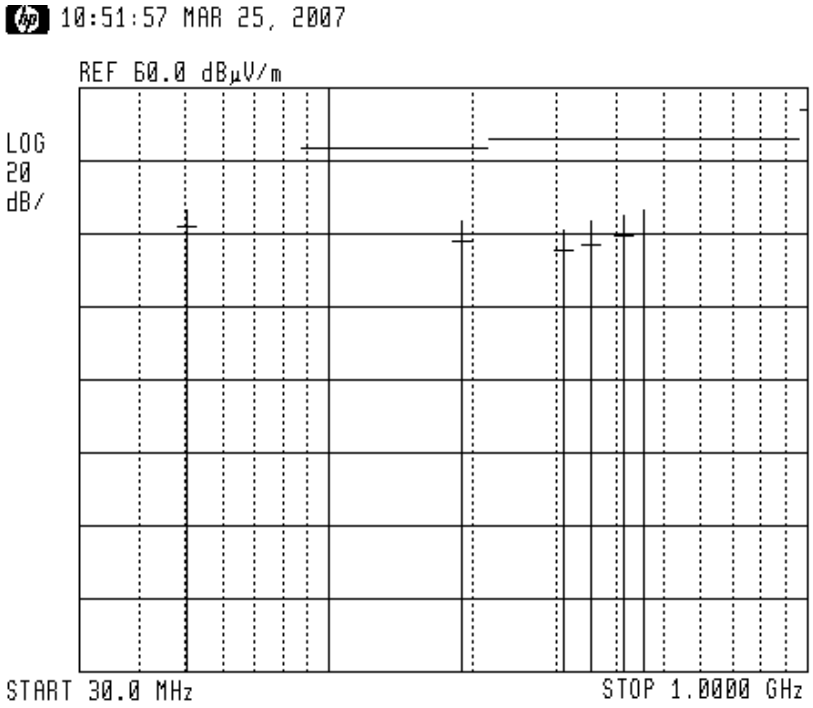

Figure 11. Radiated Emission. Antenna Polarization: HORIZONTAL Detectors: Peak, Quasi-peak

Note:

1. *Horizontal axis shows logarithmic frequency scale.*
2. *The vertical axis shows amplitude (in dB µV/m).*
3. *Peak detection is designated by the top of each vertical line.*
4. *Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.*

Radiated Emission

E.U.T Description	Data Tag
Type	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: FCC Part 15, Subpart C

Antenna Polarization: Vertical
Antenna: 3 meters distance

Frequency range: 30 MHz to 1000 MHz
Detectors: Peak, Quasi-peak

Signal Number	Frequency (MHz)	Peak dBuV/m	QP dBuV/m	QP Delta L 1 (dB)	Avg dBuV/m	Av Delta L 2 (dB)	Corr (dB)
1	39.490695	30.8	20.6	-19.4			13.4
2	40.005519	27.9	23.2	-16.8			13.3
3	41.301955	34.4	13.1	-26.9			13.1
4	52.418500	27.5	23.5	-16.5			11.3
5	142.483450	19.8	14.1	-29.4			14.6
6	150.386650	23.6	17.1	-26.4			15.0
7	310.200788	21.9	16.0	-30.0			16.4

Figure 12. Radiated Emission. Antenna Polarization: VERTICAL. Detectors: Peak, Quasi-peak

Note: QP Delta 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	Data Tag
Type	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: FCC Part 15, Subpart C

Antenna Polarization: Vertical
Antenna: 3 meters distance

Frequency range: 30 MHz to 1000 MHz
Detectors: Peak, Quasi-peak

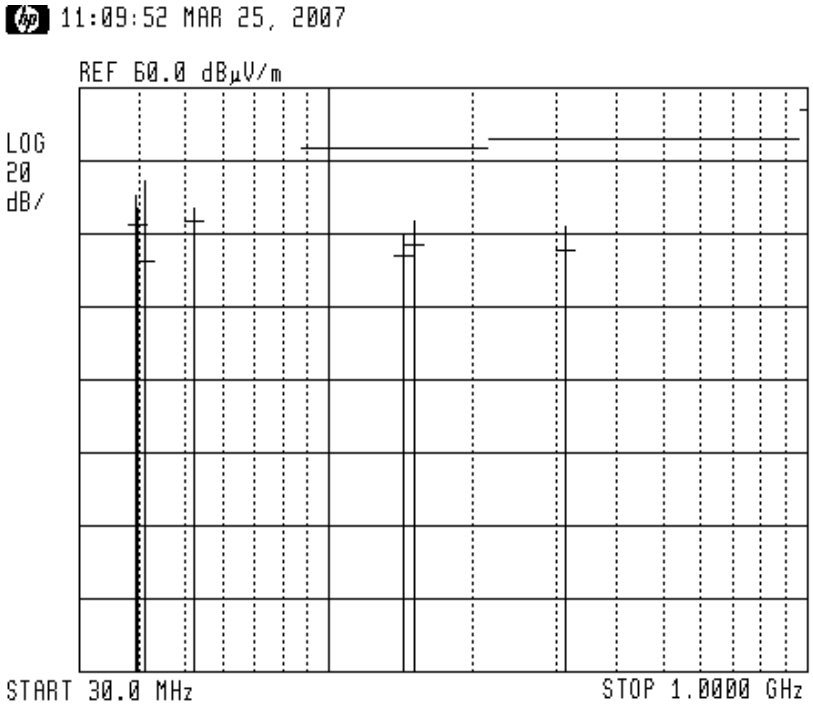

Figure 13. Radiated Emission. Antenna Polarization: VERTICAL Detectors: Peak, Quasi-peak

Note:

1. *Horizontal axis shows logarithmic frequency scale.*
2. *The vertical axis shows amplitude (in dB µV/m).*
3. *Peak detection is designated by the top of each vertical line.*
4. *Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.*

8.2 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3411A00102	November 22, 2006	1 year
RF Section	HP	85420E	3427A00103	November 22, 2006	1 year
Antenna Bioconical	ARA	BCD 235/B	1041	March 19, 2006	1 year
Antenna Log Periodic	ARA	LPD-2010/A	1038	November 30, 2006	1 year
Active Loop Antenna	EMCO	6502	9506-2950	October 16, 2006	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

8.3 Field Strength Calculation

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

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

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

9. Spurious Radiated Emission Above 1 GHz

9.1 Spurious 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 configuration tested is shown in Figure 3.

The frequency range 1 –9.2 GHz was scanned, and the list of the highest emissions was verified and updated accordingly.

The emission levels were compared to the requirement of Section 15.249.

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. 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.).

9.2 Test Data

JUDGEMENT: Passed by 11.4 dB

The margin between the emission level and the specification limit is 11.4 dB in the worst case at the frequency of 2749.45 MHz, horizontal polarization.

All other signals not included in the result tables are at least 20dB below the specification limit.

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

The details of the highest emissions are given in *Figure 14* to *Figure 16*.

TEST PERSONNEL:

Tester Signature: _____ Date: 18.04.07

Typed/Printed Name: E. Pitt

Spurious Radiated Emission Above 1 GHz

E.U.T Description	Data Tag
Model Number	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: F.C.C., Part 15, Subpart C, 15.249

Antenna Polarization: Horizontal
Frequency range: 1.0 GHz to 9.2 GHz
Test Distance: 3 meters
Detector: Peak, Average

Signal Number	Frequency (MHz)	Peak dBuV/m	Avg dBuV/m	Av Delta L 1 (dB)	Av Delta L 2 (dB)	Corr (dB)
1	1832.966463	53.0	40.7	-13.3		38.4
2	2749.449463	55.0	42.7	-11.4		44.6

Figure 14. Spurious Radiated Emission. Antenna Polarization: HORIZONTAL. Detector: Peak, Average

Av Delta 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	Data Tag
Model Number	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: F.C.C., Part 15, Subpart C, 15.249

Antenna Polarization: Horizontal
Test Distance: 3 meters
Frequency range: 1.0 GHz to 9.2 GHz
Detector: Peak, Average

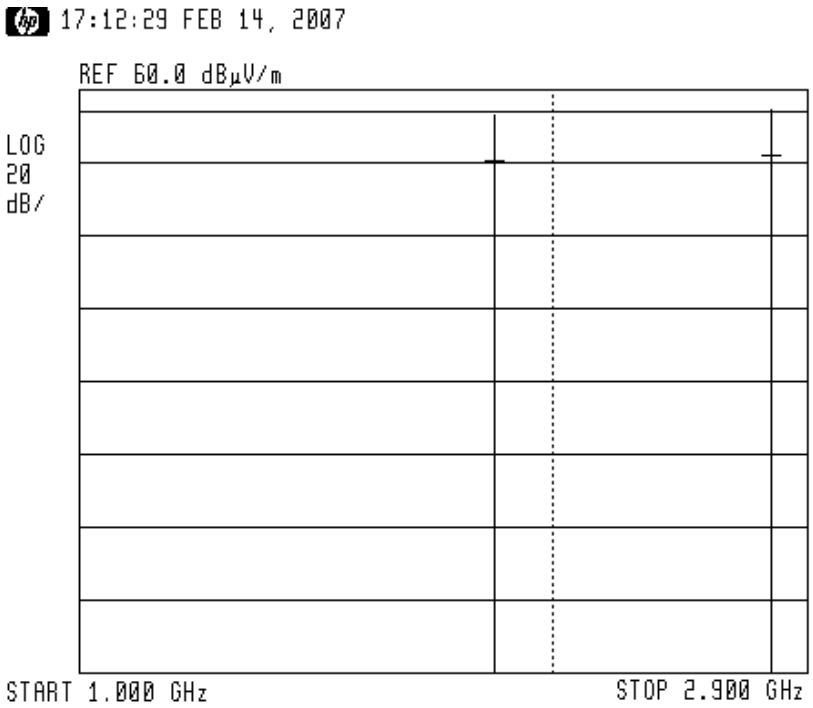

Figure 15. Spurious Radiated Emission. Antenna Polarization: HORIZONTAL. Detector: Peak, Average

Note:

1. *Horizontal axis shows logarithmic frequency scale.*
2. *The vertical axis shows amplitude (in dB µV/m).*
3. *Peak detection is designated by the top of each vertical line.*
4. *Average detection is designated by the first dash mark (from the top) of each vertical line.*

Spurious Radiated Emission Above 1 GHz

E.U.T Description	Data Tag
Model Number	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: F.C.C., Part 15, Subpart C, 15.249

Antenna Polarization: Vertical
Test Distance: 3 meters
Frequency range: 1.0 GHz to 9.2 GHz
Detector: Peak, Average

Signal Number	Frequency (MHz)	Peak dBuV/m	QP dBuV/m	QP Delta L 1 (dB)	Avg dBuV/m	Av Delta L 2 (dB)	Corr (dB)
1	1832.967250	53.4			40.9		38.4
2	2749.449638	54.9			42.4		44.6

Figure 16. Spurious Radiated Emission. Antenna Polarization: VERTICAL. Detector: Peak, Average

Spurious Radiated Emission Above 1 GHz

E.U.T Description	Data Tag
Model Number	IG-DT-44-916
Serial Number:	QMHA01053885

Specification: F.C.C., Part 15, Subpart C, 15.249

Antenna Polarization: Vertical
Test Distance: 3 meters
Frequency range: 1.0 GHz to 9.2 GHz
Detector: Peak, Average

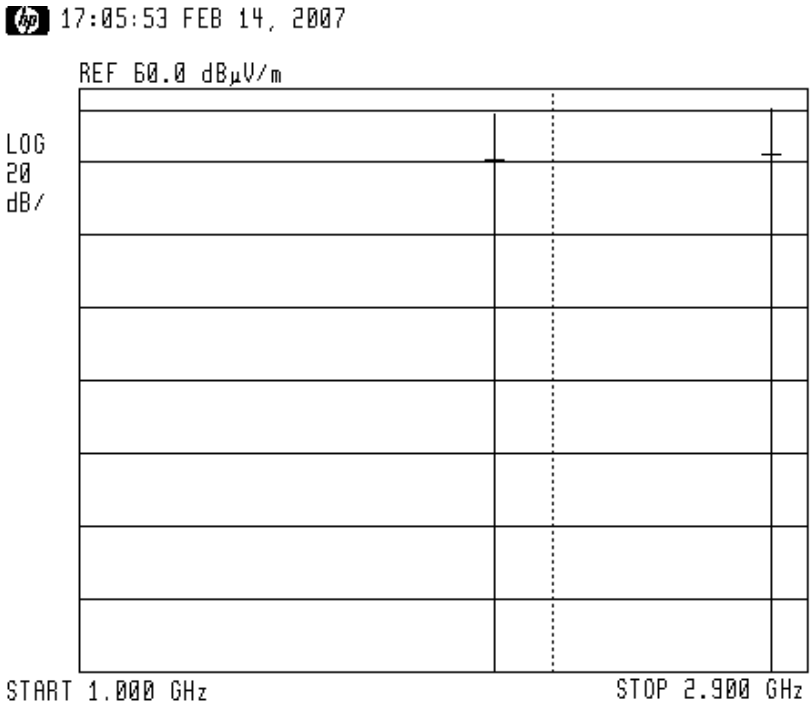

Figure 17. Spurious Radiated Emission. Antenna Polarization: VERTICAL. Detector: Peak, Average

Note:

1. *Horizontal axis shows logarithmic frequency scale.*
2. *The vertical axis shows amplitude (in dB µV/m).*
3. *Peak detection is designated by the top of each vertical line.*
4. *Average detection is designated by the first dash mark (from the top) of each vertical line.*

9.3 Test Instrumentation Used, Spurious Radiated Measurements Above 1 GHz

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Receiver	HP	85422E	3411A00102	November 22, 2006	1 year
RF Section	HP	85420E	3427A00103	November 22, 2006	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	N/A	N/A
Antenna Bioconical	ARA	BCD 235/B	1041	March 19, 2006	1Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	November 30, 2006	1 Year
Antenna-Log Periodic	A.H.System	SAS-200/511	253	January 24,2005	2 year
Spectrum Analyzer	HP	8592L	3926A01204	November 21, 2006	1 year

10. Photographs of Tested E.U.T.

Figure 18 Front View

Figure 19 Rear View

Figure 20 Front Cover Internal View

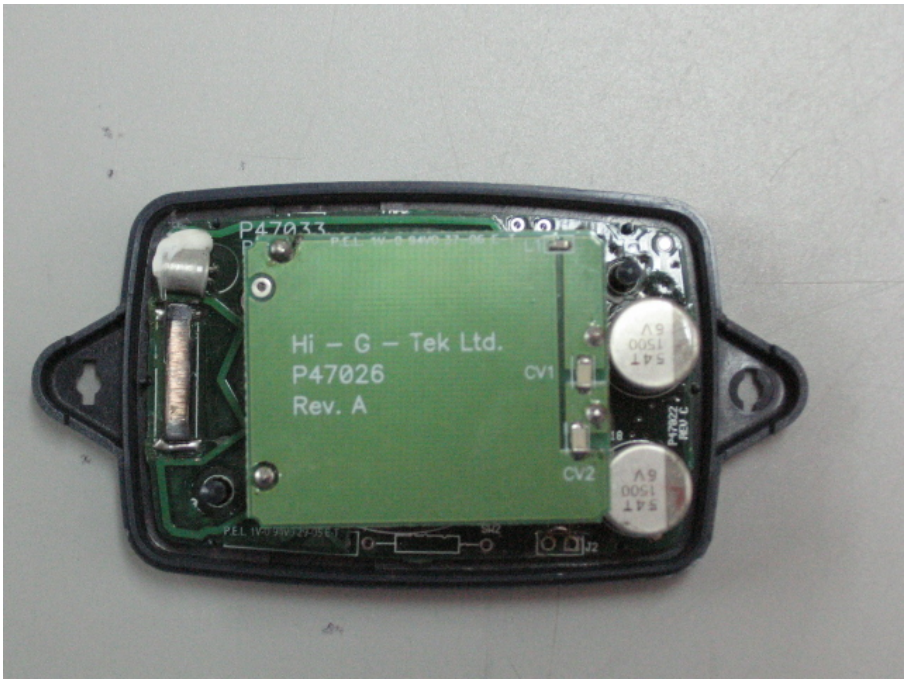

Figure 21 PCB in Unit

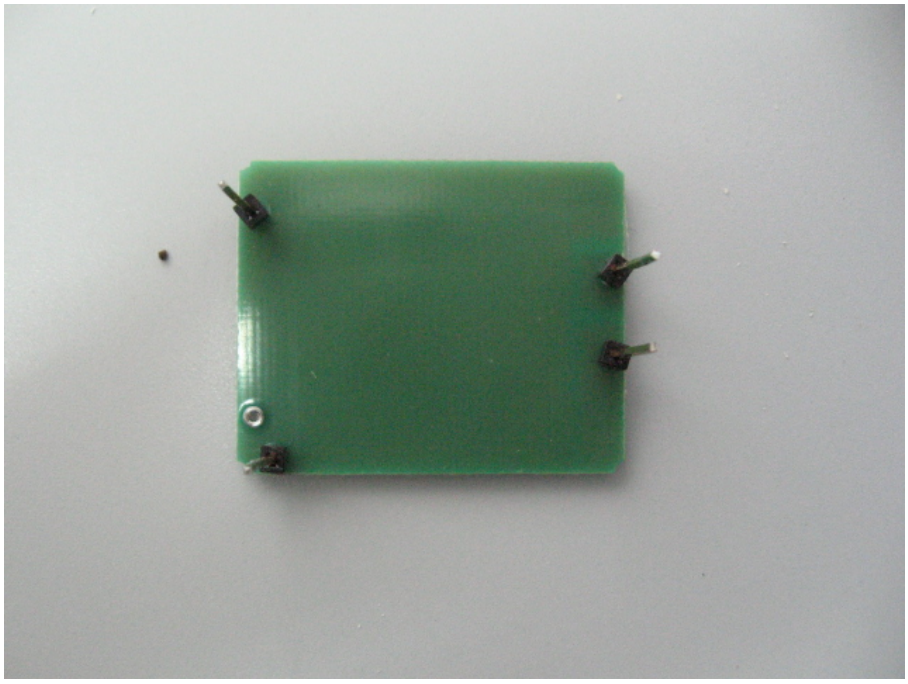

Figure 22 Antenna Side 1

Figure 23 Antenna Side 2

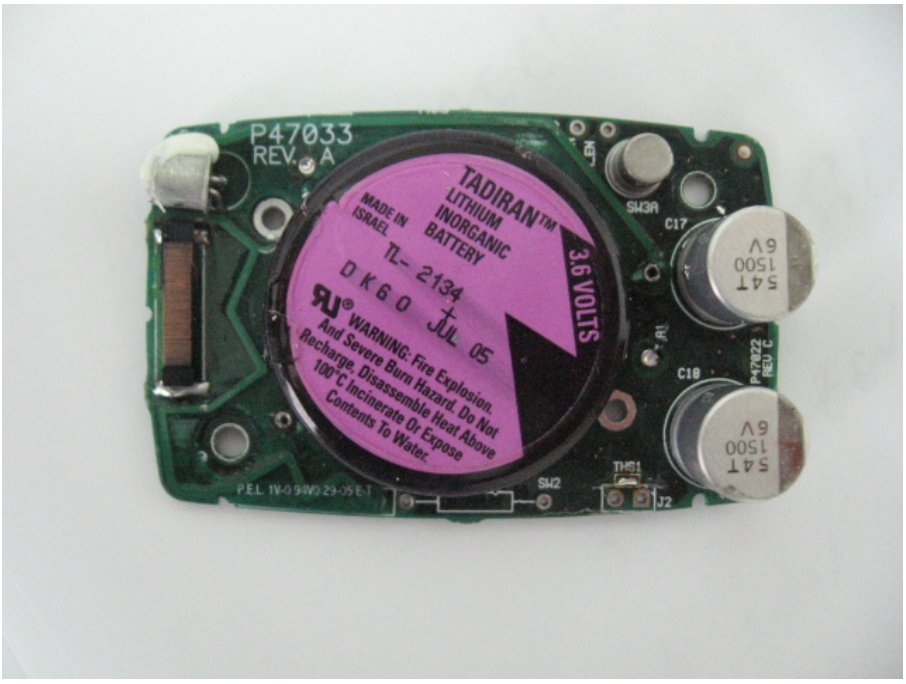

Figure 24 PCB Component Side

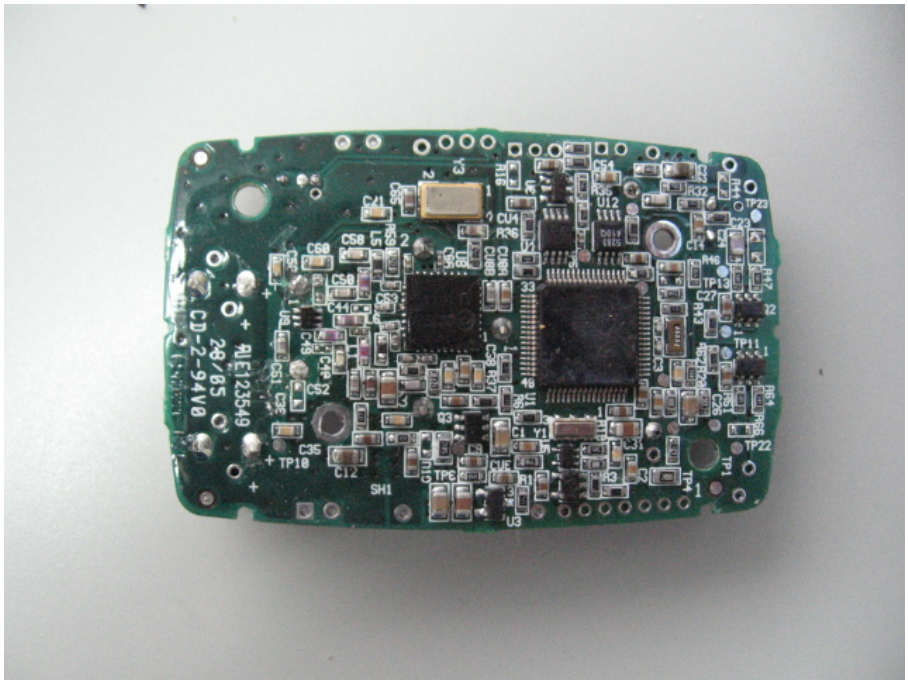

Figure 25 PCB Print Side

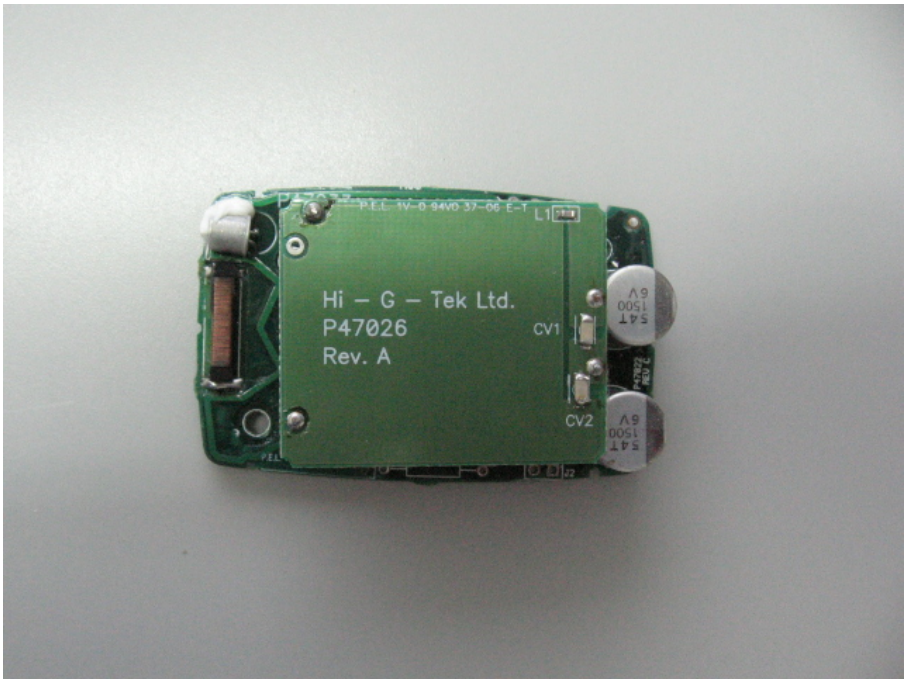

Figure 26 PCB With Antenna

11. APPENDIX A - CORRECTION FACTORS

11.1 Correction factors for CABLE

from EMI receiver to test antenna at 3 meter range.

FREQUENCY (MHz)	CORRECTION FACTOR (dB)
10.0	0.5
20.0	0.7
30.0	1.0
40.0	1.2
50.0	1.3
60.0	1.5
70.0	1.6
80.0	1.7
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

FREQUENCY (MHz)	CORRECTION FACTOR (dB)
1200.0	7.5
1400.0	8.2
1600.0	9.0
1800.0	9.6
2000.0	10.7
2300.0	11.1
2600.0	11.8
2900.0	12.8

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".

11.2 Correction factors for CABLE

from EMI receiver to test antenna at 3 meter range.

FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.2
2.0	1.6
3.0	2.0
4.0	2.4
5.0	3.0
6.0	3.4
7.0	3.8
8.0	4.2
9.0	4.6
10.0	5.0
12.0	5.8

NOTES:

1. The cable type is RG-8.

2. The overall length of the cable is 10 meters.

11.3 Correction factors for CABLE

from spectrum analyzer to test antenna above 2.9 GHz

FREQUENCY (GHz)	CORRECTION FACTOR (dB)	FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.9	14.0	9.1
2.0	2.7	15.0	9.5
3.0	3.5	16.0	9.9
4.0	4.2	17.0	10.2
5.0	4.9	18.0	10.4
6.0	5.5	19.0	10.7
7.0	6.0	20.0	10.9
8.0	6.5	21.0	11.2
9.0	7.0	22.0	11.6
10.0	7.5	23.0	11.9
11.0	7.9	24.0	12.3
12.0	8.3	25.0	12.6
13.0	8.7	26.0	13.0

NOTES:

1. The cable type is SUCOFLEX 104 E manufactured by SUHNER.

2. The cable is used for measurements above 2.9 GHz.

3. The overall length of the cable is 10 meters.

11.4 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 38M3O.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".*

11.5 Correction factors for LOG PERIODIC ANTENNA

Type SAS-200/511
at 3 meter range.

FREQUENCY (GHz)	ANTENNA FACTOR (dB)
1.0	24.9
1.5	27.8
2.0	29.9
2.5	31.2
3.0	32.8
3.5	33.6
4.0	34.3
4.5	35.2
5.0	36.2
5.5	36.7
6.0	37.2
6.5	38.1

FREQUENCY (GHz)	ANTENNA FACTOR (dB)
7.0	38.6
7.5	39.2
8.0	39.9
8.5	40.4
9.0	40.8
9.5	41.1
10.0	41.7
10.5	42.4
11.0	42.5
11.5	43.1
12.0	43.4
12.5	44.4
13.0	44.6

NOTES:

1. Antenna serial number is 253.

2. The above lists are located in file number SAS3M0.ANT for a 3 meter range.

3. The files mentioned above are located on the disk marked "Antenna Factors".

11.6 Correction factors for BICONICAL ANTENNA

Type BCD-235/B, at 3 meter range

FREQUENCY (MHz)	AFE (dB/m)
20.0	19.4
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	11.0
120.0	11.5
130.0	11.7
140.0	12.1
150.0	12.6
160.0	12.8
170.0	13.0
180.0	13.5
190.0	14.0
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
310	20.7
320	21.9
330	23.4
340	25.1
350	27.0

NOTES:

1. Antenna serial number is 1041.

2. The above list is located in file 19BC10M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver".

11.7 Correction factors for ACTIVE LOOP ANTENNA

Model 6502
S/N 9506-2950

FREQUENCY	Magnetic Antenna Factor	Electric Antenna Factor
(MHz)	(dB)	(dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2